ENERGY ASSESSMENT

FOR

ST. CLARE BUSINESS PARK

RICHMOND

VERSION 3.1

Issued by:-

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PROJECT REVISION SHEET

ST. CLARE BUSINESS PARK, SOUTHWARK

170209

Revision V3.1

Date of first issue – 09 October 2019

Prepared by: Andrew Sturt

Revision	Date	Details	Changes	Author	Checked
1.0	09-10-2019	For Planning	-	A Sturt	A Singh
2.0	09-03-2020	For Planning	Strategy revised to incorporate heat pumps	A Sturt	A Singh
2.1	12-03-2020	For Planning	Comments incorporated	A Sturt	A Singh
3.0	15-06-2022	For Planning	Window Areas amended to suit Part O	M Smith	A Sturt
3.1	21-06-2022	For Planning	Minor amendments	M Smith	A Sturt

EXECUTIVE SUMMARY

Silcock Dawson and Partners have been appointed by Notting Hill Home Ownership Ltd to provide an Energy Assessment for the proposed new development at St. Clare Business Park, Richmond. This Energy Assessment is submitted as part of an application for full planning consent.

The aim of this report is to document the findings of the investigation into energy efficiency measures and the feasibility of on-site decentralised and renewable or low carbon energy sources.

Demolition of existing buildings and erection of 1no. mixed use building between three and five storeys plus basement in height, comprising 98no. residential flats (Class C3) and 1,172sq.m of commercial floorspace (Class E); 1no. three storey building comprising 893sq.m of commercial floorspace (Class E); 14no. residential houses (Class C3); and, associated access, external landscaping and car parking. The dwellings occupy the majority of the floor area and will be designed to be energy efficient and incorporate the following key features:

1. The annual heating demand will be reduced by using insulation values better than the Notional Building[1], internal walls and floor slabs between the conditioned spaces and unheated internal spaces such as the residential entrance lobbies and refuse stores will be insulated. The target air permeability is 3.0 $m^3/hr/m^2$.
2. The dwellings will have a balanced ventilation system with heat recovery and automatic summer bypass.
3. The dwellings will be provided with 100% low energy luminaires.

The commercial units will also be provided with energy efficient LED lighting with daylight compensation controls where appropriate, in addition fabric U values will be better than the Notional Building values.

The London heat map has been consulted, and it is noted that the site is not close to an existing heat network and is over 700m away from the edge of the nearest heat map study area.

The site is within a developed sub urban area with a large number of terraced and semi detached houses. The London heat map identifies the site location within an area of low heat density, it is therefore unlikely that a district heating network will be extended to development.

However, a communal heating system is proposed for the apartments, comprising a roof mounted air source heat pump. The heat pump will be sized to ensure continuous operation and meet 100% of the annual heat demand.

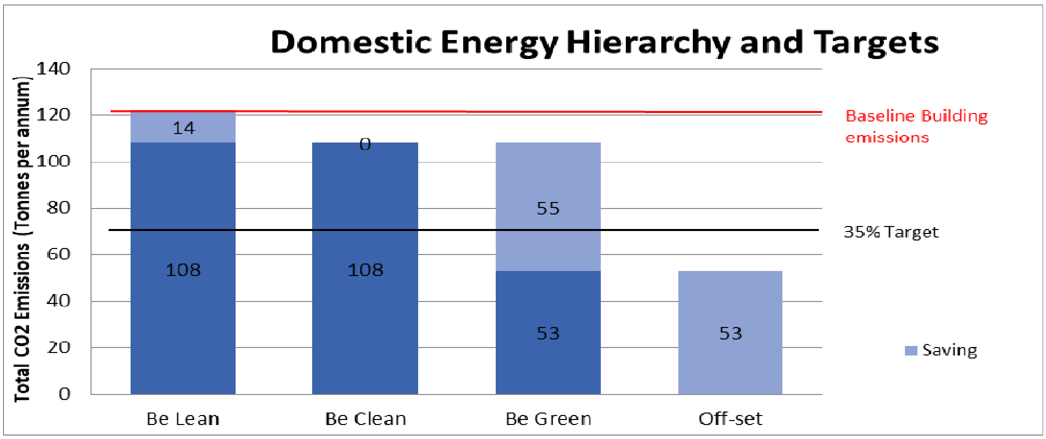
As it is unlikely that a district wide heating system will be implemented, it would be more efficient to serve the houses from individual heat pump systems, because of the higher distribution losses that would be expected from the increased pipework necessary at smaller pipe sizes.

The commercial units will be heated via reverse cycle heat pumps that will also be used to provide comfort cooling.

A large PV array will be mounted on the roof of Block 1, with all power generated directed to the residential landlord supply. The total PV capacity for the development is predicted to be 67.2kWp.

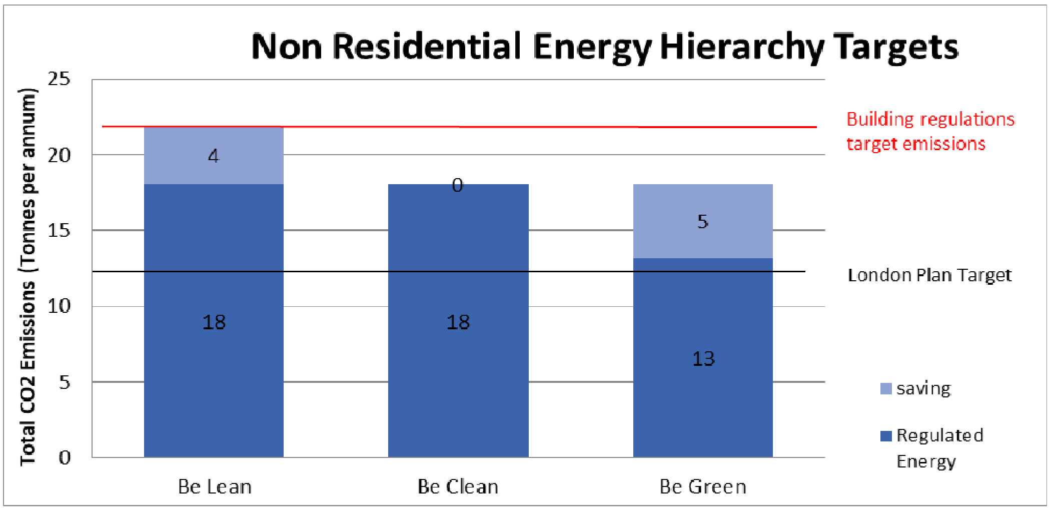
GLA Table 2: Dwelling Carbon Dioxide Emissions from each stage of the Energy Hierarchy		
	Regulated Carbon dioxide savings	
	(Tonnes CO2 per annum)	(%)
Savings from energy demand reduction	14	11
Savings from CHP	0	0
Savings from renewable energy	55	45
Cumulative on site savings	69	57

[1] Notional building forms the basis of the Target Emission Rate (TER), which is the minimum energy performance requirement for a new building.



The energy efficiency measures reduce the residential emissions by 11%, with a further 36% reduction from the heat pumps serving the dwellings plus a 9% reduction from the photovoltaic panel installations, resulting in a total CO_2 reduction of 45% or 55 tonnes when SAP 10 emission rates are applied.

GLA Table 4: Carbon Dioxide Emissions from each stage of the Energy Hierarchy		
	Regulated Carbon dioxide savings	
	(Tonnes CO2 per annum)	(%)
Savings from energy demand reduction	4	18
Savings from CHP	0	0
Savings from renewable energy	5	22
Total cumulative savings	9	40



The energy efficiency measures from the commercial units are greater at 18%, with a further 22% reduction from the air source heat pump installations.

The total CO_2 reduction as a result of the energy efficiency measures across the whole development is predicted to be 18 tonnes CO_2 or 12% below the baseline model, with a total emissions reduction of 78 tonnes or 54% once renewable energy measures are incorporated.

Table 6: Carbon Dioxide Emissions from each stage of the Energy Hierarchy			
	Total Regulated Emissions	CO2 Savings	Percentage Saving
	(Tonnes CO2/year)	(Tonnes CO2/year)	%
Part L 2013 Baseline	144		
Be Lean	126	18	12
Be Clean	126	0	0
Be Green	66	60	42
Cumulative Saving		78	54
Total off-set £		**188,056**	

Following a review of the relevant National and Local Planning Policies, this Energy Assessment proposes a strategy that positively responds to Policy 5.2 of the London Plan 2021, Policy SI2, SI3 of the ft London Plan 2021, and Policy LP22 Sustainable Design and Construction of the London Borough of Richmond upon Thames Local Plan (2017)

The zero carbon homes CO_2 offset payment is calculated to be £188,056 based on £95.00 / tonne over a 30 year period

1 INTRODUCTION

1.1 Background

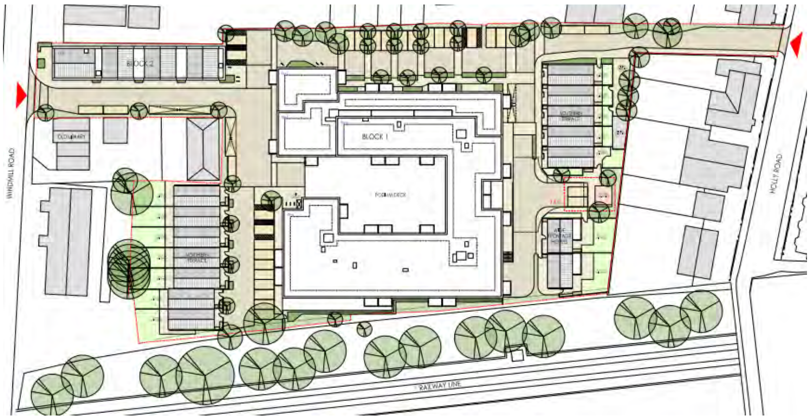
Silcock Dawson and Partners have been appointed by Notting Hill Home Ownership Ltd to provide an Energy Assessment for the proposed new development at St. Clare Business Park, Richmond. This Energy Assessment is submitted as part of an application for full planning consent.

The aim of this report is to document the findings of the investigation into energy efficiency measures and the feasibility of on-site decentralised and renewable or low carbon energy sources.

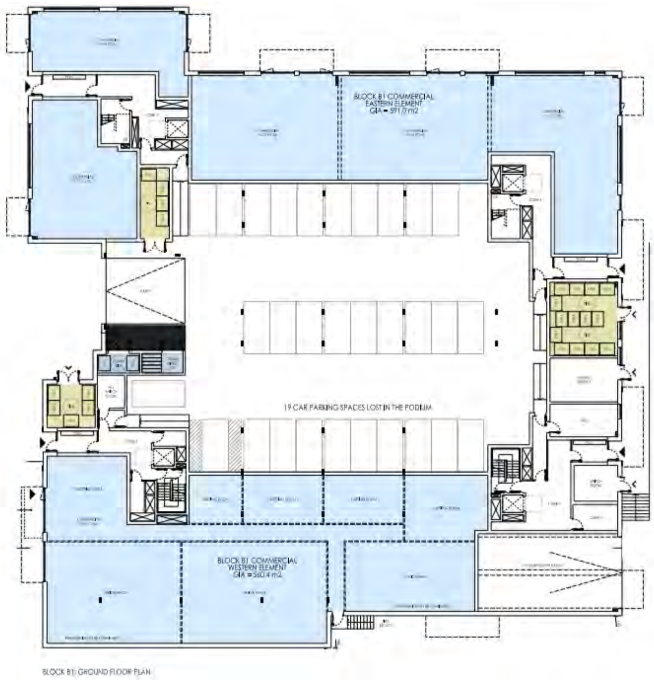
1.2 Description of the Site and Building

Demolition of existing buildings and erection of 1no. mixed use building between three and five storeys plus basement in height, comprising 98no. residential flats (Class C3) and 1,172sq.m of commercial floorspace (Class E); 1no. three storey building comprising 893sq.m of commercial floorspace (Class E); 14no. residential houses (Class C3); and, associated access, external landscaping and car parking.

The following images detail the ground and typical floor spaces, for a detailed description of the development refer to the Design and Access Statement provided by AHR Architects.

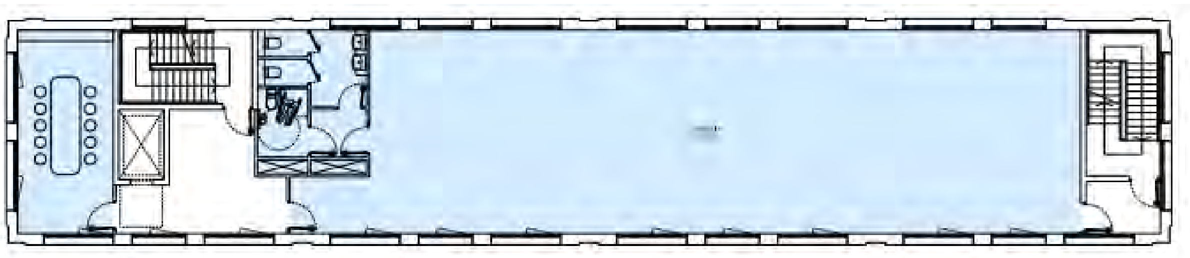


Site layout



Block 1 Ground floor (Commercial and carpark)

Block 1 First (Typical) Floor



Block 2 First (Typical) Floor

Dynamic Simulation Model Image of Block 2

2 RELEVANT PLANNING POLICIES

This Energy Strategy responds to the broader set of National, and Regional policies outlined below.

2.1 National Planning Policy

The Government has set out a planning policy framework guidance in the National Planning Policy Framework (NPPF 2021), within which planning authorities can prepare and apply their development plans. Fundamental to this guidance is the requirement to meet sustainable development objectives.

The NPPF covers a wide range of planning issues from promoting sustainable transport to facilitating the sustainable use of minerals. Climate change is covered in section 14 'Meeting the challenge of climate change, flooding and coastal change'. In summary the framework advises:

"Plans should take a proactive approach to mitigating and adapting to climate change, taking into account the long-term implications for flood risk, coastal change, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures. Policies should support appropriate measures to ensure the future resilience of communities and infrastructure to climate change impacts, such as providing space for physical protection measures, or making provision for the possible future relocation of vulnerable development and infrastructure.

New development should be planned for in ways that:

- avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure; and
- can help to reduce greenhouse gas emissions, such as through its location, orientation and design. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards.

To help increase the use and supply of renewable and low carbon energy and heat, plans should:

- provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts);
- consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and

- identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for co-locating potential heat customers and suppliers."

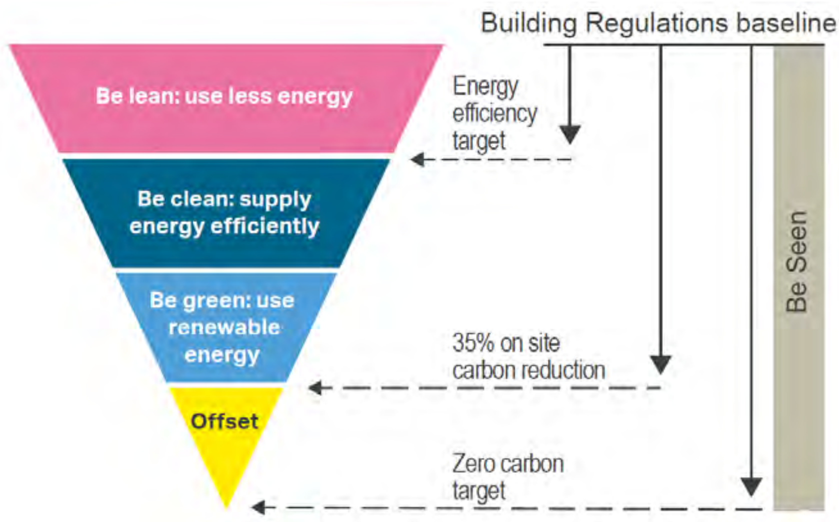
Refer to : National Planning Policy Framework (2019) for further details.

2.2 Regional Policy – The London Plan (March 2021)

2.2.1 Policy SI 2 Minimising Greenhouse Gas Emissions

A Major development should be net zero-carbon. This means reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand in accordance with the following energy hierarchy:

1. be lean: use less energy and manage demand during operation.
2. be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly.
3. be green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site.
4. be seen: monitor, verify and report on energy performance.



Source: Greater London Authority

B Major development proposals should include a detailed energy strategy to demonstrate how the zero-carbon target will be met within the framework of the energy hierarchy

C A minimum on-site reduction of at least 35 per cent beyond Building Regulations is required for major development. Residential development should achieve 10 per cent, and non-residential development should achieve 15 per cent through energy efficiency measures. Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided, in agreement with the borough, either:

1. through a cash in lieu contribution to the borough's carbon offset fund, or
2. off-site provided that an alternative proposal is identified and delivery is certain.

2.2.2 Policy SI 3 Energy Infrastructure

A Boroughs and developers should engage at an early stage with relevant energy companies and bodies to establish the future energy and infrastructure requirements arising from large-scale development proposals such as Opportunity Areas, Town Centres, other growth areas or clusters of significant new development.

B Energy masterplans should be developed for large-scale development locations (such as those outlined in Part A and other opportunities) which establish the most effective energy supply options. Energy masterplans should identify:

1. major heat loads (including anchor heat loads, with particular reference to sites such as universities, hospitals and social housing)
2. heat loads from existing buildings that can be connected to future phases of a heat network
3. major heat supply plant including opportunities to utilise heat from energy from waste plants
4. secondary heat sources, including both environmental and waste heat
5. opportunities for low and ambient temperature heat networks
6. possible land for energy centres and/or energy storage
7. possible heating and cooling network routes
8. opportunities for future proofing utility infrastructure networks to minimise the impact from road works
9. infrastructure and land requirements for electricity and gas supplies
10. implementation options for delivering feasible projects, considering issues of procurement, funding and risk, and the role of the public sector
11. opportunities to maximise renewable electricity generation and incorporate demand-side response measures.

C Development Plans should:

1. identify the need for, and suitable sites for, any necessary energy infrastructure requirements including energy centres, energy storage and upgrades to existing infrastructure
2. identify existing heating and cooling networks, identify proposed locations for future heating and cooling networks and identify opportunities for expanding and inter-connecting existing networks as well as establishing new networks.

D Major development proposals within Heat Network Priority Areas should have a communal low-temperature heating system

1) the heat source for the communal heating system should be selected in accordance with the following heating hierarchy:

a) connect to local existing or planned heat networks

b) use zero-emission or local secondary heat sources (in conjunction with heat pump, if required)

c) use low-emission combined heat and power (CHP) (only where there is a case for CHP to enable the delivery of an area-wide heat network, meet the development's electricity demand and provide demand response to the local electricity network)

d) use ultra-low NOx gas boilers.

2) CHP and ultra-low NOx gas boiler communal or district heating systems should be designed to ensure that they meet the requirements of policy SI 1 Improving Air Quality.

3) where a heat network is planned but not yet in existence the development should be designed to allow for the cost-effective connection at a later date.

E Heat networks should achieve good practice design and specification standards for primary, secondary and tertiary systems comparable to those set out in the CIBSE CP1 Heat Networks: Code of Practice for the UK or equivalent.

2.2.3 Policy SI 4 Managing Heat Risk

A Development proposals should minimise adverse impacts on the urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure.

B Major development proposals should demonstrate through an energy strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems in accordance with the following cooling hierarchy:

1) reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure

2) minimise internal heat generation through energy efficient design

3) manage the heat within the building through exposed internal thermal mass and high ceilings

4) provide passive ventilation

5) provide mechanical ventilation

6) provide active cooling systems.

2.2.4 Policy SI 5 Water Infrastructure

A In order to minimise the use of mains water, water supplies and resources should be protected and conserved in a sustainable manner.

B Development Plans should promote improvements to water supply infrastructure to contribute to security of supply. This should be done in a timely, efficient and sustainable manner taking energy consumption into account.

C Development proposals should:

1) through the use of Planning Conditions minimise the use of mains water in line with the Optional Requirement of the Building Regulations (residential development), achieving mains water consumption of 105 litres or less per head per day (excluding allowance of up to five litres for external water consumption)

2) achieve at least the BREEAM excellent standard for the ‘Wat 01’ water category164 or equivalent (commercial development)

3) incorporate measures such as smart metering, water saving and recycling measures, including retrofitting, to help to achieve lower water consumption rates and to maximise future-proofing.

D In terms of water quality, Development Plans should:

1) promote the protection and improvement of the water environment in line with the Thames River Basin Management Plan, and should take account of Catchment Plans

2) support wastewater treatment infrastructure investment to accommodate London’s growth and climate change impacts. Such infrastructure should be constructed in a timely and sustainable manner taking account of new, smart technologies, intensification opportunities on existing sites, and energy implications. Boroughs

should work with Thames Water in relation to local wastewater infrastructure requirements.

E Development proposals should:

1) seek to improve the water environment and ensure that adequate wastewater infrastructure capacity is provided

2) take action to minimise the potential for misconnections between foul and surface water networks.

F Development Plans and proposals for strategically or locally defined growth locations with particular flood risk constraints or where there is insufficient water infrastructure capacity should be informed by Integrated Water Management Strategies at an early stage

2.3 Local Policy – Local Plan (2018)

The Local Plan sets out the long term, vision, spatial strategy and strategic policies with an implementation plan up until 2033 to deliver sustainable development. The relevant policies within the Local Plan are listed below.

Policy LP 20

Climate Change Adaption

A. The Council will promote and encourage development to be fully resilient to the future impacts of climate change in order to minimise vulnerability of people and property.

B. New development, in their layout, design, construction, materials, landscaping and operation, should minimise the effects of overheating as well as minimise energy consumption in accordance with the following cooling hierarchy:

1. minimise internal heat generation through energy efficient design
2. reduce the amount of heat entering a building in summer through shading, reducing solar reflectance, fenestration, insulation and green roofs and walls
3. manage the heat within the building through exposed internal thermal mass and high ceilings
4. passive ventilation
5. mechanical ventilation
6. active cooling systems (ensuring they are the lowest carbon options).

C. Opportunities to adapt existing buildings, places and spaces to the likely effects of climate change should be maximised and will be supported.

Policy LP 22

Sustainable Design and Construction

A. Developments will be required to achieve the highest standards of sustainable design and construction in order to mitigate against climate change. Applicants will be required to comply with the following:

1. Development of 1 dwelling unit or more, or 100sqm or more of non-residential floor space (including extensions) will be required to comply with the Sustainable Construction Checklist SPD. A completed Checklist has to be submitted as part of the planning application.

2. Development that results in a new residential dwelling, including conversions, change of use, and extensions that result in a new dwelling unit, will be required to incorporate water conservation measures to achieve maximum water consumption of 110 litres per person per day for homes (including an allowance of 5 litres or less per person per day for external water consumption).

3. New non-residential buildings over 100sqm will be required to meet BREEAM 'Excellent' standard.

4. Proposals for change of use to residential will be required to meet BREEAM Domestic Refurbishment 'Excellent' standard (where feasible).

Reducing Carbon Dioxide Emissions

B. Developers are required to incorporate measures to improve energy conservation and efficiency as well as contributions to renewable and low carbon energy generation. Proposed developments are required to meet the following minimum reductions in carbon dioxide emissions:

1. All new major residential developments (10 units or more) should achieve zero carbon standards in line with London Plan policy.

2. All other new residential buildings should achieve a 35% reduction.

3. All major non-residential buildings should achieve a 35% reduction. From 2019 all major non-residential buildings should achieve zero carbon standards in line with London Plan policy.

Targets are expressed as a percentage improvement over the target emission rate (TER) based on Part L of the 2013 Building Regulations.

C. This should be achieved by following the Energy Hierarchy:

1. Be lean: use less energy

2. Be clean: supply energy efficiently

3. Be green: use renewable energy

Decentralised Energy Networks

D. The Council requires developments to contribute towards the Mayor of London target of 25% of heat and power to be generated through localised decentralised energy (DE) systems by 2025. The following will be required:

1. All new development will be required to connect to existing DE networks where feasible. This also applies where a DE network is planned and expected to be operational within 5 years of the development being completed.

2. Development proposals of 50 units or more, or new non-residential development of 1000sqm or more, will need to provide an assessment of the provision of on-site decentralised energy (DE) networks and combined heat and power (CHP).

3. Where feasible, new development of 50 units or more, or new non-residential development of 1000sqm or more, as well as schemes for the Proposal Sites identified in this Plan, will need to provide on-site DE and CHP; this is particularly necessary within the clusters identified for DE opportunities in the borough-wide Heat Mapping Study. Where on-site provision is not feasible,

provision should be made for future connection to a local DE network should one become available.

Applicants are required to consider the installation of low, or preferably ultra-low, NOx boilers to reduce the amount of NOx emitted in the borough.

Local opportunities to contribute towards decentralised energy supply from renewable and low-carbon technologies will be encouraged where appropriate.

Retrofitting

E. High standards of energy and water efficiency in existing developments will be supported wherever possible through retrofitting. Householder extensions and other development proposals that do not meet the thresholds set out in this policy are encouraged to comply with the Sustainable Construction Checklist SPD as far as possible, and opportunities for micro-generation of renewable energy will be supported in line with other policies in this Plan.

3 ENERGY DEMAND ASSESSMENT

3.1 National Calculation Methodology (NCM)

The baseline energy use and resulting carbon emission rate of the development has been assessed using the 2013 NCM methodology for the calculation of the regulated energy, such as space heating and domestic hot water consumption. NCM results for unregulated energy are also identified for information.

The emissions for the dwellings are based on a representative sample of 19 dwellings covering the lower mid level and top floors. The sample apartments were selected to represent all apartment types. Dwelling unregulated emissions are based on the BREDEM methodology.

It should be noted that as the energy consumption illustrated within this report is generated from the NCM and SAP methodologies and is not a prediction of the actual energy consumption.

The apartments were modelled using Stroma FSAP 2012 Version 1.0.4.16 and commercial spaces modelled using IES VE 2022, a Dynamic Simulation Software approved for generating Part L reports and Energy Performance Certificates.

Emissions within this report are based on the following CO_2 emission rates.

Natural Gas	0.210 $kgCO_2/kWh$
Grid electricity	0.233 $kgCO_2/kWh$
Grid displaced electricity	0.233 $kgCO_2/kWh$

As detailed within SAP10.

4 ENERGY EFFICIENT DESIGN

4.1 Dwellings

4.1.1 Passive Design Measures

The dwellings design will target highly efficient U-values for windows and air tightness.

Fabric Performance		
Element	**Notional Dwelling** **Building Regulations, Part L1A 2013**	**Proposed Measures**
Air Tightness	5 0m³/hr per m²	3.0 m³/hr per m²
External Wall U-Value	0.18 W/m²K	0.15 W/m²K
Spandrel Sections	0.18 W/m²K	0.35 W/m²K
Exposed Floor	0.13 W/m²K	0.11 W/m²K
Roof	0.13 W/m²K	0.11 W/m²K
Walls to unheated spaces*	0.13 W/m²K	0.16 W/m²K
Party Wall**	0.00 W/m²K	0.00 W/m²K
Glazing U-Value	1.4 W/m²K	1.0 W/m²K
Glazing G-Value**	0.63	0.4
Glazing LT	-	0.7
Linear Thermal Transmittance	0.05	Default Y value of 0.15

* Includes corridors, stairwells, risers and smoke ventilation shafts

** Wall between dwellings assumed to be constructed to approved method

Proposed fabric efficiency measures are predicted No improvement of the Part L Dwelling Fabric Energy Efficiency (DFEE) over the Target Fabric Energy Efficiency (TFEE)

Residential Fabric Efficiency	TFEE	DFEE	Improvement (%)
Development Total	49.22	49.24	0.0%

4.1.2 Heating, Cooling and Ventilation

For this assessment boilers with a seasonal efficiency of 89.1% have been included, along with the corresponding flue gas heat recovery device from the boiler manufacturer within the houses. As the final proposal for the apartments includes heat pumps as the community heating system, the lean measures are based on boilers with an efficiency of 95% meeting the total heat demand.

Cooling will not be provided to any dwellings, which will rely on a combination of the fixed mechanical ventilation system and openable windows.

Ventilation to the dwellings will be via balanced systems with heat recovery (MVHR). The MVHR unit used within the assessment is a Vent Axia Kinetic Advance S with the following SAP appendix Q test data; however, final unit selection will form part of the detailed design.

K+n wet rooms	SFP (W/l/s) [2012]	Efficiency (%) [2012]
n = 1	0.59	94%
n = 2	0.61	93%
n = 3	0.66	93%

4.1.3 Domestic Hot Water

Domestic hot water is responsible for approximately 41% of the regulated emissions, and in order to reduce these emissions, all domestic hot water pipework within the apartments will be insulated.

Whilst not having a direct impact on the building emissions a proportion of the water consumption is used as domestic hot water. The target dwelling water consumption rate is below 105lts/person/day.

4.1.4 Lighting

Within the dwellings, all fixed light fittings will be low energy lamps, including storage and infrequently accessed areas.

The lighting to common areas will be provided with PIR movement detectors and daylight control where appropriate.

4.1.5 Summary of Residential Carbon Emissions Following Energy Demand Reduction

The area weighted improvement over Part L (2013) for all the dwellings is 12% as illustrated in the table below. The full summary of the SAP results is detailed within appendix 3.

SAP 2012 Emission Rates	DER kgCO2/m2
Baseline Dwellings	17.97
Energy Efficient (Lean) Dwellings	15.76
Improvement	**12%**

The following tables indicate that an improvement of 11% is achieved when SAP 10 emission rates are applied with a CO_2 reduction of 14 tonnes.

Energy Consumption for energy baseline dwellings			
Item	**kWhrs/m²/ Year**	**kWhrs/ Year**	**Kg CO_2 /year**
Heating (gas)	36.7	283910	59,621
DHW (gas)	32.1	248252	52,133
Cooling	0.0	0	0
Auxiliary Energy	1.1	8400	1,957
Lighting	4.5	34944	8,142
Equipment	56.0	433,286	100,956
Total	**130**	**1,008,792**	**222,809**
Total no Equip	**74**	**575,506**	**121,853**

Energy Consumption for energy efficient dwellings			
Item	kWhrs/m²/ Year	kWhrs/ Year	Kg CO_2 /year
Heating (gas)	29.5	228787	48,045
DHW (gas)	28.9	223430	46,920
Cooling	0.0	0	0
Auxiliary Energy	2.4	18735	4,365
Lighting	4.8	36795	8,573
Equipment	56.0	433,286	100,956
Total	**122**	**941,033**	**208,860**
Total no Equip	**66**	**507,747**	**107,904**

GLA Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy		
	Carbon dioxide emissions (Tonnes CO2 per annum)	
	Regulated	Unregulated
Building Regulations 2013 Part L compliant	122	101
After energy demand reduction	108	101
After CHP	108	101
After Renewable Energy	53	101

GLA Table 2: Dwelling Carbon Dioxide Emissions from each stage of the Energy Hierarchy		
	Regulated Carbon dioxide savings	
	(Tonnes CO2 per annum)	(%)
Savings from energy demand reduction	14	11

4.2 Commercial Spaces

4.2.1 Passive Design Measures

The development will comply with building regulations through energy efficiency measures alone.

The design will target highly efficient U-values and air tightness, better than those used within the notional building calculation, as shown in the table below:

Fabric Performance		
Element	**Notional Building** **Building Regulations, Part L2A 2013**	**Proposed Measures**
Air Tightness	3 0m³/hr per m²	3.0 m³/hr per m²
External Wall U-Value	0.26 W/m²K	0.18 W/m²K
External Wall (to car park) U Value	0.26 W/m²K	0.18 W/m²K
Ground Floor	0.22 W/m²K	0.18 W/m²K
Roof	0.18 W/m²K	0.13 W/m²K
Walls to unheated spaces*	0.26 W/m²K	0.18 W/m²K
Glazing U-Value	1.6 W/m²K	1.4 W/m²K
Glazing G-Value	0.4	0.38
Glazing LT	0.71	0.7

* Boundary to unheated residential circulation and ancillary spaces

4.2.2 Heating, Cooling and Ventilation

The following systems have been assumed for the fixed mechanical building services items within the energy efficient (Lean) building.

It should be noted that air source heat pumps are proposed as the heating source for all the commercial units therefore 91% efficient gas fired boilers have been included for this stage of the hierarchy.

Space	Heating system	Cooling System	Ventilation
Block 1 (small commercial units)	Gas fired Boilers 91% efficiency	Air cooled split system SEER – 4.0	Supply and extract SFP – 1.0W/l/s Heat recovery – 75%
Block 2 Work spaces	Gas fired Boilers 91% efficiency	Air cooled split system SEER – 4.0	Natural ventilation
Block 2 Circulation	Gas fired Boilers	None	Natural ventilation
Block 2 Toilets	Gas fired Boilers	None	Extract only SFP – 0.3W/l/s

4.2.3 Domestic Hot Water

Domestic hot water consumption is anticipated to be very low, therefore electric point of use water heating devices are assumed for the final design, however, gas fired water heaters are assumed within the energy efficient model in accordance with GLA guidance notes. To minimise any losses the water heaters will be complete with time controllers, and all pipework will be insulated up to outlets.

4.2.4 Lighting

Lighting is by far the largest consumer of energy within the commercial units. The table below summarises the principle lighting performance and controls used within the building simulation.

Space	Lamp Efficacy Ll/cW	Lighting Control
Block 1 units	90	Manual control + photocell dimming at perimeter
Block 2 work space	100	Presence detection
Circulation	70	Manual Control
Toilets	70	Presence detection

4.2.5 Equipment

Equipment energy use or unregulated energy includes all the appliances, computers, and any other appliances belonging to the tenant, as the units are all being constructed on a speculative basis NCM equipment energy consumption has been identified for illustration purposes only.

4.2.6 Summary of Commercial Carbon Emissions Following Energy Demand Reduction

The area weighted improvement over Part L (2013) for all the commercial units is 19% as illustrated in the table below. The Part L2 outputs are detailed within appendix 7.

SAP 2012 Emission Rates	DER kgCO2
Baseline Commercial	14.17
Energy Efficient (Lean) Commercial	11.49
Improvement	**19%**

The annual energy consumption for the commercial units incorporating the energy efficiency measures described above are expected to reduce the emissions by 4 tonnes or 18% when SAP 10 emission rates are applied as detailed in the tables below.

Energy Consumption for Baseline Buildings (Non Residential)			
Item	kWhrs/m²/ Year	kWhrs/ Year	Kg CO_2 /year
Htg (Boilers)	16.3	32,553	6,836
DHW	2.7	5,303	1,114
Cooling	8.4	16,841	3,924
Auxiliary Energy	1.7	3,487	812
Lighting	19.9	39,641	9,236
Equipment	36.5	72,782	16,958
Total	**86**	**170,607**	**38,881**
Total no Equip	**49**	**97,825**	**21,922**

Energy Consumption for energy efficient Buildings (Non Residential) (Non Residential)			
Item	kWhrs/m²/ Year	kWhrs/ Year	Kg CO_2 /year
Htg (Boilers)	16.3	32,473	6,819
DHW	2.7	5,480	1,151
Cooling	3.9	7,793	1,816
Auxiliary Energy	3.5	7,003	1,632
Lighting	14.3	28,461	6,631
Equipment	36.5	72,782	16,958
Total	**77**	**153,993**	**35,008**
Total no Equip	**41**	**81,211**	**18,049**

GLA Table 3: Carbon Dioxide Emissions after each stage of the Energy Hierarchy		
	Carbon dioxide emissions (Tonnes CO2 per annum)	
	Regulated	Unregulated
Building Regulations 2013 Part L compliant	22	17
After energy demand reduction	18	17

GLA Table 4: Carbon Dioxide Emissions from each stage of the Energy Hierarchy		
	Regulated Carbon dioxide savings	
	(Tonnes CO2 per annum)	(%)
Savings from energy demand reduction	4	18

4.3 Summary of Energy & Carbon Emissions Following Energy Demand Reduction

The annual energy consumption for the development incorporating the energy efficiency measures described above for residential and commercial uses are detailed in the following in the tables:

Table 6: Carbon Dioxide Emissions from each stage of the Energy Hierarchy			
	Total Regulated Emissions	CO2 Savings	Percentage Saving
	(Tonnes CO2/year)	(Tonnes CO2/year)	%
Part L 2013 Baseline	144		
Be Lean	126	18	12

The tables above illustrate that the development will be energy efficient, with emissions 18% lower than the baseline building.

The energy demand for the various uses has also been calculated and is illustrated in the following table.

Energy Demand Following Efficiency Measures (MWh/yr)	Building Use	
	Domestic	Non-domestic
Space Heating	221	30
Hot Water	214	13
Lighting	37	17
Auxilary	15	19
Cooling	0	20
Unregulated Electricity	433	73
Unregulated Gas	0	0

5 RISK OF OVERHEATING

5.1 Dwellings

The Overheating Risk Assessment has been prepared using Dynamic thermal modelling and has been undertaken in accordance with the recommendations of Approved document Part O. which refers to CIBSE TM59 Design Methodology with minor amendments for the Assessment of Overheating Risk in Homes, and all apartments are classified as predominantly naturally ventilated.

The assessment is based on all apartments on the first and second floors to address the different apartment types that are at risk of overheating.

The CIBSE weather file for the London Heathrow was selected at the most appropriate location for the site. In accordance with the guidance within TM59, Design Summer Year (DSY)1 – 2020, High 50th Percentile has been used for the assessment.

Apartments at 1st and 2nd floor have been used within this sample assessment to indicate the anticipated performance of the apartments. All bedrooms are expected to comply with the criteria, with one sample lounge exceeding the criteria by one hour over the assessment period of May to September.

The overheating risk is largely due to the need to the need to achieve adequate daylight within the apartments, whilst considering the need to address the potential risk of overheating, with the following features incorporated within the design.

- The balconies are located one above the other to provide maximum external shading to the levels below.
- Solar control glazing is applied to all windows which will have a will have a G value of 0.38. The light transmission of the glass will not be below 70% and would not have a negative impact on the daylight amenity.

The houses have not been included within the assessment, these are less likely to overheat due to the ability of the units to achieve good cross flow ventilation from the front to the rear of the houses and have multiple levels allow the stack effect to increase ventilation rates on relatively still days by moving air from the ground to upper floors.

5.2 Non Dwelling Uses

It is assumed that the commercial spaces will be comfort cooled, with the following measures incorporated to minimise the cooling load.

The window designs have been optimised to maximise the daylight within the spaces, without leading to excessive solar gains, this has been achieved by limiting the use of full height glazing, and incorporating solar control glazing with a G value of 0.38 within the design.

The window frame design in Block 2 also has a significant impact in reducing the solar gain whist giving the impression of having large openings.

The majority of the units within Block 1 are dual aspect, however due to the room depth, natural ventilation is not viable and air quality is likely to deteriorate unless mechanical ventilation is provided.

Block 2 is relatively narrow, and has good natural ventilation potential on three elevations. Only limited openings are possible on the East elevation, but there are sufficient openings proposed to allow the building maintain acceptable air quality without the need for additional mechanical ventilation. Giving the building occupants the ability to provide natural ventilation should also encourage the users not to use the comfort cooling.

The Part L outputs which include solar gain checks indicate that all commercial spaces are compliant and the area weighted cooling demand for the actual buildings is around half that of the notional buildings as indicated in the table below.

	Area weighted average non-domestic cooling demand (mJ/m2)	Total area weighted non-domestic cooling demand (MJ/yr)
Actual	4.50	6387
Notional	11.40	16182

6 HEATING INFRASTRUCTURE

In accordance with GLA Energy Assessment Guidance (2018) and London Plan Policy SI3, the energy systems for the site have been determined in accordance with the following hierarchy:

1. Connection to existing low carbon heat distribution networks
2. Use zero emission or local secondary heat sources (in conjunction with heat pump if required)
3. Use low-emission combined heat and power (CHP)
4. Use ultra low NOx gas boilers

In a communal energy system, energy in the form of heat, cooling, and/or electricity is generated from a central source and distributed via a network of insulated pipes to surrounding residencies and commercial units.

The London Heat map has been reviewed and the site is over 700m away from the edge of the nearest heat map study area.

Following the above hierarchy:

1. Their are no existing heat networks in the vicinity of the development
2. The site is within a developed sub urban area with a large number of terraced and semi detached houses. The London heat map identifies the site location as within an area of low heat density, it therefore unlikely that a district heating network will be extended to development.
3. A community heating system for the apartment block is proposed. Heat will be generated via heat pumps with the external condensing units mounted within a roof mounted compound. The system will be designed to operate at low temperatures 60°C F and 30°C R, to minimise the potential distribution losses.
4. The houses are located away from the apartment block and on opposite sides of the site. Serving the houses from the community system would lead to a significant increase of pipework used on site, which in turn would increase the heat losses from the heat network and increase the service charge for all residencies.
5. It is not proposed to connect the commercial units, to the community heating system, these spaces are heated and cooled, and would be better served by reverse cycle heat pumps to provide heating and cooling as detailed within the following section.

7 LOW & ZERO CARBON TECHNOLOGIES FOR ENERGY PRODUCTION

The use of energy conversion technologies using renewable energy have been reviewed and summarised below. The main technologies available for on-site renewable energy generation are:

- Biomass
- Ground Source Heat Pumps
- Air Source Heat Pumps
- Photovoltaic Panels
- Solar Thermal Hot Water Generation
- Wind
- CHP

Refer to appendix 3 for more details and a brief explanation of renewable energy technologies.

7.1 Preliminary Technology Appraisal

Technology	Feasibility*			Comments
	H	M	L	
Biomass			✓	Not suitable for the site on grounds of fuel storage and deliveries within city centre site and wider issues relating to high levels of NOx and particulate matter generated from combusting biomass fuels.
Ground Source heat pumps			✓	Ground source heat pumps extract heat from the ground, and convert it to low grade heat for space heating and hot water. Ground source heat pumps would have to be connected to a community system, and as discussed in Section 6, the site is of insufficient scale to successfully operate as a communal heating system and is unlikely to connect into a wider heat network.
Air Source Heat Pumps	✓			Air source heat pumps extract heat from the air and convert it to low grade heat for space heating. Heat pumps can be configured to operate successfully with gas fired boilers, by pre heating the return water. This arrangement has the advantage of maximizing the operation period of the heat pump, whilst using boilers to meet the peak periods, when heat pumps are less effective with higher fuel costs. Air to air source heat pumps would be suitable for the commercial spaces particularly where these would be incorporated within a reverse cycle heat pump installation providing both space heating and cooling.

Technology	Feasibility*			Comments
	H	M	L	
Photovoltaic Panels	✓			Photovoltaic modules convert daylight directly into DC electricity and can be integrated into buildings. Space is available at roof level of the apartment block and the houses to install a series PV arrays.
Solar Hot water			✓	Solar thermal installations are a well established renewable energy system and can be one of the most cost-effective renewable energy systems available. Solar thermal installations are best suited to single occupancy installations such as houses or hotels, where the hot water can feed directly into the users hot water storage vessel and are not viable for a mixed use scheme of this nature. To minimise the number of technologies used on the development PV panels are preferred to solar thermal panels on the houses.
Wind			✓	The urban environment and the close proximity of other buildings are not favourable conditions for the installation of wind turbines. The uneven air flow caused by surrounding buildings and the potential negative impact on the visual and noise amenity of the area militate against the use of wind turbines for this development.

H - High Feasibility - No Obvious restrictions

M - Medium feasibility - Significant issues that need to be addressed

L - Low feasibility – Site unlikely to support technology

Based on this preliminary evaluation, the following technologies will be assessed:

- Photovoltaic Panels (PV)
- Air source heat pumps

7.2 Photovoltaic Panels

7.2.1 Application

Photovoltaic modules convert daylight directly into DC electricity and can be integrated into buildings. Photovoltaics (PVs) are distinct from other renewable energy technologies since they have no moving parts to be maintained and are silent. PV systems can be incorporated into buildings in various ways: on sloped roofs and flat roofs, in facades, atria and shading devices. Modules can be mounted using frames or they can be fully incorporated into the actual building fabric; for example, PV roof tiles are now available which can be fitted in place of standard tiles. Since PVs generate DC output, an inverter and other equipment is needed to deliver the power to a building or the grid in an acceptable AC form.

7.2.2 Constraints

The following constraints have been identified for the application of the PV technology at the site.

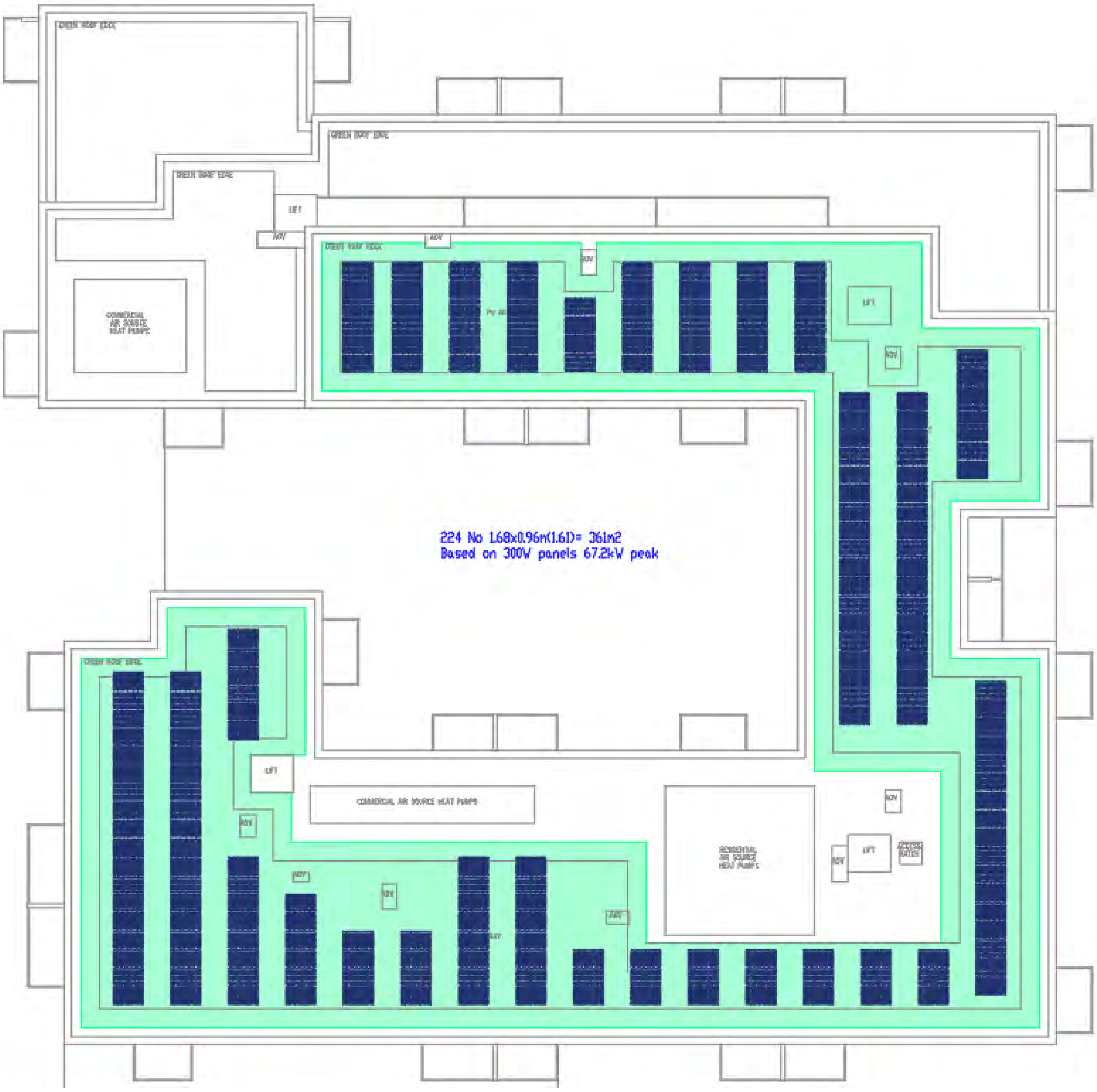
1. Connection points into the LV distribution system.
2. Over shadowing.
3. Power generated by the array on the apartment block roof will be connected to the landlords power supply, house mounted arrays will be connected to the individual property supplies.

7.2.3 Energy Reduction

Space is available on the roof of the apartment block to accommodate a 67.2kWp installation.

Approximately 360m2 of PV suitably placed on the green roofing system.

The arrays are predicted to generate 74,347kWh which equates to a CO2 reduction of 17.3 Tonnes of CO_2.



Indicative PV Layout on Residential Block

7.2.4 Conclusion

PV panels are a viable technology and are predicted to reduce the emissions to the dwellings by 9%.

7.3 Air Source heat Pumps

7.3.1 Application

The technology makes use of the energy available in the ambient air. Essentially, heat pumps take up heat at a certain temperature and release it at a higher temperature. This is achieved by means of a simple heat exchanger in the case of air source heat pumps.

The efficiency of any type of heat pump is very much dependent on the temperature level at which it has to provide the heat: the lower the temperature level, the better the coefficient of performance.

Almost all heat pumps in operation are based on the vapour compression cycle, which combines efficiency, safety and reasonable cost. The efficiency of heat pumps is measured by the ratio of the heating capacity to the power input, referred to as the Coefficient of Performance (COP). A seasonal COP of more than 4.0 is achievable from an air to air variable refrigerant flow system.

7.3.2 Constraints

The following constraints have been identified for the application of air source heat pump technology at the site.

1. Space needs to be allocated for the heat pumps in a location that provides a good air flow through and around the units.

7.3.3 Energy Reduction

Remodelling the commercial units, exchanging the gas fired heating plant assumed within the energy efficient models with air source heat pumps with an SCOP of 2.57 will reduce the commercial buildings energy consumption by 1137 kWh below the energy efficient model.

The houses were re assessed using the SAP software, exchanging the gas boilers for monoblock heat pumps with hot water storage cylinders taken from the NCM Product Characteristic Database.

Within the residential community heating plant serving the apartments, air source heat pumps can be installed to generate 100% of the heating demand, an SCOP of 2.57 has been calculated for this assessment, utilising data from a manufacturer included within Appendix 4 and sink temperatures taken from the CIBSE TRY for London.

An assessment of the distribution losses has also been undertaken and a summary of the calculation is included within Appendix 5 demonstrating that the annual distribution losses are predicted to equate to 20%.

A heat pump installation with a duty of approximately 250kW will meet 100% of the annual heat requirements resulting in a 36% CO_2 reduction.

The performance of the heat pump(s) will be monitored via the Building Management System, with sub meters monitoring the heat generated from the heat pumps and the power consumption. This will then be periodically compared to the building gas consumption and heat generated by the boilers.

7.3.4 Conclusion

The PV panels mounted on the roofs of the houses and the apartment block will have a total peak capacity of 67.2Wp, and reduce the dwelling emissions by 12 tonnes or 9%.

The provision of the heat pump within the community heating system and exchanging the boilers for heat pumps within the houses reduces the emissions by 43 tonnes or 36%

The combination of heat pumps and PV panels reduces the emissions from the dwelling by 41 tonnes as illustrated in the tables below.

Energy Consumption for energy efficient dwellings with Renewable Technology			
Item	**kWhrs/m²/ Year**	**kWhrs/ Year**	**Kg CO_2 /year**
Heating (gas)	0.0	202	42
DHW (gas)	0.0	235	49
Heating (Heat Pump)	15.7	121,198	28,239
DHW (Heat Pump)	12.9	100,058	23,314
Cooling	0.0	0	0
Auxiliary Energy	2.4	18,735	4,365
Lighting	4.8	36,795	8,573
CHP Heat	0.0	0	0
CHP Electricity	0.0	0	0
PV Electricity	-6.6	-50,781	-11,832
Equipment	56.0	433,286	100,956
Total	**85**	**659,730**	**153,707**
Total no Equip	**29**	**226,443**	**52,751**

GLA Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy		
	Carbon dioxide emissions (Tonnes CO2 per annum)	
	Regulated	**Unregulated**
Building Regulations 2013 Part L compliant	122	101
After energy demand reduction	108	101
After CHP	108	101
After Renewable Energy	53	101

GLA Table 2: Dwelling Carbon Dioxide Emissions from each stage of the Energy Hierarchy		
	Regulated Carbon dioxide savings	
	(Tonnes CO2 per annum)	**(%)**
Savings from energy demand reduction	14	11
Savings from CHP	0	0
Savings from renewable energy	55	45

Air source heat pumps are a viable technology for the commercial units in the form of an air to air heat pump, and are predicted to reduce the emissions to these uses by 36%

Energy Consumption for energy efficient buildings with Renewable Technology (Non Residential)			
Item	kWhrs/m²/ Year	kWhrs/ Year	Kg CO_2 /year
Boiler Htg	0.0	0	0
DHW	2.4	4,823	1,124
Htg. (heat pump)	5.4	10,747	2,504
Htg. (Elec)	0.0	0	0
Cooling	3.9	7,776	1,812
Auxiliary Energy	2.5	4,988	1,162
Lighting	14.3	28,461	6,631
CHP Heat	0.0	0	0
CHP Electricity	0.0	0	0
PV Electricity	0.0	0	0
Equipment	36.5	72,782	16,958
Total	**65**	**129,577**	**30,191**
Total no Equip	**28**	**56,795**	**13,233**

GLA Table 3: Carbon Dioxide Emissions after each stage of the Energy Hierarchy		
	Carbon dioxide emissions (Tonnes CO2 per annum)	
	Regulated	Unregulated
Building Regulations 2013 Part L compliant	22	17
After energy demand reduction	18	17
After CHP	18	17
After Renewable Energy	13	17

GLA Table 4: Carbon Dioxide Emissions from each stage of the Energy Hierarchy		
	Regulated Carbon dioxide savings	
	(Tonnes CO2 per annum)	(%)
Savings from energy demand reduction	4	18
Savings from CHP	0	0
Savings from renewable energy	5	22

7.4 Energy & Emissions Following the Introduction of Renewable Technologies

In total the air source heat pump installations and PV panels are predicted to reduce the emissions from the development by 60 tonnes or 42% of the baseline development emissions.

Table 6: Carbon Dioxide Emissions from each stage of the Energy Hierarchy			
	Total Regulated Emissions	CO2 Savings	Percentage Saving
	(Tonnes CO2/year)	(Tonnes CO2/year)	%
Part L 2013 Baseline	144		
Be Lean	126	18	12
Be Clean	126	0	0
Be Green	66	60	42

8 CONCLUSIONS

Following a recent review of the relevant National and Local Planning Policies, this Energy Assessment proposes a strategy that positively responds to the London Plan, Policies SI2 and SI3, the Mayor's Energy Assessment Guidance, and Policy LP22 Sustainable Design and Construction of Richmond upon Thames Local Plan (2018).

The energy efficiency measures include good fabric insulation, triple glazing, improved air tightness, high efficiency balanced whole house heat recovery units, and low energy lighting throughout. Commercial units will be fitted out with low energy light fittings with photocell controls and energy efficient ventilation systems.

The energy efficiency measures are calculated to reduce the dwelling emissions by 13% and 19% for the commercial units, when SAP 2012 emission rates are applied.

The site is not within an area described as having district heating potential as identified within the London Heat Map, and the surrounding developments are predominantly privately owned terraced or semi-detached houses with a low heat density. However, it is proposed to serve the apartments from a community heating system with an air source heat pump contributing 100% of the annual heat demand. Dedicated heat pumps will provide all the space heating and hot water within the houses and reverse cycle heat pumps providing space heating and cooling will be used to serve the commercial units.

In addition to the various heat pump installations, a 67.2Wp PV array will be mounted on the roof of the apartments block.

The total reduction of regulated emissions, once energy efficiency measures and renewable energy is considered for the whole development is 54% based on NCM building performance and SAP10 emission rates.

Table 6: Carbon Dioxide Emissions from each stage of the Energy Hierarchy			
	Total Regulated Emissions	CO2 Savings	Percentage Saving
	(Tonnes CO2/year)	(Tonnes CO2/year)	%
Part L 2013 Baseline	144		
Be Lean	126	18	12
Be Clean	126	0	0
Be Green	66	60	42
Cumulative Saving		78	54
Total off-set £		**188,056**	

The zero carbon homes CO_2 offset payment is calculated to be £188,056 for the dwellings based on £95.00 / tonne over a 30 year period.

A1 APPENDIX 1 – WATER CALCULATOR

Approved Document G - Table A1 Water Efficiency Calculator for Dwellings

Project Ref: St Clare Business Park
property Type: Dwelling

Installation Type	Unit of Measure	Capacity /flow rate	Use factor	Fixed use (litres/ person/	litres/ person/day
WC Single Flush	Flush Volume (litres)	0	*4.42*	*0*	0.00
WC Dual Flush	Full flush volume (litres)	6	*1.46*	*0*	8.76
	Part flush volume (litres)	4	*2.96*	*0*	11.84
WC's Multiple fittings	Average effective flushing volume (litres)	0.0	*4.42*	*0*	0.00
Taps (Excluding kitchen/utility room taps	Flow rate (litres/min)	5.0	*1.58*	*1.58*	9.48
Bath (where shower also present)	Capacity to overflow	130	*0.11*	*0*	14.30
Shower (where bath is also present)	Flow rate (litres/min)	8	*4.37*	*0*	34.96
Bath only	Capacity to overflow	0	*0.5*	*0*	0.00
Shower only	Flow rate (litres/min)	0	*5.6*	*0*	0.00
kitchen/utility sink taps	Flow rate (litres/min)	6	*0.44*	*10.36*	13.00
Washing machine	Litres/kg dgy load	8.87	*2.1*	*0*	18.63
Dishwasher	Litres/place setting	1	*3.6*	*0*	3.60
Waste disposal unit	Litres/use (if present=1, if absent=0)	0	*3.08*	*0*	0.00
water softener	Litre/person/day	0	*1*	*0*	0.00
	Total calculated Use				**114.57**
	Contribution from grey water (litres /person/day)				0.00
	Contribution from rain water (litres /person/day)				0.00
	Normalisation factor				0.91
	Total water consumption				104.26
	External water use				5.00
	Total water consumption				**109.26**

A2 APPENDIX 2 - RENEWABLE ENERGY OVERVIEW

The information in this appendix is not project specific and is intended to provide an overview of the technologies described.

A2.1 Biofuels

A2.1.1 Background

Biomass is an alternative solid fuel to the conventional fossil fuels and has an impact on carbon emissions that is close to neutral. Various types of biomass fuels are in use, the most common being the woody biomass, which includes forest residues such as tree thinnings, and energy crops such as willow short rotation coppice. The fuel usually takes the form of wood chips, logs and pellets. Supply and storage of the biomass fuel should be carefully considered especially for larger plants. Modern systems can be fed automatically by screw drives from fuel hoppers.

The typical applications are:

a. Biomass boilers replacing standard gas- or oil -fired boilers for space heating and hot water (for individual buildings or district heating systems).

b. Standalone room heaters for space heating.

c. Stoves with back boilers, supplying domestic hot water.

d. Biomass CHP for heat and electricity generation.

Appliances can achieve efficiencies of more than 80%.

The capital cost of automated biomass heating systems is significantly greater than that of conventional heating systems, mainly because of the more complicated feeding mechanisms and the currently smaller market for biomass appliances.

There is an ongoing public debate on the true sustainability of using biofuels. Given the number of differing views expressed by academics and engineers and contradictions in publications issued by the Government the theoretical carbon savings offered by biofuels must be treated with extreme caution. 3.1.2 to 3.1.5 below expands on this.

A2.1.2 Biofuels as a Sustainable Resource

Research undertaken by AEA technology on behalf of the Department for Transport2 stated that ‘Research has shown that biofuels can reduce carbon emissions, yet they are currently a controversial area of science. Insufficient data exists to fully understand the impact of biofuel production on communities and the environment; and, whilst biofuels could be a powerful tool in reducing carbon emissions, they must be produced in a sustainable manner if they are not to do more harm than good’ then states that ‘biofuels are currently a controversial topic area, and it is difficult to move forward in such circumstances’. The research paper listed 4 key findings:

Key finding 1: We need to improve our understanding of the indirect impacts of biofuels, particularly indirect land use change;

Key finding 2: We need to improve our knowledge of the environmental, socioeconomic and supply-chain impacts of biofuels;

Key finding 3: There is a need for new research to examine the evolution of the production, infrastructure and vehicle technologies necessary to enable us to meet longer-term biofuels targets for transport and for improving the sustainability of biofuels;

Key finding 4: There are a number of cross-cutting research gaps that need to be addressed in order to support the development of biofuels policy

[2] Biofuels Research Gap Analysis, Department for Transport, July 2009

According to the Renewable Fuels Agency3 only 18% of the liquid biofuels consumed in the UK originate in the UK. 30% of liquid biofuels originates in Brazil, and the sustainability of their production and the consequent deforestation are the topic of wider debate.

The carbon emission factor stated in the Standard Assessment Procedure (SAP) 2009 for biodiesel is 0.047kg CO2/kWhr. (The SAP methodology is used to calculate the energy consumption and carbon emissions from dwellings to demonstrate compliance with the Building Regulations and generate Energy Performance Certificates). Data published by the Renewable Fuels Agency4 shows that the mean carbon emission factor for biodiesel consumed in the UK is 0.148kgCO2/kWhr (41 gCO2e/MJ), this compares to the carbon emission factor for natural gas of 0.198kgCO2/kWhr. Given that there is a limited supply of biofuel it would be reasonable to use the mean value for the emission factor; this principle is applied to mains electricity where the carbon emissions from all sources of electricity generation are aggregated to arrive at a mean value.

The carbon emission factor stated in the SAP 2009 for wood pellets is 0.028kg CO2/kWhr. Research by AEA Technology on behalf of the Environment Agency5 showed that the emissions are actually between 0.050 and 0.140 kg CO2/kWhr, with 0.1 kgCO2/kWhr being a typical value for good practice. From this it can be concluded that the carbon savings stated when using the SAP values are overstated.

Biodiesel CHP may be technically viable for the development but the lack of certainty over the sustainability of liquid biofuels militates against this. In addition to this, concerns over the future availability of fuel supplies are a consideration. The European Renewable Energy Directive (RED) commits the UK to sourcing 10 percent of its transport energy from renewable sources by 20206. Currently only 3.5% of transport energy is from renewable sources, and 82% of this is imported. It is reasonable to conclude that as the volume of liquid biofuel that is legally required to be used for transport energy increases, the supply of the fuel for other purposes will become more expensive and difficult to procure.

A2.2 Air and Ground Source Heat Pumps

A2.2.1.1 Background

The technology makes use of the energy available in the ambient air or stored in the Earth's crust, which comes mainly from solar radiation. Essentially, heat pumps take up heat at a certain temperature and release it at a higher temperature. This is achieved by means of a simple heat exchanger in the case of air source heat pumps, or by means of either horizontal or vertical ground collectors, in which a heat exchange fluid circulates and transfers heat via a heat exchanger to the heat pump, in the case of ground source heat pumps. For the latter, when considering buildings with piled foundations, the pipes can be integrated in the design using several piling systems.

The efficiency of any type of heat pump is very much dependent on the temperature level at which it has to provide the heat: the lower the temperature level, the better the coefficient of performance.

Almost all heat pumps in operation are based on the vapour compression cycle, which combines efficiency, safety and reasonable cost. The efficiency of heat pumps is measured by the ratio of the heating capacity to the power input, referred to as the Coefficient of Performance (COP). Generally, a COP of around 2.5-3 for air source heat pumps and around 3.5-4 for ground source heat pumps is achievable for heating, assuming low temperature heat emitters such as underfloor heating. When used to generate domestic hot water at 60°C the COP falls for both types of heat pumps by around 1 point. Therefore, when it comes to domestic hot water, heat pumps can be implemented to pre-heat the water up to a certain temperature, before it enters the boiler, rather than to heat up the domestic hot water entirely up to its final required temperature.

[3] Renewable Fuels Agency Quarterly Report Apr 2010 to October 2010
[4] Renewable Fuels Agency Quarterly Report Apr 2010 to October 2010
[5] Biomass: Carbon sink or carbon sinner?, Environment Agency, April 2009
[6] Department of Energy and Climate Change website.

The approximate costs for heat pumps amount to £700 per kWth heat output for an air source heat pump, and £1,200 per kWth heat output for a ground source heat pump with horizontal trenches, and £1,400 per kWth heat output for a ground source heat pump with vertical boreholes (including the cost of bore holes).

A2.3 Solar Water Heating Systems

A2.3.1.1 Background

Solar thermal and, especially, active Solar Domestic Hot Water (SDHW) heating is a well -established renewable energy system in many countries outside the UK. It can be one of the most cost-effective renewable energy systems available.

It is appropriate for both residential and non-residential applications, and there are currently in the order of 80,000 installations in the UK.

Solar thermal systems in the UK normally operate with a back-up source of heat, such as gas or electricity. The solar system pre-heats the incoming cold water, which is topped up by the back-up heat source when there is insufficient solar energy to reach the chosen target temperature.

Solar collectors are best mounted at an incline with a southerly orientation, although orientations between south-east and south-west are acceptable. The panels can be fixed to the roof or walls.

There are three main types of solar collector that can be used in SDHW systems. These are:

a. Evacuated tubes.

b. Glazed selective surfaced flat plate.

c. Glazed non-selective surfaced flat plate.

Evacuated tube collectors are generally more expensive than flat plate type but offer an improved performance, particularly in the winter.

A2.4 Photovoltaics

A2.4.1.1 Background

Photovoltaic modules convert daylight directly into DC electricity and can be integrated into buildings. Photovoltaics (PVs) are distinct from other renewable energy technologies since they have no moving parts to be maintained and are silent. PV systems can be incorporated into buildings in various ways: on sloped roofs and flat roofs, in facades, atria and shading devices. Modules can be mounted using frames or they can be fully incorporated into the actual building fabric; for example, PV roof tiles are now available which can be fitted in place of standard tiles. Since PVs generate DC output, an inverter and other equipment is needed to deliver the power to a building or the grid in an acceptable AC form. The cost of the inverter and these components can approach 50% of the total cost of a PV system.

For PV to work effectively it should ideally face south and at an incline of 30º to the horizontal, although orientations within 45º of south are acceptable. It is essential that the system is unshaded, as even a small shadow may significantly reduce output.

A2.5 Wind Energy

A2.5.1.1 Background

Most wind turbines are installed in non-urban areas for environmental and technical reasons. However, it has become more common for smaller devices installed at the point of use, i.e. urban settings. The capacity of wind turbines range from 500W to more than 1.5 MW, but, for practical purposes and in built-up areas in particular, machines of more than 1 kW and below 500kW are likely to be considered. Individual building or community wind projects, although smaller, have the advantage of feeding electricity directly into the building's electricity circuit, thus sparing costly distribution network development and avoiding distribution losses. The downside is the still high capital cost per kW installed for smaller turbines, plus location constraints, such as visual intrusion and noise. The wind regime in urban areas is also a concern owing to higher wind turbulence which reduces the potential electricity output.

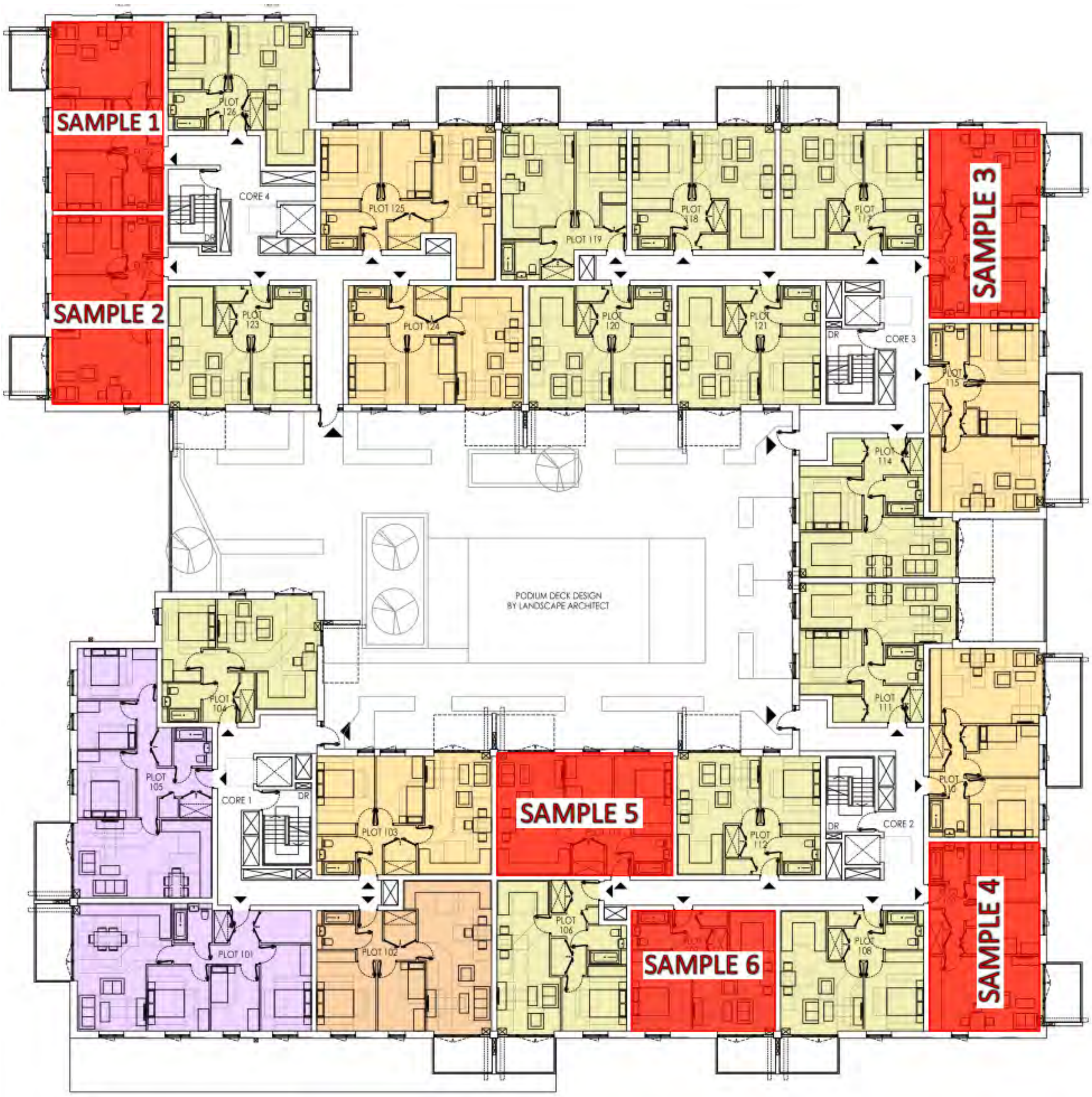
In most cases, wind turbines are connected to the electricity grid and all generated energy is used regardless of the building demand fluctuations. The output largely depends on the wind speed and the correlation between the two is a cube function. This means that in short periods of above-average wind speeds the generation increases exponentially. As a result, it is difficult to make precise calculations of the annual output of a turbine, but average figures can provide useful guidance.

The cost per kW installed varies considerably by manufacturer and size of machine with an indicative bracket of £2,500-£5, 000. With a lifespan of more than 20 years, wind turbines can save money if design and planning are carried out in a robust way.

Wind Turbine Options

Wind turbines can be mounted on horizontal or vertical axes. The horizontal mounted turbines are less expensive (around £ 20,000 for a 6 kW turbine) but generate more vibrations. The vertical mounted turbines are more expensive (around £ 22,000 for a 5 kW turbine), but almost vibration free. The table below shows the most relevant figures for both types of turbines.

A3 APPENDIX 3 – ENERGY ASSESSMENT SAMPLE APARTMENTS AND SAP 2012 SUMMARY OUTPUTS



Typical Floor Samples

Top Floor Samples

SAP 2012 Summary (Baseline)											
Sample Dwelling Ref	Sample Quantity	Area (m2)	Space Heating	Emission Factor	Domestic Hot water	Emission Factor	Lighting	Auxilary	Cooling	TER (kgCO2/m2)	TFEE (kWh/m2)
Sample 1 (Mid)	4	66.25	1837.53	0.216	2266.36	0.216	303.98	75.00	0.00	16.35	38.30
Sample 2 (Mid)	2	66.25	2464.02	0.216	2251.60	0.216	297.09	75.00	0.00	18.29	48.80
Sample 3 (Mid)	3	67	1543.19	0.216	2285.73	0.216	307.48	75.00	0.00	15.31	33.00
Sample 4 (Mid)	2	67	1768.27	0.216	2278.40	0.216	307.48	75.00	0.00	16.01	36.70
Sample 5 (Mid)	8	67	1752.01	0.216	2278.25	0.216	324.50	75.00	0.00	16.09	36.50
Sample 6 (Mid)	8	55.1	1636.45	0.216	2129.86	0.216	262.71	75.00	0.00	17.95	41.60
Sample 1 (Bottom)	6	66.25	2583.67	0.216	2248.27	0.216	303.98	75.00	0.00	18.72	50.50
Sample 2 (Bottom)	4	66.25	3189.00	0.216	2238.34	0.216	297.09	75.00	0.00	20.61	60.80
Sample 3 (Bottom)	5	67	2253.78	0.216	2265.21	0.216	307.48	75.00	0.00	17.53	44.60
Sample 4 (Bottom)	4	67	2482.24	0.216	2260.02	0.216	307.48	75.00	0.00	18.25	48.30
Sample 5 (Bottom)	16	67	2500.39	0.216	2259.13	0.216	324.50	75.00	0.00	18.44	48.60
Sample 6 (Bottom)	16	55.1	2243.46	0.216	2114.03	0.216	262.71	75.00	0.00	20.26	53.50
Sample 4 (Top)	4	67	2482.24	0.216	2260.02	0.216	307.48	75.00	0.00	18.25	48.30
Sample 5 (Top)	5	67	2500.39	0.216	2259.13	0.216	324.50	75.00	0.00	18.44	48.60
Sample 6 (Top)	5	55.1	2243.46	0.216	2114.03	0.216	262.71	75.00	0.00	20.26	53.50
Sample 7 (Top)	2	66.3	2555.24	0.216	2249.44	0.216	304.21	75.00	0.00	18.62	50.10
Sample 8 (Top)	4	70	3562.87	0.216	2275.03	0.216	321.47	75.00	0.00	20.95	63.50
House Sample 1	8	129	5300.10	0.216	2590.68	0.216	478.94	75.00	0.00	15.44	49.00
House Sample 2	6	129	6529.87	0.216	2582.54	0.216	466.84	75.00	0.00	17.44	60.30
Sample Apartments		8025.5	307500		253753		35913	8400	0		
Area Weighted Value		7744	296714		244852		34653	8105	0	17.97	49.22

SAP 2012 Summary (LEAN)											
Sample Dwelling Ref	Sample Quantity	Area (m2)	Space Heating	Emission Factor	Domestic Hot water	Emission Factor	Lighting	Auxilary	Cooling	DER (kgCO2/m2)	DFEE (kWh/m2)
Sample 1 (Mid)	4	66.25	691.91	0.216	1972.57	0.216	311.73	143.52	0	12.25	32.80
Sample 2 (Mid)	2	66.25	1555.97	0.216	1972.57	0.216	296.83	151.73	0	15.02	45.10
Sample 3 (Mid)	3	67	728.51	0.216	1979.61	0.216	315.44	145.27	0	12.30	32.10
Sample 4 (Mid)	2	67	1018.59	0.216	1979.61	0.216	315.44	148.02	0	13.26	36.60
Sample 5 (Mid)	8	67	753.75	0.216	1979.61	0.216	334.24	145.51	0	12.53	33.90
Sample 6 (Mid)	8	55.1	870.01	0.216	1859.73	0.216	270.05	124.24	0	14.41	39.40
Sample 1 (Bottom)	6	66.25	1809.12	0.216	1972.57	0.216	311.73	154.14	0	15.98	48.70
Sample 2 (Bottom)	4	66.25	2677.97	0.216	1972.57	0.216	296.83	162.39	0	18.76	60.40
Sample 3 (Bottom)	5	67	1793.51	0.216	1979.61	0.216	315.44	155.38	0	15.81	47.60
Sample 4 (Bottom)	4	67	2115.99	0.216	1979.61	0.216	315.44	158.45	0	16.87	52.00
Sample 5 (Bottom)	16	67	1877.38	0.216	1979.61	0.216	334.24	156.18	0	16.23	49.70
Sample 6 (Bottom)	16	55.1	1795.66	0.216	1859.73	0.216	270.05	133.04	0	18.13	55.00
Sample 4 (Top)	4	67	2115.99	0.216	1979.61	0.216	315.44	158.45	0	16.87	52.00
Sample 5 (Top)	5	67	1877.38	0.216	1979.61	0.216	334.24	156.18	0	16.23	49.70
Sample 6 (Top)	5	55.1	1795.66	0.216	1859.73	0.216	270.05	133.04	0	18.13	55.00
Sample 7 (Top)	2	66.3	1791.57	0.216	1973.04	0.216	311.98	154.06	0	15.91	48.40
Sample 8 (Top)	4	70	3135.97	0.216	2006.86	0.216	330.25	173.76	0	19.61	64.70
House Sample 1	8	129	4095.62	0.216	2487.69	0.216	491.27	367.71	0	13.68	48.00
House Sample 2	6	129	5937.71	0.216	2458.72	0.216	469.94	384.94	0	16.47	60.50
Sample Apartments		8025.5	232206		225162		36795	19714	0		
Area Weighted Value		7744	224062		217265		35505	19023	0	15.76	49.24

II Product Data

1. Capacity tables

(1) Correction by temperature

• CAHV-P500YA-HPB(-BS)

(1)-1 Efficiency Priority Mode

• **Capacity**

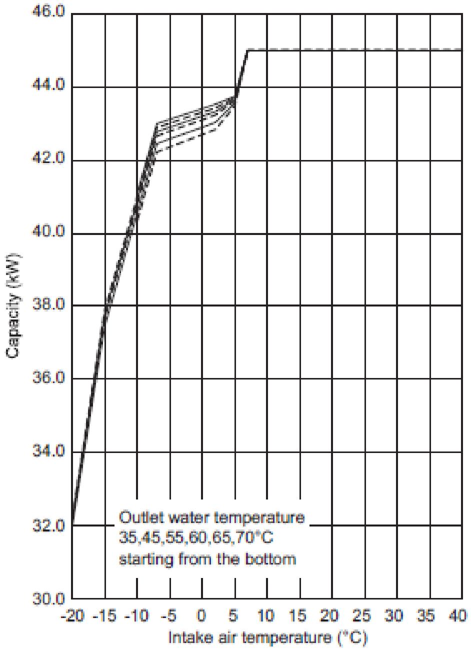
Outlet water temperature °C	Intake air temperature °C: -20	-15	-10	-7	-5	0	2	5	7	10	16	20	25	30	35	40
35	-	-	40.3	42.2	42.4	42.7	42.8	43.5	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
45	32.0	37.4	40.6	42.4	42.6	42.9	43.0	43.5	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
55	32.2	37.7	40.8	42.7	42.8	43.1	43.2	43.6	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
60	32.2	37.8	40.9	42.8	42.9	43.2	43.3	43.7	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
65	32.2	37.9	41.0	42.9	43.0	43.3	43.4	43.7	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
70	-	-	41.1	43.0	43.1	43.4	43.5	43.7	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0

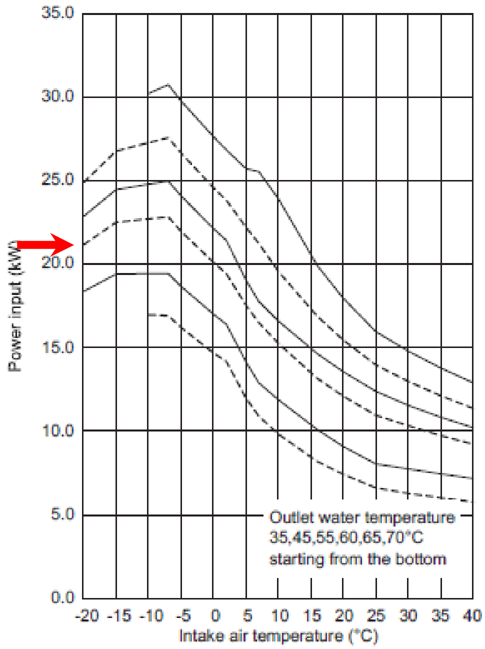
This table shows the capacity when the relative humidity is 85%.
The intake wet-bulb temperature is fixed to 32°C when the intake dry-bulb temperature is 35°C or higher.

• **Power input**

Outlet water temperature °C	Intake air temperature °C: -20	-15	-10	-7	-5	0	2	5	7	10	16	20	25	30	35	40
35	-	-	17.0	16.9	16.2	14.7	14.2	12.0	10.9	9.82	8.20	7.40	6.60	6.30	6.02	5.77
45	18.4	19.4	19.4	19.5	18.7	17.0	16.4	14.2	12.9	11.9	10.1	9.08	8.05	7.73	7.44	7.17
55	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
60	22.9	24.5	24.8	25.0	24.1	22.1	21.4	19.1	17.8	16.6	14.7	13.6	12.4	11.6	10.8	10.2
65	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
70	-	-	30.2	30.8	29.8	27.6	26.9	25.7	25.6	23.9	19.9	18.0	16.0	14.8	13.8	12.9

This table shows the power input when the relative humidity is 85%.
The intake wet-bulb temperature is fixed to 32°C when the intake dry-bulb temperature is 35°C or higher.





A5 APPENDIX 5 – COMMUNITY HEATING SYSTEM LOSSES

Distribution Loss Factor Calculation

System Flow temp	65°C
System Return Temp	35°C
Mean water temp	50°C

Kingspan heat emitted from enhanced insulation

Pipe size	W/m 95°C	W/m 60°C	W/m 50°C
20	9	7	6.43
25	9.86	7.71	7.10
32	10.83	8.46	7.78
40	11.42	9.01	8.32
50	12.61	9.94	9.18
65	14.12	11.25	10.43
80	15.28	12.17	11.28
100	17.51	14.29	13.37

No of floors/Apartments	length	pipe size	heat loss (W/m)	Total (W)
98	6	25	7.71	4533
4	120	25	7.71	3701
4	6	32	8.46	203
1	150	40	9.01	1352
1	40	50	9.94	398
0	0	65	9.18	0

Measured Losses	10.19 kW
Unaccounted losses from breaks in insulation @ 10%	1.02 kW
Total Assumed losses	11.21 kW
Annual Losses	98168 kWh
Total Heat output	503018 kWh
Distribution loss factor	**1.20**

A6 APPENDIX 6 – LEAN TER,DER AND SAP INPUTS

SAP Input

Property Details: Sample 1 (Mid)

Address:	
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	26 July 2019
Date of certificate:	15 June 2022
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	498

Property description:

Dwelling type:	Flat
Detachment:	
Year Completed:	2019

Floor Location:	Floor area:	Storey height:
Floor 0	66.25 m²	3 m

Living area:	27.2 m² (fraction 0.411)
Front of dwelling faces:	Unspecified

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
DOOR	Manufacturer	Solid			Wood
Balcony	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
N	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
E	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
DOOR	mm	0.7	0	1.4	2.4	1
Balcony		0.7	0.4	1	4.8	1
N		0.7	0.4	1	5.44	1
E		0.7	0.4	1	1.44	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
DOOR		INT	Worst case	0	0
Balcony		N	North	0	0
N		N	North	0	0
E		E	East	0	0

Overshading: Heavy

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
N	10.24	10.24	0	0.15	0	False	N/A
E	1.44	1.44	0	0.15	0	False	N/A
INT	13.2	2.4	10.8	0.16	0.43	False	N/A
Spandrel	2.4	0	2.4	0.35	0	False	N/A
Internal Elements							
Party Elements							

Thermal bridges:

SAP Input

Thermal bridges:	No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	3

Main heating system:

Main heating system:	Community heating schemes Heat source: Community boilers heat from boilers – mains gas, heat fraction 1, efficiency 95 Piping>=1991, pre-insulated, low temp, variable flow Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Boiler interlock: Yes

Main heating Control:

Main heating Control:	Charging system linked to use of community heating, programmer and TRVs Control code: 2306

Secondary heating system:

Secondary heating system:	None

Water heating:

Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Flue Gas Heat Recovery System: Database (rev 498, product index 060036) Brand name: Worcester Model: Greenstar Xtra Model qualifier: 2015 Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.5.51

Property Address: Sample 1 (Mid)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	66.25	(1a) x	3	(2a) =	198.75	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.25	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	198.75	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.05 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1.4	=	3.36			(26)
Windows Type 1			4.8	x	1/[1/(1)+ 0.04]	=	4.62			(27)
Windows Type 2			5.44	x	1/[1/(1)+ 0.04]	=	5.23			(27)
Windows Type 3			1.44	x	1/[1/(1)+ 0.04]	=	1.38			(27)
Walls Type1	10.24	10.24	0	x	0.15	=	0			(29)
Walls Type2	1.44	1.44	0	x	0.15	=	0			(29)
Walls Type3	13.2	2.4	10.8	x	0.15	=	1.62			(29)
Walls Type4	2.4	0	2.4	x	0.35	=	0.84			(29)
Total area of elements, m²			27.28							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 17.05 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 184.8 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 4.09 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 21.14 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	17.53	17.32	17.11	16.07	15.86	14.81	14.81	14.61	15.23	15.86	16.28	16.7	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	38.67	38.46	38.25	37.21	37	35.95	35.95	35.75	36.37	37	37.42	37.84	

Average = Sum(39)$_{1…12}$ /12= 37.16 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.58	0.58	0.58	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57

Average = Sum(40)$_{1…12}$ /12= 0.56 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31

(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.15 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.3 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	93.83	90.42	87.01	83.6	80.19	76.77	76.77	80.19	83.6	87.01	90.42	93.83

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Total = Sum(44)$_{1…12}$ = 1023.65 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.15	121.71	125.59	109.49	105.06	90.66	84.01	96.4	97.55	113.69	124.1	134.76

Total = Sum(45)$_{1…12}$ = 1342.17 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.87	18.26	18.84	16.42	15.76	13.6	12.6	14.46	14.63	17.05	18.61	20.21

(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01

(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01

(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26

(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	194.43	171.63	180.87	162.99	160.34	144.15	139.29	151.68	151.05	168.96	177.59	190.04	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	17.95	15.96	16.41	14.51	13.96	12.12	11.22	12.87	13.02	15.02	16.24	17.46	(63) (G2)

Output from water heater

(64)m=	173.8	153.25	161.77	145.88	143.69	129.44	125.38	136.13	135.43	151.27	158.76	169.9	

Output from water heater (annual)$_{1…12}$ 1784.71 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	90.49	80.41	85.98	79.2	79.15	72.94	72.15	76.27	75.23	82.02	84.06	89.03	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.65	15.68	12.75	9.65	7.22	6.09	6.58	8.56	11.48	14.58	17.02	18.14	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	188.39	190.35	185.42	174.93	161.69	149.25	140.94	138.98	143.91	154.4	167.64	180.08	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	(71)

Water heating gains (Table 5)

(72)m=	121.63	119.66	115.56	110	106.39	101.3	96.98	102.52	104.49	110.25	116.75	119.66	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	382.95	380.96	369.01	349.86	330.58	311.92	299.78	305.34	315.16	334.5	356.68	373.16	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	4.8	x	10.63	x	0.4	x	0.7	=	9.9	(74)
North	0.9x	0.77	x	5.44	x	10.63	x	0.4	x	0.7	=	11.22	(74)
North	0.9x	0.77	x	4.8	x	20.32	x	0.4	x	0.7	=	18.93	(74)
North	0.9x	0.77	x	5.44	x	20.32	x	0.4	x	0.7	=	21.45	(74)

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North	0.9x	0.77	x	4.8	x	34.53	x	0.4	x	0.7	=	32.16	(74)
North	0.9x	0.77	x	5.44	x	34.53	x	0.4	x	0.7	=	36.45	(74)
North	0.9x	0.77	x	4.8	x	55.46	x	0.4	x	0.7	=	51.66	(74)
North	0.9x	0.77	x	5.44	x	55.46	x	0.4	x	0.7	=	58.55	(74)
North	0.9x	0.77	x	4.8	x	74.72	x	0.4	x	0.7	=	69.59	(74)
North	0.9x	0.77	x	5.44	x	74.72	x	0.4	x	0.7	=	78.87	(74)
North	0.9x	0.77	x	4.8	x	79.99	x	0.4	x	0.7	=	74.5	(74)
North	0.9x	0.77	x	5.44	x	79.99	x	0.4	x	0.7	=	84.43	(74)
North	0.9x	0.77	x	4.8	x	74.68	x	0.4	x	0.7	=	69.55	(74)
North	0.9x	0.77	x	5.44	x	74.68	x	0.4	x	0.7	=	78.83	(74)
North	0.9x	0.77	x	4.8	x	59.25	x	0.4	x	0.7	=	55.18	(74)
North	0.9x	0.77	x	5.44	x	59.25	x	0.4	x	0.7	=	62.54	(74)
North	0.9x	0.77	x	4.8	x	41.52	x	0.4	x	0.7	=	38.67	(74)
North	0.9x	0.77	x	5.44	x	41.52	x	0.4	x	0.7	=	43.82	(74)
North	0.9x	0.77	x	4.8	x	24.19	x	0.4	x	0.7	=	22.53	(74)
North	0.9x	0.77	x	5.44	x	24.19	x	0.4	x	0.7	=	25.53	(74)
North	0.9x	0.77	x	4.8	x	13.12	x	0.4	x	0.7	=	12.22	(74)
North	0.9x	0.77	x	5.44	x	13.12	x	0.4	x	0.7	=	13.85	(74)
North	0.9x	0.77	x	4.8	x	8.86	x	0.4	x	0.7	=	8.26	(74)
North	0.9x	0.77	x	5.44	x	8.86	x	0.4	x	0.7	=	9.36	(74)
East	0.9x	0.77	x	1.44	x	19.64	x	0.4	x	0.7	=	5.49	(76)
East	0.9x	0.77	x	1.44	x	38.42	x	0.4	x	0.7	=	10.74	(76)
East	0.9x	0.77	x	1.44	x	63.27	x	0.4	x	0.7	=	17.68	(76)
East	0.9x	0.77	x	1.44	x	92.28	x	0.4	x	0.7	=	25.78	(76)
East	0.9x	0.77	x	1.44	x	113.09	x	0.4	x	0.7	=	31.6	(76)
East	0.9x	0.77	x	1.44	x	115.77	x	0.4	x	0.7	=	32.35	(76)
East	0.9x	0.77	x	1.44	x	110.22	x	0.4	x	0.7	=	30.8	(76)
East	0.9x	0.77	x	1.44	x	94.68	x	0.4	x	0.7	=	26.45	(76)
East	0.9x	0.77	x	1.44	x	73.59	x	0.4	x	0.7	=	20.56	(76)
East	0.9x	0.77	x	1.44	x	45.59	x	0.4	x	0.7	=	12.74	(76)
East	0.9x	0.77	x	1.44	x	24.49	x	0.4	x	0.7	=	6.84	(76)
East	0.9x	0.77	x	1.44	x	16.15	x	0.4	x	0.7	=	4.51	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	26.62	51.11	86.29	135.99	180.06	191.28	179.18	144.17	103.05	60.8	32.91	22.13	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	409.56	432.07	455.3	485.85	510.63	503.2	478.96	449.51	418.21	395.3	389.59	395.29	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.96	0.86	0.67	0.46	0.33	0.37	0.6	0.89	0.98	0.99	(86)

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Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.62	20.7	20.82	20.95	21	21	21	21	21	20.95	20.78	20.62	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.44	20.45	20.45	20.46	20.47	20.48	20.48	20.48	20.48	20.47	20.46	20.46	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.96	0.84	0.63	0.42	0.29	0.32	0.55	0.86	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.94	20.05	20.22	20.41	20.46	20.48	20.48	20.48	20.48	20.41	20.18	19.94	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	20.22	20.31	20.47	20.63	20.68	20.69	20.69	20.7	20.69	20.63	20.43	20.22	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	20.22	20.31	20.47	20.63	20.68	20.69	20.69	20.7	20.69	20.63	20.43	20.22	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.96	0.85	0.65	0.44	0.31	0.34	0.57	0.87	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	405.9	424.91	435.38	411.84	330.15	219.08	147.22	153.57	239.16	344.71	380.02	392.44	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	615.66	592.85	534.28	436.6	332.32	219.12	147.22	153.57	239.7	371.18	498.74	606.04	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	156.06	112.85	73.58	17.83	1.62	0	0	0	0	19.69	85.47	158.91	

Total per year (kWh/year) = Sum(98)1...5,9...12 = 626.01 (98)

Space heating requirement in kWh/m²/year 9.45 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none	0	(301)
Fraction of space heat from community system 1 – (301) =	1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers		1	(303a)
Fraction of total space heat from Community boilers	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating	**kWh/year**
Annual space heating requirement	626.01

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Space heat from Community boilers	(98) x (304a) x (305) x (306) =	657.31	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)

Water heating

Annual water heating requirement		1784.71	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	1873.94	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	25.31	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		118.21	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	118.21	(331)
Energy for lighting (calculated in Appendix L)		311.73	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		2961.19	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				95	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.22	=	575.53	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	13.14	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	588.66	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				588.66	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	61.35	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	161.79	(379)
Total CO2, kg/year	sum of (376)…(382) =				811.8	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				12.25	(384)
EI rating (section 14)					90.22	(385)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.51

Property Address: Sample 1 (Mid)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	66.25	(1a) x	3	(2a) =	198.75	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.25	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	198.75	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.1	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*		0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.35	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.37	0.37	0.33	0.32	0.28	0.28	0.28	0.3	0.32	0.34	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	0	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1	=	2.4			(26)
Windows Type 1			4.8	x1/[1/(1.4)+ 0.04]		=	6.36			(27)
Windows Type 2			5.44	x1/[1/(1.4)+ 0.04]		=	7.21			(27)
Windows Type 3			1.44	x1/[1/(1.4)+ 0.04]		=	1.91			(27)
Walls Type1	10.24	10.24	0	x	0.18	=	0			(29)
Walls Type2	1.44	1.44	0	x	0.18	=	0			(29)
Walls Type3	13.2	2.4	10.8	x	0.18	=	1.94			(29)
Walls Type4	2.4	0	2.4	x	0.18	=	0.43			(29)
Total area of elements, m²			27.28							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	20.26	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	184.8	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		1.36	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	21.62	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	37.53	37.35	37.16	36.32	36.16	35.42	35.42	35.29	35.71	36.16	36.48	36.82	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	59.15	58.97	58.79	57.94	57.78	57.05	57.05	56.91	57.33	57.78	58.11	58.44	

Average = Sum(39)$_{1…12}$ /12= 57.94 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.89	0.89	0.89	0.87	0.87	0.86	0.86	0.86	0.87	0.87	0.88	0.88

Average = Sum(40)$_{1…12}$ /12= 0.87 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.15 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.3 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	93.83	90.42	87.01	83.6	80.19	76.77	76.77	80.19	83.6	87.01	90.42	93.83	
										Total = Sum(44)$_{1…12}$ =		1023.65	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	139.15	121.71	125.59	109.49	105.06	90.66	84.01	96.4	97.55	113.69	124.1	134.76	
										Total = Sum(45)$_{1…12}$ =		1342.17	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	20.87	18.26	18.84	16.42	15.76	13.6	12.6	14.46	14.63	17.05	18.61	20.21	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	185.75	163.79	172.18	154.58	151.65	135.75	130.6	143	142.64	160.28	169.19	181.36	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	185.75	163.79	172.18	154.58	151.65	135.75	130.6	143	142.64	160.28	169.19	181.36	

Output from water heater (annual)$_{1…12}$ 1890.79 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	83.54	74.14	79.03	72.48	72.21	66.22	65.21	69.33	68.51	75.08	77.34	82.08	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	17.21	15.29	12.43	9.41	7.04	5.94	6.42	8.34	11.2	14.22	16.59	17.69	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	188.39	190.35	185.42	174.93	161.69	149.25	140.94	138.98	143.91	154.4	167.64	180.08	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	(71)
Water heating gains (Table 5)													
(72)m=	112.29	110.32	106.23	100.67	97.05	91.97	87.65	93.18	95.15	100.91	107.41	110.33	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	376.17	374.23	362.36	343.29	324.06	305.44	293.28	298.79	308.54	327.8	349.92	366.38	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	4.8	x	10.63	x	0.63	x	0.7	=	15.6	(74)
North	0.9x	0.77	x	5.44	x	10.63	x	0.63	x	0.7	=	17.68	(74)
North	0.9x	0.77	x	4.8	x	20.32	x	0.63	x	0.7	=	29.81	(74)
North	0.9x	0.77	x	5.44	x	20.32	x	0.63	x	0.7	=	33.78	(74)

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North	0.9x	0.77	x	4.8	x	34.53	x	0.63	x	0.7	=	50.65	(74)
North	0.9x	0.77	x	5.44	x	34.53	x	0.63	x	0.7	=	57.41	(74)
North	0.9x	0.77	x	4.8	x	55.46	x	0.63	x	0.7	=	81.36	(74)
North	0.9x	0.77	x	5.44	x	55.46	x	0.63	x	0.7	=	92.21	(74)
North	0.9x	0.77	x	4.8	x	74.72	x	0.63	x	0.7	=	109.6	(74)
North	0.9x	0.77	x	5.44	x	74.72	x	0.63	x	0.7	=	124.22	(74)
North	0.9x	0.77	x	4.8	x	79.99	x	0.63	x	0.7	=	117.33	(74)
North	0.9x	0.77	x	5.44	x	79.99	x	0.63	x	0.7	=	132.98	(74)
North	0.9x	0.77	x	4.8	x	74.68	x	0.63	x	0.7	=	109.55	(74)
North	0.9x	0.77	x	5.44	x	74.68	x	0.63	x	0.7	=	124.15	(74)
North	0.9x	0.77	x	4.8	x	59.25	x	0.63	x	0.7	=	86.91	(74)
North	0.9x	0.77	x	5.44	x	59.25	x	0.63	x	0.7	=	98.5	(74)
North	0.9x	0.77	x	4.8	x	41.52	x	0.63	x	0.7	=	60.9	(74)
North	0.9x	0.77	x	5.44	x	41.52	x	0.63	x	0.7	=	69.02	(74)
North	0.9x	0.77	x	4.8	x	24.19	x	0.63	x	0.7	=	35.48	(74)
North	0.9x	0.77	x	5.44	x	24.19	x	0.63	x	0.7	=	40.22	(74)
North	0.9x	0.77	x	4.8	x	13.12	x	0.63	x	0.7	=	19.24	(74)
North	0.9x	0.77	x	5.44	x	13.12	x	0.63	x	0.7	=	21.81	(74)
North	0.9x	0.77	x	4.8	x	8.86	x	0.63	x	0.7	=	13	(74)
North	0.9x	0.77	x	5.44	x	8.86	x	0.63	x	0.7	=	14.74	(74)
East	0.9x	0.77	x	1.44	x	19.64	x	0.63	x	0.7	=	8.64	(76)
East	0.9x	0.77	x	1.44	x	38.42	x	0.63	x	0.7	=	16.91	(76)
East	0.9x	0.77	x	1.44	x	63.27	x	0.63	x	0.7	=	27.85	(76)
East	0.9x	0.77	x	1.44	x	92.28	x	0.63	x	0.7	=	40.61	(76)
East	0.9x	0.77	x	1.44	x	113.09	x	0.63	x	0.7	=	49.77	(76)
East	0.9x	0.77	x	1.44	x	115.77	x	0.63	x	0.7	=	50.95	(76)
East	0.9x	0.77	x	1.44	x	110.22	x	0.63	x	0.7	=	48.51	(76)
East	0.9x	0.77	x	1.44	x	94.68	x	0.63	x	0.7	=	41.67	(76)
East	0.9x	0.77	x	1.44	x	73.59	x	0.63	x	0.7	=	32.39	(76)
East	0.9x	0.77	x	1.44	x	45.59	x	0.63	x	0.7	=	20.06	(76)
East	0.9x	0.77	x	1.44	x	24.49	x	0.63	x	0.7	=	10.78	(76)
East	0.9x	0.77	x	1.44	x	16.15	x	0.63	x	0.7	=	7.11	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	41.92	80.5	135.91	214.19	283.59	301.26	282.2	227.08	162.31	95.76	51.83	34.85	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	418.09	454.73	498.27	557.47	607.65	606.7	575.48	525.86	470.85	423.57	401.75	401.22	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.94	0.8	0.59	0.43	0.49	0.78	0.96	0.99	1	(86)

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Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.15	20.26	20.46	20.74	20.93	20.99	21	21	20.96	20.71	20.39	20.13	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.17	20.18	20.18	20.19	20.19	20.2	20.2	20.2	20.2	20.19	20.19	20.18	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.92	0.76	0.52	0.36	0.41	0.71	0.95	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.04	19.2	19.49	19.88	20.12	20.2	20.2	20.2	20.16	19.86	19.4	19.02	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.49	19.63	19.89	20.23	20.45	20.52	20.53	20.53	20.49	20.21	19.8	19.48	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.49	19.63	19.89	20.23	20.45	20.52	20.53	20.53	20.49	20.21	19.8	19.48	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.92	0.77	0.55	0.39	0.45	0.74	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	416.12	450.79	487.2	514.37	469.72	334.2	223.76	234.19	346.69	402.44	397.68	399.73	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	898.75	868.82	787.11	656.66	505.83	337.83	224.09	234.95	366.3	555.28	738.18	892.7	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	359.08	280.92	223.13	102.45	26.86	0	0	0	0	113.72	245.16	366.77	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 1718.09 (98)

Space heating requirement in kWh/m²/year 25.93 (99)

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9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	359.08	280.92	223.13	102.45	26.86	0	0	0	0	113.72	245.16	366.77	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	384.04	300.45	238.64	109.57	28.73	0	0	0	0	121.62	262.2	392.27	

Total (kWh/year) = $Sum(211)_{1...5,10...12}$ = 1837.53 (211)

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Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)

185.75	163.79	172.18	154.58	151.65	135.75	130.6	143	142.64	160.28	169.19	181.36

Efficiency of water heater 79.8 (216)

(217)m=	86.54	86.24	85.51	83.75	81.25	79.8	79.8	79.8	79.8	83.92	85.8	86.66	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	214.63	189.92	201.37	184.58	186.66	170.11	163.66	179.19	178.75	191	197.19	209.29

Total = Sum(219a)$_{1...12}$ = 2266.36 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		1837.53	
Water heating fuel used		2266.36	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		75	(231)
Electricity for lighting		303.98	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		4482.87	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	396.91	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	489.53	(264)
Space and water heating	(261) + (262) + (263) + (264) =			886.44	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	157.76	(268)
Total CO2, kg/year		sum of (265)…(271) =		1083.13	(272)

TER = 16.35 (273)

SAP Input

Property Details: Sample 2 (Mid)

Address:	
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	26 July 2019
Date of certificate:	15 June 2022
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	498

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2019	
Floor Location:	Floor area:	Storey height:
Floor 0	66.25 m²	3 m
Living area:	27.2 m² (fraction 0.411)	
Front of dwelling faces:	Unspecified	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
DOOR	Manufacturer	Solid			Wood
W	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
N	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Balcony	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
DOOR	mm	0.7	0	1.4	2.4	1
W		0.7	0.4	1	1.44	1
N		0.7	0.4	1	10.24	1
Balcony		0.7	0.4	1	4.8	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
DOOR		INT	Worst case	0	0
W		W	West	0	0
N		N	North	0	0
Balcony		N	North	0	0

Overshading: More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
<u>External Elements</u>							
N	31.8	15.04	16.76	0.15	0	False	N/A
W	18.75	1.44	17.31	0.15	0	False	N/A
INT	11.1	2.4	8.7	0.16	0.43	False	N/A
Spandrel	2.4	0	2.4	0.35	0	False	N/A
<u>Internal Elements</u>							
<u>Party Elements</u>							

Thermal bridges:

SAP Input

Thermal bridges:	No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	3

Main heating system:

Main heating system:	Community heating schemes Heat source: Community boilers heat from boilers – mains gas, heat fraction 1, efficiency 95 Piping>=1991, pre-insulated, low temp, variable flow Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Boiler interlock: Yes

Main heating Control:

Main heating Control:	Charging system linked to use of community heating, programmer and TRVs Control code: 2306

Secondary heating system:

Secondary heating system:	None

Water heating:

Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Flue Gas Heat Recovery System: Database (rev 498, product index 060036) Brand name: Worcester Model: Greenstar Xtra Model qualifier: 2015 Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

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User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.51

Property Address: Sample 2 (Mid)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	66.25	(1a) x	3	(2a) =	198.75	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.25	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	198.75	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*		0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)		0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.05 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1.4	=	3.36			(26)
Windows Type 1			1.44	x	1/[1/(1)+ 0.04]	=	1.38			(27)
Windows Type 2			10.24	x	1/[1/(1)+ 0.04]	=	9.85			(27)
Windows Type 3			4.8	x	1/[1/(1)+ 0.04]	=	4.62			(27)
Walls Type1	31.8	15.04	16.76	x	0.15	=	2.51			(29)
Walls Type2	18.75	1.44	17.31	x	0.15	=	2.6			(29)
Walls Type3	11.1	2.4	8.7	x	0.15	=	1.3			(29)
Walls Type4	2.4	0	2.4	x	0.35	=	0.84			(29)
Total area of elements, m²			64.05							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 26.46 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 632.38 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 9.61 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 36.07 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	17.53	17.32	17.11	16.07	15.86	14.81	14.81	14.61	15.23	15.86	16.28	16.7	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	53.6	53.39	53.18	52.14	51.93	50.88	50.88	50.67	51.3	51.93	52.34	52.76	

Average = Sum(39)$_{1…12}$ /12= 52.08 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.81	0.81	0.8	0.79	0.78	0.77	0.77	0.76	0.77	0.78	0.79	0.8

Average = Sum(40)$_{1…12}$ /12= 0.79 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.15 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.3 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	93.83	90.42	87.01	83.6	80.19	76.77	76.77	80.19	83.6	87.01	90.42	93.83	
									Total = Sum(44)$_{1…12}$ =			1023.65	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	139.15	121.71	125.59	109.49	105.06	90.66	84.01	96.4	97.55	113.69	124.1	134.76	
									Total = Sum(45)$_{1…12}$ =			1342.17	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	20.87	18.26	18.84	16.42	15.76	13.6	12.6	14.46	14.63	17.05	18.61	20.21	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	194.43	171.63	180.87	162.99	160.34	144.15	139.29	151.68	151.05	168.96	177.59	190.04	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	17.95	15.96	16.41	14.51	13.96	12.12	11.22	12.87	13.02	15.02	16.24	17.46	(63) (G2)

Output from water heater

(64)m=	173.8	153.25	161.77	145.88	143.69	129.44	125.38	136.13	135.43	151.27	158.76	169.9	

Output from water heater (annual)$_{1…12}$ 1784.71 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	90.49	80.41	85.98	79.2	79.15	72.94	72.15	76.27	75.23	82.02	84.06	89.03	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	16.81	14.93	12.14	9.19	6.87	5.8	6.27	8.15	10.93	13.88	16.2	17.27	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	188.39	190.35	185.42	174.93	161.69	149.25	140.94	138.98	143.91	154.4	167.64	180.08	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	(71)

Water heating gains (Table 5)

(72)m=	121.63	119.66	115.56	110	106.39	101.3	96.98	102.52	104.49	110.25	116.75	119.66	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	382.1	380.21	368.4	349.4	330.23	311.63	299.46	304.93	314.61	333.8	355.86	372.29	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	10.24	x	10.63	x	0.4	x	0.7	=	21.13	(74)
North	0.9x	0.77	x	4.8	x	10.63	x	0.4	x	0.7	=	9.9	(74)
North	0.9x	0.77	x	10.24	x	20.32	x	0.4	x	0.7	=	40.38	(74)
North	0.9x	0.77	x	4.8	x	20.32	x	0.4	x	0.7	=	18.93	(74)

North	0.9x	0.77	x	10.24	x	34.53	x	0.4	x	0.7	=	68.61	(74)
North	0.9x	0.77	x	4.8	x	34.53	x	0.4	x	0.7	=	32.16	(74)
North	0.9x	0.77	x	10.24	x	55.46	x	0.4	x	0.7	=	110.21	(74)
North	0.9x	0.77	x	4.8	x	55.46	x	0.4	x	0.7	=	51.66	(74)
North	0.9x	0.77	x	10.24	x	74.72	x	0.4	x	0.7	=	148.46	(74)
North	0.9x	0.77	x	4.8	x	74.72	x	0.4	x	0.7	=	69.59	(74)
North	0.9x	0.77	x	10.24	x	79.99	x	0.4	x	0.7	=	158.93	(74)
North	0.9x	0.77	x	4.8	x	79.99	x	0.4	x	0.7	=	74.5	(74)
North	0.9x	0.77	x	10.24	x	74.68	x	0.4	x	0.7	=	148.38	(74)
North	0.9x	0.77	x	4.8	x	74.68	x	0.4	x	0.7	=	69.55	(74)
North	0.9x	0.77	x	10.24	x	59.25	x	0.4	x	0.7	=	117.72	(74)
North	0.9x	0.77	x	4.8	x	59.25	x	0.4	x	0.7	=	55.18	(74)
North	0.9x	0.77	x	10.24	x	41.52	x	0.4	x	0.7	=	82.49	(74)
North	0.9x	0.77	x	4.8	x	41.52	x	0.4	x	0.7	=	38.67	(74)
North	0.9x	0.77	x	10.24	x	24.19	x	0.4	x	0.7	=	48.06	(74)
North	0.9x	0.77	x	4.8	x	24.19	x	0.4	x	0.7	=	22.53	(74)
North	0.9x	0.77	x	10.24	x	13.12	x	0.4	x	0.7	=	26.06	(74)
North	0.9x	0.77	x	4.8	x	13.12	x	0.4	x	0.7	=	12.22	(74)
North	0.9x	0.77	x	10.24	x	8.86	x	0.4	x	0.7	=	17.61	(74)
North	0.9x	0.77	x	4.8	x	8.86	x	0.4	x	0.7	=	8.26	(74)
West	0.9x	0.77	x	1.44	x	19.64	x	0.4	x	0.7	=	5.49	(80)
West	0.9x	0.77	x	1.44	x	38.42	x	0.4	x	0.7	=	10.74	(80)
West	0.9x	0.77	x	1.44	x	63.27	x	0.4	x	0.7	=	17.68	(80)
West	0.9x	0.77	x	1.44	x	92.28	x	0.4	x	0.7	=	25.78	(80)
West	0.9x	0.77	x	1.44	x	113.09	x	0.4	x	0.7	=	31.6	(80)
West	0.9x	0.77	x	1.44	x	115.77	x	0.4	x	0.7	=	32.35	(80)
West	0.9x	0.77	x	1.44	x	110.22	x	0.4	x	0.7	=	30.8	(80)
West	0.9x	0.77	x	1.44	x	94.68	x	0.4	x	0.7	=	26.45	(80)
West	0.9x	0.77	x	1.44	x	73.59	x	0.4	x	0.7	=	20.56	(80)
West	0.9x	0.77	x	1.44	x	45.59	x	0.4	x	0.7	=	12.74	(80)
West	0.9x	0.77	x	1.44	x	24.49	x	0.4	x	0.7	=	6.84	(80)
West	0.9x	0.77	x	1.44	x	16.15	x	0.4	x	0.7	=	4.51	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	36.52	70.04	118.45	187.65	249.65	265.77	248.73	199.36	141.72	83.33	45.12	30.38	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	418.62	450.25	486.85	537.05	579.88	577.41	548.19	504.28	456.33	417.14	400.99	402.68	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.93	0.78	0.56	0.41	0.46	0.74	0.96	0.99	1	(86)

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Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.28	20.38	20.56	20.8	20.95	21	21	21	20.98	20.79	20.5	20.27	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.25	20.25	20.25	20.26	20.27	20.28	20.28	20.28	20.28	20.27	20.26	20.26	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.91	0.73	0.5	0.34	0.39	0.68	0.94	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.28	19.42	19.69	20.04	20.23	20.28	20.28	20.28	20.26	20.02	19.61	19.27	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.69	19.81	20.04	20.35	20.52	20.57	20.58	20.58	20.55	20.34	19.98	19.68	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.69	19.81	20.04	20.35	20.52	20.57	20.58	20.58	20.55	20.34	19.98	19.68	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.91	0.75	0.52	0.37	0.42	0.7	0.94	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	416.45	446.01	475.15	491.04	435.85	302.33	202.19	211.41	320.54	392.38	396.3	401.02	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	824.75	796.27	720.24	596.98	458.24	303.92	202.31	211.68	331.02	505.52	674.04	816.61	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	303.78	235.37	182.35	76.28	16.66	0	0	0	0	84.18	199.97	309.2	

Total per year (kWh/year) = Sum(98)1...5,9...12 = 1407.78 (98)

Space heating requirement in kWh/m²/year 21.25 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme. Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none	0	(301)
Fraction of space heat from community system 1 – (301) =	1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers		1	(303a)
Fraction of total space heat from Community boilers	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		1407.78	

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Space heat from Community boilers	(98) x (304a) x (305) x (306) =	1478.17	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)

Water heating

Annual water heating requirement		1784.71	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	1873.94	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	33.52	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		118.21	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	118.21	(331)
Energy for lighting (calculated in Appendix L)		296.83	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		3767.14	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				95	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.22	=	762.16	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	17.4	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	779.56	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				779.56	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	61.35	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	154.05	(379)
Total CO2, kg/year	sum of (376)…(382) =				994.96	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				15.02	(384)
EI rating (section 14)					88.02	(385)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Sample 2 (Mid)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	66.25	(1a) x	3	(2a) =	198.75	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.25	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	198.75	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.1	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*		0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.35	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.37	0.37	0.33	0.32	0.28	0.28	0.28	0.3	0.32	0.34	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1	=	2.4			(26)
Windows Type 1			1.24	x1/[1/(1.4)+ 0.04]		=	1.64			(27)
Windows Type 2			8.8	x1/[1/(1.4)+ 0.04]		=	11.67			(27)
Windows Type 3			4.12	x1/[1/(1.4)+ 0.04]		=	5.46			(27)
Walls Type1	31.8	12.92	18.88	x	0.18	=	3.4			(29)
Walls Type2	18.75	1.24	17.51	x	0.18	=	3.15			(29)
Walls Type3	11.1	2.4	8.7	x	0.18	=	1.57			(29)
Walls Type4	2.4	0	2.4	x	0.18	=	0.43			(29)
Total area of elements, m²			64.05							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 29.72 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 664.86 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 3.2 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 32.92 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	37.53	37.35	37.16	36.32	36.16	35.42	35.42	35.29	35.71	36.16	36.48	36.82	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	70.45	70.27	70.09	69.24	69.08	68.35	68.35	68.21	68.63	69.08	69.4	69.74	

Average = Sum(39)$_{1…12}$ /12= 69.24 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.06	1.06	1.06	1.05	1.04	1.03	1.03	1.03	1.04	1.04	1.05	1.05	

Average = Sum(40)$_{1…12}$ /12= 1.05 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.15 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.3 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	93.83	90.42	87.01	83.6	80.19	76.77	76.77	80.19	83.6	87.01	90.42	93.83	

Total = Sum(44)$_{1…12}$ = 1023.65 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.15	121.71	125.59	109.49	105.06	90.66	84.01	96.4	97.55	113.69	124.1	134.76	

Total = Sum(45)$_{1…12}$ = 1342.17 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.87	18.26	18.84	16.42	15.76	13.6	12.6	14.46	14.63	17.05	18.61	20.21	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	185.75	163.79	172.18	154.58	151.65	135.75	130.6	143	142.64	160.28	169.19	181.36	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	185.75	163.79	172.18	154.58	151.65	135.75	130.6	143	142.64	160.28	169.19	181.36	

Output from water heater (annual)$_{1...12}$ 1890.79 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	83.54	74.14	79.03	72.48	72.21	66.22	65.21	69.33	68.51	75.08	77.34	82.08	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	16.82	14.94	12.15	9.2	6.88	5.81	6.27	8.15	10.94	13.9	16.22	17.29	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	188.39	190.35	185.42	174.93	161.69	149.25	140.94	138.98	143.91	154.4	167.64	180.08	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	(71)

Water heating gains (Table 5)

(72)m=	112.29	110.32	106.23	100.67	97.05	91.97	87.65	93.18	95.15	100.91	107.41	110.33	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	375.78	373.89	362.08	343.07	323.9	305.3	293.13	298.6	308.28	327.48	349.54	365.97	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	8.8	x	10.63	x	0.63	x	0.7	=	28.6	(74)
North	0.9x	0.77	x	4.12	x	10.63	x	0.63	x	0.7	=	13.39	(74)
North	0.9x	0.77	x	8.8	x	20.32	x	0.63	x	0.7	=	54.65	(74)
North	0.9x	0.77	x	4.12	x	20.32	x	0.63	x	0.7	=	25.59	(74)

North	0.9x	0.77	x	8.8	x	34.53	x	0.63	x	0.7	=	92.87	(74)
North	0.9x	0.77	x	4.12	x	34.53	x	0.63	x	0.7	=	43.48	(74)
North	0.9x	0.77	x	8.8	x	55.46	x	0.63	x	0.7	=	149.17	(74)
North	0.9x	0.77	x	4.12	x	55.46	x	0.63	x	0.7	=	69.84	(74)
North	0.9x	0.77	x	8.8	x	74.72	x	0.63	x	0.7	=	200.94	(74)
North	0.9x	0.77	x	4.12	x	74.72	x	0.63	x	0.7	=	94.08	(74)
North	0.9x	0.77	x	8.8	x	79.99	x	0.63	x	0.7	=	215.11	(74)
North	0.9x	0.77	x	4.12	x	79.99	x	0.63	x	0.7	=	100.71	(74)
North	0.9x	0.77	x	8.8	x	74.68	x	0.63	x	0.7	=	200.83	(74)
North	0.9x	0.77	x	4.12	x	74.68	x	0.63	x	0.7	=	94.03	(74)
North	0.9x	0.77	x	8.8	x	59.25	x	0.63	x	0.7	=	159.34	(74)
North	0.9x	0.77	x	4.12	x	59.25	x	0.63	x	0.7	=	74.6	(74)
North	0.9x	0.77	x	8.8	x	41.52	x	0.63	x	0.7	=	111.65	(74)
North	0.9x	0.77	x	4.12	x	41.52	x	0.63	x	0.7	=	52.27	(74)
North	0.9x	0.77	x	8.8	x	24.19	x	0.63	x	0.7	=	65.05	(74)
North	0.9x	0.77	x	4.12	x	24.19	x	0.63	x	0.7	=	30.46	(74)
North	0.9x	0.77	x	8.8	x	13.12	x	0.63	x	0.7	=	35.28	(74)
North	0.9x	0.77	x	4.12	x	13.12	x	0.63	x	0.7	=	16.52	(74)
North	0.9x	0.77	x	8.8	x	8.86	x	0.63	x	0.7	=	23.84	(74)
North	0.9x	0.77	x	4.12	x	8.86	x	0.63	x	0.7	=	11.16	(74)
West	0.9x	0.77	x	1.24	x	19.64	x	0.63	x	0.7	=	7.44	(80)
West	0.9x	0.77	x	1.24	x	38.42	x	0.63	x	0.7	=	14.56	(80)
West	0.9x	0.77	x	1.24	x	63.27	x	0.63	x	0.7	=	23.98	(80)
West	0.9x	0.77	x	1.24	x	92.28	x	0.63	x	0.7	=	34.97	(80)
West	0.9x	0.77	x	1.24	x	113.09	x	0.63	x	0.7	=	42.86	(80)
West	0.9x	0.77	x	1.24	x	115.77	x	0.63	x	0.7	=	43.87	(80)
West	0.9x	0.77	x	1.24	x	110.22	x	0.63	x	0.7	=	41.77	(80)
West	0.9x	0.77	x	1.24	x	94.68	x	0.63	x	0.7	=	35.88	(80)
West	0.9x	0.77	x	1.24	x	73.59	x	0.63	x	0.7	=	27.89	(80)
West	0.9x	0.77	x	1.24	x	45.59	x	0.63	x	0.7	=	17.28	(80)
West	0.9x	0.77	x	1.24	x	24.49	x	0.63	x	0.7	=	9.28	(80)
West	0.9x	0.77	x	1.24	x	16.15	x	0.63	x	0.7	=	6.12	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	49.43	94.8	160.32	253.97	337.87	359.7	336.63	269.81	191.82	112.79	61.08	41.12	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	425.21	468.68	522.4	597.05	661.78	665	629.77	568.41	500.1	440.27	410.62	407.1	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.95	0.83	0.63	0.47	0.54	0.82	0.97	0.99	1	(86)

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Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.92	20.04	20.28	20.61	20.87	20.98	21	20.99	20.91	20.58	20.2	19.9	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.03	20.03	20.04	20.05	20.05	20.06	20.06	20.06	20.05	20.05	20.04	20.04	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.93	0.78	0.55	0.37	0.44	0.75	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.59	18.77	19.11	19.59	19.92	20.04	20.06	20.06	19.98	19.56	19.01	18.56	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.13	19.29	19.59	20.01	20.31	20.43	20.44	20.44	20.36	19.98	19.49	19.11	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.13	19.29	19.59	20.01	20.31	20.43	20.44	20.44	20.36	19.98	19.49	19.11	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.93	0.8	0.58	0.41	0.48	0.77	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	423.16	464.59	511.2	555.02	527	388.24	261.3	272.89	387.56	421.46	406.68	405.52	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1044.98	1011.35	917.6	769.05	594.79	398.17	262.57	275.57	429.79	647.88	860.2	1039.8	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	462.64	367.42	302.36	154.1	50.43	0	0	0	0	168.46	326.53	471.9	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2303.85 (98)

Space heating requirement in kWh/m²/year 34.78 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	462.64	367.42	302.36	154.1	50.43	0	0	0	0	168.46	326.53	471.9	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	494.8	392.97	323.38	164.82	53.94	0	0	0	0	180.17	349.23	504.71	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2464.02 (211)

TER WorkSheet: New dwelling design stage

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

Water heating

Output from water heater (calculated above)

185.75	163.79	172.18	154.58	151.65	135.75	130.6	143	142.64	160.28	169.19	181.36

Efficiency of water heater 79.8 (216)

(217)m=	87.15	86.91	86.3	84.81	82.23	79.8	79.8	79.8	79.8	84.95	86.54	87.25	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	213.13	188.47	199.51	182.28	184.44	170.11	163.66	179.19	178.75	188.69	195.51	207.86

Total = Sum(219a)$_{1...12}$ = 2251.6 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2464.02	
Water heating fuel used		2251.6	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	75	(231)
Electricity for lighting		297.09	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		5087.7	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	532.23	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	486.35	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1018.57	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	154.19	(268)
Total CO2, kg/year		sum of (265)…(271) =		1211.69	(272)

TER = 18.29 (273)

SAP Input

Property Details: Sample 3 (Mid)

Address:	
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	26 July 2019
Date of certificate:	15 June 2022
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	498

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2019	
Floor Location:	Floor area:	Storey height:
Floor 0	67 m²	3 m
Living area:	27.3 m² (fraction 0.407)	
Front of dwelling faces:	Unspecified	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
DOOR	Manufacturer	Solid			Wood
E	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
S	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Balcony	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
DOOR	mm	0.7	0	1.4	2.4	1
E		0.7	0.4	1	1.44	1
S		0.7	0.4	1	5.44	1
Balcony		0.7	0.4	1	4.8	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
DOOR		INT	Worst case	0	0
E		E	East	0	0
S		S	South	0	0
Balcony		S	South	0	0

Overshading: More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
<u>External Elements</u>							
S	31.65	10.24	21.41	0.15	0	False	N/A
E	2.3	1.44	0.86	0.15	0	False	N/A
INT	11.1	2.4	8.7	0.16	0.43	False	N/A
Spandrel	2.4	0	2.4	0.35	0	False	N/A
<u>Internal Elements</u>							
<u>Party Elements</u>							

Thermal bridges:

SAP Input

Thermal bridges:	No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	3

Main heating system:

Main heating system:	Community heating schemes Heat source: Community boilers heat from boilers – mains gas, heat fraction 1, efficiency 95 Piping>=1991, pre-insulated, low temp, variable flow Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Boiler interlock: Yes

Main heating Control:

Main heating Control:	Charging system linked to use of community heating, programmer and TRVs Control code: 2306

Secondary heating system:

Secondary heating system:	None

Water heating:

Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Flue Gas Heat Recovery System: Database (rev 498, product index 060036) Brand name: Worcester Model: Greenstar Xtra Model qualifier: 2015 Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.5.51

Property Address: Sample 3 (Mid)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67	(1a) x	3	(2a) =	201	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	201	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.05 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1.4	=	3.36			(26)
Windows Type 1			1.44	x	1/[1/(1)+ 0.04]	=	1.38			(27)
Windows Type 2			5.44	x	1/[1/(1)+ 0.04]	=	5.23			(27)
Windows Type 3			4.8	x	1/[1/(1)+ 0.04]	=	4.62			(27)
Walls Type1	31.65	10.24	21.41	x	0.15	=	3.21			(29)
Walls Type2	2.3	1.44	0.86	x	0.15	=	0.13			(29)
Walls Type3	11.1	2.4	8.7	x	0.15	=	1.3			(29)
Walls Type4	2.4	0	2.4	x	0.35	=	0.84			(29)
Total area of elements, m²			47.45							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 20.07 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 467.18 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 7.12 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 27.19 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	17.73	17.52	17.31	16.25	16.04	14.98	14.98	14.77	15.41	16.04	16.46	16.89	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	44.92	44.71	44.5	43.44	43.23	42.17	42.17	41.96	42.6	43.23	43.65	44.08

Average = Sum(39)$_{1…12}$ /12= 43.39 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.67	0.67	0.66	0.65	0.65	0.63	0.63	0.63	0.64	0.65	0.65	0.66

Average = Sum(40)$_{1...12}$ /12= 0.65 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.17 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.76 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)												
(44)m=	94.34	90.91	87.48	84.05	80.62	77.19	77.19	80.62	84.05	87.48	90.91	94.34

Total = Sum(44)$_{1...12}$ = 1029.18 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.91	122.36	126.27	110.08	105.63	91.15	84.46	96.92	98.08	114.3	124.77	135.49

Total = Sum(45)$_{1...12}$ = 1349.41 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.99	18.35	18.94	16.51	15.84	13.67	12.67	14.54	14.71	17.15	18.72	20.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	195.18	172.29	181.54	163.58	160.9	144.64	139.74	152.2	151.57	169.58	178.26	190.77	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	18.03	16.04	16.49	14.58	14.03	12.18	11.28	12.94	13.08	15.09	16.32	17.54	(63) (G2)

Output from water heater

(64)m=	174.47	153.83	162.37	146.4	144.19	129.86	125.78	136.58	135.89	151.81	159.35	170.55	

Output from water heater (annual)1…12 | 1791.08 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	90.74	80.63	86.21	79.4	79.34	73.1	72.31	76.45	75.41	82.23	84.28	89.27	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.86	15.86	12.9	9.77	7.3	6.16	6.66	8.66	11.62	14.75	17.22	18.36	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	190.2	192.17	187.2	176.61	163.24	150.68	142.29	140.32	145.29	155.88	169.24	181.8	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	(71)

Water heating gains (Table 5)

(72)m=	121.96	119.98	115.87	110.27	106.64	101.53	97.18	102.75	104.73	110.52	117.06	119.99	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	385.59	383.58	371.53	352.22	332.75	313.94	301.7	307.29	317.21	336.72	359.09	375.72	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	1.44	x	19.64	x	0.4	x	0.7	=	5.49	(76)
East	0.9x	0.77	x	1.44	x	38.42	x	0.4	x	0.7	=	10.74	(76)
East	0.9x	0.77	x	1.44	x	63.27	x	0.4	x	0.7	=	17.68	(76)
East	0.9x	0.77	x	1.44	x	92.28	x	0.4	x	0.7	=	25.78	(76)

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East	0.9x	0.77	x	1.44	x	113.09	x	0.4	x	0.7	=	31.6	(76)
East	0.9x	0.77	x	1.44	x	115.77	x	0.4	x	0.7	=	32.35	(76)
East	0.9x	0.77	x	1.44	x	110.22	x	0.4	x	0.7	=	30.8	(76)
East	0.9x	0.77	x	1.44	x	94.68	x	0.4	x	0.7	=	26.45	(76)
East	0.9x	0.77	x	1.44	x	73.59	x	0.4	x	0.7	=	20.56	(76)
East	0.9x	0.77	x	1.44	x	45.59	x	0.4	x	0.7	=	12.74	(76)
East	0.9x	0.77	x	1.44	x	24.49	x	0.4	x	0.7	=	6.84	(76)
East	0.9x	0.77	x	1.44	x	16.15	x	0.4	x	0.7	=	4.51	(76)
South	0.9x	0.77	x	5.44	x	46.75	x	0.4	x	0.7	=	49.35	(78)
South	0.9x	0.77	x	4.8	x	46.75	x	0.4	x	0.7	=	43.54	(78)
South	0.9x	0.77	x	5.44	x	76.57	x	0.4	x	0.7	=	80.82	(78)
South	0.9x	0.77	x	4.8	x	76.57	x	0.4	x	0.7	=	71.31	(78)
South	0.9x	0.77	x	5.44	x	97.53	x	0.4	x	0.7	=	102.95	(78)
South	0.9x	0.77	x	4.8	x	97.53	x	0.4	x	0.7	=	90.84	(78)
South	0.9x	0.77	x	5.44	x	110.23	x	0.4	x	0.7	=	116.36	(78)
South	0.9x	0.77	x	4.8	x	110.23	x	0.4	x	0.7	=	102.67	(78)
South	0.9x	0.77	x	5.44	x	114.87	x	0.4	x	0.7	=	121.26	(78)
South	0.9x	0.77	x	4.8	x	114.87	x	0.4	x	0.7	=	106.99	(78)
South	0.9x	0.77	x	5.44	x	110.55	x	0.4	x	0.7	=	116.69	(78)
South	0.9x	0.77	x	4.8	x	110.55	x	0.4	x	0.7	=	102.96	(78)
South	0.9x	0.77	x	5.44	x	108.01	x	0.4	x	0.7	=	114.01	(78)
South	0.9x	0.77	x	4.8	x	108.01	x	0.4	x	0.7	=	100.6	(78)
South	0.9x	0.77	x	5.44	x	104.89	x	0.4	x	0.7	=	110.72	(78)
South	0.9x	0.77	x	4.8	x	104.89	x	0.4	x	0.7	=	97.7	(78)
South	0.9x	0.77	x	5.44	x	101.89	x	0.4	x	0.7	=	107.55	(78)
South	0.9x	0.77	x	4.8	x	101.89	x	0.4	x	0.7	=	94.9	(78)
South	0.9x	0.77	x	5.44	x	82.59	x	0.4	x	0.7	=	87.18	(78)
South	0.9x	0.77	x	4.8	x	82.59	x	0.4	x	0.7	=	76.92	(78)
South	0.9x	0.77	x	5.44	x	55.42	x	0.4	x	0.7	=	58.5	(78)
South	0.9x	0.77	x	4.8	x	55.42	x	0.4	x	0.7	=	51.62	(78)
South	0.9x	0.77	x	5.44	x	40.4	x	0.4	x	0.7	=	42.64	(78)
South	0.9x	0.77	x	4.8	x	40.4	x	0.4	x	0.7	=	37.63	(78)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	98.38	162.87	211.48	244.82	259.85	252	245.41	234.88	223.01	176.83	116.95	84.78	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	483.97	546.46	583.01	597.03	592.6	565.95	547.11	542.17	540.21	513.55	476.04	460.5	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.97	0.93	0.83	0.67	0.48	0.34	0.36	0.54	0.82	0.97	0.99	(86)

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Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.58	20.71	20.84	20.95	20.99	21	21	21	21	20.96	20.77	20.56	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.37	20.37	20.37	20.39	20.39	20.4	20.4	20.41	20.4	20.39	20.38	20.38	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.96	0.91	0.8	0.63	0.43	0.29	0.31	0.5	0.79	0.96	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.82	20	20.18	20.33	20.38	20.4	20.4	20.41	20.4	20.35	20.1	19.8	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	20.13	20.29	20.45	20.58	20.63	20.65	20.65	20.65	20.64	20.6	20.38	20.11	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	20.13	20.29	20.45	20.58	20.63	20.65	20.65	20.65	20.64	20.6	20.38	20.11	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.96	0.91	0.81	0.64	0.45	0.31	0.33	0.51	0.8	0.96	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	476.34	525.75	533.03	481.35	381.93	254.81	170.65	178.25	278.11	411.13	455.33	455	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	711.05	687.98	620.71	507.6	386.06	254.99	170.66	178.26	278.67	432.16	579.55	701.23	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	174.63	109.02	65.23	18.9	3.07	0	0	0	0	15.65	89.43	183.19	

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Total per year (kWh/year) = Sum(98)1...5,9...12 = 659.13 (98)

Space heating requirement in kWh/m²/year 9.84 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none	0	(301)
Fraction of space heat from community system 1 – (301) =	1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers		1	(303a)
Fraction of total space heat from Community boilers	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating **kWh/year**

Annual space heating requirement 659.13

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Space heat from Community boilers	(98) x (304a) x (305) x (306) =	692.08	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)

Water heating

Annual water heating requirement		1791.08	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	1880.63	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	25.73	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		119.54	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	119.54	(331)
Energy for lighting (calculated in Appendix L)		315.44	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		3007.71	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				95	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.22	=	584.95	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	13.35	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	598.31	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				598.31	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	62.04	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	163.72	(379)
Total CO2, kg/year	sum of (376)…(382) =				824.07	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				12.3	(384)
EI rating (section 14)					90.14	(385)

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User Details:

Assessor Name: 	**Stroma Number:**
Software Name: Stroma FSAP 2012 	**Software Version:** Version: 1.0.5.51

Property Address: Sample 3 (Mid)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67	(1a) x	3	(2a) =	201	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	201	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

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			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.1	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.35	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.37	0.36	0.33	0.32	0.28	0.28	0.27	0.3	0.32	0.33	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1	=	2.4			(26)
Windows Type 1			1.44	x1/[1/(1.4)+ 0.04]		=	1.91			(27)
Windows Type 2			5.44	x1/[1/(1.4)+ 0.04]		=	7.21			(27)
Windows Type 3			4.8	x1/[1/(1.4)+ 0.04]		=	6.36			(27)
Walls Type1	31.65	10.24	21.41	x	0.18	=	3.85			(29)
Walls Type2	2.3	1.44	0.86	x	0.18	=	0.15			(29)
Walls Type3	11.1	2.4	8.7	x	0.18	=	1.57			(29)
Walls Type4	2.4	0	2.4	x	0.18	=	0.43			(29)
Total area of elements, m²			47.45							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 23.89 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 467.18 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 2.37 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 26.26 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	37.92	37.74	37.56	36.71	36.55	35.81	35.81	35.67	36.09	36.55	36.87	37.21	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	64.19	64	63.82	62.97	62.81	62.07	62.07	61.93	62.36	62.81	63.13	63.47	

Average = Sum(39)1…12 /12= 62.97 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.96	0.96	0.95	0.94	0.94	0.93	0.93	0.92	0.93	0.94	0.94	0.95	

Average = Sum(40)$_{1...12}$ /12= 0.94 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.17 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.76 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	94.34	90.91	87.48	84.05	80.62	77.19	77.19	80.62	84.05	87.48	90.91	94.34	

Total = Sum(44)$_{1...12}$ = 1029.18 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.91	122.36	126.27	110.08	105.63	91.15	84.46	96.92	98.08	114.3	124.77	135.49	

Total = Sum(45)$_{1...12}$ = 1349.41 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.99	18.35	18.94	16.51	15.84	13.67	12.67	14.54	14.71	17.15	18.72	20.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09	

Output from water heater (annual)1…12 — 1898.03 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	83.79	74.35	79.26	72.68	72.4	66.38	65.36	69.5	68.68	75.28	77.56	82.33	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	17.41	15.46	12.58	9.52	7.12	6.01	6.49	8.44	11.33	14.38	16.79	17.89	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	190.2	192.17	187.2	176.61	163.24	150.68	142.29	140.32	145.29	155.88	169.24	181.8	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	(71)
Water heating gains (Table 5)													
(72)m=	112.63	110.65	106.53	100.94	97.31	92.19	87.85	93.42	95.4	101.18	107.72	110.65	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	378.8	376.85	364.87	345.64	326.23	307.45	295.2	300.74	310.58	330.01	352.32	368.92	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	1.44	x	19.64	x	0.63	x	0.7	=	8.64	(76)
East	0.9x	0.77	x	1.44	x	38.42	x	0.63	x	0.7	=	16.91	(76)
East	0.9x	0.77	x	1.44	x	63.27	x	0.63	x	0.7	=	27.85	(76)
East	0.9x	0.77	x	1.44	x	92.28	x	0.63	x	0.7	=	40.61	(76)

East	0.9x	0.77	x	1.44	x	113.09	x	0.63	x	0.7	=	49.77	(76)
East	0.9x	0.77	x	1.44	x	115.77	x	0.63	x	0.7	=	50.95	(76)
East	0.9x	0.77	x	1.44	x	110.22	x	0.63	x	0.7	=	48.51	(76)
East	0.9x	0.77	x	1.44	x	94.68	x	0.63	x	0.7	=	41.67	(76)
East	0.9x	0.77	x	1.44	x	73.59	x	0.63	x	0.7	=	32.39	(76)
East	0.9x	0.77	x	1.44	x	45.59	x	0.63	x	0.7	=	20.06	(76)
East	0.9x	0.77	x	1.44	x	24.49	x	0.63	x	0.7	=	10.78	(76)
East	0.9x	0.77	x	1.44	x	16.15	x	0.63	x	0.7	=	7.11	(76)
South	0.9x	0.77	x	5.44	x	46.75	x	0.63	x	0.7	=	77.73	(78)
South	0.9x	0.77	x	4.8	x	46.75	x	0.63	x	0.7	=	68.58	(78)
South	0.9x	0.77	x	5.44	x	76.57	x	0.63	x	0.7	=	127.3	(78)
South	0.9x	0.77	x	4.8	x	76.57	x	0.63	x	0.7	=	112.32	(78)
South	0.9x	0.77	x	5.44	x	97.53	x	0.63	x	0.7	=	162.15	(78)
South	0.9x	0.77	x	4.8	x	97.53	x	0.63	x	0.7	=	143.08	(78)
South	0.9x	0.77	x	5.44	x	110.23	x	0.63	x	0.7	=	183.27	(78)
South	0.9x	0.77	x	4.8	x	110.23	x	0.63	x	0.7	=	161.71	(78)
South	0.9x	0.77	x	5.44	x	114.87	x	0.63	x	0.7	=	190.98	(78)
South	0.9x	0.77	x	4.8	x	114.87	x	0.63	x	0.7	=	168.51	(78)
South	0.9x	0.77	x	5.44	x	110.55	x	0.63	x	0.7	=	183.79	(78)
South	0.9x	0.77	x	4.8	x	110.55	x	0.63	x	0.7	=	162.17	(78)
South	0.9x	0.77	x	5.44	x	108.01	x	0.63	x	0.7	=	179.57	(78)
South	0.9x	0.77	x	4.8	x	108.01	x	0.63	x	0.7	=	158.45	(78)
South	0.9x	0.77	x	5.44	x	104.89	x	0.63	x	0.7	=	174.39	(78)
South	0.9x	0.77	x	4.8	x	104.89	x	0.63	x	0.7	=	153.87	(78)
South	0.9x	0.77	x	5.44	x	101.89	x	0.63	x	0.7	=	169.39	(78)
South	0.9x	0.77	x	4.8	x	101.89	x	0.63	x	0.7	=	149.46	(78)
South	0.9x	0.77	x	5.44	x	82.59	x	0.63	x	0.7	=	137.3	(78)
South	0.9x	0.77	x	4.8	x	82.59	x	0.63	x	0.7	=	121.15	(78)
South	0.9x	0.77	x	5.44	x	55.42	x	0.63	x	0.7	=	92.13	(78)
South	0.9x	0.77	x	4.8	x	55.42	x	0.63	x	0.7	=	81.29	(78)
South	0.9x	0.77	x	5.44	x	40.4	x	0.63	x	0.7	=	67.16	(78)
South	0.9x	0.77	x	4.8	x	40.4	x	0.63	x	0.7	=	59.26	(78)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	154.95	256.53	333.08	385.59	409.26	396.91	386.53	369.93	351.23	278.51	184.2	133.53	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	533.75	633.37	697.95	731.22	735.49	704.36	681.72	670.67	661.81	608.52	536.52	502.45	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.95	0.87	0.74	0.56	0.4	0.42	0.63	0.88	0.98	0.99	(86)

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Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.21	20.4	20.61	20.82	20.94	20.99	21	21	20.98	20.83	20.49	20.17	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.12	20.12	20.12	20.13	20.14	20.15	20.15	20.15	20.14	20.14	20.13	20.13	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.97	0.93	0.84	0.69	0.49	0.32	0.35	0.56	0.85	0.97	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.08	19.36	19.65	19.94	20.09	20.14	20.14	20.15	20.13	19.96	19.49	19.03	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.54	19.78	20.04	20.3	20.44	20.49	20.49	20.49	20.48	20.32	19.89	19.5	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.54	19.78	20.04	20.3	20.44	20.49	20.49	20.49	20.48	20.32	19.89	19.5	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.97	0.93	0.85	0.71	0.51	0.35	0.38	0.59	0.86	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	526.56	612.56	648.09	619.69	520.53	361.94	241.32	253.07	389.85	521.55	519.48	497.39	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	978.32	952.46	864.45	717.63	548.68	365.41	241.63	253.53	397.64	610.24	807.75	971.04	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	336.11	228.41	160.97	70.52	20.94	0	0	0	0	65.98	207.55	352.4	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 1442.89 (98)

Space heating requirement in kWh/m²/year 21.54 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	336.11	228.41	160.97	70.52	20.94	0	0	0	0	65.98	207.55	352.4	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	359.48	244.29	172.17	75.42	22.39	0	0	0	0	70.57	221.98	376.9	

Total (kWh/year) =$Sum(211)_{1...5,10...12}$= 1543.19 (211)

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Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
									Total (kWh/year) =Sum(215)$_{1...5,10....12}$=				0	(215)

Water heating

Output from water heater (calculated above)

	186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09		
Efficiency of water heater													79.8	(216)
(217)m=	86.37	85.69	84.62	82.86	80.96	79.8	79.8	79.8	79.8	82.64	85.35	86.55		(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	215.94	191.91	204.27	187.27	188.03	170.73	164.23	179.84	179.41	194.69	199.02	210.39		
									Total = Sum(219a)$_{1...12}$ =				2285.73	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1543.19	
Water heating fuel used			2285.73	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			307.48	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			4211.4	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	333.33	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	493.72	(264)
Space and water heating	(261) + (262) + (263) + (264) =				827.05	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	159.58	(268)
Total CO2, kg/year			sum of (265)…(271) =		1025.55	(272)

TER = 15.31 (273)

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SAP Input

Property Details: Sample 4 (Mid)

Address:	
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	26 July 2019
Date of certificate:	15 June 2022
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	498

Property description:

Dwelling type:	Flat
Detachment:	
Year Completed:	2019

Floor Location:	Floor area:	Storey height:
Floor 0	67 m²	3 m

Living area:	27.3 m² (fraction 0.407)
Front of dwelling faces:	Unspecified

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
DOOR	Manufacturer	Solid			Wood
W	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
S	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Balcony	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
DOOR	mm	0.7	0	1.4	2.4	1
W		0.7	0.4	1	1.44	1
S		0.7	0.4	1	5.44	1
Balcony		0.7	0.4	1	4.8	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
DOOR		INT	Worst case	0	0
W		W	West	0	0
S		S	South	0	0
Balcony		S	South	0	0

Overshading: More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
S	31.7	10.24	21.46	0.15	0	False	N/A
W	19	1.44	17.56	0.15	0	False	N/A
INT	11.1	2.4	8.7	0.16	0.43	False	N/A
Spandrel	2.4	0	2.4	0.35	0	False	N/A
Internal Elements							
Party Elements							

Thermal bridges:

SAP Input

Thermal bridges:	No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	3

Main heating system:

Main heating system:	Community heating schemes Heat source: Community boilers heat from boilers – mains gas, heat fraction 1, efficiency 95 Piping>=1991, pre-insulated, low temp, variable flow Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Boiler interlock: Yes

Main heating Control:

Main heating Control:	Charging system linked to use of community heating, programmer and TRVs Control code: 2306

Secondary heating system:

Secondary heating system:	None

Water heating:

Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Flue Gas Heat Recovery System: Database (rev 498, product index 060036) Brand name: Worcester Model: Greenstar Xtra Model qualifier: 2015 Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.51

Property Address: Sample 4 (Mid)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67	(1a) x	3	(2a) =	201	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	201	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

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			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	79.05	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1.4	=	3.36			(26)
Windows Type 1			1.44	x	1/[1/(1)+ 0.04]	=	1.38			(27)
Windows Type 2			5.44	x	1/[1/(1)+ 0.04]	=	5.23			(27)
Windows Type 3			4.8	x	1/[1/(1)+ 0.04]	=	4.62			(27)
Walls Type1	31.7	10.24	21.46	x	0.15	=	3.22			(29)
Walls Type2	19	1.44	17.56	x	0.15	=	2.63			(29)
Walls Type3	11.1	2.4	8.7	x	0.15	=	1.3			(29)
Walls Type4	2.4	0	2.4	x	0.35	=	0.84			(29)
Total area of elements, m²			64.2							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	22.59	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	701.68	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		9.63	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	32.22	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	17.73	17.52	17.31	16.25	16.04	14.98	14.98	14.77	15.41	16.04	16.46	16.89	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	49.95	49.74	49.52	48.47	48.26	47.2	47.2	46.99	47.62	48.26	48.68	49.1	

Average = Sum(39)$_{1…12}$ /12= 48.41 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	0.75	0.74	0.74	0.72	0.72	0.7	0.7	0.7	0.71	0.72	0.73	0.73	

Average = Sum(40)$_{1…12}$ /12= 0.72 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.17 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.76 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	94.34	90.91	87.48	84.05	80.62	77.19	77.19	80.62	84.05	87.48	90.91	94.34	

Total = Sum(44)$_{1…12}$ = 1029.18 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	139.91	122.36	126.27	110.08	105.63	91.15	84.46	96.92	98.08	114.3	124.77	135.49	

Total = Sum(45)$_{1…12}$ = 1349.41 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	20.99	18.35	18.94	16.51	15.84	13.67	12.67	14.54	14.71	17.15	18.72	20.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	195.18	172.29	181.54	163.58	160.9	144.64	139.74	152.2	151.57	169.58	178.26	190.77	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	18.03	16.04	16.49	14.58	14.03	12.18	11.28	12.94	13.08	15.09	16.32	17.54	(63) (G2)

Output from water heater

(64)m=	174.47	153.83	162.37	146.4	144.19	129.86	125.78	136.58	135.89	151.81	159.35	170.55	

Output from water heater (annual)$_{1...12}$ 1791.08 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	90.74	80.63	86.21	79.4	79.34	73.1	72.31	76.45	75.41	82.23	84.28	89.27	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m=	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	17.86	15.86	12.9	9.77	7.3	6.16	6.66	8.66	11.62	14.75	17.22	18.36	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	190.2	192.17	187.2	176.61	163.24	150.68	142.29	140.32	145.29	155.88	169.24	181.8	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	(71)
Water heating gains (Table 5)													
(72)m=	121.96	119.98	115.87	110.27	106.64	101.53	97.18	102.75	104.73	110.52	117.06	119.99	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	385.59	383.58	371.53	352.22	332.75	313.94	301.7	307.29	317.21	336.72	359.09	375.72	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	5.44	x	46.75	x	0.4	x	0.7	=	49.35	(78)
South	0.9x	0.77	x	4.8	x	46.75	x	0.4	x	0.7	=	43.54	(78)
South	0.9x	0.77	x	5.44	x	76.57	x	0.4	x	0.7	=	80.82	(78)
South	0.9x	0.77	x	4.8	x	76.57	x	0.4	x	0.7	=	71.31	(78)

South	0.9x	0.77	x	5.44	x	97.53	x	0.4	x	0.7	=	102.95	(78)
South	0.9x	0.77	x	4.8	x	97.53	x	0.4	x	0.7	=	90.84	(78)
South	0.9x	0.77	x	5.44	x	110.23	x	0.4	x	0.7	=	116.36	(78)
South	0.9x	0.77	x	4.8	x	110.23	x	0.4	x	0.7	=	102.67	(78)
South	0.9x	0.77	x	5.44	x	114.87	x	0.4	x	0.7	=	121.26	(78)
South	0.9x	0.77	x	4.8	x	114.87	x	0.4	x	0.7	=	106.99	(78)
South	0.9x	0.77	x	5.44	x	110.55	x	0.4	x	0.7	=	116.69	(78)
South	0.9x	0.77	x	4.8	x	110.55	x	0.4	x	0.7	=	102.96	(78)
South	0.9x	0.77	x	5.44	x	108.01	x	0.4	x	0.7	=	114.01	(78)
South	0.9x	0.77	x	4.8	x	108.01	x	0.4	x	0.7	=	100.6	(78)
South	0.9x	0.77	x	5.44	x	104.89	x	0.4	x	0.7	=	110.72	(78)
South	0.9x	0.77	x	4.8	x	104.89	x	0.4	x	0.7	=	97.7	(78)
South	0.9x	0.77	x	5.44	x	101.89	x	0.4	x	0.7	=	107.55	(78)
South	0.9x	0.77	x	4.8	x	101.89	x	0.4	x	0.7	=	94.9	(78)
South	0.9x	0.77	x	5.44	x	82.59	x	0.4	x	0.7	=	87.18	(78)
South	0.9x	0.77	x	4.8	x	82.59	x	0.4	x	0.7	=	76.92	(78)
South	0.9x	0.77	x	5.44	x	55.42	x	0.4	x	0.7	=	58.5	(78)
South	0.9x	0.77	x	4.8	x	55.42	x	0.4	x	0.7	=	51.62	(78)
South	0.9x	0.77	x	5.44	x	40.4	x	0.4	x	0.7	=	42.64	(78)
South	0.9x	0.77	x	4.8	x	40.4	x	0.4	x	0.7	=	37.63	(78)
West	0.9x	0.77	x	1.44	x	19.64	x	0.4	x	0.7	=	5.49	(80)
West	0.9x	0.77	x	1.44	x	38.42	x	0.4	x	0.7	=	10.74	(80)
West	0.9x	0.77	x	1.44	x	63.27	x	0.4	x	0.7	=	17.68	(80)
West	0.9x	0.77	x	1.44	x	92.28	x	0.4	x	0.7	=	25.78	(80)
West	0.9x	0.77	x	1.44	x	113.09	x	0.4	x	0.7	=	31.6	(80)
West	0.9x	0.77	x	1.44	x	115.77	x	0.4	x	0.7	=	32.35	(80)
West	0.9x	0.77	x	1.44	x	110.22	x	0.4	x	0.7	=	30.8	(80)
West	0.9x	0.77	x	1.44	x	94.68	x	0.4	x	0.7	=	26.45	(80)
West	0.9x	0.77	x	1.44	x	73.59	x	0.4	x	0.7	=	20.56	(80)
West	0.9x	0.77	x	1.44	x	45.59	x	0.4	x	0.7	=	12.74	(80)
West	0.9x	0.77	x	1.44	x	24.49	x	0.4	x	0.7	=	6.84	(80)
West	0.9x	0.77	x	1.44	x	16.15	x	0.4	x	0.7	=	4.51	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	98.38	162.87	211.48	244.82	259.85	252	245.41	234.88	223.01	176.83	116.95	84.78	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	483.97	546.46	583.01	597.03	592.6	565.95	547.11	542.17	540.21	513.55	476.04	460.5	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.95	0.87	0.73	0.53	0.38	0.4	0.6	0.87	0.98	0.99	(86)

DER WorkSheet: New dwelling design stage

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.46	20.6	20.75	20.9	20.98	21	21	21	21	20.92	20.68	20.44	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.3	20.3	20.31	20.32	20.32	20.34	20.34	20.34	20.33	20.32	20.32	20.31	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.97	0.94	0.85	0.69	0.48	0.32	0.34	0.55	0.84	0.97	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.59	19.78	20	20.21	20.3	20.34	20.34	20.34	20.33	20.24	19.91	19.57	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.95	20.12	20.31	20.49	20.58	20.61	20.61	20.61	20.6	20.51	20.22	19.93	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.95	20.12	20.31	20.49	20.58	20.61	20.61	20.61	20.6	20.51	20.22	19.93	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.97	0.94	0.85	0.7	0.5	0.35	0.36	0.57	0.85	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	478.03	531.01	546.14	508.99	416.97	282.7	189.08	197.69	307.5	435.41	460.88	456.21	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	781.5	756.76	683.76	561.84	428.36	283.46	189.12	197.75	309.53	478.39	638.89	772.12	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	225.78	151.71	102.38	38.05	8.48	0	0	0	0	31.98	128.16	235.04	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 921.58 (98)

Space heating requirement in kWh/m²/year 13.75 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none	0	(301)
Fraction of space heat from community system 1 – (301) =	1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers		1	(303a)
Fraction of total space heat from Community boilers	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating	**kWh/year**
Annual space heating requirement	921.58

DER WorkSheet: New dwelling design stage

Space heat from Community boilers	(98) x (304a) x (305) x (306) =	967.66	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)

Water heating

Annual water heating requirement		1791.08	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	1880.63	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	28.48	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		119.54	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	119.54	(331)
Energy for lighting (calculated in Appendix L)		315.44	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		3283.28	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				95	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.22	=	647.61	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	14.78	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	662.39	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				662.39	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	62.04	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	163.72	(379)
Total CO2, kg/year	sum of (376)…(382) =				888.15	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				13.26	(384)
EI rating (section 14)					89.37	(385)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Sample 4 (Mid)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67	(1a) x	3	(2a) =	201	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		201	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.1	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*		0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.35	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.37	0.36	0.33	0.32	0.28	0.28	0.27	0.3	0.32	0.33	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	0	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1	=	2.4			(26)
Windows Type 1			1.44	x1/[1/(1.4)+ 0.04]		=	1.91			(27)
Windows Type 2			5.44	x1/[1/(1.4)+ 0.04]		=	7.21			(27)
Windows Type 3			4.8	x1/[1/(1.4)+ 0.04]		=	6.36			(27)
Walls Type1	31.7	10.24	21.46	x	0.18	=	3.86			(29)
Walls Type2	19	1.44	17.56	x	0.18	=	3.16			(29)
Walls Type3	11.1	2.4	8.7	x	0.18	=	1.57			(29)
Walls Type4	2.4	0	2.4	x	0.18	=	0.43			(29)
Total area of elements, m²			64.2							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	26.91	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	701.68	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		3.21	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	30.12	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	37.92	37.74	37.56	36.71	36.55	35.81	35.81	35.67	36.09	36.55	36.87	37.21	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	68.04	67.85	67.67	66.82	66.66	65.92	65.92	65.79	66.21	66.66	66.99	67.32	

Average = $Sum(39)_{1…12}$ /12= 66.82 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	1.02	1.01	1.01	1	0.99	0.98	0.98	0.98	0.99	0.99	1	1	

Average = Sum(40)$_{1…12}$ /12= 1 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.17 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.76 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	94.34	90.91	87.48	84.05	80.62	77.19	77.19	80.62	84.05	87.48	90.91	94.34	

Total = Sum(44)$_{1…12}$ = 1029.18 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	139.91	122.36	126.27	110.08	105.63	91.15	84.46	96.92	98.08	114.3	124.77	135.49	

Total = Sum(45)$_{1…12}$ = 1349.41 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	20.99	18.35	18.94	16.51	15.84	13.67	12.67	14.54	14.71	17.15	18.72	20.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09	

Output from water heater (annual)$_{1...12}$ 1898.03 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	83.79	74.35	79.26	72.68	72.4	66.38	65.36	69.5	68.68	75.28	77.56	82.33	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	17.41	15.46	12.58	9.52	7.12	6.01	6.49	8.44	11.33	14.38	16.79	17.89	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	190.2	192.17	187.2	176.61	163.24	150.68	142.29	140.32	145.29	155.88	169.24	181.8	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	(71)
Water heating gains (Table 5)													
(72)m=	112.63	110.65	106.53	100.94	97.31	92.19	87.85	93.42	95.4	101.18	107.72	110.65	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	378.8	376.85	364.87	345.64	326.23	307.45	295.2	300.74	310.58	330.01	352.32	368.92	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x 0.77	x	5.44	x	46.75	x	0.63	x	0.7	=	77.73	(78)
South	0.9x 0.77	x	4.8	x	46.75	x	0.63	x	0.7	=	68.58	(78)
South	0.9x 0.77	x	5.44	x	76.57	x	0.63	x	0.7	=	127.3	(78)
South	0.9x 0.77	x	4.8	x	76.57	x	0.63	x	0.7	=	112.32	(78)

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South	0.9x	0.77	x	5.44	x	97.53	x	0.63	x	0.7	=	162.15	(78)
South	0.9x	0.77	x	4.8	x	97.53	x	0.63	x	0.7	=	143.08	(78)
South	0.9x	0.77	x	5.44	x	110.23	x	0.63	x	0.7	=	183.27	(78)
South	0.9x	0.77	x	4.8	x	110.23	x	0.63	x	0.7	=	161.71	(78)
South	0.9x	0.77	x	5.44	x	114.87	x	0.63	x	0.7	=	190.98	(78)
South	0.9x	0.77	x	4.8	x	114.87	x	0.63	x	0.7	=	168.51	(78)
South	0.9x	0.77	x	5.44	x	110.55	x	0.63	x	0.7	=	183.79	(78)
South	0.9x	0.77	x	4.8	x	110.55	x	0.63	x	0.7	=	162.17	(78)
South	0.9x	0.77	x	5.44	x	108.01	x	0.63	x	0.7	=	179.57	(78)
South	0.9x	0.77	x	4.8	x	108.01	x	0.63	x	0.7	=	158.45	(78)
South	0.9x	0.77	x	5.44	x	104.89	x	0.63	x	0.7	=	174.39	(78)
South	0.9x	0.77	x	4.8	x	104.89	x	0.63	x	0.7	=	153.87	(78)
South	0.9x	0.77	x	5.44	x	101.89	x	0.63	x	0.7	=	169.39	(78)
South	0.9x	0.77	x	4.8	x	101.89	x	0.63	x	0.7	=	149.46	(78)
South	0.9x	0.77	x	5.44	x	82.59	x	0.63	x	0.7	=	137.3	(78)
South	0.9x	0.77	x	4.8	x	82.59	x	0.63	x	0.7	=	121.15	(78)
South	0.9x	0.77	x	5.44	x	55.42	x	0.63	x	0.7	=	92.13	(78)
South	0.9x	0.77	x	4.8	x	55.42	x	0.63	x	0.7	=	81.29	(78)
South	0.9x	0.77	x	5.44	x	40.4	x	0.63	x	0.7	=	67.16	(78)
South	0.9x	0.77	x	4.8	x	40.4	x	0.63	x	0.7	=	59.26	(78)
West	0.9x	0.77	x	1.44	x	19.64	x	0.63	x	0.7	=	8.64	(80)
West	0.9x	0.77	x	1.44	x	38.42	x	0.63	x	0.7	=	16.91	(80)
West	0.9x	0.77	x	1.44	x	63.27	x	0.63	x	0.7	=	27.85	(80)
West	0.9x	0.77	x	1.44	x	92.28	x	0.63	x	0.7	=	40.61	(80)
West	0.9x	0.77	x	1.44	x	113.09	x	0.63	x	0.7	=	49.77	(80)
West	0.9x	0.77	x	1.44	x	115.77	x	0.63	x	0.7	=	50.95	(80)
West	0.9x	0.77	x	1.44	x	110.22	x	0.63	x	0.7	=	48.51	(80)
West	0.9x	0.77	x	1.44	x	94.68	x	0.63	x	0.7	=	41.67	(80)
West	0.9x	0.77	x	1.44	x	73.59	x	0.63	x	0.7	=	32.39	(80)
West	0.9x	0.77	x	1.44	x	45.59	x	0.63	x	0.7	=	20.06	(80)
West	0.9x	0.77	x	1.44	x	24.49	x	0.63	x	0.7	=	10.78	(80)
West	0.9x	0.77	x	1.44	x	16.15	x	0.63	x	0.7	=	7.11	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	154.95	256.53	333.08	385.59	409.26	396.91	386.53	369.93	351.23	278.51	184.2	133.53	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	533.75	633.37	697.95	731.22	735.49	704.36	681.72	670.67	661.81	608.52	536.52	502.45	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.95	0.89	0.77	0.59	0.42	0.45	0.66	0.9	0.98	0.99	(86)

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Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.13	20.32	20.54	20.77	20.92	20.99	21	21	20.97	20.79	20.42	20.09	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.07	20.07	20.07	20.09	20.09	20.1	20.1	20.1	20.09	20.09	20.08	20.08	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.97	0.94	0.86	0.71	0.51	0.34	0.36	0.59	0.87	0.97	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.92	19.2	19.52	19.83	20.02	20.09	20.1	20.1	20.07	19.86	19.35	18.88	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.41	19.66	19.94	20.22	20.38	20.45	20.46	20.46	20.44	20.24	19.78	19.37	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.41	19.66	19.94	20.22	20.38	20.45	20.46	20.46	20.44	20.24	19.78	19.37	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.97	0.94	0.86	0.73	0.54	0.37	0.4	0.62	0.87	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	526.96	614.3	653.04	631.25	538.97	380.19	254.12	266.52	407.67	530.57	520.93	497.63	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1028.38	1001.43	909.31	756.12	578.96	385.93	254.7	267.36	419.79	642.71	849.7	1021.36	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	373.06	260.15	190.66	89.9	29.75	0	0	0	0	83.43	236.71	389.66	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1653.33 (98)

Space heating requirement in kWh/m²/year 24.68 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	373.06	260.15	190.66	89.9	29.75	0	0	0	0	83.43	236.71	389.66	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	398.99	278.24	203.92	96.15	31.82	0	0	0	0	89.23	253.17	416.74	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 1768.27 (211)

TER WorkSheet: New dwelling design stage

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
									Total (kWh/year) =Sum(215)$_{1...5,10...12}$=				0	(215)

Water heating

Output from water heater (calculated above)

	186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09		
Efficiency of water heater													79.8	(216)
(217)m=	86.63	86.03	85.08	83.42	81.37	79.8	79.8	79.8	79.8	83.16	85.7	86.79		(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	215.29	191.15	203.19	186.02	187.07	170.73	164.23	179.84	179.41	193.48	198.21	209.79		
									Total = Sum(219a)$_{1...12}$ =				2278.4	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1768.27	
Water heating fuel used			2278.4	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			307.48	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			4429.15	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	381.95	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	492.13	(264)
Space and water heating	(261) + (262) + (263) + (264) =			874.08	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	159.58	(268)
Total CO2, kg/year		sum of (265)…(271) =		1072.59	(272)

TER = 16.01 (273)

SAP Input

Property Details: Sample 5 (Mid)

Address:	
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	26 July 2019
Date of certificate:	15 June 2022
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	498

Property description:

Dwelling type:	Flat
Detachment:	
Year Completed:	2019

Floor Location:	Floor area:	Storey height:
Floor 0	67 m²	3 m

Living area:	27.5 m² (fraction 0.41)
Front of dwelling faces:	Unspecified

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
DOOR	Manufacturer	Solid			Wood
E	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Balcony	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
DOOR	mm	0.7	0	1.4	2.4	1
E		0.7	0.4	1	4.16	1
Balcony		0.7	0.4	1	4.8	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
DOOR		INT	Worst case	0	0
E		E	East	0	0
Balcony		E	East	0	0

Overshading:	More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
E	29.4	8.96	20.44	0.15	0	False	N/A
INT	12	2.4	9.6	0.16	0.43	False	N/A
Spandrel	2.44	0	2.44	0.35	0	False	N/A
Internal Elements							
Party Elements							

Thermal bridges:

Thermal bridges:	No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test:	Yes (As designed)

SAP Input

Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	3
Pressure test:	3

Main heating system:

Main heating system:	Community heating schemes Heat source: Community boilers heat from boilers – mains gas, heat fraction 1, efficiency 95 Piping>=1991, pre-insulated, low temp, variable flow Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Boiler interlock: Yes

Main heating Control:

Main heating Control:	Charging system linked to use of community heating, programmer and TRVs Control code: 2306

Secondary heating system:

Secondary heating system:	None

Water heating:

Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Flue Gas Heat Recovery System: Database (rev 498, product index 060036) Brand name: Worcester Model: Greenstar Xtra Model qualifier: 2015 Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.51

Property Address: Sample 5 (Mid)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67	(1a) x	3	(2a) =	201	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	201	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.05 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.25	0.25	0.25	0.23	0.23	0.22	0.22	0.21	0.22	0.23	0.24	0.24	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.25	0.25	0.25	0.23	0.23	0.22	0.22	0.21	0.22	0.23	0.24	0.24	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1.4	=	3.36			(26)
Windows Type 1			4.16	x	1/[1/(1)+ 0.04]	=	4			(27)
Windows Type 2			4.8	x	1/[1/(1)+ 0.04]	=	4.62			(27)
Walls Type1	29.4	8.96	20.44	x	0.15	=	3.07			(29)
Walls Type2	12	2.4	9.6	x	0.15	=	1.44			(29)
Walls Type3	2.44	0	2.44	x	0.35	=	0.85			(29)
Total area of elements, m²			43.84							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 17.33 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 454.72 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 6.58 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 23.91 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	16.78	16.59	16.39	15.43	15.24	14.27	14.27	14.08	14.66	15.24	15.62	16.01	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	40.69	40.5	40.3	39.34	39.15	38.18	38.18	37.99	38.57	39.15	39.53	39.92	

Average = Sum(39)$_{1\ldots12}$ /12= 39.29 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.61	0.6	0.6	0.59	0.58	0.57	0.57	0.57	0.58	0.58	0.59	0.6

Average = Sum(40)$_{1\ldots12}$ /12= 0.59 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.17 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.76 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	94.34	90.91	87.48	84.05	80.62	77.19	77.19	80.62	84.05	87.48	90.91	94.34	
											Total = Sum(44)$_{1\ldots12}$ =	1029.18	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	139.91	122.36	126.27	110.08	105.63	91.15	84.46	96.92	98.08	114.3	124.77	135.49	
											Total = Sum(45)$_{1\ldots12}$ =	1349.41	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	20.99	18.35	18.94	16.51	15.84	13.67	12.67	14.54	14.71	17.15	18.72	20.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	195.18	172.29	181.54	163.58	160.9	144.64	139.74	152.2	151.57	169.58	178.26	190.77	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	18.03	16.04	16.49	14.58	14.03	12.18	11.28	12.94	13.08	15.09	16.32	17.54	(63) (G2)

Output from water heater

(64)m=	174.47	153.83	162.37	146.4	144.19	129.86	125.78	136.58	135.89	151.81	159.35	170.55

Output from water heater (annual)$_{1…12}$ 1791.08 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	90.74	80.63	86.21	79.4	79.34	73.1	72.31	76.45	75.41	82.23	84.28	89.27	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.93	16.81	13.67	10.35	7.74	6.53	7.06	9.17	12.31	15.63	18.25	19.45	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	190.2	192.17	187.2	176.61	163.24	150.68	142.29	140.32	145.29	155.88	169.24	181.8	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	(71)

Water heating gains (Table 5)

(72)m=	121.96	119.98	115.87	110.27	106.64	101.53	97.18	102.75	104.73	110.52	117.06	119.99	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	386.65	384.53	372.3	352.8	333.19	314.31	302.1	307.81	317.9	337.6	360.11	376.81	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	4.16	x	19.64	x	0.4	x	0.7	=	15.85	(76)
East	0.9x	0.77	x	4.8	x	19.64	x	0.4	x	0.7	=	18.29	(76)
East	0.9x	0.77	x	4.16	x	38.42	x	0.4	x	0.7	=	31.01	(76)
East	0.9x	0.77	x	4.8	x	38.42	x	0.4	x	0.7	=	35.78	(76)

East	0.9x	0.77	x	4.16	x	63.27	x	0.4	x	0.7	=	51.07	(76)
East	0.9x	0.77	x	4.8	x	63.27	x	0.4	x	0.7	=	58.93	(76)
East	0.9x	0.77	x	4.16	x	92.28	x	0.4	x	0.7	=	74.49	(76)
East	0.9x	0.77	x	4.8	x	92.28	x	0.4	x	0.7	=	85.95	(76)
East	0.9x	0.77	x	4.16	x	113.09	x	0.4	x	0.7	=	91.29	(76)
East	0.9x	0.77	x	4.8	x	113.09	x	0.4	x	0.7	=	105.33	(76)
East	0.9x	0.77	x	4.16	x	115.77	x	0.4	x	0.7	=	93.45	(76)
East	0.9x	0.77	x	4.8	x	115.77	x	0.4	x	0.7	=	107.83	(76)
East	0.9x	0.77	x	4.16	x	110.22	x	0.4	x	0.7	=	88.97	(76)
East	0.9x	0.77	x	4.8	x	110.22	x	0.4	x	0.7	=	102.66	(76)
East	0.9x	0.77	x	4.16	x	94.68	x	0.4	x	0.7	=	76.42	(76)
East	0.9x	0.77	x	4.8	x	94.68	x	0.4	x	0.7	=	88.18	(76)
East	0.9x	0.77	x	4.16	x	73.59	x	0.4	x	0.7	=	59.4	(76)
East	0.9x	0.77	x	4.8	x	73.59	x	0.4	x	0.7	=	68.54	(76)
East	0.9x	0.77	x	4.16	x	45.59	x	0.4	x	0.7	=	36.8	(76)
East	0.9x	0.77	x	4.8	x	45.59	x	0.4	x	0.7	=	42.46	(76)
East	0.9x	0.77	x	4.16	x	24.49	x	0.4	x	0.7	=	19.77	(76)
East	0.9x	0.77	x	4.8	x	24.49	x	0.4	x	0.7	=	22.81	(76)
East	0.9x	0.77	x	4.16	x	16.15	x	0.4	x	0.7	=	13.04	(76)
East	0.9x	0.77	x	4.8	x	16.15	x	0.4	x	0.7	=	15.04	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	34.15	66.8	110.01	160.44	196.62	201.28	191.63	164.6	127.94	79.26	42.58	28.08	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	420.8	451.33	482.31	513.24	529.81	515.59	493.72	472.41	445.84	416.86	402.69	404.89	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.96	0.86	0.68	0.47	0.34	0.37	0.59	0.89	0.98	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.59	20.68	20.81	20.95	20.99	21	21	21	21	20.94	20.76	20.58	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.42	20.43	20.43	20.44	20.44	20.46	20.46	20.46	20.45	20.44	20.44	20.43	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.95	0.84	0.64	0.43	0.3	0.33	0.55	0.86	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.88	20	20.19	20.38	20.44	20.46	20.46	20.46	20.45	20.38	20.13	19.87	(90)

fLA = Living area ÷ (4) = | 0.41 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	20.17	20.28	20.45	20.62	20.67	20.68	20.68	20.68	20.68	20.61	20.39	20.16	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	20.17	20.28	20.45	20.62	20.67	20.68	20.68	20.68	20.68	20.61	20.39	20.16	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.95	0.84	0.66	0.45	0.32	0.34	0.57	0.87	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	417.09	443.33	458.94	433.27	347.94	232.05	155.78	162.64	252.94	362.41	393.04	402.1	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	645.83	622.86	562.13	460.86	350.99	232.14	155.78	162.65	253.6	391.95	525.37	637.24	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	170.18	120.64	76.78	19.87	2.27	0	0	0	0	21.98	95.27	174.95	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 681.96 (98)

Space heating requirement in kWh/m²/year 10.18 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers		1	(303a)
Fraction of total space heat from Community boilers	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		681.96	
Space heat from Community boilers	(98) x (304a) x (305) x (306) =	716.06	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		1791.08	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	1880.63	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	25.97	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		119.54	(330a)

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warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	119.54	(331)
Energy for lighting (calculated in Appendix L)		334.24	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		3050.47	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				95	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.22	=	590.4	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	13.48	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	603.88	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				603.88	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	62.04	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	173.47	(379)
Total CO2, kg/year	sum of (376)…(382) =				839.39	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				12.53	(384)
EI rating (section 14)					89.96	(385)

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User Details:

Assessor Name: | **Stroma Number:**

Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.51

Property Address: Sample 5 (Mid)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67	(1a) x	3	(2a) =	201	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	201	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.1	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.35	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.27	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.35	0.34	0.33	0.3	0.29	0.26	0.26	0.25	0.27	0.29	0.3	0.32

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.56	0.56	0.56	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.56	0.56	0.56	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1	=	2.4			(26)
Windows Type 1			4.16	x1/[1/(1.4)+ 0.04]		=	5.52			(27)
Windows Type 2			4.8	x1/[1/(1.4)+ 0.04]		=	6.36			(27)
Walls Type1	29.4	8.96	20.44	x	0.18	=	3.68			(29)
Walls Type2	12	2.4	9.6	x	0.18	=	1.73			(29)
Walls Type3	2.44	0	2.44	x	0.18	=	0.44			(29)
Total area of elements, m²			43.84							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 20.13 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 454.72 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 2.19 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 22.32 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	37.12	36.97	36.82	36.11	35.98	35.36	35.36	35.25	35.6	35.98	36.24	36.52	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	59.44	59.28	59.13	58.43	58.29	57.68	57.68	57.56	57.92	58.29	58.56	58.84	

Average = Sum(39)$_{1…12}$ /12= 58.43 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.89	0.88	0.88	0.87	0.87	0.86	0.86	0.86	0.86	0.87	0.87	0.88

Average = $Sum(40)_{1...12}$ /12= 0.87 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.17 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.76 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	94.34	90.91	87.48	84.05	80.62	77.19	77.19	80.62	84.05	87.48	90.91	94.34

Total = $Sum(44)_{1...12}$ = 1029.18 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.91	122.36	126.27	110.08	105.63	91.15	84.46	96.92	98.08	114.3	124.77	135.49

Total = $Sum(45)_{1...12}$ = 1349.41 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.99	18.35	18.94	16.51	15.84	13.67	12.67	14.54	14.71	17.15	18.72	20.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09	

Output from water heater (annual)$_{1...12}$ 1898.03 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	83.79	74.35	79.26	72.68	72.4	66.38	65.36	69.5	68.68	75.28	77.56	82.33	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.37	16.32	13.27	10.05	7.51	6.34	6.85	8.91	11.95	15.18	17.72	18.89	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	190.2	192.17	187.2	176.61	163.24	150.68	142.29	140.32	145.29	155.88	169.24	181.8	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	(71)

Water heating gains (Table 5)

(72)m=	112.63	110.65	106.53	100.94	97.31	92.19	87.85	93.42	95.4	101.18	107.72	110.65	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	379.77	377.7	365.57	346.16	326.63	307.78	295.56	301.21	311.21	330.81	353.25	369.91	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	4.16	x	19.64	x	0.63	x	0.7	=	24.97	(76)
East	0.9x	0.77	x	4.8	x	19.64	x	0.63	x	0.7	=	28.81	(76)
East	0.9x	0.77	x	4.16	x	38.42	x	0.63	x	0.7	=	48.85	(76)
East	0.9x	0.77	x	4.8	x	38.42	x	0.63	x	0.7	=	56.36	(76)

East	0.9x	0.77	x	4.16	x	63.27	x	0.63	x	0.7	=	80.44	(76)
East	0.9x	0.77	x	4.8	x	63.27	x	0.63	x	0.7	=	92.82	(76)
East	0.9x	0.77	x	4.16	x	92.28	x	0.63	x	0.7	=	117.32	(76)
East	0.9x	0.77	x	4.8	x	92.28	x	0.63	x	0.7	=	135.37	(76)
East	0.9x	0.77	x	4.16	x	113.09	x	0.63	x	0.7	=	143.78	(76)
East	0.9x	0.77	x	4.8	x	113.09	x	0.63	x	0.7	=	165.9	(76)
East	0.9x	0.77	x	4.16	x	115.77	x	0.63	x	0.7	=	147.18	(76)
East	0.9x	0.77	x	4.8	x	115.77	x	0.63	x	0.7	=	169.83	(76)
East	0.9x	0.77	x	4.16	x	110.22	x	0.63	x	0.7	=	140.13	(76)
East	0.9x	0.77	x	4.8	x	110.22	x	0.63	x	0.7	=	161.68	(76)
East	0.9x	0.77	x	4.16	x	94.68	x	0.63	x	0.7	=	120.37	(76)
East	0.9x	0.77	x	4.8	x	94.68	x	0.63	x	0.7	=	138.88	(76)
East	0.9x	0.77	x	4.16	x	73.59	x	0.63	x	0.7	=	93.56	(76)
East	0.9x	0.77	x	4.8	x	73.59	x	0.63	x	0.7	=	107.95	(76)
East	0.9x	0.77	x	4.16	x	45.59	x	0.63	x	0.7	=	57.96	(76)
East	0.9x	0.77	x	4.8	x	45.59	x	0.63	x	0.7	=	66.88	(76)
East	0.9x	0.77	x	4.16	x	24.49	x	0.63	x	0.7	=	31.13	(76)
East	0.9x	0.77	x	4.8	x	24.49	x	0.63	x	0.7	=	35.92	(76)
East	0.9x	0.77	x	4.16	x	16.15	x	0.63	x	0.7	=	20.53	(76)
East	0.9x	0.77	x	4.8	x	16.15	x	0.63	x	0.7	=	23.69	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	53.78	105.21	173.26	252.69	309.68	317.01	301.81	259.25	201.51	124.84	67.06	44.23	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	433.55	482.91	538.83	598.85	636.31	624.8	597.37	560.46	512.71	455.64	420.3	414.14	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.92	0.79	0.58	0.42	0.47	0.74	0.95	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.17	20.3	20.51	20.77	20.94	20.99	21	21	20.97	20.75	20.41	20.15	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.18	20.18	20.18	20.19	20.19	20.2	20.2	20.2	20.2	20.19	20.19	20.19	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.97	0.9	0.74	0.51	0.35	0.39	0.67	0.93	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.07	19.26	19.57	19.93	20.14	20.2	20.2	20.2	20.17	19.9	19.43	19.05	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.53	19.69	19.96	20.28	20.46	20.52	20.53	20.53	20.5	20.25	19.83	19.5	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	19.53	19.69	19.96	20.28	20.46	20.52	20.53	20.53	20.5	20.25	19.83	19.5	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.97	0.9	0.75	0.54	0.38	0.42	0.69	0.94	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	431.21	477.56	522.62	541.28	479.47	338.28	226.29	237.09	356.27	426.58	415.27	412.42	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	905	876.57	795.67	664.72	510.92	341.61	226.58	237.66	370.66	562.54	745.78	900.25	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	352.5	268.14	203.15	88.88	23.4	0	0	0	0	101.15	237.97	362.95	

Total per year (kWh/year) = Sum(98)1...5,9...12 = 1638.13 (98)

Space heating requirement in kWh/m²/year 24.45 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	352.5	268.14	203.15	88.88	23.4	0	0	0	0	101.15	237.97	362.95		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	377	286.78	217.27	95.06	25.03	0	0	0	0	108.18	254.51	388.18		
Total (kWh/year) =Sum(211)1...5,10...12=													1752.01	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)1...5,10...12=													0	(215)

Water heating

Output from water heater (calculated above)														
	186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09		
Efficiency of water heater													79.8	(216)
(217)m=	86.49	86.11	85.25	83.39	81.08	79.8	79.8	79.8	79.8	83.62	85.71	86.62		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	215.64	190.97	202.78	186.08	187.75	170.73	164.23	179.84	179.41	192.42	198.17	210.21		
Total = Sum(219a)1...12 =													2278.25	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1752.01

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Water heating fuel used			2278.25	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			324.5	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			4429.75	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	378.43	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	492.1	(264)
Space and water heating	(261) + (262) + (263) + (264) =			870.54	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	168.41	(268)
Total CO2, kg/year		sum of (265)…(271) =		1077.87	(272)

TER = 16.09 (273)

SAP Input

Property Details: Sample 6 (Mid)

Address:	
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	26 July 2019
Date of certificate:	15 June 2022
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	498

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2019	
Floor Location:	Floor area:	Storey height:
Floor 0	55.1 m²	3 m
Living area:	26 m² (fraction 0.472)	
Front of dwelling faces:	Unspecified	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
DOOR	Manufacturer	Solid			Wood
W	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Balcony	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
DOOR	mm	0.7	0	1.4	2.4	1
W		0.7	0.4	1	4.16	1
Balcony		0.7	0.4	1	4.8	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
DOOR		INT	Worst case	0	0
W		W	West	0	0
Balcony		W	West	0	0

Overshading: More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
W	24	8.96	15.04	0.15	0	False	N/A
INT	24	2.4	21.6	0.16	0.43	False	N/A
Spandrel	2.4	0	2.4	0.35	0	False	N/A
Internal Elements							
Party Elements							

Thermal bridges:

Thermal bridges: No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test: Yes (As designed)

SAP Input

Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	3
Pressure test:	3

Main heating system:

Main heating system:	Community heating schemes Heat source: Community boilers heat from boilers – mains gas, heat fraction 1, efficiency 95 Piping>=1991, pre-insulated, low temp, variable flow Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Boiler interlock: Yes

Main heating Control:

Main heating Control:	Charging system linked to use of community heating, programmer and TRVs Control code: 2306

Secondary heating system:

Secondary heating system:	None

Water heating:

Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Flue Gas Heat Recovery System: Database (rev 498, product index 060036) Brand name: Worcester Model: Greenstar Xtra Model qualifier: 2015 Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

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User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.5.51

Property Address: Sample 6 (Mid)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	55.1	(1a) x	3	(2a) =	165.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.1	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		165.3	(5)

2. Ventilation rate:

	main heating	secondary heating	other	total		m³ per hour	
Number of chimneys	0	+ 0	+ 0	= 0	x 40 =	0	(6a)
Number of open flues	0	+ 0	+ 0	= 0	x 20 =	0	(6b)
Number of intermittent fans				0	x 10 =	0	(7a)
Number of passive vents				0	x 10 =	0	(7b)
Number of flueless gas fires				0	x 40 =	0	(7c)

DRAFT

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0 ÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*		0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.05 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.25	0.25	0.25	0.23	0.23	0.22	0.22	0.21	0.22	0.23	0.24	0.24	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.25	0.25	0.25	0.23	0.23	0.22	0.22	0.21	0.22	0.23	0.24	0.24	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1.4	=	3.36			(26)
Windows Type 1			4.16	x	1/[1/(1)+ 0.04]	=	4			(27)
Windows Type 2			4.8	x	1/[1/(1)+ 0.04]	=	4.62			(27)
Walls Type1	24	8.96	15.04	x	0.15	=	2.26			(29)
Walls Type2	24	2.4	21.6	x	0.15	=	3.23			(29)
Walls Type3	2.4	0	2.4	x	0.35	=	0.84			(29)
Total area of elements, m²			50.4							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 18.3 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 546.56 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 7.56 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 25.86 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	13.8	13.64	13.48	12.69	12.53	11.74	11.74	11.58	12.06	12.53	12.85	13.17	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	39.66	39.51	39.35	38.55	38.4	37.6	37.6	37.44	37.92	38.4	38.71	39.03	

Average = Sum(39)$_{1…12}$ /12= 38.51 (39)

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Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

(40)m=	0.72	0.72	0.71	0.7	0.7	0.68	0.68	0.68	0.69	0.7	0.7	0.71

Average = Sum(40)$_{1...12}$ /12= 0.7 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 1.84 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 77.91 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	85.7	82.58	79.47	76.35	73.23	70.12	70.12	73.23	76.35	79.47	82.58	85.7	
											Total = Sum(44)$_{1...12}$ =	934.88	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	127.09	111.15	114.7	100	95.95	82.8	76.72	88.04	89.09	103.83	113.34	123.08	
											Total = Sum(45)$_{1...12}$ =	1225.78	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	19.06	16.67	17.2	15	14.39	12.42	11.51	13.21	13.36	15.57	17	18.46	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 0 (48)

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year — (48) x (49) = — 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a — 1.03 (52)

Temperature factor from Table 2b — 0.6 (53)

Energy lost from water storage, kWh/year — (47) x (51) x (52) x (53) = — 1.03 (54)

Enter (50) or (54) in (55) — 1.03 (55)

Water storage loss calculated for each month — ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	182.36	161.08	169.97	153.49	151.23	136.29	132	143.32	142.59	159.11	166.83	178.35	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	16.59	14.71	15.14	13.33	12.81	11.05	10.22	11.77	11.91	13.81	14.97	16.12	(63) (G2)

Output from water heater

(64)m=	163.1	143.95	152.16	137.57	135.73	122.64	119.09	128.87	128.08	142.61	149.26	159.55	

Output from water heater (annual)1…12 | 1682.61 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	86.48	76.9	82.36	76.04	76.12	70.32	69.73	73.5	72.42	78.74	80.48	85.14	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	15.29	13.58	11.05	8.36	6.25	5.28	5.7	7.41	9.95	12.63	14.74	15.72	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	160.44	162.11	157.91	148.98	137.71	127.11	120.03	118.37	122.56	131.49	142.77	153.36	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	(71)
Water heating gains (Table 5)													
(72)m=	116.23	114.43	110.7	105.62	102.32	97.67	93.73	98.78	100.58	105.84	111.78	114.44	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	342.57	340.73	330.26	313.56	296.88	280.66	270.06	275.17	283.69	300.57	319.89	334.13	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	4.16	x	19.64	x	0.4	x	0.7	=	15.85	(80)
West	0.9x	0.77	x	4.8	x	19.64	x	0.4	x	0.7	=	18.29	(80)
West	0.9x	0.77	x	4.16	x	38.42	x	0.4	x	0.7	=	31.01	(80)
West	0.9x	0.77	x	4.8	x	38.42	x	0.4	x	0.7	=	35.78	(80)

West	0.9x	0.77	x	4.16	x	63.27	x	0.4	x	0.7	=	51.07	(80)
West	0.9x	0.77	x	4.8	x	63.27	x	0.4	x	0.7	=	58.93	(80)
West	0.9x	0.77	x	4.16	x	92.28	x	0.4	x	0.7	=	74.49	(80)
West	0.9x	0.77	x	4.8	x	92.28	x	0.4	x	0.7	=	85.95	(80)
West	0.9x	0.77	x	4.16	x	113.09	x	0.4	x	0.7	=	91.29	(80)
West	0.9x	0.77	x	4.8	x	113.09	x	0.4	x	0.7	=	105.33	(80)
West	0.9x	0.77	x	4.16	x	115.77	x	0.4	x	0.7	=	93.45	(80)
West	0.9x	0.77	x	4.8	x	115.77	x	0.4	x	0.7	=	107.83	(80)
West	0.9x	0.77	x	4.16	x	110.22	x	0.4	x	0.7	=	88.97	(80)
West	0.9x	0.77	x	4.8	x	110.22	x	0.4	x	0.7	=	102.66	(80)
West	0.9x	0.77	x	4.16	x	94.68	x	0.4	x	0.7	=	76.42	(80)
West	0.9x	0.77	x	4.8	x	94.68	x	0.4	x	0.7	=	88.18	(80)
West	0.9x	0.77	x	4.16	x	73.59	x	0.4	x	0.7	=	59.4	(80)
West	0.9x	0.77	x	4.8	x	73.59	x	0.4	x	0.7	=	68.54	(80)
West	0.9x	0.77	x	4.16	x	45.59	x	0.4	x	0.7	=	36.8	(80)
West	0.9x	0.77	x	4.8	x	45.59	x	0.4	x	0.7	=	42.46	(80)
West	0.9x	0.77	x	4.16	x	24.49	x	0.4	x	0.7	=	19.77	(80)
West	0.9x	0.77	x	4.8	x	24.49	x	0.4	x	0.7	=	22.81	(80)
West	0.9x	0.77	x	4.16	x	16.15	x	0.4	x	0.7	=	13.04	(80)
West	0.9x	0.77	x	4.8	x	16.15	x	0.4	x	0.7	=	15.04	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	34.15	66.8	110.01	160.44	196.62	201.28	191.63	164.6	127.94	79.26	42.58	28.08	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	376.72	407.53	440.27	474	493.5	481.94	461.69	439.77	411.64	379.83	362.47	362.21	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.96	0.88	0.71	0.5	0.36	0.39	0.63	0.91	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.47	20.57	20.73	20.91	20.98	21	21	21	20.99	20.9	20.66	20.45	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.32	20.33	20.33	20.34	20.34	20.36	20.36	20.36	20.35	20.34	20.34	20.33	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.95	0.85	0.66	0.45	0.31	0.34	0.57	0.88	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.61	19.76	19.99	20.24	20.33	20.36	20.36	20.36	20.35	20.23	19.91	19.6	(90)

fLA = Living area ÷ (4) = | 0.47 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	20.02	20.14	20.34	20.55	20.64	20.66	20.66	20.66	20.65	20.55	20.26	20	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	20.02	20.14	20.34	20.55	20.64	20.66	20.66	20.66	20.65	20.55	20.26	20	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.95	0.86	0.68	0.47	0.33	0.36	0.6	0.89	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	373.14	400.08	419.69	407.11	336.37	227.49	152.65	159.53	246.46	336.79	354.14	359.47	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	623.38	602.1	544.52	449.25	343.17	227.85	152.67	159.56	248.48	381.89	509.64	616.78	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	186.18	135.75	92.87	30.34	5.06	0	0	0	0	33.55	111.96	191.44	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 787.15 (98)

Space heating requirement in kWh/m²/year 14.29 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers		1	(303a)
Fraction of total space heat from Community boilers	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		787.15	
Space heat from Community boilers	(98) x (304a) x (305) x (306) =	826.51	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		1682.61	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	1766.74	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	25.93	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		98.31	(330a)

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warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	98.31	(331)
Energy for lighting (calculated in Appendix L)		270.05	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		2961.62	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				95	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.22	=	589.62	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	13.46	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	603.08	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				603.08	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	51.02	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	140.16	(379)
Total CO2, kg/year	sum of (376)…(382) =				794.26	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				14.41	(384)
EI rating (section 14)					89.37	(385)

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User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.5.51

Property Address: Sample 6 (Mid)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	55.1	(1a) x	3	(2a) =	165.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.1	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	165.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

DRAFT

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.12	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.37	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.29	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.37	0.36	0.35	0.32	0.31	0.27	0.27	0.27	0.29	0.31	0.32	0.34

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.56	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.56	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1	=	2.4			(26)
Windows Type 1			4.16	x1/[1/(1.4)+ 0.04]		=	5.52			(27)
Windows Type 2			4.8	x1/[1/(1.4)+ 0.04]		=	6.36			(27)
Walls Type1	24	8.96	15.04	x	0.18	=	2.71			(29)
Walls Type2	24	2.4	21.6	x	0.18	=	3.89			(29)
Walls Type3	2.4	0	2.4	x	0.18	=	0.43			(29)
Total area of elements, m²			50.4							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 21.31 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 546.56 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 2.52 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 23.83 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	30.94	30.8	30.66	30	29.88	29.31	29.31	29.2	29.53	29.88	30.13	30.39	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	54.77	54.62	54.48	53.83	53.71	53.14	53.14	53.03	53.36	53.71	53.95	54.21	

Average = Sum(39)1…12 /12= 53.83 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.99	0.99	0.99	0.98	0.97	0.96	0.96	0.96	0.97	0.97	0.98	0.98

Average = Sum(40)$_{1…12}$ /12= 0.98 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.84 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 77.91 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	85.7	82.58	79.47	76.35	73.23	70.12	70.12	73.23	76.35	79.47	82.58	85.7	
										Total = Sum(44)$_{1…12}$ =		934.88	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	127.09	111.15	114.7	100	95.95	82.8	76.72	88.04	89.09	103.83	113.34	123.08	
										Total = Sum(45)$_{1…12}$ =		1225.78	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	19.06	16.67	17.2	15	14.39	12.42	11.51	13.21	13.36	15.57	17	18.46	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	173.68	153.24	161.29	145.09	142.54	127.89	123.32	134.64	134.18	150.42	158.43	169.67	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	173.68	153.24	161.29	145.09	142.54	127.89	123.32	134.64	134.18	150.42	158.43	169.67	

Output from water heater (annual)$_{1...12}$ | 1774.4 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	79.53	70.63	75.41	69.32	69.18	63.6	62.79	66.55	65.7	71.8	73.76	78.2	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	14.88	13.21	10.74	8.13	6.08	5.13	5.55	7.21	9.68	12.29	14.34	15.29	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	160.44	162.11	157.91	148.98	137.71	127.11	120.03	118.37	122.56	131.49	142.77	153.36	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	(71)
Water heating gains (Table 5)													
(72)m=	106.9	105.1	101.36	96.28	92.98	88.34	84.39	89.45	91.25	96.5	102.44	105.11	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	335.82	334.02	323.62	307	290.37	274.19	263.57	268.63	277.09	293.89	313.16	327.36	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	4.16	x	19.64	x	0.63	x	0.7	=	24.97	(80)
West	0.9x	0.77	x	4.8	x	19.64	x	0.63	x	0.7	=	28.81	(80)
West	0.9x	0.77	x	4.16	x	38.42	x	0.63	x	0.7	=	48.85	(80)
West	0.9x	0.77	x	4.8	x	38.42	x	0.63	x	0.7	=	56.36	(80)

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West	0.9x	0.77	x	4.16	x	63.27	x	0.63	x	0.7	=	80.44	(80)
West	0.9x	0.77	x	4.8	x	63.27	x	0.63	x	0.7	=	92.82	(80)
West	0.9x	0.77	x	4.16	x	92.28	x	0.63	x	0.7	=	117.32	(80)
West	0.9x	0.77	x	4.8	x	92.28	x	0.63	x	0.7	=	135.37	(80)
West	0.9x	0.77	x	4.16	x	113.09	x	0.63	x	0.7	=	143.78	(80)
West	0.9x	0.77	x	4.8	x	113.09	x	0.63	x	0.7	=	165.9	(80)
West	0.9x	0.77	x	4.16	x	115.77	x	0.63	x	0.7	=	147.18	(80)
West	0.9x	0.77	x	4.8	x	115.77	x	0.63	x	0.7	=	169.83	(80)
West	0.9x	0.77	x	4.16	x	110.22	x	0.63	x	0.7	=	140.13	(80)
West	0.9x	0.77	x	4.8	x	110.22	x	0.63	x	0.7	=	161.68	(80)
West	0.9x	0.77	x	4.16	x	94.68	x	0.63	x	0.7	=	120.37	(80)
West	0.9x	0.77	x	4.8	x	94.68	x	0.63	x	0.7	=	138.88	(80)
West	0.9x	0.77	x	4.16	x	73.59	x	0.63	x	0.7	=	93.56	(80)
West	0.9x	0.77	x	4.8	x	73.59	x	0.63	x	0.7	=	107.95	(80)
West	0.9x	0.77	x	4.16	x	45.59	x	0.63	x	0.7	=	57.96	(80)
West	0.9x	0.77	x	4.8	x	45.59	x	0.63	x	0.7	=	66.88	(80)
West	0.9x	0.77	x	4.16	x	24.49	x	0.63	x	0.7	=	31.13	(80)
West	0.9x	0.77	x	4.8	x	24.49	x	0.63	x	0.7	=	35.92	(80)
West	0.9x	0.77	x	4.16	x	16.15	x	0.63	x	0.7	=	20.53	(80)
West	0.9x	0.77	x	4.8	x	16.15	x	0.63	x	0.7	=	23.69	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	53.78	105.21	173.26	252.69	309.68	317.01	301.81	259.25	201.51	124.84	67.06	44.23	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	389.6	439.23	496.88	559.69	600.05	591.2	565.38	527.88	478.6	418.73	380.21	371.59	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) — 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.97	0.91	0.76	0.57	0.41	0.46	0.72	0.94	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.08	20.22	20.46	20.75	20.93	20.99	21	21	20.96	20.71	20.34	20.05	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.09	20.09	20.09	20.1	20.1	20.11	20.11	20.11	20.11	20.1	20.1	20.1	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.96	0.88	0.71	0.49	0.33	0.37	0.65	0.92	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.86	19.07	19.42	19.82	20.04	20.11	20.11	20.11	20.08	19.78	19.26	18.83	(90)

fLA = Living area ÷ (4) = 0.47 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.43	19.61	19.91	20.26	20.46	20.52	20.53	20.53	20.5	20.22	19.77	19.41	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	19.43	19.61	19.91	20.26	20.46	20.52	20.53	20.53	20.5	20.22	19.77	19.41	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.96	0.89	0.73	0.53	0.37	0.41	0.68	0.93	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	386.7	432.64	477.65	496.15	439.3	310.88	208.45	218.27	325.84	387.47	374.24	369.41	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	828.86	803.71	730.67	611.38	470.37	314.73	208.86	219.05	341.26	516.76	683.63	824.36	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	328.97	249.36	188.25	82.96	23.12	0	0	0	0	96.19	222.76	338.48	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1530.08 (98)

Space heating requirement in kWh/m²/year 27.77 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	328.97	249.36	188.25	82.96	23.12	0	0	0	0	96.19	222.76	338.48	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	351.83	266.69	201.34	88.73	24.72	0	0	0	0	102.88	238.25	362.01	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1636.45 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

Water heating

Output from water heater (calculated above)

	173.68	153.24	161.29	145.09	142.54	127.89	123.32	134.64	134.18	150.42	158.43	169.67	
Efficiency of water heater												79.8	(216)
(217)m=	86.49	86.11	85.23	83.39	81.14	79.8	79.8	79.8	79.8	83.66	85.72	86.62	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	200.81	177.96	189.25	173.99	175.68	160.26	154.53	168.72	168.15	179.81	184.82	195.88

Total = Sum(219a)$_{1...12}$ = 2129.86 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1636.45

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Water heating fuel used			2129.86	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			262.71	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			4104.02	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	353.47	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	460.05	(264)
Space and water heating	(261) + (262) + (263) + (264) =			813.52	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	136.34	(268)
Total CO2, kg/year		sum of (265)…(271) =		988.79	(272)

TER = 17.95 (273)

SAP Input

Property Details: Sample 1 (Bottom)

Address:	
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	26 July 2019
Date of certificate:	15 June 2022
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	498

Property description:

Dwelling type:	Flat
Detachment:	
Year Completed:	2022

Floor Location:	Floor area:	Storey height:
Floor 0	66.25 m²	3 m

Living area:	27.2 m² (fraction 0.411)
Front of dwelling faces:	Unspecified

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
DOOR	Manufacturer	Solid			Wood
Balcony	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
N	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
E	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
DOOR	mm	0.7	0	1.4	2.4	1
Balcony		0.7	0.4	1	4.8	1
N		0.7	0.4	1	5.44	1
E		0.7	0.4	1	1.44	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
DOOR		INT	Worst case	0	0
Balcony		N	North	0	0
N		N	North	0	0
E		E	East	0	0

Overshading: Heavy

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
N	10.24	10.24	0	0.15	0	False	N/A
E	1.44	1.44	0	0.15	0	False	N/A
INT	13.2	2.4	10.8	0.16	0.43	False	N/A
Spandrel	2.4	0	2.4	0.35	0	False	N/A
Floor	66.25			0.11			N/A
Internal Elements							
Party Elements							

SAP Input

Thermal bridges:

Thermal bridges:	No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	3

Main heating system:

Main heating system:	Community heating schemes Heat source: Community boilers heat from boilers – mains gas, heat fraction 1, efficiency 95 Piping>=1991, pre-insulated, low temp, variable flow Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Boiler interlock: Yes

Main heating Control:

Main heating Control:	Charging system linked to use of community heating, programmer and TRVs Control code: 2306

Secondary heating system:

Secondary heating system:	None

Water heating:

Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Flue Gas Heat Recovery System: Database (rev 498, product index 060036) Brand name: Worcester Model: Greenstar Xtra Model qualifier: 2015 Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

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User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.5.51

Property Address: Sample 1 (Bottom)

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	66.25	(1a)	x	3	(2a)	=	198.75	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.25	(4)						
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	=	198.75	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	79.05	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1.4	=	3.36			(26)
Windows Type 1			4.8	x	1/[1/(1)+ 0.04]	=	4.62			(27)
Windows Type 2			5.44	x	1/[1/(1)+ 0.04]	=	5.23			(27)
Windows Type 3			1.44	x	1/[1/(1)+ 0.04]	=	1.38			(27)
Floor			66.25	x	0.11	=	7.2875			(28)
Walls Type1	10.24	10.24	0	x	0.15	=	0			(29)
Walls Type2	1.44	1.44	0	x	0.15	=	0			(29)
Walls Type3	13.2	2.4	10.8	x	0.15	=	1.62			(29)
Walls Type4	2.4	0	2.4	x	0.35	=	0.84			(29)
Total area of elements, m²			93.53							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	24.34	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	5153.55	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		14.03	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	38.36	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(38)m=	17.53	17.32	17.11	16.07	15.86	14.81	14.81	14.61	15.23	15.86	16.28	16.7	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	55.9	55.69	55.48	54.43	54.22	53.18	53.18	52.97	53.6	54.22	54.64	55.06	

Average = Sum(39)$_{1...12}$ /12= 54.38 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.84	0.84	0.84	0.82	0.82	0.8	0.8	0.8	0.81	0.82	0.82	0.83	

Average = Sum(40)$_{1...12}$ /12= 0.82 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.15 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.3 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	93.83	90.42	87.01	83.6	80.19	76.77	76.77	80.19	83.6	87.01	90.42	93.83

Total = Sum(44)$_{1...12}$ = 1023.65 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.15	121.71	125.59	109.49	105.06	90.66	84.01	96.4	97.55	113.69	124.1	134.76

Total = Sum(45)$_{1...12}$ = 1342.17 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.87	18.26	18.84	16.42	15.76	13.6	12.6	14.46	14.63	17.05	18.61	20.21	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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Primary circuit loss (annual) from Table 3	0	(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	194.43	171.63	180.87	162.99	160.34	144.15	139.29	151.68	151.05	168.96	177.59	190.04	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	17.95	15.96	16.41	14.51	13.96	12.12	11.22	12.87	13.02	15.02	16.24	17.46	(63) (G2)

Output from water heater

(64)m=	173.8	153.25	161.77	145.88	143.69	129.44	125.38	136.13	135.43	151.27	158.76	169.9	

Output from water heater (annual)$_{1...12}$ 1784.71 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	90.49	80.41	85.98	79.2	79.15	72.94	72.15	76.27	75.23	82.02	84.06	89.03	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.65	15.68	12.75	9.65	7.22	6.09	6.58	8.56	11.48	14.58	17.02	18.14	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	188.39	190.35	185.42	174.93	161.69	149.25	140.94	138.98	143.91	154.4	167.64	180.08	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	(71)

Water heating gains (Table 5)

(72)m=	121.63	119.66	115.56	110	106.39	101.3	96.98	102.52	104.49	110.25	116.75	119.66	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	382.95	380.96	369.01	349.86	330.58	311.92	299.78	305.34	315.16	334.5	356.68	373.16	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	4.8	x	10.63	x	0.4	x	0.7	=	9.9	(74)

North	0.9x	0.77	x	5.44	x	10.63	x	0.4	x	0.7	=	11.22	(74)
North	0.9x	0.77	x	4.8	x	20.32	x	0.4	x	0.7	=	18.93	(74)
North	0.9x	0.77	x	5.44	x	20.32	x	0.4	x	0.7	=	21.45	(74)
North	0.9x	0.77	x	4.8	x	34.53	x	0.4	x	0.7	=	32.16	(74)
North	0.9x	0.77	x	5.44	x	34.53	x	0.4	x	0.7	=	36.45	(74)
North	0.9x	0.77	x	4.8	x	55.46	x	0.4	x	0.7	=	51.66	(74)
North	0.9x	0.77	x	5.44	x	55.46	x	0.4	x	0.7	=	58.55	(74)
North	0.9x	0.77	x	4.8	x	74.72	x	0.4	x	0.7	=	69.59	(74)
North	0.9x	0.77	x	5.44	x	74.72	x	0.4	x	0.7	=	78.87	(74)
North	0.9x	0.77	x	4.8	x	79.99	x	0.4	x	0.7	=	74.5	(74)
North	0.9x	0.77	x	5.44	x	79.99	x	0.4	x	0.7	=	84.43	(74)
North	0.9x	0.77	x	4.8	x	74.68	x	0.4	x	0.7	=	69.55	(74)
North	0.9x	0.77	x	5.44	x	74.68	x	0.4	x	0.7	=	78.83	(74)
North	0.9x	0.77	x	4.8	x	59.25	x	0.4	x	0.7	=	55.18	(74)
North	0.9x	0.77	x	5.44	x	59.25	x	0.4	x	0.7	=	62.54	(74)
North	0.9x	0.77	x	4.8	x	41.52	x	0.4	x	0.7	=	38.67	(74)
North	0.9x	0.77	x	5.44	x	41.52	x	0.4	x	0.7	=	43.82	(74)
North	0.9x	0.77	x	4.8	x	24.19	x	0.4	x	0.7	=	22.53	(74)
North	0.9x	0.77	x	5.44	x	24.19	x	0.4	x	0.7	=	25.53	(74)
North	0.9x	0.77	x	4.8	x	13.12	x	0.4	x	0.7	=	12.22	(74)
North	0.9x	0.77	x	5.44	x	13.12	x	0.4	x	0.7	=	13.85	(74)
North	0.9x	0.77	x	4.8	x	8.86	x	0.4	x	0.7	=	8.26	(74)
North	0.9x	0.77	x	5.44	x	8.86	x	0.4	x	0.7	=	9.36	(74)
East	0.9x	0.77	x	1.44	x	19.64	x	0.4	x	0.7	=	5.49	(76)
East	0.9x	0.77	x	1.44	x	38.42	x	0.4	x	0.7	=	10.74	(76)
East	0.9x	0.77	x	1.44	x	63.27	x	0.4	x	0.7	=	17.68	(76)
East	0.9x	0.77	x	1.44	x	92.28	x	0.4	x	0.7	=	25.78	(76)
East	0.9x	0.77	x	1.44	x	113.09	x	0.4	x	0.7	=	31.6	(76)
East	0.9x	0.77	x	1.44	x	115.77	x	0.4	x	0.7	=	32.35	(76)
East	0.9x	0.77	x	1.44	x	110.22	x	0.4	x	0.7	=	30.8	(76)
East	0.9x	0.77	x	1.44	x	94.68	x	0.4	x	0.7	=	26.45	(76)
East	0.9x	0.77	x	1.44	x	73.59	x	0.4	x	0.7	=	20.56	(76)
East	0.9x	0.77	x	1.44	x	45.59	x	0.4	x	0.7	=	12.74	(76)
East	0.9x	0.77	x	1.44	x	24.49	x	0.4	x	0.7	=	6.84	(76)
East	0.9x	0.77	x	1.44	x	16.15	x	0.4	x	0.7	=	4.51	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	26.62	51.11	86.29	135.99	180.06	191.28	179.18	144.17	103.05	60.8	32.91	22.13	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	409.56	432.07	455.3	485.85	510.63	503.2	478.96	449.51	418.21	395.3	389.59	395.29	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(86)m=	1	1	0.99	0.96	0.86	0.66	0.49	0.54	0.81	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.21	20.3	20.47	20.71	20.9	20.99	21	21	20.95	20.73	20.44	20.2	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.22	20.22	20.22	20.23	20.24	20.25	20.25	20.25	20.25	20.24	20.23	20.23	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.95	0.82	0.59	0.4	0.45	0.75	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.16	19.29	19.53	19.89	20.14	20.24	20.25	20.25	20.21	19.92	19.5	19.15	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.59	19.7	19.92	20.23	20.46	20.55	20.56	20.56	20.51	20.25	19.89	19.58	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.59	19.7	19.92	20.23	20.46	20.55	20.56	20.56	20.51	20.25	19.89	19.58	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.95	0.84	0.62	0.44	0.49	0.77	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	407.75	428.97	447.98	460.55	426.73	311.12	210.01	219.38	322.79	378.38	385.92	393.87	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	854.66	824.31	744.35	616.55	474.78	316.34	210.46	220.27	343.8	523.3	698.67	846.93	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	332.5	265.66	220.5	112.32	35.75	0	0	0	0	107.82	225.18	337.08	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 1636.82 (98)

Space heating requirement in kWh/m²/year 24.71 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none 0 (301)

Fraction of space heat from community system 1 – (301) = 1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers 1 (303a)

Fraction of total space heat from Community boilers (302) x (303a) = 1 (304a)

Factor for control and charging method (Table 4c(3)) for community heating system 1 (305)

Distribution loss factor (Table 12c) for community heating system 1.05 (306)

Space heating **kWh/year**

Annual space heating requirement 1636.82

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Space heat from Community boilers	(98) x (304a) x (305) x (306) =	1718.66	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)

Water heating

Annual water heating requirement		1784.71	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	1873.94	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	35.93	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		118.21	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	118.21	(331)
Energy for lighting (calculated in Appendix L)		311.73	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		4022.53	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				95	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.22	=	816.84	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	18.65	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	835.49	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				835.49	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	61.35	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	161.79	(379)
Total CO2, kg/year	sum of (376)…(382) =				1058.63	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				15.98	(384)
EI rating (section 14)					87.25	(385)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.5.51

Property Address: Sample 1 (Bottom)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	66.25	(1a) x	3	(2a) =	198.75	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.25	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	198.75	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.1	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.35	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.37	0.37	0.33	0.32	0.28	0.28	0.28	0.3	0.32	0.34	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	0	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1	=	2.4			(26)
Windows Type 1			4.8	x1/[1/(1.4)+ 0.04]		=	6.36			(27)
Windows Type 2			5.44	x1/[1/(1.4)+ 0.04]		=	7.21			(27)
Windows Type 3			1.44	x1/[1/(1.4)+ 0.04]		=	1.91			(27)
Floor			66.25	x	0.13	=	8.612499			(28)
Walls Type1	10.24	10.24	0	x	0.18	=	0			(29)
Walls Type2	1.44	1.44	0	x	0.18	=	0			(29)
Walls Type3	13.2	2.4	10.8	x	0.18	=	1.94			(29)
Walls Type4	2.4	0	2.4	x	0.18	=	0.43			(29)
Total area of elements, m²			93.53							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	28.87	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	5153.55	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		4.68	(36)
if details of thermal bridging are not known (36) = 0.05 x (31)			
Total fabric heat loss	(33) + (36) =	33.55	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

(38)m=	37.53	37.35	37.16	36.32	36.16	35.42	35.42	35.29	35.71	36.16	36.48	36.82	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	71.08	70.89	70.71	69.87	69.71	68.97	68.97	68.84	69.26	69.71	70.03	70.37	

Average = Sum(39)$_{1...12}$ /12= 69.87 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.07	1.07	1.07	1.05	1.05	1.04	1.04	1.04	1.05	1.05	1.06	1.06	

Average = Sum(40)$_{1...12}$ /12= 1.05 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.15 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.3 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	93.83	90.42	87.01	83.6	80.19	76.77	76.77	80.19	83.6	87.01	90.42	93.83	

Total = Sum(44)$_{1...12}$ = 1023.65 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.15	121.71	125.59	109.49	105.06	90.66	84.01	96.4	97.55	113.69	124.1	134.76	

Total = Sum(45)$_{1...12}$ = 1342.17 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.87	18.26	18.84	16.42	15.76	13.6	12.6	14.46	14.63	17.05	18.61	20.21	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	185.75	163.79	172.18	154.58	151.65	135.75	130.6	143	142.64	160.28	169.19	181.36	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	185.75	163.79	172.18	154.58	151.65	135.75	130.6	143	142.64	160.28	169.19	181.36	

Output from water heater (annual)$_{1...12}$ | 1890.79 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	83.54	74.14	79.03	72.48	72.21	66.22	65.21	69.33	68.51	75.08	77.34	82.08	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.21	15.29	12.43	9.41	7.04	5.94	6.42	8.34	11.2	14.22	16.59	17.69	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	188.39	190.35	185.42	174.93	161.69	149.25	140.94	138.98	143.91	154.4	167.64	180.08	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	(71)

Water heating gains (Table 5)

(72)m=	112.29	110.32	106.23	100.67	97.05	91.97	87.65	93.18	95.15	100.91	107.41	110.33	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	376.17	374.23	362.36	343.29	324.06	305.44	293.28	298.79	308.54	327.8	349.92	366.38	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	4.8	x	10.63	x	0.63	x	0.7	=	15.6	(74)

North	0.9x	0.77	x	5.44	x	10.63	x	0.63	x	0.7	=	17.68	(74)
North	0.9x	0.77	x	4.8	x	20.32	x	0.63	x	0.7	=	29.81	(74)
North	0.9x	0.77	x	5.44	x	20.32	x	0.63	x	0.7	=	33.78	(74)
North	0.9x	0.77	x	4.8	x	34.53	x	0.63	x	0.7	=	50.65	(74)
North	0.9x	0.77	x	5.44	x	34.53	x	0.63	x	0.7	=	57.41	(74)
North	0.9x	0.77	x	4.8	x	55.46	x	0.63	x	0.7	=	81.36	(74)
North	0.9x	0.77	x	5.44	x	55.46	x	0.63	x	0.7	=	92.21	(74)
North	0.9x	0.77	x	4.8	x	74.72	x	0.63	x	0.7	=	109.6	(74)
North	0.9x	0.77	x	5.44	x	74.72	x	0.63	x	0.7	=	124.22	(74)
North	0.9x	0.77	x	4.8	x	79.99	x	0.63	x	0.7	=	117.33	(74)
North	0.9x	0.77	x	5.44	x	79.99	x	0.63	x	0.7	=	132.98	(74)
North	0.9x	0.77	x	4.8	x	74.68	x	0.63	x	0.7	=	109.55	(74)
North	0.9x	0.77	x	5.44	x	74.68	x	0.63	x	0.7	=	124.15	(74)
North	0.9x	0.77	x	4.8	x	59.25	x	0.63	x	0.7	=	86.91	(74)
North	0.9x	0.77	x	5.44	x	59.25	x	0.63	x	0.7	=	98.5	(74)
North	0.9x	0.77	x	4.8	x	41.52	x	0.63	x	0.7	=	60.9	(74)
North	0.9x	0.77	x	5.44	x	41.52	x	0.63	x	0.7	=	69.02	(74)
North	0.9x	0.77	x	4.8	x	24.19	x	0.63	x	0.7	=	35.48	(74)
North	0.9x	0.77	x	5.44	x	24.19	x	0.63	x	0.7	=	40.22	(74)
North	0.9x	0.77	x	4.8	x	13.12	x	0.63	x	0.7	=	19.24	(74)
North	0.9x	0.77	x	5.44	x	13.12	x	0.63	x	0.7	=	21.81	(74)
North	0.9x	0.77	x	4.8	x	8.86	x	0.63	x	0.7	=	13	(74)
North	0.9x	0.77	x	5.44	x	8.86	x	0.63	x	0.7	=	14.74	(74)
East	0.9x	0.77	x	1.44	x	19.64	x	0.63	x	0.7	=	8.64	(76)
East	0.9x	0.77	x	1.44	x	38.42	x	0.63	x	0.7	=	16.91	(76)
East	0.9x	0.77	x	1.44	x	63.27	x	0.63	x	0.7	=	27.85	(76)
East	0.9x	0.77	x	1.44	x	92.28	x	0.63	x	0.7	=	40.61	(76)
East	0.9x	0.77	x	1.44	x	113.09	x	0.63	x	0.7	=	49.77	(76)
East	0.9x	0.77	x	1.44	x	115.77	x	0.63	x	0.7	=	50.95	(76)
East	0.9x	0.77	x	1.44	x	110.22	x	0.63	x	0.7	=	48.51	(76)
East	0.9x	0.77	x	1.44	x	94.68	x	0.63	x	0.7	=	41.67	(76)
East	0.9x	0.77	x	1.44	x	73.59	x	0.63	x	0.7	=	32.39	(76)
East	0.9x	0.77	x	1.44	x	45.59	x	0.63	x	0.7	=	20.06	(76)
East	0.9x	0.77	x	1.44	x	24.49	x	0.63	x	0.7	=	10.78	(76)
East	0.9x	0.77	x	1.44	x	16.15	x	0.63	x	0.7	=	7.11	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	41.92	80.5	135.91	214.19	283.59	301.26	282.2	227.08	162.31	95.76	51.83	34.85	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	418.09	454.73	498.27	557.47	607.65	606.7	575.48	525.86	470.85	423.57	401.75	401.22	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

(86)m=	1	1	0.99	0.96	0.87	0.69	0.52	0.59	0.85	0.98	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.89	20.01	20.23	20.55	20.83	20.96	20.99	20.99	20.89	20.55	20.17	19.87	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.02	20.03	20.03	20.04	20.04	20.05	20.05	20.05	20.05	20.04	20.04	20.03	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.95	0.82	0.6	0.41	0.47	0.78	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.55	18.72	19.05	19.51	19.87	20.03	20.05	20.05	19.95	19.51	18.97	18.53	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.1	19.25	19.53	19.94	20.26	20.41	20.44	20.43	20.34	19.94	19.46	19.08	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.1	19.25	19.53	19.94	20.26	20.41	20.44	20.43	20.34	19.94	19.46	19.08	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.94	0.84	0.64	0.46	0.52	0.81	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	416.22	451.26	489.5	526.74	508.08	385.54	262.46	273.52	379.46	408.05	398.26	399.77	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1051.94	1017.23	921.65	771.19	596.93	400.82	264.54	277.6	432	651.01	865.64	1046.97	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	472.98	380.33	321.52	176	66.1	0	0	0	0	180.77	336.52	481.52	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 2415.73 (98)

Space heating requirement in kWh/m²/year 36.46 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	472.98	380.33	321.52	176	66.1	0	0	0	0	180.77	336.52	481.52	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	505.86	406.77	343.87	188.24	70.7	0	0	0	0	193.34	359.91	514.99	

Total (kWh/year) =$Sum(211)_{1...5,10...12}$= 2583.67 (211)

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Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

Water heating

Output from water heater (calculated above)

185.75	163.79	172.18	154.58	151.65	135.75	130.6	143	142.64	160.28	169.19	181.36

Efficiency of water heater 79.8 (216)

(217)m=	87.2	86.99	86.46	85.16	82.77	79.8	79.8	79.8	79.8	85.14	86.61	87.3	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	213.01	188.29	199.16	181.52	183.22	170.11	163.66	179.19	178.75	188.27	195.34	207.75

Total = Sum(219a)$_{1...12}$ = 2248.27 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2583.67	
Water heating fuel used		2248.27	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	75	(231)
Electricity for lighting		303.98	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		5210.92	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	558.07	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	485.63	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1043.7	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	157.76	(268)
Total CO2, kg/year		sum of (265)…(271) =		1240.39	(272)

TER = 18.72 (273)

SAP Input

Property Details: Sample 2 (Bottom)

Address:	
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	26 July 2019
Date of certificate:	15 June 2022
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	498

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2022	
Floor Location:	Floor area:	Storey height:
Floor 0	66.25 m²	3 m
Living area:	27.2 m² (fraction 0.411)	
Front of dwelling faces:	Unspecified	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
DOOR	Manufacturer	Solid			Wood
W	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
N	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Balcony	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
DOOR	mm	0.7	0	1.4	2.4	1
W		0.7	0.4	1	1.44	1
N		0.7	0.4	1	10.24	1
Balcony		0.7	0.4	1	4.8	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
DOOR		INT	Worst case	0	0
W		W	West	0	0
N		N	North	0	0
Balcony		N	North	0	0

Overshading: More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
N	31.8	15.04	16.76	0.15	0	False	N/A
W	18.75	1.44	17.31	0.15	0	False	N/A
INT	11.1	2.4	8.7	0.16	0.43	False	N/A
Spandrel	2.4	0	2.4	0.35	0	False	N/A
Exposed	66.25			0.11			N/A
Internal Elements							
Party Elements							

SAP Input

Thermal bridges:	
Thermal bridges:	No information on thermal bridging (y=0.15) (y =0.15)
Ventilation:	
Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	3
Main heating system:	
Main heating system:	Community heating schemes Heat source: Community boilers heat from boilers – mains gas, heat fraction 1, efficiency 95 Piping>=1991, pre-insulated, low temp, variable flow Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Boiler interlock: Yes
Main heating Control:	
Main heating Control:	Charging system linked to use of community heating, programmer and TRVs Control code: 2306
Secondary heating system:	
Secondary heating system:	None
Water heating:	
Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Flue Gas Heat Recovery System: Database (rev 498, product index 060036) Brand name: Worcester Model: Greenstar Xtra Model qualifier: 2015 Solar panel: False
Others:	
Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Sample 2 (Bottom)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	66.25	(1a) x	3	(2a) =	198.75	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.25	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		198.75	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.05 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1.4	=	3.36			(26)
Windows Type 1			1.44	x	1/[1/(1)+ 0.04]	=	1.38			(27)
Windows Type 2			10.24	x	1/[1/(1)+ 0.04]	=	9.85			(27)
Windows Type 3			4.8	x	1/[1/(1)+ 0.04]	=	4.62			(27)
Floor			66.25	x	0.11	=	7.2875			(28)
Walls Type1	31.8	15.04	16.76	x	0.15	=	2.51			(29)
Walls Type2	18.75	1.44	17.31	x	0.15	=	2.6			(29)
Walls Type3	11.1	2.4	8.7	x	0.15	=	1.3			(29)
Walls Type4	2.4	0	2.4	x	0.35	=	0.84			(29)
Total area of elements, m²			130.3							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 33.75 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5601.13 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.55 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 53.29 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(38)m=	17.53	17.32	17.11	16.07	15.86	14.81	14.81	14.61	15.23	15.86	16.28	16.7	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	70.82	70.61	70.41	69.36	69.15	68.11	68.11	67.9	68.52	69.15	69.57	69.99	

Average = Sum(39)$_{1...12}$ /12= 69.31 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.07	1.07	1.06	1.05	1.04	1.03	1.03	1.02	1.03	1.04	1.05	1.06	

Average = Sum(40)$_{1...12}$ /12= 1.05 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.15 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.3 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	93.83	90.42	87.01	83.6	80.19	76.77	76.77	80.19	83.6	87.01	90.42	93.83	

Total = Sum(44)$_{1...12}$ = 1023.65 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.15	121.71	125.59	109.49	105.06	90.66	84.01	96.4	97.55	113.69	124.1	134.76	

Total = Sum(45)$_{1...12}$ = 1342.17 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.87	18.26	18.84	16.42	15.76	13.6	12.6	14.46	14.63	17.05	18.61	20.21	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	194.43	171.63	180.87	162.99	160.34	144.15	139.29	151.68	151.05	168.96	177.59	190.04	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	17.95	15.96	16.41	14.51	13.96	12.12	11.22	12.87	13.02	15.02	16.24	17.46	(63) (G2)

Output from water heater

(64)m=	173.8	153.25	161.77	145.88	143.69	129.44	125.38	136.13	135.43	151.27	158.76	169.9	

Output from water heater (annual)1…12 — 1784.71 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	90.49	80.41	85.98	79.2	79.15	72.94	72.15	76.27	75.23	82.02	84.06	89.03	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	16.81	14.93	12.14	9.19	6.87	5.8	6.27	8.15	10.93	13.88	16.2	17.27	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	188.39	190.35	185.42	174.93	161.69	149.25	140.94	138.98	143.91	154.4	167.64	180.08	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	(71)
Water heating gains (Table 5)													
(72)m=	121.63	119.66	115.56	110	106.39	101.3	96.98	102.52	104.49	110.25	116.75	119.66	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	382.1	380.21	368.4	349.4	330.23	311.63	299.46	304.93	314.61	333.8	355.86	372.29	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	10.24	x	10.63	x	0.4	x	0.7	=	21.13	(74)

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North	0.9x	0.77	x	4.8	x	10.63	x	0.4	x	0.7	=	9.9	(74)
North	0.9x	0.77	x	10.24	x	20.32	x	0.4	x	0.7	=	40.38	(74)
North	0.9x	0.77	x	4.8	x	20.32	x	0.4	x	0.7	=	18.93	(74)
North	0.9x	0.77	x	10.24	x	34.53	x	0.4	x	0.7	=	68.61	(74)
North	0.9x	0.77	x	4.8	x	34.53	x	0.4	x	0.7	=	32.16	(74)
North	0.9x	0.77	x	10.24	x	55.46	x	0.4	x	0.7	=	110.21	(74)
North	0.9x	0.77	x	4.8	x	55.46	x	0.4	x	0.7	=	51.66	(74)
North	0.9x	0.77	x	10.24	x	74.72	x	0.4	x	0.7	=	148.46	(74)
North	0.9x	0.77	x	4.8	x	74.72	x	0.4	x	0.7	=	69.59	(74)
North	0.9x	0.77	x	10.24	x	79.99	x	0.4	x	0.7	=	158.93	(74)
North	0.9x	0.77	x	4.8	x	79.99	x	0.4	x	0.7	=	74.5	(74)
North	0.9x	0.77	x	10.24	x	74.68	x	0.4	x	0.7	=	148.38	(74)
North	0.9x	0.77	x	4.8	x	74.68	x	0.4	x	0.7	=	69.55	(74)
North	0.9x	0.77	x	10.24	x	59.25	x	0.4	x	0.7	=	117.72	(74)
North	0.9x	0.77	x	4.8	x	59.25	x	0.4	x	0.7	=	55.18	(74)
North	0.9x	0.77	x	10.24	x	41.52	x	0.4	x	0.7	=	82.49	(74)
North	0.9x	0.77	x	4.8	x	41.52	x	0.4	x	0.7	=	38.67	(74)
North	0.9x	0.77	x	10.24	x	24.19	x	0.4	x	0.7	=	48.06	(74)
North	0.9x	0.77	x	4.8	x	24.19	x	0.4	x	0.7	=	22.53	(74)
North	0.9x	0.77	x	10.24	x	13.12	x	0.4	x	0.7	=	26.06	(74)
North	0.9x	0.77	x	4.8	x	13.12	x	0.4	x	0.7	=	12.22	(74)
North	0.9x	0.77	x	10.24	x	8.86	x	0.4	x	0.7	=	17.61	(74)
North	0.9x	0.77	x	4.8	x	8.86	x	0.4	x	0.7	=	8.26	(74)
West	0.9x	0.77	x	1.44	x	19.64	x	0.4	x	0.7	=	5.49	(80)
West	0.9x	0.77	x	1.44	x	38.42	x	0.4	x	0.7	=	10.74	(80)
West	0.9x	0.77	x	1.44	x	63.27	x	0.4	x	0.7	=	17.68	(80)
West	0.9x	0.77	x	1.44	x	92.28	x	0.4	x	0.7	=	25.78	(80)
West	0.9x	0.77	x	1.44	x	113.09	x	0.4	x	0.7	=	31.6	(80)
West	0.9x	0.77	x	1.44	x	115.77	x	0.4	x	0.7	=	32.35	(80)
West	0.9x	0.77	x	1.44	x	110.22	x	0.4	x	0.7	=	30.8	(80)
West	0.9x	0.77	x	1.44	x	94.68	x	0.4	x	0.7	=	26.45	(80)
West	0.9x	0.77	x	1.44	x	73.59	x	0.4	x	0.7	=	20.56	(80)
West	0.9x	0.77	x	1.44	x	45.59	x	0.4	x	0.7	=	12.74	(80)
West	0.9x	0.77	x	1.44	x	24.49	x	0.4	x	0.7	=	6.84	(80)
West	0.9x	0.77	x	1.44	x	16.15	x	0.4	x	0.7	=	4.51	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	36.52	70.04	118.45	187.65	249.65	265.77	248.73	199.36	141.72	83.33	45.12	30.38	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	418.62	450.25	486.85	537.05	579.88	577.41	548.19	504.28	456.33	417.14	400.99	402.68	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(86)m=	1	1	0.99	0.97	0.88	0.71	0.54	0.6	0.86	0.98	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.9	20.01	20.22	20.54	20.81	20.96	20.99	20.99	20.88	20.55	20.18	19.88	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.03	20.03	20.03	20.04	20.05	20.06	20.06	20.06	20.05	20.05	20.04	20.04	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.95	0.84	0.62	0.43	0.49	0.79	0.97	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.56	18.72	19.03	19.49	19.86	20.03	20.06	20.06	19.96	19.52	18.98	18.54	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.11	19.25	19.52	19.92	20.25	20.41	20.44	20.44	20.34	19.94	19.47	19.09	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.11	19.25	19.52	19.92	20.25	20.41	20.44	20.44	20.34	19.94	19.47	19.09	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.95	0.85	0.66	0.47	0.54	0.82	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	416.74	446.95	479.02	510.77	494.47	378.91	259.27	269.81	372.68	402.55	397.52	401.2	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1048.81	1013.26	916.88	764.42	591.28	395.99	261.62	274.24	427.48	645.97	860.75	1042.39	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	470.26	380.56	325.77	182.63	72.03	0	0	0	0	181.11	333.52	477.05	

Total per year (kWh/year) = Sum(98)1...5,9...12 = 2422.93 (98)

Space heating requirement in kWh/m²/year 36.57 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none 0 (301)

Fraction of space heat from community system 1 – (301) = 1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers 1 (303a)

Fraction of total space heat from Community boilers (302) x (303a) = 1 (304a)

Factor for control and charging method (Table 4c(3)) for community heating system 1 (305)

Distribution loss factor (Table 12c) for community heating system 1.05 (306)

Space heating **kWh/year**

Annual space heating requirement 2422.93

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Space heat from Community boilers	(98) x (304a) x (305) x (306) =	2544.07	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)

Water heating

Annual water heating requirement		1784.71	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	1873.94	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	44.18	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		118.21	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	118.21	(331)
Energy for lighting (calculated in Appendix L)		296.83	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		4833.05	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				95	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.22	=	1004.52	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	22.93	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	1027.45	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				1027.45	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	61.35	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	154.05	(379)

Total CO2, kg/year	sum of (376)…(382) =	1242.85	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =	18.76	(384)
EI rating (section 14)		85.03	(385)

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User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.5.51

Property Address: Sample 2 (Bottom)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	66.25	(1a) x	3	(2a) =	198.75	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.25	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	198.75	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.1	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*		0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.35	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.37	0.37	0.33	0.32	0.28	0.28	0.28	0.3	0.32	0.34	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1	=	2.4			(26)
Windows Type 1			1.24	x1/[1/(1.4)+ 0.04]		=	1.64			(27)
Windows Type 2			8.8	x1/[1/(1.4)+ 0.04]		=	11.67			(27)
Windows Type 3			4.12	x1/[1/(1.4)+ 0.04]		=	5.46			(27)
Floor			66.25	x	0.13	=	8.612499			(28)
Walls Type1	31.8	12.92	18.88	x	0.18	=	3.4			(29)
Walls Type2	18.75	1.24	17.51	x	0.18	=	3.15			(29)
Walls Type3	11.1	2.4	8.7	x	0.18	=	1.57			(29)
Walls Type4	2.4	0	2.4	x	0.18	=	0.43			(29)
Total area of elements, m²			130.3							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 38.33 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5633.61 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 6.52 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 44.85 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

(38)m=	37.53	37.35	37.16	36.32	36.16	35.42	35.42	35.29	35.71	36.16	36.48	36.82	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	82.38	82.19	82.01	81.17	81.01	80.27	80.27	80.13	80.56	81.01	81.33	81.66	

Average = Sum(39)1…12 /12= 81.17 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.24	1.24	1.24	1.23	1.22	1.21	1.21	1.21	1.22	1.22	1.23	1.23	

Average = Sum(40)1…12 /12= 1.23 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.15 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.3 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	93.83	90.42	87.01	83.6	80.19	76.77	76.77	80.19	83.6	87.01	90.42	93.83	

Total = Sum(44)1…12 = 1023.65 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.15	121.71	125.59	109.49	105.06	90.66	84.01	96.4	97.55	113.69	124.1	134.76	

Total = Sum(45)1…12 = 1342.17 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.87	18.26	18.84	16.42	15.76	13.6	12.6	14.46	14.63	17.05	18.61	20.21	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

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Primary circuit loss (annual) from Table 3	0	(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	185.75	163.79	172.18	154.58	151.65	135.75	130.6	143	142.64	160.28	169.19	181.36	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	185.75	163.79	172.18	154.58	151.65	135.75	130.6	143	142.64	160.28	169.19	181.36	

Output from water heater (annual)$_{1…12}$ 1890.79 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	83.54	74.14	79.03	72.48	72.21	66.22	65.21	69.33	68.51	75.08	77.34	82.08	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	16.82	14.94	12.15	9.2	6.88	5.81	6.27	8.15	10.94	13.9	16.22	17.29	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	188.39	190.35	185.42	174.93	161.69	149.25	140.94	138.98	143.91	154.4	167.64	180.08	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	(71)

Water heating gains (Table 5)

(72)m=	112.29	110.32	106.23	100.67	97.05	91.97	87.65	93.18	95.15	100.91	107.41	110.33	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	375.78	373.89	362.08	343.07	323.9	305.3	293.13	298.6	308.28	327.48	349.54	365.97	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	8.8	x	10.63	x	0.63	x	0.7	=	28.6	(74)

North	0.9x	0.77	x	4.12	x	10.63	x	0.63	x	0.7	=	13.39	(74)
North	0.9x	0.77	x	8.8	x	20.32	x	0.63	x	0.7	=	54.65	(74)
North	0.9x	0.77	x	4.12	x	20.32	x	0.63	x	0.7	=	25.59	(74)
North	0.9x	0.77	x	8.8	x	34.53	x	0.63	x	0.7	=	92.87	(74)
North	0.9x	0.77	x	4.12	x	34.53	x	0.63	x	0.7	=	43.48	(74)
North	0.9x	0.77	x	8.8	x	55.46	x	0.63	x	0.7	=	149.17	(74)
North	0.9x	0.77	x	4.12	x	55.46	x	0.63	x	0.7	=	69.84	(74)
North	0.9x	0.77	x	8.8	x	74.72	x	0.63	x	0.7	=	200.94	(74)
North	0.9x	0.77	x	4.12	x	74.72	x	0.63	x	0.7	=	94.08	(74)
North	0.9x	0.77	x	8.8	x	79.99	x	0.63	x	0.7	=	215.11	(74)
North	0.9x	0.77	x	4.12	x	79.99	x	0.63	x	0.7	=	100.71	(74)
North	0.9x	0.77	x	8.8	x	74.68	x	0.63	x	0.7	=	200.83	(74)
North	0.9x	0.77	x	4.12	x	74.68	x	0.63	x	0.7	=	94.03	(74)
North	0.9x	0.77	x	8.8	x	59.25	x	0.63	x	0.7	=	159.34	(74)
North	0.9x	0.77	x	4.12	x	59.25	x	0.63	x	0.7	=	74.6	(74)
North	0.9x	0.77	x	8.8	x	41.52	x	0.63	x	0.7	=	111.65	(74)
North	0.9x	0.77	x	4.12	x	41.52	x	0.63	x	0.7	=	52.27	(74)
North	0.9x	0.77	x	8.8	x	24.19	x	0.63	x	0.7	=	65.05	(74)
North	0.9x	0.77	x	4.12	x	24.19	x	0.63	x	0.7	=	30.46	(74)
North	0.9x	0.77	x	8.8	x	13.12	x	0.63	x	0.7	=	35.28	(74)
North	0.9x	0.77	x	4.12	x	13.12	x	0.63	x	0.7	=	16.52	(74)
North	0.9x	0.77	x	8.8	x	8.86	x	0.63	x	0.7	=	23.84	(74)
North	0.9x	0.77	x	4.12	x	8.86	x	0.63	x	0.7	=	11.16	(74)
West	0.9x	0.77	x	1.24	x	19.64	x	0.63	x	0.7	=	7.44	(80)
West	0.9x	0.77	x	1.24	x	38.42	x	0.63	x	0.7	=	14.56	(80)
West	0.9x	0.77	x	1.24	x	63.27	x	0.63	x	0.7	=	23.98	(80)
West	0.9x	0.77	x	1.24	x	92.28	x	0.63	x	0.7	=	34.97	(80)
West	0.9x	0.77	x	1.24	x	113.09	x	0.63	x	0.7	=	42.86	(80)
West	0.9x	0.77	x	1.24	x	115.77	x	0.63	x	0.7	=	43.87	(80)
West	0.9x	0.77	x	1.24	x	110.22	x	0.63	x	0.7	=	41.77	(80)
West	0.9x	0.77	x	1.24	x	94.68	x	0.63	x	0.7	=	35.88	(80)
West	0.9x	0.77	x	1.24	x	73.59	x	0.63	x	0.7	=	27.89	(80)
West	0.9x	0.77	x	1.24	x	45.59	x	0.63	x	0.7	=	17.28	(80)
West	0.9x	0.77	x	1.24	x	24.49	x	0.63	x	0.7	=	9.28	(80)
West	0.9x	0.77	x	1.24	x	16.15	x	0.63	x	0.7	=	6.12	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	49.43	94.8	160.32	253.97	337.87	359.7	336.63	269.81	191.82	112.79	61.08	41.12	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	425.21	468.68	522.4	597.05	661.78	665	629.77	568.41	500.1	440.27	410.62	407.1	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

(86)m=	1	1	0.99	0.96	0.88	0.71	0.55	0.62	0.87	0.98	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.67	19.81	20.06	20.43	20.76	20.94	20.99	20.98	20.83	20.42	19.99	19.65	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.89	19.89	19.89	19.9	19.9	19.91	19.91	19.91	19.91	19.9	19.9	19.89	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.95	0.83	0.61	0.42	0.49	0.8	0.97	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.13	18.32	18.7	19.23	19.66	19.87	19.91	19.9	19.77	19.23	18.6	18.1	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.76	18.93	19.26	19.72	20.11	20.31	20.35	20.34	20.2	19.72	19.17	18.74	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.76	18.93	19.26	19.72	20.11	20.31	20.35	20.34	20.2	19.72	19.17	18.74	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.94	0.84	0.65	0.47	0.54	0.82	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	423.1	464.73	512.49	563.19	555.3	431.57	296.43	307.45	410.43	424.55	406.86	405.45	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1191.45	1153.28	1046.23	878.35	681.52	458.31	300.96	315.97	491.67	738.8	981.8	1187.27	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	571.65	462.7	397.1	226.91	93.91	0	0	0	0	233.81	413.96	581.67	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 2981.71 (98)

Space heating requirement in kWh/m²/year 45.01 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	571.65	462.7	397.1	226.91	93.91	0	0	0	0	233.81	413.96	581.67	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	611.39	494.87	424.71	242.69	100.44	0	0	0	0	250.06	442.73	622.11	

Total (kWh/year) =$Sum(211)_{1...5,10...12}$= 3189 (211)

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Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
								Total (kWh/year) =Sum(215)$_{1...5,10...12}$=					0	(215)

Water heating

Output from water heater (calculated above)

	185.75	163.79	172.18	154.58	151.65	135.75	130.6	143	142.64	160.28	169.19	181.36		
Efficiency of water heater													79.8	(216)
(217)m=	87.62	87.43	86.97	85.84	83.58	79.8	79.8	79.8	79.8	85.82	87.11	87.7		(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	212	187.33	197.97	180.09	181.45	170.11	163.66	179.19	178.75	186.77	194.22	206.78		
								Total = Sum(219a)$_{1...12}$ =					2238.34	(219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		3189	
Water heating fuel used		2238.34	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	75	(231)
Electricity for lighting		297.09	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		5799.42	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	688.82	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	483.48	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1172.3	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	154.19	(268)
Total CO2, kg/year		sum of (265)…(271) =		1365.42	(272)

TER = 20.61 (273)

SAP Input

Property Details: Sample 3 (Bottom)

Address:	
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	26 July 2019
Date of certificate:	15 June 2022
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	498

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2022	
Floor Location:	Floor area:	Storey height:
Floor 0	67 m²	3 m
Living area:	27.3 m² (fraction 0.407)	
Front of dwelling faces:	Unspecified	

DRAFT

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
DOOR	Manufacturer	Solid			Wood
E	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
S	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Balcony	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
DOOR	mm	0.7	0	1.4	2.4	1
E		0.7	0.4	1	1.44	1
S		0.7	0.4	1	5.44	1
Balcony		0.7	0.4	1	4.8	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
DOOR		INT	Worst case	0	0
E		E	East	0	0
S		S	South	0	0
Balcony		S	South	0	0

Overshading: More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
S	31.65	10.24	21.41	0.15	0	False	N/A
E	2.3	1.44	0.86	0.15	0	False	N/A
INT	11.1	2.4	8.7	0.16	0.43	False	N/A
Spandrel	2.4	0	2.4	0.35	0	False	N/A
Exposed	67			0.11			N/A
Internal Elements							
Party Elements							

SAP Input

Thermal bridges:	
Thermal bridges:	No information on thermal bridging (y=0.15) (y =0.15)
Ventilation:	
Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	3
Main heating system:	
Main heating system:	Community heating schemes Heat source: Community boilers heat from boilers – mains gas, heat fraction 1, efficiency 95 Piping>=1991, pre-insulated, low temp, variable flow Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Boiler interlock: Yes
Main heating Control:	
Main heating Control:	Charging system linked to use of community heating, programmer and TRVs Control code: 2306
Secondary heating system:	
Secondary heating system:	None
Water heating:	
Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Flue Gas Heat Recovery System: Database (rev 498, product index 060036) Brand name: Worcester Model: Greenstar Xtra Model qualifier: 2015 Solar panel: False
Others:	
Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.5.51

Property Address: Sample 3 (Bottom)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67	(1a) x	3	(2a) =	201	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		201	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	79.05	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1.4	=	3.36			(26)
Windows Type 1			1.44	x	1/[1/(1)+ 0.04]	=	1.38			(27)
Windows Type 2			5.44	x	1/[1/(1)+ 0.04]	=	5.23			(27)
Windows Type 3			4.8	x	1/[1/(1)+ 0.04]	=	4.62			(27)
Floor			67	x	0.11	=	7.37			(28)
Walls Type1	31.65	10.24	21.41	x	0.15	=	3.21			(29)
Walls Type2	2.3	1.44	0.86	x	0.15	=	0.13			(29)
Walls Type3	11.1	2.4	8.7	x	0.15	=	1.3			(29)
Walls Type4	2.4	0	2.4	x	0.35	=	0.84			(29)
Total area of elements, m²			114.45							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	27.44	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	5492.18	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		17.17	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	44.61	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

(38)m=	17.73	17.52	17.31	16.25	16.04	14.98	14.98	14.77	15.41	16.04	16.46	16.89	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	62.34	62.13	61.92	60.86	60.65	59.59	59.59	59.38	60.02	60.65	61.07	61.5	

Average = Sum(39)$_{1...12}$ /12= 60.81 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.93	0.93	0.92	0.91	0.91	0.89	0.89	0.89	0.9	0.91	0.91	0.92	

Average = Sum(40)$_{1...12}$ /12= 0.91 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.17 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.76 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	94.34	90.91	87.48	84.05	80.62	77.19	77.19	80.62	84.05	87.48	90.91	94.34	

Total = Sum(44)$_{1...12}$ = 1029.18 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.91	122.36	126.27	110.08	105.63	91.15	84.46	96.92	98.08	114.3	124.77	135.49	

Total = Sum(45)$_{1...12}$ = 1349.41 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.99	18.35	18.94	16.51	15.84	13.67	12.67	14.54	14.71	17.15	18.72	20.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	195.18	172.29	181.54	163.58	160.9	144.64	139.74	152.2	151.57	169.58	178.26	190.77	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	18.03	16.04	16.49	14.58	14.03	12.18	11.28	12.94	13.08	15.09	16.32	17.54	(63) (G2)

Output from water heater

(64)m=	174.47	153.83	162.37	146.4	144.19	129.86	125.78	136.58	135.89	151.81	159.35	170.55	

Output from water heater (annual)$_{1...12}$ | 1791.08 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	90.74	80.63	86.21	79.4	79.34	73.1	72.31	76.45	75.41	82.23	84.28	89.27	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.86	15.86	12.9	9.77	7.3	6.16	6.66	8.66	11.62	14.75	17.22	18.36	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	190.2	192.17	187.2	176.61	163.24	150.68	142.29	140.32	145.29	155.88	169.24	181.8	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	(71)

Water heating gains (Table 5)

(72)m=	121.96	119.98	115.87	110.27	106.64	101.53	97.18	102.75	104.73	110.52	117.06	119.99	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	385.59	383.58	371.53	352.22	332.75	313.94	301.7	307.29	317.21	336.72	359.09	375.72	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	1.44	x	19.64	x	0.4	x	0.7	=	5.49	(76)

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East	0.9x	0.77	x	1.44	x	38.42	x	0.4	x	0.7	=	10.74	(76)
East	0.9x	0.77	x	1.44	x	63.27	x	0.4	x	0.7	=	17.68	(76)
East	0.9x	0.77	x	1.44	x	92.28	x	0.4	x	0.7	=	25.78	(76)
East	0.9x	0.77	x	1.44	x	113.09	x	0.4	x	0.7	=	31.6	(76)
East	0.9x	0.77	x	1.44	x	115.77	x	0.4	x	0.7	=	32.35	(76)
East	0.9x	0.77	x	1.44	x	110.22	x	0.4	x	0.7	=	30.8	(76)
East	0.9x	0.77	x	1.44	x	94.68	x	0.4	x	0.7	=	26.45	(76)
East	0.9x	0.77	x	1.44	x	73.59	x	0.4	x	0.7	=	20.56	(76)
East	0.9x	0.77	x	1.44	x	45.59	x	0.4	x	0.7	=	12.74	(76)
East	0.9x	0.77	x	1.44	x	24.49	x	0.4	x	0.7	=	6.84	(76)
East	0.9x	0.77	x	1.44	x	16.15	x	0.4	x	0.7	=	4.51	(76)
South	0.9x	0.77	x	5.44	x	46.75	x	0.4	x	0.7	=	49.35	(78)
South	0.9x	0.77	x	4.8	x	46.75	x	0.4	x	0.7	=	43.54	(78)
South	0.9x	0.77	x	5.44	x	76.57	x	0.4	x	0.7	=	80.82	(78)
South	0.9x	0.77	x	4.8	x	76.57	x	0.4	x	0.7	=	71.31	(78)
South	0.9x	0.77	x	5.44	x	97.53	x	0.4	x	0.7	=	102.95	(78)
South	0.9x	0.77	x	4.8	x	97.53	x	0.4	x	0.7	=	90.84	(78)
South	0.9x	0.77	x	5.44	x	110.23	x	0.4	x	0.7	=	116.36	(78)
South	0.9x	0.77	x	4.8	x	110.23	x	0.4	x	0.7	=	102.67	(78)
South	0.9x	0.77	x	5.44	x	114.87	x	0.4	x	0.7	=	121.26	(78)
South	0.9x	0.77	x	4.8	x	114.87	x	0.4	x	0.7	=	106.99	(78)
South	0.9x	0.77	x	5.44	x	110.55	x	0.4	x	0.7	=	116.69	(78)
South	0.9x	0.77	x	4.8	x	110.55	x	0.4	x	0.7	=	102.96	(78)
South	0.9x	0.77	x	5.44	x	108.01	x	0.4	x	0.7	=	114.01	(78)
South	0.9x	0.77	x	4.8	x	108.01	x	0.4	x	0.7	=	100.6	(78)
South	0.9x	0.77	x	5.44	x	104.89	x	0.4	x	0.7	=	110.72	(78)
South	0.9x	0.77	x	4.8	x	104.89	x	0.4	x	0.7	=	97.7	(78)
South	0.9x	0.77	x	5.44	x	101.89	x	0.4	x	0.7	=	107.55	(78)
South	0.9x	0.77	x	4.8	x	101.89	x	0.4	x	0.7	=	94.9	(78)
South	0.9x	0.77	x	5.44	x	82.59	x	0.4	x	0.7	=	87.18	(78)
South	0.9x	0.77	x	4.8	x	82.59	x	0.4	x	0.7	=	76.92	(78)
South	0.9x	0.77	x	5.44	x	55.42	x	0.4	x	0.7	=	58.5	(78)
South	0.9x	0.77	x	4.8	x	55.42	x	0.4	x	0.7	=	51.62	(78)
South	0.9x	0.77	x	5.44	x	40.4	x	0.4	x	0.7	=	42.64	(78)
South	0.9x	0.77	x	4.8	x	40.4	x	0.4	x	0.7	=	37.63	(78)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	98.38	162.87	211.48	244.82	259.85	252	245.41	234.88	223.01	176.83	116.95	84.78	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	483.97	546.46	583.01	597.03	592.6	565.95	547.11	542.17	540.21	513.55	476.04	460.5	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(86)m=	0.99	0.99	0.97	0.93	0.84	0.65	0.48	0.5	0.73	0.93	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.18	20.33	20.52	20.74	20.9	20.98	21	21	20.97	20.78	20.44	20.16	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.14	20.14	20.15	20.16	20.16	20.18	20.18	20.18	20.17	20.16	20.16	20.15	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.96	0.91	0.79	0.58	0.39	0.41	0.65	0.91	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.06	19.27	19.54	19.86	20.07	20.17	20.18	20.18	20.15	19.92	19.45	19.03	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.52	19.7	19.94	20.21	20.41	20.5	20.51	20.51	20.48	20.27	19.85	19.49	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.52	19.7	19.94	20.21	20.41	20.5	20.51	20.51	20.48	20.27	19.85	19.49	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.96	0.91	0.81	0.61	0.42	0.45	0.68	0.91	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	479.68	536.39	560.58	544.81	477.3	344.35	232.38	243.23	368.39	467.11	466.47	457.34	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	948.58	919.51	832.1	688.65	528.07	351.52	233.05	244.17	382.99	586.3	778.98	940.32	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	348.86	257.46	202.01	103.57	37.77	0	0	0	0	88.68	225	359.34	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1622.69 (98)

Space heating requirement in kWh/m²/year 24.22 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none 0 (301)

Fraction of space heat from community system 1 – (301) = 1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers 1 (303a)

Fraction of total space heat from Community boilers (302) x (303a) = 1 (304a)

Factor for control and charging method (Table 4c(3)) for community heating system 1 (305)

Distribution loss factor (Table 12c) for community heating system 1.05 (306)

Space heating **kWh/year**

Annual space heating requirement 1622.69

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Space heat from Community boilers	(98) x (304a) x (305) x (306) =	1703.83	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)

Water heating

Annual water heating requirement		1791.08	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	1880.63	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	35.84	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		119.54	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	119.54	(331)
Energy for lighting (calculated in Appendix L)		315.44	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		4019.45	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				95	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.22	=	814.99	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	18.6	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	833.6	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				833.6	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	62.04	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	163.72	(379)

Total CO2, kg/year	sum of (376)…(382) =	1059.36	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =	15.81	(384)
EI rating (section 14)		87.33	(385)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**

Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.51

Property Address: Sample 3 (Bottom)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67	(1a) x	3	(2a) =	201	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	201	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.1	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.35	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.37	0.36	0.33	0.32	0.28	0.28	0.27	0.3	0.32	0.33	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1	=	2.4			(26)
Windows Type 1			1.44	x1/[1/(1.4)+ 0.04]		=	1.91			(27)
Windows Type 2			5.44	x1/[1/(1.4)+ 0.04]		=	7.21			(27)
Windows Type 3			4.8	x1/[1/(1.4)+ 0.04]		=	6.36			(27)
Floor			67	x	0.13	=	8.71			(28)
Walls Type1	31.65	10.24	21.41	x	0.18	=	3.85			(29)
Walls Type2	2.3	1.44	0.86	x	0.18	=	0.15			(29)
Walls Type3	11.1	2.4	8.7	x	0.18	=	1.57			(29)
Walls Type4	2.4	0	2.4	x	0.18	=	0.43			(29)
Total area of elements, m²			114.45							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 32.6 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5492.18 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 5.72 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 38.32 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(38)m=	37.92	37.74	37.56	36.71	36.55	35.81	35.81	35.67	36.09	36.55	36.87	37.21		(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(39)m=	76.25	76.06	75.88	75.03	74.87	74.13	74.13	73.99	74.42	74.87	75.19	75.53		

Average = Sum(39)$_{1...12}$ /12= 75.03 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(40)m=	1.14	1.14	1.13	1.12	1.12	1.11	1.11	1.1	1.11	1.12	1.12	1.13

Average = Sum(40)$_{1...12}$ /12= 1.12 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.17 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.76 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	94.34	90.91	87.48	84.05	80.62	77.19	77.19	80.62	84.05	87.48	90.91	94.34

Total = Sum(44)$_{1...12}$ = 1029.18 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(45)m=	139.91	122.36	126.27	110.08	105.63	91.15	84.46	96.92	98.08	114.3	124.77	135.49

Total = Sum(45)$_{1...12}$ = 1349.41 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	20.99	18.35	18.94	16.51	15.84	13.67	12.67	14.54	14.71	17.15	18.72	20.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09	

Output from water heater (annual)$_{1...12}$ | 1898.03 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	83.79	74.35	79.26	72.68	72.4	66.38	65.36	69.5	68.68	75.28	77.56	82.33	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.41	15.46	12.58	9.52	7.12	6.01	6.49	8.44	11.33	14.38	16.79	17.89	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	190.2	192.17	187.2	176.61	163.24	150.68	142.29	140.32	145.29	155.88	169.24	181.8	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	(71)

Water heating gains (Table 5)

(72)m=	112.63	110.65	106.53	100.94	97.31	92.19	87.85	93.42	95.4	101.18	107.72	110.65	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	378.8	376.85	364.87	345.64	326.23	307.45	295.2	300.74	310.58	330.01	352.32	368.92	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	1.44	x	19.64	x	0.63	x	0.7	=	8.64	(76)

East	0.9x	0.77	x	1.44	x	38.42	x	0.63	x	0.7	=	16.91	(76)
East	0.9x	0.77	x	1.44	x	63.27	x	0.63	x	0.7	=	27.85	(76)
East	0.9x	0.77	x	1.44	x	92.28	x	0.63	x	0.7	=	40.61	(76)
East	0.9x	0.77	x	1.44	x	113.09	x	0.63	x	0.7	=	49.77	(76)
East	0.9x	0.77	x	1.44	x	115.77	x	0.63	x	0.7	=	50.95	(76)
East	0.9x	0.77	x	1.44	x	110.22	x	0.63	x	0.7	=	48.51	(76)
East	0.9x	0.77	x	1.44	x	94.68	x	0.63	x	0.7	=	41.67	(76)
East	0.9x	0.77	x	1.44	x	73.59	x	0.63	x	0.7	=	32.39	(76)
East	0.9x	0.77	x	1.44	x	45.59	x	0.63	x	0.7	=	20.06	(76)
East	0.9x	0.77	x	1.44	x	24.49	x	0.63	x	0.7	=	10.78	(76)
East	0.9x	0.77	x	1.44	x	16.15	x	0.63	x	0.7	=	7.11	(76)
South	0.9x	0.77	x	5.44	x	46.75	x	0.63	x	0.7	=	77.73	(78)
South	0.9x	0.77	x	4.8	x	46.75	x	0.63	x	0.7	=	68.58	(78)
South	0.9x	0.77	x	5.44	x	76.57	x	0.63	x	0.7	=	127.3	(78)
South	0.9x	0.77	x	4.8	x	76.57	x	0.63	x	0.7	=	112.32	(78)
South	0.9x	0.77	x	5.44	x	97.53	x	0.63	x	0.7	=	162.15	(78)
South	0.9x	0.77	x	4.8	x	97.53	x	0.63	x	0.7	=	143.08	(78)
South	0.9x	0.77	x	5.44	x	110.23	x	0.63	x	0.7	=	183.27	(78)
South	0.9x	0.77	x	4.8	x	110.23	x	0.63	x	0.7	=	161.71	(78)
South	0.9x	0.77	x	5.44	x	114.87	x	0.63	x	0.7	=	190.98	(78)
South	0.9x	0.77	x	4.8	x	114.87	x	0.63	x	0.7	=	168.51	(78)
South	0.9x	0.77	x	5.44	x	110.55	x	0.63	x	0.7	=	183.79	(78)
South	0.9x	0.77	x	4.8	x	110.55	x	0.63	x	0.7	=	162.17	(78)
South	0.9x	0.77	x	5.44	x	108.01	x	0.63	x	0.7	=	179.57	(78)
South	0.9x	0.77	x	4.8	x	108.01	x	0.63	x	0.7	=	158.45	(78)
South	0.9x	0.77	x	5.44	x	104.89	x	0.63	x	0.7	=	174.39	(78)
South	0.9x	0.77	x	4.8	x	104.89	x	0.63	x	0.7	=	153.87	(78)
South	0.9x	0.77	x	5.44	x	101.89	x	0.63	x	0.7	=	169.39	(78)
South	0.9x	0.77	x	4.8	x	101.89	x	0.63	x	0.7	=	149.46	(78)
South	0.9x	0.77	x	5.44	x	82.59	x	0.63	x	0.7	=	137.3	(78)
South	0.9x	0.77	x	4.8	x	82.59	x	0.63	x	0.7	=	121.15	(78)
South	0.9x	0.77	x	5.44	x	55.42	x	0.63	x	0.7	=	92.13	(78)
South	0.9x	0.77	x	4.8	x	55.42	x	0.63	x	0.7	=	81.29	(78)
South	0.9x	0.77	x	5.44	x	40.4	x	0.63	x	0.7	=	67.16	(78)
South	0.9x	0.77	x	4.8	x	40.4	x	0.63	x	0.7	=	59.26	(78)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	154.95	256.53	333.08	385.59	409.26	396.91	386.53	369.93	351.23	278.51	184.2	133.53	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	533.75	633.37	697.95	731.22	735.49	704.36	681.72	670.67	661.81	608.52	536.52	502.45	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(86)m=	0.99	0.98	0.96	0.91	0.81	0.64	0.47	0.5	0.72	0.92	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.96	20.15	20.4	20.66	20.86	20.97	20.99	20.99	20.94	20.69	20.27	19.92	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.97	19.97	19.97	19.98	19.99	20	20	20	19.99	19.99	19.98	19.98	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.95	0.89	0.76	0.55	0.37	0.39	0.63	0.89	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.6	18.89	19.23	19.6	19.86	19.98	19.99	19.99	19.95	19.66	19.07	18.55	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.15	19.4	19.71	20.04	20.27	20.38	20.4	20.4	20.36	20.08	19.56	19.11	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.15	19.4	19.71	20.04	20.27	20.38	20.4	20.4	20.36	20.08	19.56	19.11	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.97	0.95	0.89	0.78	0.59	0.41	0.44	0.67	0.89	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	527.45	616.68	660.14	648.81	570.04	415.14	280.11	293.69	440.29	544.15	522.89	497.9	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1132.43	1103.12	1002.19	835.48	641.41	428.52	281.81	296.07	465.61	709.61	936.7	1125.95	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	450.1	326.88	254.48	134.4	53.1	0	0	0	0	123.1	297.94	467.27	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2107.29 (98)

Space heating requirement in kWh/m²/year 31.45 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	450.1	326.88	254.48	134.4	53.1	0	0	0	0	123.1	297.94	467.27	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	481.39	349.61	272.17	143.75	56.79	0	0	0	0	131.66	318.65	499.75	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2253.78 (211)

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Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

Water heating

Output from water heater (calculated above)

186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09

Efficiency of water heater 79.8 (216)

(217)m=	87.08	86.61	85.84	84.43	82.32	79.8	79.8	79.8	79.8	84.11	86.3	87.22	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	214.17	189.87	201.37	183.78	184.92	170.73	164.23	179.84	179.41	191.29	196.83	208.76

Total = Sum(219a)$_{1...12}$ = 2265.21 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2253.78	
Water heating fuel used		2265.21	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		75	(231)
Electricity for lighting		307.48	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		4901.47	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	486.82	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	489.29	(264)
Space and water heating	(261) + (262) + (263) + (264) =			976.1	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	159.58	(268)
Total CO2, kg/year		sum of (265)…(271) =		1174.61	(272)

TER = 17.53 (273)

SAP Input

Property Details: Sample 4 (Bottom)

Address:	
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	26 July 2019
Date of certificate:	15 June 2022
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	498

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2022	
Floor Location:	Floor area:	Storey height:
Floor 0	67 m²	3 m
Living area:	27.3 m² (fraction 0.407)	
Front of dwelling faces:	Unspecified	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
DOOR	Manufacturer	Solid			Wood
W	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
S	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Balcony	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
DOOR	mm	0.7	0	1.4	2.4	1
W		0.7	0.4	1	1.44	1
S		0.7	0.4	1	5.44	1
Balcony		0.7	0.4	1	4.8	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
DOOR		INT	Worst case	0	0
W		W	West	0	0
S		S	South	0	0
Balcony		S	South	0	0

Overshading: More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
S	31.7	10.24	21.46	0.15	0	False	N/A
W	19	1.44	17.56	0.15	0	False	N/A
INT	11.1	2.4	8.7	0.16	0.43	False	N/A
Spandrel	2.4	0	2.4	0.35	0	False	N/A
Exposed	67			0.11			N/A
Internal Elements							
Party Elements							

SAP Input

Thermal bridges:	
Thermal bridges:	No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:	
Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	3

Main heating system:	
Main heating system:	Community heating schemes Heat source: Community boilers heat from boilers – mains gas, heat fraction 1, efficiency 95 Piping>=1991, pre-insulated, low temp, variable flow Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Boiler interlock: Yes

Main heating Control:	
Main heating Control:	Charging system linked to use of community heating, programmer and TRVs Control code: 2306

Secondary heating system:	
Secondary heating system:	None

Water heating:	
Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Flue Gas Heat Recovery System: Database (rev 498, product index 060036) Brand name: Worcester Model: Greenstar Xtra Model qualifier: 2015 Solar panel: False

Others:	
Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.5.51

Property Address: Sample 4 (Bottom)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67	(1a) x	3	(2a) =	201	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	201	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*		0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.05 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1.4	=	3.36			(26)
Windows Type 1			1.44	x	1/[1/(1)+ 0.04]	=	1.38			(27)
Windows Type 2			5.44	x	1/[1/(1)+ 0.04]	=	5.23			(27)
Windows Type 3			4.8	x	1/[1/(1)+ 0.04]	=	4.62			(27)
Floor			67	x	0.11	=	7.37			(28)
Walls Type1	31.7	10.24	21.46	x	0.15	=	3.22			(29)
Walls Type2	19	1.44	17.56	x	0.15	=	2.63			(29)
Walls Type3	11.1	2.4	8.7	x	0.15	=	1.3			(29)
Walls Type4	2.4	0	2.4	x	0.35	=	0.84			(29)
Total area of elements, m²			131.2							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 29.96 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5726.68 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.68 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 49.64 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

DER WorkSheet: New dwelling design stage

(38)m=	17.73	17.52	17.31	16.25	16.04	14.98	14.98	14.77	15.41	16.04	16.46	16.89		(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	67.37	67.16	66.94	65.89	65.68	64.62	64.62	64.41	65.04	65.68	66.1	66.52		

Average = Sum(39)$_{1...12}$ /12= 65.83 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.01	1	1	0.98	0.98	0.96	0.96	0.96	0.97	0.98	0.99	0.99		

Average = Sum(40)$_{1...12}$ /12= 0.98 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.17 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.76 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)														
(44)m=	94.34	90.91	87.48	84.05	80.62	77.19	77.19	80.62	84.05	87.48	90.91	94.34		

Total = Sum(44)$_{1...12}$ = 1029.18 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.91	122.36	126.27	110.08	105.63	91.15	84.46	96.92	98.08	114.3	124.77	135.49

Total = Sum(45)$_{1...12}$ = 1349.41 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.99	18.35	18.94	16.51	15.84	13.67	12.67	14.54	14.71	17.15	18.72	20.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	195.18	172.29	181.54	163.58	160.9	144.64	139.74	152.2	151.57	169.58	178.26	190.77	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	18.03	16.04	16.49	14.58	14.03	12.18	11.28	12.94	13.08	15.09	16.32	17.54	(63) (G2)

Output from water heater

(64)m=	174.47	153.83	162.37	146.4	144.19	129.86	125.78	136.58	135.89	151.81	159.35	170.55	

Output from water heater (annual)1…12 | 1791.08 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	90.74	80.63	86.21	79.4	79.34	73.1	72.31	76.45	75.41	82.23	84.28	89.27	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.86	15.86	12.9	9.77	7.3	6.16	6.66	8.66	11.62	14.75	17.22	18.36	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	190.2	192.17	187.2	176.61	163.24	150.68	142.29	140.32	145.29	155.88	169.24	181.8	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	(71)

Water heating gains (Table 5)

(72)m=	121.96	119.98	115.87	110.27	106.64	101.53	97.18	102.75	104.73	110.52	117.06	119.99	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	385.59	383.58	371.53	352.22	332.75	313.94	301.7	307.29	317.21	336.72	359.09	375.72	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	5.44	x	46.75	x	0.4	x	0.7	=	49.35	(78)

South	0.9x	0.77	x	4.8	x	46.75	x	0.4	x	0.7	=	43.54	(78)
South	0.9x	0.77	x	5.44	x	76.57	x	0.4	x	0.7	=	80.82	(78)
South	0.9x	0.77	x	4.8	x	76.57	x	0.4	x	0.7	=	71.31	(78)
South	0.9x	0.77	x	5.44	x	97.53	x	0.4	x	0.7	=	102.95	(78)
South	0.9x	0.77	x	4.8	x	97.53	x	0.4	x	0.7	=	90.84	(78)
South	0.9x	0.77	x	5.44	x	110.23	x	0.4	x	0.7	=	116.36	(78)
South	0.9x	0.77	x	4.8	x	110.23	x	0.4	x	0.7	=	102.67	(78)
South	0.9x	0.77	x	5.44	x	114.87	x	0.4	x	0.7	=	121.26	(78)
South	0.9x	0.77	x	4.8	x	114.87	x	0.4	x	0.7	=	106.99	(78)
South	0.9x	0.77	x	5.44	x	110.55	x	0.4	x	0.7	=	116.69	(78)
South	0.9x	0.77	x	4.8	x	110.55	x	0.4	x	0.7	=	102.96	(78)
South	0.9x	0.77	x	5.44	x	108.01	x	0.4	x	0.7	=	114.01	(78)
South	0.9x	0.77	x	4.8	x	108.01	x	0.4	x	0.7	=	100.6	(78)
South	0.9x	0.77	x	5.44	x	104.89	x	0.4	x	0.7	=	110.72	(78)
South	0.9x	0.77	x	4.8	x	104.89	x	0.4	x	0.7	=	97.7	(78)
South	0.9x	0.77	x	5.44	x	101.89	x	0.4	x	0.7	=	107.55	(78)
South	0.9x	0.77	x	4.8	x	101.89	x	0.4	x	0.7	=	94.9	(78)
South	0.9x	0.77	x	5.44	x	82.59	x	0.4	x	0.7	=	87.18	(78)
South	0.9x	0.77	x	4.8	x	82.59	x	0.4	x	0.7	=	76.92	(78)
South	0.9x	0.77	x	5.44	x	55.42	x	0.4	x	0.7	=	58.5	(78)
South	0.9x	0.77	x	4.8	x	55.42	x	0.4	x	0.7	=	51.62	(78)
South	0.9x	0.77	x	5.44	x	40.4	x	0.4	x	0.7	=	42.64	(78)
South	0.9x	0.77	x	4.8	x	40.4	x	0.4	x	0.7	=	37.63	(78)
West	0.9x	0.77	x	1.44	x	19.64	x	0.4	x	0.7	=	5.49	(80)
West	0.9x	0.77	x	1.44	x	38.42	x	0.4	x	0.7	=	10.74	(80)
West	0.9x	0.77	x	1.44	x	63.27	x	0.4	x	0.7	=	17.68	(80)
West	0.9x	0.77	x	1.44	x	92.28	x	0.4	x	0.7	=	25.78	(80)
West	0.9x	0.77	x	1.44	x	113.09	x	0.4	x	0.7	=	31.6	(80)
West	0.9x	0.77	x	1.44	x	115.77	x	0.4	x	0.7	=	32.35	(80)
West	0.9x	0.77	x	1.44	x	110.22	x	0.4	x	0.7	=	30.8	(80)
West	0.9x	0.77	x	1.44	x	94.68	x	0.4	x	0.7	=	26.45	(80)
West	0.9x	0.77	x	1.44	x	73.59	x	0.4	x	0.7	=	20.56	(80)
West	0.9x	0.77	x	1.44	x	45.59	x	0.4	x	0.7	=	12.74	(80)
West	0.9x	0.77	x	1.44	x	24.49	x	0.4	x	0.7	=	6.84	(80)
West	0.9x	0.77	x	1.44	x	16.15	x	0.4	x	0.7	=	4.51	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	98.38	162.87	211.48	244.82	259.85	252	245.41	234.88	223.01	176.83	116.95	84.78	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	483.97	546.46	583.01	597.03	592.6	565.95	547.11	542.17	540.21	513.55	476.04	460.5	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)	21	(85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(86)m=	0.99	0.99	0.98	0.94	0.86	0.69	0.51	0.54	0.76	0.94	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.07	20.22	20.42	20.66	20.86	20.97	21	20.99	20.95	20.71	20.35	20.05	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.08	20.08	20.08	20.1	20.1	20.11	20.11	20.12	20.11	20.1	20.09	20.09	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.97	0.92	0.82	0.61	0.41	0.44	0.69	0.92	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.85	19.07	19.36	19.7	19.96	20.09	20.11	20.11	20.07	19.78	19.27	18.82	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.35	19.54	19.79	20.09	20.33	20.45	20.47	20.47	20.43	20.16	19.71	19.32	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.35	19.54	19.79	20.09	20.33	20.45	20.47	20.47	20.43	20.16	19.71	19.32	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.97	0.92	0.83	0.65	0.45	0.48	0.72	0.92	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	479.93	537.31	563.24	552.12	492.69	365.13	248.72	260.28	387.24	473.6	467.42	457.5	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1013.82	982.98	889.74	737.57	566.46	378.05	250.18	262.28	411.46	627.84	833.51	1006	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	397.22	299.49	242.92	133.53	54.89	0	0	0	0	114.75	263.58	408.09	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 1914.46 (98)

Space heating requirement in kWh/m²/year 28.57 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none 0 (301)

Fraction of space heat from community system 1 – (301) = 1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers 1 (303a)

Fraction of total space heat from Community boilers (302) x (303a) = 1 (304a)

Factor for control and charging method (Table 4c(3)) for community heating system 1 (305)

Distribution loss factor (Table 12c) for community heating system 1.05 (306)

Space heating **kWh/year**

Annual space heating requirement 1914.46

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Space heat from Community boilers	(98) x (304a) x (305) x (306) =	2010.19	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)

Water heating

Annual water heating requirement		1791.08	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	1880.63	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	38.91	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		119.54	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	119.54	(331)
Energy for lighting (calculated in Appendix L)		315.44	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		4325.81	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				95	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.22	=	884.65	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	20.19	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	904.84	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				904.84	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	62.04	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	163.72	(379)
Total CO2, kg/year	sum of (376)…(382) =				1130.6	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				16.87	(384)
EI rating (section 14)					86.47	(385)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Sample 4 (Bottom)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67	(1a) x	3	(2a) =	201	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	201	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.1	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.35	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.37	0.36	0.33	0.32	0.28	0.28	0.27	0.3	0.32	0.33	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	0	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1	=	2.4			(26)
Windows Type 1			1.44	x1/[1/(1.4)+ 0.04]		=	1.91			(27)
Windows Type 2			5.44	x1/[1/(1.4)+ 0.04]		=	7.21			(27)
Windows Type 3			4.8	x1/[1/(1.4)+ 0.04]		=	6.36			(27)
Floor			67	x	0.13	=	8.71			(28)
Walls Type1	31.7	10.24	21.46	x	0.18	=	3.86			(29)
Walls Type2	19	1.44	17.56	x	0.18	=	3.16			(29)
Walls Type3	11.1	2.4	8.7	x	0.18	=	1.57			(29)
Walls Type4	2.4	0	2.4	x	0.18	=	0.43			(29)
Total area of elements, m²			131.2							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	35.62	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	5726.68	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		6.56	(36)
if details of thermal bridging are not known (36) = 0.05 x (31)			
Total fabric heat loss	(33) + (36) =	42.18	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(38)m=	37.92	37.74	37.56	36.71	36.55	35.81	35.81	35.67	36.09	36.55	36.87	37.21	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	80.1	79.91	79.73	78.88	78.72	77.98	77.98	77.85	78.27	78.72	79.05	79.38

Average = $Sum(39)_{1...12}$ /12= 78.88 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.2	1.19	1.19	1.18	1.17	1.16	1.16	1.16	1.17	1.17	1.18	1.18

Average = $Sum(40)_{1...12}$ /12= 1.18 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.17 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.76 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	94.34	90.91	87.48	84.05	80.62	77.19	77.19	80.62	84.05	87.48	90.91	94.34

Total = $Sum(44)_{1...12}$ = 1029.18 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.91	122.36	126.27	110.08	105.63	91.15	84.46	96.92	98.08	114.3	124.77	135.49

Total = $Sum(45)_{1...12}$ = 1349.41 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.99	18.35	18.94	16.51	15.84	13.67	12.67	14.54	14.71	17.15	18.72	20.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09	

Output from water heater (annual)$_{1...12}$ | 1898.03 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	83.79	74.35	79.26	72.68	72.4	66.38	65.36	69.5	68.68	75.28	77.56	82.33	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.41	15.46	12.58	9.52	7.12	6.01	6.49	8.44	11.33	14.38	16.79	17.89	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	190.2	192.17	187.2	176.61	163.24	150.68	142.29	140.32	145.29	155.88	169.24	181.8	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	(71)

Water heating gains (Table 5)

(72)m=	112.63	110.65	106.53	100.94	97.31	92.19	87.85	93.42	95.4	101.18	107.72	110.65	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	378.8	376.85	364.87	345.64	326.23	307.45	295.2	300.74	310.58	330.01	352.32	368.92	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	5.44	x	46.75	x	0.63	x	0.7	=	77.73	(78)

South	0.9x	0.77	x	4.8	x	46.75	x	0.63	x	0.7	=	68.58	(78)
South	0.9x	0.77	x	5.44	x	76.57	x	0.63	x	0.7	=	127.3	(78)
South	0.9x	0.77	x	4.8	x	76.57	x	0.63	x	0.7	=	112.32	(78)
South	0.9x	0.77	x	5.44	x	97.53	x	0.63	x	0.7	=	162.15	(78)
South	0.9x	0.77	x	4.8	x	97.53	x	0.63	x	0.7	=	143.08	(78)
South	0.9x	0.77	x	5.44	x	110.23	x	0.63	x	0.7	=	183.27	(78)
South	0.9x	0.77	x	4.8	x	110.23	x	0.63	x	0.7	=	161.71	(78)
South	0.9x	0.77	x	5.44	x	114.87	x	0.63	x	0.7	=	190.98	(78)
South	0.9x	0.77	x	4.8	x	114.87	x	0.63	x	0.7	=	168.51	(78)
South	0.9x	0.77	x	5.44	x	110.55	x	0.63	x	0.7	=	183.79	(78)
South	0.9x	0.77	x	4.8	x	110.55	x	0.63	x	0.7	=	162.17	(78)
South	0.9x	0.77	x	5.44	x	108.01	x	0.63	x	0.7	=	179.57	(78)
South	0.9x	0.77	x	4.8	x	108.01	x	0.63	x	0.7	=	158.45	(78)
South	0.9x	0.77	x	5.44	x	104.89	x	0.63	x	0.7	=	174.39	(78)
South	0.9x	0.77	x	4.8	x	104.89	x	0.63	x	0.7	=	153.87	(78)
South	0.9x	0.77	x	5.44	x	101.89	x	0.63	x	0.7	=	169.39	(78)
South	0.9x	0.77	x	4.8	x	101.89	x	0.63	x	0.7	=	149.46	(78)
South	0.9x	0.77	x	5.44	x	82.59	x	0.63	x	0.7	=	137.3	(78)
South	0.9x	0.77	x	4.8	x	82.59	x	0.63	x	0.7	=	121.15	(78)
South	0.9x	0.77	x	5.44	x	55.42	x	0.63	x	0.7	=	92.13	(78)
South	0.9x	0.77	x	4.8	x	55.42	x	0.63	x	0.7	=	81.29	(78)
South	0.9x	0.77	x	5.44	x	40.4	x	0.63	x	0.7	=	67.16	(78)
South	0.9x	0.77	x	4.8	x	40.4	x	0.63	x	0.7	=	59.26	(78)
West	0.9x	0.77	x	1.44	x	19.64	x	0.63	x	0.7	=	8.64	(80)
West	0.9x	0.77	x	1.44	x	38.42	x	0.63	x	0.7	=	16.91	(80)
West	0.9x	0.77	x	1.44	x	63.27	x	0.63	x	0.7	=	27.85	(80)
West	0.9x	0.77	x	1.44	x	92.28	x	0.63	x	0.7	=	40.61	(80)
West	0.9x	0.77	x	1.44	x	113.09	x	0.63	x	0.7	=	49.77	(80)
West	0.9x	0.77	x	1.44	x	115.77	x	0.63	x	0.7	=	50.95	(80)
West	0.9x	0.77	x	1.44	x	110.22	x	0.63	x	0.7	=	48.51	(80)
West	0.9x	0.77	x	1.44	x	94.68	x	0.63	x	0.7	=	41.67	(80)
West	0.9x	0.77	x	1.44	x	73.59	x	0.63	x	0.7	=	32.39	(80)
West	0.9x	0.77	x	1.44	x	45.59	x	0.63	x	0.7	=	20.06	(80)
West	0.9x	0.77	x	1.44	x	24.49	x	0.63	x	0.7	=	10.78	(80)
West	0.9x	0.77	x	1.44	x	16.15	x	0.63	x	0.7	=	7.11	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	154.95	256.53	333.08	385.59	409.26	396.91	386.53	369.93	351.23	278.51	184.2	133.53	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	533.75	633.37	697.95	731.22	735.49	704.36	681.72	670.67	661.81	608.52	536.52	502.45	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(86)m=	0.99	0.98	0.96	0.92	0.83	0.67	0.49	0.52	0.74	0.93	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.88	20.08	20.33	20.61	20.83	20.96	20.99	20.99	20.93	20.65	20.2	19.84	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.92	19.93	19.93	19.94	19.94	19.95	19.95	19.95	19.95	19.94	19.94	19.93	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.95	0.9	0.78	0.57	0.38	0.41	0.65	0.9	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.45	18.74	19.1	19.5	19.78	19.92	19.95	19.95	19.89	19.56	18.94	18.4	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.03	19.29	19.6	19.95	20.21	20.34	20.37	20.37	20.32	20	19.45	18.99	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.03	19.29	19.6	19.95	20.21	20.34	20.37	20.37	20.32	20	19.45	18.99	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.97	0.95	0.9	0.79	0.61	0.43	0.46	0.68	0.9	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	527.57	617.4	662.41	654.69	581.4	429.59	291.61	305.62	453.17	548.67	523.48	497.96	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1180.11	1149.67	1044.63	871.6	669.77	447.95	294.18	309.17	486.44	740.03	976.5	1173.88	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	485.48	357.69	284.37	156.17	65.75	0	0	0	0	142.37	326.17	502.88	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2320.89 (98)

Space heating requirement in kWh/m²/year 34.64 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	485.48	357.69	284.37	156.17	65.75	0	0	0	0	142.37	326.17	502.88	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	519.24	382.55	304.14	167.03	70.32	0	0	0	0	152.27	348.85	537.84	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2482.24 (211)

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Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)

186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09

Efficiency of water heater 79.8 (216)

(217)m=	87.25	86.83	86.13	84.83	82.75	79.8	79.8	79.8	79.8	84.49	86.53	87.39	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	213.75	189.38	200.69	182.92	183.95	170.73	164.23	179.84	179.41	190.43	196.31	208.37

Total = Sum(219a)$_{1...12}$ = 2260.02 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2482.24	
Water heating fuel used		2260.02	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		75	(231)
Electricity for lighting		307.48	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		5124.74	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	536.16	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	488.16	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1024.33	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	159.58	(268)
Total CO2, kg/year		sum of (265)…(271) =		1222.83	(272)

TER = 18.25 (273)

SAP Input

Property Details: Sample 5 (Bottom)

Address:	
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	26 July 2019
Date of certificate:	15 June 2022
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	498

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2022	
Floor Location:	Floor area:	Storey height:
Floor 0	67 m²	3 m
Living area:	27.5 m² (fraction 0.41)	
Front of dwelling faces:	Unspecified	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
DOOR	Manufacturer	Solid			Wood
E	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Balcony	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
DOOR	mm	0.7	0	1.4	2.4	1
E		0.7	0.4	1	4.16	1
Balcony		0.7	0.4	1	4.8	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
DOOR		INT	Worst case	0	0
E		E	East	0	0
Balcony		E	East	0	0

Overshading: More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
<u>External Elements</u>							
E	29.4	8.96	20.44	0.15	0	False	N/A
INT	12	2.4	9.6	0.16	0.43	False	N/A
Spandrel	2.44	0	2.44	0.35	0	False	N/A
Exposed	67			0.11			N/A
<u>Internal Elements</u>							
<u>Party Elements</u>							

Thermal bridges:

Thermal bridges: No information on thermal bridging (y=0.15) (y =0.15)

SAP Input

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	3
Pressure test:	3

Main heating system:

Main heating system:	Community heating schemes Heat source: Community boilers heat from boilers – mains gas, heat fraction 1, efficiency 95 Piping>=1991, pre-insulated, low temp, variable flow Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Boiler interlock: Yes

Main heating Control:

Main heating Control:	Charging system linked to use of community heating, programmer and TRVs Control code: 2306

Secondary heating system:

Secondary heating system:	None

Water heating:

Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Flue Gas Heat Recovery System: Database (rev 498, product index 060036) Brand name: Worcester Model: Greenstar Xtra Model qualifier: 2015 Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Sample 5 (Bottom)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67	(1a) x	3	(2a) =	201	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	201	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.05 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.25	0.25	0.25	0.23	0.23	0.22	0.22	0.21	0.22	0.23	0.24	0.24	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.25	0.25	0.25	0.23	0.23	0.22	0.22	0.21	0.22	0.23	0.24	0.24	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1.4	=	3.36			(26)
Windows Type 1			4.16	x	1/[1/(1)+ 0.04]	=	4			(27)
Windows Type 2			4.8	x	1/[1/(1)+ 0.04]	=	4.62			(27)
Floor			67	x	0.11	=	7.37			(28)
Walls Type1	29.4	8.96	20.44	x	0.15	=	3.07			(29)
Walls Type2	12	2.4	9.6	x	0.15	=	1.44			(29)
Walls Type3	2.44	0	2.44	x	0.35	=	0.85			(29)
Total area of elements, m²			110.84							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 24.7 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5479.72 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 16.63 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 41.33 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	16.78	16.59	16.39	15.43	15.24	14.27	14.27	14.08	14.66	15.24	15.62	16.01	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	58.11	57.92	57.72	56.76	56.57	55.6	55.6	55.41	55.99	56.57	56.95	57.34	

Average = Sum(39)$_{1…12}$ /12= 56.71 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.87	0.86	0.86	0.85	0.84	0.83	0.83	0.83	0.84	0.84	0.85	0.86

Average = Sum(40)1…12 /12= 0.85 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.17 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.76 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	94.34	90.91	87.48	84.05	80.62	77.19	77.19	80.62	84.05	87.48	90.91	94.34	
									Total = Sum(44)1…12 =			1029.18	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	139.91	122.36	126.27	110.08	105.63	91.15	84.46	96.92	98.08	114.3	124.77	135.49	
									Total = Sum(45)1…12 =			1349.41	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	20.99	18.35	18.94	16.51	15.84	13.67	12.67	14.54	14.71	17.15	18.72	20.32	(46)

Water storage loss:
Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)
If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)
Water storage loss:
a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)
Temperature factor from Table 2b 0 (49)
Energy lost from water storage, kWh/year (48) x (49) = 110 (50)
b) If manufacturer’s declared cylinder loss factor is not known:
Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)
If community heating see section 4.3
Volume factor from Table 2a 1.03 (52)
Temperature factor from Table 2b 0.6 (53)
Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)
Enter (50) or (54) in (55) 1.03 (55)
Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 0 (58)
Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	195.18	172.29	181.54	163.58	160.9	144.64	139.74	152.2	151.57	169.58	178.26	190.77	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	18.03	16.04	16.49	14.58	14.03	12.18	11.28	12.94	13.08	15.09	16.32	17.54	(63) (G2)

Output from water heater

(64)m=	174.47	153.83	162.37	146.4	144.19	129.86	125.78	136.58	135.89	151.81	159.35	170.55	

Output from water heater (annual)$_{1...12}$ | 1791.08 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	90.74	80.63	86.21	79.4	79.34	73.1	72.31	76.45	75.41	82.23	84.28	89.27	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.93	16.81	13.67	10.35	7.74	6.53	7.06	9.17	12.31	15.63	18.25	19.45	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	190.2	192.17	187.2	176.61	163.24	150.68	142.29	140.32	145.29	155.88	169.24	181.8	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	(71)

Water heating gains (Table 5)

(72)m=	121.96	119.98	115.87	110.27	106.64	101.53	97.18	102.75	104.73	110.52	117.06	119.99	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	386.65	384.53	372.3	352.8	333.19	314.31	302.1	307.81	317.9	337.6	360.11	376.81	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	4.16	x	19.64	x	0.4	x	0.7	=	15.85	(76)
East	0.9x	0.77	x	4.8	x	19.64	x	0.4	x	0.7	=	18.29	(76)
East	0.9x	0.77	x	4.16	x	38.42	x	0.4	x	0.7	=	31.01	(76)
East	0.9x	0.77	x	4.8	x	38.42	x	0.4	x	0.7	=	35.78	(76)

East	0.9x	0.77	x	4.16	x	63.27	x	0.4	x	0.7	=	51.07	(76)
East	0.9x	0.77	x	4.8	x	63.27	x	0.4	x	0.7	=	58.93	(76)
East	0.9x	0.77	x	4.16	x	92.28	x	0.4	x	0.7	=	74.49	(76)
East	0.9x	0.77	x	4.8	x	92.28	x	0.4	x	0.7	=	85.95	(76)
East	0.9x	0.77	x	4.16	x	113.09	x	0.4	x	0.7	=	91.29	(76)
East	0.9x	0.77	x	4.8	x	113.09	x	0.4	x	0.7	=	105.33	(76)
East	0.9x	0.77	x	4.16	x	115.77	x	0.4	x	0.7	=	93.45	(76)
East	0.9x	0.77	x	4.8	x	115.77	x	0.4	x	0.7	=	107.83	(76)
East	0.9x	0.77	x	4.16	x	110.22	x	0.4	x	0.7	=	88.97	(76)
East	0.9x	0.77	x	4.8	x	110.22	x	0.4	x	0.7	=	102.66	(76)
East	0.9x	0.77	x	4.16	x	94.68	x	0.4	x	0.7	=	76.42	(76)
East	0.9x	0.77	x	4.8	x	94.68	x	0.4	x	0.7	=	88.18	(76)
East	0.9x	0.77	x	4.16	x	73.59	x	0.4	x	0.7	=	59.4	(76)
East	0.9x	0.77	x	4.8	x	73.59	x	0.4	x	0.7	=	68.54	(76)
East	0.9x	0.77	x	4.16	x	45.59	x	0.4	x	0.7	=	36.8	(76)
East	0.9x	0.77	x	4.8	x	45.59	x	0.4	x	0.7	=	42.46	(76)
East	0.9x	0.77	x	4.16	x	24.49	x	0.4	x	0.7	=	19.77	(76)
East	0.9x	0.77	x	4.8	x	24.49	x	0.4	x	0.7	=	22.81	(76)
East	0.9x	0.77	x	4.16	x	16.15	x	0.4	x	0.7	=	13.04	(76)
East	0.9x	0.77	x	4.8	x	16.15	x	0.4	x	0.7	=	15.04	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	34.15	66.8	110.01	160.44	196.62	201.28	191.63	164.6	127.94	79.26	42.58	28.08	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	420.8	451.33	482.31	513.24	529.81	515.59	493.72	472.41	445.84	416.86	402.69	404.89	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.96	0.86	0.67	0.49	0.54	0.8	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.19	20.29	20.47	20.71	20.9	20.98	21	21	20.95	20.72	20.42	20.17	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.2	20.2	20.2	20.21	20.22	20.23	20.23	20.23	20.22	20.22	20.21	20.21	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.94	0.82	0.6	0.41	0.45	0.73	0.95	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.1	19.25	19.51	19.87	20.11	20.22	20.23	20.23	20.19	19.9	19.46	19.09	(90)

fLA = Living area ÷ (4) = | 0.41 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.55	19.67	19.9	20.21	20.44	20.53	20.54	20.54	20.5	20.24	19.85	19.53	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	19.55	19.67	19.9	20.21	20.44	20.53	20.54	20.54	20.5	20.24	19.85	19.53	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.94	0.83	0.63	0.44	0.48	0.76	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	418.82	447.64	473.1	483.44	442.06	323.33	218.68	228.6	337.53	396.95	398.63	403.37	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	886.02	855.69	773.75	642.13	494.16	329.85	219.26	229.62	358.42	545.05	726.2	879.21	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	347.6	274.21	223.69	114.26	38.77	0	0	0	0	110.19	235.85	354.02	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1698.58 (98)

Space heating requirement in kWh/m²/year 25.35 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers		1	(303a)
Fraction of total space heat from Community boilers	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		1698.58	
Space heat from Community boilers	(98) x (304a) x (305) x (306) =	1783.51	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		1791.08	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	1880.63	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	36.64	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		119.54	(330a)

warm air heating system fans				0	(330b)
pump for solar water heating				0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =			119.54	(331)
Energy for lighting (calculated in Appendix L)				334.24	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =				4117.92	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				95	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.22	=	833.11	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	19.02	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	852.13	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				852.13	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	62.04	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	173.47	(379)
Total CO2, kg/year	sum of (376)…(382) =				1087.64	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				16.23	(384)
EI rating (section 14)					86.99	(385)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Sample 5 (Bottom)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67	(1a) x	3	(2a) =	201	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	201	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.1	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.35	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.27	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.35	0.34	0.33	0.3	0.29	0.26	0.26	0.25	0.27	0.29	0.3	0.32

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.56	0.56	0.56	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.56	0.56	0.56	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1	=	2.4			(26)
Windows Type 1			4.16	x1/[1/(1.4)+ 0.04]		=	5.52			(27)
Windows Type 2			4.8	x1/[1/(1.4)+ 0.04]		=	6.36			(27)
Floor			67	x	0.13	=	8.71			(28)
Walls Type1	29.4	8.96	20.44	x	0.18	=	3.68			(29)
Walls Type2	12	2.4	9.6	x	0.18	=	1.73			(29)
Walls Type3	2.44	0	2.44	x	0.18	=	0.44			(29)
Total area of elements, m²			110.84							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.84 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5479.72 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 5.54 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 34.38 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	37.12	36.97	36.82	36.11	35.98	35.36	35.36	35.25	35.6	35.98	36.24	36.52	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	71.5	71.34	71.19	70.49	70.35	69.74	69.74	69.62	69.98	70.35	70.62	70.9	

Average = Sum(39)$_{1…12}$ /12= 70.49 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.07	1.06	1.06	1.05	1.05	1.04	1.04	1.04	1.04	1.05	1.05	1.06

Average = Sum(40)$_{1…12}$ /12= 1.05 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.17 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.76 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	94.34	90.91	87.48	84.05	80.62	77.19	77.19	80.62	84.05	87.48	90.91	94.34	
Total = Sum(44)$_{1…12}$ =												1029.18	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	139.91	122.36	126.27	110.08	105.63	91.15	84.46	96.92	98.08	114.3	124.77	135.49	
Total = Sum(45)$_{1…12}$ =												1349.41	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	20.99	18.35	18.94	16.51	15.84	13.67	12.67	14.54	14.71	17.15	18.72	20.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09	

Output from water heater (annual)$_{1...12}$ 1898.03 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	83.79	74.35	79.26	72.68	72.4	66.38	65.36	69.5	68.68	75.28	77.56	82.33	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.37	16.32	13.27	10.05	7.51	6.34	6.85	8.91	11.95	15.18	17.72	18.89	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	190.2	192.17	187.2	176.61	163.24	150.68	142.29	140.32	145.29	155.88	169.24	181.8	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	(71)

Water heating gains (Table 5)

(72)m=	112.63	110.65	106.53	100.94	97.31	92.19	87.85	93.42	95.4	101.18	107.72	110.65	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	379.77	377.7	365.57	346.16	326.63	307.78	295.56	301.21	311.21	330.81	353.25	369.91	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	4.16	x	19.64	x	0.63	x	0.7	=	24.97	(76)
East	0.9x	0.77	x	4.8	x	19.64	x	0.63	x	0.7	=	28.81	(76)
East	0.9x	0.77	x	4.16	x	38.42	x	0.63	x	0.7	=	48.85	(76)
East	0.9x	0.77	x	4.8	x	38.42	x	0.63	x	0.7	=	56.36	(76)

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East	0.9x	0.77	x	4.16	x	63.27	x	0.63	x	0.7	=	80.44	(76)
East	0.9x	0.77	x	4.8	x	63.27	x	0.63	x	0.7	=	92.82	(76)
East	0.9x	0.77	x	4.16	x	92.28	x	0.63	x	0.7	=	117.32	(76)
East	0.9x	0.77	x	4.8	x	92.28	x	0.63	x	0.7	=	135.37	(76)
East	0.9x	0.77	x	4.16	x	113.09	x	0.63	x	0.7	=	143.78	(76)
East	0.9x	0.77	x	4.8	x	113.09	x	0.63	x	0.7	=	165.9	(76)
East	0.9x	0.77	x	4.16	x	115.77	x	0.63	x	0.7	=	147.18	(76)
East	0.9x	0.77	x	4.8	x	115.77	x	0.63	x	0.7	=	169.83	(76)
East	0.9x	0.77	x	4.16	x	110.22	x	0.63	x	0.7	=	140.13	(76)
East	0.9x	0.77	x	4.8	x	110.22	x	0.63	x	0.7	=	161.68	(76)
East	0.9x	0.77	x	4.16	x	94.68	x	0.63	x	0.7	=	120.37	(76)
East	0.9x	0.77	x	4.8	x	94.68	x	0.63	x	0.7	=	138.88	(76)
East	0.9x	0.77	x	4.16	x	73.59	x	0.63	x	0.7	=	93.56	(76)
East	0.9x	0.77	x	4.8	x	73.59	x	0.63	x	0.7	=	107.95	(76)
East	0.9x	0.77	x	4.16	x	45.59	x	0.63	x	0.7	=	57.96	(76)
East	0.9x	0.77	x	4.8	x	45.59	x	0.63	x	0.7	=	66.88	(76)
East	0.9x	0.77	x	4.16	x	24.49	x	0.63	x	0.7	=	31.13	(76)
East	0.9x	0.77	x	4.8	x	24.49	x	0.63	x	0.7	=	35.92	(76)
East	0.9x	0.77	x	4.16	x	16.15	x	0.63	x	0.7	=	20.53	(76)
East	0.9x	0.77	x	4.8	x	16.15	x	0.63	x	0.7	=	23.69	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	53.78	105.21	173.26	252.69	309.68	317.01	301.81	259.25	201.51	124.84	67.06	44.23	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	433.55	482.91	538.83	598.85	636.31	624.8	597.37	560.46	512.71	455.64	420.3	414.14	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.95	0.86	0.68	0.51	0.56	0.82	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.92	20.05	20.29	20.6	20.84	20.97	20.99	20.99	20.91	20.59	20.2	19.89	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.03	20.03	20.03	20.04	20.04	20.05	20.05	20.05	20.05	20.04	20.04	20.04	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.93	0.81	0.59	0.4	0.45	0.75	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.58	18.78	19.12	19.57	19.89	20.03	20.05	20.05	19.98	19.56	19	18.55	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.13	19.3	19.6	19.99	20.28	20.41	20.44	20.43	20.36	19.98	19.49	19.1	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	19.13	19.3	19.6	19.99	20.28	20.41	20.44	20.43	20.36	19.98	19.49	19.1	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation factor for gains, hm:														
(94)m=	0.99	0.99	0.98	0.93	0.82	0.63	0.44	0.5	0.77	0.95	0.99	1		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	431.37	478.35	526.41	558.24	522.37	391.03	265.65	277.6	395.38	434.69	416.08	412.49		(95)
Monthly average external temperature from Table 8														
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]														
(97)m=	1060.36	1027.32	932.66	781.63	603.7	405.41	267.51	280.88	437.95	660.12	875.06	1056.59		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	467.97	368.9	302.25	160.84	60.51	0	0	0	0	167.71	330.47	479.21		
Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =													2337.86	(98)
Space heating requirement in kWh/m²/year													34.89	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	467.97	368.9	302.25	160.84	60.51	0	0	0	0	167.71	330.47	479.21		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	500.5	394.55	323.26	172.02	64.72	0	0	0	0	179.37	353.44	512.52		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													2500.39	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

Output from water heater (calculated above)														
	186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09		
Efficiency of water heater													79.8	(216)
(217)m=	87.17	86.91	86.29	84.91	82.58	79.8	79.8	79.8	79.8	84.92	86.56	87.28		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	213.95	189.22	200.33	182.75	184.34	170.73	164.23	179.84	179.41	189.46	196.24	208.63		
Total = Sum(219a)$_{1...12}$ =													2259.13	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		2500.39

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Water heating fuel used			2259.13	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			324.5	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			5159.01	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	540.08	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	487.97	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1028.05	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	168.41	(268)
Total CO2, kg/year		sum of (265)…(271) =		1235.39	(272)
TER =				18.44	(273)

SAP Input

Property Details: Sample 6 (Bottom)

Address:	
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	26 July 2019
Date of certificate:	15 June 2022
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	498

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2022	
Floor Location:	Floor area:	Storey height:
Floor 0	55.1 m²	3 m
Living area:	26 m² (fraction 0.472)	
Front of dwelling faces:	Unspecified	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
DOOR	Manufacturer	Solid			Wood
W	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Balcony	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
DOOR	mm	0.7	0	1.4	2.4	1
W		0.7	0.4	1	4.16	1
Balcony		0.7	0.4	1	4.8	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
DOOR		INT	Worst case	0	0
W		W	West	0	0
Balcony		W	West	0	0

Overshading: More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
W	24	8.96	15.04	0.15	0	False	N/A
INT	24	2.4	21.6	0.16	0.43	False	N/A
Spandrel	2.4	0	2.4	0.35	0	False	N/A
Exposed	55.1			0.11			N/A
Internal Elements							
Party Elements							

Thermal bridges:

Thermal bridges: No information on thermal bridging (y=0.15) (y =0.15)

SAP Input

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	3
Pressure test:	3

Main heating system:

Main heating system:	Community heating schemes Heat source: Community boilers heat from boilers – mains gas, heat fraction 1, efficiency 95 Piping>=1991, pre-insulated, low temp, variable flow Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Boiler interlock: Yes

Main heating Control:

Main heating Control:	Charging system linked to use of community heating, programmer and TRVs Control code: 2306

Secondary heating system:

Secondary heating system:	None

Water heating:

Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Flue Gas Heat Recovery System: Database (rev 498, product index 060036) Brand name: Worcester Model: Greenstar Xtra Model qualifier: 2015 Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

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User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.5.51

Property Address: Sample 6 (Bottom)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	55.1	(1a) x	3	(2a) =	165.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.1	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	165.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

DRAFT

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35				
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration		0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate		(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			3	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
Number of sides sheltered			3	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor		(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.05 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.25	0.25	0.25	0.23	0.23	0.22	0.22	0.21	0.22	0.23	0.24	0.24	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.25	0.25	0.25	0.23	0.23	0.22	0.22	0.21	0.22	0.23	0.24	0.24	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1.4	=	3.36			(26)
Windows Type 1			4.16	x	1/[1/(1)+ 0.04]	=	4			(27)
Windows Type 2			4.8	x	1/[1/(1)+ 0.04]	=	4.62			(27)
Floor			55.1	x	0.11	=	6.061			(28)
Walls Type1	24	8.96	15.04	x	0.15	=	2.26			(29)
Walls Type2	24	2.4	21.6	x	0.15	=	3.23			(29)
Walls Type3	2.4	0	2.4	x	0.35	=	0.84			(29)
Total area of elements, m²			105.5							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 24.37 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 4679.06 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 15.83 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 40.19 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	13.8	13.64	13.48	12.69	12.53	11.74	11.74	11.58	12.06	12.53	12.85	13.17	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	53.99	53.83	53.67	52.88	52.72	51.93	51.93	51.77	52.25	52.72	53.04	53.36	

Average = Sum(39)$_{1…12}$ /12= 52.84 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.98	0.98	0.97	0.96	0.96	0.94	0.94	0.94	0.95	0.96	0.96	0.97

Average = Sum(40)$_{1...12}$ /12= 0.96 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.84 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 77.91 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	85.7	82.58	79.47	76.35	73.23	70.12	70.12	73.23	76.35	79.47	82.58	85.7

Total = Sum(44)$_{1...12}$ = 934.88 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	127.09	111.15	114.7	100	95.95	82.8	76.72	88.04	89.09	103.83	113.34	123.08

Total = Sum(45)$_{1...12}$ = 1225.78 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.06	16.67	17.2	15	14.39	12.42	11.51	13.21	13.36	15.57	17	18.46	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	182.36	161.08	169.97	153.49	151.23	136.29	132	143.32	142.59	159.11	166.83	178.35	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	16.59	14.71	15.14	13.33	12.81	11.05	10.22	11.77	11.91	13.81	14.97	16.12	(63) (G2)

Output from water heater

(64)m=	163.1	143.95	152.16	137.57	135.73	122.64	119.09	128.87	128.08	142.61	149.26	159.55	

Output from water heater (annual)1…12 1682.61 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	86.48	76.9	82.36	76.04	76.12	70.32	69.73	73.5	72.42	78.74	80.48	85.14	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	15.29	13.58	11.05	8.36	6.25	5.28	5.7	7.41	9.95	12.63	14.74	15.72	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	160.44	162.11	157.91	148.98	137.71	127.11	120.03	118.37	122.56	131.49	142.77	153.36	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	(71)
Water heating gains (Table 5)													
(72)m=	116.23	114.43	110.7	105.62	102.32	97.67	93.73	98.78	100.58	105.84	111.78	114.44	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	342.57	340.73	330.26	313.56	296.88	280.66	270.06	275.17	283.69	300.57	319.89	334.13	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	4.16	x	19.64	x	0.4	x	0.7	=	15.85	(80)
West	0.9x	0.77	x	4.8	x	19.64	x	0.4	x	0.7	=	18.29	(80)
West	0.9x	0.77	x	4.16	x	38.42	x	0.4	x	0.7	=	31.01	(80)
West	0.9x	0.77	x	4.8	x	38.42	x	0.4	x	0.7	=	35.78	(80)

West	0.9x	0.77	x	4.16	x	63.27	x	0.4	x	0.7	=	51.07	(80)
West	0.9x	0.77	x	4.8	x	63.27	x	0.4	x	0.7	=	58.93	(80)
West	0.9x	0.77	x	4.16	x	92.28	x	0.4	x	0.7	=	74.49	(80)
West	0.9x	0.77	x	4.8	x	92.28	x	0.4	x	0.7	=	85.95	(80)
West	0.9x	0.77	x	4.16	x	113.09	x	0.4	x	0.7	=	91.29	(80)
West	0.9x	0.77	x	4.8	x	113.09	x	0.4	x	0.7	=	105.33	(80)
West	0.9x	0.77	x	4.16	x	115.77	x	0.4	x	0.7	=	93.45	(80)
West	0.9x	0.77	x	4.8	x	115.77	x	0.4	x	0.7	=	107.83	(80)
West	0.9x	0.77	x	4.16	x	110.22	x	0.4	x	0.7	=	88.97	(80)
West	0.9x	0.77	x	4.8	x	110.22	x	0.4	x	0.7	=	102.66	(80)
West	0.9x	0.77	x	4.16	x	94.68	x	0.4	x	0.7	=	76.42	(80)
West	0.9x	0.77	x	4.8	x	94.68	x	0.4	x	0.7	=	88.18	(80)
West	0.9x	0.77	x	4.16	x	73.59	x	0.4	x	0.7	=	59.4	(80)
West	0.9x	0.77	x	4.8	x	73.59	x	0.4	x	0.7	=	68.54	(80)
West	0.9x	0.77	x	4.16	x	45.59	x	0.4	x	0.7	=	36.8	(80)
West	0.9x	0.77	x	4.8	x	45.59	x	0.4	x	0.7	=	42.46	(80)
West	0.9x	0.77	x	4.16	x	24.49	x	0.4	x	0.7	=	19.77	(80)
West	0.9x	0.77	x	4.8	x	24.49	x	0.4	x	0.7	=	22.81	(80)
West	0.9x	0.77	x	4.16	x	16.15	x	0.4	x	0.7	=	13.04	(80)
West	0.9x	0.77	x	4.8	x	16.15	x	0.4	x	0.7	=	15.04	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	34.15	66.8	110.01	160.44	196.62	201.28	191.63	164.6	127.94	79.26	42.58	28.08	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	376.72	407.53	440.27	474	493.5	481.94	461.69	439.77	411.64	379.83	362.47	362.21	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) — 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.95	0.85	0.66	0.49	0.53	0.79	0.96	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.07	20.19	20.39	20.66	20.88	20.98	21	20.99	20.94	20.68	20.33	20.06	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.1	20.1	20.1	20.12	20.12	20.13	20.13	20.13	20.13	20.12	20.11	20.11	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.98	0.93	0.8	0.58	0.4	0.44	0.72	0.94	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.87	19.03	19.33	19.72	20	20.12	20.13	20.13	20.08	19.75	19.26	18.85	(90)

fLA = Living area ÷ (4) = 0.47 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.44	19.58	19.83	20.17	20.41	20.52	20.54	20.54	20.49	20.19	19.76	19.42	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	19.44	19.58	19.83	20.17	20.41	20.52	20.54	20.54	20.49	20.19	19.76	19.42	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.93	0.82	0.62	0.44	0.48	0.75	0.95	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	374.3	403.06	429.5	441.63	405.39	299.4	203.63	212.72	309.59	359.08	357.76	360.31	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	817.25	790.13	715.57	595.82	459.34	307.59	204.56	214.28	333.61	505.4	671.72	812.02	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	329.56	260.12	212.84	111.02	40.14	0	0	0	0	108.86	226.05	336.07	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1624.65 (98)

Space heating requirement in kWh/m²/year 29.49 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers		1	(303a)
Fraction of total space heat from Community boilers	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		1624.65	
Space heat from Community boilers	(98) x (304a) x (305) x (306) =	1705.88	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		1682.61	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	1766.74	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	34.73	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		98.31	(330a)

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warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	98.31	(331)
Energy for lighting (calculated in Appendix L)		270.05	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		3840.99	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				95	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.22	=	789.57	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	18.02	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	807.59	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				807.59	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	51.02	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	140.16	(379)
Total CO2, kg/year	sum of (376)…(382) =				998.77	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				18.13	(384)
EI rating (section 14)					86.63	(385)

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User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.51

Property Address: Sample 6 (Bottom)

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	55.1	(1a)	x	3	(2a)	=	165.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.1	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			165.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

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			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.12	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.37	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.29	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.37	0.36	0.35	0.32	0.31	0.27	0.27	0.27	0.29	0.31	0.32	0.34

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.56	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.56	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1	=	2.4			(26)
Windows Type 1			4.16	x1/[1/(1.4)+ 0.04]		=	5.52			(27)
Windows Type 2			4.8	x1/[1/(1.4)+ 0.04]		=	6.36			(27)
Floor			55.1	x	0.13	=	7.163			(28)
Walls Type1	24	8.96	15.04	x	0.18	=	2.71			(29)
Walls Type2	24	2.4	21.6	x	0.18	=	3.89			(29)
Walls Type3	2.4	0	2.4	x	0.18	=	0.43			(29)
Total area of elements, m²			105.5							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.47 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 4679.06 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 5.28 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 33.74 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	30.94	30.8	30.66	30	29.88	29.31	29.31	29.2	29.53	29.88	30.13	30.39	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	64.68	64.54	64.4	63.75	63.62	63.05	63.05	62.95	63.27	63.62	63.87	64.13

Average = Sum(39)$_{1…12}$ /12= 63.75 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.17	1.17	1.17	1.16	1.15	1.14	1.14	1.14	1.15	1.15	1.16	1.16

Average = Sum(40)$_{1…12}$ /12= 1.16 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.84 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 77.91 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	85.7	82.58	79.47	76.35	73.23	70.12	70.12	73.23	76.35	79.47	82.58	85.7

Total = Sum(44)$_{1…12}$ = 934.88 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	127.09	111.15	114.7	100	95.95	82.8	76.72	88.04	89.09	103.83	113.34	123.08

Total = Sum(45)$_{1…12}$ = 1225.78 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.06	16.67	17.2	15	14.39	12.42	11.51	13.21	13.36	15.57	17	18.46	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	173.68	153.24	161.29	145.09	142.54	127.89	123.32	134.64	134.18	150.42	158.43	169.67	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	173.68	153.24	161.29	145.09	142.54	127.89	123.32	134.64	134.18	150.42	158.43	169.67	

Output from water heater (annual)$_{1...12}$ 1774.4 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	79.53	70.63	75.41	69.32	69.18	63.6	62.79	66.55	65.7	71.8	73.76	78.2	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	14.88	13.21	10.74	8.13	6.08	5.13	5.55	7.21	9.68	12.29	14.34	15.29	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	160.44	162.11	157.91	148.98	137.71	127.11	120.03	118.37	122.56	131.49	142.77	153.36	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	(71)

Water heating gains (Table 5)

(72)m=	106.9	105.1	101.36	96.28	92.98	88.34	84.39	89.45	91.25	96.5	102.44	105.11	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	335.82	334.02	323.62	307	290.37	274.19	263.57	268.63	277.09	293.89	313.16	327.36	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	4.16	x	19.64	x	0.63	x	0.7	=	24.97	(80)
West	0.9x	0.77	x	4.8	x	19.64	x	0.63	x	0.7	=	28.81	(80)
West	0.9x	0.77	x	4.16	x	38.42	x	0.63	x	0.7	=	48.85	(80)
West	0.9x	0.77	x	4.8	x	38.42	x	0.63	x	0.7	=	56.36	(80)

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West	0.9x	0.77	x	4.16	x	63.27	x	0.63	x	0.7	=	80.44	(80)
West	0.9x	0.77	x	4.8	x	63.27	x	0.63	x	0.7	=	92.82	(80)
West	0.9x	0.77	x	4.16	x	92.28	x	0.63	x	0.7	=	117.32	(80)
West	0.9x	0.77	x	4.8	x	92.28	x	0.63	x	0.7	=	135.37	(80)
West	0.9x	0.77	x	4.16	x	113.09	x	0.63	x	0.7	=	143.78	(80)
West	0.9x	0.77	x	4.8	x	113.09	x	0.63	x	0.7	=	165.9	(80)
West	0.9x	0.77	x	4.16	x	115.77	x	0.63	x	0.7	=	147.18	(80)
West	0.9x	0.77	x	4.8	x	115.77	x	0.63	x	0.7	=	169.83	(80)
West	0.9x	0.77	x	4.16	x	110.22	x	0.63	x	0.7	=	140.13	(80)
West	0.9x	0.77	x	4.8	x	110.22	x	0.63	x	0.7	=	161.68	(80)
West	0.9x	0.77	x	4.16	x	94.68	x	0.63	x	0.7	=	120.37	(80)
West	0.9x	0.77	x	4.8	x	94.68	x	0.63	x	0.7	=	138.88	(80)
West	0.9x	0.77	x	4.16	x	73.59	x	0.63	x	0.7	=	93.56	(80)
West	0.9x	0.77	x	4.8	x	73.59	x	0.63	x	0.7	=	107.95	(80)
West	0.9x	0.77	x	4.16	x	45.59	x	0.63	x	0.7	=	57.96	(80)
West	0.9x	0.77	x	4.8	x	45.59	x	0.63	x	0.7	=	66.88	(80)
West	0.9x	0.77	x	4.16	x	24.49	x	0.63	x	0.7	=	31.13	(80)
West	0.9x	0.77	x	4.8	x	24.49	x	0.63	x	0.7	=	35.92	(80)
West	0.9x	0.77	x	4.16	x	16.15	x	0.63	x	0.7	=	20.53	(80)
West	0.9x	0.77	x	4.8	x	16.15	x	0.63	x	0.7	=	23.69	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	53.78	105.21	173.26	252.69	309.68	317.01	301.81	259.25	201.51	124.84	67.06	44.23	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	389.6	439.23	496.88	559.69	600.05	591.2	565.38	527.88	478.6	418.73	380.21	371.59	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.94	0.83	0.65	0.48	0.54	0.79	0.96	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.83	19.98	20.24	20.58	20.84	20.96	20.99	20.99	20.9	20.56	20.13	19.8	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.94	19.94	19.95	19.95	19.96	19.96	19.96	19.97	19.96	19.96	19.95	19.95	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.97	0.91	0.77	0.56	0.37	0.42	0.71	0.94	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.39	18.61	18.99	19.47	19.8	19.94	19.96	19.96	19.89	19.46	18.84	18.36	(90)

fLA = Living area ÷ (4) = 0.47 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.07	19.25	19.58	19.99	20.29	20.42	20.45	20.45	20.37	19.98	19.45	19.04	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	19.07	19.25	19.58	19.99	20.29	20.42	20.45	20.45	20.37	19.98	19.45	19.04	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation factor for gains, hm:														
(94)m=	0.99	0.99	0.97	0.91	0.79	0.6	0.43	0.48	0.75	0.94	0.99	0.99		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	386.85	433.43	481.37	511.66	475.54	353.93	240.73	251.36	357.64	394.66	375	369.48		(95)
Monthly average external temperature from Table 8														
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]														
(97)m=	955.18	926.41	842.45	707.2	546.66	367.27	242.68	254.72	396.54	596.52	788.88	951.45		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	422.83	331.29	268.64	140.79	52.92	0	0	0	0	150.19	297.99	432.99		
Total per year (kWh/year) = Sum(98)1...5,9...12 =													2097.63	(98)
Space heating requirement in kWh/m²/year													38.07	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	422.83	331.29	268.64	140.79	52.92	0	0	0	0	150.19	297.99	432.99		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	452.23	354.32	287.32	150.58	56.59	0	0	0	0	160.63	318.71	463.09		
Total (kWh/year) =Sum(211)1...5,10....12=													2243.46	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)1...5,10....12=													0	(215)

Water heating

Output from water heater (calculated above)														
	173.68	153.24	161.29	145.09	142.54	127.89	123.32	134.64	134.18	150.42	158.43	169.67		
Efficiency of water heater													79.8	(216)
(217)m=	87.1	86.82	86.17	84.73	82.44	79.8	79.8	79.8	79.8	84.81	86.48	87.21		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	199.41	176.5	187.19	171.23	172.91	160.26	154.53	168.72	168.15	177.37	183.21	194.56		
Total = Sum(219a)1...12 =													2114.03	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		2243.46

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Water heating fuel used			2114.03	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			262.71	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			4695.2	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	484.59	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	456.63	(264)
Space and water heating	(261) + (262) + (263) + (264) =			941.22	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	136.34	(268)
Total CO2, kg/year		sum of (265)…(271) =		1116.49	(272)

TER = 20.26 (273)

SAP Input

Property Details: Sample 4 (Top)

Address:	
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	26 July 2019
Date of certificate:	15 June 2022
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	498

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2022	
Floor Location:	Floor area:	Storey height:
Floor 0	67 m²	3 m
Living area:	27.3 m² (fraction 0.407)	
Front of dwelling faces:	Unspecified	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
DOOR	Manufacturer	Solid			Wood
W	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
S	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Balcony	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
DOOR	mm	0.7	0	1.4	2.4	1
W		0.7	0.4	1	1.44	1
S		0.7	0.4	1	5.44	1
Balcony		0.7	0.4	1	4.8	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
DOOR		INT	Worst case	0	0
W		W	West	0	0
S		S	South	0	0
Balcony		S	South	0	0

Overshading: More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
S	31.7	10.24	21.46	0.15	0	False	N/A
W	19	1.44	17.56	0.15	0	False	N/A
INT	11.1	2.4	8.7	0.16	0.43	False	N/A
Spandrel	2.4	0	2.4	0.35	0	False	N/A
Roof	67	0	67	0.11	0		N/A
Internal Elements							
Party Elements							

SAP Input

Thermal bridges:	
Thermal bridges:	No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:	
Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	3

Main heating system:	
Main heating system:	Community heating schemes Heat source: Community boilers heat from boilers – mains gas, heat fraction 1, efficiency 95 Piping>=1991, pre-insulated, low temp, variable flow Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Boiler interlock: Yes

Main heating Control:	
Main heating Control:	Charging system linked to use of community heating, programmer and TRVs Control code: 2306

Secondary heating system:	
Secondary heating system:	None

Water heating:	
Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Flue Gas Heat Recovery System: Database (rev 498, product index 060036) Brand name: Worcester Model: Greenstar Xtra Model qualifier: 2015 Solar panel: False

Others:	
Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.5.51

Property Address: Sample 4 (Top)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67	(1a) x	3	(2a) =	201	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		201	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.05 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1.4	=	3.36			(26)
Windows Type 1			1.44	x	1/[1/(1)+ 0.04]	=	1.38			(27)
Windows Type 2			5.44	x	1/[1/(1)+ 0.04]	=	5.23			(27)
Windows Type 3			4.8	x	1/[1/(1)+ 0.04]	=	4.62			(27)
Walls Type1	31.7	10.24	21.46	x	0.15	=	3.22			(29)
Walls Type2	19	1.44	17.56	x	0.15	=	2.63			(29)
Walls Type3	11.1	2.4	8.7	x	0.15	=	1.3			(29)
Walls Type4	2.4	0	2.4	x	0.35	=	0.84			(29)
Roof	67	0	67	x	0.11	=	7.37			(30)
Total area of elements, m²			131.2							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 29.96 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 1304.68 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.68 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 49.64 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(38)m=	17.73	17.52	17.31	16.25	16.04	14.98	14.98	14.77	15.41	16.04	16.46	16.89	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	67.37	67.16	66.94	65.89	65.68	64.62	64.62	64.41	65.04	65.68	66.1	66.52	

Average = Sum(39)$_{1...12}$ /12= 65.83 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.01	1	1	0.98	0.98	0.96	0.96	0.96	0.97	0.98	0.99	0.99

Average = Sum(40)$_{1...12}$ /12= 0.98 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.17 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.76 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	94.34	90.91	87.48	84.05	80.62	77.19	77.19	80.62	84.05	87.48	90.91	94.34	
												Total = Sum(44)$_{1...12}$ = 1029.18	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	139.91	122.36	126.27	110.08	105.63	91.15	84.46	96.92	98.08	114.3	124.77	135.49	
												Total = Sum(45)$_{1...12}$ = 1349.41	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.99	18.35	18.94	16.51	15.84	13.67	12.67	14.54	14.71	17.15	18.72	20.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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Primary circuit loss (annual) from Table 3	0	(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	195.18	172.29	181.54	163.58	160.9	144.64	139.74	152.2	151.57	169.58	178.26	190.77	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	18.03	16.04	16.49	14.58	14.03	12.18	11.28	12.94	13.08	15.09	16.32	17.54	(63) (G2)

Output from water heater

(64)m=	174.47	153.83	162.37	146.4	144.19	129.86	125.78	136.58	135.89	151.81	159.35	170.55	

Output from water heater (annual)$_{1…12}$	1791.08	(64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	90.74	80.63	86.21	79.4	79.34	73.1	72.31	76.45	75.41	82.23	84.28	89.27	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.86	15.86	12.9	9.77	7.3	6.16	6.66	8.66	11.62	14.75	17.22	18.36	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	190.2	192.17	187.2	176.61	163.24	150.68	142.29	140.32	145.29	155.88	169.24	181.8	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	(71)

Water heating gains (Table 5)

(72)m=	121.96	119.98	115.87	110.27	106.64	101.53	97.18	102.75	104.73	110.52	117.06	119.99	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	385.59	383.58	371.53	352.22	332.75	313.94	301.7	307.29	317.21	336.72	359.09	375.72	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	5.44	x	46.75	x	0.4	x	0.7	=	49.35	(78)

South	0.9x	0.77	x	4.8	x	46.75	x	0.4	x	0.7	=	43.54	(78)
South	0.9x	0.77	x	5.44	x	76.57	x	0.4	x	0.7	=	80.82	(78)
South	0.9x	0.77	x	4.8	x	76.57	x	0.4	x	0.7	=	71.31	(78)
South	0.9x	0.77	x	5.44	x	97.53	x	0.4	x	0.7	=	102.95	(78)
South	0.9x	0.77	x	4.8	x	97.53	x	0.4	x	0.7	=	90.84	(78)
South	0.9x	0.77	x	5.44	x	110.23	x	0.4	x	0.7	=	116.36	(78)
South	0.9x	0.77	x	4.8	x	110.23	x	0.4	x	0.7	=	102.67	(78)
South	0.9x	0.77	x	5.44	x	114.87	x	0.4	x	0.7	=	121.26	(78)
South	0.9x	0.77	x	4.8	x	114.87	x	0.4	x	0.7	=	106.99	(78)
South	0.9x	0.77	x	5.44	x	110.55	x	0.4	x	0.7	=	116.69	(78)
South	0.9x	0.77	x	4.8	x	110.55	x	0.4	x	0.7	=	102.96	(78)
South	0.9x	0.77	x	5.44	x	108.01	x	0.4	x	0.7	=	114.01	(78)
South	0.9x	0.77	x	4.8	x	108.01	x	0.4	x	0.7	=	100.6	(78)
South	0.9x	0.77	x	5.44	x	104.89	x	0.4	x	0.7	=	110.72	(78)
South	0.9x	0.77	x	4.8	x	104.89	x	0.4	x	0.7	=	97.7	(78)
South	0.9x	0.77	x	5.44	x	101.89	x	0.4	x	0.7	=	107.55	(78)
South	0.9x	0.77	x	4.8	x	101.89	x	0.4	x	0.7	=	94.9	(78)
South	0.9x	0.77	x	5.44	x	82.59	x	0.4	x	0.7	=	87.18	(78)
South	0.9x	0.77	x	4.8	x	82.59	x	0.4	x	0.7	=	76.92	(78)
South	0.9x	0.77	x	5.44	x	55.42	x	0.4	x	0.7	=	58.5	(78)
South	0.9x	0.77	x	4.8	x	55.42	x	0.4	x	0.7	=	51.62	(78)
South	0.9x	0.77	x	5.44	x	40.4	x	0.4	x	0.7	=	42.64	(78)
South	0.9x	0.77	x	4.8	x	40.4	x	0.4	x	0.7	=	37.63	(78)
West	0.9x	0.77	x	1.44	x	19.64	x	0.4	x	0.7	=	5.49	(80)
West	0.9x	0.77	x	1.44	x	38.42	x	0.4	x	0.7	=	10.74	(80)
West	0.9x	0.77	x	1.44	x	63.27	x	0.4	x	0.7	=	17.68	(80)
West	0.9x	0.77	x	1.44	x	92.28	x	0.4	x	0.7	=	25.78	(80)
West	0.9x	0.77	x	1.44	x	113.09	x	0.4	x	0.7	=	31.6	(80)
West	0.9x	0.77	x	1.44	x	115.77	x	0.4	x	0.7	=	32.35	(80)
West	0.9x	0.77	x	1.44	x	110.22	x	0.4	x	0.7	=	30.8	(80)
West	0.9x	0.77	x	1.44	x	94.68	x	0.4	x	0.7	=	26.45	(80)
West	0.9x	0.77	x	1.44	x	73.59	x	0.4	x	0.7	=	20.56	(80)
West	0.9x	0.77	x	1.44	x	45.59	x	0.4	x	0.7	=	12.74	(80)
West	0.9x	0.77	x	1.44	x	24.49	x	0.4	x	0.7	=	6.84	(80)
West	0.9x	0.77	x	1.44	x	16.15	x	0.4	x	0.7	=	4.51	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	98.38	162.87	211.48	244.82	259.85	252	245.41	234.88	223.01	176.83	116.95	84.78	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	483.97	546.46	583.01	597.03	592.6	565.95	547.11	542.17	540.21	513.55	476.04	460.5	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(86)m=	0.99	0.99	0.98	0.94	0.86	0.69	0.51	0.54	0.76	0.94	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.07	20.22	20.42	20.66	20.86	20.97	21	20.99	20.95	20.71	20.35	20.05	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.08	20.08	20.08	20.1	20.1	20.11	20.11	20.12	20.11	20.1	20.09	20.09	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.97	0.92	0.82	0.61	0.41	0.44	0.69	0.92	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.85	19.07	19.36	19.7	19.96	20.09	20.11	20.11	20.07	19.78	19.27	18.82	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.35	19.54	19.79	20.09	20.33	20.45	20.47	20.47	20.43	20.16	19.71	19.32	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.35	19.54	19.79	20.09	20.33	20.45	20.47	20.47	20.43	20.16	19.71	19.32	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.97	0.92	0.83	0.65	0.45	0.48	0.72	0.92	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	479.93	537.31	563.24	552.12	492.69	365.13	248.72	260.28	387.24	473.6	467.42	457.5	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1013.82	982.98	889.74	737.57	566.46	378.05	250.18	262.28	411.46	627.84	833.51	1006	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	397.22	299.49	242.92	133.53	54.89	0	0	0	0	114.75	263.58	408.09	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 1914.46 (98)

Space heating requirement in kWh/m²/year 28.57 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none 0 (301)

Fraction of space heat from community system 1 – (301) = 1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers 1 (303a)

Fraction of total space heat from Community boilers (302) x (303a) = 1 (304a)

Factor for control and charging method (Table 4c(3)) for community heating system 1 (305)

Distribution loss factor (Table 12c) for community heating system 1.05 (306)

Space heating	**kWh/year**
Annual space heating requirement	1914.46

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Space heat from Community boilers	(98) x (304a) x (305) x (306) =	2010.19	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)

Water heating

Annual water heating requirement		1791.08	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	1880.63	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	38.91	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		119.54	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	119.54	(331)
Energy for lighting (calculated in Appendix L)		315.44	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		4325.81	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				95	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.22	=	884.65	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	20.19	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	904.84	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				904.84	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	62.04	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	163.72	(379)

Total CO2, kg/year	sum of (376)…(382) =	1130.6	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =	16.87	(384)
EI rating (section 14)		86.47	(385)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Sample 4 (Top)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67	(1a) x	3	(2a) =	201	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		201	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

DRAFT

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.1	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*			0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration		0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate		(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.35	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
Number of sides sheltered			2	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor		(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.37	0.36	0.33	0.32	0.28	0.28	0.27	0.3	0.32	0.33	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1	=	2.4			(26)
Windows Type 1			1.44	x1/[1/(1.4)+ 0.04]		=	1.91			(27)
Windows Type 2			5.44	x1/[1/(1.4)+ 0.04]		=	7.21			(27)
Windows Type 3			4.8	x1/[1/(1.4)+ 0.04]		=	6.36			(27)
Walls Type1	31.7	10.24	21.46	x	0.18	=	3.86			(29)
Walls Type2	19	1.44	17.56	x	0.18	=	3.16			(29)
Walls Type3	11.1	2.4	8.7	x	0.18	=	1.57			(29)
Walls Type4	2.4	0	2.4	x	0.18	=	0.43			(29)
Roof	67	0	67	x	0.13	=	8.71			(30)
Total area of elements, m²			131.2							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 35.62 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 1304.68 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 6.56 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 42.18 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(38)m=	37.92	37.74	37.56	36.71	36.55	35.81	35.81	35.67	36.09	36.55	36.87	37.21	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	80.1	79.91	79.73	78.88	78.72	77.98	77.98	77.85	78.27	78.72	79.05	79.38	

Average = Sum(39)1…12 /12= 78.88 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.2	1.19	1.19	1.18	1.17	1.16	1.16	1.16	1.17	1.17	1.18	1.18	

Average = Sum(40)1…12 /12= 1.18 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.17 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.76 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	94.34	90.91	87.48	84.05	80.62	77.19	77.19	80.62	84.05	87.48	90.91	94.34	

Total = Sum(44)1…12 = 1029.18 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.91	122.36	126.27	110.08	105.63	91.15	84.46	96.92	98.08	114.3	124.77	135.49	

Total = Sum(45)1…12 = 1349.41 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.99	18.35	18.94	16.51	15.84	13.67	12.67	14.54	14.71	17.15	18.72	20.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09	

Output from water heater (annual)1…12 | 1898.03 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	83.79	74.35	79.26	72.68	72.4	66.38	65.36	69.5	68.68	75.28	77.56	82.33	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.41	15.46	12.58	9.52	7.12	6.01	6.49	8.44	11.33	14.38	16.79	17.89	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	190.2	192.17	187.2	176.61	163.24	150.68	142.29	140.32	145.29	155.88	169.24	181.8	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	(71)

Water heating gains (Table 5)

(72)m=	112.63	110.65	106.53	100.94	97.31	92.19	87.85	93.42	95.4	101.18	107.72	110.65	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	378.8	376.85	364.87	345.64	326.23	307.45	295.2	300.74	310.58	330.01	352.32	368.92	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x 0.77	x	5.44	x	46.75	x	0.63	x	0.7	=	77.73	(78)

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South	0.9x	0.77	x	4.8	x	46.75	x	0.63	x	0.7	=	68.58	(78)
South	0.9x	0.77	x	5.44	x	76.57	x	0.63	x	0.7	=	127.3	(78)
South	0.9x	0.77	x	4.8	x	76.57	x	0.63	x	0.7	=	112.32	(78)
South	0.9x	0.77	x	5.44	x	97.53	x	0.63	x	0.7	=	162.15	(78)
South	0.9x	0.77	x	4.8	x	97.53	x	0.63	x	0.7	=	143.08	(78)
South	0.9x	0.77	x	5.44	x	110.23	x	0.63	x	0.7	=	183.27	(78)
South	0.9x	0.77	x	4.8	x	110.23	x	0.63	x	0.7	=	161.71	(78)
South	0.9x	0.77	x	5.44	x	114.87	x	0.63	x	0.7	=	190.98	(78)
South	0.9x	0.77	x	4.8	x	114.87	x	0.63	x	0.7	=	168.51	(78)
South	0.9x	0.77	x	5.44	x	110.55	x	0.63	x	0.7	=	183.79	(78)
South	0.9x	0.77	x	4.8	x	110.55	x	0.63	x	0.7	=	162.17	(78)
South	0.9x	0.77	x	5.44	x	108.01	x	0.63	x	0.7	=	179.57	(78)
South	0.9x	0.77	x	4.8	x	108.01	x	0.63	x	0.7	=	158.45	(78)
South	0.9x	0.77	x	5.44	x	104.89	x	0.63	x	0.7	=	174.39	(78)
South	0.9x	0.77	x	4.8	x	104.89	x	0.63	x	0.7	=	153.87	(78)
South	0.9x	0.77	x	5.44	x	101.89	x	0.63	x	0.7	=	169.39	(78)
South	0.9x	0.77	x	4.8	x	101.89	x	0.63	x	0.7	=	149.46	(78)
South	0.9x	0.77	x	5.44	x	82.59	x	0.63	x	0.7	=	137.3	(78)
South	0.9x	0.77	x	4.8	x	82.59	x	0.63	x	0.7	=	121.15	(78)
South	0.9x	0.77	x	5.44	x	55.42	x	0.63	x	0.7	=	92.13	(78)
South	0.9x	0.77	x	4.8	x	55.42	x	0.63	x	0.7	=	81.29	(78)
South	0.9x	0.77	x	5.44	x	40.4	x	0.63	x	0.7	=	67.16	(78)
South	0.9x	0.77	x	4.8	x	40.4	x	0.63	x	0.7	=	59.26	(78)
West	0.9x	0.77	x	1.44	x	19.64	x	0.63	x	0.7	=	8.64	(80)
West	0.9x	0.77	x	1.44	x	38.42	x	0.63	x	0.7	=	16.91	(80)
West	0.9x	0.77	x	1.44	x	63.27	x	0.63	x	0.7	=	27.85	(80)
West	0.9x	0.77	x	1.44	x	92.28	x	0.63	x	0.7	=	40.61	(80)
West	0.9x	0.77	x	1.44	x	113.09	x	0.63	x	0.7	=	49.77	(80)
West	0.9x	0.77	x	1.44	x	115.77	x	0.63	x	0.7	=	50.95	(80)
West	0.9x	0.77	x	1.44	x	110.22	x	0.63	x	0.7	=	48.51	(80)
West	0.9x	0.77	x	1.44	x	94.68	x	0.63	x	0.7	=	41.67	(80)
West	0.9x	0.77	x	1.44	x	73.59	x	0.63	x	0.7	=	32.39	(80)
West	0.9x	0.77	x	1.44	x	45.59	x	0.63	x	0.7	=	20.06	(80)
West	0.9x	0.77	x	1.44	x	24.49	x	0.63	x	0.7	=	10.78	(80)
West	0.9x	0.77	x	1.44	x	16.15	x	0.63	x	0.7	=	7.11	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	154.95	256.53	333.08	385.59	409.26	396.91	386.53	369.93	351.23	278.51	184.2	133.53	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	533.75	633.37	697.95	731.22	735.49	704.36	681.72	670.67	661.81	608.52	536.52	502.45	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(86)m=	0.99	0.98	0.96	0.92	0.83	0.67	0.49	0.52	0.74	0.93	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.88	20.08	20.33	20.61	20.83	20.96	20.99	20.99	20.93	20.65	20.2	19.84	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.92	19.93	19.93	19.94	19.94	19.95	19.95	19.95	19.95	19.94	19.94	19.93	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.95	0.9	0.78	0.57	0.38	0.41	0.65	0.9	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.45	18.74	19.1	19.5	19.78	19.92	19.95	19.95	19.89	19.56	18.94	18.4	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.03	19.29	19.6	19.95	20.21	20.34	20.37	20.37	20.32	20	19.45	18.99	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.03	19.29	19.6	19.95	20.21	20.34	20.37	20.37	20.32	20	19.45	18.99	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.97	0.95	0.9	0.79	0.61	0.43	0.46	0.68	0.9	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	527.57	617.4	662.41	654.69	581.4	429.59	291.61	305.62	453.17	548.67	523.48	497.96	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1180.11	1149.67	1044.63	871.6	669.77	447.95	294.18	309.17	486.44	740.03	976.5	1173.88	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	485.48	357.69	284.37	156.17	65.75	0	0	0	0	142.37	326.17	502.88	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2320.89 (98)

Space heating requirement in kWh/m²/year 34.64 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	485.48	357.69	284.37	156.17	65.75	0	0	0	0	142.37	326.17	502.88	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	519.24	382.55	304.14	167.03	70.32	0	0	0	0	152.27	348.85	537.84	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2482.24 (211)

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Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

Water heating

Output from water heater (calculated above)

186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09

Efficiency of water heater 79.8 (216)

(217)m=	87.25	86.83	86.13	84.83	82.75	79.8	79.8	79.8	79.8	84.49	86.53	87.39	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	213.75	189.38	200.69	182.92	183.95	170.73	164.23	179.84	179.41	190.43	196.31	208.37

Total = Sum(219a)$_{1...12}$ = 2260.02 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2482.24	
Water heating fuel used		2260.02	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		75	(231)
Electricity for lighting		307.48	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		5124.74	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	536.16	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	488.16	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1024.33	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	159.58	(268)
Total CO2, kg/year			sum of (265)…(271) =		1222.83	(272)

TER = 18.25 (273)

SAP Input

Property Details: Sample 5 (Top)

Address:	
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	26 July 2019
Date of certificate:	15 June 2022
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	498

Property description:

Dwelling type:	Flat
Detachment:	
Year Completed:	2022

Floor Location:	Floor area:	Storey height:
Floor 0	67 m²	3 m

Living area:	27.5 m² (fraction 0.41)
Front of dwelling faces:	Unspecified

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
DOOR	Manufacturer	Solid			Wood
E	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Balcony	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
DOOR	mm	0.7	0	1.4	2.4	1
E		0.7	0.4	1	4.16	1
Balcony		0.7	0.4	1	4.8	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
DOOR		INT	Worst case	0	0
E		E	East	0	0
Balcony		E	East	0	0

Overshading: More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
E	29.4	8.96	20.44	0.15	0	False	N/A
INT	12	2.4	9.6	0.16	0.43	False	N/A
Spandrel	2.44	0	2.44	0.35	0	False	N/A
Roof	67	0	67	0.11	0		N/A
Internal Elements							
Party Elements							

Thermal bridges:

Thermal bridges: No information on thermal bridging (y=0.15) (y =0.15)

SAP Input

Ventilation:	
Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	3
Pressure test:	3

Main heating system:	
Main heating system:	Community heating schemes Heat source: Community boilers heat from boilers – mains gas, heat fraction 1, efficiency 95 Piping>=1991, pre-insulated, low temp, variable flow Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Boiler interlock: Yes

Main heating Control:	
Main heating Control:	Charging system linked to use of community heating, programmer and TRVs Control code: 2306

Secondary heating system:	
Secondary heating system:	None

Water heating:	
Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Flue Gas Heat Recovery System: Database (rev 498, product index 060036) Brand name: Worcester Model: Greenstar Xtra Model qualifier: 2015 Solar panel: False

Others:	
Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Sample 5 (Top)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67	(1a) x	3	(2a) =	201	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	201	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	79.05	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.25	0.25	0.25	0.23	0.23	0.22	0.22	0.21	0.22	0.23	0.24	0.24	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.25	0.25	0.25	0.23	0.23	0.22	0.22	0.21	0.22	0.23	0.24	0.24	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1.4	=	3.36			(26)
Windows Type 1			4.16	x	1/[1/(1)+ 0.04]	=	4			(27)
Windows Type 2			4.8	x	1/[1/(1)+ 0.04]	=	4.62			(27)
Walls Type1	29.4	8.96	20.44	x	0.15	=	3.07			(29)
Walls Type2	12	2.4	9.6	x	0.15	=	1.44			(29)
Walls Type3	2.44	0	2.44	x	0.35	=	0.85			(29)
Roof	67	0	67	x	0.11	=	7.37			(30)
Total area of elements, m²			110.84							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	24.7	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	1057.72	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		16.63	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	41.33	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	16.78	16.59	16.39	15.43	15.24	14.27	14.27	14.08	14.66	15.24	15.62	16.01	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	58.11	57.92	57.72	56.76	56.57	55.6	55.6	55.41	55.99	56.57	56.95	57.34	

Average = Sum(39)$_{1…12}$ /12= 56.71 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.87	0.86	0.86	0.85	0.84	0.83	0.83	0.83	0.84	0.84	0.85	0.86

Average = Sum(40)$_{1...12}$ /12= 0.85 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.17 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.76 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	94.34	90.91	87.48	84.05	80.62	77.19	77.19	80.62	84.05	87.48	90.91	94.34

Total = Sum(44)$_{1...12}$ = 1029.18 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.91	122.36	126.27	110.08	105.63	91.15	84.46	96.92	98.08	114.3	124.77	135.49

Total = Sum(45)$_{1...12}$ = 1349.41 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.99	18.35	18.94	16.51	15.84	13.67	12.67	14.54	14.71	17.15	18.72	20.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	195.18	172.29	181.54	163.58	160.9	144.64	139.74	152.2	151.57	169.58	178.26	190.77	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	18.03	16.04	16.49	14.58	14.03	12.18	11.28	12.94	13.08	15.09	16.32	17.54	(63) (G2)

Output from water heater

(64)m=	174.47	153.83	162.37	146.4	144.19	129.86	125.78	136.58	135.89	151.81	159.35	170.55	

Output from water heater (annual)1…12 | 1791.08 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	90.74	80.63	86.21	79.4	79.34	73.1	72.31	76.45	75.41	82.23	84.28	89.27	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.93	16.81	13.67	10.35	7.74	6.53	7.06	9.17	12.31	15.63	18.25	19.45	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	190.2	192.17	187.2	176.61	163.24	150.68	142.29	140.32	145.29	155.88	169.24	181.8	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	(71)

Water heating gains (Table 5)

(72)m=	121.96	119.98	115.87	110.27	106.64	101.53	97.18	102.75	104.73	110.52	117.06	119.99	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	386.65	384.53	372.3	352.8	333.19	314.31	302.1	307.81	317.9	337.6	360.11	376.81	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	4.16	x	19.64	x	0.4	x	0.7	=	15.85	(76)
East	0.9x	0.77	x	4.8	x	19.64	x	0.4	x	0.7	=	18.29	(76)
East	0.9x	0.77	x	4.16	x	38.42	x	0.4	x	0.7	=	31.01	(76)
East	0.9x	0.77	x	4.8	x	38.42	x	0.4	x	0.7	=	35.78	(76)

East	0.9x	0.77	x	4.16	x	63.27	x	0.4	x	0.7	=	51.07	(76)
East	0.9x	0.77	x	4.8	x	63.27	x	0.4	x	0.7	=	58.93	(76)
East	0.9x	0.77	x	4.16	x	92.28	x	0.4	x	0.7	=	74.49	(76)
East	0.9x	0.77	x	4.8	x	92.28	x	0.4	x	0.7	=	85.95	(76)
East	0.9x	0.77	x	4.16	x	113.09	x	0.4	x	0.7	=	91.29	(76)
East	0.9x	0.77	x	4.8	x	113.09	x	0.4	x	0.7	=	105.33	(76)
East	0.9x	0.77	x	4.16	x	115.77	x	0.4	x	0.7	=	93.45	(76)
East	0.9x	0.77	x	4.8	x	115.77	x	0.4	x	0.7	=	107.83	(76)
East	0.9x	0.77	x	4.16	x	110.22	x	0.4	x	0.7	=	88.97	(76)
East	0.9x	0.77	x	4.8	x	110.22	x	0.4	x	0.7	=	102.66	(76)
East	0.9x	0.77	x	4.16	x	94.68	x	0.4	x	0.7	=	76.42	(76)
East	0.9x	0.77	x	4.8	x	94.68	x	0.4	x	0.7	=	88.18	(76)
East	0.9x	0.77	x	4.16	x	73.59	x	0.4	x	0.7	=	59.4	(76)
East	0.9x	0.77	x	4.8	x	73.59	x	0.4	x	0.7	=	68.54	(76)
East	0.9x	0.77	x	4.16	x	45.59	x	0.4	x	0.7	=	36.8	(76)
East	0.9x	0.77	x	4.8	x	45.59	x	0.4	x	0.7	=	42.46	(76)
East	0.9x	0.77	x	4.16	x	24.49	x	0.4	x	0.7	=	19.77	(76)
East	0.9x	0.77	x	4.8	x	24.49	x	0.4	x	0.7	=	22.81	(76)
East	0.9x	0.77	x	4.16	x	16.15	x	0.4	x	0.7	=	13.04	(76)
East	0.9x	0.77	x	4.8	x	16.15	x	0.4	x	0.7	=	15.04	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	34.15	66.8	110.01	160.44	196.62	201.28	191.63	164.6	127.94	79.26	42.58	28.08	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	420.8	451.33	482.31	513.24	529.81	515.59	493.72	472.41	445.84	416.86	402.69	404.89	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.96	0.86	0.67	0.49	0.54	0.8	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.19	20.29	20.47	20.71	20.9	20.98	21	21	20.95	20.72	20.42	20.17	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.2	20.2	20.2	20.21	20.22	20.23	20.23	20.23	20.22	20.22	20.21	20.21	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.94	0.82	0.6	0.41	0.45	0.73	0.95	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.1	19.25	19.51	19.87	20.11	20.22	20.23	20.23	20.19	19.9	19.46	19.09	(90)

fLA = Living area ÷ (4) = | 0.41 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.55	19.67	19.9	20.21	20.44	20.53	20.54	20.54	20.5	20.24	19.85	19.53	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.55	19.67	19.9	20.21	20.44	20.53	20.54	20.54	20.5	20.24	19.85	19.53	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.94	0.83	0.63	0.44	0.48	0.76	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	418.82	447.64	473.1	483.44	442.06	323.33	218.68	228.6	337.53	396.95	398.63	403.37	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	886.02	855.69	773.75	642.13	494.16	329.85	219.26	229.62	358.42	545.05	726.2	879.21	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	347.6	274.21	223.69	114.26	38.77	0	0	0	0	110.19	235.85	354.02	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 1698.58 (98)

Space heating requirement in kWh/m²/year 25.35 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.			
Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers		1	(303a)
Fraction of total space heat from Community boilers	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		1698.58	
Space heat from Community boilers	(98) x (304a) x (305) x (306) =	1783.51	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		1791.08	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	1880.63	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	36.64	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		119.54	(330a)

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warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	119.54	(331)
Energy for lighting (calculated in Appendix L)		334.24	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		4117.92	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				95	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.22	=	833.11	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	19.02	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	852.13	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				852.13	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	62.04	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	173.47	(379)
Total CO2, kg/year	sum of (376)…(382) =				1087.64	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				16.23	(384)
EI rating (section 14)					86.99	(385)

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User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.51

Property Address: Sample 5 (Top)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67	(1a) x	3	(2a) =	201	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	201	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.1	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.35	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.27	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.35	0.34	0.33	0.3	0.29	0.26	0.26	0.25	0.27	0.29	0.3	0.32

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.56	0.56	0.56	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.56	0.56	0.56	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1	=	2.4			(26)
Windows Type 1			4.16	x1/[1/(1.4)+ 0.04]		=	5.52			(27)
Windows Type 2			4.8	x1/[1/(1.4)+ 0.04]		=	6.36			(27)
Walls Type1	29.4	8.96	20.44	x	0.18	=	3.68			(29)
Walls Type2	12	2.4	9.6	x	0.18	=	1.73			(29)
Walls Type3	2.44	0	2.44	x	0.18	=	0.44			(29)
Roof	67	0	67	x	0.13	=	8.71			(30)
Total area of elements, m²			110.84							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.84 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 1057.72 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 5.54 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 34.38 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	37.12	36.97	36.82	36.11	35.98	35.36	35.36	35.25	35.6	35.98	36.24	36.52	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	71.5	71.34	71.19	70.49	70.35	69.74	69.74	69.62	69.98	70.35	70.62	70.9	

Average = $Sum(39)_{1...12}$ /12= 70.49 (39)

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Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

(40)m=	1.07	1.06	1.06	1.05	1.05	1.04	1.04	1.04	1.04	1.05	1.05	1.06

Average = Sum(40)$_{1…12}$ /12= 1.05 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.17 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 85.76 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	94.34	90.91	87.48	84.05	80.62	77.19	77.19	80.62	84.05	87.48	90.91	94.34	
(45)m=	139.91	122.36	126.27	110.08	105.63	91.15	84.46	96.92	98.08	114.3	124.77	135.49	
(46)m=	20.99	18.35	18.94	16.51	15.84	13.67	12.67	14.54	14.71	17.15	18.72	20.32	(46)

Total = Sum(44)$_{1…12}$ = 1029.18 (44)

Total = Sum(45)$_{1…12}$ = 1349.41 (45)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 1.39 (48)

Temperature factor from Table 2b — 0.54 (49)

Energy lost from water storage, kWh/year — (48) x (49) = 0.75 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

Energy lost from water storage, kWh/year — (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) — 0.75 (55)

Water storage loss calculated for each month — ((56)m = (55) × (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
(62)m=	186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09	(62)
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09

Output from water heater (annual)1…12 | 1898.03 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	83.79	74.35	79.26	72.68	72.4	66.38	65.36	69.5	68.68	75.28	77.56	82.33	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.37	16.32	13.27	10.05	7.51	6.34	6.85	8.91	11.95	15.18	17.72	18.89	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	190.2	192.17	187.2	176.61	163.24	150.68	142.29	140.32	145.29	155.88	169.24	181.8	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	(71)

Water heating gains (Table 5)

(72)m=	112.63	110.65	106.53	100.94	97.31	92.19	87.85	93.42	95.4	101.18	107.72	110.65	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	379.77	377.7	365.57	346.16	326.63	307.78	295.56	301.21	311.21	330.81	353.25	369.91	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	4.16	x	19.64	x	0.63	x	0.7	=	24.97	(76)
East	0.9x	0.77	x	4.8	x	19.64	x	0.63	x	0.7	=	28.81	(76)
East	0.9x	0.77	x	4.16	x	38.42	x	0.63	x	0.7	=	48.85	(76)
East	0.9x	0.77	x	4.8	x	38.42	x	0.63	x	0.7	=	56.36	(76)

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East	0.9x	0.77	x	4.16	x	63.27	x	0.63	x	0.7	=	80.44	(76)
East	0.9x	0.77	x	4.8	x	63.27	x	0.63	x	0.7	=	92.82	(76)
East	0.9x	0.77	x	4.16	x	92.28	x	0.63	x	0.7	=	117.32	(76)
East	0.9x	0.77	x	4.8	x	92.28	x	0.63	x	0.7	=	135.37	(76)
East	0.9x	0.77	x	4.16	x	113.09	x	0.63	x	0.7	=	143.78	(76)
East	0.9x	0.77	x	4.8	x	113.09	x	0.63	x	0.7	=	165.9	(76)
East	0.9x	0.77	x	4.16	x	115.77	x	0.63	x	0.7	=	147.18	(76)
East	0.9x	0.77	x	4.8	x	115.77	x	0.63	x	0.7	=	169.83	(76)
East	0.9x	0.77	x	4.16	x	110.22	x	0.63	x	0.7	=	140.13	(76)
East	0.9x	0.77	x	4.8	x	110.22	x	0.63	x	0.7	=	161.68	(76)
East	0.9x	0.77	x	4.16	x	94.68	x	0.63	x	0.7	=	120.37	(76)
East	0.9x	0.77	x	4.8	x	94.68	x	0.63	x	0.7	=	138.88	(76)
East	0.9x	0.77	x	4.16	x	73.59	x	0.63	x	0.7	=	93.56	(76)
East	0.9x	0.77	x	4.8	x	73.59	x	0.63	x	0.7	=	107.95	(76)
East	0.9x	0.77	x	4.16	x	45.59	x	0.63	x	0.7	=	57.96	(76)
East	0.9x	0.77	x	4.8	x	45.59	x	0.63	x	0.7	=	66.88	(76)
East	0.9x	0.77	x	4.16	x	24.49	x	0.63	x	0.7	=	31.13	(76)
East	0.9x	0.77	x	4.8	x	24.49	x	0.63	x	0.7	=	35.92	(76)
East	0.9x	0.77	x	4.16	x	16.15	x	0.63	x	0.7	=	20.53	(76)
East	0.9x	0.77	x	4.8	x	16.15	x	0.63	x	0.7	=	23.69	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	53.78	105.21	173.26	252.69	309.68	317.01	301.81	259.25	201.51	124.84	67.06	44.23	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	433.55	482.91	538.83	598.85	636.31	624.8	597.37	560.46	512.71	455.64	420.3	414.14	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.95	0.86	0.68	0.51	0.56	0.82	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.92	20.05	20.29	20.6	20.84	20.97	20.99	20.99	20.91	20.59	20.2	19.89	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.03	20.03	20.03	20.04	20.04	20.05	20.05	20.05	20.05	20.04	20.04	20.04	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.93	0.81	0.59	0.4	0.45	0.75	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.58	18.78	19.12	19.57	19.89	20.03	20.05	20.05	19.98	19.56	19	18.55	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.13	19.3	19.6	19.99	20.28	20.41	20.44	20.43	20.36	19.98	19.49	19.1	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(93)m=	19.13	19.3	19.6	19.99	20.28	20.41	20.44	20.43	20.36	19.98	19.49	19.1		(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation factor for gains, hm:														
(94)m=	0.99	0.99	0.98	0.93	0.82	0.63	0.44	0.5	0.77	0.95	0.99	1		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	431.37	478.35	526.41	558.24	522.37	391.03	265.65	277.6	395.38	434.69	416.08	412.49		(95)
Monthly average external temperature from Table 8														
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]														
(97)m=	1060.36	1027.32	932.66	781.63	603.7	405.41	267.51	280.88	437.95	660.12	875.06	1056.59		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	467.97	368.9	302.25	160.84	60.51	0	0	0	0	167.71	330.47	479.21		
Total per year (kWh/year) = Sum(98)1...5,9...12 =													2337.86	(98)
Space heating requirement in kWh/m²/year													34.89	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	467.97	368.9	302.25	160.84	60.51	0	0	0	0	167.71	330.47	479.21		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	500.5	394.55	323.26	172.02	64.72	0	0	0	0	179.37	353.44	512.52		
Total (kWh/year) =Sum(211)1...5,10....12=													2500.39	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)1...5,10....12=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)														
	186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09		
Efficiency of water heater													79.8	(216)
(217)m=	87.17	86.91	86.29	84.91	82.58	79.8	79.8	79.8	79.8	84.92	86.56	87.28		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	213.95	189.22	200.33	182.75	184.34	170.73	164.23	179.84	179.41	189.46	196.24	208.63		
Total = Sum(219a)1...12 =													2259.13	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		2500.39

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Water heating fuel used			2259.13	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			324.5	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			5159.01	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	540.08	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	487.97	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1028.05	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	168.41	(268)
Total CO2, kg/year		sum of (265)…(271) =		1235.39	(272)
TER =				18.44	(273)

SAP Input

Property Details: Sample 6 (Top)

Address:	
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	26 July 2019
Date of certificate:	15 June 2022
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	498

Property description:

Dwelling type:	Flat
Detachment:	
Year Completed:	2022

Floor Location:	Floor area:	Storey height:
Floor 0	55.1 m²	3 m

Living area:	26 m² (fraction 0.472)
Front of dwelling faces:	Unspecified

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
DOOR	Manufacturer	Solid			Wood
W	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Balcony	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
DOOR	mm	0.7	0	1.4	2.4	1
W		0.7	0.4	1	4.16	1
Balcony		0.7	0.4	1	4.8	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
DOOR		INT	Worst case	0	0
W		W	West	0	0
Balcony		W	West	0	0

Overshading: More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
W	24	8.96	15.04	0.15	0	False	N/A
INT	24	2.4	21.6	0.16	0.43	False	N/A
Spandrel	2.4	0	2.4	0.35	0	False	N/A
Roof	55.1	0	55.1	0.11	0		N/A
Internal Elements							
Party Elements							

Thermal bridges:

Thermal bridges: No information on thermal bridging (y=0.15) (y =0.15)

SAP Input

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	3
Pressure test:	3

Main heating system:

Main heating system:	Community heating schemes Heat source: Community boilers heat from boilers – mains gas, heat fraction 1, efficiency 95 Piping>=1991, pre-insulated, low temp, variable flow Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Boiler interlock: Yes

Main heating Control:

Main heating Control:	Charging system linked to use of community heating, programmer and TRVs Control code: 2306

Secondary heating system:

Secondary heating system:	None

Water heating:

Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Flue Gas Heat Recovery System: Database (rev 498, product index 060036) Brand name: Worcester Model: Greenstar Xtra Model qualifier: 2015 Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: **Stroma Number:**
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.51

Property Address: Sample 6 (Top)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	55.1	(1a) x	3	(2a) =	165.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.1	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		165.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.05 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.25	0.25	0.25	0.23	0.23	0.22	0.22	0.21	0.22	0.23	0.24	0.24	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.25	0.25	0.25	0.23	0.23	0.22	0.22	0.21	0.22	0.23	0.24	0.24	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1.4	=	3.36			(26)
Windows Type 1			4.16	x	1/[1/(1)+ 0.04]	=	4			(27)
Windows Type 2			4.8	x	1/[1/(1)+ 0.04]	=	4.62			(27)
Walls Type1	24	8.96	15.04	x	0.15	=	2.26			(29)
Walls Type2	24	2.4	21.6	x	0.15	=	3.23			(29)
Walls Type3	2.4	0	2.4	x	0.35	=	0.84			(29)
Roof	55.1	0	55.1	x	0.11	=	6.06			(30)
Total area of elements, m²			105.5							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 24.37 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 1042.46 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 15.83 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 40.19 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	13.8	13.64	13.48	12.69	12.53	11.74	11.74	11.58	12.06	12.53	12.85	13.17	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	53.99	53.83	53.67	52.88	52.72	51.93	51.93	51.77	52.25	52.72	53.04	53.36	

Average = Sum(39)$_{1…12}$ /12= 52.84 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.98	0.98	0.97	0.96	0.96	0.94	0.94	0.94	0.95	0.96	0.96	0.97

Average = Sum(40)$_{1...12}$ /12= 0.96 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.84 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 77.91 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	85.7	82.58	79.47	76.35	73.23	70.12	70.12	73.23	76.35	79.47	82.58	85.7

Total = Sum(44)$_{1...12}$ = 934.88 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	127.09	111.15	114.7	100	95.95	82.8	76.72	88.04	89.09	103.83	113.34	123.08

Total = Sum(45)$_{1...12}$ = 1225.78 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.06	16.67	17.2	15	14.39	12.42	11.51	13.21	13.36	15.57	17	18.46	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	182.36	161.08	169.97	153.49	151.23	136.29	132	143.32	142.59	159.11	166.83	178.35	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	16.59	14.71	15.14	13.33	12.81	11.05	10.22	11.77	11.91	13.81	14.97	16.12	(63) (G2)

Output from water heater

(64)m=	163.1	143.95	152.16	137.57	135.73	122.64	119.09	128.87	128.08	142.61	149.26	159.55

Output from water heater (annual)1…12 | 1682.61 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	86.48	76.9	82.36	76.04	76.12	70.32	69.73	73.5	72.42	78.74	80.48	85.14	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.29	13.58	11.05	8.36	6.25	5.28	5.7	7.41	9.95	12.63	14.74	15.72	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	160.44	162.11	157.91	148.98	137.71	127.11	120.03	118.37	122.56	131.49	142.77	153.36	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	(71)

Water heating gains (Table 5)

(72)m=	116.23	114.43	110.7	105.62	102.32	97.67	93.73	98.78	100.58	105.84	111.78	114.44	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	342.57	340.73	330.26	313.56	296.88	280.66	270.06	275.17	283.69	300.57	319.89	334.13	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	4.16	x	19.64	x	0.4	x	0.7	=	15.85	(80)
West	0.9x	0.77	x	4.8	x	19.64	x	0.4	x	0.7	=	18.29	(80)
West	0.9x	0.77	x	4.16	x	38.42	x	0.4	x	0.7	=	31.01	(80)
West	0.9x	0.77	x	4.8	x	38.42	x	0.4	x	0.7	=	35.78	(80)

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West	0.9x	0.77	x	4.16	x	63.27	x	0.4	x	0.7	=	51.07	(80)
West	0.9x	0.77	x	4.8	x	63.27	x	0.4	x	0.7	=	58.93	(80)
West	0.9x	0.77	x	4.16	x	92.28	x	0.4	x	0.7	=	74.49	(80)
West	0.9x	0.77	x	4.8	x	92.28	x	0.4	x	0.7	=	85.95	(80)
West	0.9x	0.77	x	4.16	x	113.09	x	0.4	x	0.7	=	91.29	(80)
West	0.9x	0.77	x	4.8	x	113.09	x	0.4	x	0.7	=	105.33	(80)
West	0.9x	0.77	x	4.16	x	115.77	x	0.4	x	0.7	=	93.45	(80)
West	0.9x	0.77	x	4.8	x	115.77	x	0.4	x	0.7	=	107.83	(80)
West	0.9x	0.77	x	4.16	x	110.22	x	0.4	x	0.7	=	88.97	(80)
West	0.9x	0.77	x	4.8	x	110.22	x	0.4	x	0.7	=	102.66	(80)
West	0.9x	0.77	x	4.16	x	94.68	x	0.4	x	0.7	=	76.42	(80)
West	0.9x	0.77	x	4.8	x	94.68	x	0.4	x	0.7	=	88.18	(80)
West	0.9x	0.77	x	4.16	x	73.59	x	0.4	x	0.7	=	59.4	(80)
West	0.9x	0.77	x	4.8	x	73.59	x	0.4	x	0.7	=	68.54	(80)
West	0.9x	0.77	x	4.16	x	45.59	x	0.4	x	0.7	=	36.8	(80)
West	0.9x	0.77	x	4.8	x	45.59	x	0.4	x	0.7	=	42.46	(80)
West	0.9x	0.77	x	4.16	x	24.49	x	0.4	x	0.7	=	19.77	(80)
West	0.9x	0.77	x	4.8	x	24.49	x	0.4	x	0.7	=	22.81	(80)
West	0.9x	0.77	x	4.16	x	16.15	x	0.4	x	0.7	=	13.04	(80)
West	0.9x	0.77	x	4.8	x	16.15	x	0.4	x	0.7	=	15.04	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	34.15	66.8	110.01	160.44	196.62	201.28	191.63	164.6	127.94	79.26	42.58	28.08	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	376.72	407.53	440.27	474	493.5	481.94	461.69	439.77	411.64	379.83	362.47	362.21	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.95	0.85	0.66	0.49	0.53	0.79	0.96	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.07	20.19	20.39	20.66	20.88	20.98	21	20.99	20.94	20.68	20.33	20.06	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.1	20.1	20.1	20.12	20.12	20.13	20.13	20.13	20.13	20.12	20.11	20.11	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.98	0.93	0.8	0.58	0.4	0.44	0.72	0.94	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.87	19.03	19.33	19.72	20	20.12	20.13	20.13	20.08	19.75	19.26	18.85	(90)

fLA = Living area ÷ (4) = | 0.47 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.44	19.58	19.83	20.17	20.41	20.52	20.54	20.54	20.49	20.19	19.76	19.42	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	19.44	19.58	19.83	20.17	20.41	20.52	20.54	20.54	20.49	20.19	19.76	19.42	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.93	0.82	0.62	0.44	0.48	0.75	0.95	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	374.3	403.06	429.5	441.63	405.39	299.4	203.63	212.72	309.59	359.08	357.76	360.31	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	817.25	790.13	715.57	595.82	459.34	307.59	204.56	214.28	333.61	505.4	671.72	812.02	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	329.56	260.12	212.84	111.02	40.14	0	0	0	0	108.86	226.05	336.07	

	Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	1624.65	(98)
Space heating requirement in kWh/m²/year		29.49	(99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers		1	(303a)
Fraction of total space heat from Community boilers	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		1624.65	
Space heat from Community boilers	(98) x (304a) x (305) x (306) =	1705.88	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		1682.61	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	1766.74	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	34.73	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		98.31	(330a)

warm air heating system fans			0	(330b)
pump for solar water heating			0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =		98.31	(331)
Energy for lighting (calculated in Appendix L)			270.05	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =			3840.99	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				95	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.22	=	789.57	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	18.02	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	807.59	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				807.59	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	51.02	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	140.16	(379)
Total CO2, kg/year	sum of (376)…(382) =				998.77	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				18.13	(384)
EI rating (section 14)					86.63	(385)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version: Version: 1.0.5.51

Property Address: Sample 6 (Top)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	55.1	(1a) x	3	(2a) =	165.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.1	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	165.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.12	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.37	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.29	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.37	0.36	0.35	0.32	0.31	0.27	0.27	0.27	0.29	0.31	0.32	0.34

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.56	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.56	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1	=	2.4			(26)
Windows Type 1			4.16	x1/[1/(1.4)+ 0.04]		=	5.52			(27)
Windows Type 2			4.8	x1/[1/(1.4)+ 0.04]		=	6.36			(27)
Walls Type1	24	8.96	15.04	x	0.18	=	2.71			(29)
Walls Type2	24	2.4	21.6	x	0.18	=	3.89			(29)
Walls Type3	2.4	0	2.4	x	0.18	=	0.43			(29)
Roof	55.1	0	55.1	x	0.13	=	7.16			(30)
Total area of elements, m²			105.5							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.47 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 1042.46 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 5.28 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 33.74 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	30.94	30.8	30.66	30	29.88	29.31	29.31	29.2	29.53	29.88	30.13	30.39	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	64.68	64.54	64.4	63.75	63.62	63.05	63.05	62.95	63.27	63.62	63.87	64.13	

Average = Sum(39)1…12 /12= 63.75 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	1.17	1.17	1.17	1.16	1.15	1.14	1.14	1.14	1.15	1.15	1.16	1.16	

Average = Sum(40)$_{1…12}$ /12= 1.16 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.84 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 77.91 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	85.7	82.58	79.47	76.35	73.23	70.12	70.12	73.23	76.35	79.47	82.58	85.7	

Total = Sum(44)$_{1…12}$ = 934.88 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	127.09	111.15	114.7	100	95.95	82.8	76.72	88.04	89.09	103.83	113.34	123.08	

Total = Sum(45)$_{1…12}$ = 1225.78 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	19.06	16.67	17.2	15	14.39	12.42	11.51	13.21	13.36	15.57	17	18.46	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	173.68	153.24	161.29	145.09	142.54	127.89	123.32	134.64	134.18	150.42	158.43	169.67	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	173.68	153.24	161.29	145.09	142.54	127.89	123.32	134.64	134.18	150.42	158.43	169.67	

Output from water heater (annual)$_{1…12}$ 1774.4 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	79.53	70.63	75.41	69.32	69.18	63.6	62.79	66.55	65.7	71.8	73.76	78.2	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	14.88	13.21	10.74	8.13	6.08	5.13	5.55	7.21	9.68	12.29	14.34	15.29	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	160.44	162.11	157.91	148.98	137.71	127.11	120.03	118.37	122.56	131.49	142.77	153.36	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	(71)

Water heating gains (Table 5)

(72)m=	106.9	105.1	101.36	96.28	92.98	88.34	84.39	89.45	91.25	96.5	102.44	105.11	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	335.82	334.02	323.62	307	290.37	274.19	263.57	268.63	277.09	293.89	313.16	327.36	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	4.16	x	19.64	x	0.63	x	0.7	=	24.97	(80)
West	0.9x	0.77	x	4.8	x	19.64	x	0.63	x	0.7	=	28.81	(80)
West	0.9x	0.77	x	4.16	x	38.42	x	0.63	x	0.7	=	48.85	(80)
West	0.9x	0.77	x	4.8	x	38.42	x	0.63	x	0.7	=	56.36	(80)

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West	0.9x	0.77	x	4.16	x	63.27	x	0.63	x	0.7	=	80.44	(80)
West	0.9x	0.77	x	4.8	x	63.27	x	0.63	x	0.7	=	92.82	(80)
West	0.9x	0.77	x	4.16	x	92.28	x	0.63	x	0.7	=	117.32	(80)
West	0.9x	0.77	x	4.8	x	92.28	x	0.63	x	0.7	=	135.37	(80)
West	0.9x	0.77	x	4.16	x	113.09	x	0.63	x	0.7	=	143.78	(80)
West	0.9x	0.77	x	4.8	x	113.09	x	0.63	x	0.7	=	165.9	(80)
West	0.9x	0.77	x	4.16	x	115.77	x	0.63	x	0.7	=	147.18	(80)
West	0.9x	0.77	x	4.8	x	115.77	x	0.63	x	0.7	=	169.83	(80)
West	0.9x	0.77	x	4.16	x	110.22	x	0.63	x	0.7	=	140.13	(80)
West	0.9x	0.77	x	4.8	x	110.22	x	0.63	x	0.7	=	161.68	(80)
West	0.9x	0.77	x	4.16	x	94.68	x	0.63	x	0.7	=	120.37	(80)
West	0.9x	0.77	x	4.8	x	94.68	x	0.63	x	0.7	=	138.88	(80)
West	0.9x	0.77	x	4.16	x	73.59	x	0.63	x	0.7	=	93.56	(80)
West	0.9x	0.77	x	4.8	x	73.59	x	0.63	x	0.7	=	107.95	(80)
West	0.9x	0.77	x	4.16	x	45.59	x	0.63	x	0.7	=	57.96	(80)
West	0.9x	0.77	x	4.8	x	45.59	x	0.63	x	0.7	=	66.88	(80)
West	0.9x	0.77	x	4.16	x	24.49	x	0.63	x	0.7	=	31.13	(80)
West	0.9x	0.77	x	4.8	x	24.49	x	0.63	x	0.7	=	35.92	(80)
West	0.9x	0.77	x	4.16	x	16.15	x	0.63	x	0.7	=	20.53	(80)
West	0.9x	0.77	x	4.8	x	16.15	x	0.63	x	0.7	=	23.69	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	53.78	105.21	173.26	252.69	309.68	317.01	301.81	259.25	201.51	124.84	67.06	44.23	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	389.6	439.23	496.88	559.69	600.05	591.2	565.38	527.88	478.6	418.73	380.21	371.59	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) — 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.94	0.83	0.65	0.48	0.54	0.79	0.96	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.83	19.98	20.24	20.58	20.84	20.96	20.99	20.99	20.9	20.56	20.13	19.8	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.94	19.94	19.95	19.95	19.96	19.96	19.96	19.97	19.96	19.96	19.95	19.95	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.97	0.91	0.77	0.56	0.37	0.42	0.71	0.94	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.39	18.61	18.99	19.47	19.8	19.94	19.96	19.96	19.89	19.46	18.84	18.36	(90)

fLA = Living area ÷ (4) = 0.47 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.07	19.25	19.58	19.99	20.29	20.42	20.45	20.45	20.37	19.98	19.45	19.04	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	19.07	19.25	19.58	19.99	20.29	20.42	20.45	20.45	20.37	19.98	19.45	19.04	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation factor for gains, hm:														
(94)m=	0.99	0.99	0.97	0.91	0.79	0.6	0.43	0.48	0.75	0.94	0.99	0.99		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	386.85	433.43	481.37	511.66	475.54	353.93	240.73	251.36	357.64	394.66	375	369.48		(95)
Monthly average external temperature from Table 8														
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]														
(97)m=	955.18	926.41	842.45	707.2	546.66	367.27	242.68	254.72	396.54	596.52	788.88	951.45		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	422.83	331.29	268.64	140.79	52.92	0	0	0	0	150.19	297.99	432.99		
Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ =													2097.63	(98)
Space heating requirement in kWh/m²/year													38.07	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	422.83	331.29	268.64	140.79	52.92	0	0	0	0	150.19	297.99	432.99		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	452.23	354.32	287.32	150.58	56.59	0	0	0	0	160.63	318.71	463.09		
Total (kWh/year) =$Sum(211)_{1...5,10....12}$=													2243.46	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =$Sum(215)_{1...5,10....12}$=													0	(215)

Water heating

Output from water heater (calculated above)														
	173.68	153.24	161.29	145.09	142.54	127.89	123.32	134.64	134.18	150.42	158.43	169.67		
Efficiency of water heater													79.8	(216)
(217)m=	87.1	86.82	86.17	84.73	82.44	79.8	79.8	79.8	79.8	84.81	86.48	87.21		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	199.41	176.5	187.19	171.23	172.91	160.26	154.53	168.72	168.15	177.37	183.21	194.56		
Total = $Sum(219a)_{1...12}$ =													2114.03	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		2243.46

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Water heating fuel used			2114.03	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			262.71	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			4695.2	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	484.59	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	456.63	(264)
Space and water heating	(261) + (262) + (263) + (264) =			941.22	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	136.34	(268)
Total CO2, kg/year		sum of (265)…(271) =		1116.49	(272)

TER = 20.26 (273)

SAP Input

Property Details: Sample 7 (Top)

Address:
Located in: England
Region: South East England
UPRN:
Date of assessment: 26 July 2019
Date of certificate: 15 June 2022
Assessment type: New dwelling design stage
Transaction type: None of the above
Tenure type: Unknown
Related party disclosure: No related party
Thermal Mass Parameter: Indicative Value Medium
Water use <= 125 litres/person/day: True
PCDF Version: 498

Property description:

Dwelling type: Flat
Detachment:
Year Completed: 2022

Floor Location:	Floor area:	Storey height:
Floor 0	66.3 m²	3 m

Living area: 23 m² (fraction 0.347)
Front of dwelling faces: Unspecified

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
DOOR	Manufacturer	Solid			Wood
Balcony	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
N	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
E	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
DOOR	mm	0.7	0	1.4	2.4	1
Balcony		0.7	0.4	1	4.8	1
N		0.7	0.4	1	5.44	1
E		0.7	0.4	1	1.44	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
DOOR		INT	Worst case	0	0
Balcony		N	North	0	0
N		N	North	0	0
E		E	East	0	0

Overshading: Heavy

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
<u>External Elements</u>							
N	10.24	10.24	0	0.15	0	False	N/A
E	1.44	1.44	0	0.15	0	False	N/A
INT	13.2	2.4	10.8	0.16	0.43	False	N/A
Spandrel	2.4	0	2.4	0.35	0	False	N/A
Roof	66.3	0	66.3	0.11	0		N/A
<u>Internal Elements</u>							
<u>Party Elements</u>							

SAP Input

Thermal bridges:	
Thermal bridges:	No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:	
Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	3

Main heating system:	
Main heating system:	Community heating schemes Heat source: Community boilers heat from boilers – mains gas, heat fraction 1, efficiency 95 Piping>=1991, pre-insulated, low temp, variable flow Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Boiler interlock: Yes

Main heating Control:	
Main heating Control:	Charging system linked to use of community heating, programmer and TRVs Control code: 2306

Secondary heating system:	
Secondary heating system:	None

Water heating:	
Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Flue Gas Heat Recovery System: Database (rev 498, product index 060036) Brand name: Worcester Model: Greenstar Xtra Model qualifier: 2015 Solar panel: False

Others:	
Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**

Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.51

Property Address: Sample 7 (Top)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	66.3	(1a) x	3	(2a) =	198.9	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.3	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	198.9	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	79.05	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1.4	=	3.36			(26)
Windows Type 1			4.8	x	1/[1/(1)+ 0.04]	=	4.62			(27)
Windows Type 2			5.44	x	1/[1/(1)+ 0.04]	=	5.23			(27)
Windows Type 3			1.44	x	1/[1/(1)+ 0.04]	=	1.38			(27)
Walls Type1	10.24	10.24	0	x	0.15	=	0			(29)
Walls Type2	1.44	1.44	0	x	0.15	=	0			(29)
Walls Type3	13.2	2.4	10.8	x	0.15	=	1.62			(29)
Walls Type4	2.4	0	2.4	x	0.35	=	0.84			(29)
Roof	66.3	0	66.3	x	0.11	=	7.29			(30)
Total area of elements, m²			93.58							(31)

* *for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

** *include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	24.34	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	781.5	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		14.04	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	38.38	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(38)m=	17.55	17.34	17.13	16.08	15.87	14.83	14.83	14.62	15.24	15.87	16.29	16.71	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	55.92	55.71	55.5	54.46	54.25	53.2	53.2	52.99	53.62	54.25	54.67	55.09	

Average = Sum(39)$_{1…12}$ /12= 54.41 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.84	0.84	0.84	0.82	0.82	0.8	0.8	0.8	0.81	0.82	0.82	0.83	

Average = Sum(40)$_{1…12}$ /12= 0.82 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.15 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.34 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	93.87	90.46	87.04	83.63	80.22	76.8	76.8	80.22	83.63	87.04	90.46	93.87	
												Total = Sum(44)$_{1…12}$ = 1024.02	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	139.2	121.75	125.63	109.53	105.1	90.69	84.04	96.44	97.59	113.73	124.14	134.81	
												Total = Sum(45)$_{1…12}$ = 1342.66	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.88	18.26	18.85	16.43	15.76	13.6	12.61	14.47	14.64	17.06	18.62	20.22	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	194.48	171.68	180.91	163.02	160.37	144.18	139.32	151.71	151.08	169.01	177.64	190.09	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	17.95	15.97	16.42	14.51	13.97	12.12	11.22	12.87	13.02	15.02	16.25	17.46	(63) (G2)

Output from water heater

(64)m=	173.85	153.29	161.81	145.92	143.72	129.47	125.41	136.16	135.46	151.3	158.8	169.95	

Output from water heater (annual)$_{1...12}$ | 1785.13 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	90.51	80.42	85.99	79.21	79.17	72.95	72.16	76.29	75.24	82.04	84.07	89.05	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	107.65	107.65	107.65	107.65	107.65	107.65	107.65	107.65	107.65	107.65	107.65	107.65	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.67	15.69	12.76	9.66	7.22	6.1	6.59	8.56	11.49	14.59	17.03	18.16	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	188.51	190.47	185.54	175.04	161.8	149.35	141.03	139.07	144	154.5	167.74	180.19	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.77	33.77	33.77	33.77	33.77	33.77	33.77	33.77	33.77	33.77	33.77	33.77	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.12	-86.12	-86.12	-86.12	-86.12	-86.12	-86.12	-86.12	-86.12	-86.12	-86.12	-86.12	(71)

Water heating gains (Table 5)

(72)m=	121.65	119.68	115.58	110.02	106.41	101.32	97	102.54	104.5	110.26	116.77	119.69	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	383.12	381.13	369.18	350.02	330.72	312.06	299.91	305.47	315.3	334.65	356.84	373.33	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	4.8	x	10.63	x	0.4	x	0.7	=	9.9	(74)

North	0.9x	0.77	x	5.44	x	10.63	x	0.4	x	0.7	=	11.22	(74)
North	0.9x	0.77	x	4.8	x	20.32	x	0.4	x	0.7	=	18.93	(74)
North	0.9x	0.77	x	5.44	x	20.32	x	0.4	x	0.7	=	21.45	(74)
North	0.9x	0.77	x	4.8	x	34.53	x	0.4	x	0.7	=	32.16	(74)
North	0.9x	0.77	x	5.44	x	34.53	x	0.4	x	0.7	=	36.45	(74)
North	0.9x	0.77	x	4.8	x	55.46	x	0.4	x	0.7	=	51.66	(74)
North	0.9x	0.77	x	5.44	x	55.46	x	0.4	x	0.7	=	58.55	(74)
North	0.9x	0.77	x	4.8	x	74.72	x	0.4	x	0.7	=	69.59	(74)
North	0.9x	0.77	x	5.44	x	74.72	x	0.4	x	0.7	=	78.87	(74)
North	0.9x	0.77	x	4.8	x	79.99	x	0.4	x	0.7	=	74.5	(74)
North	0.9x	0.77	x	5.44	x	79.99	x	0.4	x	0.7	=	84.43	(74)
North	0.9x	0.77	x	4.8	x	74.68	x	0.4	x	0.7	=	69.55	(74)
North	0.9x	0.77	x	5.44	x	74.68	x	0.4	x	0.7	=	78.83	(74)
North	0.9x	0.77	x	4.8	x	59.25	x	0.4	x	0.7	=	55.18	(74)
North	0.9x	0.77	x	5.44	x	59.25	x	0.4	x	0.7	=	62.54	(74)
North	0.9x	0.77	x	4.8	x	41.52	x	0.4	x	0.7	=	38.67	(74)
North	0.9x	0.77	x	5.44	x	41.52	x	0.4	x	0.7	=	43.82	(74)
North	0.9x	0.77	x	4.8	x	24.19	x	0.4	x	0.7	=	22.53	(74)
North	0.9x	0.77	x	5.44	x	24.19	x	0.4	x	0.7	=	25.53	(74)
North	0.9x	0.77	x	4.8	x	13.12	x	0.4	x	0.7	=	12.22	(74)
North	0.9x	0.77	x	5.44	x	13.12	x	0.4	x	0.7	=	13.85	(74)
North	0.9x	0.77	x	4.8	x	8.86	x	0.4	x	0.7	=	8.26	(74)
North	0.9x	0.77	x	5.44	x	8.86	x	0.4	x	0.7	=	9.36	(74)
East	0.9x	0.77	x	1.44	x	19.64	x	0.4	x	0.7	=	5.49	(76)
East	0.9x	0.77	x	1.44	x	38.42	x	0.4	x	0.7	=	10.74	(76)
East	0.9x	0.77	x	1.44	x	63.27	x	0.4	x	0.7	=	17.68	(76)
East	0.9x	0.77	x	1.44	x	92.28	x	0.4	x	0.7	=	25.78	(76)
East	0.9x	0.77	x	1.44	x	113.09	x	0.4	x	0.7	=	31.6	(76)
East	0.9x	0.77	x	1.44	x	115.77	x	0.4	x	0.7	=	32.35	(76)
East	0.9x	0.77	x	1.44	x	110.22	x	0.4	x	0.7	=	30.8	(76)
East	0.9x	0.77	x	1.44	x	94.68	x	0.4	x	0.7	=	26.45	(76)
East	0.9x	0.77	x	1.44	x	73.59	x	0.4	x	0.7	=	20.56	(76)
East	0.9x	0.77	x	1.44	x	45.59	x	0.4	x	0.7	=	12.74	(76)
East	0.9x	0.77	x	1.44	x	24.49	x	0.4	x	0.7	=	6.84	(76)
East	0.9x	0.77	x	1.44	x	16.15	x	0.4	x	0.7	=	4.51	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	26.62	51.11	86.29	135.99	180.06	191.28	179.18	144.17	103.05	60.8	32.91	22.13	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	409.74	432.25	455.47	486.01	510.78	503.34	479.08	449.64	418.35	395.45	389.75	395.46	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(86)m=	1	1	0.99	0.96	0.86	0.66	0.49	0.54	0.81	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.21	20.3	20.47	20.71	20.9	20.99	21	21	20.95	20.73	20.44	20.2	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.22	20.22	20.22	20.23	20.24	20.25	20.25	20.25	20.25	20.24	20.23	20.23	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.95	0.82	0.59	0.4	0.45	0.75	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.16	19.29	19.53	19.89	20.14	20.24	20.25	20.25	20.21	19.92	19.5	19.15	(90)

fLA = Living area ÷ (4) = 0.35 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.52	19.64	19.86	20.17	20.41	20.5	20.51	20.51	20.47	20.2	19.83	19.52	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.52	19.64	19.86	20.17	20.41	20.5	20.51	20.51	20.47	20.2	19.83	19.52	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.95	0.83	0.61	0.43	0.48	0.77	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	407.88	429.08	447.99	460.21	425.51	309	207.61	217.04	321.2	378.12	385.99	394.01	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	851.32	821.11	741.41	614	472.37	313.96	208.03	217.86	341.42	520.76	695.74	843.66	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	329.92	263.45	218.31	110.73	34.86	0	0	0	0	106.12	223.02	334.54	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1620.95 (98)

Space heating requirement in kWh/m²/year 24.45 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none 0 (301)

Fraction of space heat from community system 1 – (301) = 1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers 1 (303a)

Fraction of total space heat from Community boilers (302) x (303a) = 1 (304a)

Factor for control and charging method (Table 4c(3)) for community heating system 1 (305)

Distribution loss factor (Table 12c) for community heating system 1.05 (306)

Space heating **kWh/year**

Annual space heating requirement 1620.95

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Space heat from Community boilers	(98) x (304a) x (305) x (306) =	1701.99	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)

Water heating

Annual water heating requirement		1785.13	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	1874.39	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	35.76	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		118.3	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	118.3	(331)
Energy for lighting (calculated in Appendix L)		311.98	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		4006.66	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				95	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.22	=	813.16	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	18.56	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	831.72	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				831.72	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	61.4	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	161.92	(379)
Total CO2, kg/year	sum of (376)…(382) =				1055.03	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				15.91	(384)
EI rating (section 14)					87.3	(385)

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User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.5.51

Property Address: Sample 7 (Top)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	66.3	(1a) x	3	(2a) =	198.9	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.3	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	198.9	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20 ÷ (5) =	0.1	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35				
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)		0.35	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.37	0.37	0.33	0.32	0.28	0.28	0.28	0.3	0.32	0.34	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1	=	2.4			(26)
Windows Type 1			4.8	x1/[1/(1.4)+ 0.04]		=	6.36			(27)
Windows Type 2			5.44	x1/[1/(1.4)+ 0.04]		=	7.21			(27)
Windows Type 3			1.44	x1/[1/(1.4)+ 0.04]		=	1.91			(27)
Walls Type1	10.24	10.24	0	x	0.18	=	0			(29)
Walls Type2	1.44	1.44	0	x	0.18	=	0			(29)
Walls Type3	13.2	2.4	10.8	x	0.18	=	1.94			(29)
Walls Type4	2.4	0	2.4	x	0.18	=	0.43			(29)
Roof	66.3	0	66.3	x	0.13	=	8.62			(30)
Total area of elements, m²			93.58							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.88 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 781.5 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 4.68 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 33.56 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(38)m=	37.56	37.37	37.19	36.34	36.19	35.45	35.45	35.31	35.73	36.19	36.51	36.84	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	71.11	70.93	70.75	69.9	69.74	69.01	69.01	68.87	69.29	69.74	70.07	70.4	

Average = Sum(39)$_{1...12}$ /12= 69.9 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.07	1.07	1.07	1.05	1.05	1.04	1.04	1.04	1.05	1.05	1.06	1.06

Average = Sum(40)$_{1...12}$ /12= 1.05 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.15 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.34 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	93.87	90.46	87.04	83.63	80.22	76.8	76.8	80.22	83.63	87.04	90.46	93.87

Total = Sum(44)$_{1...12}$ = 1024.02 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.2	121.75	125.63	109.53	105.1	90.69	84.04	96.44	97.59	113.73	124.14	134.81

Total = Sum(45)$_{1...12}$ = 1342.66 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.88	18.26	18.85	16.43	15.76	13.6	12.61	14.47	14.64	17.06	18.62	20.22	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

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Primary circuit loss (annual) from Table 3	0	(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	185.8	163.83	172.23	154.62	151.69	135.78	130.63	143.03	142.68	160.32	169.24	181.41	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	185.8	163.83	172.23	154.62	151.69	135.78	130.63	143.03	142.68	160.32	169.24	181.41	

Output from water heater (annual)$_{1...12}$	1891.27	(64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	83.56	74.15	79.05	72.49	72.22	66.23	65.22	69.34	68.52	75.09	77.35	82.1	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	107.65	107.65	107.65	107.65	107.65	107.65	107.65	107.65	107.65	107.65	107.65	107.65	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.23	15.3	12.44	9.42	7.04	5.94	6.42	8.35	11.21	14.23	16.61	17.7	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	188.51	190.47	185.54	175.04	161.8	149.35	141.03	139.07	144	154.5	167.74	180.19	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.77	33.77	33.77	33.77	33.77	33.77	33.77	33.77	33.77	33.77	33.77	33.77	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.12	-86.12	-86.12	-86.12	-86.12	-86.12	-86.12	-86.12	-86.12	-86.12	-86.12	-86.12	(71)

Water heating gains (Table 5)

(72)m=	112.31	110.34	106.25	100.68	97.07	91.98	87.66	93.2	95.17	100.93	107.43	110.35	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	376.35	374.41	362.53	343.44	324.21	305.57	293.41	298.92	308.67	327.95	350.08	366.55	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	4.8	x	10.63	x	0.63	x	0.7	=	15.6	(74)

North	0.9x	0.77	x	5.44	x	10.63	x	0.63	x	0.7	=	17.68	(74)
North	0.9x	0.77	x	4.8	x	20.32	x	0.63	x	0.7	=	29.81	(74)
North	0.9x	0.77	x	5.44	x	20.32	x	0.63	x	0.7	=	33.78	(74)
North	0.9x	0.77	x	4.8	x	34.53	x	0.63	x	0.7	=	50.65	(74)
North	0.9x	0.77	x	5.44	x	34.53	x	0.63	x	0.7	=	57.41	(74)
North	0.9x	0.77	x	4.8	x	55.46	x	0.63	x	0.7	=	81.36	(74)
North	0.9x	0.77	x	5.44	x	55.46	x	0.63	x	0.7	=	92.21	(74)
North	0.9x	0.77	x	4.8	x	74.72	x	0.63	x	0.7	=	109.6	(74)
North	0.9x	0.77	x	5.44	x	74.72	x	0.63	x	0.7	=	124.22	(74)
North	0.9x	0.77	x	4.8	x	79.99	x	0.63	x	0.7	=	117.33	(74)
North	0.9x	0.77	x	5.44	x	79.99	x	0.63	x	0.7	=	132.98	(74)
North	0.9x	0.77	x	4.8	x	74.68	x	0.63	x	0.7	=	109.55	(74)
North	0.9x	0.77	x	5.44	x	74.68	x	0.63	x	0.7	=	124.15	(74)
North	0.9x	0.77	x	4.8	x	59.25	x	0.63	x	0.7	=	86.91	(74)
North	0.9x	0.77	x	5.44	x	59.25	x	0.63	x	0.7	=	98.5	(74)
North	0.9x	0.77	x	4.8	x	41.52	x	0.63	x	0.7	=	60.9	(74)
North	0.9x	0.77	x	5.44	x	41.52	x	0.63	x	0.7	=	69.02	(74)
North	0.9x	0.77	x	4.8	x	24.19	x	0.63	x	0.7	=	35.48	(74)
North	0.9x	0.77	x	5.44	x	24.19	x	0.63	x	0.7	=	40.22	(74)
North	0.9x	0.77	x	4.8	x	13.12	x	0.63	x	0.7	=	19.24	(74)
North	0.9x	0.77	x	5.44	x	13.12	x	0.63	x	0.7	=	21.81	(74)
North	0.9x	0.77	x	4.8	x	8.86	x	0.63	x	0.7	=	13	(74)
North	0.9x	0.77	x	5.44	x	8.86	x	0.63	x	0.7	=	14.74	(74)
East	0.9x	0.77	x	1.44	x	19.64	x	0.63	x	0.7	=	8.64	(76)
East	0.9x	0.77	x	1.44	x	38.42	x	0.63	x	0.7	=	16.91	(76)
East	0.9x	0.77	x	1.44	x	63.27	x	0.63	x	0.7	=	27.85	(76)
East	0.9x	0.77	x	1.44	x	92.28	x	0.63	x	0.7	=	40.61	(76)
East	0.9x	0.77	x	1.44	x	113.09	x	0.63	x	0.7	=	49.77	(76)
East	0.9x	0.77	x	1.44	x	115.77	x	0.63	x	0.7	=	50.95	(76)
East	0.9x	0.77	x	1.44	x	110.22	x	0.63	x	0.7	=	48.51	(76)
East	0.9x	0.77	x	1.44	x	94.68	x	0.63	x	0.7	=	41.67	(76)
East	0.9x	0.77	x	1.44	x	73.59	x	0.63	x	0.7	=	32.39	(76)
East	0.9x	0.77	x	1.44	x	45.59	x	0.63	x	0.7	=	20.06	(76)
East	0.9x	0.77	x	1.44	x	24.49	x	0.63	x	0.7	=	10.78	(76)
East	0.9x	0.77	x	1.44	x	16.15	x	0.63	x	0.7	=	7.11	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	41.92	80.5	135.91	214.19	283.59	301.26	282.2	227.08	162.31	95.76	51.83	34.85	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	418.27	454.91	498.43	557.63	607.8	606.83	575.61	525.99	470.98	423.71	401.91	401.39	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(86)m=	1	1	0.99	0.96	0.87	0.69	0.52	0.59	0.85	0.98	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.89	20.01	20.23	20.55	20.83	20.96	20.99	20.99	20.89	20.55	20.17	19.87	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.02	20.03	20.03	20.04	20.04	20.05	20.05	20.05	20.05	20.04	20.04	20.03	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.95	0.82	0.6	0.41	0.47	0.78	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.55	18.72	19.05	19.51	19.87	20.03	20.05	20.05	19.95	19.51	18.97	18.53	(90)

fLA = Living area ÷ (4) = 0.35 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.01	19.17	19.46	19.87	20.2	20.35	20.38	20.37	20.28	19.87	19.38	18.99	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.01	19.17	19.46	19.87	20.2	20.35	20.38	20.37	20.28	19.87	19.38	18.99	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.94	0.83	0.63	0.45	0.51	0.8	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	416.34	451.35	489.45	526.23	506.4	382.38	258.62	269.85	377.5	407.76	398.32	399.9	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1046.39	1011.92	916.77	766.93	592.98	396.91	260.53	273.62	428.11	646.74	860.71	1041.48	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	468.76	376.71	317.92	173.3	64.42	0	0	0	0	177.8	332.92	477.33	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2389.15 (98)

Space heating requirement in kWh/m²/year 36.04 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	468.76	376.71	317.92	173.3	64.42	0	0	0	0	177.8	332.92	477.33	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	501.34	402.9	340.02	185.35	68.89	0	0	0	0	190.16	356.06	510.51	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2555.24 (211)

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Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
											Total (kWh/year) =Sum(215)$_{1...5,10...12}$=		0	(215)

Water heating

Output from water heater (calculated above)

	185.8	163.83	172.23	154.62	151.69	135.78	130.63	143.03	142.68	160.32	169.24	181.41		
Efficiency of water heater													79.8	(216)
(217)m=	87.18	86.97	86.43	85.12	82.71	79.8	79.8	79.8	79.8	85.09	86.59	87.28		(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	213.12	188.39	199.27	181.66	183.39	170.15	163.7	179.24	178.8	188.42	195.45	207.85		
											Total = Sum(219a)$_{1...12}$ =		2249.44	(219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2555.24	
Water heating fuel used		2249.44	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	75	(231)
Electricity for lighting		304.21	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		5183.89	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	551.93	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	485.88	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1037.81	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	157.88	(268)
Total CO2, kg/year		sum of (265)…(271) =		1234.62	(272)

TER =	18.62	(273)

SAP Input

Property Details: Sample 8 (Top)

Address:	
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	26 July 2019
Date of certificate:	15 June 2022
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	498

Property description:

Dwelling type:	Flat
Detachment:	
Year Completed:	2022

Floor Location:	Floor area:	Storey height:
Floor 0	70 m²	3 m

Living area:	26 m² (fraction 0.371)
Front of dwelling faces:	Unspecified

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
DOOR	Manufacturer	Solid			Wood
W	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
N	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Balcony	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
DOOR	mm	0.7	0	1.4	2.4	1
W		0.7	0.4	1	2.72	1
N		0.7	0.4	1	4.16	1
Balcony		0.7	0.4	1	4.8	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
DOOR		INT	Worst case	0	0
W		W	West	0	0
N		N	North	0	0
Balcony		N	North	0	0

Overshading: More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
<u>External Elements</u>							
N	29.4	8.96	20.44	0.15	0	False	N/A
W	29.4	2.72	26.68	0.15	0	False	N/A
INT	14.1	2.4	11.7	0.16	0.43	False	N/A
Spandrel	2.4	0	2.4	0.35	0	False	N/A
E	17.1	0	17.1	0.15	0	False	N/A
Roof	70	0	70	0.11	0		N/A

<u>Internal Elements</u>

SAP Input

Party Elements

Thermal bridges:	
Thermal bridges:	No information on thermal bridging (y=0.15) (y =0.15)
Ventilation:	
Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	3
Main heating system:	
Main heating system:	Community heating schemes Heat source: Community boilers heat from boilers – mains gas, heat fraction 1, efficiency 95 Piping>=1991, pre-insulated, low temp, variable flow Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Boiler interlock: Yes
Main heating Control:	
Main heating Control:	Charging system linked to use of community heating, programmer and TRVs Control code: 2306
Secondary heating system:	
Secondary heating system:	None
Water heating:	
Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Flue Gas Heat Recovery System: Database (rev 498, product index 060036) Brand name: Worcester Model: Greenstar Xtra Model qualifier: 2015 Solar panel: False
Others:	
Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Sample 8 (Top)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	70	(1a) x	3	(2a) =	210	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	70	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	210	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*		0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.05 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1.4	=	3.36			(26)
Windows Type 1			2.72	x	1/[1/(1)+ 0.04]	=	2.62			(27)
Windows Type 2			4.16	x	1/[1/(1)+ 0.04]	=	4			(27)
Windows Type 3			4.8	x	1/[1/(1)+ 0.04]	=	4.62			(27)
Walls Type1	29.4	8.96	20.44	x	0.15	=	3.07			(29)
Walls Type2	29.4	2.72	26.68	x	0.15	=	4			(29)
Walls Type3	14.1	2.4	11.7	x	0.15	=	1.75			(29)
Walls Type4	2.4	0	2.4	x	0.35	=	0.84			(29)
Walls Type5	17.1	0	17.1	x	0.15	=	2.57			(29)
Roof	70	0	70	x	0.11	=	7.7			(30)
Total area of elements, m²			162.4							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 34.52 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 1726.48 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 24.36 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 58.88 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	18.52	18.3	18.08	16.98	16.76	15.65	15.65	15.43	16.09	16.76	17.2	17.64	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	77.4	77.18	76.96	75.85	75.63	74.53	74.53	74.31	74.97	75.63	76.07	76.52	

Average = Sum(39)$_{1...12}$ /12= 75.8 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.11	1.1	1.1	1.08	1.08	1.06	1.06	1.06	1.07	1.08	1.09	1.09	

Average = Sum(40)$_{1...12}$ /12= 1.08 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.25 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 87.55 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	96.3	92.8	89.3	85.79	82.29	78.79	78.79	82.29	85.79	89.3	92.8	96.3	

Total = Sum(44)$_{1...12}$ = 1050.55 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	142.81	124.9	128.89	112.37	107.82	93.04	86.22	98.93	100.12	116.67	127.36	138.3	

Total = Sum(45)$_{1...12}$ = 1377.43 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.42	18.74	19.33	16.86	16.17	13.96	12.93	14.84	15.02	17.5	19.1	20.75	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	198.09	174.83	184.17	165.86	163.1	146.53	141.49	154.21	153.61	171.95	180.85	193.58	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	18.35	16.34	16.79	14.86	14.3	12.43	11.52	13.19	13.34	15.37	16.62	17.85	(63) (G2)

Output from water heater

(64)m=	177.06	156.07	164.69	148.41	146.11	131.51	127.29	138.34	137.67	153.9	161.64	173.05	

Output from water heater (annual)$_{1...12}$ | 1815.73 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	91.71	81.47	87.08	80.16	80.07	73.73	72.89	77.12	76.08	83.02	85.14	90.21	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	112.31	112.31	112.31	112.31	112.31	112.31	112.31	112.31	112.31	112.31	112.31	112.31	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.7	16.61	13.51	10.23	7.64	6.45	6.97	9.06	12.17	15.45	18.03	19.22	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	197.3	199.34	194.19	183.2	169.34	156.31	147.6	145.55	150.71	161.7	175.56	188.59	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.23	34.23	34.23	34.23	34.23	34.23	34.23	34.23	34.23	34.23	34.23	34.23	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	(71)

Water heating gains (Table 5)

(72)m=	123.26	121.24	117.04	111.33	107.62	102.4	97.97	103.65	105.67	111.58	118.25	121.25	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	395.95	393.88	381.42	361.45	341.3	321.86	309.23	314.96	325.24	345.42	368.53	385.75	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

DER WorkSheet: New dwelling design stage

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	4.16	x	10.63	x	0.4	x	0.7	=	8.58	(74)
North	0.9x	0.77	x	4.8	x	10.63	x	0.4	x	0.7	=	9.9	(74)
North	0.9x	0.77	x	4.16	x	20.32	x	0.4	x	0.7	=	16.4	(74)
North	0.9x	0.77	x	4.8	x	20.32	x	0.4	x	0.7	=	18.93	(74)
North	0.9x	0.77	x	4.16	x	34.53	x	0.4	x	0.7	=	27.87	(74)
North	0.9x	0.77	x	4.8	x	34.53	x	0.4	x	0.7	=	32.16	(74)
North	0.9x	0.77	x	4.16	x	55.46	x	0.4	x	0.7	=	44.77	(74)
North	0.9x	0.77	x	4.8	x	55.46	x	0.4	x	0.7	=	51.66	(74)
North	0.9x	0.77	x	4.16	x	74.72	x	0.4	x	0.7	=	60.31	(74)
North	0.9x	0.77	x	4.8	x	74.72	x	0.4	x	0.7	=	69.59	(74)
North	0.9x	0.77	x	4.16	x	79.99	x	0.4	x	0.7	=	64.56	(74)
North	0.9x	0.77	x	4.8	x	79.99	x	0.4	x	0.7	=	74.5	(74)
North	0.9x	0.77	x	4.16	x	74.68	x	0.4	x	0.7	=	60.28	(74)
North	0.9x	0.77	x	4.8	x	74.68	x	0.4	x	0.7	=	69.55	(74)
North	0.9x	0.77	x	4.16	x	59.25	x	0.4	x	0.7	=	47.82	(74)
North	0.9x	0.77	x	4.8	x	59.25	x	0.4	x	0.7	=	55.18	(74)
North	0.9x	0.77	x	4.16	x	41.52	x	0.4	x	0.7	=	33.51	(74)
North	0.9x	0.77	x	4.8	x	41.52	x	0.4	x	0.7	=	38.67	(74)
North	0.9x	0.77	x	4.16	x	24.19	x	0.4	x	0.7	=	19.53	(74)
North	0.9x	0.77	x	4.8	x	24.19	x	0.4	x	0.7	=	22.53	(74)
North	0.9x	0.77	x	4.16	x	13.12	x	0.4	x	0.7	=	10.59	(74)
North	0.9x	0.77	x	4.8	x	13.12	x	0.4	x	0.7	=	12.22	(74)
North	0.9x	0.77	x	4.16	x	8.86	x	0.4	x	0.7	=	7.16	(74)
North	0.9x	0.77	x	4.8	x	8.86	x	0.4	x	0.7	=	8.26	(74)
West	0.9x	0.77	x	2.72	x	19.64	x	0.4	x	0.7	=	10.37	(80)
West	0.9x	0.77	x	2.72	x	38.42	x	0.4	x	0.7	=	20.28	(80)
West	0.9x	0.77	x	2.72	x	63.27	x	0.4	x	0.7	=	33.39	(80)
West	0.9x	0.77	x	2.72	x	92.28	x	0.4	x	0.7	=	48.7	(80)
West	0.9x	0.77	x	2.72	x	113.09	x	0.4	x	0.7	=	59.69	(80)
West	0.9x	0.77	x	2.72	x	115.77	x	0.4	x	0.7	=	61.1	(80)
West	0.9x	0.77	x	2.72	x	110.22	x	0.4	x	0.7	=	58.17	(80)
West	0.9x	0.77	x	2.72	x	94.68	x	0.4	x	0.7	=	49.97	(80)
West	0.9x	0.77	x	2.72	x	73.59	x	0.4	x	0.7	=	38.84	(80)
West	0.9x	0.77	x	2.72	x	45.59	x	0.4	x	0.7	=	24.06	(80)
West	0.9x	0.77	x	2.72	x	24.49	x	0.4	x	0.7	=	12.93	(80)
West	0.9x	0.77	x	2.72	x	16.15	x	0.4	x	0.7	=	8.52	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	28.85	55.61	93.43	145.13	189.59	200.16	188	152.97	111.02	66.12	35.73	23.94	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	424.8	449.49	474.85	506.58	530.89	522.02	497.24	467.94	436.26	411.53	404.27	409.69	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.93	0.8	0.63	0.69	0.9	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.83	19.92	20.13	20.43	20.72	20.92	20.98	20.97	20.83	20.48	20.11	19.81	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20	20	20	20.01	20.02	20.03	20.03	20.03	20.02	20.02	20.01	20.01	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.9	0.72	0.51	0.56	0.85	0.98	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.43	18.58	18.87	19.32	19.72	19.97	20.02	20.02	19.88	19.4	18.86	18.42	(90)

fLA = Living area ÷ (4) = 0.37 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.95	19.08	19.34	19.73	20.09	20.32	20.38	20.37	20.23	19.8	19.32	18.93	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.95	19.08	19.34	19.73	20.09	20.32	20.38	20.37	20.23	19.8	19.32	18.93	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.99	0.97	0.91	0.75	0.55	0.61	0.86	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	423.17	446.89	469.38	490.63	480.76	389.94	275.64	285.54	376.52	400.66	401.39	408.38	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1133.7	1094.16	988.1	821.43	634.54	426.61	281.65	295.3	459.75	695.89	929.91	1127.45	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	528.64	434.97	385.93	238.18	114.42	0	0	0	0	219.65	380.53	534.99	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2837.3 (98)

Space heating requirement in kWh/m²/year 40.53 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.
Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none 0 (301)

Fraction of space heat from community system 1 – (301) = 1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers 1 (303a)

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Fraction of total space heat from Community boilers	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		2837.3	
Space heat from Community boilers	(98) x (304a) x (305) x (306) =	2979.17	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		1815.73	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	1906.52	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	48.86	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		124.9	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	124.9	(331)
Energy for lighting (calculated in Appendix L)		330.25	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		5340.83	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				95	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.22	=	1110.85	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	25.36	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	1136.21	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				1136.21	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	64.82	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	171.4	(379)
Total CO2, kg/year	sum of (376)…(382) =				1372.43	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				19.61	(384)
EI rating (section 14)					84.01	(385)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.51

Property Address: Sample 8 (Top)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	70	(1a) x	3	(2a) =	210	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	70	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	210	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

DRAFT

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.1	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.35	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.29	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.37	0.37	0.36	0.32	0.32	0.28	0.28	0.27	0.29	0.32	0.33	0.34

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1	=	2.4			(26)
Windows Type 1			2.72	x1/[1/(1.4)+ 0.04]		=	3.61			(27)
Windows Type 2			4.16	x1/[1/(1.4)+ 0.04]		=	5.52			(27)
Windows Type 3			4.8	x1/[1/(1.4)+ 0.04]		=	6.36			(27)
Walls Type1	29.4	8.96	20.44	x	0.18	=	3.68			(29)
Walls Type2	29.4	2.72	26.68	x	0.18	=	4.8			(29)
Walls Type3	14.1	2.4	11.7	x	0.18	=	2.11			(29)
Walls Type4	2.4	0	2.4	x	0.18	=	0.43			(29)
Walls Type5	17.1	0	17.1	x	0.18	=	3.08			(29)
Roof	70	0	70	x	0.13	=	9.1			(30)
Total area of elements, m²			162.4							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	41.08	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	1726.48	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 8.12 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 49.2 (37)

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Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	39.5	39.31	39.13	38.26	38.1	37.34	37.34	37.2	37.63	38.1	38.43	38.77	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	88.7	88.51	88.33	87.46	87.3	86.55	86.55	86.41	86.84	87.3	87.63	87.97	

Average = Sum(39)$_{1\ldots12}$ /12= 87.46 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.27	1.26	1.26	1.25	1.25	1.24	1.24	1.23	1.24	1.25	1.25	1.26	

Average = Sum(40)$_{1\ldots12}$ /12= 1.25 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.25 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 87.55 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	96.3	92.8	89.3	85.79	82.29	78.79	78.79	82.29	85.79	89.3	92.8	96.3	

Total = Sum(44)$_{1\ldots12}$ = 1050.55 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	142.81	124.9	128.89	112.37	107.82	93.04	86.22	98.93	100.12	116.67	127.36	138.3	

Total = Sum(45)$_{1\ldots12}$ = 1377.43 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.42	18.74	19.33	16.86	16.17	13.96	12.93	14.84	15.02	17.5	19.1	20.75	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

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If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	189.41	166.99	175.48	157.46	154.41	138.13	132.81	145.53	145.21	163.27	172.45	184.9	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	189.41	166.99	175.48	157.46	154.41	138.13	132.81	145.53	145.21	163.27	172.45	184.9	

Output from water heater (annual)$_{1…12}$ — 1926.05 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	84.76	75.2	80.13	73.44	73.13	67.01	65.94	70.17	69.36	76.07	78.42	83.26	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	112.31	112.31	112.31	112.31	112.31	112.31	112.31	112.31	112.31	112.31	112.31	112.31	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.2	16.17	13.15	9.95	7.44	6.28	6.79	8.82	11.84	15.04	17.55	18.71	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	197.3	199.34	194.19	183.2	169.34	156.31	147.6	145.55	150.71	161.7	175.56	188.59	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.23	34.23	34.23	34.23	34.23	34.23	34.23	34.23	34.23	34.23	34.23	34.23	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	(71)

Water heating gains (Table 5)

(72)m=	113.93	111.9	107.7	101.99	98.29	93.07	88.63	94.32	96.34	102.24	108.92	111.91	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	389.12	387.11	374.73	354.84	334.76	315.35	302.71	308.39	318.58	338.67	361.72	378.9	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	4.16	x	10.63	x	0.63	x	0.7	=	13.52	(74)
North	0.9x	0.77	x	4.8	x	10.63	x	0.63	x	0.7	=	15.6	(74)
North	0.9x	0.77	x	4.16	x	20.32	x	0.63	x	0.7	=	25.84	(74)
North	0.9x	0.77	x	4.8	x	20.32	x	0.63	x	0.7	=	29.81	(74)
North	0.9x	0.77	x	4.16	x	34.53	x	0.63	x	0.7	=	43.9	(74)
North	0.9x	0.77	x	4.8	x	34.53	x	0.63	x	0.7	=	50.65	(74)
North	0.9x	0.77	x	4.16	x	55.46	x	0.63	x	0.7	=	70.51	(74)
North	0.9x	0.77	x	4.8	x	55.46	x	0.63	x	0.7	=	81.36	(74)
North	0.9x	0.77	x	4.16	x	74.72	x	0.63	x	0.7	=	94.99	(74)
North	0.9x	0.77	x	4.8	x	74.72	x	0.63	x	0.7	=	109.6	(74)
North	0.9x	0.77	x	4.16	x	79.99	x	0.63	x	0.7	=	101.69	(74)
North	0.9x	0.77	x	4.8	x	79.99	x	0.63	x	0.7	=	117.33	(74)
North	0.9x	0.77	x	4.16	x	74.68	x	0.63	x	0.7	=	94.94	(74)
North	0.9x	0.77	x	4.8	x	74.68	x	0.63	x	0.7	=	109.55	(74)
North	0.9x	0.77	x	4.16	x	59.25	x	0.63	x	0.7	=	75.32	(74)
North	0.9x	0.77	x	4.8	x	59.25	x	0.63	x	0.7	=	86.91	(74)
North	0.9x	0.77	x	4.16	x	41.52	x	0.63	x	0.7	=	52.78	(74)
North	0.9x	0.77	x	4.8	x	41.52	x	0.63	x	0.7	=	60.9	(74)
North	0.9x	0.77	x	4.16	x	24.19	x	0.63	x	0.7	=	30.75	(74)
North	0.9x	0.77	x	4.8	x	24.19	x	0.63	x	0.7	=	35.48	(74)
North	0.9x	0.77	x	4.16	x	13.12	x	0.63	x	0.7	=	16.68	(74)
North	0.9x	0.77	x	4.8	x	13.12	x	0.63	x	0.7	=	19.24	(74)
North	0.9x	0.77	x	4.16	x	8.86	x	0.63	x	0.7	=	11.27	(74)
North	0.9x	0.77	x	4.8	x	8.86	x	0.63	x	0.7	=	13	(74)
West	0.9x	0.77	x	2.72	x	19.64	x	0.63	x	0.7	=	16.33	(80)
West	0.9x	0.77	x	2.72	x	38.42	x	0.63	x	0.7	=	31.94	(80)
West	0.9x	0.77	x	2.72	x	63.27	x	0.63	x	0.7	=	52.6	(80)
West	0.9x	0.77	x	2.72	x	92.28	x	0.63	x	0.7	=	76.71	(80)
West	0.9x	0.77	x	2.72	x	113.09	x	0.63	x	0.7	=	94.01	(80)
West	0.9x	0.77	x	2.72	x	115.77	x	0.63	x	0.7	=	96.24	(80)
West	0.9x	0.77	x	2.72	x	110.22	x	0.63	x	0.7	=	91.62	(80)
West	0.9x	0.77	x	2.72	x	94.68	x	0.63	x	0.7	=	78.7	(80)
West	0.9x	0.77	x	2.72	x	73.59	x	0.63	x	0.7	=	61.17	(80)
West	0.9x	0.77	x	2.72	x	45.59	x	0.63	x	0.7	=	37.9	(80)
West	0.9x	0.77	x	2.72	x	24.49	x	0.63	x	0.7	=	20.36	(80)
West	0.9x	0.77	x	2.72	x	16.15	x	0.63	x	0.7	=	13.43	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.44	87.58	147.15	228.59	298.6	315.26	296.11	240.93	174.86	104.13	56.28	37.7	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	434.56	474.69	521.88	583.43	633.36	630.61	598.82	549.32	493.44	442.8	418	416.6	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.91	0.77	0.61	0.67	0.9	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.62	19.75	20	20.35	20.69	20.91	20.98	20.96	20.79	20.38	19.94	19.6	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.87	19.87	19.87	19.88	19.88	19.89	19.89	19.89	19.89	19.88	19.88	19.87	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.96	0.87	0.67	0.47	0.53	0.83	0.97	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.04	18.23	18.59	19.11	19.57	19.83	19.88	19.88	19.71	19.15	18.52	18.02	(90)

fLA = Living area ÷ (4) = | 0.37 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.63	18.79	19.11	19.57	19.98	20.23	20.29	20.28	20.11	19.61	19.05	18.61	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.63	18.79	19.11	19.57	19.98	20.23	20.29	20.28	20.11	19.61	19.05	18.61	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.96	0.87	0.71	0.52	0.59	0.85	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	432.62	471.22	513.72	557.68	554.1	445.04	311.51	321.98	418.44	429.37	414.62	415.07	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1271.15	1229.67	1113.98	933.26	723.24	487.18	319.26	335.28	522.1	786.17	1047.06	1267.35	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	623.86	509.67	446.59	270.41	125.84	0	0	0	0	265.46	455.35	634.09	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 3331.28 | (98)

Space heating requirement in kWh/m²/year | 47.59 | (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	623.86	509.67	446.59	270.41	125.84	0	0	0	0	265.46	455.35	634.09		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	667.23	545.1	477.63	289.21	134.59	0	0	0	0	283.91	487.01	678.17		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													3562.87	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Output from water heater (calculated above)	189.41	166.99	175.48	157.46	154.41	138.13	132.81	145.53	145.21	163.27	172.45	184.9		
Efficiency of water heater													79.8	(216)
(217)m=	87.76	87.6	87.2	86.24	84.27	79.8	79.8	79.8	79.8	86.1	87.29	87.84		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	215.82	190.62	201.24	182.57	183.23	173.1	166.43	182.37	181.96	189.62	197.57	210.49		
Total = Sum(219a)$_{1...12}$ =													2275.03	(219)

Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			3562.87	
Water heating fuel used			2275.03	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			321.47	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			6234.37	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	769.58	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	491.41	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1260.99	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	166.84	(268)
Total CO2, kg/year		sum of (265)…(271) =		1466.76	(272)

TER = 20.95 (273)

SAP Input

Property Details: House Sample 1

Address:	
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	26 July 2019
Date of certificate:	15 June 2022
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	498

Property description:

Dwelling type:	House	
Detachment:	Mid-terrace	
Year Completed:	2019	
Floor Location:	Floor area:	Storey height:
Floor 0	129 m²	3 m
Living area:	30 m² (fraction 0.233)	
Front of dwelling faces:	Unspecified	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
DOOR	Manufacturer	Solid			Wood
N	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
S	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
DOOR	mm	0.7	0	1.4	2.4	1
N		0.7	0.4	1	12.3	1
S		0.7	0.4	1	10.3	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
DOOR		S	Worst case	0	0
N		N	North	0	0
S		S	South	0	0

Overshading: More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
N	42	12.3	29.7	0.15	0	False	N/A
S	44	12.7	31.3	0.15	0	False	N/A
Roof	46	0	46	0.11	0		N/A
Exposed	46			0.11			N/A
Internal Elements							
Party Elements							

Thermal bridges:

Thermal bridges: No information on thermal bridging (y=0.15) (y =0.15)

SAP Input

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	3

Main heating system:

Main heating system:	Boiler systems with radiators or underfloor heating Gas boilers and oil boilers Fuel: mains gas Info Source: Boiler Database Database: (rev 498, product index 016888) Efficiency: Winter 79.9 % Summer: 90.0 Brand name: Worcester Model: Greenstar Model qualifier: 34CDi Combi (Combi boiler) Systems with radiators Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Boiler interlock: Yes Weather Compensator

Main heating Control:

Main heating Control:	Time and temperature zone control by suitable arrangement of plumbing and electrical services Control code: 2110

Secondary heating system:

Secondary heating system:	None

Water heating:

Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Flue Gas Heat Recovery System: Database (rev 498, product index 060036) Brand name: Worcester Model: Greenstar Xtra Model qualifier: 2015 Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.5.51

Property Address: House Sample 1

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	129	(1a) x	3	(2a) =	387	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	129	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	387	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0 ÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.05 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1.4	=	3.36			(26)
Windows Type 1			12.3	x	1/[1/(1)+ 0.04]	=	11.83			(27)
Windows Type 2			10.3	x	1/[1/(1)+ 0.04]	=	9.9			(27)
Floor			46	x	0.11	=	5.06			(28)
Walls Type1	42	12.3	29.7	x	0.15	=	4.46			(29)
Walls Type2	44	12.7	31.3	x	0.15	=	4.7			(29)
Roof	46	0	46	x	0.11	=	5.06			(30)
Total area of elements, m²			178							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 44.36 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 4718 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 26.7 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 71.06 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	34.14	33.73	33.32	31.29	30.88	28.85	28.85	28.44	29.66	30.88	31.7	32.51	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	105.2	104.79	104.39	102.35	101.94	99.91	99.91	99.5	100.72	101.94	102.76	103.57	

Average = Sum(39)$_{1…12}$ /12= 102.25 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.82	0.81	0.81	0.79	0.79	0.77	0.77	0.77	0.78	0.79	0.8	0.8	

Average = Sum(40)1…12 /12= 0.79 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.89 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 102.89 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	113.18	109.07	104.95	100.84	96.72	92.6	92.6	96.72	100.84	104.95	109.07	113.18	

Total = Sum(44)1…12 = 1234.72 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	167.85	146.8	151.48	132.07	126.72	109.35	101.33	116.28	117.67	137.13	149.69	162.55	

Total = Sum(45)1…12 = 1618.91 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	25.18	22.02	22.72	19.81	19.01	16.4	15.2	17.44	17.65	20.57	22.45	24.38	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	50.96	46.03	50.96	49.32	50.96	49.32	50.96	50.96	49.32	50.96	49.32	50.96	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	218.81	192.83	202.44	181.38	177.68	158.67	152.29	167.24	166.98	188.09	199	213.51	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	22.65	19.62	19.53	16.37	13.93	10.6	9.82	11.27	11.4	16.79	19.53	22.21	(63) (G2)

Output from water heater

(64)m=	193.68	170.97	180.44	162.62	161.28	145.68	140	153.5	153.19	168.83	177.08	188.83	

Output from water heater (annual)$_{1...12}$ 1996.09 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	68.55	60.32	63.11	56.24	54.87	48.69	46.43	51.4	51.45	58.34	62.1	66.79	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	144.62	144.62	144.62	144.62	144.62	144.62	144.62	144.62	144.62	144.62	144.62	144.62	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	27.82	24.71	20.09	15.21	11.37	9.6	10.37	13.48	18.1	22.98	26.82	28.59	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	296.51	299.59	291.83	275.33	254.49	234.91	221.83	218.75	226.5	243.01	263.85	283.43	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	37.46	37.46	37.46	37.46	37.46	37.46	37.46	37.46	37.46	37.46	37.46	37.46	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	(71)
Water heating gains (Table 5)													
(72)m=	92.14	89.76	84.82	78.11	73.76	67.62	62.41	69.09	71.46	78.41	86.25	89.77	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	485.85	483.44	466.14	438.04	409	381.52	363.99	370.71	385.45	413.78	446.3	471.17	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	12.3	x	10.63	x	0.4	x	0.7	=	25.38	(74)
North	0.9x	0.77	x	12.3	x	20.32	x	0.4	x	0.7	=	48.5	(74)
North	0.9x	0.77	x	12.3	x	34.53	x	0.4	x	0.7	=	82.41	(74)
North	0.9x	0.77	x	12.3	x	55.46	x	0.4	x	0.7	=	132.38	(74)

North	0.9x	0.77	x	12.3	x	74.72	x	0.4	x	0.7	=	178.32	(74)
North	0.9x	0.77	x	12.3	x	79.99	x	0.4	x	0.7	=	190.9	(74)
North	0.9x	0.77	x	12.3	x	74.68	x	0.4	x	0.7	=	178.23	(74)
North	0.9x	0.77	x	12.3	x	59.25	x	0.4	x	0.7	=	141.4	(74)
North	0.9x	0.77	x	12.3	x	41.52	x	0.4	x	0.7	=	99.09	(74)
North	0.9x	0.77	x	12.3	x	24.19	x	0.4	x	0.7	=	57.73	(74)
North	0.9x	0.77	x	12.3	x	13.12	x	0.4	x	0.7	=	31.31	(74)
North	0.9x	0.77	x	12.3	x	8.86	x	0.4	x	0.7	=	21.16	(74)
South	0.9x	0.77	x	10.3	x	46.75	x	0.4	x	0.7	=	93.44	(78)
South	0.9x	0.77	x	10.3	x	76.57	x	0.4	x	0.7	=	153.03	(78)
South	0.9x	0.77	x	10.3	x	97.53	x	0.4	x	0.7	=	194.93	(78)
South	0.9x	0.77	x	10.3	x	110.23	x	0.4	x	0.7	=	220.32	(78)
South	0.9x	0.77	x	10.3	x	114.87	x	0.4	x	0.7	=	229.58	(78)
South	0.9x	0.77	x	10.3	x	110.55	x	0.4	x	0.7	=	220.94	(78)
South	0.9x	0.77	x	10.3	x	108.01	x	0.4	x	0.7	=	215.87	(78)
South	0.9x	0.77	x	10.3	x	104.89	x	0.4	x	0.7	=	209.64	(78)
South	0.9x	0.77	x	10.3	x	101.89	x	0.4	x	0.7	=	203.63	(78)
South	0.9x	0.77	x	10.3	x	82.59	x	0.4	x	0.7	=	165.06	(78)
South	0.9x	0.77	x	10.3	x	55.42	x	0.4	x	0.7	=	110.76	(78)
South	0.9x	0.77	x	10.3	x	40.4	x	0.4	x	0.7	=	80.74	(78)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	118.82	201.53	277.35	352.69	407.91	411.84	394.1	351.05	302.72	222.79	142.07	101.9	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	604.67	684.97	743.48	790.73	816.91	793.36	758.1	721.75	688.16	636.57	588.36	573.07	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.98	0.93	0.76	0.57	0.62	0.88	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.11	20.22	20.4	20.64	20.85	20.97	21	20.99	20.93	20.66	20.35	20.09	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.24	20.24	20.25	20.26	20.26	20.28	20.28	20.28	20.27	20.26	20.26	20.25	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.98	0.9	0.69	0.48	0.53	0.83	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.02	19.19	19.45	19.81	20.1	20.26	20.27	20.28	20.21	19.85	19.38	19.01	(90)

fLA = Living area ÷ (4) = | 0.23 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.27	19.43	19.67	20.01	20.28	20.42	20.44	20.44	20.38	20.04	19.61	19.26	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	19.27	19.43	19.67	20.01	20.28	20.42	20.44	20.44	20.38	20.04	19.61	19.26	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.97	0.9	0.71	0.5	0.55	0.83	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	604.04	683.18	737.96	769.34	735.57	562.33	382.21	399.26	573.84	623.4	586.8	572.66	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1575.27	1522.84	1375.2	1136.66	874.5	581.79	383.86	402.26	632.16	962.34	1285.31	1560.01	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	722.59	564.25	474.11	264.47	103.36	0	0	0	0	252.17	502.93	734.59	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3618.48 (98)

Space heating requirement in kWh/m²/year 28.05 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	722.59	564.25	474.11	264.47	103.36	0	0	0	0	252.17	502.93	734.59		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	776.98	606.72	509.79	284.38	111.14	0	0	0	0	271.15	540.78	789.89		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													3890.84	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

Output from water heater (calculated above)														
	193.68	170.97	180.44	162.62	161.28	145.68	140	153.5	153.19	168.83	177.08	188.83		
Efficiency of water heater													79.9	(216)
(217)m=	87.66	87.43	86.97	85.87	83.56	79.9	79.9	79.9	79.9	85.66	87.13	87.73		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	220.95	195.56	207.47	189.38	193.01	182.33	175.22	192.11	191.72	197.09	203.23	215.23		
Total = Sum(219a)$_{1...12}$ =													2363.31	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		3890.84

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Water heating fuel used			2363.31	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		230.17		(230a)
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		305.17	(231)
Electricity for lighting			491.27	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			7050.58	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	840.42	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	510.47	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1350.9	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	158.38	(267)
Electricity for lighting	(232)	x	0.519	=	254.97	(268)
Total CO2, kg/year			sum of (265)…(271) =		1764.25	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		13.68	(273)
EI rating (section 14)					86	(274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**

Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.51

Property Address: House Sample 1

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	129	(1a) x	3	(2a) =	387	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	129	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	387	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							4	x 10 =	40	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40	÷ (5) =	0.1	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.35	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.38	0.37	0.33	0.32	0.29	0.29	0.28	0.3	0.32	0.34	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	0	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.55	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.55	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1	=	2.4			(26)
Windows Type 1			12.3	x1/[1/(1.4)+ 0.04]		=	16.31			(27)
Windows Type 2			10.3	x1/[1/(1.4)+ 0.04]		=	13.66			(27)
Floor			46	x	0.13	=	5.98			(28)
Walls Type1	42	12.3	29.7	x	0.18	=	5.35			(29)
Walls Type2	44	12.7	31.3	x	0.18	=	5.63			(29)
Roof	46	0	46	x	0.13	=	5.98			(30)
Total area of elements, m²			178							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	55.3	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	4718	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		8.9	(36)
if details of thermal bridging are not known (36) = 0.05 x (31)			
Total fabric heat loss	(33) + (36) =	64.2	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	73.22	72.86	72.5	70.83	70.51	69.05	69.05	68.78	69.62	70.51	71.15	71.81	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	137.42	137.06	136.7	135.03	134.71	133.26	133.26	132.99	133.82	134.71	135.35	136.01	

Average = Sum(39)$_{1…12}$ /12= 135.03 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(40)m=	1.07	1.06	1.06	1.05	1.04	1.03	1.03	1.03	1.04	1.04	1.05	1.05

Average = Sum(40)$_{1\ldots12}$ /12= 1.05 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.89 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 102.89 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	113.18	109.07	104.95	100.84	96.72	92.6	92.6	96.72	100.84	104.95	109.07	113.18

Total = Sum(44)$_{1\ldots12}$ = 1234.72 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(45)m=	167.85	146.8	151.48	132.07	126.72	109.35	101.33	116.28	117.67	137.13	149.69	162.55

Total = Sum(45)$_{1\ldots12}$ = 1618.91 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	25.18	22.02	22.72	19.81	19.01	16.4	15.2	17.44	17.65	20.57	22.45	24.38	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	50.96	46.03	50.96	49.32	49.29	45.67	47.19	49.29	49.32	50.96	49.32	50.96	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	218.81	192.83	202.44	181.38	176.01	155.02	148.52	165.57	166.98	188.09	199	213.51	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	218.81	192.83	202.44	181.38	176.01	155.02	148.52	165.57	166.98	188.09	199	213.51	

Output from water heater (annual)1…12 2208.15 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	68.55	60.32	63.11	56.24	54.46	47.78	45.49	50.98	51.45	58.34	62.1	66.79	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	144.62	144.62	144.62	144.62	144.62	144.62	144.62	144.62	144.62	144.62	144.62	144.62	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	27.12	24.09	19.59	14.83	11.09	9.36	10.11	13.15	17.64	22.4	26.15	27.87	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	296.51	299.59	291.83	275.33	254.49	234.91	221.83	218.75	226.5	243.01	263.85	283.43	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	37.46	37.46	37.46	37.46	37.46	37.46	37.46	37.46	37.46	37.46	37.46	37.46	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	(71)
Water heating gains (Table 5)													
(72)m=	92.14	89.76	84.82	78.11	73.19	66.36	61.14	68.53	71.46	78.41	86.25	89.77	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	485.15	482.82	465.63	437.66	408.16	380.01	362.47	369.81	384.99	413.2	445.63	470.46	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	12.3	x	10.63	x	0.63	x	0.7	=	39.97	(74)
North	0.9x	0.77	x	12.3	x	20.32	x	0.63	x	0.7	=	76.39	(74)
North	0.9x	0.77	x	12.3	x	34.53	x	0.63	x	0.7	=	129.8	(74)
North	0.9x	0.77	x	12.3	x	55.46	x	0.63	x	0.7	=	208.49	(74)

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North	0.9x	0.77	x	12.3	x	74.72	x	0.63	x	0.7	=	280.86	(74)
North	0.9x	0.77	x	12.3	x	79.99	x	0.63	x	0.7	=	300.67	(74)
North	0.9x	0.77	x	12.3	x	74.68	x	0.63	x	0.7	=	280.71	(74)
North	0.9x	0.77	x	12.3	x	59.25	x	0.63	x	0.7	=	222.71	(74)
North	0.9x	0.77	x	12.3	x	41.52	x	0.63	x	0.7	=	156.06	(74)
North	0.9x	0.77	x	12.3	x	24.19	x	0.63	x	0.7	=	90.93	(74)
North	0.9x	0.77	x	12.3	x	13.12	x	0.63	x	0.7	=	49.31	(74)
North	0.9x	0.77	x	12.3	x	8.86	x	0.63	x	0.7	=	33.32	(74)
South	0.9x	0.77	x	10.3	x	46.75	x	0.63	x	0.7	=	147.17	(78)
South	0.9x	0.77	x	10.3	x	76.57	x	0.63	x	0.7	=	241.02	(78)
South	0.9x	0.77	x	10.3	x	97.53	x	0.63	x	0.7	=	307.02	(78)
South	0.9x	0.77	x	10.3	x	110.23	x	0.63	x	0.7	=	347	(78)
South	0.9x	0.77	x	10.3	x	114.87	x	0.63	x	0.7	=	361.59	(78)
South	0.9x	0.77	x	10.3	x	110.55	x	0.63	x	0.7	=	347.98	(78)
South	0.9x	0.77	x	10.3	x	108.01	x	0.63	x	0.7	=	340	(78)
South	0.9x	0.77	x	10.3	x	104.89	x	0.63	x	0.7	=	330.19	(78)
South	0.9x	0.77	x	10.3	x	101.89	x	0.63	x	0.7	=	320.72	(78)
South	0.9x	0.77	x	10.3	x	82.59	x	0.63	x	0.7	=	259.96	(78)
South	0.9x	0.77	x	10.3	x	55.42	x	0.63	x	0.7	=	174.44	(78)
South	0.9x	0.77	x	10.3	x	40.4	x	0.63	x	0.7	=	127.17	(78)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	187.14	317.41	436.82	555.49	642.45	648.65	620.71	552.9	476.78	350.89	223.75	160.49	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	672.29	800.23	902.45	993.15	1050.61	1028.66	983.18	922.7	861.77	764.1	669.38	630.94	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.91	0.76	0.58	0.64	0.87	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.8	19.96	20.2	20.5	20.78	20.94	20.99	20.98	20.87	20.52	20.1	19.77	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.03	20.03	20.03	20.04	20.05	20.06	20.06	20.06	20.05	20.05	20.04	20.04	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.87	0.67	0.46	0.52	0.81	0.97	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.42	18.65	19	19.45	19.82	20.02	20.05	20.05	19.95	19.47	18.86	18.38	(90)

fLA = Living area ÷ (4) = | 0.23 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.74	18.95	19.27	19.69	20.04	20.23	20.27	20.27	20.16	19.72	19.15	18.71	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.74	18.95	19.27	19.69	20.04	20.23	20.27	20.27	20.16	19.72	19.15	18.71	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.99	0.96	0.87	0.69	0.49	0.55	0.82	0.97	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	670.92	795.98	889.66	949.93	915.67	709.18	483.61	504.86	705.39	741.09	666.19	630.02	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1984	1926.05	1746.33	1457.35	1123.89	750.62	489.02	514.26	811.06	1227.95	1631.17	1973.2	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	976.93	759.4	637.36	365.34	154.92	0	0	0	0	362.23	694.79	999.33	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4950.29 (98)

Space heating requirement in kWh/m²/year 38.37 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	976.93	759.4	637.36	365.34	154.92	0	0	0	0	362.23	694.79	999.33	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	1045.96	813.07	682.4	391.15	165.86	0	0	0	0	387.83	743.88	1069.94	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 5300.1 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)													
	218.81	192.83	202.44	181.38	176.01	155.02	148.52	165.57	166.98	188.09	199	213.51	
Efficiency of water heater												80.3	(216)
(217)m=	88.37	88.15	87.74	86.78	84.73	80.3	80.3	80.3	80.3	86.67	87.94	88.44	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	247.61	218.74	230.73	209.02	207.73	193.05	184.96	206.18	207.95	217.01	226.3	241.41	

Total = Sum(219a)$_{1...12}$ = 2590.68 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		5300.1

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Water heating fuel used			2590.68	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			478.94	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			8444.72	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	1144.82	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	559.59	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1704.41	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	248.57	(268)
Total CO2, kg/year			sum of (265)…(271) =		1991.9	(272)

TER = 15.44 (273)

SAP Input

Property Details: House Sample 2

Address:	
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	26 July 2019
Date of certificate:	15 June 2022
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	498

Property description:

Dwelling type:	House
Detachment:	Mid-terrace
Year Completed:	2019

Floor Location:	Floor area:	Storey height:
Floor 0	129 m²	3 m

Living area:	30 m² (fraction 0.233)
Front of dwelling faces:	Unspecified

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
DOOR	Manufacturer	Solid			Wood
N	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
S	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
E	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
DOOR	mm	0.7	0	1.4	2.4	1
N		0.7	0.4	1	12.3	1
S		0.7	0.4	1	10.3	1
E		0.7	0.4	1	7	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
DOOR		S	Worst case	0	0
N		N	North	0	0
S		S	South	0	0
E		E	East	0	0

Overshading: More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
N	42	12.3	29.7	0.15	0	False	N/A
S	44	12.7	31.3	0.15	0	False	N/A
E	91	7	84	0.15	0	False	N/A
Roof	46	0	46	0.11	0		N/A
Exposed	46			0.11			N/A
Internal Elements							
Party Elements							

SAP Input

Thermal bridges:

Thermal bridges:	No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	3

Main heating system:

Main heating system:	Boiler systems with radiators or underfloor heating Gas boilers and oil boilers Fuel: mains gas Info Source: Boiler Database Database: (rev 498, product index 016888) Efficiency: Winter 79.9 % Summer: 90.0 Brand name: Worcester Model: Greenstar Model qualifier: 34CDi Combi (Combi boiler) Systems with radiators Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Boiler interlock: Yes Weather Compensator

Main heating Control:

Main heating Control:	Time and temperature zone control by suitable arrangement of plumbing and electrical services Control code: 2110

Secondary heating system:

Secondary heating system:	None

Water heating:

Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Flue Gas Heat Recovery System: Database (rev 498, product index 060036) Brand name: Worcester Model: Greenstar Xtra Model qualifier: 2015 Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English

SAP Input

Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

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User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.51

Property Address: House Sample 2

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	129	(1a) x	3	(2a) =	387	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	129	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		387	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.05 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1.4	=	3.36			(26)
Windows Type 1			12.3	x	1/[1/(1)+ 0.04]	=	11.83			(27)
Windows Type 2			10.3	x	1/[1/(1)+ 0.04]	=	9.9			(27)
Windows Type 3			7	x	1/[1/(1)+ 0.04]	=	6.73			(27)
Floor			46	x	0.11	=	5.06			(28)
Walls Type1	42	12.3	29.7	x	0.15	=	4.46			(29)
Walls Type2	44	12.7	31.3	x	0.15	=	4.7			(29)
Walls Type3	91	7	84	x	0.15	=	12.6			(29)
Roof	46	0	46	x	0.11	=	5.06			(30)
Total area of elements, m²			269							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 63.69 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5894 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 40.35 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 104.04 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

(38)m=	34.14	33.73	33.32	31.29	30.88	28.85	28.85	28.44	29.66	30.88	31.7	32.51	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	138.18	137.77	137.37	135.33	134.92	132.89	132.89	132.48	133.7	134.92	135.74	136.55	

Average = Sum(39)$_{1…12}$ /12= 135.23 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.07	1.07	1.06	1.05	1.05	1.03	1.03	1.03	1.04	1.05	1.05	1.06	

Average = Sum(40)$_{1…12}$ /12= 1.05 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.89 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 102.89 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	113.18	109.07	104.95	100.84	96.72	92.6	92.6	96.72	100.84	104.95	109.07	113.18	

Total = Sum(44)$_{1…12}$ = 1234.72 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	167.85	146.8	151.48	132.07	126.72	109.35	101.33	116.28	117.67	137.13	149.69	162.55	

Total = Sum(45)$_{1…12}$ = 1618.91 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	25.18	22.02	22.72	19.81	19.01	16.4	15.2	17.44	17.65	20.57	22.45	24.38	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

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Primary circuit loss (annual) from Table 3	0	(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	50.96	46.03	50.96	49.32	50.96	49.32	50.96	50.96	49.32	50.96	49.32	50.96	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	218.81	192.83	202.44	181.38	177.68	158.67	152.29	167.24	166.98	188.09	199	213.51	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	24.37	21.06	20.83	17.22	15.23	10.6	9.82	11.27	11.4	17.68	20.89	23.87	(63) (G2)

Output from water heater

(64)m=	191.96	169.54	179.14	161.77	159.98	145.68	140	153.5	153.19	167.93	175.72	187.16	

Output from water heater (annual)$_{1...12}$	1985.58	(64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	68.55	60.32	63.11	56.24	54.87	48.69	46.43	51.4	51.45	58.34	62.1	66.79	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	144.62	144.62	144.62	144.62	144.62	144.62	144.62	144.62	144.62	144.62	144.62	144.62	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	26.61	23.63	19.22	14.55	10.88	9.18	9.92	12.9	17.31	21.98	25.66	27.35	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	296.51	299.59	291.83	275.33	254.49	234.91	221.83	218.75	226.5	243.01	263.85	283.43	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	37.46	37.46	37.46	37.46	37.46	37.46	37.46	37.46	37.46	37.46	37.46	37.46	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	(71)

Water heating gains (Table 5)

(72)m=	92.14	89.76	84.82	78.11	73.76	67.62	62.41	69.09	71.46	78.41	86.25	89.77	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	484.64	482.37	465.26	437.38	408.51	381.1	363.54	370.12	384.66	412.78	445.14	469.93	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	12.3	x	10.63	x	0.4	x	0.7	=	25.38	(74)

North	0.9x	0.77	x	12.3	x	20.32	x	0.4	x	0.7	=	48.5	(74)
North	0.9x	0.77	x	12.3	x	34.53	x	0.4	x	0.7	=	82.41	(74)
North	0.9x	0.77	x	12.3	x	55.46	x	0.4	x	0.7	=	132.38	(74)
North	0.9x	0.77	x	12.3	x	74.72	x	0.4	x	0.7	=	178.32	(74)
North	0.9x	0.77	x	12.3	x	79.99	x	0.4	x	0.7	=	190.9	(74)
North	0.9x	0.77	x	12.3	x	74.68	x	0.4	x	0.7	=	178.23	(74)
North	0.9x	0.77	x	12.3	x	59.25	x	0.4	x	0.7	=	141.4	(74)
North	0.9x	0.77	x	12.3	x	41.52	x	0.4	x	0.7	=	99.09	(74)
North	0.9x	0.77	x	12.3	x	24.19	x	0.4	x	0.7	=	57.73	(74)
North	0.9x	0.77	x	12.3	x	13.12	x	0.4	x	0.7	=	31.31	(74)
North	0.9x	0.77	x	12.3	x	8.86	x	0.4	x	0.7	=	21.16	(74)
East	0.9x	0.77	x	7	x	19.64	x	0.4	x	0.7	=	26.68	(76)
East	0.9x	0.77	x	7	x	38.42	x	0.4	x	0.7	=	52.19	(76)
East	0.9x	0.77	x	7	x	63.27	x	0.4	x	0.7	=	85.94	(76)
East	0.9x	0.77	x	7	x	92.28	x	0.4	x	0.7	=	125.34	(76)
East	0.9x	0.77	x	7	x	113.09	x	0.4	x	0.7	=	153.61	(76)
East	0.9x	0.77	x	7	x	115.77	x	0.4	x	0.7	=	157.25	(76)
East	0.9x	0.77	x	7	x	110.22	x	0.4	x	0.7	=	149.71	(76)
East	0.9x	0.77	x	7	x	94.68	x	0.4	x	0.7	=	128.6	(76)
East	0.9x	0.77	x	7	x	73.59	x	0.4	x	0.7	=	99.95	(76)
East	0.9x	0.77	x	7	x	45.59	x	0.4	x	0.7	=	61.92	(76)
East	0.9x	0.77	x	7	x	24.49	x	0.4	x	0.7	=	33.26	(76)
East	0.9x	0.77	x	7	x	16.15	x	0.4	x	0.7	=	21.94	(76)
South	0.9x	0.77	x	10.3	x	46.75	x	0.4	x	0.7	=	93.44	(78)
South	0.9x	0.77	x	10.3	x	76.57	x	0.4	x	0.7	=	153.03	(78)
South	0.9x	0.77	x	10.3	x	97.53	x	0.4	x	0.7	=	194.93	(78)
South	0.9x	0.77	x	10.3	x	110.23	x	0.4	x	0.7	=	220.32	(78)
South	0.9x	0.77	x	10.3	x	114.87	x	0.4	x	0.7	=	229.58	(78)
South	0.9x	0.77	x	10.3	x	110.55	x	0.4	x	0.7	=	220.94	(78)
South	0.9x	0.77	x	10.3	x	108.01	x	0.4	x	0.7	=	215.87	(78)
South	0.9x	0.77	x	10.3	x	104.89	x	0.4	x	0.7	=	209.64	(78)
South	0.9x	0.77	x	10.3	x	101.89	x	0.4	x	0.7	=	203.63	(78)
South	0.9x	0.77	x	10.3	x	82.59	x	0.4	x	0.7	=	165.06	(78)
South	0.9x	0.77	x	10.3	x	55.42	x	0.4	x	0.7	=	110.76	(78)
South	0.9x	0.77	x	10.3	x	40.4	x	0.4	x	0.7	=	80.74	(78)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	145.49	253.72	363.29	478.03	561.52	569.09	543.81	479.64	402.67	284.71	175.33	123.83	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	630.14	736.08	828.55	915.41	970.03	950.19	907.35	849.76	787.33	697.49	620.46	593.77	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(86)m=	1	1	0.99	0.98	0.93	0.8	0.62	0.68	0.9	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.76	19.9	20.14	20.45	20.74	20.93	20.99	20.98	20.84	20.47	20.06	19.74	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.02	20.03	20.03	20.04	20.05	20.06	20.06	20.06	20.05	20.05	20.04	20.03	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.9	0.71	0.5	0.56	0.85	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.35	18.57	18.91	19.37	19.77	20.01	20.05	20.05	19.92	19.4	18.81	18.33	(90)

fLA = Living area ÷ (4) = 0.23 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.68	18.88	19.19	19.62	20	20.22	20.27	20.27	20.13	19.65	19.1	18.66	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.68	18.88	19.19	19.62	20	20.22	20.27	20.27	20.13	19.65	19.1	18.66	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.97	0.9	0.73	0.53	0.59	0.86	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	629.18	733.39	820.34	885.97	871.09	693.14	480.03	499.15	673.38	682.78	618.36	593.11	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1987.27	1925.65	1743.62	1451.11	1119.25	747.03	487.61	512.14	806.34	1221.42	1628.46	1974.65	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1010.42	801.2	686.92	406.91	184.64	0	0	0	0	400.74	727.27	1027.86	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 5245.96 (98)

Space heating requirement in kWh/m²/year 40.67 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	1010.42	801.2	686.92	406.91	184.64	0	0	0	0	400.74	727.27	1027.86	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	1086.47	861.51	738.62	437.53	198.53	0	0	0	0	430.91	782.01	1105.23	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 5640.82 (211)

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Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

Water heating

Output from water heater (calculated above)

191.96	169.54	179.14	161.77	159.98	145.68	140	153.5	153.19	167.93	175.72	187.16

Efficiency of water heater 79.9 (216)

(217)m=	88.22	88.06	87.71	86.88	85.01	79.9	79.9	79.9	79.9	86.76	87.84	88.28

(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	217.6	192.54	204.25	186.21	188.19	182.33	175.22	192.11	191.72	193.56	200.04	212.01

Total = Sum(219a)$_{1...12}$ = 2335.78 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		5640.82	
Water heating fuel used		2335.78	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	230.17		(230a)
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	305.17	(231)
Electricity for lighting		469.94	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		8751.7	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	1218.42	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	504.53	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1722.94	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	158.38	(267)
Electricity for lighting	(232) x	0.519	=	243.9	(268)
Total CO2, kg/year		sum of (265)…(271) =		2125.22	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		16.47	(273)
EI rating (section 14)				84	(274)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: House Sample 2

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	129	(1a) x	3	(2a) =	387	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	129	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	387	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							4	x 10 =	40	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40	÷ (5) =	0.1	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.35	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.38	0.37	0.33	0.32	0.29	0.29	0.28	0.3	0.32	0.34	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.55	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.55	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1	=	2.4			(26)
Windows Type 1			12.3	x1/[1/(1.4)+ 0.04]		=	16.31			(27)
Windows Type 2			10.3	x1/[1/(1.4)+ 0.04]		=	13.66			(27)
Windows Type 3			7	x1/[1/(1.4)+ 0.04]		=	9.28			(27)
Floor			46	x	0.13	=	5.98			(28)
Walls Type1	42	12.3	29.7	x	0.18	=	5.35			(29)
Walls Type2	44	12.7	31.3	x	0.18	=	5.63			(29)
Walls Type3	91	7	84	x	0.18	=	15.12			(29)
Roof	46	0	46	x	0.13	=	5.98			(30)
Total area of elements, m²			269							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 79.7 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5894 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 13.45 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 93.15 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(38)m=	73.22	72.86	72.5	70.83	70.51	69.05	69.05	68.78	69.62	70.51	71.15	71.81	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	166.37	166.01	165.65	163.98	163.66	162.21	162.21	161.94	162.77	163.66	164.3	164.96

Average = Sum(39)$_{1...12}$ /12= 163.98 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.29	1.29	1.28	1.27	1.27	1.26	1.26	1.26	1.26	1.27	1.27	1.28

Average = Sum(40)$_{1...12}$ /12= 1.27 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.89 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 102.89 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	113.18	109.07	104.95	100.84	96.72	92.6	92.6	96.72	100.84	104.95	109.07	113.18

Total = Sum(44)$_{1...12}$ = 1234.72 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	167.85	146.8	151.48	132.07	126.72	109.35	101.33	116.28	117.67	137.13	149.69	162.55

Total = Sum(45)$_{1...12}$ = 1618.91 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	25.18	22.02	22.72	19.81	19.01	16.4	15.2	17.44	17.65	20.57	22.45	24.38	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	50.96	46.03	50.96	49.32	49.29	45.67	47.19	49.29	49.32	50.96	49.32	50.96	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	218.81	192.83	202.44	181.38	176.01	155.02	148.52	165.57	166.98	188.09	199	213.51	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	218.81	192.83	202.44	181.38	176.01	155.02	148.52	165.57	166.98	188.09	199	213.51	

Output from water heater (annual)$_{1...12}$ | 2208.15 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	68.55	60.32	63.11	56.24	54.46	47.78	45.49	50.98	51.45	58.34	62.1	66.79	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	144.62	144.62	144.62	144.62	144.62	144.62	144.62	144.62	144.62	144.62	144.62	144.62	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	26.43	23.48	19.09	14.46	10.81	9.12	9.86	12.81	17.2	21.84	25.49	27.17	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	296.51	299.59	291.83	275.33	254.49	234.91	221.83	218.75	226.5	243.01	263.85	283.43	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	37.46	37.46	37.46	37.46	37.46	37.46	37.46	37.46	37.46	37.46	37.46	37.46	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	(71)

Water heating gains (Table 5)

(72)m=	92.14	89.76	84.82	78.11	73.19	66.36	61.14	68.53	71.46	78.41	86.25	89.77	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	484.47	482.21	465.14	437.28	407.88	379.77	362.21	369.47	384.55	412.64	444.97	469.75	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	12.3	x	10.63	x	0.63	x	0.7	=	39.97	(74)

North	0.9x	0.77	x	12.3	x	20.32	x	0.63	x	0.7	=	76.39	(74)
North	0.9x	0.77	x	12.3	x	34.53	x	0.63	x	0.7	=	129.8	(74)
North	0.9x	0.77	x	12.3	x	55.46	x	0.63	x	0.7	=	208.49	(74)
North	0.9x	0.77	x	12.3	x	74.72	x	0.63	x	0.7	=	280.86	(74)
North	0.9x	0.77	x	12.3	x	79.99	x	0.63	x	0.7	=	300.67	(74)
North	0.9x	0.77	x	12.3	x	74.68	x	0.63	x	0.7	=	280.71	(74)
North	0.9x	0.77	x	12.3	x	59.25	x	0.63	x	0.7	=	222.71	(74)
North	0.9x	0.77	x	12.3	x	41.52	x	0.63	x	0.7	=	156.06	(74)
North	0.9x	0.77	x	12.3	x	24.19	x	0.63	x	0.7	=	90.93	(74)
North	0.9x	0.77	x	12.3	x	13.12	x	0.63	x	0.7	=	49.31	(74)
North	0.9x	0.77	x	12.3	x	8.86	x	0.63	x	0.7	=	33.32	(74)
East	0.9x	0.77	x	7	x	19.64	x	0.63	x	0.7	=	42.02	(76)
East	0.9x	0.77	x	7	x	38.42	x	0.63	x	0.7	=	82.19	(76)
East	0.9x	0.77	x	7	x	63.27	x	0.63	x	0.7	=	135.36	(76)
East	0.9x	0.77	x	7	x	92.28	x	0.63	x	0.7	=	197.41	(76)
East	0.9x	0.77	x	7	x	113.09	x	0.63	x	0.7	=	241.94	(76)
East	0.9x	0.77	x	7	x	115.77	x	0.63	x	0.7	=	247.67	(76)
East	0.9x	0.77	x	7	x	110.22	x	0.63	x	0.7	=	235.79	(76)
East	0.9x	0.77	x	7	x	94.68	x	0.63	x	0.7	=	202.54	(76)
East	0.9x	0.77	x	7	x	73.59	x	0.63	x	0.7	=	157.43	(76)
East	0.9x	0.77	x	7	x	45.59	x	0.63	x	0.7	=	97.53	(76)
East	0.9x	0.77	x	7	x	24.49	x	0.63	x	0.7	=	52.39	(76)
East	0.9x	0.77	x	7	x	16.15	x	0.63	x	0.7	=	34.55	(76)
South	0.9x	0.77	x	10.3	x	46.75	x	0.63	x	0.7	=	147.17	(78)
South	0.9x	0.77	x	10.3	x	76.57	x	0.63	x	0.7	=	241.02	(78)
South	0.9x	0.77	x	10.3	x	97.53	x	0.63	x	0.7	=	307.02	(78)
South	0.9x	0.77	x	10.3	x	110.23	x	0.63	x	0.7	=	347	(78)
South	0.9x	0.77	x	10.3	x	114.87	x	0.63	x	0.7	=	361.59	(78)
South	0.9x	0.77	x	10.3	x	110.55	x	0.63	x	0.7	=	347.98	(78)
South	0.9x	0.77	x	10.3	x	108.01	x	0.63	x	0.7	=	340	(78)
South	0.9x	0.77	x	10.3	x	104.89	x	0.63	x	0.7	=	330.19	(78)
South	0.9x	0.77	x	10.3	x	101.89	x	0.63	x	0.7	=	320.72	(78)
South	0.9x	0.77	x	10.3	x	82.59	x	0.63	x	0.7	=	259.96	(78)
South	0.9x	0.77	x	10.3	x	55.42	x	0.63	x	0.7	=	174.44	(78)
South	0.9x	0.77	x	10.3	x	40.4	x	0.63	x	0.7	=	127.17	(78)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	229.15	399.6	572.18	752.9	884.39	896.32	856.5	755.44	634.21	448.42	276.14	195.04	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	713.62	881.81	1037.32	1190.19	1292.27	1276.09	1218.71	1124.91	1018.76	861.06	721.11	664.79	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

(86)m=	1	1	0.99	0.96	0.88	0.73	0.56	0.63	0.86	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.53	19.73	20.02	20.4	20.73	20.92	20.98	20.97	20.82	20.39	19.89	19.5	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.85	19.85	19.85	19.86	19.87	19.87	19.87	19.88	19.87	19.87	19.86	19.86	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.94	0.84	0.63	0.43	0.49	0.79	0.97	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.9	18.18	18.61	19.16	19.6	19.82	19.87	19.86	19.73	19.15	18.42	17.86	(90)

fLA = Living area ÷ (4) = 0.23 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.28	18.54	18.94	19.45	19.86	20.08	20.13	20.12	19.98	19.44	18.76	18.24	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.28	18.54	18.94	19.45	19.86	20.08	20.13	20.12	19.98	19.44	18.76	18.24	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.94	0.84	0.65	0.46	0.52	0.8	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	711.43	874.73	1015.01	1115.71	1080.75	831.92	563.17	587.23	812.18	828.07	716.24	663.31	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	2325.79	2264.41	2060.77	1729.87	1335.76	888.83	572.09	602.68	957.68	1446.72	1916.3	2316.08	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1201.08	933.86	778.05	442.19	189.73	0	0	0	0	460.28	864.05	1229.66	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 6098.9 (98)

Space heating requirement in kWh/m²/year 47.28 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	1201.08	933.86	778.05	442.19	189.73	0	0	0	0	460.28	864.05	1229.66	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	1285.96	999.85	833.02	473.44	203.13	0	0	0	0	492.8	925.1	1316.56	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 6529.87 (211)

TER WorkSheet: New dwelling design stage

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)

218.81	192.83	202.44	181.38	176.01	155.02	148.52	165.57	166.98	188.09	199	213.51

Efficiency of water heater 80.3 (216)

(217)m=	88.68	88.5	88.11	87.21	85.24	80.3	80.3	80.3	80.3	87.22	88.32	88.75	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	246.73	217.9	229.76	207.99	206.49	193.05	184.96	206.18	207.95	215.65	225.32	240.58

Total = Sum(219a)$_{1...12}$ = 2582.54 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		6529.87	
Water heating fuel used		2582.54	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		75	(231)
Electricity for lighting		466.84	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		9654.25	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	1410.45	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	557.83	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1968.28	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	242.29	(268)
Total CO2, kg/year		sum of (265)…(271) =		2249.49	(272)

TER = 17.44 (273)

A7 APPENDIX 7 – GREEN TER,DER AND SAP INPUTS

SAP Input

Property Details: Sample 1 (Mid)

Address:	
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	26 July 2019
Date of certificate:	15 June 2022
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	498

Property description:

Dwelling type:	Flat
Detachment:	
Year Completed:	2019

Floor Location:	Floor area:	Storey height:
Floor 0	66.25 m²	3 m

Living area:	27.2 m² (fraction 0.411)
Front of dwelling faces:	Unspecified

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
DOOR	Manufacturer	Solid			Wood
Balcony	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
N	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
E	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
DOOR	mm	0.7	0	1.4	2.4	1
Balcony		0.7	0.4	1	4.8	1
N		0.7	0.4	1	5.44	1
E		0.7	0.4	1	1.44	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
DOOR		INT	Worst case	0	0
Balcony		N	North	0	0
N		N	North	0	0
E		E	East	0	0

Overshading: Heavy

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
<u>External Elements</u>							
N	10.24	10.24	0	0.15	0	False	N/A
E	1.44	1.44	0	0.15	0	False	N/A
INT	13.2	2.4	10.8	0.16	0.43	False	N/A
Spandrel	2.4	0	2.4	0.35	0	False	N/A
<u>Internal Elements</u>							
<u>Party Elements</u>							

Thermal bridges:

SAP Input

Thermal bridges:	No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	3

Main heating system:

Main heating system:	Community heating schemes Heat source: Community heat pump heat from electric heat pump, heat fraction 1, efficiency 256 Piping>=1991, pre-insulated, low temp, variable flow Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Boiler interlock: Yes

Main heating Control:

Main heating Control:	Charging system linked to use of community heating, programmer and TRVs Control code: 2306

Secondary heating system:

Secondary heating system:	None

Water heating:

Water heating:	From main heating system Water code: 901 Fuel :heat from electric heat pump No hot water cylinder Flue Gas Heat Recovery System: Database (rev 498, product index 060036) Brand name: Worcester Model: Greenstar Xtra Model qualifier: 2015 Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	Photovoltaic 1 Installed Peak power: 0.6 Tilt of collector: 30° Overshading: None or very little Collector Orientation: South
Assess Zero Carbon Home:	No

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Sample 1 (Mid)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	66.25	(1a) x	3	(2a) =	198.75	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.25	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	198.75	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*		0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.05 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1.4	=	3.36			(26)
Windows Type 1			4.8	x	1/[1/(1)+ 0.04]	=	4.62			(27)
Windows Type 2			5.44	x	1/[1/(1)+ 0.04]	=	5.23			(27)
Windows Type 3			1.44	x	1/[1/(1)+ 0.04]	=	1.38			(27)
Walls Type1	10.24	10.24	0	x	0.15	=	0			(29)
Walls Type2	1.44	1.44	0	x	0.15	=	0			(29)
Walls Type3	13.2	2.4	10.8	x	0.15	=	1.62			(29)
Walls Type4	2.4	0	2.4	x	0.35	=	0.84			(29)
Total area of elements, m²			27.28							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 17.05 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 184.8 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 4.09 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 21.14 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	17.53	17.32	17.11	16.07	15.86	14.81	14.81	14.61	15.23	15.86	16.28	16.7	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	38.67	38.46	38.25	37.21	37	35.95	35.95	35.75	36.37	37	37.42	37.84	

Average = Sum(39)$_{1…12}$ /12= 37.16 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.58	0.58	0.58	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57

Average = Sum(40)1…12 /12= 0.56 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31

(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.15 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.3 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	93.83	90.42	87.01	83.6	80.19	76.77	76.77	80.19	83.6	87.01	90.42	93.83

Total = Sum(44)1…12 = 1023.65 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.15	121.71	125.59	109.49	105.06	90.66	84.01	96.4	97.55	113.69	124.1	134.76

Total = Sum(45)1…12 = 1342.17 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.87	18.26	18.84	16.42	15.76	13.6	12.6	14.46	14.63	17.05	18.61	20.21

(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01

(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01

(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26

(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	194.43	171.63	180.87	162.99	160.34	144.15	139.29	151.68	151.05	168.96	177.59	190.04	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	17.95	15.96	16.41	14.51	13.96	12.12	11.22	12.87	13.02	15.02	16.24	17.46	(63) (G2)

Output from water heater

(64)m=	173.8	153.25	161.77	145.88	143.69	129.44	125.38	136.13	135.43	151.27	158.76	169.9	

Output from water heater (annual)$_{1...12}$ 1784.71 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	90.49	80.41	85.98	79.2	79.15	72.94	72.15	76.27	75.23	82.02	84.06	89.03	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.65	15.68	12.75	9.65	7.22	6.09	6.58	8.56	11.48	14.58	17.02	18.14	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	188.39	190.35	185.42	174.93	161.69	149.25	140.94	138.98	143.91	154.4	167.64	180.08	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	(71)

Water heating gains (Table 5)

(72)m=	121.63	119.66	115.56	110	106.39	101.3	96.98	102.52	104.49	110.25	116.75	119.66	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	382.95	380.96	369.01	349.86	330.58	311.92	299.78	305.34	315.16	334.5	356.68	373.16	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	4.8	x	10.63	x	0.4	x	0.7	=	9.9	(74)
North	0.9x	0.77	x	5.44	x	10.63	x	0.4	x	0.7	=	11.22	(74)
North	0.9x	0.77	x	4.8	x	20.32	x	0.4	x	0.7	=	18.93	(74)
North	0.9x	0.77	x	5.44	x	20.32	x	0.4	x	0.7	=	21.45	(74)

North	0.9x	0.77	x	4.8	x	34.53	x	0.4	x	0.7	=	32.16	(74)
North	0.9x	0.77	x	5.44	x	34.53	x	0.4	x	0.7	=	36.45	(74)
North	0.9x	0.77	x	4.8	x	55.46	x	0.4	x	0.7	=	51.66	(74)
North	0.9x	0.77	x	5.44	x	55.46	x	0.4	x	0.7	=	58.55	(74)
North	0.9x	0.77	x	4.8	x	74.72	x	0.4	x	0.7	=	69.59	(74)
North	0.9x	0.77	x	5.44	x	74.72	x	0.4	x	0.7	=	78.87	(74)
North	0.9x	0.77	x	4.8	x	79.99	x	0.4	x	0.7	=	74.5	(74)
North	0.9x	0.77	x	5.44	x	79.99	x	0.4	x	0.7	=	84.43	(74)
North	0.9x	0.77	x	4.8	x	74.68	x	0.4	x	0.7	=	69.55	(74)
North	0.9x	0.77	x	5.44	x	74.68	x	0.4	x	0.7	=	78.83	(74)
North	0.9x	0.77	x	4.8	x	59.25	x	0.4	x	0.7	=	55.18	(74)
North	0.9x	0.77	x	5.44	x	59.25	x	0.4	x	0.7	=	62.54	(74)
North	0.9x	0.77	x	4.8	x	41.52	x	0.4	x	0.7	=	38.67	(74)
North	0.9x	0.77	x	5.44	x	41.52	x	0.4	x	0.7	=	43.82	(74)
North	0.9x	0.77	x	4.8	x	24.19	x	0.4	x	0.7	=	22.53	(74)
North	0.9x	0.77	x	5.44	x	24.19	x	0.4	x	0.7	=	25.53	(74)
North	0.9x	0.77	x	4.8	x	13.12	x	0.4	x	0.7	=	12.22	(74)
North	0.9x	0.77	x	5.44	x	13.12	x	0.4	x	0.7	=	13.85	(74)
North	0.9x	0.77	x	4.8	x	8.86	x	0.4	x	0.7	=	8.26	(74)
North	0.9x	0.77	x	5.44	x	8.86	x	0.4	x	0.7	=	9.36	(74)
East	0.9x	0.77	x	1.44	x	19.64	x	0.4	x	0.7	=	5.49	(76)
East	0.9x	0.77	x	1.44	x	38.42	x	0.4	x	0.7	=	10.74	(76)
East	0.9x	0.77	x	1.44	x	63.27	x	0.4	x	0.7	=	17.68	(76)
East	0.9x	0.77	x	1.44	x	92.28	x	0.4	x	0.7	=	25.78	(76)
East	0.9x	0.77	x	1.44	x	113.09	x	0.4	x	0.7	=	31.6	(76)
East	0.9x	0.77	x	1.44	x	115.77	x	0.4	x	0.7	=	32.35	(76)
East	0.9x	0.77	x	1.44	x	110.22	x	0.4	x	0.7	=	30.8	(76)
East	0.9x	0.77	x	1.44	x	94.68	x	0.4	x	0.7	=	26.45	(76)
East	0.9x	0.77	x	1.44	x	73.59	x	0.4	x	0.7	=	20.56	(76)
East	0.9x	0.77	x	1.44	x	45.59	x	0.4	x	0.7	=	12.74	(76)
East	0.9x	0.77	x	1.44	x	24.49	x	0.4	x	0.7	=	6.84	(76)
East	0.9x	0.77	x	1.44	x	16.15	x	0.4	x	0.7	=	4.51	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	26.62	51.11	86.29	135.99	180.06	191.28	179.18	144.17	103.05	60.8	32.91	22.13	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	409.56	432.07	455.3	485.85	510.63	503.2	478.96	449.51	418.21	395.3	389.59	395.29	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.96	0.86	0.67	0.46	0.33	0.37	0.6	0.89	0.98	0.99	(86)

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Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.62	20.7	20.82	20.95	21	21	21	21	21	20.95	20.78	20.62	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.44	20.45	20.45	20.46	20.47	20.48	20.48	20.48	20.48	20.47	20.46	20.46	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.96	0.84	0.63	0.42	0.29	0.32	0.55	0.86	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.94	20.05	20.22	20.41	20.46	20.48	20.48	20.48	20.48	20.41	20.18	19.94	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	20.22	20.31	20.47	20.63	20.68	20.69	20.69	20.7	20.69	20.63	20.43	20.22	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	20.22	20.31	20.47	20.63	20.68	20.69	20.69	20.7	20.69	20.63	20.43	20.22	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.96	0.85	0.65	0.44	0.31	0.34	0.57	0.87	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	405.9	424.91	435.38	411.84	330.15	219.08	147.22	153.57	239.16	344.71	380.02	392.44	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	615.66	592.85	534.28	436.6	332.32	219.12	147.22	153.57	239.7	371.18	498.74	606.04	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	156.06	112.85	73.58	17.83	1.62	0	0	0	0	19.69	85.47	158.91	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 626.01 (98)

Space heating requirement in kWh/m²/year 9.45 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none	0	(301)
Fraction of space heat from community system 1 – (301) =	1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating	**kWh/year**
Annual space heating requirement	626.01

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Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	657.31	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)

Water heating

Annual water heating requirement		1784.71	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	1873.94	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	25.31	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		118.21	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	118.21	(331)
Energy for lighting (calculated in Appendix L)		311.73	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-518.17	(333)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		2443.02	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				256	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	513.17	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	13.14	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	526.31	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.52	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				526.31	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	61.35	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	161.79	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1			0.52	x 0.01 =	-268.93	(380)
Total CO2, kg/year	sum of (376)…(382) =				480.51	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				7.25	(384)
EI rating (section 14)					94.21	(385)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Sample 1 (Mid)

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	66.25	(1a)	x	3	(2a)	=	198.75	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.25	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			198.75	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.1	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.35	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.37	0.37	0.33	0.32	0.28	0.28	0.28	0.3	0.32	0.34	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1	=	2.4			(26)
Windows Type 1			4.8	x1/[1/(1.4)+ 0.04]		=	6.36			(27)
Windows Type 2			5.44	x1/[1/(1.4)+ 0.04]		=	7.21			(27)
Windows Type 3			1.44	x1/[1/(1.4)+ 0.04]		=	1.91			(27)
Walls Type1	10.24	10.24	0	x	0.18	=	0			(29)
Walls Type2	1.44	1.44	0	x	0.18	=	0			(29)
Walls Type3	13.2	2.4	10.8	x	0.18	=	1.94			(29)
Walls Type4	2.4	0	2.4	x	0.18	=	0.43			(29)
Total area of elements, m²			27.28							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 20.26 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 184.8 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 1.36 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 21.62 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	37.53	37.35	37.16	36.32	36.16	35.42	35.42	35.29	35.71	36.16	36.48	36.82	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	59.15	58.97	58.79	57.94	57.78	57.05	57.05	56.91	57.33	57.78	58.11	58.44

Average = Sum(39)$_{1…12}$ /12= 57.94 (39)

TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K   (40)m = (39)m ÷ (4)

(40)m=	0.89	0.89	0.89	0.87	0.87	0.86	0.86	0.86	0.87	0.87	0.88	0.88

Average = Sum(40)$_{1…12}$ /12= 0.87 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.15 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.3 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	93.83	90.42	87.01	83.6	80.19	76.77	76.77	80.19	83.6	87.01	90.42	93.83

Total = Sum(44)$_{1…12}$ = 1023.65 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.15	121.71	125.59	109.49	105.06	90.66	84.01	96.4	97.55	113.69	124.1	134.76

Total = Sum(45)$_{1…12}$ = 1342.17 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.87	18.26	18.84	16.42	15.76	13.6	12.6	14.46	14.63	17.05	18.61	20.21	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	185.75	163.79	172.18	154.58	151.65	135.75	130.6	143	142.64	160.28	169.19	181.36	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	185.75	163.79	172.18	154.58	151.65	135.75	130.6	143	142.64	160.28	169.19	181.36

Output from water heater (annual)1…12 | 1890.79 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	83.54	74.14	79.03	72.48	72.21	66.22	65.21	69.33	68.51	75.08	77.34	82.08	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	17.21	15.29	12.43	9.41	7.04	5.94	6.42	8.34	11.2	14.22	16.59	17.69	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	188.39	190.35	185.42	174.93	161.69	149.25	140.94	138.98	143.91	154.4	167.64	180.08	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	(71)
Water heating gains (Table 5)													
(72)m=	112.29	110.32	106.23	100.67	97.05	91.97	87.65	93.18	95.15	100.91	107.41	110.33	(72)
Total internal gains =						(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m							
(73)m=	376.17	374.23	362.36	343.29	324.06	305.44	293.28	298.79	308.54	327.8	349.92	366.38	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	4.8	x	10.63	x	0.63	x	0.7	=	15.6	(74)
North	0.9x	0.77	x	5.44	x	10.63	x	0.63	x	0.7	=	17.68	(74)
North	0.9x	0.77	x	4.8	x	20.32	x	0.63	x	0.7	=	29.81	(74)
North	0.9x	0.77	x	5.44	x	20.32	x	0.63	x	0.7	=	33.78	(74)

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North	0.9x	0.77	x	4.8	x	34.53	x	0.63	x	0.7	=	50.65	(74)
North	0.9x	0.77	x	5.44	x	34.53	x	0.63	x	0.7	=	57.41	(74)
North	0.9x	0.77	x	4.8	x	55.46	x	0.63	x	0.7	=	81.36	(74)
North	0.9x	0.77	x	5.44	x	55.46	x	0.63	x	0.7	=	92.21	(74)
North	0.9x	0.77	x	4.8	x	74.72	x	0.63	x	0.7	=	109.6	(74)
North	0.9x	0.77	x	5.44	x	74.72	x	0.63	x	0.7	=	124.22	(74)
North	0.9x	0.77	x	4.8	x	79.99	x	0.63	x	0.7	=	117.33	(74)
North	0.9x	0.77	x	5.44	x	79.99	x	0.63	x	0.7	=	132.98	(74)
North	0.9x	0.77	x	4.8	x	74.68	x	0.63	x	0.7	=	109.55	(74)
North	0.9x	0.77	x	5.44	x	74.68	x	0.63	x	0.7	=	124.15	(74)
North	0.9x	0.77	x	4.8	x	59.25	x	0.63	x	0.7	=	86.91	(74)
North	0.9x	0.77	x	5.44	x	59.25	x	0.63	x	0.7	=	98.5	(74)
North	0.9x	0.77	x	4.8	x	41.52	x	0.63	x	0.7	=	60.9	(74)
North	0.9x	0.77	x	5.44	x	41.52	x	0.63	x	0.7	=	69.02	(74)
North	0.9x	0.77	x	4.8	x	24.19	x	0.63	x	0.7	=	35.48	(74)
North	0.9x	0.77	x	5.44	x	24.19	x	0.63	x	0.7	=	40.22	(74)
North	0.9x	0.77	x	4.8	x	13.12	x	0.63	x	0.7	=	19.24	(74)
North	0.9x	0.77	x	5.44	x	13.12	x	0.63	x	0.7	=	21.81	(74)
North	0.9x	0.77	x	4.8	x	8.86	x	0.63	x	0.7	=	13	(74)
North	0.9x	0.77	x	5.44	x	8.86	x	0.63	x	0.7	=	14.74	(74)
East	0.9x	0.77	x	1.44	x	19.64	x	0.63	x	0.7	=	8.64	(76)
East	0.9x	0.77	x	1.44	x	38.42	x	0.63	x	0.7	=	16.91	(76)
East	0.9x	0.77	x	1.44	x	63.27	x	0.63	x	0.7	=	27.85	(76)
East	0.9x	0.77	x	1.44	x	92.28	x	0.63	x	0.7	=	40.61	(76)
East	0.9x	0.77	x	1.44	x	113.09	x	0.63	x	0.7	=	49.77	(76)
East	0.9x	0.77	x	1.44	x	115.77	x	0.63	x	0.7	=	50.95	(76)
East	0.9x	0.77	x	1.44	x	110.22	x	0.63	x	0.7	=	48.51	(76)
East	0.9x	0.77	x	1.44	x	94.68	x	0.63	x	0.7	=	41.67	(76)
East	0.9x	0.77	x	1.44	x	73.59	x	0.63	x	0.7	=	32.39	(76)
East	0.9x	0.77	x	1.44	x	45.59	x	0.63	x	0.7	=	20.06	(76)
East	0.9x	0.77	x	1.44	x	24.49	x	0.63	x	0.7	=	10.78	(76)
East	0.9x	0.77	x	1.44	x	16.15	x	0.63	x	0.7	=	7.11	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	41.92	80.5	135.91	214.19	283.59	301.26	282.2	227.08	162.31	95.76	51.83	34.85	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	418.09	454.73	498.27	557.47	607.65	606.7	575.48	525.86	470.85	423.57	401.75	401.22	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.94	0.8	0.59	0.43	0.49	0.78	0.96	0.99	1	(86)

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Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.15	20.26	20.46	20.74	20.93	20.99	21	21	20.96	20.71	20.39	20.13	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.17	20.18	20.18	20.19	20.19	20.2	20.2	20.2	20.2	20.19	20.19	20.18	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.92	0.76	0.52	0.36	0.41	0.71	0.95	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.04	19.2	19.49	19.88	20.12	20.2	20.2	20.2	20.16	19.86	19.4	19.02	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.49	19.63	19.89	20.23	20.45	20.52	20.53	20.53	20.49	20.21	19.8	19.48	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.49	19.63	19.89	20.23	20.45	20.52	20.53	20.53	20.49	20.21	19.8	19.48	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.92	0.77	0.55	0.39	0.45	0.74	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	416.12	450.79	487.2	514.37	469.72	334.2	223.76	234.19	346.69	402.44	397.68	399.73	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	898.75	868.82	787.11	656.66	505.83	337.83	224.09	234.95	366.3	555.28	738.18	892.7	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	359.08	280.92	223.13	102.45	26.86	0	0	0	0	113.72	245.16	366.77	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1718.09 (98)

Space heating requirement in kWh/m²/year 25.93 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	359.08	280.92	223.13	102.45	26.86	0	0	0	0	113.72	245.16	366.77	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	384.04	300.45	238.64	109.57	28.73	0	0	0	0	121.62	262.2	392.27	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 1837.53 (211)

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Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)

185.75	163.79	172.18	154.58	151.65	135.75	130.6	143	142.64	160.28	169.19	181.36

Efficiency of water heater 79.8 (216)

(217)m=	86.54	86.24	85.51	83.75	81.25	79.8	79.8	79.8	79.8	83.92	85.8	86.66

(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	214.63	189.92	201.37	184.58	186.66	170.11	163.66	179.19	178.75	191	197.19	209.29

Total = Sum(219a)$_{1...12}$ = 2266.36 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1837.53	
Water heating fuel used			2266.36	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			303.98	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			4482.87	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	396.91	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	489.53	(264)
Space and water heating	(261) + (262) + (263) + (264) =			886.44	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	157.76	(268)
Total CO2, kg/year		sum of (265)…(271) =		1083.13	(272)

TER = 23.71 (273)

SAP Input

Property Details: Sample 2 (Mid)

Address:	
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	26 July 2019
Date of certificate:	15 June 2022
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	498

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2019	
Floor Location:	Floor area:	Storey height:
Floor 0	66.25 m²	3 m
Living area:	27.2 m² (fraction 0.411)	
Front of dwelling faces:	Unspecified	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
DOOR	Manufacturer	Solid			Wood
W	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
N	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Balcony	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
DOOR	mm	0.7	0	1.4	2.4	1
W		0.7	0.4	1	1.44	1
N		0.7	0.4	1	10.24	1
Balcony		0.7	0.4	1	4.8	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
DOOR		INT	Worst case	0	0
W		W	West	0	0
N		N	North	0	0
Balcony		N	North	0	0

Overshading: More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
<u>External Elements</u>							
N	31.8	15.04	16.76	0.15	0	False	N/A
W	18.75	1.44	17.31	0.15	0	False	N/A
INT	11.1	2.4	8.7	0.16	0.43	False	N/A
Spandrel	2.4	0	2.4	0.35	0	False	N/A
<u>Internal Elements</u>							
<u>Party Elements</u>							

Thermal bridges:

SAP Input

Thermal bridges:	No information on thermal bridging (y=0.15) (y =0.15)
Ventilation:	
Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	3
Main heating system:	
Main heating system:	Community heating schemes Heat source: Community heat pump heat from electric heat pump, heat fraction 1, efficiency 256 Piping>=1991, pre-insulated, low temp, variable flow Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Boiler interlock: Yes
Main heating Control:	
Main heating Control:	Charging system linked to use of community heating, programmer and TRVs Control code: 2306
Secondary heating system:	
Secondary heating system:	None
Water heating:	
Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Flue Gas Heat Recovery System: Database (rev 498, product index 060036) Brand name: Worcester Model: Greenstar Xtra Model qualifier: 2015 Solar panel: False
Others:	
Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	Photovoltaic 1 Installed Peak power: 0.6 Tilt of collector: 30° Overshading: None or very little Collector Orientation: South
Assess Zero Carbon Home:	No

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Sample 2 (Mid)

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	66.25	(1a)	x	3	(2a)	=	198.75	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.25	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			198.75	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*		0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)		0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.05 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1.4	=	3.36			(26)
Windows Type 1			1.44	x	1/[1/(1)+ 0.04]	=	1.38			(27)
Windows Type 2			10.24	x	1/[1/(1)+ 0.04]	=	9.85			(27)
Windows Type 3			4.8	x	1/[1/(1)+ 0.04]	=	4.62			(27)
Walls Type1	31.8	15.04	16.76	x	0.15	=	2.51			(29)
Walls Type2	18.75	1.44	17.31	x	0.15	=	2.6			(29)
Walls Type3	11.1	2.4	8.7	x	0.15	=	1.3			(29)
Walls Type4	2.4	0	2.4	x	0.35	=	0.84			(29)
Total area of elements, m²			64.05							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 26.46 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 632.38 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 9.61 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 36.07 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	17.53	17.32	17.11	16.07	15.86	14.81	14.81	14.61	15.23	15.86	16.28	16.7	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	53.6	53.39	53.18	52.14	51.93	50.88	50.88	50.67	51.3	51.93	52.34	52.76	

Average = Sum(39)$_{1\ldots12}$ /12= 52.08 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	0.81	0.81	0.8	0.79	0.78	0.77	0.77	0.76	0.77	0.78	0.79	0.8	

Average = Sum(40)$_{1…12}$ /12= 0.79 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.15 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.3 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	93.83	90.42	87.01	83.6	80.19	76.77	76.77	80.19	83.6	87.01	90.42	93.83	

Total = Sum(44)$_{1…12}$ = 1023.65 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	139.15	121.71	125.59	109.49	105.06	90.66	84.01	96.4	97.55	113.69	124.1	134.76	

Total = Sum(45)$_{1…12}$ = 1342.17 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	20.87	18.26	18.84	16.42	15.76	13.6	12.6	14.46	14.63	17.05	18.61	20.21	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	194.43	171.63	180.87	162.99	160.34	144.15	139.29	151.68	151.05	168.96	177.59	190.04	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	17.95	15.96	16.41	14.51	13.96	12.12	11.22	12.87	13.02	15.02	16.24	17.46	(63) (G2)

Output from water heater

(64)m=	173.8	153.25	161.77	145.88	143.69	129.44	125.38	136.13	135.43	151.27	158.76	169.9	

Output from water heater (annual)$_{1...12}$ 1784.71 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	90.49	80.41	85.98	79.2	79.15	72.94	72.15	76.27	75.23	82.02	84.06	89.03	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	16.81	14.93	12.14	9.19	6.87	5.8	6.27	8.15	10.93	13.88	16.2	17.27	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	188.39	190.35	185.42	174.93	161.69	149.25	140.94	138.98	143.91	154.4	167.64	180.08	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	(71)

Water heating gains (Table 5)

(72)m=	121.63	119.66	115.56	110	106.39	101.3	96.98	102.52	104.49	110.25	116.75	119.66	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	382.1	380.21	368.4	349.4	330.23	311.63	299.46	304.93	314.61	333.8	355.86	372.29	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	10.24	x	10.63	x	0.4	x	0.7	=	21.13	(74)
North	0.9x	0.77	x	4.8	x	10.63	x	0.4	x	0.7	=	9.9	(74)
North	0.9x	0.77	x	10.24	x	20.32	x	0.4	x	0.7	=	40.38	(74)
North	0.9x	0.77	x	4.8	x	20.32	x	0.4	x	0.7	=	18.93	(74)

North	0.9x	0.77	x	10.24	x	34.53	x	0.4	x	0.7	=	68.61	(74)
North	0.9x	0.77	x	4.8	x	34.53	x	0.4	x	0.7	=	32.16	(74)
North	0.9x	0.77	x	10.24	x	55.46	x	0.4	x	0.7	=	110.21	(74)
North	0.9x	0.77	x	4.8	x	55.46	x	0.4	x	0.7	=	51.66	(74)
North	0.9x	0.77	x	10.24	x	74.72	x	0.4	x	0.7	=	148.46	(74)
North	0.9x	0.77	x	4.8	x	74.72	x	0.4	x	0.7	=	69.59	(74)
North	0.9x	0.77	x	10.24	x	79.99	x	0.4	x	0.7	=	158.93	(74)
North	0.9x	0.77	x	4.8	x	79.99	x	0.4	x	0.7	=	74.5	(74)
North	0.9x	0.77	x	10.24	x	74.68	x	0.4	x	0.7	=	148.38	(74)
North	0.9x	0.77	x	4.8	x	74.68	x	0.4	x	0.7	=	69.55	(74)
North	0.9x	0.77	x	10.24	x	59.25	x	0.4	x	0.7	=	117.72	(74)
North	0.9x	0.77	x	4.8	x	59.25	x	0.4	x	0.7	=	55.18	(74)
North	0.9x	0.77	x	10.24	x	41.52	x	0.4	x	0.7	=	82.49	(74)
North	0.9x	0.77	x	4.8	x	41.52	x	0.4	x	0.7	=	38.67	(74)
North	0.9x	0.77	x	10.24	x	24.19	x	0.4	x	0.7	=	48.06	(74)
North	0.9x	0.77	x	4.8	x	24.19	x	0.4	x	0.7	=	22.53	(74)
North	0.9x	0.77	x	10.24	x	13.12	x	0.4	x	0.7	=	26.06	(74)
North	0.9x	0.77	x	4.8	x	13.12	x	0.4	x	0.7	=	12.22	(74)
North	0.9x	0.77	x	10.24	x	8.86	x	0.4	x	0.7	=	17.61	(74)
North	0.9x	0.77	x	4.8	x	8.86	x	0.4	x	0.7	=	8.26	(74)
West	0.9x	0.77	x	1.44	x	19.64	x	0.4	x	0.7	=	5.49	(80)
West	0.9x	0.77	x	1.44	x	38.42	x	0.4	x	0.7	=	10.74	(80)
West	0.9x	0.77	x	1.44	x	63.27	x	0.4	x	0.7	=	17.68	(80)
West	0.9x	0.77	x	1.44	x	92.28	x	0.4	x	0.7	=	25.78	(80)
West	0.9x	0.77	x	1.44	x	113.09	x	0.4	x	0.7	=	31.6	(80)
West	0.9x	0.77	x	1.44	x	115.77	x	0.4	x	0.7	=	32.35	(80)
West	0.9x	0.77	x	1.44	x	110.22	x	0.4	x	0.7	=	30.8	(80)
West	0.9x	0.77	x	1.44	x	94.68	x	0.4	x	0.7	=	26.45	(80)
West	0.9x	0.77	x	1.44	x	73.59	x	0.4	x	0.7	=	20.56	(80)
West	0.9x	0.77	x	1.44	x	45.59	x	0.4	x	0.7	=	12.74	(80)
West	0.9x	0.77	x	1.44	x	24.49	x	0.4	x	0.7	=	6.84	(80)
West	0.9x	0.77	x	1.44	x	16.15	x	0.4	x	0.7	=	4.51	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	36.52	70.04	118.45	187.65	249.65	265.77	248.73	199.36	141.72	83.33	45.12	30.38	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	418.62	450.25	486.85	537.05	579.88	577.41	548.19	504.28	456.33	417.14	400.99	402.68	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.93	0.78	0.56	0.41	0.46	0.74	0.96	0.99	1	(86)

DER WorkSheet: New dwelling design stage

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.28	20.38	20.56	20.8	20.95	21	21	21	20.98	20.79	20.5	20.27	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.25	20.25	20.25	20.26	20.27	20.28	20.28	20.28	20.28	20.27	20.26	20.26	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.91	0.73	0.5	0.34	0.39	0.68	0.94	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.28	19.42	19.69	20.04	20.23	20.28	20.28	20.28	20.26	20.02	19.61	19.27	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.69	19.81	20.04	20.35	20.52	20.57	20.58	20.58	20.55	20.34	19.98	19.68	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.69	19.81	20.04	20.35	20.52	20.57	20.58	20.58	20.55	20.34	19.98	19.68	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.91	0.75	0.52	0.37	0.42	0.7	0.94	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	416.45	446.01	475.15	491.04	435.85	302.33	202.19	211.41	320.54	392.38	396.3	401.02	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	824.75	796.27	720.24	596.98	458.24	303.92	202.31	211.68	331.02	505.52	674.04	816.61	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	303.78	235.37	182.35	76.28	16.66	0	0	0	0	84.18	199.97	309.2	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1407.78 (98)

Space heating requirement in kWh/m²/year 21.25 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none	0	(301)
Fraction of space heat from community system 1 – (301) =	1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating **kWh/year**

Annual space heating requirement 1407.78

DER WorkSheet: New dwelling design stage

Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	1478.17	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)

Water heating

Annual water heating requirement		1784.71	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	1873.94	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	33.52	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		118.21	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	118.21	(331)
Energy for lighting (calculated in Appendix L)		296.83	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-518.17	(333)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		3248.97	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				256	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	679.59	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	17.4	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	696.99	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				696.99	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	61.35	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	154.05	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1		0.52		x 0.01 =	-268.93	(380)
Total CO2, kg/year	sum of (376)…(382) =				643.46	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				9.71	(384)
EI rating (section 14)					92.25	(385)

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User Details:

Assessor Name: | **Stroma Number:**

Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.51

Property Address: Sample 2 (Mid)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	66.25	(1a) x	3	(2a) =	198.75	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.25	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	198.75	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20 ÷ (5) =	0.1	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.35	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.37	0.37	0.33	0.32	0.28	0.28	0.28	0.3	0.32	0.34	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1	=	2.4			(26)
Windows Type 1			1.24	x1/[1/(1.4)+ 0.04]		=	1.64			(27)
Windows Type 2			8.8	x1/[1/(1.4)+ 0.04]		=	11.67			(27)
Windows Type 3			4.12	x1/[1/(1.4)+ 0.04]		=	5.46			(27)
Walls Type1	31.8	12.92	18.88	x	0.18	=	3.4			(29)
Walls Type2	18.75	1.24	17.51	x	0.18	=	3.15			(29)
Walls Type3	11.1	2.4	8.7	x	0.18	=	1.57			(29)
Walls Type4	2.4	0	2.4	x	0.18	=	0.43			(29)
Total area of elements, m²			64.05							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 29.72 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 664.86 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 3.2 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 32.92 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	37.53	37.35	37.16	36.32	36.16	35.42	35.42	35.29	35.71	36.16	36.48	36.82	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	70.45	70.27	70.09	69.24	69.08	68.35	68.35	68.21	68.63	69.08	69.4	69.74	

Average = Sum(39)$_{1…12}$ /12= 69.24 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.06	1.06	1.06	1.05	1.04	1.03	1.03	1.03	1.04	1.04	1.05	1.05

Average = Sum(40)$_{1…12}$ /12= 1.05 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.15 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.3 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	93.83	90.42	87.01	83.6	80.19	76.77	76.77	80.19	83.6	87.01	90.42	93.83

Total = Sum(44)$_{1…12}$ = 1023.65 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.15	121.71	125.59	109.49	105.06	90.66	84.01	96.4	97.55	113.69	124.1	134.76

Total = Sum(45)$_{1…12}$ = 1342.17 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.87	18.26	18.84	16.42	15.76	13.6	12.6	14.46	14.63	17.05	18.61	20.21	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	185.75	163.79	172.18	154.58	151.65	135.75	130.6	143	142.64	160.28	169.19	181.36	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	185.75	163.79	172.18	154.58	151.65	135.75	130.6	143	142.64	160.28	169.19	181.36	

Output from water heater (annual)$_{1…12}$ 1890.79 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	83.54	74.14	79.03	72.48	72.21	66.22	65.21	69.33	68.51	75.08	77.34	82.08	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	16.82	14.94	12.15	9.2	6.88	5.81	6.27	8.15	10.94	13.9	16.22	17.29	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	188.39	190.35	185.42	174.93	161.69	149.25	140.94	138.98	143.91	154.4	167.64	180.08	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	(71)

Water heating gains (Table 5)

(72)m=	112.29	110.32	106.23	100.67	97.05	91.97	87.65	93.18	95.15	100.91	107.41	110.33	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	375.78	373.89	362.08	343.07	323.9	305.3	293.13	298.6	308.28	327.48	349.54	365.97	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	8.8	x	10.63	x	0.63	x	0.7	=	28.6	(74)
North	0.9x	0.77	x	4.12	x	10.63	x	0.63	x	0.7	=	13.39	(74)
North	0.9x	0.77	x	8.8	x	20.32	x	0.63	x	0.7	=	54.65	(74)
North	0.9x	0.77	x	4.12	x	20.32	x	0.63	x	0.7	=	25.59	(74)

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North	0.9x	0.77	x	8.8	x	34.53	x	0.63	x	0.7	=	92.87	(74)
North	0.9x	0.77	x	4.12	x	34.53	x	0.63	x	0.7	=	43.48	(74)
North	0.9x	0.77	x	8.8	x	55.46	x	0.63	x	0.7	=	149.17	(74)
North	0.9x	0.77	x	4.12	x	55.46	x	0.63	x	0.7	=	69.84	(74)
North	0.9x	0.77	x	8.8	x	74.72	x	0.63	x	0.7	=	200.94	(74)
North	0.9x	0.77	x	4.12	x	74.72	x	0.63	x	0.7	=	94.08	(74)
North	0.9x	0.77	x	8.8	x	79.99	x	0.63	x	0.7	=	215.11	(74)
North	0.9x	0.77	x	4.12	x	79.99	x	0.63	x	0.7	=	100.71	(74)
North	0.9x	0.77	x	8.8	x	74.68	x	0.63	x	0.7	=	200.83	(74)
North	0.9x	0.77	x	4.12	x	74.68	x	0.63	x	0.7	=	94.03	(74)
North	0.9x	0.77	x	8.8	x	59.25	x	0.63	x	0.7	=	159.34	(74)
North	0.9x	0.77	x	4.12	x	59.25	x	0.63	x	0.7	=	74.6	(74)
North	0.9x	0.77	x	8.8	x	41.52	x	0.63	x	0.7	=	111.65	(74)
North	0.9x	0.77	x	4.12	x	41.52	x	0.63	x	0.7	=	52.27	(74)
North	0.9x	0.77	x	8.8	x	24.19	x	0.63	x	0.7	=	65.05	(74)
North	0.9x	0.77	x	4.12	x	24.19	x	0.63	x	0.7	=	30.46	(74)
North	0.9x	0.77	x	8.8	x	13.12	x	0.63	x	0.7	=	35.28	(74)
North	0.9x	0.77	x	4.12	x	13.12	x	0.63	x	0.7	=	16.52	(74)
North	0.9x	0.77	x	8.8	x	8.86	x	0.63	x	0.7	=	23.84	(74)
North	0.9x	0.77	x	4.12	x	8.86	x	0.63	x	0.7	=	11.16	(74)
West	0.9x	0.77	x	1.24	x	19.64	x	0.63	x	0.7	=	7.44	(80)
West	0.9x	0.77	x	1.24	x	38.42	x	0.63	x	0.7	=	14.56	(80)
West	0.9x	0.77	x	1.24	x	63.27	x	0.63	x	0.7	=	23.98	(80)
West	0.9x	0.77	x	1.24	x	92.28	x	0.63	x	0.7	=	34.97	(80)
West	0.9x	0.77	x	1.24	x	113.09	x	0.63	x	0.7	=	42.86	(80)
West	0.9x	0.77	x	1.24	x	115.77	x	0.63	x	0.7	=	43.87	(80)
West	0.9x	0.77	x	1.24	x	110.22	x	0.63	x	0.7	=	41.77	(80)
West	0.9x	0.77	x	1.24	x	94.68	x	0.63	x	0.7	=	35.88	(80)
West	0.9x	0.77	x	1.24	x	73.59	x	0.63	x	0.7	=	27.89	(80)
West	0.9x	0.77	x	1.24	x	45.59	x	0.63	x	0.7	=	17.28	(80)
West	0.9x	0.77	x	1.24	x	24.49	x	0.63	x	0.7	=	9.28	(80)
West	0.9x	0.77	x	1.24	x	16.15	x	0.63	x	0.7	=	6.12	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	49.43	94.8	160.32	253.97	337.87	359.7	336.63	269.81	191.82	112.79	61.08	41.12	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	425.21	468.68	522.4	597.05	661.78	665	629.77	568.41	500.1	440.27	410.62	407.1	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.95	0.83	0.63	0.47	0.54	0.82	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.92	20.04	20.28	20.61	20.87	20.98	21	20.99	20.91	20.58	20.2	19.9	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.03	20.03	20.04	20.05	20.05	20.06	20.06	20.06	20.05	20.05	20.04	20.04	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.93	0.78	0.55	0.37	0.44	0.75	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.59	18.77	19.11	19.59	19.92	20.04	20.06	20.06	19.98	19.56	19.01	18.56	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.13	19.29	19.59	20.01	20.31	20.43	20.44	20.44	20.36	19.98	19.49	19.11	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.13	19.29	19.59	20.01	20.31	20.43	20.44	20.44	20.36	19.98	19.49	19.11	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.93	0.8	0.58	0.41	0.48	0.77	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	423.16	464.59	511.2	555.02	527	388.24	261.3	272.89	387.56	421.46	406.68	405.52	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1044.98	1011.35	917.6	769.05	594.79	398.17	262.57	275.57	429.79	647.88	860.2	1039.8	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	462.64	367.42	302.36	154.1	50.43	0	0	0	0	168.46	326.53	471.9	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2303.85 (98)

Space heating requirement in kWh/m²/year 34.78 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	462.64	367.42	302.36	154.1	50.43	0	0	0	0	168.46	326.53	471.9	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	494.8	392.97	323.38	164.82	53.94	0	0	0	0	180.17	349.23	504.71	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2464.02 (211)

TER WorkSheet: New dwelling design stage

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)

185.75	163.79	172.18	154.58	151.65	135.75	130.6	143	142.64	160.28	169.19	181.36

Efficiency of water heater 79.8 (216)

(217)m=	87.15	86.91	86.3	84.81	82.23	79.8	79.8	79.8	79.8	84.95	86.54	87.25	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	213.13	188.47	199.51	182.28	184.44	170.11	163.66	179.19	178.75	188.69	195.51	207.86

Total = Sum(219a)$_{1...12}$ = 2251.6 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2464.02	
Water heating fuel used		2251.6	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		75	(231)
Electricity for lighting		297.09	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		5087.7	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	532.23	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	486.35	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1018.57	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	154.19	(268)
Total CO2, kg/year		sum of (265)…(271) =		1211.69	(272)

TER = 18.29 (273)

SAP Input

Property Details: Sample 3 (Mid)

Address:	
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	26 July 2019
Date of certificate:	15 June 2022
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	498

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2019	
Floor Location:	Floor area:	Storey height:
Floor 0	67 m²	3 m
Living area:	27.3 m² (fraction 0.407)	
Front of dwelling faces:	Unspecified	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
DOOR	Manufacturer	Solid			Wood
E	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
S	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Balcony	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
DOOR	mm	0.7	0	1.4	2.4	1
E		0.7	0.4	1	1.44	1
S		0.7	0.4	1	5.44	1
Balcony		0.7	0.4	1	4.8	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
DOOR		INT	Worst case	0	0
E		E	East	0	0
S		S	South	0	0
Balcony		S	South	0	0

Overshading: More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
<u>External Elements</u>							
S	31.65	10.24	21.41	0.15	0	False	N/A
E	2.3	1.44	0.86	0.15	0	False	N/A
INT	11.1	2.4	8.7	0.16	0.43	False	N/A
Spandrel	2.4	0	2.4	0.35	0	False	N/A
<u>Internal Elements</u>							
<u>Party Elements</u>							

Thermal bridges:

SAP Input

Thermal bridges:	No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	3

Main heating system:

Main heating system:	Community heating schemes Heat source: Community heat pump heat from electric heat pump, heat fraction 1, efficiency 256 Piping>=1991, pre-insulated, low temp, variable flow Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Boiler interlock: Yes

Main heating Control:

Main heating Control:	Charging system linked to use of community heating, programmer and TRVs Control code: 2306

Secondary heating system:

Secondary heating system:	None

Water heating:

Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Flue Gas Heat Recovery System: Database (rev 498, product index 060036) Brand name: Worcester Model: Greenstar Xtra Model qualifier: 2015 Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	Photovoltaic 1 Installed Peak power: 0.6 Tilt of collector: 30° Overshading: None or very little Collector Orientation: South
Assess Zero Carbon Home:	No

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Sample 3 (Mid)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67	(1a) x	3	(2a) =	201	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	201	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	79.05	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1.4	=	3.36			(26)
Windows Type 1			1.44	x	1/[1/(1)+ 0.04]	=	1.38			(27)
Windows Type 2			5.44	x	1/[1/(1)+ 0.04]	=	5.23			(27)
Windows Type 3			4.8	x	1/[1/(1)+ 0.04]	=	4.62			(27)
Walls Type1	31.65	10.24	21.41	x	0.15	=	3.21			(29)
Walls Type2	2.3	1.44	0.86	x	0.15	=	0.13			(29)
Walls Type3	11.1	2.4	8.7	x	0.15	=	1.3			(29)
Walls Type4	2.4	0	2.4	x	0.35	=	0.84			(29)
Total area of elements, m²			47.45							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	20.07	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	467.18	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		7.12	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	27.19	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	17.73	17.52	17.31	16.25	16.04	14.98	14.98	14.77	15.41	16.04	16.46	16.89	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	44.92	44.71	44.5	43.44	43.23	42.17	42.17	41.96	42.6	43.23	43.65	44.08	

Average = Sum(39)$_{1…12}$ /12= 43.39 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.67	0.67	0.66	0.65	0.65	0.63	0.63	0.63	0.64	0.65	0.65	0.66

Average = Sum(40)$_{1…12}$ /12= 0.65 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.17 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.76 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	94.34	90.91	87.48	84.05	80.62	77.19	77.19	80.62	84.05	87.48	90.91	94.34	
Total = Sum(44)$_{1…12}$ = 1029.18													(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	139.91	122.36	126.27	110.08	105.63	91.15	84.46	96.92	98.08	114.3	124.77	135.49	
Total = Sum(45)$_{1…12}$ = 1349.41													(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	20.99	18.35	18.94	16.51	15.84	13.67	12.67	14.54	14.71	17.15	18.72	20.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	195.18	172.29	181.54	163.58	160.9	144.64	139.74	152.2	151.57	169.58	178.26	190.77	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	18.03	16.04	16.49	14.58	14.03	12.18	11.28	12.94	13.08	15.09	16.32	17.54	(63) (G2)

Output from water heater

(64)m=	174.47	153.83	162.37	146.4	144.19	129.86	125.78	136.58	135.89	151.81	159.35	170.55	

Output from water heater (annual)1…12 1791.08 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	90.74	80.63	86.21	79.4	79.34	73.1	72.31	76.45	75.41	82.23	84.28	89.27	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.86	15.86	12.9	9.77	7.3	6.16	6.66	8.66	11.62	14.75	17.22	18.36	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	190.2	192.17	187.2	176.61	163.24	150.68	142.29	140.32	145.29	155.88	169.24	181.8	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	(71)

Water heating gains (Table 5)

(72)m=	121.96	119.98	115.87	110.27	106.64	101.53	97.18	102.75	104.73	110.52	117.06	119.99	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	385.59	383.58	371.53	352.22	332.75	313.94	301.7	307.29	317.21	336.72	359.09	375.72	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	1.44	x	19.64	x	0.4	x	0.7	=	5.49	(76)
East	0.9x	0.77	x	1.44	x	38.42	x	0.4	x	0.7	=	10.74	(76)
East	0.9x	0.77	x	1.44	x	63.27	x	0.4	x	0.7	=	17.68	(76)
East	0.9x	0.77	x	1.44	x	92.28	x	0.4	x	0.7	=	25.78	(76)

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East	0.9x	0.77	x	1.44	x	113.09	x	0.4	x	0.7	=	31.6	(76)
East	0.9x	0.77	x	1.44	x	115.77	x	0.4	x	0.7	=	32.35	(76)
East	0.9x	0.77	x	1.44	x	110.22	x	0.4	x	0.7	=	30.8	(76)
East	0.9x	0.77	x	1.44	x	94.68	x	0.4	x	0.7	=	26.45	(76)
East	0.9x	0.77	x	1.44	x	73.59	x	0.4	x	0.7	=	20.56	(76)
East	0.9x	0.77	x	1.44	x	45.59	x	0.4	x	0.7	=	12.74	(76)
East	0.9x	0.77	x	1.44	x	24.49	x	0.4	x	0.7	=	6.84	(76)
East	0.9x	0.77	x	1.44	x	16.15	x	0.4	x	0.7	=	4.51	(76)
South	0.9x	0.77	x	5.44	x	46.75	x	0.4	x	0.7	=	49.35	(78)
South	0.9x	0.77	x	4.8	x	46.75	x	0.4	x	0.7	=	43.54	(78)
South	0.9x	0.77	x	5.44	x	76.57	x	0.4	x	0.7	=	80.82	(78)
South	0.9x	0.77	x	4.8	x	76.57	x	0.4	x	0.7	=	71.31	(78)
South	0.9x	0.77	x	5.44	x	97.53	x	0.4	x	0.7	=	102.95	(78)
South	0.9x	0.77	x	4.8	x	97.53	x	0.4	x	0.7	=	90.84	(78)
South	0.9x	0.77	x	5.44	x	110.23	x	0.4	x	0.7	=	116.36	(78)
South	0.9x	0.77	x	4.8	x	110.23	x	0.4	x	0.7	=	102.67	(78)
South	0.9x	0.77	x	5.44	x	114.87	x	0.4	x	0.7	=	121.26	(78)
South	0.9x	0.77	x	4.8	x	114.87	x	0.4	x	0.7	=	106.99	(78)
South	0.9x	0.77	x	5.44	x	110.55	x	0.4	x	0.7	=	116.69	(78)
South	0.9x	0.77	x	4.8	x	110.55	x	0.4	x	0.7	=	102.96	(78)
South	0.9x	0.77	x	5.44	x	108.01	x	0.4	x	0.7	=	114.01	(78)
South	0.9x	0.77	x	4.8	x	108.01	x	0.4	x	0.7	=	100.6	(78)
South	0.9x	0.77	x	5.44	x	104.89	x	0.4	x	0.7	=	110.72	(78)
South	0.9x	0.77	x	4.8	x	104.89	x	0.4	x	0.7	=	97.7	(78)
South	0.9x	0.77	x	5.44	x	101.89	x	0.4	x	0.7	=	107.55	(78)
South	0.9x	0.77	x	4.8	x	101.89	x	0.4	x	0.7	=	94.9	(78)
South	0.9x	0.77	x	5.44	x	82.59	x	0.4	x	0.7	=	87.18	(78)
South	0.9x	0.77	x	4.8	x	82.59	x	0.4	x	0.7	=	76.92	(78)
South	0.9x	0.77	x	5.44	x	55.42	x	0.4	x	0.7	=	58.5	(78)
South	0.9x	0.77	x	4.8	x	55.42	x	0.4	x	0.7	=	51.62	(78)
South	0.9x	0.77	x	5.44	x	40.4	x	0.4	x	0.7	=	42.64	(78)
South	0.9x	0.77	x	4.8	x	40.4	x	0.4	x	0.7	=	37.63	(78)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	98.38	162.87	211.48	244.82	259.85	252	245.41	234.88	223.01	176.83	116.95	84.78	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	483.97	546.46	583.01	597.03	592.6	565.95	547.11	542.17	540.21	513.55	476.04	460.5	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.97	0.93	0.83	0.67	0.48	0.34	0.36	0.54	0.82	0.97	0.99	(86)

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Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.58	20.71	20.84	20.95	20.99	21	21	21	21	20.96	20.77	20.56	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.37	20.37	20.37	20.39	20.39	20.4	20.4	20.41	20.4	20.39	20.38	20.38	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.96	0.91	0.8	0.63	0.43	0.29	0.31	0.5	0.79	0.96	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.82	20	20.18	20.33	20.38	20.4	20.4	20.41	20.4	20.35	20.1	19.8	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	20.13	20.29	20.45	20.58	20.63	20.65	20.65	20.65	20.64	20.6	20.38	20.11	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	20.13	20.29	20.45	20.58	20.63	20.65	20.65	20.65	20.64	20.6	20.38	20.11	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.96	0.91	0.81	0.64	0.45	0.31	0.33	0.51	0.8	0.96	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	476.34	525.75	533.03	481.35	381.93	254.81	170.65	178.25	278.11	411.13	455.33	455	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	711.05	687.98	620.71	507.6	386.06	254.99	170.66	178.26	278.67	432.16	579.55	701.23	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	174.63	109.02	65.23	18.9	3.07	0	0	0	0	15.65	89.43	183.19	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 659.13 (98)

Space heating requirement in kWh/m²/year 9.84 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating	**kWh/year**
Annual space heating requirement	659.13

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Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	692.08	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)

Water heating

Annual water heating requirement		1791.08	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	1880.63	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	25.73	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		119.54	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	119.54	(331)
Energy for lighting (calculated in Appendix L)		315.44	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-518.17	(333)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		2489.53	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				256	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	521.58	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	13.35	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	534.93	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				534.93	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	62.04	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	163.72	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1		0.52	x 0.01 =		-268.93	(380)
Total CO2, kg/year	sum of (376)…(382) =				491.76	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				7.34	(384)
EI rating (section 14)					94.12	(385)

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User Details:

Assessor Name: **Stroma Number:**
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.51

Property Address: Sample 3 (Mid)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67	(1a) x	3	(2a) =	201	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	201	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.1	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.35	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.37	0.36	0.33	0.32	0.28	0.28	0.27	0.3	0.32	0.33	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1	=	2.4			(26)
Windows Type 1			1.44	x1/[1/(1.4)+ 0.04]		=	1.91			(27)
Windows Type 2			5.44	x1/[1/(1.4)+ 0.04]		=	7.21			(27)
Windows Type 3			4.8	x1/[1/(1.4)+ 0.04]		=	6.36			(27)
Walls Type1	31.65	10.24	21.41	x	0.18	=	3.85			(29)
Walls Type2	2.3	1.44	0.86	x	0.18	=	0.15			(29)
Walls Type3	11.1	2.4	8.7	x	0.18	=	1.57			(29)
Walls Type4	2.4	0	2.4	x	0.18	=	0.43			(29)
Total area of elements, m²			47.45							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 23.89 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 467.18 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 2.37 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 26.26 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	37.92	37.74	37.56	36.71	36.55	35.81	35.81	35.67	36.09	36.55	36.87	37.21	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	64.19	64	63.82	62.97	62.81	62.07	62.07	61.93	62.36	62.81	63.13	63.47	

Average = Sum(39)$_{1…12}$ /12= 62.97 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.96	0.96	0.95	0.94	0.94	0.93	0.93	0.92	0.93	0.94	0.94	0.95

Average = Sum(40)₁…₁₂ /12= 0.94 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.17 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.76 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	94.34	90.91	87.48	84.05	80.62	77.19	77.19	80.62	84.05	87.48	90.91	94.34

Total = Sum(44)₁…₁₂ = 1029.18 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.91	122.36	126.27	110.08	105.63	91.15	84.46	96.92	98.08	114.3	124.77	135.49

Total = Sum(45)₁…₁₂ = 1349.41 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.99	18.35	18.94	16.51	15.84	13.67	12.67	14.54	14.71	17.15	18.72	20.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09	

Output from water heater (annual)$_{1...12}$ 1898.03 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	83.79	74.35	79.26	72.68	72.4	66.38	65.36	69.5	68.68	75.28	77.56	82.33	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.41	15.46	12.58	9.52	7.12	6.01	6.49	8.44	11.33	14.38	16.79	17.89	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	190.2	192.17	187.2	176.61	163.24	150.68	142.29	140.32	145.29	155.88	169.24	181.8	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	(71)

Water heating gains (Table 5)

(72)m=	112.63	110.65	106.53	100.94	97.31	92.19	87.85	93.42	95.4	101.18	107.72	110.65	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	378.8	376.85	364.87	345.64	326.23	307.45	295.2	300.74	310.58	330.01	352.32	368.92	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	1.44	x	19.64	x	0.63	x	0.7	=	8.64	(76)
East	0.9x	0.77	x	1.44	x	38.42	x	0.63	x	0.7	=	16.91	(76)
East	0.9x	0.77	x	1.44	x	63.27	x	0.63	x	0.7	=	27.85	(76)
East	0.9x	0.77	x	1.44	x	92.28	x	0.63	x	0.7	=	40.61	(76)

East	0.9x	0.77	x	1.44	x	113.09	x	0.63	x	0.7	=	49.77	(76)
East	0.9x	0.77	x	1.44	x	115.77	x	0.63	x	0.7	=	50.95	(76)
East	0.9x	0.77	x	1.44	x	110.22	x	0.63	x	0.7	=	48.51	(76)
East	0.9x	0.77	x	1.44	x	94.68	x	0.63	x	0.7	=	41.67	(76)
East	0.9x	0.77	x	1.44	x	73.59	x	0.63	x	0.7	=	32.39	(76)
East	0.9x	0.77	x	1.44	x	45.59	x	0.63	x	0.7	=	20.06	(76)
East	0.9x	0.77	x	1.44	x	24.49	x	0.63	x	0.7	=	10.78	(76)
East	0.9x	0.77	x	1.44	x	16.15	x	0.63	x	0.7	=	7.11	(76)
South	0.9x	0.77	x	5.44	x	46.75	x	0.63	x	0.7	=	77.73	(78)
South	0.9x	0.77	x	4.8	x	46.75	x	0.63	x	0.7	=	68.58	(78)
South	0.9x	0.77	x	5.44	x	76.57	x	0.63	x	0.7	=	127.3	(78)
South	0.9x	0.77	x	4.8	x	76.57	x	0.63	x	0.7	=	112.32	(78)
South	0.9x	0.77	x	5.44	x	97.53	x	0.63	x	0.7	=	162.15	(78)
South	0.9x	0.77	x	4.8	x	97.53	x	0.63	x	0.7	=	143.08	(78)
South	0.9x	0.77	x	5.44	x	110.23	x	0.63	x	0.7	=	183.27	(78)
South	0.9x	0.77	x	4.8	x	110.23	x	0.63	x	0.7	=	161.71	(78)
South	0.9x	0.77	x	5.44	x	114.87	x	0.63	x	0.7	=	190.98	(78)
South	0.9x	0.77	x	4.8	x	114.87	x	0.63	x	0.7	=	168.51	(78)
South	0.9x	0.77	x	5.44	x	110.55	x	0.63	x	0.7	=	183.79	(78)
South	0.9x	0.77	x	4.8	x	110.55	x	0.63	x	0.7	=	162.17	(78)
South	0.9x	0.77	x	5.44	x	108.01	x	0.63	x	0.7	=	179.57	(78)
South	0.9x	0.77	x	4.8	x	108.01	x	0.63	x	0.7	=	158.45	(78)
South	0.9x	0.77	x	5.44	x	104.89	x	0.63	x	0.7	=	174.39	(78)
South	0.9x	0.77	x	4.8	x	104.89	x	0.63	x	0.7	=	153.87	(78)
South	0.9x	0.77	x	5.44	x	101.89	x	0.63	x	0.7	=	169.39	(78)
South	0.9x	0.77	x	4.8	x	101.89	x	0.63	x	0.7	=	149.46	(78)
South	0.9x	0.77	x	5.44	x	82.59	x	0.63	x	0.7	=	137.3	(78)
South	0.9x	0.77	x	4.8	x	82.59	x	0.63	x	0.7	=	121.15	(78)
South	0.9x	0.77	x	5.44	x	55.42	x	0.63	x	0.7	=	92.13	(78)
South	0.9x	0.77	x	4.8	x	55.42	x	0.63	x	0.7	=	81.29	(78)
South	0.9x	0.77	x	5.44	x	40.4	x	0.63	x	0.7	=	67.16	(78)
South	0.9x	0.77	x	4.8	x	40.4	x	0.63	x	0.7	=	59.26	(78)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	154.95	256.53	333.08	385.59	409.26	396.91	386.53	369.93	351.23	278.51	184.2	133.53	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	533.75	633.37	697.95	731.22	735.49	704.36	681.72	670.67	661.81	608.52	536.52	502.45	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.95	0.87	0.74	0.56	0.4	0.42	0.63	0.88	0.98	0.99	(86)

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Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.21	20.4	20.61	20.82	20.94	20.99	21	21	20.98	20.83	20.49	20.17	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.12	20.12	20.12	20.13	20.14	20.15	20.15	20.15	20.14	20.14	20.13	20.13	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.97	0.93	0.84	0.69	0.49	0.32	0.35	0.56	0.85	0.97	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.08	19.36	19.65	19.94	20.09	20.14	20.14	20.15	20.13	19.96	19.49	19.03	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.54	19.78	20.04	20.3	20.44	20.49	20.49	20.49	20.48	20.32	19.89	19.5	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.54	19.78	20.04	20.3	20.44	20.49	20.49	20.49	20.48	20.32	19.89	19.5	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.97	0.93	0.85	0.71	0.51	0.35	0.38	0.59	0.86	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	526.56	612.56	648.09	619.69	520.53	361.94	241.32	253.07	389.85	521.55	519.48	497.39	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	978.32	952.46	864.45	717.63	548.68	365.41	241.63	253.53	397.64	610.24	807.75	971.04	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	336.11	228.41	160.97	70.52	20.94	0	0	0	0	65.98	207.55	352.4	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1442.89 (98)

Space heating requirement in kWh/m²/year 21.54 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	336.11	228.41	160.97	70.52	20.94	0	0	0	0	65.98	207.55	352.4	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	359.48	244.29	172.17	75.42	22.39	0	0	0	0	70.57	221.98	376.9	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 1543.19 (211)

TER WorkSheet: New dwelling design stage

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

Water heating

Output from water heater (calculated above)

186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09

Efficiency of water heater 79.8 (216)

(217)m=	86.37	85.69	84.62	82.86	80.96	79.8	79.8	79.8	79.8	82.64	85.35	86.55	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	215.94	191.91	204.27	187.27	188.03	170.73	164.23	179.84	179.41	194.69	199.02	210.39

Total = Sum(219a)$_{1...12}$ = 2285.73 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		1543.19	
Water heating fuel used		2285.73	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		75	(231)
Electricity for lighting		307.48	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		4211.4	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	333.33	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	493.72	(264)
Space and water heating	(261) + (262) + (263) + (264) =			827.05	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	159.58	(268)
Total CO2, kg/year		sum of (265)…(271) =		1025.55	(272)

TER = 15.31 (273)

SAP Input

Property Details: Sample 4 (Mid)

Address:	
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	26 July 2019
Date of certificate:	15 June 2022
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	498

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2019	
Floor Location:	Floor area:	Storey height:
Floor 0	67 m²	3 m
Living area:	27.3 m² (fraction 0.407)	
Front of dwelling faces:	Unspecified	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
DOOR	Manufacturer	Solid			Wood
W	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
S	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Balcony	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
DOOR	mm	0.7	0	1.4	2.4	1
W		0.7	0.4	1	1.44	1
S		0.7	0.4	1	5.44	1
Balcony		0.7	0.4	1	4.8	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
DOOR		INT	Worst case	0	0
W		W	West	0	0
S		S	South	0	0
Balcony		S	South	0	0

Overshading: More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
S	31.7	10.24	21.46	0.15	0	False	N/A
W	19	1.44	17.56	0.15	0	False	N/A
INT	11.1	2.4	8.7	0.16	0.43	False	N/A
Spandrel	2.4	0	2.4	0.35	0	False	N/A
Internal Elements							
Party Elements							

Thermal bridges:

SAP Input

Thermal bridges:	No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	3

Main heating system:

Main heating system:	Community heating schemes Heat source: Community heat pump heat from electric heat pump, heat fraction 1, efficiency 256 Piping>=1991, pre-insulated, low temp, variable flow Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Boiler interlock: Yes

Main heating Control:

Main heating Control:	Charging system linked to use of community heating, programmer and TRVs Control code: 2306

Secondary heating system:

Secondary heating system:	None

Water heating:

Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Flue Gas Heat Recovery System: Database (rev 498, product index 060036) Brand name: Worcester Model: Greenstar Xtra Model qualifier: 2015 Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	Photovoltaic 1 Installed Peak power: 0.6 Tilt of collector: 30° Overshading: None or very little Collector Orientation: South
Assess Zero Carbon Home:	No

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: **Stroma Number:**

Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.51

Property Address: Sample 4 (Mid)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67	(1a) x	3	(2a) =	201	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	201	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0 ÷ (5) =	0	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*		0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)		0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.05 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1.4	=	3.36			(26)
Windows Type 1			1.44	x	1/[1/(1)+ 0.04]	=	1.38			(27)
Windows Type 2			5.44	x	1/[1/(1)+ 0.04]	=	5.23			(27)
Windows Type 3			4.8	x	1/[1/(1)+ 0.04]	=	4.62			(27)
Walls Type1	31.7	10.24	21.46	x	0.15	=	3.22			(29)
Walls Type2	19	1.44	17.56	x	0.15	=	2.63			(29)
Walls Type3	11.1	2.4	8.7	x	0.15	=	1.3			(29)
Walls Type4	2.4	0	2.4	x	0.35	=	0.84			(29)
Total area of elements, m²			64.2							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 22.59 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 701.68 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 9.63 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 32.22 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	17.73	17.52	17.31	16.25	16.04	14.98	14.98	14.77	15.41	16.04	16.46	16.89	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	49.95	49.74	49.52	48.47	48.26	47.2	47.2	46.99	47.62	48.26	48.68	49.1	

Average = Sum(39)$_{1…12}$ /12= 48.41 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.75	0.74	0.74	0.72	0.72	0.7	0.7	0.7	0.71	0.72	0.73	0.73

Average = Sum(40)$_{1…12}$ /12= 0.72 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.17 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.76 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	94.34	90.91	87.48	84.05	80.62	77.19	77.19	80.62	84.05	87.48	90.91	94.34	
										Total = Sum(44)$_{1…12}$ =		1029.18	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	139.91	122.36	126.27	110.08	105.63	91.15	84.46	96.92	98.08	114.3	124.77	135.49	
										Total = Sum(45)$_{1…12}$ =		1349.41	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	20.99	18.35	18.94	16.51	15.84	13.67	12.67	14.54	14.71	17.15	18.72	20.32	(46)

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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	195.18	172.29	181.54	163.58	160.9	144.64	139.74	152.2	151.57	169.58	178.26	190.77	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	18.03	16.04	16.49	14.58	14.03	12.18	11.28	12.94	13.08	15.09	16.32	17.54	(63) (G2)

Output from water heater

(64)m=	174.47	153.83	162.37	146.4	144.19	129.86	125.78	136.58	135.89	151.81	159.35	170.55	

Output from water heater (annual)$_{1...12}$ 1791.08 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	90.74	80.63	86.21	79.4	79.34	73.1	72.31	76.45	75.41	82.23	84.28	89.27	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	17.86	15.86	12.9	9.77	7.3	6.16	6.66	8.66	11.62	14.75	17.22	18.36	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	190.2	192.17	187.2	176.61	163.24	150.68	142.29	140.32	145.29	155.88	169.24	181.8	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	(71)
Water heating gains (Table 5)													
(72)m=	121.96	119.98	115.87	110.27	106.64	101.53	97.18	102.75	104.73	110.52	117.06	119.99	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	385.59	383.58	371.53	352.22	332.75	313.94	301.7	307.29	317.21	336.72	359.09	375.72	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	5.44	x	46.75	x	0.4	x	0.7	=	49.35	(78)
South	0.9x	0.77	x	4.8	x	46.75	x	0.4	x	0.7	=	43.54	(78)
South	0.9x	0.77	x	5.44	x	76.57	x	0.4	x	0.7	=	80.82	(78)
South	0.9x	0.77	x	4.8	x	76.57	x	0.4	x	0.7	=	71.31	(78)

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South	0.9x	0.77	x	5.44	x	97.53	x	0.4	x	0.7	=	102.95	(78)
South	0.9x	0.77	x	4.8	x	97.53	x	0.4	x	0.7	=	90.84	(78)
South	0.9x	0.77	x	5.44	x	110.23	x	0.4	x	0.7	=	116.36	(78)
South	0.9x	0.77	x	4.8	x	110.23	x	0.4	x	0.7	=	102.67	(78)
South	0.9x	0.77	x	5.44	x	114.87	x	0.4	x	0.7	=	121.26	(78)
South	0.9x	0.77	x	4.8	x	114.87	x	0.4	x	0.7	=	106.99	(78)
South	0.9x	0.77	x	5.44	x	110.55	x	0.4	x	0.7	=	116.69	(78)
South	0.9x	0.77	x	4.8	x	110.55	x	0.4	x	0.7	=	102.96	(78)
South	0.9x	0.77	x	5.44	x	108.01	x	0.4	x	0.7	=	114.01	(78)
South	0.9x	0.77	x	4.8	x	108.01	x	0.4	x	0.7	=	100.6	(78)
South	0.9x	0.77	x	5.44	x	104.89	x	0.4	x	0.7	=	110.72	(78)
South	0.9x	0.77	x	4.8	x	104.89	x	0.4	x	0.7	=	97.7	(78)
South	0.9x	0.77	x	5.44	x	101.89	x	0.4	x	0.7	=	107.55	(78)
South	0.9x	0.77	x	4.8	x	101.89	x	0.4	x	0.7	=	94.9	(78)
South	0.9x	0.77	x	5.44	x	82.59	x	0.4	x	0.7	=	87.18	(78)
South	0.9x	0.77	x	4.8	x	82.59	x	0.4	x	0.7	=	76.92	(78)
South	0.9x	0.77	x	5.44	x	55.42	x	0.4	x	0.7	=	58.5	(78)
South	0.9x	0.77	x	4.8	x	55.42	x	0.4	x	0.7	=	51.62	(78)
South	0.9x	0.77	x	5.44	x	40.4	x	0.4	x	0.7	=	42.64	(78)
South	0.9x	0.77	x	4.8	x	40.4	x	0.4	x	0.7	=	37.63	(78)
West	0.9x	0.77	x	1.44	x	19.64	x	0.4	x	0.7	=	5.49	(80)
West	0.9x	0.77	x	1.44	x	38.42	x	0.4	x	0.7	=	10.74	(80)
West	0.9x	0.77	x	1.44	x	63.27	x	0.4	x	0.7	=	17.68	(80)
West	0.9x	0.77	x	1.44	x	92.28	x	0.4	x	0.7	=	25.78	(80)
West	0.9x	0.77	x	1.44	x	113.09	x	0.4	x	0.7	=	31.6	(80)
West	0.9x	0.77	x	1.44	x	115.77	x	0.4	x	0.7	=	32.35	(80)
West	0.9x	0.77	x	1.44	x	110.22	x	0.4	x	0.7	=	30.8	(80)
West	0.9x	0.77	x	1.44	x	94.68	x	0.4	x	0.7	=	26.45	(80)
West	0.9x	0.77	x	1.44	x	73.59	x	0.4	x	0.7	=	20.56	(80)
West	0.9x	0.77	x	1.44	x	45.59	x	0.4	x	0.7	=	12.74	(80)
West	0.9x	0.77	x	1.44	x	24.49	x	0.4	x	0.7	=	6.84	(80)
West	0.9x	0.77	x	1.44	x	16.15	x	0.4	x	0.7	=	4.51	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	98.38	162.87	211.48	244.82	259.85	252	245.41	234.88	223.01	176.83	116.95	84.78	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	483.97	546.46	583.01	597.03	592.6	565.95	547.11	542.17	540.21	513.55	476.04	460.5	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.95	0.87	0.73	0.53	0.38	0.4	0.6	0.87	0.98	0.99	(86)

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Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.46	20.6	20.75	20.9	20.98	21	21	21	21	20.92	20.68	20.44	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.3	20.3	20.31	20.32	20.32	20.34	20.34	20.34	20.33	20.32	20.32	20.31	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.97	0.94	0.85	0.69	0.48	0.32	0.34	0.55	0.84	0.97	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.59	19.78	20	20.21	20.3	20.34	20.34	20.34	20.33	20.24	19.91	19.57	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.95	20.12	20.31	20.49	20.58	20.61	20.61	20.61	20.6	20.51	20.22	19.93	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.95	20.12	20.31	20.49	20.58	20.61	20.61	20.61	20.6	20.51	20.22	19.93	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.97	0.94	0.85	0.7	0.5	0.35	0.36	0.57	0.85	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	478.03	531.01	546.14	508.99	416.97	282.7	189.08	197.69	307.5	435.41	460.88	456.21	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	781.5	756.76	683.76	561.84	428.36	283.46	189.12	197.75	309.53	478.39	638.89	772.12	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	225.78	151.71	102.38	38.05	8.48	0	0	0	0	31.98	128.16	235.04	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 921.58 (98)

Space heating requirement in kWh/m²/year 13.75 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none	0	(301)
Fraction of space heat from community system 1 – (301) =	1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump	1	(303a)
Fraction of total space heat from Community heat pump (302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system	1	(305)
Distribution loss factor (Table 12c) for community heating system	1.05	(306)

Space heating	**kWh/year**
Annual space heating requirement	921.58

DER WorkSheet: New dwelling design stage

Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	967.66	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)

Water heating

Annual water heating requirement		1791.08	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	1880.63	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	28.48	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		119.54	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	119.54	(331)
Energy for lighting (calculated in Appendix L)		315.44	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-518.17	(333)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		2765.11	(338)

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12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				256	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	577.45	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	14.78	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	592.23	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				592.23	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	62.04	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	163.72	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1		0.52		x 0.01 =	-268.93	(380)
Total CO2, kg/year	sum of (376)…(382) =				549.06	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				8.19	(384)
EI rating (section 14)					93.43	(385)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Sample 4 (Mid)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67	(1a) x	3	(2a) =	201	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		201	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.1	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.35	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.37	0.36	0.33	0.32	0.28	0.28	0.27	0.3	0.32	0.33	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1	=	2.4			(26)
Windows Type 1			1.44	x1/[1/(1.4)+ 0.04]		=	1.91			(27)
Windows Type 2			5.44	x1/[1/(1.4)+ 0.04]		=	7.21			(27)
Windows Type 3			4.8	x1/[1/(1.4)+ 0.04]		=	6.36			(27)
Walls Type1	31.7	10.24	21.46	x	0.18	=	3.86			(29)
Walls Type2	19	1.44	17.56	x	0.18	=	3.16			(29)
Walls Type3	11.1	2.4	8.7	x	0.18	=	1.57			(29)
Walls Type4	2.4	0	2.4	x	0.18	=	0.43			(29)
Total area of elements, m²			64.2							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 26.91 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 701.68 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 3.21 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 30.12 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	37.92	37.74	37.56	36.71	36.55	35.81	35.81	35.67	36.09	36.55	36.87	37.21	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	68.04	67.85	67.67	66.82	66.66	65.92	65.92	65.79	66.21	66.66	66.99	67.32	

Average = Sum(39)$_{1…12}$ /12= 66.82 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.02	1.01	1.01	1	0.99	0.98	0.98	0.98	0.99	0.99	1	1

Average = Sum(40)$_{1...12}$ /12= 1 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.17 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.76 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	94.34	90.91	87.48	84.05	80.62	77.19	77.19	80.62	84.05	87.48	90.91	94.34	
											Total = Sum(44)$_{1...12}$ =	1029.18	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	139.91	122.36	126.27	110.08	105.63	91.15	84.46	96.92	98.08	114.3	124.77	135.49	
											Total = Sum(45)$_{1...12}$ =	1349.41	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	20.99	18.35	18.94	16.51	15.84	13.67	12.67	14.54	14.71	17.15	18.72	20.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09	

Output from water heater (annual)$_{1...12}$ 1898.03 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	83.79	74.35	79.26	72.68	72.4	66.38	65.36	69.5	68.68	75.28	77.56	82.33	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	17.41	15.46	12.58	9.52	7.12	6.01	6.49	8.44	11.33	14.38	16.79	17.89	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	190.2	192.17	187.2	176.61	163.24	150.68	142.29	140.32	145.29	155.88	169.24	181.8	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	(71)
Water heating gains (Table 5)													
(72)m=	112.63	110.65	106.53	100.94	97.31	92.19	87.85	93.42	95.4	101.18	107.72	110.65	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	378.8	376.85	364.87	345.64	326.23	307.45	295.2	300.74	310.58	330.01	352.32	368.92	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	5.44	x	46.75	x	0.63	x	0.7	=	77.73	(78)
South	0.9x	0.77	x	4.8	x	46.75	x	0.63	x	0.7	=	68.58	(78)
South	0.9x	0.77	x	5.44	x	76.57	x	0.63	x	0.7	=	127.3	(78)
South	0.9x	0.77	x	4.8	x	76.57	x	0.63	x	0.7	=	112.32	(78)

South	0.9x	0.77	x	5.44	x	97.53	x	0.63	x	0.7	=	162.15	(78)
South	0.9x	0.77	x	4.8	x	97.53	x	0.63	x	0.7	=	143.08	(78)
South	0.9x	0.77	x	5.44	x	110.23	x	0.63	x	0.7	=	183.27	(78)
South	0.9x	0.77	x	4.8	x	110.23	x	0.63	x	0.7	=	161.71	(78)
South	0.9x	0.77	x	5.44	x	114.87	x	0.63	x	0.7	=	190.98	(78)
South	0.9x	0.77	x	4.8	x	114.87	x	0.63	x	0.7	=	168.51	(78)
South	0.9x	0.77	x	5.44	x	110.55	x	0.63	x	0.7	=	183.79	(78)
South	0.9x	0.77	x	4.8	x	110.55	x	0.63	x	0.7	=	162.17	(78)
South	0.9x	0.77	x	5.44	x	108.01	x	0.63	x	0.7	=	179.57	(78)
South	0.9x	0.77	x	4.8	x	108.01	x	0.63	x	0.7	=	158.45	(78)
South	0.9x	0.77	x	5.44	x	104.89	x	0.63	x	0.7	=	174.39	(78)
South	0.9x	0.77	x	4.8	x	104.89	x	0.63	x	0.7	=	153.87	(78)
South	0.9x	0.77	x	5.44	x	101.89	x	0.63	x	0.7	=	169.39	(78)
South	0.9x	0.77	x	4.8	x	101.89	x	0.63	x	0.7	=	149.46	(78)
South	0.9x	0.77	x	5.44	x	82.59	x	0.63	x	0.7	=	137.3	(78)
South	0.9x	0.77	x	4.8	x	82.59	x	0.63	x	0.7	=	121.15	(78)
South	0.9x	0.77	x	5.44	x	55.42	x	0.63	x	0.7	=	92.13	(78)
South	0.9x	0.77	x	4.8	x	55.42	x	0.63	x	0.7	=	81.29	(78)
South	0.9x	0.77	x	5.44	x	40.4	x	0.63	x	0.7	=	67.16	(78)
South	0.9x	0.77	x	4.8	x	40.4	x	0.63	x	0.7	=	59.26	(78)
West	0.9x	0.77	x	1.44	x	19.64	x	0.63	x	0.7	=	8.64	(80)
West	0.9x	0.77	x	1.44	x	38.42	x	0.63	x	0.7	=	16.91	(80)
West	0.9x	0.77	x	1.44	x	63.27	x	0.63	x	0.7	=	27.85	(80)
West	0.9x	0.77	x	1.44	x	92.28	x	0.63	x	0.7	=	40.61	(80)
West	0.9x	0.77	x	1.44	x	113.09	x	0.63	x	0.7	=	49.77	(80)
West	0.9x	0.77	x	1.44	x	115.77	x	0.63	x	0.7	=	50.95	(80)
West	0.9x	0.77	x	1.44	x	110.22	x	0.63	x	0.7	=	48.51	(80)
West	0.9x	0.77	x	1.44	x	94.68	x	0.63	x	0.7	=	41.67	(80)
West	0.9x	0.77	x	1.44	x	73.59	x	0.63	x	0.7	=	32.39	(80)
West	0.9x	0.77	x	1.44	x	45.59	x	0.63	x	0.7	=	20.06	(80)
West	0.9x	0.77	x	1.44	x	24.49	x	0.63	x	0.7	=	10.78	(80)
West	0.9x	0.77	x	1.44	x	16.15	x	0.63	x	0.7	=	7.11	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	154.95	256.53	333.08	385.59	409.26	396.91	386.53	369.93	351.23	278.51	184.2	133.53	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	533.75	633.37	697.95	731.22	735.49	704.36	681.72	670.67	661.81	608.52	536.52	502.45	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.95	0.89	0.77	0.59	0.42	0.45	0.66	0.9	0.98	0.99	(86)

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Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.13	20.32	20.54	20.77	20.92	20.99	21	21	20.97	20.79	20.42	20.09	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.07	20.07	20.07	20.09	20.09	20.1	20.1	20.1	20.09	20.09	20.08	20.08	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.97	0.94	0.86	0.71	0.51	0.34	0.36	0.59	0.87	0.97	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.92	19.2	19.52	19.83	20.02	20.09	20.1	20.1	20.07	19.86	19.35	18.88	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.41	19.66	19.94	20.22	20.38	20.45	20.46	20.46	20.44	20.24	19.78	19.37	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.41	19.66	19.94	20.22	20.38	20.45	20.46	20.46	20.44	20.24	19.78	19.37	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.97	0.94	0.86	0.73	0.54	0.37	0.4	0.62	0.87	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	526.96	614.3	653.04	631.25	538.97	380.19	254.12	266.52	407.67	530.57	520.93	497.63	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1028.38	1001.43	909.31	756.12	578.96	385.93	254.7	267.36	419.79	642.71	849.7	1021.36	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	373.06	260.15	190.66	89.9	29.75	0	0	0	0	83.43	236.71	389.66	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 1653.33 (98)

Space heating requirement in kWh/m²/year 24.68 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	373.06	260.15	190.66	89.9	29.75	0	0	0	0	83.43	236.71	389.66	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	398.99	278.24	203.92	96.15	31.82	0	0	0	0	89.23	253.17	416.74	

Total (kWh/year) =$Sum(211)_{1...5,10...12}$= 1768.27 (211)

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Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)

186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09

Efficiency of water heater 79.8 (216)

(217)m=	86.63	86.03	85.08	83.42	81.37	79.8	79.8	79.8	79.8	83.16	85.7	86.79	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	215.29	191.15	203.19	186.02	187.07	170.73	164.23	179.84	179.41	193.48	198.21	209.79

Total = Sum(219a)$_{1...12}$ = 2278.4 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		1768.27	
Water heating fuel used		2278.4	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year — sum of (230a)…(230g) =		75	(231)
Electricity for lighting		307.48	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		4429.15	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	381.95	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	492.13	(264)
Space and water heating	(261) + (262) + (263) + (264) =			874.08	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	159.58	(268)
Total CO2, kg/year		sum of (265)…(271) =		1072.59	(272)

TER = 16.01 (273)

SAP Input

Property Details: Sample 5 (Mid)

Address:	
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	26 July 2019
Date of certificate:	15 June 2022
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	498

Property description:

Dwelling type:	Flat
Detachment:	
Year Completed:	2019

Floor Location:	Floor area:	Storey height:
Floor 0	67 m²	3 m

Living area:	27.5 m² (fraction 0.41)
Front of dwelling faces:	Unspecified

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
DOOR	Manufacturer	Solid			Wood
E	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Balcony	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
DOOR	mm	0.7	0	1.4	2.4	1
E		0.7	0.4	1	4.16	1
Balcony		0.7	0.4	1	4.8	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
DOOR		INT	Worst case	0	0
E		E	East	0	0
Balcony		E	East	0	0

Overshading:	More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
E	29.4	8.96	20.44	0.15	0	False	N/A
INT	12	2.4	9.6	0.16	0.43	False	N/A
Spandrel	2.44	0	2.44	0.35	0	False	N/A
Internal Elements							
Party Elements							

Thermal bridges:

Thermal bridges:	No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test:	Yes (As designed)

SAP Input

Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	3
Pressure test:	3

Main heating system:

Main heating system:	Community heating schemes Heat source: Community heat pump heat from electric heat pump, heat fraction 1, efficiency 256 Piping>=1991, pre-insulated, low temp, variable flow Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Boiler interlock: Yes

Main heating Control:

Main heating Control:	Charging system linked to use of community heating, programmer and TRVs Control code: 2306

Secondary heating system:

Secondary heating system:	None

Water heating:

Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Flue Gas Heat Recovery System: Database (rev 498, product index 060036) Brand name: Worcester Model: Greenstar Xtra Model qualifier: 2015 Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	Photovoltaic 1 Installed Peak power: 0.6 Tilt of collector: 30° Overshading: None or very little Collector Orientation: South
Assess Zero Carbon Home:	No

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: **Stroma Number:**
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.51

Property Address: Sample 5 (Mid)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67	(1a) x	3	(2a) =	201	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	201	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*			0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration		0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate		(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			3	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
Number of sides sheltered			3	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor		(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.05 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.25	0.25	0.25	0.23	0.23	0.22	0.22	0.21	0.22	0.23	0.24	0.24	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.25	0.25	0.25	0.23	0.23	0.22	0.22	0.21	0.22	0.23	0.24	0.24	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1.4	=	3.36			(26)
Windows Type 1			4.16	x	1/[1/(1)+ 0.04]	=	4			(27)
Windows Type 2			4.8	x	1/[1/(1)+ 0.04]	=	4.62			(27)
Walls Type1	29.4	8.96	20.44	x	0.15	=	3.07			(29)
Walls Type2	12	2.4	9.6	x	0.15	=	1.44			(29)
Walls Type3	2.44	0	2.44	x	0.35	=	0.85			(29)
Total area of elements, m²			43.84							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 17.33 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 454.72 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 6.58 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 23.91 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	16.78	16.59	16.39	15.43	15.24	14.27	14.27	14.08	14.66	15.24	15.62	16.01	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	40.69	40.5	40.3	39.34	39.15	38.18	38.18	37.99	38.57	39.15	39.53	39.92	

Average = Sum(39)$_{1…12}$ /12= 39.29 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(40)m=	0.61	0.6	0.6	0.59	0.58	0.57	0.57	0.57	0.58	0.58	0.59	0.6

Average = Sum(40)$_{1…12}$ /12= 0.59 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31

(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.17 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.76 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	94.34	90.91	87.48	84.05	80.62	77.19	77.19	80.62	84.05	87.48	90.91	94.34

Total = Sum(44)$_{1…12}$ = 1029.18 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(45)m=	139.91	122.36	126.27	110.08	105.63	91.15	84.46	96.92	98.08	114.3	124.77	135.49

Total = Sum(45)$_{1…12}$ = 1349.41 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(46)m=	20.99	18.35	18.94	16.51	15.84	13.67	12.67	14.54	14.71	17.15	18.72	20.32

(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01

(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01

(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26

(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	195.18	172.29	181.54	163.58	160.9	144.64	139.74	152.2	151.57	169.58	178.26	190.77	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	18.03	16.04	16.49	14.58	14.03	12.18	11.28	12.94	13.08	15.09	16.32	17.54	(63) (G2)

Output from water heater

(64)m=	174.47	153.83	162.37	146.4	144.19	129.86	125.78	136.58	135.89	151.81	159.35	170.55	

Output from water heater (annual)$_{1...12}$ 1791.08 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	90.74	80.63	86.21	79.4	79.34	73.1	72.31	76.45	75.41	82.23	84.28	89.27	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	18.93	16.81	13.67	10.35	7.74	6.53	7.06	9.17	12.31	15.63	18.25	19.45	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	190.2	192.17	187.2	176.61	163.24	150.68	142.29	140.32	145.29	155.88	169.24	181.8	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	(71)
Water heating gains (Table 5)													
(72)m=	121.96	119.98	115.87	110.27	106.64	101.53	97.18	102.75	104.73	110.52	117.06	119.99	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	386.65	384.53	372.3	352.8	333.19	314.31	302.1	307.81	317.9	337.6	360.11	376.81	(73)

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6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	4.16	x	19.64	x	0.4	x	0.7	=	15.85	(76)
East	0.9x	0.77	x	4.8	x	19.64	x	0.4	x	0.7	=	18.29	(76)
East	0.9x	0.77	x	4.16	x	38.42	x	0.4	x	0.7	=	31.01	(76)
East	0.9x	0.77	x	4.8	x	38.42	x	0.4	x	0.7	=	35.78	(76)

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East	0.9x	0.77	x	4.16	x	63.27	x	0.4	x	0.7	=	51.07	(76)
East	0.9x	0.77	x	4.8	x	63.27	x	0.4	x	0.7	=	58.93	(76)
East	0.9x	0.77	x	4.16	x	92.28	x	0.4	x	0.7	=	74.49	(76)
East	0.9x	0.77	x	4.8	x	92.28	x	0.4	x	0.7	=	85.95	(76)
East	0.9x	0.77	x	4.16	x	113.09	x	0.4	x	0.7	=	91.29	(76)
East	0.9x	0.77	x	4.8	x	113.09	x	0.4	x	0.7	=	105.33	(76)
East	0.9x	0.77	x	4.16	x	115.77	x	0.4	x	0.7	=	93.45	(76)
East	0.9x	0.77	x	4.8	x	115.77	x	0.4	x	0.7	=	107.83	(76)
East	0.9x	0.77	x	4.16	x	110.22	x	0.4	x	0.7	=	88.97	(76)
East	0.9x	0.77	x	4.8	x	110.22	x	0.4	x	0.7	=	102.66	(76)
East	0.9x	0.77	x	4.16	x	94.68	x	0.4	x	0.7	=	76.42	(76)
East	0.9x	0.77	x	4.8	x	94.68	x	0.4	x	0.7	=	88.18	(76)
East	0.9x	0.77	x	4.16	x	73.59	x	0.4	x	0.7	=	59.4	(76)
East	0.9x	0.77	x	4.8	x	73.59	x	0.4	x	0.7	=	68.54	(76)
East	0.9x	0.77	x	4.16	x	45.59	x	0.4	x	0.7	=	36.8	(76)
East	0.9x	0.77	x	4.8	x	45.59	x	0.4	x	0.7	=	42.46	(76)
East	0.9x	0.77	x	4.16	x	24.49	x	0.4	x	0.7	=	19.77	(76)
East	0.9x	0.77	x	4.8	x	24.49	x	0.4	x	0.7	=	22.81	(76)
East	0.9x	0.77	x	4.16	x	16.15	x	0.4	x	0.7	=	13.04	(76)
East	0.9x	0.77	x	4.8	x	16.15	x	0.4	x	0.7	=	15.04	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	34.15	66.8	110.01	160.44	196.62	201.28	191.63	164.6	127.94	79.26	42.58	28.08	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	420.8	451.33	482.31	513.24	529.81	515.59	493.72	472.41	445.84	416.86	402.69	404.89	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.96	0.86	0.68	0.47	0.34	0.37	0.59	0.89	0.98	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.59	20.68	20.81	20.95	20.99	21	21	21	21	20.94	20.76	20.58	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.42	20.43	20.43	20.44	20.44	20.46	20.46	20.46	20.45	20.44	20.44	20.43	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.95	0.84	0.64	0.43	0.3	0.33	0.55	0.86	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.88	20	20.19	20.38	20.44	20.46	20.46	20.46	20.45	20.38	20.13	19.87	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	20.17	20.28	20.45	20.62	20.67	20.68	20.68	20.68	20.68	20.61	20.39	20.16	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	20.17	20.28	20.45	20.62	20.67	20.68	20.68	20.68	20.68	20.61	20.39	20.16	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.95	0.84	0.66	0.45	0.32	0.34	0.57	0.87	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	417.09	443.33	458.94	433.27	347.94	232.05	155.78	162.64	252.94	362.41	393.04	402.1	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	645.83	622.86	562.13	460.86	350.99	232.14	155.78	162.65	253.6	391.95	525.37	637.24	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	170.18	120.64	76.78	19.87	2.27	0	0	0	0	21.98	95.27	174.95	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 681.96 (98)

Space heating requirement in kWh/m²/year 10.18 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		681.96	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	716.06	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		1791.08	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	1880.63	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	25.97	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		119.54	(330a)

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warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	119.54	(331)
Energy for lighting (calculated in Appendix L)		334.24	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-518.17	(333)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		2532.29	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				256	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	526.44	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	13.48	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	539.91	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				539.91	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	62.04	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	173.47	(379)
Energy saving/generation technologies (333) to (334) as applicable						
Item 1		0.52	x 0.01 =		-268.93	(380)
Total CO2, kg/year	sum of (376)…(382) =				506.5	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				7.56	(384)
EI rating (section 14)					93.94	(385)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Sample 5 (Mid)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67	(1a) x	3	(2a) =	201	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	201	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

DRAFT

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.1	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.35	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.27	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.35	0.34	0.33	0.3	0.29	0.26	0.26	0.25	0.27	0.29	0.3	0.32

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.56	0.56	0.56	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.56	0.56	0.56	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1	=	2.4			(26)
Windows Type 1			4.16	x1/[1/(1.4)+ 0.04]		=	5.52			(27)
Windows Type 2			4.8	x1/[1/(1.4)+ 0.04]		=	6.36			(27)
Walls Type1	29.4	8.96	20.44	x	0.18	=	3.68			(29)
Walls Type2	12	2.4	9.6	x	0.18	=	1.73			(29)
Walls Type3	2.44	0	2.44	x	0.18	=	0.44			(29)
Total area of elements, m²			43.84							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 20.13 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 454.72 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 2.19 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 22.32 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	37.12	36.97	36.82	36.11	35.98	35.36	35.36	35.25	35.6	35.98	36.24	36.52	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	59.44	59.28	59.13	58.43	58.29	57.68	57.68	57.56	57.92	58.29	58.56	58.84	

Average = $Sum(39)_{1…12}$ /12= 58.43 (39)

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Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

(40)m=	0.89	0.88	0.88	0.87	0.87	0.86	0.86	0.86	0.86	0.87	0.87	0.88

Average = Sum(40)$_{1…12}$ /12= 0.87 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.17 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 85.76 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	94.34	90.91	87.48	84.05	80.62	77.19	77.19	80.62	84.05	87.48	90.91	94.34	
										Total = Sum(44)$_{1…12}$ =		1029.18	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	139.91	122.36	126.27	110.08	105.63	91.15	84.46	96.92	98.08	114.3	124.77	135.49	
										Total = Sum(45)$_{1…12}$ =		1349.41	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	20.99	18.35	18.94	16.51	15.84	13.67	12.67	14.54	14.71	17.15	18.72	20.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 1.39 (48)

Temperature factor from Table 2b — 0.54 (49)

Energy lost from water storage, kWh/year — (48) x (49) = 0.75 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

Energy lost from water storage, kWh/year — (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) — 0.75 (55)

Water storage loss calculated for each month — ((56)m = (55) × (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09

Output from water heater (annual)$_{1...12}$ 1898.03 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	83.79	74.35	79.26	72.68	72.4	66.38	65.36	69.5	68.68	75.28	77.56	82.33	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.37	16.32	13.27	10.05	7.51	6.34	6.85	8.91	11.95	15.18	17.72	18.89	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	190.2	192.17	187.2	176.61	163.24	150.68	142.29	140.32	145.29	155.88	169.24	181.8	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	(71)

Water heating gains (Table 5)

(72)m=	112.63	110.65	106.53	100.94	97.31	92.19	87.85	93.42	95.4	101.18	107.72	110.65	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	379.77	377.7	365.57	346.16	326.63	307.78	295.56	301.21	311.21	330.81	353.25	369.91	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	4.16	x	19.64	x	0.63	x	0.7	=	24.97	(76)
East	0.9x	0.77	x	4.8	x	19.64	x	0.63	x	0.7	=	28.81	(76)
East	0.9x	0.77	x	4.16	x	38.42	x	0.63	x	0.7	=	48.85	(76)
East	0.9x	0.77	x	4.8	x	38.42	x	0.63	x	0.7	=	56.36	(76)

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East	0.9x	0.77	x	4.16	x	63.27	x	0.63	x	0.7	=	80.44	(76)
East	0.9x	0.77	x	4.8	x	63.27	x	0.63	x	0.7	=	92.82	(76)
East	0.9x	0.77	x	4.16	x	92.28	x	0.63	x	0.7	=	117.32	(76)
East	0.9x	0.77	x	4.8	x	92.28	x	0.63	x	0.7	=	135.37	(76)
East	0.9x	0.77	x	4.16	x	113.09	x	0.63	x	0.7	=	143.78	(76)
East	0.9x	0.77	x	4.8	x	113.09	x	0.63	x	0.7	=	165.9	(76)
East	0.9x	0.77	x	4.16	x	115.77	x	0.63	x	0.7	=	147.18	(76)
East	0.9x	0.77	x	4.8	x	115.77	x	0.63	x	0.7	=	169.83	(76)
East	0.9x	0.77	x	4.16	x	110.22	x	0.63	x	0.7	=	140.13	(76)
East	0.9x	0.77	x	4.8	x	110.22	x	0.63	x	0.7	=	161.68	(76)
East	0.9x	0.77	x	4.16	x	94.68	x	0.63	x	0.7	=	120.37	(76)
East	0.9x	0.77	x	4.8	x	94.68	x	0.63	x	0.7	=	138.88	(76)
East	0.9x	0.77	x	4.16	x	73.59	x	0.63	x	0.7	=	93.56	(76)
East	0.9x	0.77	x	4.8	x	73.59	x	0.63	x	0.7	=	107.95	(76)
East	0.9x	0.77	x	4.16	x	45.59	x	0.63	x	0.7	=	57.96	(76)
East	0.9x	0.77	x	4.8	x	45.59	x	0.63	x	0.7	=	66.88	(76)
East	0.9x	0.77	x	4.16	x	24.49	x	0.63	x	0.7	=	31.13	(76)
East	0.9x	0.77	x	4.8	x	24.49	x	0.63	x	0.7	=	35.92	(76)
East	0.9x	0.77	x	4.16	x	16.15	x	0.63	x	0.7	=	20.53	(76)
East	0.9x	0.77	x	4.8	x	16.15	x	0.63	x	0.7	=	23.69	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	53.78	105.21	173.26	252.69	309.68	317.01	301.81	259.25	201.51	124.84	67.06	44.23	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	433.55	482.91	538.83	598.85	636.31	624.8	597.37	560.46	512.71	455.64	420.3	414.14	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.92	0.79	0.58	0.42	0.47	0.74	0.95	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.17	20.3	20.51	20.77	20.94	20.99	21	21	20.97	20.75	20.41	20.15	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.18	20.18	20.18	20.19	20.19	20.2	20.2	20.2	20.2	20.19	20.19	20.19	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.97	0.9	0.74	0.51	0.35	0.39	0.67	0.93	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.07	19.26	19.57	19.93	20.14	20.2	20.2	20.2	20.17	19.9	19.43	19.05	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.53	19.69	19.96	20.28	20.46	20.52	20.53	20.53	20.5	20.25	19.83	19.5	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.53	19.69	19.96	20.28	20.46	20.52	20.53	20.53	20.5	20.25	19.83	19.5	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation factor for gains, hm:														
(94)m=	0.99	0.99	0.97	0.9	0.75	0.54	0.38	0.42	0.69	0.94	0.99	1		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	431.21	477.56	522.62	541.28	479.47	338.28	226.29	237.09	356.27	426.58	415.27	412.42		(95)
Monthly average external temperature from Table 8														
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]														
(97)m=	905	876.57	795.67	664.72	510.92	341.61	226.58	237.66	370.66	562.54	745.78	900.25		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	352.5	268.14	203.15	88.88	23.4	0	0	0	0	101.15	237.97	362.95		
Total per year (kWh/year) = Sum(98)1...5,9...12 =													1638.13	(98)
Space heating requirement in kWh/m²/year													24.45	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	352.5	268.14	203.15	88.88	23.4	0	0	0	0	101.15	237.97	362.95		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	377	286.78	217.27	95.06	25.03	0	0	0	0	108.18	254.51	388.18		
Total (kWh/year) =Sum(211)1...5,10...12=													1752.01	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)1...5,10...12=													0	(215)

Water heating

Output from water heater (calculated above)														
	186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09		
Efficiency of water heater													79.8	(216)
(217)m=	86.49	86.11	85.25	83.39	81.08	79.8	79.8	79.8	79.8	83.62	85.71	86.62		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	215.64	190.97	202.78	186.08	187.75	170.73	164.23	179.84	179.41	192.42	198.17	210.21		
Total = Sum(219a)1...12 =													2278.25	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1752.01

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Water heating fuel used		2278.25	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		75	(231)
Electricity for lighting		324.5	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		4429.75	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	378.43	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	492.1	(264)
Space and water heating	(261) + (262) + (263) + (264) =			870.54	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	168.41	(268)
Total CO2, kg/year		sum of (265)…(271) =		1077.87	(272)

TER = 16.09 (273)

SAP Input

Property Details: Sample 6 (Mid)

Address:	
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	26 July 2019
Date of certificate:	15 June 2022
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	498

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2019	
Floor Location:	Floor area:	Storey height:
Floor 0	55.1 m²	3 m
Living area:	26 m² (fraction 0.472)	
Front of dwelling faces:	Unspecified	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
DOOR	Manufacturer	Solid			Wood
W	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Balcony	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
DOOR	mm	0.7	0	1.4	2.4	1
W		0.7	0.4	1	4.16	1
Balcony		0.7	0.4	1	4.8	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
DOOR		INT	Worst case	0	0
W		W	West	0	0
Balcony		W	West	0	0

Overshading: More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
W	24	8.96	15.04	0.15	0	False	N/A
INT	24	2.4	21.6	0.16	0.43	False	N/A
Spandrel	2.4	0	2.4	0.35	0	False	N/A
Internal Elements							
Party Elements							

Thermal bridges:

Thermal bridges: No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test: Yes (As designed)

SAP Input

Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	3
Pressure test:	3

Main heating system:

Main heating system:	Community heating schemes Heat source: Community heat pump heat from electric heat pump, heat fraction 1, efficiency 256 Piping>=1991, pre-insulated, low temp, variable flow Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Boiler interlock: Yes

Main heating Control:

Main heating Control:	Charging system linked to use of community heating, programmer and TRVs Control code: 2306

Secondary heating system:

Secondary heating system:	None

Water heating:

Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Flue Gas Heat Recovery System: Database (rev 498, product index 060036) Brand name: Worcester Model: Greenstar Xtra Model qualifier: 2015 Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	Photovoltaic 1 Installed Peak power: 0.6 Tilt of collector: 30° Overshading: None or very little Collector Orientation: South
Assess Zero Carbon Home:	No

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User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.51

Property Address: Sample 6 (Mid)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	55.1	(1a) x	3	(2a) =	165.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.1	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	165.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

DRAFT

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35				
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration		0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate		(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			3	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
Number of sides sheltered			3	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor		(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.05 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.25	0.25	0.25	0.23	0.23	0.22	0.22	0.21	0.22	0.23	0.24	0.24	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.25	0.25	0.25	0.23	0.23	0.22	0.22	0.21	0.22	0.23	0.24	0.24	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1.4	=	3.36			(26)
Windows Type 1			4.16	x	1/[1/(1)+ 0.04]	=	4			(27)
Windows Type 2			4.8	x	1/[1/(1)+ 0.04]	=	4.62			(27)
Walls Type1	24	8.96	15.04	x	0.15	=	2.26			(29)
Walls Type2	24	2.4	21.6	x	0.15	=	3.23			(29)
Walls Type3	2.4	0	2.4	x	0.35	=	0.84			(29)
Total area of elements, m²			50.4							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 18.3 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 546.56 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 7.56 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 25.86 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	13.8	13.64	13.48	12.69	12.53	11.74	11.74	11.58	12.06	12.53	12.85	13.17	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	39.66	39.51	39.35	38.55	38.4	37.6	37.6	37.44	37.92	38.4	38.71	39.03	

Average = Sum(39)$_{1…12}$ /12= 38.51 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.72	0.72	0.71	0.7	0.7	0.68	0.68	0.68	0.69	0.7	0.7	0.71

Average = $Sum(40)_{1...12}$ /12= 0.7 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.84 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 77.91 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	85.7	82.58	79.47	76.35	73.23	70.12	70.12	73.23	76.35	79.47	82.58	85.7	

Total = $Sum(44)_{1...12}$ = 934.88 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	127.09	111.15	114.7	100	95.95	82.8	76.72	88.04	89.09	103.83	113.34	123.08	

Total = $Sum(45)_{1...12}$ = 1225.78 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.06	16.67	17.2	15	14.39	12.42	11.51	13.21	13.36	15.57	17	18.46	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	182.36	161.08	169.97	153.49	151.23	136.29	132	143.32	142.59	159.11	166.83	178.35	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	16.59	14.71	15.14	13.33	12.81	11.05	10.22	11.77	11.91	13.81	14.97	16.12	(63) (G2)

Output from water heater

(64)m=	163.1	143.95	152.16	137.57	135.73	122.64	119.09	128.87	128.08	142.61	149.26	159.55	

Output from water heater (annual)$_{1...12}$ 1682.61 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	86.48	76.9	82.36	76.04	76.12	70.32	69.73	73.5	72.42	78.74	80.48	85.14	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	15.29	13.58	11.05	8.36	6.25	5.28	5.7	7.41	9.95	12.63	14.74	15.72	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	160.44	162.11	157.91	148.98	137.71	127.11	120.03	118.37	122.56	131.49	142.77	153.36	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	(71)
Water heating gains (Table 5)													
(72)m=	116.23	114.43	110.7	105.62	102.32	97.67	93.73	98.78	100.58	105.84	111.78	114.44	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	342.57	340.73	330.26	313.56	296.88	280.66	270.06	275.17	283.69	300.57	319.89	334.13	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	4.16	x	19.64	x	0.4	x	0.7	=	15.85	(80)
West	0.9x	0.77	x	4.8	x	19.64	x	0.4	x	0.7	=	18.29	(80)
West	0.9x	0.77	x	4.16	x	38.42	x	0.4	x	0.7	=	31.01	(80)
West	0.9x	0.77	x	4.8	x	38.42	x	0.4	x	0.7	=	35.78	(80)

West	0.9x	0.77	x	4.16	x	63.27	x	0.4	x	0.7	=	51.07	(80)
West	0.9x	0.77	x	4.8	x	63.27	x	0.4	x	0.7	=	58.93	(80)
West	0.9x	0.77	x	4.16	x	92.28	x	0.4	x	0.7	=	74.49	(80)
West	0.9x	0.77	x	4.8	x	92.28	x	0.4	x	0.7	=	85.95	(80)
West	0.9x	0.77	x	4.16	x	113.09	x	0.4	x	0.7	=	91.29	(80)
West	0.9x	0.77	x	4.8	x	113.09	x	0.4	x	0.7	=	105.33	(80)
West	0.9x	0.77	x	4.16	x	115.77	x	0.4	x	0.7	=	93.45	(80)
West	0.9x	0.77	x	4.8	x	115.77	x	0.4	x	0.7	=	107.83	(80)
West	0.9x	0.77	x	4.16	x	110.22	x	0.4	x	0.7	=	88.97	(80)
West	0.9x	0.77	x	4.8	x	110.22	x	0.4	x	0.7	=	102.66	(80)
West	0.9x	0.77	x	4.16	x	94.68	x	0.4	x	0.7	=	76.42	(80)
West	0.9x	0.77	x	4.8	x	94.68	x	0.4	x	0.7	=	88.18	(80)
West	0.9x	0.77	x	4.16	x	73.59	x	0.4	x	0.7	=	59.4	(80)
West	0.9x	0.77	x	4.8	x	73.59	x	0.4	x	0.7	=	68.54	(80)
West	0.9x	0.77	x	4.16	x	45.59	x	0.4	x	0.7	=	36.8	(80)
West	0.9x	0.77	x	4.8	x	45.59	x	0.4	x	0.7	=	42.46	(80)
West	0.9x	0.77	x	4.16	x	24.49	x	0.4	x	0.7	=	19.77	(80)
West	0.9x	0.77	x	4.8	x	24.49	x	0.4	x	0.7	=	22.81	(80)
West	0.9x	0.77	x	4.16	x	16.15	x	0.4	x	0.7	=	13.04	(80)
West	0.9x	0.77	x	4.8	x	16.15	x	0.4	x	0.7	=	15.04	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	34.15	66.8	110.01	160.44	196.62	201.28	191.63	164.6	127.94	79.26	42.58	28.08	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	376.72	407.53	440.27	474	493.5	481.94	461.69	439.77	411.64	379.83	362.47	362.21	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.96	0.88	0.71	0.5	0.36	0.39	0.63	0.91	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.47	20.57	20.73	20.91	20.98	21	21	21	20.99	20.9	20.66	20.45	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.32	20.33	20.33	20.34	20.34	20.36	20.36	20.36	20.35	20.34	20.34	20.33	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.95	0.85	0.66	0.45	0.31	0.34	0.57	0.88	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.61	19.76	19.99	20.24	20.33	20.36	20.36	20.36	20.35	20.23	19.91	19.6	(90)

fLA = Living area ÷ (4) = | 0.47 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	20.02	20.14	20.34	20.55	20.64	20.66	20.66	20.66	20.65	20.55	20.26	20	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	20.02	20.14	20.34	20.55	20.64	20.66	20.66	20.66	20.65	20.55	20.26	20	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.95	0.86	0.68	0.47	0.33	0.36	0.6	0.89	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	373.14	400.08	419.69	407.11	336.37	227.49	152.65	159.53	246.46	336.79	354.14	359.47	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	623.38	602.1	544.52	449.25	343.17	227.85	152.67	159.56	248.48	381.89	509.64	616.78	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	186.18	135.75	92.87	30.34	5.06	0	0	0	0	33.55	111.96	191.44	

Total per year (kWh/year) = $\text{Sum}(98)_{1...5,9...12}$ = 787.15 (98)

Space heating requirement in kWh/m²/year 14.29 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		787.15	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	826.51	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		1682.61	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	1766.74	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	25.93	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		98.31	(330a)

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warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	98.31	(331)
Energy for lighting (calculated in Appendix L)		270.05	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-518.17	(333)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		2443.44	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				256	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	525.74	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	13.46	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	539.2	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				539.2	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	51.02	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	140.16	(379)
Energy saving/generation technologies (333) to (334) as applicable						
Item 1			0.52	x 0.01 =	-268.93	(380)
Total CO2, kg/year	sum of (376)…(382) =				461.45	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				8.37	(384)
EI rating (section 14)					93.82	(385)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Sample 6 (Mid)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	55.1	(1a) x	3	(2a) =	165.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.1	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	165.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

DRAFT

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.12	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.37	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.29	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.37	0.36	0.35	0.32	0.31	0.27	0.27	0.27	0.29	0.31	0.32	0.34

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.56	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.56	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1	=	2.4			(26)
Windows Type 1			4.16	x1/[1/(1.4)+ 0.04]		=	5.52			(27)
Windows Type 2			4.8	x1/[1/(1.4)+ 0.04]		=	6.36			(27)
Walls Type1	24	8.96	15.04	x	0.18	=	2.71			(29)
Walls Type2	24	2.4	21.6	x	0.18	=	3.89			(29)
Walls Type3	2.4	0	2.4	x	0.18	=	0.43			(29)
Total area of elements, m²			50.4							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 21.31 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 546.56 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 2.52 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 23.83 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	30.94	30.8	30.66	30	29.88	29.31	29.31	29.2	29.53	29.88	30.13	30.39	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	54.77	54.62	54.48	53.83	53.71	53.14	53.14	53.03	53.36	53.71	53.95	54.21	

Average = Sum(39)$_{1…12}$ /12= 53.83 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.99	0.99	0.99	0.98	0.97	0.96	0.96	0.96	0.97	0.97	0.98	0.98

Average = Sum(40)$_{1…12}$ /12= 0.98 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.84 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 77.91 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	85.7	82.58	79.47	76.35	73.23	70.12	70.12	73.23	76.35	79.47	82.58	85.7	
										Total = Sum(44)$_{1…12}$ =		934.88	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	127.09	111.15	114.7	100	95.95	82.8	76.72	88.04	89.09	103.83	113.34	123.08	
										Total = Sum(45)$_{1…12}$ =		1225.78	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	19.06	16.67	17.2	15	14.39	12.42	11.51	13.21	13.36	15.57	17	18.46	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	173.68	153.24	161.29	145.09	142.54	127.89	123.32	134.64	134.18	150.42	158.43	169.67	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	173.68	153.24	161.29	145.09	142.54	127.89	123.32	134.64	134.18	150.42	158.43	169.67	

Output from water heater (annual)$_{1...12}$ 1774.4 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	79.53	70.63	75.41	69.32	69.18	63.6	62.79	66.55	65.7	71.8	73.76	78.2	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	14.88	13.21	10.74	8.13	6.08	5.13	5.55	7.21	9.68	12.29	14.34	15.29	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	160.44	162.11	157.91	148.98	137.71	127.11	120.03	118.37	122.56	131.49	142.77	153.36	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	(71)

Water heating gains (Table 5)

(72)m=	106.9	105.1	101.36	96.28	92.98	88.34	84.39	89.45	91.25	96.5	102.44	105.11	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	335.82	334.02	323.62	307	290.37	274.19	263.57	268.63	277.09	293.89	313.16	327.36	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	4.16	x	19.64	x	0.63	x	0.7	=	24.97	(80)
West	0.9x	0.77	x	4.8	x	19.64	x	0.63	x	0.7	=	28.81	(80)
West	0.9x	0.77	x	4.16	x	38.42	x	0.63	x	0.7	=	48.85	(80)
West	0.9x	0.77	x	4.8	x	38.42	x	0.63	x	0.7	=	56.36	(80)

West	0.9x	0.77	x	4.16	x	63.27	x	0.63	x	0.7	=	80.44	(80)
West	0.9x	0.77	x	4.8	x	63.27	x	0.63	x	0.7	=	92.82	(80)
West	0.9x	0.77	x	4.16	x	92.28	x	0.63	x	0.7	=	117.32	(80)
West	0.9x	0.77	x	4.8	x	92.28	x	0.63	x	0.7	=	135.37	(80)
West	0.9x	0.77	x	4.16	x	113.09	x	0.63	x	0.7	=	143.78	(80)
West	0.9x	0.77	x	4.8	x	113.09	x	0.63	x	0.7	=	165.9	(80)
West	0.9x	0.77	x	4.16	x	115.77	x	0.63	x	0.7	=	147.18	(80)
West	0.9x	0.77	x	4.8	x	115.77	x	0.63	x	0.7	=	169.83	(80)
West	0.9x	0.77	x	4.16	x	110.22	x	0.63	x	0.7	=	140.13	(80)
West	0.9x	0.77	x	4.8	x	110.22	x	0.63	x	0.7	=	161.68	(80)
West	0.9x	0.77	x	4.16	x	94.68	x	0.63	x	0.7	=	120.37	(80)
West	0.9x	0.77	x	4.8	x	94.68	x	0.63	x	0.7	=	138.88	(80)
West	0.9x	0.77	x	4.16	x	73.59	x	0.63	x	0.7	=	93.56	(80)
West	0.9x	0.77	x	4.8	x	73.59	x	0.63	x	0.7	=	107.95	(80)
West	0.9x	0.77	x	4.16	x	45.59	x	0.63	x	0.7	=	57.96	(80)
West	0.9x	0.77	x	4.8	x	45.59	x	0.63	x	0.7	=	66.88	(80)
West	0.9x	0.77	x	4.16	x	24.49	x	0.63	x	0.7	=	31.13	(80)
West	0.9x	0.77	x	4.8	x	24.49	x	0.63	x	0.7	=	35.92	(80)
West	0.9x	0.77	x	4.16	x	16.15	x	0.63	x	0.7	=	20.53	(80)
West	0.9x	0.77	x	4.8	x	16.15	x	0.63	x	0.7	=	23.69	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	53.78	105.21	173.26	252.69	309.68	317.01	301.81	259.25	201.51	124.84	67.06	44.23	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	389.6	439.23	496.88	559.69	600.05	591.2	565.38	527.88	478.6	418.73	380.21	371.59	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.97	0.91	0.76	0.57	0.41	0.46	0.72	0.94	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.08	20.22	20.46	20.75	20.93	20.99	21	21	20.96	20.71	20.34	20.05	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.09	20.09	20.09	20.1	20.1	20.11	20.11	20.11	20.11	20.1	20.1	20.1	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.96	0.88	0.71	0.49	0.33	0.37	0.65	0.92	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.86	19.07	19.42	19.82	20.04	20.11	20.11	20.11	20.08	19.78	19.26	18.83	(90)

fLA = Living area ÷ (4) = 0.47 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.43	19.61	19.91	20.26	20.46	20.52	20.53	20.53	20.5	20.22	19.77	19.41	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	19.43	19.61	19.91	20.26	20.46	20.52	20.53	20.53	20.5	20.22	19.77	19.41	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.96	0.89	0.73	0.53	0.37	0.41	0.68	0.93	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	386.7	432.64	477.65	496.15	439.3	310.88	208.45	218.27	325.84	387.47	374.24	369.41	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	828.86	803.71	730.67	611.38	470.37	314.73	208.86	219.05	341.26	516.76	683.63	824.36	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	328.97	249.36	188.25	82.96	23.12	0	0	0	0	96.19	222.76	338.48	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1530.08 (98)

Space heating requirement in kWh/m²/year 27.77 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	328.97	249.36	188.25	82.96	23.12	0	0	0	0	96.19	222.76	338.48		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	351.83	266.69	201.34	88.73	24.72	0	0	0	0	102.88	238.25	362.01		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													1636.45	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

Output from water heater (calculated above)														
	173.68	153.24	161.29	145.09	142.54	127.89	123.32	134.64	134.18	150.42	158.43	169.67		
Efficiency of water heater													79.8	(216)
(217)m=	86.49	86.11	85.23	83.39	81.14	79.8	79.8	79.8	79.8	83.66	85.72	86.62		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	200.81	177.96	189.25	173.99	175.68	160.26	154.53	168.72	168.15	179.81	184.82	195.88		
Total = Sum(219a)$_{1...12}$ =													2129.86	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1636.45

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Water heating fuel used			2129.86	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			262.71	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			4104.02	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	353.47	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	460.05	(264)
Space and water heating	(261) + (262) + (263) + (264) =			813.52	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	136.34	(268)
Total CO2, kg/year		sum of (265)…(271) =		988.79	(272)
TER =				17.95	(273)

SAP Input

Property Details: Sample 1 (Bottom)

Address:	
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	26 July 2019
Date of certificate:	15 June 2022
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	498

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2022	
Floor Location:	Floor area:	Storey height:
Floor 0	66.25 m²	3 m
Living area:	27.2 m² (fraction 0.411)	
Front of dwelling faces:	Unspecified	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
DOOR	Manufacturer	Solid			Wood
Balcony	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
N	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
E	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
DOOR	mm	0.7	0	1.4	2.4	1
Balcony		0.7	0.4	1	4.8	1
N		0.7	0.4	1	5.44	1
E		0.7	0.4	1	1.44	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
DOOR		INT	Worst case	0	0
Balcony		N	North	0	0
N		N	North	0	0
E		E	East	0	0

Overshading: Heavy

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
N	10.24	10.24	0	0.15	0	False	N/A
E	1.44	1.44	0	0.15	0	False	N/A
INT	13.2	2.4	10.8	0.16	0.43	False	N/A
Spandrel	2.4	0	2.4	0.35	0	False	N/A
Floor	66.25			0.11			N/A
Internal Elements							
Party Elements							

SAP Input

Thermal bridges:

Thermal bridges:	No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	3

Main heating system:

Main heating system:	Community heating schemes Heat source: Community heat pump heat from electric heat pump, heat fraction 1, efficiency 256 Piping>=1991, pre-insulated, low temp, variable flow Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Boiler interlock: Yes

Main heating Control:

Main heating Control:	Charging system linked to use of community heating, programmer and TRVs Control code: 2306

Secondary heating system:

Secondary heating system:	None

Water heating:

Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Flue Gas Heat Recovery System: Database (rev 498, product index 060036) Brand name: Worcester Model: Greenstar Xtra Model qualifier: 2015 Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	Photovoltaic 1 Installed Peak power: 0.6 Tilt of collector: 30° Overshading: None or very little Collector Orientation: South
Assess Zero Carbon Home:	No

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**

Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.51

Property Address: Sample 1 (Bottom)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	66.25	(1a) x	3	(2a) =	198.75	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.25	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	198.75	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.05 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1.4	=	3.36			(26)
Windows Type 1			4.8	x	1/[1/(1)+ 0.04]	=	4.62			(27)
Windows Type 2			5.44	x	1/[1/(1)+ 0.04]	=	5.23			(27)
Windows Type 3			1.44	x	1/[1/(1)+ 0.04]	=	1.38			(27)
Floor			66.25	x	0.11	=	7.2875			(28)
Walls Type1	10.24	10.24	0	x	0.15	=	0			(29)
Walls Type2	1.44	1.44	0	x	0.15	=	0			(29)
Walls Type3	13.2	2.4	10.8	x	0.15	=	1.62			(29)
Walls Type4	2.4	0	2.4	x	0.35	=	0.84			(29)
Total area of elements, m²			93.53							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 24.34 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5153.55 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 14.03 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 38.36 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(38)m=	17.53	17.32	17.11	16.07	15.86	14.81	14.81	14.61	15.23	15.86	16.28	16.7	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	55.9	55.69	55.48	54.43	54.22	53.18	53.18	52.97	53.6	54.22	54.64	55.06	

Average = Sum(39)1…12 /12= 54.38 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.84	0.84	0.84	0.82	0.82	0.8	0.8	0.8	0.81	0.82	0.82	0.83	

Average = Sum(40)1…12 /12= 0.82 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.15 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.3 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	93.83	90.42	87.01	83.6	80.19	76.77	76.77	80.19	83.6	87.01	90.42	93.83	

Total = Sum(44)1…12 = 1023.65 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.15	121.71	125.59	109.49	105.06	90.66	84.01	96.4	97.55	113.69	124.1	134.76	

Total = Sum(45)1…12 = 1342.17 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.87	18.26	18.84	16.42	15.76	13.6	12.6	14.46	14.63	17.05	18.61	20.21	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	194.43	171.63	180.87	162.99	160.34	144.15	139.29	151.68	151.05	168.96	177.59	190.04	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	17.95	15.96	16.41	14.51	13.96	12.12	11.22	12.87	13.02	15.02	16.24	17.46	(63) (G2)

Output from water heater

(64)m=	173.8	153.25	161.77	145.88	143.69	129.44	125.38	136.13	135.43	151.27	158.76	169.9	

Output from water heater (annual)1…12 | 1784.71 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	90.49	80.41	85.98	79.2	79.15	72.94	72.15	76.27	75.23	82.02	84.06	89.03	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.65	15.68	12.75	9.65	7.22	6.09	6.58	8.56	11.48	14.58	17.02	18.14	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	188.39	190.35	185.42	174.93	161.69	149.25	140.94	138.98	143.91	154.4	167.64	180.08	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	(71)

Water heating gains (Table 5)

(72)m=	121.63	119.66	115.56	110	106.39	101.3	96.98	102.52	104.49	110.25	116.75	119.66	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	382.95	380.96	369.01	349.86	330.58	311.92	299.78	305.34	315.16	334.5	356.68	373.16	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	4.8	x	10.63	x	0.4	x	0.7	=	9.9	(74)

North	0.9x	0.77	x	5.44	x	10.63	x	0.4	x	0.7	=	11.22	(74)
North	0.9x	0.77	x	4.8	x	20.32	x	0.4	x	0.7	=	18.93	(74)
North	0.9x	0.77	x	5.44	x	20.32	x	0.4	x	0.7	=	21.45	(74)
North	0.9x	0.77	x	4.8	x	34.53	x	0.4	x	0.7	=	32.16	(74)
North	0.9x	0.77	x	5.44	x	34.53	x	0.4	x	0.7	=	36.45	(74)
North	0.9x	0.77	x	4.8	x	55.46	x	0.4	x	0.7	=	51.66	(74)
North	0.9x	0.77	x	5.44	x	55.46	x	0.4	x	0.7	=	58.55	(74)
North	0.9x	0.77	x	4.8	x	74.72	x	0.4	x	0.7	=	69.59	(74)
North	0.9x	0.77	x	5.44	x	74.72	x	0.4	x	0.7	=	78.87	(74)
North	0.9x	0.77	x	4.8	x	79.99	x	0.4	x	0.7	=	74.5	(74)
North	0.9x	0.77	x	5.44	x	79.99	x	0.4	x	0.7	=	84.43	(74)
North	0.9x	0.77	x	4.8	x	74.68	x	0.4	x	0.7	=	69.55	(74)
North	0.9x	0.77	x	5.44	x	74.68	x	0.4	x	0.7	=	78.83	(74)
North	0.9x	0.77	x	4.8	x	59.25	x	0.4	x	0.7	=	55.18	(74)
North	0.9x	0.77	x	5.44	x	59.25	x	0.4	x	0.7	=	62.54	(74)
North	0.9x	0.77	x	4.8	x	41.52	x	0.4	x	0.7	=	38.67	(74)
North	0.9x	0.77	x	5.44	x	41.52	x	0.4	x	0.7	=	43.82	(74)
North	0.9x	0.77	x	4.8	x	24.19	x	0.4	x	0.7	=	22.53	(74)
North	0.9x	0.77	x	5.44	x	24.19	x	0.4	x	0.7	=	25.53	(74)
North	0.9x	0.77	x	4.8	x	13.12	x	0.4	x	0.7	=	12.22	(74)
North	0.9x	0.77	x	5.44	x	13.12	x	0.4	x	0.7	=	13.85	(74)
North	0.9x	0.77	x	4.8	x	8.86	x	0.4	x	0.7	=	8.26	(74)
North	0.9x	0.77	x	5.44	x	8.86	x	0.4	x	0.7	=	9.36	(74)
East	0.9x	0.77	x	1.44	x	19.64	x	0.4	x	0.7	=	5.49	(76)
East	0.9x	0.77	x	1.44	x	38.42	x	0.4	x	0.7	=	10.74	(76)
East	0.9x	0.77	x	1.44	x	63.27	x	0.4	x	0.7	=	17.68	(76)
East	0.9x	0.77	x	1.44	x	92.28	x	0.4	x	0.7	=	25.78	(76)
East	0.9x	0.77	x	1.44	x	113.09	x	0.4	x	0.7	=	31.6	(76)
East	0.9x	0.77	x	1.44	x	115.77	x	0.4	x	0.7	=	32.35	(76)
East	0.9x	0.77	x	1.44	x	110.22	x	0.4	x	0.7	=	30.8	(76)
East	0.9x	0.77	x	1.44	x	94.68	x	0.4	x	0.7	=	26.45	(76)
East	0.9x	0.77	x	1.44	x	73.59	x	0.4	x	0.7	=	20.56	(76)
East	0.9x	0.77	x	1.44	x	45.59	x	0.4	x	0.7	=	12.74	(76)
East	0.9x	0.77	x	1.44	x	24.49	x	0.4	x	0.7	=	6.84	(76)
East	0.9x	0.77	x	1.44	x	16.15	x	0.4	x	0.7	=	4.51	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	26.62	51.11	86.29	135.99	180.06	191.28	179.18	144.17	103.05	60.8	32.91	22.13	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	409.56	432.07	455.3	485.85	510.63	503.2	478.96	449.51	418.21	395.3	389.59	395.29	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(86)m=	1	1	0.99	0.96	0.86	0.66	0.49	0.54	0.81	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.21	20.3	20.47	20.71	20.9	20.99	21	21	20.95	20.73	20.44	20.2	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.22	20.22	20.22	20.23	20.24	20.25	20.25	20.25	20.25	20.24	20.23	20.23	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.95	0.82	0.59	0.4	0.45	0.75	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.16	19.29	19.53	19.89	20.14	20.24	20.25	20.25	20.21	19.92	19.5	19.15	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.59	19.7	19.92	20.23	20.46	20.55	20.56	20.56	20.51	20.25	19.89	19.58	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.59	19.7	19.92	20.23	20.46	20.55	20.56	20.56	20.51	20.25	19.89	19.58	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.95	0.84	0.62	0.44	0.49	0.77	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	407.75	428.97	447.98	460.55	426.73	311.12	210.01	219.38	322.79	378.38	385.92	393.87	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	854.66	824.31	744.35	616.55	474.78	316.34	210.46	220.27	343.8	523.3	698.67	846.93	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	332.5	265.66	220.5	112.32	35.75	0	0	0	0	107.82	225.18	337.08	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1636.82 (98)

Space heating requirement in kWh/m²/year 24.71 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating	**kWh/year**
Annual space heating requirement	1636.82

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Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	1718.66	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)

Water heating

Annual water heating requirement		1784.71	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	1873.94	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	35.93	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		118.21	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	118.21	(331)
Energy for lighting (calculated in Appendix L)		311.73	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-518.17	(333)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		3504.36	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				256	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	728.34	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	18.65	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	746.99	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				746.99	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	61.35	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	161.79	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1		0.52	x 0.01 =		-268.93	(380)
Total CO2, kg/year	sum of (376)…(382) =				701.19	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				10.58	(384)
EI rating (section 14)					91.55	(385)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**

Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.51

Property Address: Sample 1 (Bottom)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	66.25	(1a) x	3	(2a) =	198.75	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.25	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	198.75	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.1	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.35	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.37	0.37	0.33	0.32	0.28	0.28	0.28	0.3	0.32	0.34	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1	=	2.4			(26)
Windows Type 1			4.8	x1/[1/(1.4)+ 0.04]		=	6.36			(27)
Windows Type 2			5.44	x1/[1/(1.4)+ 0.04]		=	7.21			(27)
Windows Type 3			1.44	x1/[1/(1.4)+ 0.04]		=	1.91			(27)
Floor			66.25	x	0.13	=	8.612499			(28)
Walls Type1	10.24	10.24	0	x	0.18	=	0			(29)
Walls Type2	1.44	1.44	0	x	0.18	=	0			(29)
Walls Type3	13.2	2.4	10.8	x	0.18	=	1.94			(29)
Walls Type4	2.4	0	2.4	x	0.18	=	0.43			(29)
Total area of elements, m²			93.53							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.87 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5153.55 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 4.68 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 33.55 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(38)m=	37.53	37.35	37.16	36.32	36.16	35.42	35.42	35.29	35.71	36.16	36.48	36.82	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	71.08	70.89	70.71	69.87	69.71	68.97	68.97	68.84	69.26	69.71	70.03	70.37	

Average = Sum(39)$_{1...12}$ /12= 69.87 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.07	1.07	1.07	1.05	1.05	1.04	1.04	1.04	1.05	1.05	1.06	1.06	

Average = Sum(40)$_{1...12}$ /12= 1.05 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.15 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.3 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	93.83	90.42	87.01	83.6	80.19	76.77	76.77	80.19	83.6	87.01	90.42	93.83

Total = Sum(44)$_{1...12}$ = 1023.65 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.15	121.71	125.59	109.49	105.06	90.66	84.01	96.4	97.55	113.69	124.1	134.76

Total = Sum(45)$_{1...12}$ = 1342.17 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.87	18.26	18.84	16.42	15.76	13.6	12.6	14.46	14.63	17.05	18.61	20.21	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	185.75	163.79	172.18	154.58	151.65	135.75	130.6	143	142.64	160.28	169.19	181.36	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	185.75	163.79	172.18	154.58	151.65	135.75	130.6	143	142.64	160.28	169.19	181.36	

Output from water heater (annual)1…12 | 1890.79 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	83.54	74.14	79.03	72.48	72.21	66.22	65.21	69.33	68.51	75.08	77.34	82.08	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.21	15.29	12.43	9.41	7.04	5.94	6.42	8.34	11.2	14.22	16.59	17.69	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	188.39	190.35	185.42	174.93	161.69	149.25	140.94	138.98	143.91	154.4	167.64	180.08	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	(71)

Water heating gains (Table 5)

(72)m=	112.29	110.32	106.23	100.67	97.05	91.97	87.65	93.18	95.15	100.91	107.41	110.33	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	376.17	374.23	362.36	343.29	324.06	305.44	293.28	298.79	308.54	327.8	349.92	366.38	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	4.8	x	10.63	x	0.63	x	0.7	=	15.6	(74)

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North	0.9x	0.77	x	5.44	x	10.63	x	0.63	x	0.7	=	17.68	(74)
North	0.9x	0.77	x	4.8	x	20.32	x	0.63	x	0.7	=	29.81	(74)
North	0.9x	0.77	x	5.44	x	20.32	x	0.63	x	0.7	=	33.78	(74)
North	0.9x	0.77	x	4.8	x	34.53	x	0.63	x	0.7	=	50.65	(74)
North	0.9x	0.77	x	5.44	x	34.53	x	0.63	x	0.7	=	57.41	(74)
North	0.9x	0.77	x	4.8	x	55.46	x	0.63	x	0.7	=	81.36	(74)
North	0.9x	0.77	x	5.44	x	55.46	x	0.63	x	0.7	=	92.21	(74)
North	0.9x	0.77	x	4.8	x	74.72	x	0.63	x	0.7	=	109.6	(74)
North	0.9x	0.77	x	5.44	x	74.72	x	0.63	x	0.7	=	124.22	(74)
North	0.9x	0.77	x	4.8	x	79.99	x	0.63	x	0.7	=	117.33	(74)
North	0.9x	0.77	x	5.44	x	79.99	x	0.63	x	0.7	=	132.98	(74)
North	0.9x	0.77	x	4.8	x	74.68	x	0.63	x	0.7	=	109.55	(74)
North	0.9x	0.77	x	5.44	x	74.68	x	0.63	x	0.7	=	124.15	(74)
North	0.9x	0.77	x	4.8	x	59.25	x	0.63	x	0.7	=	86.91	(74)
North	0.9x	0.77	x	5.44	x	59.25	x	0.63	x	0.7	=	98.5	(74)
North	0.9x	0.77	x	4.8	x	41.52	x	0.63	x	0.7	=	60.9	(74)
North	0.9x	0.77	x	5.44	x	41.52	x	0.63	x	0.7	=	69.02	(74)
North	0.9x	0.77	x	4.8	x	24.19	x	0.63	x	0.7	=	35.48	(74)
North	0.9x	0.77	x	5.44	x	24.19	x	0.63	x	0.7	=	40.22	(74)
North	0.9x	0.77	x	4.8	x	13.12	x	0.63	x	0.7	=	19.24	(74)
North	0.9x	0.77	x	5.44	x	13.12	x	0.63	x	0.7	=	21.81	(74)
North	0.9x	0.77	x	4.8	x	8.86	x	0.63	x	0.7	=	13	(74)
North	0.9x	0.77	x	5.44	x	8.86	x	0.63	x	0.7	=	14.74	(74)
East	0.9x	0.77	x	1.44	x	19.64	x	0.63	x	0.7	=	8.64	(76)
East	0.9x	0.77	x	1.44	x	38.42	x	0.63	x	0.7	=	16.91	(76)
East	0.9x	0.77	x	1.44	x	63.27	x	0.63	x	0.7	=	27.85	(76)
East	0.9x	0.77	x	1.44	x	92.28	x	0.63	x	0.7	=	40.61	(76)
East	0.9x	0.77	x	1.44	x	113.09	x	0.63	x	0.7	=	49.77	(76)
East	0.9x	0.77	x	1.44	x	115.77	x	0.63	x	0.7	=	50.95	(76)
East	0.9x	0.77	x	1.44	x	110.22	x	0.63	x	0.7	=	48.51	(76)
East	0.9x	0.77	x	1.44	x	94.68	x	0.63	x	0.7	=	41.67	(76)
East	0.9x	0.77	x	1.44	x	73.59	x	0.63	x	0.7	=	32.39	(76)
East	0.9x	0.77	x	1.44	x	45.59	x	0.63	x	0.7	=	20.06	(76)
East	0.9x	0.77	x	1.44	x	24.49	x	0.63	x	0.7	=	10.78	(76)
East	0.9x	0.77	x	1.44	x	16.15	x	0.63	x	0.7	=	7.11	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	41.92	80.5	135.91	214.19	283.59	301.26	282.2	227.08	162.31	95.76	51.83	34.85	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	418.09	454.73	498.27	557.47	607.65	606.7	575.48	525.86	470.85	423.57	401.75	401.22	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

(86)m=	1	1	0.99	0.96	0.87	0.69	0.52	0.59	0.85	0.98	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.89	20.01	20.23	20.55	20.83	20.96	20.99	20.99	20.89	20.55	20.17	19.87	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.02	20.03	20.03	20.04	20.04	20.05	20.05	20.05	20.05	20.04	20.04	20.03	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.95	0.82	0.6	0.41	0.47	0.78	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.55	18.72	19.05	19.51	19.87	20.03	20.05	20.05	19.95	19.51	18.97	18.53	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.1	19.25	19.53	19.94	20.26	20.41	20.44	20.43	20.34	19.94	19.46	19.08	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.1	19.25	19.53	19.94	20.26	20.41	20.44	20.43	20.34	19.94	19.46	19.08	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.94	0.84	0.64	0.46	0.52	0.81	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	416.22	451.26	489.5	526.74	508.08	385.54	262.46	273.52	379.46	408.05	398.26	399.77	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1051.94	1017.23	921.65	771.19	596.93	400.82	264.54	277.6	432	651.01	865.64	1046.97	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	472.98	380.33	321.52	176	66.1	0	0	0	0	180.77	336.52	481.52	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2415.73 (98)

Space heating requirement in kWh/m²/year 36.46 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	472.98	380.33	321.52	176	66.1	0	0	0	0	180.77	336.52	481.52	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	505.86	406.77	343.87	188.24	70.7	0	0	0	0	193.34	359.91	514.99	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2583.67 (211)

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Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)

185.75	163.79	172.18	154.58	151.65	135.75	130.6	143	142.64	160.28	169.19	181.36

Efficiency of water heater 79.8 (216)

(217)m=	87.2	86.99	86.46	85.16	82.77	79.8	79.8	79.8	79.8	85.14	86.61	87.3	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	213.01	188.29	199.16	181.52	183.22	170.11	163.66	179.19	178.75	188.27	195.34	207.75

Total = Sum(219a)$_{1...12}$ = 2248.27 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2583.67	
Water heating fuel used		2248.27	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	75	(231)
Electricity for lighting		303.98	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		5210.92	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	558.07	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	485.63	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1043.7	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	157.76	(268)
Total CO2, kg/year		sum of (265)…(271) =		1240.39	(272)

TER = 18.72 (273)

SAP Input

Property Details: Sample 2 (Bottom)

Address:	
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	26 July 2019
Date of certificate:	15 June 2022
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	498

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2022	
Floor Location:	Floor area:	Storey height:
Floor 0	66.25 m²	3 m
Living area:	27.2 m² (fraction 0.411)	
Front of dwelling faces:	Unspecified	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
DOOR	Manufacturer	Solid			Wood
W	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
N	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Balcony	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
DOOR	mm	0.7	0	1.4	2.4	1
W		0.7	0.4	1	1.44	1
N		0.7	0.4	1	10.24	1
Balcony		0.7	0.4	1	4.8	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
DOOR		INT	Worst case	0	0
W		W	West	0	0
N		N	North	0	0
Balcony		N	North	0	0

Overshading: More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
N	31.8	15.04	16.76	0.15	0	False	N/A
W	18.75	1.44	17.31	0.15	0	False	N/A
INT	11.1	2.4	8.7	0.16	0.43	False	N/A
Spandrel	2.4	0	2.4	0.35	0	False	N/A
Exposed	66.25			0.11			N/A
Internal Elements							
Party Elements							

SAP Input

Thermal bridges:

Thermal bridges:	No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	3

Main heating system:

Main heating system:	Community heating schemes Heat source: Community heat pump heat from electric heat pump, heat fraction 1, efficiency 256 Piping>=1991, pre-insulated, low temp, variable flow Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Boiler interlock: Yes

Main heating Control:

Main heating Control:	Charging system linked to use of community heating, programmer and TRVs Control code: 2306

Secondary heating system:

Secondary heating system:	None

Water heating:

Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Flue Gas Heat Recovery System: Database (rev 498, product index 060036) Brand name: Worcester Model: Greenstar Xtra Model qualifier: 2015 Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	Photovoltaic 1 Installed Peak power: 0.6 Tilt of collector: 30° Overshading: None or very little Collector Orientation: South
Assess Zero Carbon Home:	No

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Sample 2 (Bottom)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	66.25	(1a) x	3	(2a) =	198.75	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.25	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	198.75	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*		0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	79.05	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1.4	=	3.36			(26)
Windows Type 1			1.44	x	1/[1/(1)+ 0.04]	=	1.38			(27)
Windows Type 2			10.24	x	1/[1/(1)+ 0.04]	=	9.85			(27)
Windows Type 3			4.8	x	1/[1/(1)+ 0.04]	=	4.62			(27)
Floor			66.25	x	0.11	=	7.2875			(28)
Walls Type1	31.8	15.04	16.76	x	0.15	=	2.51			(29)
Walls Type2	18.75	1.44	17.31	x	0.15	=	2.6			(29)
Walls Type3	11.1	2.4	8.7	x	0.15	=	1.3			(29)
Walls Type4	2.4	0	2.4	x	0.35	=	0.84			(29)
Total area of elements, m²			130.3							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	33.75	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	5601.13	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		19.55	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	53.29	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	17.53	17.32	17.11	16.07	15.86	14.81	14.81	14.61	15.23	15.86	16.28	16.7	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	70.82	70.61	70.41	69.36	69.15	68.11	68.11	67.9	68.52	69.15	69.57	69.99	

Average = Sum(39)1…12 /12= 69.31 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.07	1.07	1.06	1.05	1.04	1.03	1.03	1.02	1.03	1.04	1.05	1.06	

Average = Sum(40)1…12 /12= 1.05 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.15 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.3 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	93.83	90.42	87.01	83.6	80.19	76.77	76.77	80.19	83.6	87.01	90.42	93.83	

Total = Sum(44)1…12 = 1023.65 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.15	121.71	125.59	109.49	105.06	90.66	84.01	96.4	97.55	113.69	124.1	134.76	

Total = Sum(45)1…12 = 1342.17 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.87	18.26	18.84	16.42	15.76	13.6	12.6	14.46	14.63	17.05	18.61	20.21	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3												0	(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	194.43	171.63	180.87	162.99	160.34	144.15	139.29	151.68	151.05	168.96	177.59	190.04	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	17.95	15.96	16.41	14.51	13.96	12.12	11.22	12.87	13.02	15.02	16.24	17.46	(63) (G2)

Output from water heater

(64)m=	173.8	153.25	161.77	145.88	143.69	129.44	125.38	136.13	135.43	151.27	158.76	169.9	
										Output from water heater (annual)1…12		1784.71	(64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	90.49	80.41	85.98	79.2	79.15	72.94	72.15	76.27	75.23	82.02	84.06	89.03	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	16.81	14.93	12.14	9.19	6.87	5.8	6.27	8.15	10.93	13.88	16.2	17.27	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	188.39	190.35	185.42	174.93	161.69	149.25	140.94	138.98	143.91	154.4	167.64	180.08	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	(71)
Water heating gains (Table 5)													
(72)m=	121.63	119.66	115.56	110	106.39	101.3	96.98	102.52	104.49	110.25	116.75	119.66	(72)
Total internal gains =							(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m						
(73)m=	382.1	380.21	368.4	349.4	330.23	311.63	299.46	304.93	314.61	333.8	355.86	372.29	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	10.24	x	10.63	x	0.4	x	0.7	=	21.13	(74)

North	0.9x	0.77	x	4.8	x	10.63	x	0.4	x	0.7	=	9.9	(74)
North	0.9x	0.77	x	10.24	x	20.32	x	0.4	x	0.7	=	40.38	(74)
North	0.9x	0.77	x	4.8	x	20.32	x	0.4	x	0.7	=	18.93	(74)
North	0.9x	0.77	x	10.24	x	34.53	x	0.4	x	0.7	=	68.61	(74)
North	0.9x	0.77	x	4.8	x	34.53	x	0.4	x	0.7	=	32.16	(74)
North	0.9x	0.77	x	10.24	x	55.46	x	0.4	x	0.7	=	110.21	(74)
North	0.9x	0.77	x	4.8	x	55.46	x	0.4	x	0.7	=	51.66	(74)
North	0.9x	0.77	x	10.24	x	74.72	x	0.4	x	0.7	=	148.46	(74)
North	0.9x	0.77	x	4.8	x	74.72	x	0.4	x	0.7	=	69.59	(74)
North	0.9x	0.77	x	10.24	x	79.99	x	0.4	x	0.7	=	158.93	(74)
North	0.9x	0.77	x	4.8	x	79.99	x	0.4	x	0.7	=	74.5	(74)
North	0.9x	0.77	x	10.24	x	74.68	x	0.4	x	0.7	=	148.38	(74)
North	0.9x	0.77	x	4.8	x	74.68	x	0.4	x	0.7	=	69.55	(74)
North	0.9x	0.77	x	10.24	x	59.25	x	0.4	x	0.7	=	117.72	(74)
North	0.9x	0.77	x	4.8	x	59.25	x	0.4	x	0.7	=	55.18	(74)
North	0.9x	0.77	x	10.24	x	41.52	x	0.4	x	0.7	=	82.49	(74)
North	0.9x	0.77	x	4.8	x	41.52	x	0.4	x	0.7	=	38.67	(74)
North	0.9x	0.77	x	10.24	x	24.19	x	0.4	x	0.7	=	48.06	(74)
North	0.9x	0.77	x	4.8	x	24.19	x	0.4	x	0.7	=	22.53	(74)
North	0.9x	0.77	x	10.24	x	13.12	x	0.4	x	0.7	=	26.06	(74)
North	0.9x	0.77	x	4.8	x	13.12	x	0.4	x	0.7	=	12.22	(74)
North	0.9x	0.77	x	10.24	x	8.86	x	0.4	x	0.7	=	17.61	(74)
North	0.9x	0.77	x	4.8	x	8.86	x	0.4	x	0.7	=	8.26	(74)
West	0.9x	0.77	x	1.44	x	19.64	x	0.4	x	0.7	=	5.49	(80)
West	0.9x	0.77	x	1.44	x	38.42	x	0.4	x	0.7	=	10.74	(80)
West	0.9x	0.77	x	1.44	x	63.27	x	0.4	x	0.7	=	17.68	(80)
West	0.9x	0.77	x	1.44	x	92.28	x	0.4	x	0.7	=	25.78	(80)
West	0.9x	0.77	x	1.44	x	113.09	x	0.4	x	0.7	=	31.6	(80)
West	0.9x	0.77	x	1.44	x	115.77	x	0.4	x	0.7	=	32.35	(80)
West	0.9x	0.77	x	1.44	x	110.22	x	0.4	x	0.7	=	30.8	(80)
West	0.9x	0.77	x	1.44	x	94.68	x	0.4	x	0.7	=	26.45	(80)
West	0.9x	0.77	x	1.44	x	73.59	x	0.4	x	0.7	=	20.56	(80)
West	0.9x	0.77	x	1.44	x	45.59	x	0.4	x	0.7	=	12.74	(80)
West	0.9x	0.77	x	1.44	x	24.49	x	0.4	x	0.7	=	6.84	(80)
West	0.9x	0.77	x	1.44	x	16.15	x	0.4	x	0.7	=	4.51	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	36.52	70.04	118.45	187.65	249.65	265.77	248.73	199.36	141.72	83.33	45.12	30.38	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	418.62	450.25	486.85	537.05	579.88	577.41	548.19	504.28	456.33	417.14	400.99	402.68	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(86)m=	1	1	0.99	0.97	0.88	0.71	0.54	0.6	0.86	0.98	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.9	20.01	20.22	20.54	20.81	20.96	20.99	20.99	20.88	20.55	20.18	19.88	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.03	20.03	20.03	20.04	20.05	20.06	20.06	20.06	20.05	20.05	20.04	20.04	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.95	0.84	0.62	0.43	0.49	0.79	0.97	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.56	18.72	19.03	19.49	19.86	20.03	20.06	20.06	19.96	19.52	18.98	18.54	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.11	19.25	19.52	19.92	20.25	20.41	20.44	20.44	20.34	19.94	19.47	19.09	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.11	19.25	19.52	19.92	20.25	20.41	20.44	20.44	20.34	19.94	19.47	19.09	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.95	0.85	0.66	0.47	0.54	0.82	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	416.74	446.95	479.02	510.77	494.47	378.91	259.27	269.81	372.68	402.55	397.52	401.2	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1048.81	1013.26	916.88	764.42	591.28	395.99	261.62	274.24	427.48	645.97	860.75	1042.39	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	470.26	380.56	325.77	182.63	72.03	0	0	0	0	181.11	333.52	477.05	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2422.93 (98)

Space heating requirement in kWh/m²/year 36.57 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none 0 (301)

Fraction of space heat from community system 1 – (301) = 1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump 1 (303a)

Fraction of total space heat from Community heat pump (302) x (303a) = 1 (304a)

Factor for control and charging method (Table 4c(3)) for community heating system 1 (305)

Distribution loss factor (Table 12c) for community heating system 1.05 (306)

Space heating **kWh/year**

Annual space heating requirement 2422.93

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Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	2544.07	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		1784.71	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	1873.94	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	44.18	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		118.21	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	118.21	(331)
Energy for lighting (calculated in Appendix L)		296.83	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-518.17	(333)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		4314.88	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				256	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	895.68	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	22.93	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	918.61	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				918.61	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	61.35	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	154.05	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1			0.52	x 0.01 =	-268.93	(380)
Total CO2, kg/year	sum of (376)…(382) =				865.08	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				13.06	(384)
EI rating (section 14)					89.58	(385)

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User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.5.51

Property Address: Sample 2 (Bottom)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	66.25	(1a) x	3	(2a) =	198.75	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.25	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	198.75	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

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			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.1	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*			0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration		0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate		(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.35	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
Number of sides sheltered			2	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor		(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.37	0.37	0.33	0.32	0.28	0.28	0.28	0.3	0.32	0.34	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1	=	2.4			(26)
Windows Type 1			1.24	x1/[1/(1.4)+ 0.04]		=	1.64			(27)
Windows Type 2			8.8	x1/[1/(1.4)+ 0.04]		=	11.67			(27)
Windows Type 3			4.12	x1/[1/(1.4)+ 0.04]		=	5.46			(27)
Floor			66.25	x	0.13	=	8.612499			(28)
Walls Type1	31.8	12.92	18.88	x	0.18	=	3.4			(29)
Walls Type2	18.75	1.24	17.51	x	0.18	=	3.15			(29)
Walls Type3	11.1	2.4	8.7	x	0.18	=	1.57			(29)
Walls Type4	2.4	0	2.4	x	0.18	=	0.43			(29)
Total area of elements, m²			130.3							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 38.33 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5633.61 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 6.52 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 44.85 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(38)m=	37.53	37.35	37.16	36.32	36.16	35.42	35.42	35.29	35.71	36.16	36.48	36.82	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	82.38	82.19	82.01	81.17	81.01	80.27	80.27	80.13	80.56	81.01	81.33	81.66	

Average = Sum(39)$_{1...12}$ /12= 81.17 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.24	1.24	1.24	1.23	1.22	1.21	1.21	1.21	1.22	1.22	1.23	1.23	

Average = Sum(40)$_{1...12}$ /12= 1.23 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.15 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.3 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	93.83	90.42	87.01	83.6	80.19	76.77	76.77	80.19	83.6	87.01	90.42	93.83

Total = Sum(44)$_{1...12}$ = 1023.65 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.15	121.71	125.59	109.49	105.06	90.66	84.01	96.4	97.55	113.69	124.1	134.76

Total = Sum(45)$_{1...12}$ = 1342.17 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.87	18.26	18.84	16.42	15.76	13.6	12.6	14.46	14.63	17.05	18.61	20.21	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

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Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	185.75	163.79	172.18	154.58	151.65	135.75	130.6	143	142.64	160.28	169.19	181.36	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	185.75	163.79	172.18	154.58	151.65	135.75	130.6	143	142.64	160.28	169.19	181.36	

Output from water heater (annual)$_{1...12}$ — 1890.79 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	83.54	74.14	79.03	72.48	72.21	66.22	65.21	69.33	68.51	75.08	77.34	82.08	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	107.59	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	16.82	14.94	12.15	9.2	6.88	5.81	6.27	8.15	10.94	13.9	16.22	17.29	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	188.39	190.35	185.42	174.93	161.69	149.25	140.94	138.98	143.91	154.4	167.64	180.08	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	33.76	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	-86.07	(71)

Water heating gains (Table 5)

(72)m=	112.29	110.32	106.23	100.67	97.05	91.97	87.65	93.18	95.15	100.91	107.41	110.33	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	375.78	373.89	362.08	343.07	323.9	305.3	293.13	298.6	308.28	327.48	349.54	365.97	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	8.8	x	10.63	x	0.63	x	0.7	=	28.6	(74)

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North	0.9x	0.77	x	4.12	x	10.63	x	0.63	x	0.7	=	13.39	(74)
North	0.9x	0.77	x	8.8	x	20.32	x	0.63	x	0.7	=	54.65	(74)
North	0.9x	0.77	x	4.12	x	20.32	x	0.63	x	0.7	=	25.59	(74)
North	0.9x	0.77	x	8.8	x	34.53	x	0.63	x	0.7	=	92.87	(74)
North	0.9x	0.77	x	4.12	x	34.53	x	0.63	x	0.7	=	43.48	(74)
North	0.9x	0.77	x	8.8	x	55.46	x	0.63	x	0.7	=	149.17	(74)
North	0.9x	0.77	x	4.12	x	55.46	x	0.63	x	0.7	=	69.84	(74)
North	0.9x	0.77	x	8.8	x	74.72	x	0.63	x	0.7	=	200.94	(74)
North	0.9x	0.77	x	4.12	x	74.72	x	0.63	x	0.7	=	94.08	(74)
North	0.9x	0.77	x	8.8	x	79.99	x	0.63	x	0.7	=	215.11	(74)
North	0.9x	0.77	x	4.12	x	79.99	x	0.63	x	0.7	=	100.71	(74)
North	0.9x	0.77	x	8.8	x	74.68	x	0.63	x	0.7	=	200.83	(74)
North	0.9x	0.77	x	4.12	x	74.68	x	0.63	x	0.7	=	94.03	(74)
North	0.9x	0.77	x	8.8	x	59.25	x	0.63	x	0.7	=	159.34	(74)
North	0.9x	0.77	x	4.12	x	59.25	x	0.63	x	0.7	=	74.6	(74)
North	0.9x	0.77	x	8.8	x	41.52	x	0.63	x	0.7	=	111.65	(74)
North	0.9x	0.77	x	4.12	x	41.52	x	0.63	x	0.7	=	52.27	(74)
North	0.9x	0.77	x	8.8	x	24.19	x	0.63	x	0.7	=	65.05	(74)
North	0.9x	0.77	x	4.12	x	24.19	x	0.63	x	0.7	=	30.46	(74)
North	0.9x	0.77	x	8.8	x	13.12	x	0.63	x	0.7	=	35.28	(74)
North	0.9x	0.77	x	4.12	x	13.12	x	0.63	x	0.7	=	16.52	(74)
North	0.9x	0.77	x	8.8	x	8.86	x	0.63	x	0.7	=	23.84	(74)
North	0.9x	0.77	x	4.12	x	8.86	x	0.63	x	0.7	=	11.16	(74)
West	0.9x	0.77	x	1.24	x	19.64	x	0.63	x	0.7	=	7.44	(80)
West	0.9x	0.77	x	1.24	x	38.42	x	0.63	x	0.7	=	14.56	(80)
West	0.9x	0.77	x	1.24	x	63.27	x	0.63	x	0.7	=	23.98	(80)
West	0.9x	0.77	x	1.24	x	92.28	x	0.63	x	0.7	=	34.97	(80)
West	0.9x	0.77	x	1.24	x	113.09	x	0.63	x	0.7	=	42.86	(80)
West	0.9x	0.77	x	1.24	x	115.77	x	0.63	x	0.7	=	43.87	(80)
West	0.9x	0.77	x	1.24	x	110.22	x	0.63	x	0.7	=	41.77	(80)
West	0.9x	0.77	x	1.24	x	94.68	x	0.63	x	0.7	=	35.88	(80)
West	0.9x	0.77	x	1.24	x	73.59	x	0.63	x	0.7	=	27.89	(80)
West	0.9x	0.77	x	1.24	x	45.59	x	0.63	x	0.7	=	17.28	(80)
West	0.9x	0.77	x	1.24	x	24.49	x	0.63	x	0.7	=	9.28	(80)
West	0.9x	0.77	x	1.24	x	16.15	x	0.63	x	0.7	=	6.12	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	49.43	94.8	160.32	253.97	337.87	359.7	336.63	269.81	191.82	112.79	61.08	41.12	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	425.21	468.68	522.4	597.05	661.78	665	629.77	568.41	500.1	440.27	410.62	407.1	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

TER WorkSheet: New dwelling design stage

(86)m=	1	1	0.99	0.96	0.88	0.71	0.55	0.62	0.87	0.98	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.67	19.81	20.06	20.43	20.76	20.94	20.99	20.98	20.83	20.42	19.99	19.65	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.89	19.89	19.89	19.9	19.9	19.91	19.91	19.91	19.91	19.9	19.9	19.89	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.95	0.83	0.61	0.42	0.49	0.8	0.97	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.13	18.32	18.7	19.23	19.66	19.87	19.91	19.9	19.77	19.23	18.6	18.1	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.76	18.93	19.26	19.72	20.11	20.31	20.35	20.34	20.2	19.72	19.17	18.74	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.76	18.93	19.26	19.72	20.11	20.31	20.35	20.34	20.2	19.72	19.17	18.74	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.94	0.84	0.65	0.47	0.54	0.82	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	423.1	464.73	512.49	563.19	555.3	431.57	296.43	307.45	410.43	424.55	406.86	405.45	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1191.45	1153.28	1046.23	878.35	681.52	458.31	300.96	315.97	491.67	738.8	981.8	1187.27	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	571.65	462.7	397.1	226.91	93.91	0	0	0	0	233.81	413.96	581.67	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2981.71 (98)

Space heating requirement in kWh/m²/year 45.01 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	571.65	462.7	397.1	226.91	93.91	0	0	0	0	233.81	413.96	581.67	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	611.39	494.87	424.71	242.69	100.44	0	0	0	0	250.06	442.73	622.11	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 3189 (211)

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Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)

185.75	163.79	172.18	154.58	151.65	135.75	130.6	143	142.64	160.28	169.19	181.36

Efficiency of water heater 79.8 (216)

(217)m=	87.62	87.43	86.97	85.84	83.58	79.8	79.8	79.8	79.8	85.82	87.11	87.7	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	212	187.33	197.97	180.09	181.45	170.11	163.66	179.19	178.75	186.77	194.22	206.78

Total = Sum(219a)$_{1...12}$ = 2238.34 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		3189	
Water heating fuel used		2238.34	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	75	(231)
Electricity for lighting		297.09	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		5799.42	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	688.82	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	483.48	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1172.3	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	154.19	(268)
Total CO2, kg/year		sum of (265)…(271) =		1365.42	(272)

TER = 20.61 (273)

SAP Input

Property Details: Sample 3 (Bottom)

Address:	
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	26 July 2019
Date of certificate:	15 June 2022
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	498

Property description:

Dwelling type:	Flat
Detachment:	
Year Completed:	2022

Floor Location:	Floor area:	Storey height:
Floor 0	67 m²	3 m

Living area:	27.3 m² (fraction 0.407)
Front of dwelling faces:	Unspecified

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
DOOR	Manufacturer	Solid			Wood
E	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
S	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Balcony	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
DOOR	mm	0.7	0	1.4	2.4	1
E		0.7	0.4	1	1.44	1
S		0.7	0.4	1	5.44	1
Balcony		0.7	0.4	1	4.8	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
DOOR		INT	Worst case	0	0
E		E	East	0	0
S		S	South	0	0
Balcony		S	South	0	0

Overshading: More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
<u>External Elements</u>							
S	31.65	10.24	21.41	0.15	0	False	N/A
E	2.3	1.44	0.86	0.15	0	False	N/A
INT	11.1	2.4	8.7	0.16	0.43	False	N/A
Spandrel	2.4	0	2.4	0.35	0	False	N/A
Exposed	67			0.11			N/A
<u>Internal Elements</u>							
<u>Party Elements</u>							

SAP Input

Thermal bridges:	
Thermal bridges:	No information on thermal bridging (y=0.15) (y =0.15)
Ventilation:	
Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	3
Main heating system:	
Main heating system:	Community heating schemes Heat source: Community heat pump heat from electric heat pump, heat fraction 1, efficiency 256 Piping>=1991, pre-insulated, low temp, variable flow Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Boiler interlock: Yes
Main heating Control:	
Main heating Control:	Charging system linked to use of community heating, programmer and TRVs Control code: 2306
Secondary heating system:	
Secondary heating system:	None
Water heating:	
Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Flue Gas Heat Recovery System: Database (rev 498, product index 060036) Brand name: Worcester Model: Greenstar Xtra Model qualifier: 2015 Solar panel: False
Others:	
Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	Photovoltaic 1 Installed Peak power: 0.6 Tilt of collector: 30° Overshading: None or very little Collector Orientation: South
Assess Zero Carbon Home:	No

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: **Stroma Number:**
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.51

Property Address: Sample 3 (Bottom)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67	(1a) x	3	(2a) =	201	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	201	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

DRAFT

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.05 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1.4	=	3.36			(26)
Windows Type 1			1.44	x	1/[1/(1)+ 0.04]	=	1.38			(27)
Windows Type 2			5.44	x	1/[1/(1)+ 0.04]	=	5.23			(27)
Windows Type 3			4.8	x	1/[1/(1)+ 0.04]	=	4.62			(27)
Floor			67	x	0.11	=	7.37			(28)
Walls Type1	31.65	10.24	21.41	x	0.15	=	3.21			(29)
Walls Type2	2.3	1.44	0.86	x	0.15	=	0.13			(29)
Walls Type3	11.1	2.4	8.7	x	0.15	=	1.3			(29)
Walls Type4	2.4	0	2.4	x	0.35	=	0.84			(29)
Total area of elements, m²			114.45							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 27.44 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5492.18 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 17.17 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 44.61 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

DER WorkSheet: New dwelling design stage

(38)m=	17.73	17.52	17.31	16.25	16.04	14.98	14.98	14.77	15.41	16.04	16.46	16.89	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	62.34	62.13	61.92	60.86	60.65	59.59	59.59	59.38	60.02	60.65	61.07	61.5	

Average = Sum(39)$_{1...12}$ /12= 60.81 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.93	0.93	0.92	0.91	0.91	0.89	0.89	0.89	0.9	0.91	0.91	0.92

Average = Sum(40)$_{1...12}$ /12= 0.91 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.17 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.76 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	94.34	90.91	87.48	84.05	80.62	77.19	77.19	80.62	84.05	87.48	90.91	94.34

Total = Sum(44)$_{1...12}$ = 1029.18 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.91	122.36	126.27	110.08	105.63	91.15	84.46	96.92	98.08	114.3	124.77	135.49

Total = Sum(45)$_{1...12}$ = 1349.41 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.99	18.35	18.94	16.51	15.84	13.67	12.67	14.54	14.71	17.15	18.72	20.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	195.18	172.29	181.54	163.58	160.9	144.64	139.74	152.2	151.57	169.58	178.26	190.77	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	18.03	16.04	16.49	14.58	14.03	12.18	11.28	12.94	13.08	15.09	16.32	17.54	(63) (G2)

Output from water heater

(64)m=	174.47	153.83	162.37	146.4	144.19	129.86	125.78	136.58	135.89	151.81	159.35	170.55	

Output from water heater (annual)$_{1...12}$ | 1791.08 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	90.74	80.63	86.21	79.4	79.34	73.1	72.31	76.45	75.41	82.23	84.28	89.27	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.86	15.86	12.9	9.77	7.3	6.16	6.66	8.66	11.62	14.75	17.22	18.36	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	190.2	192.17	187.2	176.61	163.24	150.68	142.29	140.32	145.29	155.88	169.24	181.8	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	(71)

Water heating gains (Table 5)

(72)m=	121.96	119.98	115.87	110.27	106.64	101.53	97.18	102.75	104.73	110.52	117.06	119.99	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	385.59	383.58	371.53	352.22	332.75	313.94	301.7	307.29	317.21	336.72	359.09	375.72	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	1.44	x	19.64	x	0.4	x	0.7	=	5.49	(76)

East	0.9x	0.77	x	1.44	x	38.42	x	0.4	x	0.7	=	10.74	(76)
East	0.9x	0.77	x	1.44	x	63.27	x	0.4	x	0.7	=	17.68	(76)
East	0.9x	0.77	x	1.44	x	92.28	x	0.4	x	0.7	=	25.78	(76)
East	0.9x	0.77	x	1.44	x	113.09	x	0.4	x	0.7	=	31.6	(76)
East	0.9x	0.77	x	1.44	x	115.77	x	0.4	x	0.7	=	32.35	(76)
East	0.9x	0.77	x	1.44	x	110.22	x	0.4	x	0.7	=	30.8	(76)
East	0.9x	0.77	x	1.44	x	94.68	x	0.4	x	0.7	=	26.45	(76)
East	0.9x	0.77	x	1.44	x	73.59	x	0.4	x	0.7	=	20.56	(76)
East	0.9x	0.77	x	1.44	x	45.59	x	0.4	x	0.7	=	12.74	(76)
East	0.9x	0.77	x	1.44	x	24.49	x	0.4	x	0.7	=	6.84	(76)
East	0.9x	0.77	x	1.44	x	16.15	x	0.4	x	0.7	=	4.51	(76)
South	0.9x	0.77	x	5.44	x	46.75	x	0.4	x	0.7	=	49.35	(78)
South	0.9x	0.77	x	4.8	x	46.75	x	0.4	x	0.7	=	43.54	(78)
South	0.9x	0.77	x	5.44	x	76.57	x	0.4	x	0.7	=	80.82	(78)
South	0.9x	0.77	x	4.8	x	76.57	x	0.4	x	0.7	=	71.31	(78)
South	0.9x	0.77	x	5.44	x	97.53	x	0.4	x	0.7	=	102.95	(78)
South	0.9x	0.77	x	4.8	x	97.53	x	0.4	x	0.7	=	90.84	(78)
South	0.9x	0.77	x	5.44	x	110.23	x	0.4	x	0.7	=	116.36	(78)
South	0.9x	0.77	x	4.8	x	110.23	x	0.4	x	0.7	=	102.67	(78)
South	0.9x	0.77	x	5.44	x	114.87	x	0.4	x	0.7	=	121.26	(78)
South	0.9x	0.77	x	4.8	x	114.87	x	0.4	x	0.7	=	106.99	(78)
South	0.9x	0.77	x	5.44	x	110.55	x	0.4	x	0.7	=	116.69	(78)
South	0.9x	0.77	x	4.8	x	110.55	x	0.4	x	0.7	=	102.96	(78)
South	0.9x	0.77	x	5.44	x	108.01	x	0.4	x	0.7	=	114.01	(78)
South	0.9x	0.77	x	4.8	x	108.01	x	0.4	x	0.7	=	100.6	(78)
South	0.9x	0.77	x	5.44	x	104.89	x	0.4	x	0.7	=	110.72	(78)
South	0.9x	0.77	x	4.8	x	104.89	x	0.4	x	0.7	=	97.7	(78)
South	0.9x	0.77	x	5.44	x	101.89	x	0.4	x	0.7	=	107.55	(78)
South	0.9x	0.77	x	4.8	x	101.89	x	0.4	x	0.7	=	94.9	(78)
South	0.9x	0.77	x	5.44	x	82.59	x	0.4	x	0.7	=	87.18	(78)
South	0.9x	0.77	x	4.8	x	82.59	x	0.4	x	0.7	=	76.92	(78)
South	0.9x	0.77	x	5.44	x	55.42	x	0.4	x	0.7	=	58.5	(78)
South	0.9x	0.77	x	4.8	x	55.42	x	0.4	x	0.7	=	51.62	(78)
South	0.9x	0.77	x	5.44	x	40.4	x	0.4	x	0.7	=	42.64	(78)
South	0.9x	0.77	x	4.8	x	40.4	x	0.4	x	0.7	=	37.63	(78)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	98.38	162.87	211.48	244.82	259.85	252	245.41	234.88	223.01	176.83	116.95	84.78	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	483.97	546.46	583.01	597.03	592.6	565.95	547.11	542.17	540.21	513.55	476.04	460.5	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

(86)m=	0.99	0.99	0.97	0.93	0.84	0.65	0.48	0.5	0.73	0.93	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.18	20.33	20.52	20.74	20.9	20.98	21	21	20.97	20.78	20.44	20.16	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.14	20.14	20.15	20.16	20.16	20.18	20.18	20.18	20.17	20.16	20.16	20.15	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.96	0.91	0.79	0.58	0.39	0.41	0.65	0.91	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.06	19.27	19.54	19.86	20.07	20.17	20.18	20.18	20.15	19.92	19.45	19.03	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.52	19.7	19.94	20.21	20.41	20.5	20.51	20.51	20.48	20.27	19.85	19.49	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.52	19.7	19.94	20.21	20.41	20.5	20.51	20.51	20.48	20.27	19.85	19.49	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.96	0.91	0.81	0.61	0.42	0.45	0.68	0.91	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	479.68	536.39	560.58	544.81	477.3	344.35	232.38	243.23	368.39	467.11	466.47	457.34	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	948.58	919.51	832.1	688.65	528.07	351.52	233.05	244.17	382.99	586.3	778.98	940.32	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	348.86	257.46	202.01	103.57	37.77	0	0	0	0	88.68	225	359.34	

Total per year (kWh/year) = $\text{Sum}(98)_{1...5,9...12}$ = 1622.69 (98)

Space heating requirement in kWh/m²/year 24.22 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none 0 (301)

Fraction of space heat from community system 1 – (301) = 1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump 1 (303a)

Fraction of total space heat from Community heat pump (302) x (303a) = 1 (304a)

Factor for control and charging method (Table 4c(3)) for community heating system 1 (305)

Distribution loss factor (Table 12c) for community heating system 1.05 (306)

Space heating **kWh/year**

Annual space heating requirement 1622.69

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Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	1703.83	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)

Water heating

Annual water heating requirement		1791.08	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	1880.63	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	35.84	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		119.54	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	119.54	(331)
Energy for lighting (calculated in Appendix L)		315.44	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-518.17	(333)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		3501.28	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	**Emission factor kg CO2/kWh**		**Emissions kg CO2/year**	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				256	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	726.69	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	18.6	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	745.3	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				745.3	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	62.04	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	163.72	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1		0.52		x 0.01 =	-268.93	(380)
Total CO2, kg/year	sum of (376)…(382) =				702.13	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				10.48	(384)
EI rating (section 14)					91.6	(385)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**

Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.51

Property Address: Sample 3 (Bottom)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67	(1a) x	3	(2a) =	201	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		201	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.1	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35				
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration		0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate		(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.35	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
Number of sides sheltered			2	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor		(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.37	0.36	0.33	0.32	0.28	0.28	0.27	0.3	0.32	0.33	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1	=	2.4			(26)
Windows Type 1			1.44	x1/[1/(1.4)+ 0.04]		=	1.91			(27)
Windows Type 2			5.44	x1/[1/(1.4)+ 0.04]		=	7.21			(27)
Windows Type 3			4.8	x1/[1/(1.4)+ 0.04]		=	6.36			(27)
Floor			67	x	0.13	=	8.71			(28)
Walls Type1	31.65	10.24	21.41	x	0.18	=	3.85			(29)
Walls Type2	2.3	1.44	0.86	x	0.18	=	0.15			(29)
Walls Type3	11.1	2.4	8.7	x	0.18	=	1.57			(29)
Walls Type4	2.4	0	2.4	x	0.18	=	0.43			(29)
Total area of elements, m²			114.45							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 32.6 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5492.18 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 5.72 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 38.32 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

TER WorkSheet: New dwelling design stage

(38)m=	37.92	37.74	37.56	36.71	36.55	35.81	35.81	35.67	36.09	36.55	36.87	37.21	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	76.25	76.06	75.88	75.03	74.87	74.13	74.13	73.99	74.42	74.87	75.19	75.53	

Average = Sum(39)1…12 /12= 75.03 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.14	1.14	1.13	1.12	1.12	1.11	1.11	1.1	1.11	1.12	1.12	1.13	

Average = Sum(40)1…12 /12= 1.12 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.17 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.76 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	94.34	90.91	87.48	84.05	80.62	77.19	77.19	80.62	84.05	87.48	90.91	94.34	

Total = Sum(44)1…12 = 1029.18 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.91	122.36	126.27	110.08	105.63	91.15	84.46	96.92	98.08	114.3	124.77	135.49	

Total = Sum(45)1…12 = 1349.41 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.99	18.35	18.94	16.51	15.84	13.67	12.67	14.54	14.71	17.15	18.72	20.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09	

Output from water heater (annual)$_{1...12}$ | 1898.03 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	83.79	74.35	79.26	72.68	72.4	66.38	65.36	69.5	68.68	75.28	77.56	82.33	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	17.41	15.46	12.58	9.52	7.12	6.01	6.49	8.44	11.33	14.38	16.79	17.89	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	190.2	192.17	187.2	176.61	163.24	150.68	142.29	140.32	145.29	155.88	169.24	181.8	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	(71)
Water heating gains (Table 5)													
(72)m=	112.63	110.65	106.53	100.94	97.31	92.19	87.85	93.42	95.4	101.18	107.72	110.65	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	378.8	376.85	364.87	345.64	326.23	307.45	295.2	300.74	310.58	330.01	352.32	368.92	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	1.44	x	19.64	x	0.63	x	0.7	=	8.64	(76)

East	0.9x	0.77	x	1.44	x	38.42	x	0.63	x	0.7	=	16.91	(76)
East	0.9x	0.77	x	1.44	x	63.27	x	0.63	x	0.7	=	27.85	(76)
East	0.9x	0.77	x	1.44	x	92.28	x	0.63	x	0.7	=	40.61	(76)
East	0.9x	0.77	x	1.44	x	113.09	x	0.63	x	0.7	=	49.77	(76)
East	0.9x	0.77	x	1.44	x	115.77	x	0.63	x	0.7	=	50.95	(76)
East	0.9x	0.77	x	1.44	x	110.22	x	0.63	x	0.7	=	48.51	(76)
East	0.9x	0.77	x	1.44	x	94.68	x	0.63	x	0.7	=	41.67	(76)
East	0.9x	0.77	x	1.44	x	73.59	x	0.63	x	0.7	=	32.39	(76)
East	0.9x	0.77	x	1.44	x	45.59	x	0.63	x	0.7	=	20.06	(76)
East	0.9x	0.77	x	1.44	x	24.49	x	0.63	x	0.7	=	10.78	(76)
East	0.9x	0.77	x	1.44	x	16.15	x	0.63	x	0.7	=	7.11	(76)
South	0.9x	0.77	x	5.44	x	46.75	x	0.63	x	0.7	=	77.73	(78)
South	0.9x	0.77	x	4.8	x	46.75	x	0.63	x	0.7	=	68.58	(78)
South	0.9x	0.77	x	5.44	x	76.57	x	0.63	x	0.7	=	127.3	(78)
South	0.9x	0.77	x	4.8	x	76.57	x	0.63	x	0.7	=	112.32	(78)
South	0.9x	0.77	x	5.44	x	97.53	x	0.63	x	0.7	=	162.15	(78)
South	0.9x	0.77	x	4.8	x	97.53	x	0.63	x	0.7	=	143.08	(78)
South	0.9x	0.77	x	5.44	x	110.23	x	0.63	x	0.7	=	183.27	(78)
South	0.9x	0.77	x	4.8	x	110.23	x	0.63	x	0.7	=	161.71	(78)
South	0.9x	0.77	x	5.44	x	114.87	x	0.63	x	0.7	=	190.98	(78)
South	0.9x	0.77	x	4.8	x	114.87	x	0.63	x	0.7	=	168.51	(78)
South	0.9x	0.77	x	5.44	x	110.55	x	0.63	x	0.7	=	183.79	(78)
South	0.9x	0.77	x	4.8	x	110.55	x	0.63	x	0.7	=	162.17	(78)
South	0.9x	0.77	x	5.44	x	108.01	x	0.63	x	0.7	=	179.57	(78)
South	0.9x	0.77	x	4.8	x	108.01	x	0.63	x	0.7	=	158.45	(78)
South	0.9x	0.77	x	5.44	x	104.89	x	0.63	x	0.7	=	174.39	(78)
South	0.9x	0.77	x	4.8	x	104.89	x	0.63	x	0.7	=	153.87	(78)
South	0.9x	0.77	x	5.44	x	101.89	x	0.63	x	0.7	=	169.39	(78)
South	0.9x	0.77	x	4.8	x	101.89	x	0.63	x	0.7	=	149.46	(78)
South	0.9x	0.77	x	5.44	x	82.59	x	0.63	x	0.7	=	137.3	(78)
South	0.9x	0.77	x	4.8	x	82.59	x	0.63	x	0.7	=	121.15	(78)
South	0.9x	0.77	x	5.44	x	55.42	x	0.63	x	0.7	=	92.13	(78)
South	0.9x	0.77	x	4.8	x	55.42	x	0.63	x	0.7	=	81.29	(78)
South	0.9x	0.77	x	5.44	x	40.4	x	0.63	x	0.7	=	67.16	(78)
South	0.9x	0.77	x	4.8	x	40.4	x	0.63	x	0.7	=	59.26	(78)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	154.95	256.53	333.08	385.59	409.26	396.91	386.53	369.93	351.23	278.51	184.2	133.53	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	533.75	633.37	697.95	731.22	735.49	704.36	681.72	670.67	661.81	608.52	536.52	502.45	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

(86)m=	0.99	0.98	0.96	0.91	0.81	0.64	0.47	0.5	0.72	0.92	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.96	20.15	20.4	20.66	20.86	20.97	20.99	20.99	20.94	20.69	20.27	19.92	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.97	19.97	19.97	19.98	19.99	20	20	20	19.99	19.99	19.98	19.98	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.95	0.89	0.76	0.55	0.37	0.39	0.63	0.89	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.6	18.89	19.23	19.6	19.86	19.98	19.99	19.99	19.95	19.66	19.07	18.55	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.15	19.4	19.71	20.04	20.27	20.38	20.4	20.4	20.36	20.08	19.56	19.11	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.15	19.4	19.71	20.04	20.27	20.38	20.4	20.4	20.36	20.08	19.56	19.11	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.97	0.95	0.89	0.78	0.59	0.41	0.44	0.67	0.89	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	527.45	616.68	660.14	648.81	570.04	415.14	280.11	293.69	440.29	544.15	522.89	497.9	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1132.43	1103.12	1002.19	835.48	641.41	428.52	281.81	296.07	465.61	709.61	936.7	1125.95	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	450.1	326.88	254.48	134.4	53.1	0	0	0	0	123.1	297.94	467.27	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2107.29 (98)

Space heating requirement in kWh/m²/year 31.45 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	450.1	326.88	254.48	134.4	53.1	0	0	0	0	123.1	297.94	467.27	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	481.39	349.61	272.17	143.75	56.79	0	0	0	0	131.66	318.65	499.75	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2253.78 (211)

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Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)

186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09

Efficiency of water heater 79.8 (216)

(217)m=	87.08	86.61	85.84	84.43	82.32	79.8	79.8	79.8	79.8	84.11	86.3	87.22

(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	214.17	189.87	201.37	183.78	184.92	170.73	164.23	179.84	179.41	191.29	196.83	208.76

Total = Sum(219a)$_{1...12}$ = 2265.21 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2253.78	
Water heating fuel used		2265.21	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	75	(231)
Electricity for lighting		307.48	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		4901.47	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	486.82	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	489.29	(264)
Space and water heating	(261) + (262) + (263) + (264) =			976.1	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	159.58	(268)
Total CO2, kg/year		sum of (265)…(271) =		1174.61	(272)

TER = 17.53 (273)

SAP Input

Property Details: Sample 4 (Bottom)

Address:	
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	26 July 2019
Date of certificate:	15 June 2022
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	498

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2022	
Floor Location:	Floor area:	Storey height:
Floor 0	67 m²	3 m
Living area:	27.3 m² (fraction 0.407)	
Front of dwelling faces:	Unspecified	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
DOOR	Manufacturer	Solid			Wood
W	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
S	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Balcony	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
DOOR	mm	0.7	0	1.4	2.4	1
W		0.7	0.4	1	1.44	1
S		0.7	0.4	1	5.44	1
Balcony		0.7	0.4	1	4.8	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
DOOR		INT	Worst case	0	0
W		W	West	0	0
S		S	South	0	0
Balcony		S	South	0	0

Overshading: More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
S	31.7	10.24	21.46	0.15	0	False	N/A
W	19	1.44	17.56	0.15	0	False	N/A
INT	11.1	2.4	8.7	0.16	0.43	False	N/A
Spandrel	2.4	0	2.4	0.35	0	False	N/A
Exposed	67			0.11			N/A
Internal Elements							
Party Elements							

SAP Input

Thermal bridges:	
Thermal bridges:	No information on thermal bridging (y=0.15) (y =0.15)
Ventilation:	
Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	3
Main heating system:	
Main heating system:	Community heating schemes Heat source: Community heat pump heat from electric heat pump, heat fraction 1, efficiency 256 Piping>=1991, pre-insulated, low temp, variable flow Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Boiler interlock: Yes
Main heating Control:	
Main heating Control:	Charging system linked to use of community heating, programmer and TRVs Control code: 2306
Secondary heating system:	
Secondary heating system:	None
Water heating:	
Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Flue Gas Heat Recovery System: Database (rev 498, product index 060036) Brand name: Worcester Model: Greenstar Xtra Model qualifier: 2015 Solar panel: False
Others:	
Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	Photovoltaic 1 Installed Peak power: 0.6 Tilt of collector: 30° Overshading: None or very little Collector Orientation: South
Assess Zero Carbon Home:	No

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User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.5.51

Property Address: Sample 4 (Bottom)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67	(1a) x	3	(2a) =	201	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	201	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

DRAFT

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*		0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	79.05	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1.4	=	3.36			(26)
Windows Type 1			1.44	x	1/[1/(1)+ 0.04]	=	1.38			(27)
Windows Type 2			5.44	x	1/[1/(1)+ 0.04]	=	5.23			(27)
Windows Type 3			4.8	x	1/[1/(1)+ 0.04]	=	4.62			(27)
Floor			67	x	0.11	=	7.37			(28)
Walls Type1	31.7	10.24	21.46	x	0.15	=	3.22			(29)
Walls Type2	19	1.44	17.56	x	0.15	=	2.63			(29)
Walls Type3	11.1	2.4	8.7	x	0.15	=	1.3			(29)
Walls Type4	2.4	0	2.4	x	0.35	=	0.84			(29)
Total area of elements, m²			131.2							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	29.96	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	5726.68	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		19.68	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	49.64	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(38)m=	17.73	17.52	17.31	16.25	16.04	14.98	14.98	14.77	15.41	16.04	16.46	16.89	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	67.37	67.16	66.94	65.89	65.68	64.62	64.62	64.41	65.04	65.68	66.1	66.52	

Average = Sum(39)$_{1...12}$ /12= 65.83 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.01	1	1	0.98	0.98	0.96	0.96	0.96	0.97	0.98	0.99	0.99	

Average = Sum(40)$_{1...12}$ /12= 0.98 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.17 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.76 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	94.34	90.91	87.48	84.05	80.62	77.19	77.19	80.62	84.05	87.48	90.91	94.34	

Total = Sum(44)$_{1...12}$ = 1029.18 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.91	122.36	126.27	110.08	105.63	91.15	84.46	96.92	98.08	114.3	124.77	135.49	

Total = Sum(45)$_{1...12}$ = 1349.41 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.99	18.35	18.94	16.51	15.84	13.67	12.67	14.54	14.71	17.15	18.72	20.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	195.18	172.29	181.54	163.58	160.9	144.64	139.74	152.2	151.57	169.58	178.26	190.77	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	18.03	16.04	16.49	14.58	14.03	12.18	11.28	12.94	13.08	15.09	16.32	17.54	(63) (G2)

Output from water heater

(64)m=	174.47	153.83	162.37	146.4	144.19	129.86	125.78	136.58	135.89	151.81	159.35	170.55	

Output from water heater (annual)$_{1...12}$ | 1791.08 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	90.74	80.63	86.21	79.4	79.34	73.1	72.31	76.45	75.41	82.23	84.28	89.27	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.86	15.86	12.9	9.77	7.3	6.16	6.66	8.66	11.62	14.75	17.22	18.36	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	190.2	192.17	187.2	176.61	163.24	150.68	142.29	140.32	145.29	155.88	169.24	181.8	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	(71)

Water heating gains (Table 5)

(72)m=	121.96	119.98	115.87	110.27	106.64	101.53	97.18	102.75	104.73	110.52	117.06	119.99	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	385.59	383.58	371.53	352.22	332.75	313.94	301.7	307.29	317.21	336.72	359.09	375.72	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	5.44	x	46.75	x	0.4	x	0.7	=	49.35	(78)

South	0.9x	0.77	x	4.8	x	46.75	x	0.4	x	0.7	=	43.54	(78)
South	0.9x	0.77	x	5.44	x	76.57	x	0.4	x	0.7	=	80.82	(78)
South	0.9x	0.77	x	4.8	x	76.57	x	0.4	x	0.7	=	71.31	(78)
South	0.9x	0.77	x	5.44	x	97.53	x	0.4	x	0.7	=	102.95	(78)
South	0.9x	0.77	x	4.8	x	97.53	x	0.4	x	0.7	=	90.84	(78)
South	0.9x	0.77	x	5.44	x	110.23	x	0.4	x	0.7	=	116.36	(78)
South	0.9x	0.77	x	4.8	x	110.23	x	0.4	x	0.7	=	102.67	(78)
South	0.9x	0.77	x	5.44	x	114.87	x	0.4	x	0.7	=	121.26	(78)
South	0.9x	0.77	x	4.8	x	114.87	x	0.4	x	0.7	=	106.99	(78)
South	0.9x	0.77	x	5.44	x	110.55	x	0.4	x	0.7	=	116.69	(78)
South	0.9x	0.77	x	4.8	x	110.55	x	0.4	x	0.7	=	102.96	(78)
South	0.9x	0.77	x	5.44	x	108.01	x	0.4	x	0.7	=	114.01	(78)
South	0.9x	0.77	x	4.8	x	108.01	x	0.4	x	0.7	=	100.6	(78)
South	0.9x	0.77	x	5.44	x	104.89	x	0.4	x	0.7	=	110.72	(78)
South	0.9x	0.77	x	4.8	x	104.89	x	0.4	x	0.7	=	97.7	(78)
South	0.9x	0.77	x	5.44	x	101.89	x	0.4	x	0.7	=	107.55	(78)
South	0.9x	0.77	x	4.8	x	101.89	x	0.4	x	0.7	=	94.9	(78)
South	0.9x	0.77	x	5.44	x	82.59	x	0.4	x	0.7	=	87.18	(78)
South	0.9x	0.77	x	4.8	x	82.59	x	0.4	x	0.7	=	76.92	(78)
South	0.9x	0.77	x	5.44	x	55.42	x	0.4	x	0.7	=	58.5	(78)
South	0.9x	0.77	x	4.8	x	55.42	x	0.4	x	0.7	=	51.62	(78)
South	0.9x	0.77	x	5.44	x	40.4	x	0.4	x	0.7	=	42.64	(78)
South	0.9x	0.77	x	4.8	x	40.4	x	0.4	x	0.7	=	37.63	(78)
West	0.9x	0.77	x	1.44	x	19.64	x	0.4	x	0.7	=	5.49	(80)
West	0.9x	0.77	x	1.44	x	38.42	x	0.4	x	0.7	=	10.74	(80)
West	0.9x	0.77	x	1.44	x	63.27	x	0.4	x	0.7	=	17.68	(80)
West	0.9x	0.77	x	1.44	x	92.28	x	0.4	x	0.7	=	25.78	(80)
West	0.9x	0.77	x	1.44	x	113.09	x	0.4	x	0.7	=	31.6	(80)
West	0.9x	0.77	x	1.44	x	115.77	x	0.4	x	0.7	=	32.35	(80)
West	0.9x	0.77	x	1.44	x	110.22	x	0.4	x	0.7	=	30.8	(80)
West	0.9x	0.77	x	1.44	x	94.68	x	0.4	x	0.7	=	26.45	(80)
West	0.9x	0.77	x	1.44	x	73.59	x	0.4	x	0.7	=	20.56	(80)
West	0.9x	0.77	x	1.44	x	45.59	x	0.4	x	0.7	=	12.74	(80)
West	0.9x	0.77	x	1.44	x	24.49	x	0.4	x	0.7	=	6.84	(80)
West	0.9x	0.77	x	1.44	x	16.15	x	0.4	x	0.7	=	4.51	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	98.38	162.87	211.48	244.82	259.85	252	245.41	234.88	223.01	176.83	116.95	84.78	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	483.97	546.46	583.01	597.03	592.6	565.95	547.11	542.17	540.21	513.55	476.04	460.5	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(86)m=	0.99	0.99	0.98	0.94	0.86	0.69	0.51	0.54	0.76	0.94	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.07	20.22	20.42	20.66	20.86	20.97	21	20.99	20.95	20.71	20.35	20.05	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.08	20.08	20.08	20.1	20.1	20.11	20.11	20.12	20.11	20.1	20.09	20.09	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.97	0.92	0.82	0.61	0.41	0.44	0.69	0.92	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.85	19.07	19.36	19.7	19.96	20.09	20.11	20.11	20.07	19.78	19.27	18.82	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.35	19.54	19.79	20.09	20.33	20.45	20.47	20.47	20.43	20.16	19.71	19.32	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.35	19.54	19.79	20.09	20.33	20.45	20.47	20.47	20.43	20.16	19.71	19.32	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.97	0.92	0.83	0.65	0.45	0.48	0.72	0.92	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	479.93	537.31	563.24	552.12	492.69	365.13	248.72	260.28	387.24	473.6	467.42	457.5	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1013.82	982.98	889.74	737.57	566.46	378.05	250.18	262.28	411.46	627.84	833.51	1006	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	397.22	299.49	242.92	133.53	54.89	0	0	0	0	114.75	263.58	408.09	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1914.46 (98)

Space heating requirement in kWh/m²/year 28.57 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none 0 (301)

Fraction of space heat from community system 1 – (301) = 1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump 1 (303a)

Fraction of total space heat from Community heat pump (302) x (303a) = 1 (304a)

Factor for control and charging method (Table 4c(3)) for community heating system 1 (305)

Distribution loss factor (Table 12c) for community heating system 1.05 (306)

Space heating **kWh/year**

Annual space heating requirement 1914.46

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Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	2010.19	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)

Water heating

Annual water heating requirement		1791.08	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	1880.63	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	38.91	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		119.54	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	119.54	(331)
Energy for lighting (calculated in Appendix L)		315.44	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-518.17	(333)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		3807.64	(338)

12b. CO_2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				256	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	788.8	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	20.19	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	809	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				809	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	62.04	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	163.72	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1		0.52		x 0.01 =	-268.93	(380)
Total CO2, kg/year	sum of (376)…(382) =				765.82	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				11.43	(384)
EI rating (section 14)					90.84	(385)

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User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.5.51

Property Address: Sample 4 (Bottom)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67	(1a) x	3	(2a) =	201	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	201	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

DRAFT

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.1	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*		0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.35	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.37	0.36	0.33	0.32	0.28	0.28	0.27	0.3	0.32	0.33	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1	=	2.4			(26)
Windows Type 1			1.44	x1/[1/(1.4)+ 0.04]		=	1.91			(27)
Windows Type 2			5.44	x1/[1/(1.4)+ 0.04]		=	7.21			(27)
Windows Type 3			4.8	x1/[1/(1.4)+ 0.04]		=	6.36			(27)
Floor			67	x	0.13	=	8.71			(28)
Walls Type1	31.7	10.24	21.46	x	0.18	=	3.86			(29)
Walls Type2	19	1.44	17.56	x	0.18	=	3.16			(29)
Walls Type3	11.1	2.4	8.7	x	0.18	=	1.57			(29)
Walls Type4	2.4	0	2.4	x	0.18	=	0.43			(29)
Total area of elements, m²			131.2							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 35.62 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5726.68 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 6.56 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 42.18 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(38)m=	37.92	37.74	37.56	36.71	36.55	35.81	35.81	35.67	36.09	36.55	36.87	37.21	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	80.1	79.91	79.73	78.88	78.72	77.98	77.98	77.85	78.27	78.72	79.05	79.38	

Average = Sum(39)$_{1...12}$ /12= 78.88 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.2	1.19	1.19	1.18	1.17	1.16	1.16	1.16	1.17	1.17	1.18	1.18	

Average = Sum(40)$_{1...12}$ /12= 1.18 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.17 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.76 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	94.34	90.91	87.48	84.05	80.62	77.19	77.19	80.62	84.05	87.48	90.91	94.34	

Total = Sum(44)$_{1...12}$ = 1029.18 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.91	122.36	126.27	110.08	105.63	91.15	84.46	96.92	98.08	114.3	124.77	135.49	

Total = Sum(45)$_{1...12}$ = 1349.41 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.99	18.35	18.94	16.51	15.84	13.67	12.67	14.54	14.71	17.15	18.72	20.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09	

Output from water heater (annual)$_{1...12}$ | 1898.03 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	83.79	74.35	79.26	72.68	72.4	66.38	65.36	69.5	68.68	75.28	77.56	82.33	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.41	15.46	12.58	9.52	7.12	6.01	6.49	8.44	11.33	14.38	16.79	17.89	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	190.2	192.17	187.2	176.61	163.24	150.68	142.29	140.32	145.29	155.88	169.24	181.8	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	(71)

Water heating gains (Table 5)

(72)m=	112.63	110.65	106.53	100.94	97.31	92.19	87.85	93.42	95.4	101.18	107.72	110.65	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	378.8	376.85	364.87	345.64	326.23	307.45	295.2	300.74	310.58	330.01	352.32	368.92	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	5.44	x	46.75	x	0.63	x	0.7	=	77.73	(78)

South	0.9x	0.77	x	4.8	x	46.75	x	0.63	x	0.7	=	68.58	(78)
South	0.9x	0.77	x	5.44	x	76.57	x	0.63	x	0.7	=	127.3	(78)
South	0.9x	0.77	x	4.8	x	76.57	x	0.63	x	0.7	=	112.32	(78)
South	0.9x	0.77	x	5.44	x	97.53	x	0.63	x	0.7	=	162.15	(78)
South	0.9x	0.77	x	4.8	x	97.53	x	0.63	x	0.7	=	143.08	(78)
South	0.9x	0.77	x	5.44	x	110.23	x	0.63	x	0.7	=	183.27	(78)
South	0.9x	0.77	x	4.8	x	110.23	x	0.63	x	0.7	=	161.71	(78)
South	0.9x	0.77	x	5.44	x	114.87	x	0.63	x	0.7	=	190.98	(78)
South	0.9x	0.77	x	4.8	x	114.87	x	0.63	x	0.7	=	168.51	(78)
South	0.9x	0.77	x	5.44	x	110.55	x	0.63	x	0.7	=	183.79	(78)
South	0.9x	0.77	x	4.8	x	110.55	x	0.63	x	0.7	=	162.17	(78)
South	0.9x	0.77	x	5.44	x	108.01	x	0.63	x	0.7	=	179.57	(78)
South	0.9x	0.77	x	4.8	x	108.01	x	0.63	x	0.7	=	158.45	(78)
South	0.9x	0.77	x	5.44	x	104.89	x	0.63	x	0.7	=	174.39	(78)
South	0.9x	0.77	x	4.8	x	104.89	x	0.63	x	0.7	=	153.87	(78)
South	0.9x	0.77	x	5.44	x	101.89	x	0.63	x	0.7	=	169.39	(78)
South	0.9x	0.77	x	4.8	x	101.89	x	0.63	x	0.7	=	149.46	(78)
South	0.9x	0.77	x	5.44	x	82.59	x	0.63	x	0.7	=	137.3	(78)
South	0.9x	0.77	x	4.8	x	82.59	x	0.63	x	0.7	=	121.15	(78)
South	0.9x	0.77	x	5.44	x	55.42	x	0.63	x	0.7	=	92.13	(78)
South	0.9x	0.77	x	4.8	x	55.42	x	0.63	x	0.7	=	81.29	(78)
South	0.9x	0.77	x	5.44	x	40.4	x	0.63	x	0.7	=	67.16	(78)
South	0.9x	0.77	x	4.8	x	40.4	x	0.63	x	0.7	=	59.26	(78)
West	0.9x	0.77	x	1.44	x	19.64	x	0.63	x	0.7	=	8.64	(80)
West	0.9x	0.77	x	1.44	x	38.42	x	0.63	x	0.7	=	16.91	(80)
West	0.9x	0.77	x	1.44	x	63.27	x	0.63	x	0.7	=	27.85	(80)
West	0.9x	0.77	x	1.44	x	92.28	x	0.63	x	0.7	=	40.61	(80)
West	0.9x	0.77	x	1.44	x	113.09	x	0.63	x	0.7	=	49.77	(80)
West	0.9x	0.77	x	1.44	x	115.77	x	0.63	x	0.7	=	50.95	(80)
West	0.9x	0.77	x	1.44	x	110.22	x	0.63	x	0.7	=	48.51	(80)
West	0.9x	0.77	x	1.44	x	94.68	x	0.63	x	0.7	=	41.67	(80)
West	0.9x	0.77	x	1.44	x	73.59	x	0.63	x	0.7	=	32.39	(80)
West	0.9x	0.77	x	1.44	x	45.59	x	0.63	x	0.7	=	20.06	(80)
West	0.9x	0.77	x	1.44	x	24.49	x	0.63	x	0.7	=	10.78	(80)
West	0.9x	0.77	x	1.44	x	16.15	x	0.63	x	0.7	=	7.11	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	154.95	256.53	333.08	385.59	409.26	396.91	386.53	369.93	351.23	278.51	184.2	133.53	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	533.75	633.37	697.95	731.22	735.49	704.36	681.72	670.67	661.81	608.52	536.52	502.45	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(86)m=	0.99	0.98	0.96	0.92	0.83	0.67	0.49	0.52	0.74	0.93	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.88	20.08	20.33	20.61	20.83	20.96	20.99	20.99	20.93	20.65	20.2	19.84	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.92	19.93	19.93	19.94	19.94	19.95	19.95	19.95	19.95	19.94	19.94	19.93	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.95	0.9	0.78	0.57	0.38	0.41	0.65	0.9	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.45	18.74	19.1	19.5	19.78	19.92	19.95	19.95	19.89	19.56	18.94	18.4	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.03	19.29	19.6	19.95	20.21	20.34	20.37	20.37	20.32	20	19.45	18.99	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.03	19.29	19.6	19.95	20.21	20.34	20.37	20.37	20.32	20	19.45	18.99	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.97	0.95	0.9	0.79	0.61	0.43	0.46	0.68	0.9	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	527.57	617.4	662.41	654.69	581.4	429.59	291.61	305.62	453.17	548.67	523.48	497.96	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1180.11	1149.67	1044.63	871.6	669.77	447.95	294.18	309.17	486.44	740.03	976.5	1173.88	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	485.48	357.69	284.37	156.17	65.75	0	0	0	0	142.37	326.17	502.88	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2320.89 (98)

Space heating requirement in kWh/m²/year 34.64 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	485.48	357.69	284.37	156.17	65.75	0	0	0	0	142.37	326.17	502.88	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	519.24	382.55	304.14	167.03	70.32	0	0	0	0	152.27	348.85	537.84	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2482.24 (211)

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Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)

186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09

Efficiency of water heater 79.8 (216)

(217)m=	87.25	86.83	86.13	84.83	82.75	79.8	79.8	79.8	79.8	84.49	86.53	87.39	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	213.75	189.38	200.69	182.92	183.95	170.73	164.23	179.84	179.41	190.43	196.31	208.37

Total = Sum(219a)$_{1...12}$ = 2260.02 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2482.24	
Water heating fuel used		2260.02	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		75	(231)
Electricity for lighting		307.48	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		5124.74	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	536.16	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	488.16	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1024.33	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	159.58	(268)
Total CO2, kg/year		sum of (265)…(271) =		1222.83	(272)

TER = 18.25 (273)

DRAFT

SAP Input

Property Details: Sample 5 (Bottom)

Address:	
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	26 July 2019
Date of certificate:	15 June 2022
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	498

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2022	
Floor Location:	Floor area:	Storey height:
Floor 0	67 m²	3 m
Living area:	27.5 m² (fraction 0.41)	
Front of dwelling faces:	Unspecified	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
DOOR	Manufacturer	Solid			Wood
E	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Balcony	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
DOOR	mm	0.7	0	1.4	2.4	1
E		0.7	0.4	1	4.16	1
Balcony		0.7	0.4	1	4.8	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
DOOR		INT	Worst case	0	0
E		E	East	0	0
Balcony		E	East	0	0

Overshading: More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
E	29.4	8.96	20.44	0.15	0	False	N/A
INT	12	2.4	9.6	0.16	0.43	False	N/A
Spandrel	2.44	0	2.44	0.35	0	False	N/A
Exposed	67			0.11			N/A
Internal Elements							
Party Elements							

Thermal bridges:

Thermal bridges: No information on thermal bridging (y=0.15) (y =0.15)

SAP Input

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	3
Pressure test:	3

Main heating system:

Main heating system:	Community heating schemes Heat source: Community heat pump heat from electric heat pump, heat fraction 1, efficiency 256 Piping>=1991, pre-insulated, low temp, variable flow Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Boiler interlock: Yes

Main heating Control:

Main heating Control:	Charging system linked to use of community heating, programmer and TRVs Control code: 2306

Secondary heating system:

Secondary heating system:	None

Water heating:

Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Flue Gas Heat Recovery System: Database (rev 498, product index 060036) Brand name: Worcester Model: Greenstar Xtra Model qualifier: 2015 Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	Photovoltaic 1 Installed Peak power: 0.6 Tilt of collector: 30° Overshading: None or very little Collector Orientation: South
Assess Zero Carbon Home:	No

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.5.51

Property Address: Sample 5 (Bottom)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67	(1a) x	3	(2a) =	201	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		201	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0 ÷ (5) =	0	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)		0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.05 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.25	0.25	0.25	0.23	0.23	0.22	0.22	0.21	0.22	0.23	0.24	0.24	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.25	0.25	0.25	0.23	0.23	0.22	0.22	0.21	0.22	0.23	0.24	0.24	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1.4	=	3.36			(26)
Windows Type 1			4.16	x	1/[1/(1)+ 0.04]	=	4			(27)
Windows Type 2			4.8	x	1/[1/(1)+ 0.04]	=	4.62			(27)
Floor			67	x	0.11	=	7.37			(28)
Walls Type1	29.4	8.96	20.44	x	0.15	=	3.07			(29)
Walls Type2	12	2.4	9.6	x	0.15	=	1.44			(29)
Walls Type3	2.44	0	2.44	x	0.35	=	0.85			(29)
Total area of elements, m²			110.84							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 24.7 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5479.72 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 16.63 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 41.33 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	16.78	16.59	16.39	15.43	15.24	14.27	14.27	14.08	14.66	15.24	15.62	16.01	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	58.11	57.92	57.72	56.76	56.57	55.6	55.6	55.41	55.99	56.57	56.95	57.34	

Average = Sum(39)$_{1…12}$ /12= 56.71 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.87	0.86	0.86	0.85	0.84	0.83	0.83	0.83	0.84	0.84	0.85	0.86

Average = Sum(40)$_{1...12}$ /12= 0.85 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.17 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.76 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	94.34	90.91	87.48	84.05	80.62	77.19	77.19	80.62	84.05	87.48	90.91	94.34	
										Total = Sum(44)$_{1...12}$ =		1029.18	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	139.91	122.36	126.27	110.08	105.63	91.15	84.46	96.92	98.08	114.3	124.77	135.49	
										Total = Sum(45)$_{1...12}$ =		1349.41	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	20.99	18.35	18.94	16.51	15.84	13.67	12.67	14.54	14.71	17.15	18.72	20.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	195.18	172.29	181.54	163.58	160.9	144.64	139.74	152.2	151.57	169.58	178.26	190.77	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	18.03	16.04	16.49	14.58	14.03	12.18	11.28	12.94	13.08	15.09	16.32	17.54	(63) (G2)

Output from water heater

(64)m=	174.47	153.83	162.37	146.4	144.19	129.86	125.78	136.58	135.89	151.81	159.35	170.55	

Output from water heater (annual)1…12 | 1791.08 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	90.74	80.63	86.21	79.4	79.34	73.1	72.31	76.45	75.41	82.23	84.28	89.27	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	18.93	16.81	13.67	10.35	7.74	6.53	7.06	9.17	12.31	15.63	18.25	19.45	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	190.2	192.17	187.2	176.61	163.24	150.68	142.29	140.32	145.29	155.88	169.24	181.8	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	(71)
Water heating gains (Table 5)													
(72)m=	121.96	119.98	115.87	110.27	106.64	101.53	97.18	102.75	104.73	110.52	117.06	119.99	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	386.65	384.53	372.3	352.8	333.19	314.31	302.1	307.81	317.9	337.6	360.11	376.81	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	4.16	x	19.64	x	0.4	x	0.7	=	15.85	(76)
East	0.9x	0.77	x	4.8	x	19.64	x	0.4	x	0.7	=	18.29	(76)
East	0.9x	0.77	x	4.16	x	38.42	x	0.4	x	0.7	=	31.01	(76)
East	0.9x	0.77	x	4.8	x	38.42	x	0.4	x	0.7	=	35.78	(76)

East	0.9x	0.77	x	4.16	x	63.27	x	0.4	x	0.7	=	51.07	(76)
East	0.9x	0.77	x	4.8	x	63.27	x	0.4	x	0.7	=	58.93	(76)
East	0.9x	0.77	x	4.16	x	92.28	x	0.4	x	0.7	=	74.49	(76)
East	0.9x	0.77	x	4.8	x	92.28	x	0.4	x	0.7	=	85.95	(76)
East	0.9x	0.77	x	4.16	x	113.09	x	0.4	x	0.7	=	91.29	(76)
East	0.9x	0.77	x	4.8	x	113.09	x	0.4	x	0.7	=	105.33	(76)
East	0.9x	0.77	x	4.16	x	115.77	x	0.4	x	0.7	=	93.45	(76)
East	0.9x	0.77	x	4.8	x	115.77	x	0.4	x	0.7	=	107.83	(76)
East	0.9x	0.77	x	4.16	x	110.22	x	0.4	x	0.7	=	88.97	(76)
East	0.9x	0.77	x	4.8	x	110.22	x	0.4	x	0.7	=	102.66	(76)
East	0.9x	0.77	x	4.16	x	94.68	x	0.4	x	0.7	=	76.42	(76)
East	0.9x	0.77	x	4.8	x	94.68	x	0.4	x	0.7	=	88.18	(76)
East	0.9x	0.77	x	4.16	x	73.59	x	0.4	x	0.7	=	59.4	(76)
East	0.9x	0.77	x	4.8	x	73.59	x	0.4	x	0.7	=	68.54	(76)
East	0.9x	0.77	x	4.16	x	45.59	x	0.4	x	0.7	=	36.8	(76)
East	0.9x	0.77	x	4.8	x	45.59	x	0.4	x	0.7	=	42.46	(76)
East	0.9x	0.77	x	4.16	x	24.49	x	0.4	x	0.7	=	19.77	(76)
East	0.9x	0.77	x	4.8	x	24.49	x	0.4	x	0.7	=	22.81	(76)
East	0.9x	0.77	x	4.16	x	16.15	x	0.4	x	0.7	=	13.04	(76)
East	0.9x	0.77	x	4.8	x	16.15	x	0.4	x	0.7	=	15.04	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	34.15	66.8	110.01	160.44	196.62	201.28	191.63	164.6	127.94	79.26	42.58	28.08	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	420.8	451.33	482.31	513.24	529.81	515.59	493.72	472.41	445.84	416.86	402.69	404.89	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.96	0.86	0.67	0.49	0.54	0.8	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.19	20.29	20.47	20.71	20.9	20.98	21	21	20.95	20.72	20.42	20.17	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.2	20.2	20.2	20.21	20.22	20.23	20.23	20.23	20.22	20.22	20.21	20.21	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.94	0.82	0.6	0.41	0.45	0.73	0.95	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.1	19.25	19.51	19.87	20.11	20.22	20.23	20.23	20.19	19.9	19.46	19.09	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.55	19.67	19.9	20.21	20.44	20.53	20.54	20.54	20.5	20.24	19.85	19.53	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	19.55	19.67	19.9	20.21	20.44	20.53	20.54	20.54	20.5	20.24	19.85	19.53	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.94	0.83	0.63	0.44	0.48	0.76	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	418.82	447.64	473.1	483.44	442.06	323.33	218.68	228.6	337.53	396.95	398.63	403.37	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	886.02	855.69	773.75	642.13	494.16	329.85	219.26	229.62	358.42	545.05	726.2	879.21	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	347.6	274.21	223.69	114.26	38.77	0	0	0	0	110.19	235.85	354.02	

Total per year (kWh/year) = Sum(98)1...5,9...12 = 1698.58 (98)

Space heating requirement in kWh/m²/year 25.35 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		1698.58	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	1783.51	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		1791.08	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	1880.63	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	36.64	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		119.54	(330a)

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warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	119.54	(331)
Energy for lighting (calculated in Appendix L)		334.24	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-518.17	(333)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		3599.75	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				256	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	742.85	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	19.02	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	761.86	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				761.86	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	62.04	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	173.47	(379)
Energy saving/generation technologies (333) to (334) as applicable						
Item 1			0.52	x 0.01 =	-268.93	(380)
Total CO2, kg/year	sum of (376)…(382) =				728.45	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				10.87	(384)
EI rating (section 14)					91.28	(385)

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User Details:

Assessor Name: | **Stroma Number:**

Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.51

Property Address: Sample 5 (Bottom)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67	(1a) x	3	(2a) =	201	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	201	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.1	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)		0.35	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.27	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.35	0.34	0.33	0.3	0.29	0.26	0.26	0.25	0.27	0.29	0.3	0.32

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.56	0.56	0.56	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.56	0.56	0.56	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1	=	2.4			(26)
Windows Type 1			4.16	x1/[1/(1.4)+ 0.04]		=	5.52			(27)
Windows Type 2			4.8	x1/[1/(1.4)+ 0.04]		=	6.36			(27)
Floor			67	x	0.13	=	8.71			(28)
Walls Type1	29.4	8.96	20.44	x	0.18	=	3.68			(29)
Walls Type2	12	2.4	9.6	x	0.18	=	1.73			(29)
Walls Type3	2.44	0	2.44	x	0.18	=	0.44			(29)
Total area of elements, m²			110.84							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.84 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5479.72 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 5.54 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 34.38 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	37.12	36.97	36.82	36.11	35.98	35.36	35.36	35.25	35.6	35.98	36.24	36.52	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	71.5	71.34	71.19	70.49	70.35	69.74	69.74	69.62	69.98	70.35	70.62	70.9	

Average = Sum(39)$_{1\ldots12}$ /12= 70.49 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	1.07	1.06	1.06	1.05	1.05	1.04	1.04	1.04	1.04	1.05	1.05	1.06	

Average = Sum(40)$_{1…12}$ /12= 1.05 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.17 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.76 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	94.34	90.91	87.48	84.05	80.62	77.19	77.19	80.62	84.05	87.48	90.91	94.34	

Total = Sum(44)$_{1…12}$ = 1029.18 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	139.91	122.36	126.27	110.08	105.63	91.15	84.46	96.92	98.08	114.3	124.77	135.49	

Total = Sum(45)$_{1…12}$ = 1349.41 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	20.99	18.35	18.94	16.51	15.84	13.67	12.67	14.54	14.71	17.15	18.72	20.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09	

Output from water heater (annual)$_{1...12}$ 1898.03 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	83.79	74.35	79.26	72.68	72.4	66.38	65.36	69.5	68.68	75.28	77.56	82.33	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	18.37	16.32	13.27	10.05	7.51	6.34	6.85	8.91	11.95	15.18	17.72	18.89	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	190.2	192.17	187.2	176.61	163.24	150.68	142.29	140.32	145.29	155.88	169.24	181.8	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	(71)
Water heating gains (Table 5)													
(72)m=	112.63	110.65	106.53	100.94	97.31	92.19	87.85	93.42	95.4	101.18	107.72	110.65	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	379.77	377.7	365.57	346.16	326.63	307.78	295.56	301.21	311.21	330.81	353.25	369.91	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	4.16	x	19.64	x	0.63	x	0.7	=	24.97	(76)
East	0.9x	0.77	x	4.8	x	19.64	x	0.63	x	0.7	=	28.81	(76)
East	0.9x	0.77	x	4.16	x	38.42	x	0.63	x	0.7	=	48.85	(76)
East	0.9x	0.77	x	4.8	x	38.42	x	0.63	x	0.7	=	56.36	(76)

East	0.9x	0.77	x	4.16	x	63.27	x	0.63	x	0.7	=	80.44	(76)
East	0.9x	0.77	x	4.8	x	63.27	x	0.63	x	0.7	=	92.82	(76)
East	0.9x	0.77	x	4.16	x	92.28	x	0.63	x	0.7	=	117.32	(76)
East	0.9x	0.77	x	4.8	x	92.28	x	0.63	x	0.7	=	135.37	(76)
East	0.9x	0.77	x	4.16	x	113.09	x	0.63	x	0.7	=	143.78	(76)
East	0.9x	0.77	x	4.8	x	113.09	x	0.63	x	0.7	=	165.9	(76)
East	0.9x	0.77	x	4.16	x	115.77	x	0.63	x	0.7	=	147.18	(76)
East	0.9x	0.77	x	4.8	x	115.77	x	0.63	x	0.7	=	169.83	(76)
East	0.9x	0.77	x	4.16	x	110.22	x	0.63	x	0.7	=	140.13	(76)
East	0.9x	0.77	x	4.8	x	110.22	x	0.63	x	0.7	=	161.68	(76)
East	0.9x	0.77	x	4.16	x	94.68	x	0.63	x	0.7	=	120.37	(76)
East	0.9x	0.77	x	4.8	x	94.68	x	0.63	x	0.7	=	138.88	(76)
East	0.9x	0.77	x	4.16	x	73.59	x	0.63	x	0.7	=	93.56	(76)
East	0.9x	0.77	x	4.8	x	73.59	x	0.63	x	0.7	=	107.95	(76)
East	0.9x	0.77	x	4.16	x	45.59	x	0.63	x	0.7	=	57.96	(76)
East	0.9x	0.77	x	4.8	x	45.59	x	0.63	x	0.7	=	66.88	(76)
East	0.9x	0.77	x	4.16	x	24.49	x	0.63	x	0.7	=	31.13	(76)
East	0.9x	0.77	x	4.8	x	24.49	x	0.63	x	0.7	=	35.92	(76)
East	0.9x	0.77	x	4.16	x	16.15	x	0.63	x	0.7	=	20.53	(76)
East	0.9x	0.77	x	4.8	x	16.15	x	0.63	x	0.7	=	23.69	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	53.78	105.21	173.26	252.69	309.68	317.01	301.81	259.25	201.51	124.84	67.06	44.23	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	433.55	482.91	538.83	598.85	636.31	624.8	597.37	560.46	512.71	455.64	420.3	414.14	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.95	0.86	0.68	0.51	0.56	0.82	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.92	20.05	20.29	20.6	20.84	20.97	20.99	20.99	20.91	20.59	20.2	19.89	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.03	20.03	20.03	20.04	20.04	20.05	20.05	20.05	20.05	20.04	20.04	20.04	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.93	0.81	0.59	0.4	0.45	0.75	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.58	18.78	19.12	19.57	19.89	20.03	20.05	20.05	19.98	19.56	19	18.55	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.13	19.3	19.6	19.99	20.28	20.41	20.44	20.43	20.36	19.98	19.49	19.1	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.13	19.3	19.6	19.99	20.28	20.41	20.44	20.43	20.36	19.98	19.49	19.1	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.93	0.82	0.63	0.44	0.5	0.77	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	431.37	478.35	526.41	558.24	522.37	391.03	265.65	277.6	395.38	434.69	416.08	412.49	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1060.36	1027.32	932.66	781.63	603.7	405.41	267.51	280.88	437.95	660.12	875.06	1056.59	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	467.97	368.9	302.25	160.84	60.51	0	0	0	0	167.71	330.47	479.21	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2337.86 (98)

Space heating requirement in kWh/m²/year 34.89 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	467.97	368.9	302.25	160.84	60.51	0	0	0	0	167.71	330.47	479.21	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	500.5	394.55	323.26	172.02	64.72	0	0	0	0	179.37	353.44	512.52	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2500.39 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)													
	186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09	
Efficiency of water heater												79.8	(216)
(217)m=	87.17	86.91	86.29	84.91	82.58	79.8	79.8	79.8	79.8	84.92	86.56	87.28	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	213.95	189.22	200.33	182.75	184.34	170.73	164.23	179.84	179.41	189.46	196.24	208.63	

Total = Sum(219a)$_{1...12}$ = 2259.13 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		2500.39

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Water heating fuel used			2259.13	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			324.5	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			5159.01	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	540.08	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	487.97	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1028.05	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	168.41	(268)
Total CO2, kg/year		sum of (265)…(271) =		1235.39	(272)
TER =				18.44	(273)

SAP Input

Property Details: Sample 6 (Bottom)

Address:	
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	26 July 2019
Date of certificate:	15 June 2022
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	498

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2022	
Floor Location:	Floor area:	Storey height:
Floor 0	55.1 m²	3 m
Living area:	26 m² (fraction 0.472)	
Front of dwelling faces:	Unspecified	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
DOOR	Manufacturer	Solid			Wood
W	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Balcony	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
DOOR	mm	0.7	0	1.4	2.4	1
W		0.7	0.4	1	4.16	1
Balcony		0.7	0.4	1	4.8	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
DOOR		INT	Worst case	0	0
W		W	West	0	0
Balcony		W	West	0	0

Overshading: More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
W	24	8.96	15.04	0.15	0	False	N/A
INT	24	2.4	21.6	0.16	0.43	False	N/A
Spandrel	2.4	0	2.4	0.35	0	False	N/A
Exposed	55.1			0.11			N/A
Internal Elements							
Party Elements							

Thermal bridges:

Thermal bridges: No information on thermal bridging (y=0.15) (y =0.15)

SAP Input

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	3
Pressure test:	3

Main heating system:

Main heating system:	Community heating schemes Heat source: Community heat pump heat from electric heat pump, heat fraction 1, efficiency 256 Piping>=1991, pre-insulated, low temp, variable flow Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Boiler interlock: Yes

Main heating Control:

Main heating Control:	Charging system linked to use of community heating, programmer and TRVs Control code: 2306

Secondary heating system:

Secondary heating system:	None

Water heating:

Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Flue Gas Heat Recovery System: Database (rev 498, product index 060036) Brand name: Worcester Model: Greenstar Xtra Model qualifier: 2015 Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	Photovoltaic 1 Installed Peak power: 0.6 Tilt of collector: 30° Overshading: None or very little Collector Orientation: South
Assess Zero Carbon Home:	No

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.5.51

Property Address: Sample 6 (Bottom)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	55.1	(1a) x	3	(2a) =	165.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.1	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	165.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

DRAFT

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.05 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.25	0.25	0.25	0.23	0.23	0.22	0.22	0.21	0.22	0.23	0.24	0.24	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.25	0.25	0.25	0.23	0.23	0.22	0.22	0.21	0.22	0.23	0.24	0.24	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1.4	=	3.36			(26)
Windows Type 1			4.16	x	1/[1/(1)+ 0.04]	=	4			(27)
Windows Type 2			4.8	x	1/[1/(1)+ 0.04]	=	4.62			(27)
Floor			55.1	x	0.11	=	6.061			(28)
Walls Type1	24	8.96	15.04	x	0.15	=	2.26			(29)
Walls Type2	24	2.4	21.6	x	0.15	=	3.23			(29)
Walls Type3	2.4	0	2.4	x	0.35	=	0.84			(29)
Total area of elements, m²			105.5							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 24.37 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 4679.06 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 15.83 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 40.19 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	13.8	13.64	13.48	12.69	12.53	11.74	11.74	11.58	12.06	12.53	12.85	13.17	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	53.99	53.83	53.67	52.88	52.72	51.93	51.93	51.77	52.25	52.72	53.04	53.36	

Average = Sum(39)$_{1…12}$ /12= 52.84 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	0.98	0.98	0.97	0.96	0.96	0.94	0.94	0.94	0.95	0.96	0.96	0.97	

Average = Sum(40)$_{1…12}$ /12= 0.96 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.84 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 77.91 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	85.7	82.58	79.47	76.35	73.23	70.12	70.12	73.23	76.35	79.47	82.58	85.7	

Total = Sum(44)$_{1…12}$ = 934.88 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	127.09	111.15	114.7	100	95.95	82.8	76.72	88.04	89.09	103.83	113.34	123.08	

Total = Sum(45)$_{1…12}$ = 1225.78 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	19.06	16.67	17.2	15	14.39	12.42	11.51	13.21	13.36	15.57	17	18.46	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	182.36	161.08	169.97	153.49	151.23	136.29	132	143.32	142.59	159.11	166.83	178.35	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	16.59	14.71	15.14	13.33	12.81	11.05	10.22	11.77	11.91	13.81	14.97	16.12	(63) (G2)

Output from water heater

(64)m=	163.1	143.95	152.16	137.57	135.73	122.64	119.09	128.87	128.08	142.61	149.26	159.55	

Output from water heater (annual)$_{1...12}$ 1682.61 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	86.48	76.9	82.36	76.04	76.12	70.32	69.73	73.5	72.42	78.74	80.48	85.14	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.29	13.58	11.05	8.36	6.25	5.28	5.7	7.41	9.95	12.63	14.74	15.72	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	160.44	162.11	157.91	148.98	137.71	127.11	120.03	118.37	122.56	131.49	142.77	153.36	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	(71)

Water heating gains (Table 5)

(72)m=	116.23	114.43	110.7	105.62	102.32	97.67	93.73	98.78	100.58	105.84	111.78	114.44	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	342.57	340.73	330.26	313.56	296.88	280.66	270.06	275.17	283.69	300.57	319.89	334.13	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	4.16	x	19.64	x	0.4	x	0.7	=	15.85	(80)
West	0.9x	0.77	x	4.8	x	19.64	x	0.4	x	0.7	=	18.29	(80)
West	0.9x	0.77	x	4.16	x	38.42	x	0.4	x	0.7	=	31.01	(80)
West	0.9x	0.77	x	4.8	x	38.42	x	0.4	x	0.7	=	35.78	(80)

West	0.9x	0.77	x	4.16	x	63.27	x	0.4	x	0.7	=	51.07	(80)
West	0.9x	0.77	x	4.8	x	63.27	x	0.4	x	0.7	=	58.93	(80)
West	0.9x	0.77	x	4.16	x	92.28	x	0.4	x	0.7	=	74.49	(80)
West	0.9x	0.77	x	4.8	x	92.28	x	0.4	x	0.7	=	85.95	(80)
West	0.9x	0.77	x	4.16	x	113.09	x	0.4	x	0.7	=	91.29	(80)
West	0.9x	0.77	x	4.8	x	113.09	x	0.4	x	0.7	=	105.33	(80)
West	0.9x	0.77	x	4.16	x	115.77	x	0.4	x	0.7	=	93.45	(80)
West	0.9x	0.77	x	4.8	x	115.77	x	0.4	x	0.7	=	107.83	(80)
West	0.9x	0.77	x	4.16	x	110.22	x	0.4	x	0.7	=	88.97	(80)
West	0.9x	0.77	x	4.8	x	110.22	x	0.4	x	0.7	=	102.66	(80)
West	0.9x	0.77	x	4.16	x	94.68	x	0.4	x	0.7	=	76.42	(80)
West	0.9x	0.77	x	4.8	x	94.68	x	0.4	x	0.7	=	88.18	(80)
West	0.9x	0.77	x	4.16	x	73.59	x	0.4	x	0.7	=	59.4	(80)
West	0.9x	0.77	x	4.8	x	73.59	x	0.4	x	0.7	=	68.54	(80)
West	0.9x	0.77	x	4.16	x	45.59	x	0.4	x	0.7	=	36.8	(80)
West	0.9x	0.77	x	4.8	x	45.59	x	0.4	x	0.7	=	42.46	(80)
West	0.9x	0.77	x	4.16	x	24.49	x	0.4	x	0.7	=	19.77	(80)
West	0.9x	0.77	x	4.8	x	24.49	x	0.4	x	0.7	=	22.81	(80)
West	0.9x	0.77	x	4.16	x	16.15	x	0.4	x	0.7	=	13.04	(80)
West	0.9x	0.77	x	4.8	x	16.15	x	0.4	x	0.7	=	15.04	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	34.15	66.8	110.01	160.44	196.62	201.28	191.63	164.6	127.94	79.26	42.58	28.08	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	376.72	407.53	440.27	474	493.5	481.94	461.69	439.77	411.64	379.83	362.47	362.21	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.95	0.85	0.66	0.49	0.53	0.79	0.96	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.07	20.19	20.39	20.66	20.88	20.98	21	20.99	20.94	20.68	20.33	20.06	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.1	20.1	20.1	20.12	20.12	20.13	20.13	20.13	20.13	20.12	20.11	20.11	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.98	0.93	0.8	0.58	0.4	0.44	0.72	0.94	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.87	19.03	19.33	19.72	20	20.12	20.13	20.13	20.08	19.75	19.26	18.85	(90)

fLA = Living area ÷ (4) = | 0.47 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.44	19.58	19.83	20.17	20.41	20.52	20.54	20.54	20.49	20.19	19.76	19.42	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.44	19.58	19.83	20.17	20.41	20.52	20.54	20.54	20.49	20.19	19.76	19.42	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.93	0.82	0.62	0.44	0.48	0.75	0.95	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	374.3	403.06	429.5	441.63	405.39	299.4	203.63	212.72	309.59	359.08	357.76	360.31	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	817.25	790.13	715.57	595.82	459.34	307.59	204.56	214.28	333.61	505.4	671.72	812.02	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	329.56	260.12	212.84	111.02	40.14	0	0	0	0	108.86	226.05	336.07	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 1624.65 (98)

Space heating requirement in kWh/m²/year 29.49 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		1624.65	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	1705.88	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		1682.61	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	1766.74	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	34.73	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		98.31	(330a)

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warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	98.31	(331)
Energy for lighting (calculated in Appendix L)		270.05	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-518.17	(333)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		3322.82	(338)

12b. CO_2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				256	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	704.02	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	18.02	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	722.04	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				722.04	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	51.02	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	140.16	(379)
Energy saving/generation technologies (333) to (334) as applicable						
Item 1		0.52		x 0.01 =	-268.93	(380)
Total CO2, kg/year	sum of (376)…(382) =				644.29	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				11.69	(384)
EI rating (section 14)					91.38	(385)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Sample 6 (Bottom)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	55.1	(1a) x	3	(2a) =	165.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.1	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	165.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20 ÷ (5) =	0.12	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.37	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.29	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.37	0.36	0.35	0.32	0.31	0.27	0.27	0.27	0.29	0.31	0.32	0.34

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.56	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.56	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1	=	2.4			(26)
Windows Type 1			4.16	x1/[1/(1.4)+ 0.04]		=	5.52			(27)
Windows Type 2			4.8	x1/[1/(1.4)+ 0.04]		=	6.36			(27)
Floor			55.1	x	0.13	=	7.163			(28)
Walls Type1	24	8.96	15.04	x	0.18	=	2.71			(29)
Walls Type2	24	2.4	21.6	x	0.18	=	3.89			(29)
Walls Type3	2.4	0	2.4	x	0.18	=	0.43			(29)
Total area of elements, m²			105.5							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	28.47	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	4679.06	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 5.28 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 33.74 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	30.94	30.8	30.66	30	29.88	29.31	29.31	29.2	29.53	29.88	30.13	30.39	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	64.68	64.54	64.4	63.75	63.62	63.05	63.05	62.95	63.27	63.62	63.87	64.13

Average = Sum(39)$_{1…12}$ /12= 63.75 (39)

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Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

(40)m=	1.17	1.17	1.17	1.16	1.15	1.14	1.14	1.14	1.15	1.15	1.16	1.16

Average = Sum(40)1…12 /12= 1.16 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 1.84 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 77.91 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	85.7	82.58	79.47	76.35	73.23	70.12	70.12	73.23	76.35	79.47	82.58	85.7	
										Total = Sum(44)1…12 =		934.88	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	127.09	111.15	114.7	100	95.95	82.8	76.72	88.04	89.09	103.83	113.34	123.08	
										Total = Sum(45)1…12 =		1225.78	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	19.06	16.67	17.2	15	14.39	12.42	11.51	13.21	13.36	15.57	17	18.46	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 1.39 (48)

Temperature factor from Table 2b — 0.54 (49)

Energy lost from water storage, kWh/year — (48) x (49) = — 0.75 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

Energy lost from water storage, kWh/year — (47) x (51) x (52) x (53) = — 0 (54)

Enter (50) or (54) in (55) — 0.75 (55)

Water storage loss calculated for each month — ((56)m = (55) × (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	173.68	153.24	161.29	145.09	142.54	127.89	123.32	134.64	134.18	150.42	158.43	169.67	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	173.68	153.24	161.29	145.09	142.54	127.89	123.32	134.64	134.18	150.42	158.43	169.67	

Output from water heater (annual)1…12 | 1774.4 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	79.53	70.63	75.41	69.32	69.18	63.6	62.79	66.55	65.7	71.8	73.76	78.2	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	14.88	13.21	10.74	8.13	6.08	5.13	5.55	7.21	9.68	12.29	14.34	15.29	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	160.44	162.11	157.91	148.98	137.71	127.11	120.03	118.37	122.56	131.49	142.77	153.36	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	(71)
Water heating gains (Table 5)													
(72)m=	106.9	105.1	101.36	96.28	92.98	88.34	84.39	89.45	91.25	96.5	102.44	105.11	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	335.82	334.02	323.62	307	290.37	274.19	263.57	268.63	277.09	293.89	313.16	327.36	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	4.16	x	19.64	x	0.63	x	0.7	=	24.97	(80)
West	0.9x	0.77	x	4.8	x	19.64	x	0.63	x	0.7	=	28.81	(80)
West	0.9x	0.77	x	4.16	x	38.42	x	0.63	x	0.7	=	48.85	(80)
West	0.9x	0.77	x	4.8	x	38.42	x	0.63	x	0.7	=	56.36	(80)

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West	0.9x	0.77	x	4.16	x	63.27	x	0.63	x	0.7	=	80.44	(80)
West	0.9x	0.77	x	4.8	x	63.27	x	0.63	x	0.7	=	92.82	(80)
West	0.9x	0.77	x	4.16	x	92.28	x	0.63	x	0.7	=	117.32	(80)
West	0.9x	0.77	x	4.8	x	92.28	x	0.63	x	0.7	=	135.37	(80)
West	0.9x	0.77	x	4.16	x	113.09	x	0.63	x	0.7	=	143.78	(80)
West	0.9x	0.77	x	4.8	x	113.09	x	0.63	x	0.7	=	165.9	(80)
West	0.9x	0.77	x	4.16	x	115.77	x	0.63	x	0.7	=	147.18	(80)
West	0.9x	0.77	x	4.8	x	115.77	x	0.63	x	0.7	=	169.83	(80)
West	0.9x	0.77	x	4.16	x	110.22	x	0.63	x	0.7	=	140.13	(80)
West	0.9x	0.77	x	4.8	x	110.22	x	0.63	x	0.7	=	161.68	(80)
West	0.9x	0.77	x	4.16	x	94.68	x	0.63	x	0.7	=	120.37	(80)
West	0.9x	0.77	x	4.8	x	94.68	x	0.63	x	0.7	=	138.88	(80)
West	0.9x	0.77	x	4.16	x	73.59	x	0.63	x	0.7	=	93.56	(80)
West	0.9x	0.77	x	4.8	x	73.59	x	0.63	x	0.7	=	107.95	(80)
West	0.9x	0.77	x	4.16	x	45.59	x	0.63	x	0.7	=	57.96	(80)
West	0.9x	0.77	x	4.8	x	45.59	x	0.63	x	0.7	=	66.88	(80)
West	0.9x	0.77	x	4.16	x	24.49	x	0.63	x	0.7	=	31.13	(80)
West	0.9x	0.77	x	4.8	x	24.49	x	0.63	x	0.7	=	35.92	(80)
West	0.9x	0.77	x	4.16	x	16.15	x	0.63	x	0.7	=	20.53	(80)
West	0.9x	0.77	x	4.8	x	16.15	x	0.63	x	0.7	=	23.69	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	53.78	105.21	173.26	252.69	309.68	317.01	301.81	259.25	201.51	124.84	67.06	44.23	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	389.6	439.23	496.88	559.69	600.05	591.2	565.38	527.88	478.6	418.73	380.21	371.59	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.94	0.83	0.65	0.48	0.54	0.79	0.96	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.83	19.98	20.24	20.58	20.84	20.96	20.99	20.99	20.9	20.56	20.13	19.8	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.94	19.94	19.95	19.95	19.96	19.96	19.96	19.97	19.96	19.96	19.95	19.95	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.97	0.91	0.77	0.56	0.37	0.42	0.71	0.94	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.39	18.61	18.99	19.47	19.8	19.94	19.96	19.96	19.89	19.46	18.84	18.36	(90)

fLA = Living area ÷ (4) = 0.47 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.07	19.25	19.58	19.99	20.29	20.42	20.45	20.45	20.37	19.98	19.45	19.04	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.07	19.25	19.58	19.99	20.29	20.42	20.45	20.45	20.37	19.98	19.45	19.04	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.97	0.91	0.79	0.6	0.43	0.48	0.75	0.94	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	386.85	433.43	481.37	511.66	475.54	353.93	240.73	251.36	357.64	394.66	375	369.48	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	955.18	926.41	842.45	707.2	546.66	367.27	242.68	254.72	396.54	596.52	788.88	951.45	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	422.83	331.29	268.64	140.79	52.92	0	0	0	0	150.19	297.99	432.99	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2097.63 (98)

Space heating requirement in kWh/m²/year 38.07 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	422.83	331.29	268.64	140.79	52.92	0	0	0	0	150.19	297.99	432.99		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	452.23	354.32	287.32	150.58	56.59	0	0	0	0	160.63	318.71	463.09		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													2243.46	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)														
	173.68	153.24	161.29	145.09	142.54	127.89	123.32	134.64	134.18	150.42	158.43	169.67		
Efficiency of water heater													79.8	(216)
(217)m=	87.1	86.82	86.17	84.73	82.44	79.8	79.8	79.8	79.8	84.81	86.48	87.21		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	199.41	176.5	187.19	171.23	172.91	160.26	154.53	168.72	168.15	177.37	183.21	194.56		
Total = Sum(219a)$_{1...12}$ =													2114.03	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		2243.46

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Water heating fuel used			2114.03	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			262.71	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			4695.2	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	484.59	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	456.63	(264)
Space and water heating	(261) + (262) + (263) + (264) =				941.22	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	136.34	(268)
Total CO2, kg/year			sum of (265)…(271) =		1116.49	(272)
TER =					20.26	(273)

SAP Input

Property Details: Sample 4 (Top)

Address:	
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	26 July 2019
Date of certificate:	15 June 2022
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	498

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2022	
Floor Location:	Floor area:	Storey height:
Floor 0	67 m²	3 m
Living area:	27.3 m² (fraction 0.407)	
Front of dwelling faces:	Unspecified	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
DOOR	Manufacturer	Solid			Wood
W	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
S	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Balcony	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
DOOR	mm	0.7	0	1.4	2.4	1
W		0.7	0.4	1	1.44	1
S		0.7	0.4	1	5.44	1
Balcony		0.7	0.4	1	4.8	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
DOOR		INT	Worst case	0	0
W		W	West	0	0
S		S	South	0	0
Balcony		S	South	0	0

Overshading: More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
S	31.7	10.24	21.46	0.15	0	False	N/A
W	19	1.44	17.56	0.15	0	False	N/A
INT	11.1	2.4	8.7	0.16	0.43	False	N/A
Spandrel	2.4	0	2.4	0.35	0	False	N/A
Roof	67	0	67	0.11	0		N/A
Internal Elements							
Party Elements							

SAP Input

Thermal bridges:

Thermal bridges:	No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	3

Main heating system:

Main heating system:	Community heating schemes Heat source: Community heat pump heat from electric heat pump, heat fraction 1, efficiency 256 Piping>=1991, pre-insulated, low temp, variable flow Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Boiler interlock: Yes

Main heating Control:

Main heating Control:	Charging system linked to use of community heating, programmer and TRVs Control code: 2306

Secondary heating system:

Secondary heating system:	None

Water heating:

Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Flue Gas Heat Recovery System: Database (rev 498, product index 060036) Brand name: Worcester Model: Greenstar Xtra Model qualifier: 2015 Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	<u>Photovoltaic 1</u> Installed Peak power: 0.6 Tilt of collector: 30° Overshading: None or very little Collector Orientation: South
Assess Zero Carbon Home:	No

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User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.51

Property Address: Sample 4 (Top)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67	(1a) x	3	(2a) =	201	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	201	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	79.05	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1.4	=	3.36			(26)
Windows Type 1			1.44	x	1/[1/(1)+ 0.04]	=	1.38			(27)
Windows Type 2			5.44	x	1/[1/(1)+ 0.04]	=	5.23			(27)
Windows Type 3			4.8	x	1/[1/(1)+ 0.04]	=	4.62			(27)
Walls Type1	31.7	10.24	21.46	x	0.15	=	3.22			(29)
Walls Type2	19	1.44	17.56	x	0.15	=	2.63			(29)
Walls Type3	11.1	2.4	8.7	x	0.15	=	1.3			(29)
Walls Type4	2.4	0	2.4	x	0.35	=	0.84			(29)
Roof	67	0	67	x	0.11	=	7.37			(30)
Total area of elements, m²			131.2							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	29.96	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	1304.68	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		19.68	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	49.64	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(38)m=	17.73	17.52	17.31	16.25	16.04	14.98	14.98	14.77	15.41	16.04	16.46	16.89	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	67.37	67.16	66.94	65.89	65.68	64.62	64.62	64.41	65.04	65.68	66.1	66.52	

Average = $Sum(39)_{1...12}$ /12= 65.83 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.01	1	1	0.98	0.98	0.96	0.96	0.96	0.97	0.98	0.99	0.99	

Average = $Sum(40)_{1...12}$ /12= 0.98 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.17 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.76 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	94.34	90.91	87.48	84.05	80.62	77.19	77.19	80.62	84.05	87.48	90.91	94.34	

Total = $Sum(44)_{1...12}$ = 1029.18 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.91	122.36	126.27	110.08	105.63	91.15	84.46	96.92	98.08	114.3	124.77	135.49	

Total = $Sum(45)_{1...12}$ = 1349.41 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.99	18.35	18.94	16.51	15.84	13.67	12.67	14.54	14.71	17.15	18.72	20.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	195.18	172.29	181.54	163.58	160.9	144.64	139.74	152.2	151.57	169.58	178.26	190.77	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	18.03	16.04	16.49	14.58	14.03	12.18	11.28	12.94	13.08	15.09	16.32	17.54	(63) (G2)

Output from water heater

(64)m=	174.47	153.83	162.37	146.4	144.19	129.86	125.78	136.58	135.89	151.81	159.35	170.55	

Output from water heater (annual)$_{1...12}$ | 1791.08 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	90.74	80.63	86.21	79.4	79.34	73.1	72.31	76.45	75.41	82.23	84.28	89.27	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.86	15.86	12.9	9.77	7.3	6.16	6.66	8.66	11.62	14.75	17.22	18.36	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	190.2	192.17	187.2	176.61	163.24	150.68	142.29	140.32	145.29	155.88	169.24	181.8	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	(71)

Water heating gains (Table 5)

(72)m=	121.96	119.98	115.87	110.27	106.64	101.53	97.18	102.75	104.73	110.52	117.06	119.99	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	385.59	383.58	371.53	352.22	332.75	313.94	301.7	307.29	317.21	336.72	359.09	375.72	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	5.44	x	46.75	x	0.4	x	0.7	=	49.35	(78)

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South	0.9x	0.77	x	4.8	x	46.75	x	0.4	x	0.7	=	43.54	(78)
South	0.9x	0.77	x	5.44	x	76.57	x	0.4	x	0.7	=	80.82	(78)
South	0.9x	0.77	x	4.8	x	76.57	x	0.4	x	0.7	=	71.31	(78)
South	0.9x	0.77	x	5.44	x	97.53	x	0.4	x	0.7	=	102.95	(78)
South	0.9x	0.77	x	4.8	x	97.53	x	0.4	x	0.7	=	90.84	(78)
South	0.9x	0.77	x	5.44	x	110.23	x	0.4	x	0.7	=	116.36	(78)
South	0.9x	0.77	x	4.8	x	110.23	x	0.4	x	0.7	=	102.67	(78)
South	0.9x	0.77	x	5.44	x	114.87	x	0.4	x	0.7	=	121.26	(78)
South	0.9x	0.77	x	4.8	x	114.87	x	0.4	x	0.7	=	106.99	(78)
South	0.9x	0.77	x	5.44	x	110.55	x	0.4	x	0.7	=	116.69	(78)
South	0.9x	0.77	x	4.8	x	110.55	x	0.4	x	0.7	=	102.96	(78)
South	0.9x	0.77	x	5.44	x	108.01	x	0.4	x	0.7	=	114.01	(78)
South	0.9x	0.77	x	4.8	x	108.01	x	0.4	x	0.7	=	100.6	(78)
South	0.9x	0.77	x	5.44	x	104.89	x	0.4	x	0.7	=	110.72	(78)
South	0.9x	0.77	x	4.8	x	104.89	x	0.4	x	0.7	=	97.7	(78)
South	0.9x	0.77	x	5.44	x	101.89	x	0.4	x	0.7	=	107.55	(78)
South	0.9x	0.77	x	4.8	x	101.89	x	0.4	x	0.7	=	94.9	(78)
South	0.9x	0.77	x	5.44	x	82.59	x	0.4	x	0.7	=	87.18	(78)
South	0.9x	0.77	x	4.8	x	82.59	x	0.4	x	0.7	=	76.92	(78)
South	0.9x	0.77	x	5.44	x	55.42	x	0.4	x	0.7	=	58.5	(78)
South	0.9x	0.77	x	4.8	x	55.42	x	0.4	x	0.7	=	51.62	(78)
South	0.9x	0.77	x	5.44	x	40.4	x	0.4	x	0.7	=	42.64	(78)
South	0.9x	0.77	x	4.8	x	40.4	x	0.4	x	0.7	=	37.63	(78)
West	0.9x	0.77	x	1.44	x	19.64	x	0.4	x	0.7	=	5.49	(80)
West	0.9x	0.77	x	1.44	x	38.42	x	0.4	x	0.7	=	10.74	(80)
West	0.9x	0.77	x	1.44	x	63.27	x	0.4	x	0.7	=	17.68	(80)
West	0.9x	0.77	x	1.44	x	92.28	x	0.4	x	0.7	=	25.78	(80)
West	0.9x	0.77	x	1.44	x	113.09	x	0.4	x	0.7	=	31.6	(80)
West	0.9x	0.77	x	1.44	x	115.77	x	0.4	x	0.7	=	32.35	(80)
West	0.9x	0.77	x	1.44	x	110.22	x	0.4	x	0.7	=	30.8	(80)
West	0.9x	0.77	x	1.44	x	94.68	x	0.4	x	0.7	=	26.45	(80)
West	0.9x	0.77	x	1.44	x	73.59	x	0.4	x	0.7	=	20.56	(80)
West	0.9x	0.77	x	1.44	x	45.59	x	0.4	x	0.7	=	12.74	(80)
West	0.9x	0.77	x	1.44	x	24.49	x	0.4	x	0.7	=	6.84	(80)
West	0.9x	0.77	x	1.44	x	16.15	x	0.4	x	0.7	=	4.51	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	98.38	162.87	211.48	244.82	259.85	252	245.41	234.88	223.01	176.83	116.95	84.78	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	483.97	546.46	583.01	597.03	592.6	565.95	547.11	542.17	540.21	513.55	476.04	460.5	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(86)m=	0.99	0.99	0.98	0.94	0.86	0.69	0.51	0.54	0.76	0.94	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.07	20.22	20.42	20.66	20.86	20.97	21	20.99	20.95	20.71	20.35	20.05	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.08	20.08	20.08	20.1	20.1	20.11	20.11	20.12	20.11	20.1	20.09	20.09	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.97	0.92	0.82	0.61	0.41	0.44	0.69	0.92	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.85	19.07	19.36	19.7	19.96	20.09	20.11	20.11	20.07	19.78	19.27	18.82	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.35	19.54	19.79	20.09	20.33	20.45	20.47	20.47	20.43	20.16	19.71	19.32	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.35	19.54	19.79	20.09	20.33	20.45	20.47	20.47	20.43	20.16	19.71	19.32	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.97	0.92	0.83	0.65	0.45	0.48	0.72	0.92	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	479.93	537.31	563.24	552.12	492.69	365.13	248.72	260.28	387.24	473.6	467.42	457.5	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1013.82	982.98	889.74	737.57	566.46	378.05	250.18	262.28	411.46	627.84	833.51	1006	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	397.22	299.49	242.92	133.53	54.89	0	0	0	0	114.75	263.58	408.09	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 1914.46 (98)

Space heating requirement in kWh/m²/year 28.57 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none	0	(301)
Fraction of space heat from community system 1 – (301) =	1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating **kWh/year**

Annual space heating requirement 1914.46

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Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	2010.19	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)

Water heating

Annual water heating requirement		1791.08	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	1880.63	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	38.91	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		119.54	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	119.54	(331)
Energy for lighting (calculated in Appendix L)		315.44	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-518.17	(333)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		3807.64	(338)

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12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				256	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	788.8	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	20.19	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	809	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				809	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	62.04	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	163.72	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1		0.52		x 0.01 =	-268.93	(380)
Total CO2, kg/year	sum of (376)…(382) =				765.82	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				11.43	(384)
EI rating (section 14)					90.84	(385)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Sample 4 (Top)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67	(1a) x	3	(2a) =	201	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	201	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.1	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.35	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.37	0.36	0.33	0.32	0.28	0.28	0.27	0.3	0.32	0.33	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1	=	2.4			(26)
Windows Type 1			1.44	x1/[1/(1.4)+ 0.04]		=	1.91			(27)
Windows Type 2			5.44	x1/[1/(1.4)+ 0.04]		=	7.21			(27)
Windows Type 3			4.8	x1/[1/(1.4)+ 0.04]		=	6.36			(27)
Walls Type1	31.7	10.24	21.46	x	0.18	=	3.86			(29)
Walls Type2	19	1.44	17.56	x	0.18	=	3.16			(29)
Walls Type3	11.1	2.4	8.7	x	0.18	=	1.57			(29)
Walls Type4	2.4	0	2.4	x	0.18	=	0.43			(29)
Roof	67	0	67	x	0.13	=	8.71			(30)
Total area of elements, m²			131.2							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 35.62 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 1304.68 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 6.56 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 42.18 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

(38)m=	37.92	37.74	37.56	36.71	36.55	35.81	35.81	35.67	36.09	36.55	36.87	37.21	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	80.1	79.91	79.73	78.88	78.72	77.98	77.98	77.85	78.27	78.72	79.05	79.38	

Average = Sum(39)1…12 /12= 78.88 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.2	1.19	1.19	1.18	1.17	1.16	1.16	1.16	1.17	1.17	1.18	1.18	

Average = Sum(40)1…12 /12= 1.18 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.17 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.76 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	94.34	90.91	87.48	84.05	80.62	77.19	77.19	80.62	84.05	87.48	90.91	94.34	

Total = Sum(44)1…12 = 1029.18 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.91	122.36	126.27	110.08	105.63	91.15	84.46	96.92	98.08	114.3	124.77	135.49	

Total = Sum(45)1…12 = 1349.41 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.99	18.35	18.94	16.51	15.84	13.67	12.67	14.54	14.71	17.15	18.72	20.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09	

Output from water heater (annual)$_{1...12}$ | 1898.03 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	83.79	74.35	79.26	72.68	72.4	66.38	65.36	69.5	68.68	75.28	77.56	82.33	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.41	15.46	12.58	9.52	7.12	6.01	6.49	8.44	11.33	14.38	16.79	17.89	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	190.2	192.17	187.2	176.61	163.24	150.68	142.29	140.32	145.29	155.88	169.24	181.8	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	(71)

Water heating gains (Table 5)

(72)m=	112.63	110.65	106.53	100.94	97.31	92.19	87.85	93.42	95.4	101.18	107.72	110.65	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	378.8	376.85	364.87	345.64	326.23	307.45	295.2	300.74	310.58	330.01	352.32	368.92	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	5.44	x	46.75	x	0.63	x	0.7	=	77.73	(78)

South	0.9x	0.77	x	4.8	x	46.75	x	0.63	x	0.7	=	68.58	(78)
South	0.9x	0.77	x	5.44	x	76.57	x	0.63	x	0.7	=	127.3	(78)
South	0.9x	0.77	x	4.8	x	76.57	x	0.63	x	0.7	=	112.32	(78)
South	0.9x	0.77	x	5.44	x	97.53	x	0.63	x	0.7	=	162.15	(78)
South	0.9x	0.77	x	4.8	x	97.53	x	0.63	x	0.7	=	143.08	(78)
South	0.9x	0.77	x	5.44	x	110.23	x	0.63	x	0.7	=	183.27	(78)
South	0.9x	0.77	x	4.8	x	110.23	x	0.63	x	0.7	=	161.71	(78)
South	0.9x	0.77	x	5.44	x	114.87	x	0.63	x	0.7	=	190.98	(78)
South	0.9x	0.77	x	4.8	x	114.87	x	0.63	x	0.7	=	168.51	(78)
South	0.9x	0.77	x	5.44	x	110.55	x	0.63	x	0.7	=	183.79	(78)
South	0.9x	0.77	x	4.8	x	110.55	x	0.63	x	0.7	=	162.17	(78)
South	0.9x	0.77	x	5.44	x	108.01	x	0.63	x	0.7	=	179.57	(78)
South	0.9x	0.77	x	4.8	x	108.01	x	0.63	x	0.7	=	158.45	(78)
South	0.9x	0.77	x	5.44	x	104.89	x	0.63	x	0.7	=	174.39	(78)
South	0.9x	0.77	x	4.8	x	104.89	x	0.63	x	0.7	=	153.87	(78)
South	0.9x	0.77	x	5.44	x	101.89	x	0.63	x	0.7	=	169.39	(78)
South	0.9x	0.77	x	4.8	x	101.89	x	0.63	x	0.7	=	149.46	(78)
South	0.9x	0.77	x	5.44	x	82.59	x	0.63	x	0.7	=	137.3	(78)
South	0.9x	0.77	x	4.8	x	82.59	x	0.63	x	0.7	=	121.15	(78)
South	0.9x	0.77	x	5.44	x	55.42	x	0.63	x	0.7	=	92.13	(78)
South	0.9x	0.77	x	4.8	x	55.42	x	0.63	x	0.7	=	81.29	(78)
South	0.9x	0.77	x	5.44	x	40.4	x	0.63	x	0.7	=	67.16	(78)
South	0.9x	0.77	x	4.8	x	40.4	x	0.63	x	0.7	=	59.26	(78)
West	0.9x	0.77	x	1.44	x	19.64	x	0.63	x	0.7	=	8.64	(80)
West	0.9x	0.77	x	1.44	x	38.42	x	0.63	x	0.7	=	16.91	(80)
West	0.9x	0.77	x	1.44	x	63.27	x	0.63	x	0.7	=	27.85	(80)
West	0.9x	0.77	x	1.44	x	92.28	x	0.63	x	0.7	=	40.61	(80)
West	0.9x	0.77	x	1.44	x	113.09	x	0.63	x	0.7	=	49.77	(80)
West	0.9x	0.77	x	1.44	x	115.77	x	0.63	x	0.7	=	50.95	(80)
West	0.9x	0.77	x	1.44	x	110.22	x	0.63	x	0.7	=	48.51	(80)
West	0.9x	0.77	x	1.44	x	94.68	x	0.63	x	0.7	=	41.67	(80)
West	0.9x	0.77	x	1.44	x	73.59	x	0.63	x	0.7	=	32.39	(80)
West	0.9x	0.77	x	1.44	x	45.59	x	0.63	x	0.7	=	20.06	(80)
West	0.9x	0.77	x	1.44	x	24.49	x	0.63	x	0.7	=	10.78	(80)
West	0.9x	0.77	x	1.44	x	16.15	x	0.63	x	0.7	=	7.11	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	154.95	256.53	333.08	385.59	409.26	396.91	386.53	369.93	351.23	278.51	184.2	133.53	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	533.75	633.37	697.95	731.22	735.49	704.36	681.72	670.67	661.81	608.52	536.52	502.45	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(86)m=	0.99	0.98	0.96	0.92	0.83	0.67	0.49	0.52	0.74	0.93	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.88	20.08	20.33	20.61	20.83	20.96	20.99	20.99	20.93	20.65	20.2	19.84	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.92	19.93	19.93	19.94	19.94	19.95	19.95	19.95	19.95	19.94	19.94	19.93	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.95	0.9	0.78	0.57	0.38	0.41	0.65	0.9	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.45	18.74	19.1	19.5	19.78	19.92	19.95	19.95	19.89	19.56	18.94	18.4	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.03	19.29	19.6	19.95	20.21	20.34	20.37	20.37	20.32	20	19.45	18.99	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.03	19.29	19.6	19.95	20.21	20.34	20.37	20.37	20.32	20	19.45	18.99	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.97	0.95	0.9	0.79	0.61	0.43	0.46	0.68	0.9	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	527.57	617.4	662.41	654.69	581.4	429.59	291.61	305.62	453.17	548.67	523.48	497.96	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1180.11	1149.67	1044.63	871.6	669.77	447.95	294.18	309.17	486.44	740.03	976.5	1173.88	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	485.48	357.69	284.37	156.17	65.75	0	0	0	0	142.37	326.17	502.88	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2320.89 (98)

Space heating requirement in kWh/m²/year 34.64 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	485.48	357.69	284.37	156.17	65.75	0	0	0	0	142.37	326.17	502.88	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	519.24	382.55	304.14	167.03	70.32	0	0	0	0	152.27	348.85	537.84	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2482.24 (211)

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Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)

186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09

Efficiency of water heater 79.8 (216)

(217)m=	87.25	86.83	86.13	84.83	82.75	79.8	79.8	79.8	79.8	84.49	86.53	87.39	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	213.75	189.38	200.69	182.92	183.95	170.73	164.23	179.84	179.41	190.43	196.31	208.37

Total = Sum(219a)$_{1...12}$ = 2260.02 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2482.24	
Water heating fuel used		2260.02	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	75	(231)
Electricity for lighting		307.48	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		5124.74	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	536.16	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	488.16	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1024.33	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	159.58	(268)
Total CO2, kg/year			sum of (265)…(271) =		1222.83	(272)

TER = 18.25 (273)

SAP Input

Property Details: Sample 5 (Top)

Address:	
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	26 July 2019
Date of certificate:	15 June 2022
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	498

Property description:

Dwelling type:	Flat
Detachment:	
Year Completed:	2022

Floor Location:	Floor area:	Storey height:
Floor 0	67 m²	3 m

Living area:	27.5 m² (fraction 0.41)
Front of dwelling faces:	Unspecified

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
DOOR	Manufacturer	Solid			Wood
E	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Balcony	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
DOOR	mm	0.7	0	1.4	2.4	1
E		0.7	0.4	1	4.16	1
Balcony		0.7	0.4	1	4.8	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
DOOR		INT	Worst case	0	0
E		E	East	0	0
Balcony		E	East	0	0

Overshading: More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
<u>External Elements</u>							
E	29.4	8.96	20.44	0.15	0	False	N/A
INT	12	2.4	9.6	0.16	0.43	False	N/A
Spandrel	2.44	0	2.44	0.35	0	False	N/A
Roof	67	0	67	0.11	0		N/A
<u>Internal Elements</u>							
<u>Party Elements</u>							

Thermal bridges:

Thermal bridges: No information on thermal bridging (y=0.15) (y =0.15)

SAP Input

Ventilation:

Pressure test: Yes (As designed)

Ventilation: Balanced with heat recovery
Number of wet rooms: Kitchen + 1
Ductwork: Insulation, rigid
Approved Installation Scheme: True

Number of chimneys: 0
Number of open flues: 0
Number of fans: 0
Number of passive stacks: 0
Number of sides sheltered: 3
Pressure test: 3

Main heating system:

Main heating system: Community heating schemes
Heat source: Community heat pump
heat from electric heat pump, heat fraction 1, efficiency 256
Piping>=1991, pre-insulated, low temp, variable flow
Central heating pump : 2013 or later
Design flow temperature: Design flow temperature >45°C
Boiler interlock: Yes

Main heating Control:

Main heating Control: Charging system linked to use of community heating, programmer and TRVs
Control code: 2306

Secondary heating system:

Secondary heating system: None

Water heating:

Water heating: From main heating system
Water code: 901
Fuel :mains gas
No hot water cylinder
Flue Gas Heat Recovery System:
Database (rev 498, product index 060036)
Brand name: Worcester
Model: Greenstar Xtra
Model qualifier: 2015
Solar panel: False

Others:

Electricity tariff: Standard Tariff
In Smoke Control Area: Yes
Conservatory: No conservatory
Low energy lights: 100%
Terrain type: Dense urban
EPC language: English
Wind turbine: No

Photovoltaics: Photovoltaic 1
Installed Peak power: 0.6
Tilt of collector: 30°
Overshading: None or very little
Collector Orientation: South

Assess Zero Carbon Home: No

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Sample 5 (Top)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67	(1a) x	3	(2a) =	201	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	201	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.05 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.25	0.25	0.25	0.23	0.23	0.22	0.22	0.21	0.22	0.23	0.24	0.24	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.25	0.25	0.25	0.23	0.23	0.22	0.22	0.21	0.22	0.23	0.24	0.24	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1.4	=	3.36			(26)
Windows Type 1			4.16	x	1/[1/(1)+ 0.04]	=	4			(27)
Windows Type 2			4.8	x	1/[1/(1)+ 0.04]	=	4.62			(27)
Walls Type1	29.4	8.96	20.44	x	0.15	=	3.07			(29)
Walls Type2	12	2.4	9.6	x	0.15	=	1.44			(29)
Walls Type3	2.44	0	2.44	x	0.35	=	0.85			(29)
Roof	67	0	67	x	0.11	=	7.37			(30)
Total area of elements, m²			110.84							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 24.7 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 1057.72 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 16.63 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 41.33 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	16.78	16.59	16.39	15.43	15.24	14.27	14.27	14.08	14.66	15.24	15.62	16.01	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	58.11	57.92	57.72	56.76	56.57	55.6	55.6	55.41	55.99	56.57	56.95	57.34	

Average = Sum(39)$_{1…12}$ /12= 56.71 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.87	0.86	0.86	0.85	0.84	0.83	0.83	0.83	0.84	0.84	0.85	0.86

Average = Sum(40)1…12 /12= 0.85 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.17 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.76 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	94.34	90.91	87.48	84.05	80.62	77.19	77.19	80.62	84.05	87.48	90.91	94.34	
										Total = Sum(44)1…12 =		1029.18	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	139.91	122.36	126.27	110.08	105.63	91.15	84.46	96.92	98.08	114.3	124.77	135.49	
										Total = Sum(45)1…12 =		1349.41	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	20.99	18.35	18.94	16.51	15.84	13.67	12.67	14.54	14.71	17.15	18.72	20.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	195.18	172.29	181.54	163.58	160.9	144.64	139.74	152.2	151.57	169.58	178.26	190.77	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	18.03	16.04	16.49	14.58	14.03	12.18	11.28	12.94	13.08	15.09	16.32	17.54	(63) (G2)

Output from water heater

(64)m=	174.47	153.83	162.37	146.4	144.19	129.86	125.78	136.58	135.89	151.81	159.35	170.55	

Output from water heater (annual)1…12 | 1791.08 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	90.74	80.63	86.21	79.4	79.34	73.1	72.31	76.45	75.41	82.23	84.28	89.27	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	18.93	16.81	13.67	10.35	7.74	6.53	7.06	9.17	12.31	15.63	18.25	19.45	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	190.2	192.17	187.2	176.61	163.24	150.68	142.29	140.32	145.29	155.88	169.24	181.8	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	(71)
Water heating gains (Table 5)													
(72)m=	121.96	119.98	115.87	110.27	106.64	101.53	97.18	102.75	104.73	110.52	117.06	119.99	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	386.65	384.53	372.3	352.8	333.19	314.31	302.1	307.81	317.9	337.6	360.11	376.81	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	4.16	x	19.64	x	0.4	x	0.7	=	15.85	(76)
East	0.9x	0.77	x	4.8	x	19.64	x	0.4	x	0.7	=	18.29	(76)
East	0.9x	0.77	x	4.16	x	38.42	x	0.4	x	0.7	=	31.01	(76)
East	0.9x	0.77	x	4.8	x	38.42	x	0.4	x	0.7	=	35.78	(76)

East	0.9x	0.77	x	4.16	x	63.27	x	0.4	x	0.7	=	51.07	(76)
East	0.9x	0.77	x	4.8	x	63.27	x	0.4	x	0.7	=	58.93	(76)
East	0.9x	0.77	x	4.16	x	92.28	x	0.4	x	0.7	=	74.49	(76)
East	0.9x	0.77	x	4.8	x	92.28	x	0.4	x	0.7	=	85.95	(76)
East	0.9x	0.77	x	4.16	x	113.09	x	0.4	x	0.7	=	91.29	(76)
East	0.9x	0.77	x	4.8	x	113.09	x	0.4	x	0.7	=	105.33	(76)
East	0.9x	0.77	x	4.16	x	115.77	x	0.4	x	0.7	=	93.45	(76)
East	0.9x	0.77	x	4.8	x	115.77	x	0.4	x	0.7	=	107.83	(76)
East	0.9x	0.77	x	4.16	x	110.22	x	0.4	x	0.7	=	88.97	(76)
East	0.9x	0.77	x	4.8	x	110.22	x	0.4	x	0.7	=	102.66	(76)
East	0.9x	0.77	x	4.16	x	94.68	x	0.4	x	0.7	=	76.42	(76)
East	0.9x	0.77	x	4.8	x	94.68	x	0.4	x	0.7	=	88.18	(76)
East	0.9x	0.77	x	4.16	x	73.59	x	0.4	x	0.7	=	59.4	(76)
East	0.9x	0.77	x	4.8	x	73.59	x	0.4	x	0.7	=	68.54	(76)
East	0.9x	0.77	x	4.16	x	45.59	x	0.4	x	0.7	=	36.8	(76)
East	0.9x	0.77	x	4.8	x	45.59	x	0.4	x	0.7	=	42.46	(76)
East	0.9x	0.77	x	4.16	x	24.49	x	0.4	x	0.7	=	19.77	(76)
East	0.9x	0.77	x	4.8	x	24.49	x	0.4	x	0.7	=	22.81	(76)
East	0.9x	0.77	x	4.16	x	16.15	x	0.4	x	0.7	=	13.04	(76)
East	0.9x	0.77	x	4.8	x	16.15	x	0.4	x	0.7	=	15.04	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	34.15	66.8	110.01	160.44	196.62	201.28	191.63	164.6	127.94	79.26	42.58	28.08	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	420.8	451.33	482.31	513.24	529.81	515.59	493.72	472.41	445.84	416.86	402.69	404.89	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) — 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.96	0.86	0.67	0.49	0.54	0.8	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.19	20.29	20.47	20.71	20.9	20.98	21	21	20.95	20.72	20.42	20.17	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.2	20.2	20.2	20.21	20.22	20.23	20.23	20.23	20.22	20.22	20.21	20.21	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.94	0.82	0.6	0.41	0.45	0.73	0.95	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.1	19.25	19.51	19.87	20.11	20.22	20.23	20.23	20.19	19.9	19.46	19.09	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.55	19.67	19.9	20.21	20.44	20.53	20.54	20.54	20.5	20.24	19.85	19.53	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	19.55	19.67	19.9	20.21	20.44	20.53	20.54	20.54	20.5	20.24	19.85	19.53	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.94	0.83	0.63	0.44	0.48	0.76	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	418.82	447.64	473.1	483.44	442.06	323.33	218.68	228.6	337.53	396.95	398.63	403.37	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	886.02	855.69	773.75	642.13	494.16	329.85	219.26	229.62	358.42	545.05	726.2	879.21	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	347.6	274.21	223.69	114.26	38.77	0	0	0	0	110.19	235.85	354.02	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1698.58 (98)

Space heating requirement in kWh/m²/year 25.35 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		1698.58	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	1783.51	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		1791.08	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	1880.63	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	36.64	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		119.54	(330a)

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warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	119.54	(331)
Energy for lighting (calculated in Appendix L)		334.24	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-518.17	(333)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		3599.75	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				256	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	742.85	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	19.02	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	761.86	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				761.86	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	62.04	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	173.47	(379)
Energy saving/generation technologies (333) to (334) as applicable						
Item 1		0.52		x 0.01 =	-268.93	(380)
Total CO2, kg/year	sum of (376)…(382) =				728.45	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				10.87	(384)
EI rating (section 14)					91.28	(385)

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User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.5.51

Property Address: Sample 5 (Top)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67	(1a) x	3	(2a) =	201	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	201	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

DRAFT

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.1	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35				
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration		0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate		(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.35	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
Number of sides sheltered			3	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor		(21) = (18) x (20) =	0.27	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.35	0.34	0.33	0.3	0.29	0.26	0.26	0.25	0.27	0.29	0.3	0.32

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.56	0.56	0.56	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.56	0.56	0.56	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1	=	2.4			(26)
Windows Type 1			4.16	x1/[1/(1.4)+ 0.04]		=	5.52			(27)
Windows Type 2			4.8	x1/[1/(1.4)+ 0.04]		=	6.36			(27)
Walls Type1	29.4	8.96	20.44	x	0.18	=	3.68			(29)
Walls Type2	12	2.4	9.6	x	0.18	=	1.73			(29)
Walls Type3	2.44	0	2.44	x	0.18	=	0.44			(29)
Roof	67	0	67	x	0.13	=	8.71			(30)
Total area of elements, m²			110.84							(31)

* *for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

** *include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.84 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 1057.72 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 5.54 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 34.38 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	37.12	36.97	36.82	36.11	35.98	35.36	35.36	35.25	35.6	35.98	36.24	36.52	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	71.5	71.34	71.19	70.49	70.35	69.74	69.74	69.62	69.98	70.35	70.62	70.9	

Average = Sum(39)$_{1…12}$ /12= 70.49 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	1.07	1.06	1.06	1.05	1.05	1.04	1.04	1.04	1.04	1.05	1.05	1.06	

Average = Sum(40)$_{1…12}$ /12= 1.05 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.17 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.76 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	94.34	90.91	87.48	84.05	80.62	77.19	77.19	80.62	84.05	87.48	90.91	94.34	

Total = Sum(44)$_{1…12}$ = 1029.18 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	139.91	122.36	126.27	110.08	105.63	91.15	84.46	96.92	98.08	114.3	124.77	135.49	

Total = Sum(45)$_{1…12}$ = 1349.41 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	20.99	18.35	18.94	16.51	15.84	13.67	12.67	14.54	14.71	17.15	18.72	20.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09	

Output from water heater (annual)$_{1...12}$ 1898.03 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	83.79	74.35	79.26	72.68	72.4	66.38	65.36	69.5	68.68	75.28	77.56	82.33	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	108.56	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	18.37	16.32	13.27	10.05	7.51	6.34	6.85	8.91	11.95	15.18	17.72	18.89	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	190.2	192.17	187.2	176.61	163.24	150.68	142.29	140.32	145.29	155.88	169.24	181.8	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	-86.85	(71)
Water heating gains (Table 5)													
(72)m=	112.63	110.65	106.53	100.94	97.31	92.19	87.85	93.42	95.4	101.18	107.72	110.65	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	379.77	377.7	365.57	346.16	326.63	307.78	295.56	301.21	311.21	330.81	353.25	369.91	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	4.16	x	19.64	x	0.63	x	0.7	=	24.97	(76)
East	0.9x	0.77	x	4.8	x	19.64	x	0.63	x	0.7	=	28.81	(76)
East	0.9x	0.77	x	4.16	x	38.42	x	0.63	x	0.7	=	48.85	(76)
East	0.9x	0.77	x	4.8	x	38.42	x	0.63	x	0.7	=	56.36	(76)

East	0.9x	0.77	x	4.16	x	63.27	x	0.63	x	0.7	=	80.44	(76)
East	0.9x	0.77	x	4.8	x	63.27	x	0.63	x	0.7	=	92.82	(76)
East	0.9x	0.77	x	4.16	x	92.28	x	0.63	x	0.7	=	117.32	(76)
East	0.9x	0.77	x	4.8	x	92.28	x	0.63	x	0.7	=	135.37	(76)
East	0.9x	0.77	x	4.16	x	113.09	x	0.63	x	0.7	=	143.78	(76)
East	0.9x	0.77	x	4.8	x	113.09	x	0.63	x	0.7	=	165.9	(76)
East	0.9x	0.77	x	4.16	x	115.77	x	0.63	x	0.7	=	147.18	(76)
East	0.9x	0.77	x	4.8	x	115.77	x	0.63	x	0.7	=	169.83	(76)
East	0.9x	0.77	x	4.16	x	110.22	x	0.63	x	0.7	=	140.13	(76)
East	0.9x	0.77	x	4.8	x	110.22	x	0.63	x	0.7	=	161.68	(76)
East	0.9x	0.77	x	4.16	x	94.68	x	0.63	x	0.7	=	120.37	(76)
East	0.9x	0.77	x	4.8	x	94.68	x	0.63	x	0.7	=	138.88	(76)
East	0.9x	0.77	x	4.16	x	73.59	x	0.63	x	0.7	=	93.56	(76)
East	0.9x	0.77	x	4.8	x	73.59	x	0.63	x	0.7	=	107.95	(76)
East	0.9x	0.77	x	4.16	x	45.59	x	0.63	x	0.7	=	57.96	(76)
East	0.9x	0.77	x	4.8	x	45.59	x	0.63	x	0.7	=	66.88	(76)
East	0.9x	0.77	x	4.16	x	24.49	x	0.63	x	0.7	=	31.13	(76)
East	0.9x	0.77	x	4.8	x	24.49	x	0.63	x	0.7	=	35.92	(76)
East	0.9x	0.77	x	4.16	x	16.15	x	0.63	x	0.7	=	20.53	(76)
East	0.9x	0.77	x	4.8	x	16.15	x	0.63	x	0.7	=	23.69	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	53.78	105.21	173.26	252.69	309.68	317.01	301.81	259.25	201.51	124.84	67.06	44.23	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	433.55	482.91	538.83	598.85	636.31	624.8	597.37	560.46	512.71	455.64	420.3	414.14	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.95	0.86	0.68	0.51	0.56	0.82	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.92	20.05	20.29	20.6	20.84	20.97	20.99	20.99	20.91	20.59	20.2	19.89	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.03	20.03	20.03	20.04	20.04	20.05	20.05	20.05	20.05	20.04	20.04	20.04	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.93	0.81	0.59	0.4	0.45	0.75	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.58	18.78	19.12	19.57	19.89	20.03	20.05	20.05	19.98	19.56	19	18.55	(90)

fLA = Living area ÷ (4) = 0.41 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.13	19.3	19.6	19.99	20.28	20.41	20.44	20.43	20.36	19.98	19.49	19.1	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	19.13	19.3	19.6	19.99	20.28	20.41	20.44	20.43	20.36	19.98	19.49	19.1	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.93	0.82	0.63	0.44	0.5	0.77	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	431.37	478.35	526.41	558.24	522.37	391.03	265.65	277.6	395.38	434.69	416.08	412.49	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1060.36	1027.32	932.66	781.63	603.7	405.41	267.51	280.88	437.95	660.12	875.06	1056.59	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	467.97	368.9	302.25	160.84	60.51	0	0	0	0	167.71	330.47	479.21	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 2337.86 (98)

Space heating requirement in kWh/m²/year 34.89 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	467.97	368.9	302.25	160.84	60.51	0	0	0	0	167.71	330.47	479.21	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	500.5	394.55	323.26	172.02	64.72	0	0	0	0	179.37	353.44	512.52	

Total (kWh/year) =$Sum(211)_{1...5,10....12}$= 2500.39 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =$Sum(215)_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)													
	186.5	164.45	172.86	155.17	152.22	136.24	131.06	143.52	143.17	160.9	169.86	182.09	
Efficiency of water heater												79.8	(216)
(217)m=	87.17	86.91	86.29	84.91	82.58	79.8	79.8	79.8	79.8	84.92	86.56	87.28	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	213.95	189.22	200.33	182.75	184.34	170.73	164.23	179.84	179.41	189.46	196.24	208.63	

Total = $Sum(219a)_{1...12}$ = 2259.13 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		2500.39

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Water heating fuel used			2259.13	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			324.5	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			5159.01	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	540.08	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	487.97	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1028.05	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	168.41	(268)
Total CO2, kg/year		sum of (265)…(271) =		1235.39	(272)

TER =	18.44	(273)

SAP Input

Property Details: Sample 6 (Top)

Address:	
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	26 July 2019
Date of certificate:	15 June 2022
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	498

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2022	
Floor Location:	Floor area:	Storey height:
Floor 0	55.1 m²	3 m
Living area:	26 m² (fraction 0.472)	
Front of dwelling faces:	Unspecified	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
DOOR	Manufacturer	Solid			Wood
W	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Balcony	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
DOOR	mm	0.7	0	1.4	2.4	1
W		0.7	0.4	1	4.16	1
Balcony		0.7	0.4	1	4.8	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
DOOR		INT	Worst case	0	0
W		W	West	0	0
Balcony		W	West	0	0

Overshading: More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
W	24	8.96	15.04	0.15	0	False	N/A
INT	24	2.4	21.6	0.16	0.43	False	N/A
Spandrel	2.4	0	2.4	0.35	0	False	N/A
Roof	55.1	0	55.1	0.11	0		N/A
Internal Elements							
Party Elements							

Thermal bridges:

Thermal bridges: No information on thermal bridging (y=0.15) (y =0.15)

SAP Input

Ventilation:	
Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	3
Pressure test:	3
Main heating system:	
Main heating system:	Community heating schemes Heat source: Community heat pump heat from electric heat pump, heat fraction 1, efficiency 256 Piping>=1991, pre-insulated, low temp, variable flow Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Boiler interlock: Yes
Main heating Control:	
Main heating Control:	Charging system linked to use of community heating, programmer and TRVs Control code: 2306
Secondary heating system:	
Secondary heating system:	None
Water heating:	
Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Flue Gas Heat Recovery System: Database (rev 498, product index 060036) Brand name: Worcester Model: Greenstar Xtra Model qualifier: 2015 Solar panel: False
Others:	
Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	Photovoltaic 1 Installed Peak power: 0.6 Tilt of collector: 30° Overshading: None or very little Collector Orientation: South
Assess Zero Carbon Home:	No

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User Details:

Assessor Name: | **Stroma Number:**

Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.51

Property Address: Sample 6 (Top)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	55.1	(1a) x	3	(2a) =	165.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.1	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	165.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.05 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.25	0.25	0.25	0.23	0.23	0.22	0.22	0.21	0.22	0.23	0.24	0.24	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.25	0.25	0.25	0.23	0.23	0.22	0.22	0.21	0.22	0.23	0.24	0.24	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1.4	=	3.36			(26)
Windows Type 1			4.16	x	1/[1/(1)+ 0.04]	=	4			(27)
Windows Type 2			4.8	x	1/[1/(1)+ 0.04]	=	4.62			(27)
Walls Type1	24	8.96	15.04	x	0.15	=	2.26			(29)
Walls Type2	24	2.4	21.6	x	0.15	=	3.23			(29)
Walls Type3	2.4	0	2.4	x	0.35	=	0.84			(29)
Roof	55.1	0	55.1	x	0.11	=	6.06			(30)
Total area of elements, m²			105.5							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 24.37 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 1042.46 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 15.83 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 40.19 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	13.8	13.64	13.48	12.69	12.53	11.74	11.74	11.58	12.06	12.53	12.85	13.17	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	53.99	53.83	53.67	52.88	52.72	51.93	51.93	51.77	52.25	52.72	53.04	53.36

Average = Sum(39)$_{1\ldots12}$ /12= 52.84 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.98	0.98	0.97	0.96	0.96	0.94	0.94	0.94	0.95	0.96	0.96	0.97

Average = $Sum(40)_{1 \ldots 12}$ /12= 0.96 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.84 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 77.91 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	85.7	82.58	79.47	76.35	73.23	70.12	70.12	73.23	76.35	79.47	82.58	85.7	
										Total = $Sum(44)_{1 \ldots 12}$ =		934.88	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	127.09	111.15	114.7	100	95.95	82.8	76.72	88.04	89.09	103.83	113.34	123.08	
										Total = $Sum(45)_{1 \ldots 12}$ =		1225.78	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	19.06	16.67	17.2	15	14.39	12.42	11.51	13.21	13.36	15.57	17	18.46	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	182.36	161.08	169.97	153.49	151.23	136.29	132	143.32	142.59	159.11	166.83	178.35	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	16.59	14.71	15.14	13.33	12.81	11.05	10.22	11.77	11.91	13.81	14.97	16.12	(63) (G2)

Output from water heater

(64)m=	163.1	143.95	152.16	137.57	135.73	122.64	119.09	128.87	128.08	142.61	149.26	159.55

Output from water heater (annual)$_{1…12}$ 1682.61 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	86.48	76.9	82.36	76.04	76.12	70.32	69.73	73.5	72.42	78.74	80.48	85.14	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	15.29	13.58	11.05	8.36	6.25	5.28	5.7	7.41	9.95	12.63	14.74	15.72	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	160.44	162.11	157.91	148.98	137.71	127.11	120.03	118.37	122.56	131.49	142.77	153.36	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	(71)
Water heating gains (Table 5)													
(72)m=	116.23	114.43	110.7	105.62	102.32	97.67	93.73	98.78	100.58	105.84	111.78	114.44	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	342.57	340.73	330.26	313.56	296.88	280.66	270.06	275.17	283.69	300.57	319.89	334.13	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	4.16	x	19.64	x	0.4	x	0.7	=	15.85	(80)
West	0.9x	0.77	x	4.8	x	19.64	x	0.4	x	0.7	=	18.29	(80)
West	0.9x	0.77	x	4.16	x	38.42	x	0.4	x	0.7	=	31.01	(80)
West	0.9x	0.77	x	4.8	x	38.42	x	0.4	x	0.7	=	35.78	(80)

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West	0.9x	0.77	x	4.16	x	63.27	x	0.4	x	0.7	=	51.07	(80)
West	0.9x	0.77	x	4.8	x	63.27	x	0.4	x	0.7	=	58.93	(80)
West	0.9x	0.77	x	4.16	x	92.28	x	0.4	x	0.7	=	74.49	(80)
West	0.9x	0.77	x	4.8	x	92.28	x	0.4	x	0.7	=	85.95	(80)
West	0.9x	0.77	x	4.16	x	113.09	x	0.4	x	0.7	=	91.29	(80)
West	0.9x	0.77	x	4.8	x	113.09	x	0.4	x	0.7	=	105.33	(80)
West	0.9x	0.77	x	4.16	x	115.77	x	0.4	x	0.7	=	93.45	(80)
West	0.9x	0.77	x	4.8	x	115.77	x	0.4	x	0.7	=	107.83	(80)
West	0.9x	0.77	x	4.16	x	110.22	x	0.4	x	0.7	=	88.97	(80)
West	0.9x	0.77	x	4.8	x	110.22	x	0.4	x	0.7	=	102.66	(80)
West	0.9x	0.77	x	4.16	x	94.68	x	0.4	x	0.7	=	76.42	(80)
West	0.9x	0.77	x	4.8	x	94.68	x	0.4	x	0.7	=	88.18	(80)
West	0.9x	0.77	x	4.16	x	73.59	x	0.4	x	0.7	=	59.4	(80)
West	0.9x	0.77	x	4.8	x	73.59	x	0.4	x	0.7	=	68.54	(80)
West	0.9x	0.77	x	4.16	x	45.59	x	0.4	x	0.7	=	36.8	(80)
West	0.9x	0.77	x	4.8	x	45.59	x	0.4	x	0.7	=	42.46	(80)
West	0.9x	0.77	x	4.16	x	24.49	x	0.4	x	0.7	=	19.77	(80)
West	0.9x	0.77	x	4.8	x	24.49	x	0.4	x	0.7	=	22.81	(80)
West	0.9x	0.77	x	4.16	x	16.15	x	0.4	x	0.7	=	13.04	(80)
West	0.9x	0.77	x	4.8	x	16.15	x	0.4	x	0.7	=	15.04	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	34.15	66.8	110.01	160.44	196.62	201.28	191.63	164.6	127.94	79.26	42.58	28.08	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	376.72	407.53	440.27	474	493.5	481.94	461.69	439.77	411.64	379.83	362.47	362.21	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) — 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.95	0.85	0.66	0.49	0.53	0.79	0.96	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.07	20.19	20.39	20.66	20.88	20.98	21	20.99	20.94	20.68	20.33	20.06	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.1	20.1	20.1	20.12	20.12	20.13	20.13	20.13	20.13	20.12	20.11	20.11	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.98	0.93	0.8	0.58	0.4	0.44	0.72	0.94	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.87	19.03	19.33	19.72	20	20.12	20.13	20.13	20.08	19.75	19.26	18.85	(90)

fLA = Living area ÷ (4) = 0.47 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.44	19.58	19.83	20.17	20.41	20.52	20.54	20.54	20.49	20.19	19.76	19.42	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	19.44	19.58	19.83	20.17	20.41	20.52	20.54	20.54	20.49	20.19	19.76	19.42	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.93	0.82	0.62	0.44	0.48	0.75	0.95	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	374.3	403.06	429.5	441.63	405.39	299.4	203.63	212.72	309.59	359.08	357.76	360.31	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	817.25	790.13	715.57	595.82	459.34	307.59	204.56	214.28	333.61	505.4	671.72	812.02	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	329.56	260.12	212.84	111.02	40.14	0	0	0	0	108.86	226.05	336.07	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 1624.65 (98)

Space heating requirement in kWh/m²/year 29.49 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		1624.65	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	1705.88	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		1682.61	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	1766.74	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	34.73	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		98.31	(330a)

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warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	98.31	(331)
Energy for lighting (calculated in Appendix L)		270.05	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-518.17	(333)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		3322.82	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				256	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	704.02	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	18.02	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	722.04	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				722.04	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	51.02	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	140.16	(379)
Energy saving/generation technologies (333) to (334) as applicable						
Item 1		0.52		x 0.01 =	-268.93	(380)
Total CO2, kg/year	sum of (376)…(382) =				644.29	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				11.69	(384)
EI rating (section 14)					91.38	(385)

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User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.51

Property Address: Sample 6 (Top)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	55.1	(1a) x	3	(2a) =	165.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.1	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	165.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.12	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*		0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.37	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.29	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.37	0.36	0.35	0.32	0.31	0.27	0.27	0.27	0.29	0.31	0.32	0.34

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	0	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.56	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.56	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1	=	2.4			(26)
Windows Type 1			4.16	x1/[1/(1.4)+ 0.04]		=	5.52			(27)
Windows Type 2			4.8	x1/[1/(1.4)+ 0.04]		=	6.36			(27)
Walls Type1	24	8.96	15.04	x	0.18	=	2.71			(29)
Walls Type2	24	2.4	21.6	x	0.18	=	3.89			(29)
Walls Type3	2.4	0	2.4	x	0.18	=	0.43			(29)
Roof	55.1	0	55.1	x	0.13	=	7.16			(30)
Total area of elements, m²			105.5							(31)

* *for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

** *include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	28.47	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	1042.46	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		5.28	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	33.74	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	30.94	30.8	30.66	30	29.88	29.31	29.31	29.2	29.53	29.88	30.13	30.39	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	64.68	64.54	64.4	63.75	63.62	63.05	63.05	62.95	63.27	63.62	63.87	64.13

Average = Sum(39)$_{1…12}$ /12= 63.75 (39)

TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.17	1.17	1.17	1.16	1.15	1.14	1.14	1.14	1.15	1.15	1.16	1.16

Average = Sum(40)1…12 /12= 1.16 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.84 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 77.91 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	85.7	82.58	79.47	76.35	73.23	70.12	70.12	73.23	76.35	79.47	82.58	85.7

Total = Sum(44)1…12 = 934.88 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	127.09	111.15	114.7	100	95.95	82.8	76.72	88.04	89.09	103.83	113.34	123.08

Total = Sum(45)1…12 = 1225.78 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.06	16.67	17.2	15	14.39	12.42	11.51	13.21	13.36	15.57	17	18.46	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

TER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	173.68	153.24	161.29	145.09	142.54	127.89	123.32	134.64	134.18	150.42	158.43	169.67	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	173.68	153.24	161.29	145.09	142.54	127.89	123.32	134.64	134.18	150.42	158.43	169.67	

Output from water heater (annual)1…12 | 1774.4 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	79.53	70.63	75.41	69.32	69.18	63.6	62.79	66.55	65.7	71.8	73.76	78.2	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	92.01	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	14.88	13.21	10.74	8.13	6.08	5.13	5.55	7.21	9.68	12.29	14.34	15.29	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	160.44	162.11	157.91	148.98	137.71	127.11	120.03	118.37	122.56	131.49	142.77	153.36	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	-73.61	(71)
Water heating gains (Table 5)													
(72)m=	106.9	105.1	101.36	96.28	92.98	88.34	84.39	89.45	91.25	96.5	102.44	105.11	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	335.82	334.02	323.62	307	290.37	274.19	263.57	268.63	277.09	293.89	313.16	327.36	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	4.16	x	19.64	x	0.63	x	0.7	=	24.97	(80)
West	0.9x	0.77	x	4.8	x	19.64	x	0.63	x	0.7	=	28.81	(80)
West	0.9x	0.77	x	4.16	x	38.42	x	0.63	x	0.7	=	48.85	(80)
West	0.9x	0.77	x	4.8	x	38.42	x	0.63	x	0.7	=	56.36	(80)

West	0.9x	0.77	x	4.16	x	63.27	x	0.63	x	0.7	=	80.44	(80)
West	0.9x	0.77	x	4.8	x	63.27	x	0.63	x	0.7	=	92.82	(80)
West	0.9x	0.77	x	4.16	x	92.28	x	0.63	x	0.7	=	117.32	(80)
West	0.9x	0.77	x	4.8	x	92.28	x	0.63	x	0.7	=	135.37	(80)
West	0.9x	0.77	x	4.16	x	113.09	x	0.63	x	0.7	=	143.78	(80)
West	0.9x	0.77	x	4.8	x	113.09	x	0.63	x	0.7	=	165.9	(80)
West	0.9x	0.77	x	4.16	x	115.77	x	0.63	x	0.7	=	147.18	(80)
West	0.9x	0.77	x	4.8	x	115.77	x	0.63	x	0.7	=	169.83	(80)
West	0.9x	0.77	x	4.16	x	110.22	x	0.63	x	0.7	=	140.13	(80)
West	0.9x	0.77	x	4.8	x	110.22	x	0.63	x	0.7	=	161.68	(80)
West	0.9x	0.77	x	4.16	x	94.68	x	0.63	x	0.7	=	120.37	(80)
West	0.9x	0.77	x	4.8	x	94.68	x	0.63	x	0.7	=	138.88	(80)
West	0.9x	0.77	x	4.16	x	73.59	x	0.63	x	0.7	=	93.56	(80)
West	0.9x	0.77	x	4.8	x	73.59	x	0.63	x	0.7	=	107.95	(80)
West	0.9x	0.77	x	4.16	x	45.59	x	0.63	x	0.7	=	57.96	(80)
West	0.9x	0.77	x	4.8	x	45.59	x	0.63	x	0.7	=	66.88	(80)
West	0.9x	0.77	x	4.16	x	24.49	x	0.63	x	0.7	=	31.13	(80)
West	0.9x	0.77	x	4.8	x	24.49	x	0.63	x	0.7	=	35.92	(80)
West	0.9x	0.77	x	4.16	x	16.15	x	0.63	x	0.7	=	20.53	(80)
West	0.9x	0.77	x	4.8	x	16.15	x	0.63	x	0.7	=	23.69	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	53.78	105.21	173.26	252.69	309.68	317.01	301.81	259.25	201.51	124.84	67.06	44.23	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	389.6	439.23	496.88	559.69	600.05	591.2	565.38	527.88	478.6	418.73	380.21	371.59	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.94	0.83	0.65	0.48	0.54	0.79	0.96	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.83	19.98	20.24	20.58	20.84	20.96	20.99	20.99	20.9	20.56	20.13	19.8	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.94	19.94	19.95	19.95	19.96	19.96	19.96	19.97	19.96	19.96	19.95	19.95	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.97	0.91	0.77	0.56	0.37	0.42	0.71	0.94	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.39	18.61	18.99	19.47	19.8	19.94	19.96	19.96	19.89	19.46	18.84	18.36	(90)

fLA = Living area ÷ (4) = | 0.47 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.07	19.25	19.58	19.99	20.29	20.42	20.45	20.45	20.37	19.98	19.45	19.04	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.07	19.25	19.58	19.99	20.29	20.42	20.45	20.45	20.37	19.98	19.45	19.04	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation factor for gains, hm:														
(94)m=	0.99	0.99	0.97	0.91	0.79	0.6	0.43	0.48	0.75	0.94	0.99	0.99		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	386.85	433.43	481.37	511.66	475.54	353.93	240.73	251.36	357.64	394.66	375	369.48		(95)
Monthly average external temperature from Table 8														
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]														
(97)m=	955.18	926.41	842.45	707.2	546.66	367.27	242.68	254.72	396.54	596.52	788.88	951.45		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	422.83	331.29	268.64	140.79	52.92	0	0	0	0	150.19	297.99	432.99		
									Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =				2097.63	(98)
Space heating requirement in kWh/m²/year													38.07	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	422.83	331.29	268.64	140.79	52.92	0	0	0	0	150.19	297.99	432.99		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	452.23	354.32	287.32	150.58	56.59	0	0	0	0	160.63	318.71	463.09		
									Total (kWh/year) =Sum(211)$_{1...5,10....12}$=				2243.46	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
									Total (kWh/year) =Sum(215)$_{1...5,10....12}$=				0	(215)

Water heating

Output from water heater (calculated above)														
	173.68	153.24	161.29	145.09	142.54	127.89	123.32	134.64	134.18	150.42	158.43	169.67		
Efficiency of water heater													79.8	(216)
(217)m=	87.1	86.82	86.17	84.73	82.44	79.8	79.8	79.8	79.8	84.81	86.48	87.21		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	199.41	176.5	187.19	171.23	172.91	160.26	154.53	168.72	168.15	177.37	183.21	194.56		
									Total = Sum(219a)$_{1...12}$ =				2114.03	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		2243.46

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Water heating fuel used			2114.03	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			262.71	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			4695.2	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	484.59	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	456.63	(264)
Space and water heating	(261) + (262) + (263) + (264) =			941.22	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	136.34	(268)
Total CO2, kg/year		sum of (265)…(271) =		1116.49	(272)

TER = 20.26 (273)

SAP Input

Property Details: Sample 7 (Top)

Address:	
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	26 July 2019
Date of certificate:	15 June 2022
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	498

Property description:

Dwelling type:	Flat
Detachment:	
Year Completed:	2022

Floor Location:	Floor area:	Storey height:
Floor 0	66.3 m²	3 m

Living area:	23 m² (fraction 0.347)
Front of dwelling faces:	Unspecified

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
DOOR	Manufacturer	Solid			Wood
Balcony	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
N	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
E	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
DOOR	mm	0.7	0	1.4	2.4	1
Balcony		0.7	0.4	1	4.8	1
N		0.7	0.4	1	5.44	1
E		0.7	0.4	1	1.44	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
DOOR		INT	Worst case	0	0
Balcony		N	North	0	0
N		N	North	0	0
E		E	East	0	0

Overshading: Heavy

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
N	10.24	10.24	0	0.15	0	False	N/A
E	1.44	1.44	0	0.15	0	False	N/A
INT	13.2	2.4	10.8	0.16	0.43	False	N/A
Spandrel	2.4	0	2.4	0.35	0	False	N/A
Roof	66.3	0	66.3	0.11	0		N/A
Internal Elements							
Party Elements							

SAP Input

Thermal bridges:

Thermal bridges:	No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	3

Main heating system:

Main heating system:	Community heating schemes Heat source: Community heat pump heat from electric heat pump, heat fraction 1, efficiency 256 Piping>=1991, pre-insulated, low temp, variable flow Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Boiler interlock: Yes

Main heating Control:

Main heating Control:	Charging system linked to use of community heating, programmer and TRVs Control code: 2306

Secondary heating system:

Secondary heating system:	None

Water heating:

Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Flue Gas Heat Recovery System: Database (rev 498, product index 060036) Brand name: Worcester Model: Greenstar Xtra Model qualifier: 2015 Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	Photovoltaic 1 Installed Peak power: 0.6 Tilt of collector: 30° Overshading: None or very little Collector Orientation: South
Assess Zero Carbon Home:	No

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Sample 7 (Top)

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	66.3	(1a)	x	3	(2a)	=	198.9	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.3	(4)						
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	=	198.9	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*		0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	79.05	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1.4	=	3.36			(26)
Windows Type 1			4.8	x	1/[1/(1)+ 0.04]	=	4.62			(27)
Windows Type 2			5.44	x	1/[1/(1)+ 0.04]	=	5.23			(27)
Windows Type 3			1.44	x	1/[1/(1)+ 0.04]	=	1.38			(27)
Walls Type1	10.24	10.24	0	x	0.15	=	0			(29)
Walls Type2	1.44	1.44	0	x	0.15	=	0			(29)
Walls Type3	13.2	2.4	10.8	x	0.15	=	1.62			(29)
Walls Type4	2.4	0	2.4	x	0.35	=	0.84			(29)
Roof	66.3	0	66.3	x	0.11	=	7.29			(30)
Total area of elements, m²			93.58							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	24.34	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	781.5	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		14.04	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	38.38	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

DER WorkSheet: New dwelling design stage

(38)m=	17.55	17.34	17.13	16.08	15.87	14.83	14.83	14.62	15.24	15.87	16.29	16.71	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	55.92	55.71	55.5	54.46	54.25	53.2	53.2	52.99	53.62	54.25	54.67	55.09	

Average = Sum(39)$_{1...12}$ /12= 54.41 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.84	0.84	0.84	0.82	0.82	0.8	0.8	0.8	0.81	0.82	0.82	0.83	

Average = Sum(40)$_{1...12}$ /12= 0.82 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.15 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.34 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	93.87	90.46	87.04	83.63	80.22	76.8	76.8	80.22	83.63	87.04	90.46	93.87	

Total = Sum(44)$_{1...12}$ = 1024.02 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.2	121.75	125.63	109.53	105.1	90.69	84.04	96.44	97.59	113.73	124.14	134.81	

Total = Sum(45)$_{1...12}$ = 1342.66 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.88	18.26	18.85	16.43	15.76	13.6	12.61	14.47	14.64	17.06	18.62	20.22	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	194.48	171.68	180.91	163.02	160.37	144.18	139.32	151.71	151.08	169.01	177.64	190.09	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	17.95	15.97	16.42	14.51	13.97	12.12	11.22	12.87	13.02	15.02	16.25	17.46	(63) (G2)

Output from water heater

(64)m=	173.85	153.29	161.81	145.92	143.72	129.47	125.41	136.16	135.46	151.3	158.8	169.95	

Output from water heater (annual)$_{1...12}$ | 1785.13 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	90.51	80.42	85.99	79.21	79.17	72.95	72.16	76.29	75.24	82.04	84.07	89.05	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	107.65	107.65	107.65	107.65	107.65	107.65	107.65	107.65	107.65	107.65	107.65	107.65	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.67	15.69	12.76	9.66	7.22	6.1	6.59	8.56	11.49	14.59	17.03	18.16	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	188.51	190.47	185.54	175.04	161.8	149.35	141.03	139.07	144	154.5	167.74	180.19	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.77	33.77	33.77	33.77	33.77	33.77	33.77	33.77	33.77	33.77	33.77	33.77	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.12	-86.12	-86.12	-86.12	-86.12	-86.12	-86.12	-86.12	-86.12	-86.12	-86.12	-86.12	(71)

Water heating gains (Table 5)

(72)m=	121.65	119.68	115.58	110.02	106.41	101.32	97	102.54	104.5	110.26	116.77	119.69	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	383.12	381.13	369.18	350.02	330.72	312.06	299.91	305.47	315.3	334.65	356.84	373.33	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	4.8	x	10.63	x	0.4	x	0.7	=	9.9	(74)

North	0.9x	0.77	x	5.44	x	10.63	x	0.4	x	0.7	=	11.22	(74)
North	0.9x	0.77	x	4.8	x	20.32	x	0.4	x	0.7	=	18.93	(74)
North	0.9x	0.77	x	5.44	x	20.32	x	0.4	x	0.7	=	21.45	(74)
North	0.9x	0.77	x	4.8	x	34.53	x	0.4	x	0.7	=	32.16	(74)
North	0.9x	0.77	x	5.44	x	34.53	x	0.4	x	0.7	=	36.45	(74)
North	0.9x	0.77	x	4.8	x	55.46	x	0.4	x	0.7	=	51.66	(74)
North	0.9x	0.77	x	5.44	x	55.46	x	0.4	x	0.7	=	58.55	(74)
North	0.9x	0.77	x	4.8	x	74.72	x	0.4	x	0.7	=	69.59	(74)
North	0.9x	0.77	x	5.44	x	74.72	x	0.4	x	0.7	=	78.87	(74)
North	0.9x	0.77	x	4.8	x	79.99	x	0.4	x	0.7	=	74.5	(74)
North	0.9x	0.77	x	5.44	x	79.99	x	0.4	x	0.7	=	84.43	(74)
North	0.9x	0.77	x	4.8	x	74.68	x	0.4	x	0.7	=	69.55	(74)
North	0.9x	0.77	x	5.44	x	74.68	x	0.4	x	0.7	=	78.83	(74)
North	0.9x	0.77	x	4.8	x	59.25	x	0.4	x	0.7	=	55.18	(74)
North	0.9x	0.77	x	5.44	x	59.25	x	0.4	x	0.7	=	62.54	(74)
North	0.9x	0.77	x	4.8	x	41.52	x	0.4	x	0.7	=	38.67	(74)
North	0.9x	0.77	x	5.44	x	41.52	x	0.4	x	0.7	=	43.82	(74)
North	0.9x	0.77	x	4.8	x	24.19	x	0.4	x	0.7	=	22.53	(74)
North	0.9x	0.77	x	5.44	x	24.19	x	0.4	x	0.7	=	25.53	(74)
North	0.9x	0.77	x	4.8	x	13.12	x	0.4	x	0.7	=	12.22	(74)
North	0.9x	0.77	x	5.44	x	13.12	x	0.4	x	0.7	=	13.85	(74)
North	0.9x	0.77	x	4.8	x	8.86	x	0.4	x	0.7	=	8.26	(74)
North	0.9x	0.77	x	5.44	x	8.86	x	0.4	x	0.7	=	9.36	(74)
East	0.9x	0.77	x	1.44	x	19.64	x	0.4	x	0.7	=	5.49	(76)
East	0.9x	0.77	x	1.44	x	38.42	x	0.4	x	0.7	=	10.74	(76)
East	0.9x	0.77	x	1.44	x	63.27	x	0.4	x	0.7	=	17.68	(76)
East	0.9x	0.77	x	1.44	x	92.28	x	0.4	x	0.7	=	25.78	(76)
East	0.9x	0.77	x	1.44	x	113.09	x	0.4	x	0.7	=	31.6	(76)
East	0.9x	0.77	x	1.44	x	115.77	x	0.4	x	0.7	=	32.35	(76)
East	0.9x	0.77	x	1.44	x	110.22	x	0.4	x	0.7	=	30.8	(76)
East	0.9x	0.77	x	1.44	x	94.68	x	0.4	x	0.7	=	26.45	(76)
East	0.9x	0.77	x	1.44	x	73.59	x	0.4	x	0.7	=	20.56	(76)
East	0.9x	0.77	x	1.44	x	45.59	x	0.4	x	0.7	=	12.74	(76)
East	0.9x	0.77	x	1.44	x	24.49	x	0.4	x	0.7	=	6.84	(76)
East	0.9x	0.77	x	1.44	x	16.15	x	0.4	x	0.7	=	4.51	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	26.62	51.11	86.29	135.99	180.06	191.28	179.18	144.17	103.05	60.8	32.91	22.13	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	409.74	432.25	455.47	486.01	510.78	503.34	479.08	449.64	418.35	395.45	389.75	395.46	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

(86)m=	1	1	0.99	0.96	0.86	0.66	0.49	0.54	0.81	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.21	20.3	20.47	20.71	20.9	20.99	21	21	20.95	20.73	20.44	20.2	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.22	20.22	20.22	20.23	20.24	20.25	20.25	20.25	20.25	20.24	20.23	20.23	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.95	0.82	0.59	0.4	0.45	0.75	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.16	19.29	19.53	19.89	20.14	20.24	20.25	20.25	20.21	19.92	19.5	19.15	(90)

fLA = Living area ÷ (4) = 0.35 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.52	19.64	19.86	20.17	20.41	20.5	20.51	20.51	20.47	20.2	19.83	19.52	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.52	19.64	19.86	20.17	20.41	20.5	20.51	20.51	20.47	20.2	19.83	19.52	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.95	0.83	0.61	0.43	0.48	0.77	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	407.88	429.08	447.99	460.21	425.51	309	207.61	217.04	321.2	378.12	385.99	394.01	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	851.32	821.11	741.41	614	472.37	313.96	208.03	217.86	341.42	520.76	695.74	843.66	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	329.92	263.45	218.31	110.73	34.86	0	0	0	0	106.12	223.02	334.54	

Total per year (kWh/year) = $\text{Sum}(98)_{1...5,9...12}$ = 1620.95 (98)

Space heating requirement in kWh/m²/year 24.45 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none	0	(301)
Fraction of space heat from community system 1 – (301) =	1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating **kWh/year**

Annual space heating requirement 1620.95

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Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	1701.99	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)

Water heating

Annual water heating requirement		1785.13	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	1874.39	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	35.76	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		118.3	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	118.3	(331)
Energy for lighting (calculated in Appendix L)		311.98	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-518.17	(333)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		3488.48	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				256	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	725.06	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	18.56	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	743.62	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				743.62	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	61.4	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	161.92	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1		0.52		x 0.01 =	-268.93	(380)

Total CO2, kg/year	sum of (376)…(382) =	698	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =	10.53	(384)
EI rating (section 14)		91.6	(385)

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User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.51

Property Address: Sample 7 (Top)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	66.3	(1a) x	3	(2a) =	198.9	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.3	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		198.9	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

DRAFT

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.1	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.35	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.37	0.37	0.33	0.32	0.28	0.28	0.28	0.3	0.32	0.34	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	0	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1	=	2.4			(26)
Windows Type 1			4.8	x1/[1/(1.4)+ 0.04]		=	6.36			(27)
Windows Type 2			5.44	x1/[1/(1.4)+ 0.04]		=	7.21			(27)
Windows Type 3			1.44	x1/[1/(1.4)+ 0.04]		=	1.91			(27)
Walls Type1	10.24	10.24	0	x	0.18	=	0			(29)
Walls Type2	1.44	1.44	0	x	0.18	=	0			(29)
Walls Type3	13.2	2.4	10.8	x	0.18	=	1.94			(29)
Walls Type4	2.4	0	2.4	x	0.18	=	0.43			(29)
Roof	66.3	0	66.3	x	0.13	=	8.62			(30)
Total area of elements, m²			93.58							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	28.88	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	781.5	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		4.68	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	33.56	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(38)m=	37.56	37.37	37.19	36.34	36.19	35.45	35.45	35.31	35.73	36.19	36.51	36.84	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	71.11	70.93	70.75	69.9	69.74	69.01	69.01	68.87	69.29	69.74	70.07	70.4	

Average = Sum(39)$_{1...12}$ /12= 69.9 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.07	1.07	1.07	1.05	1.05	1.04	1.04	1.04	1.05	1.05	1.06	1.06	

Average = Sum(40)$_{1...12}$ /12= 1.05 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.15 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.34 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	93.87	90.46	87.04	83.63	80.22	76.8	76.8	80.22	83.63	87.04	90.46	93.87	

Total = Sum(44)$_{1...12}$ = 1024.02 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.2	121.75	125.63	109.53	105.1	90.69	84.04	96.44	97.59	113.73	124.14	134.81	

Total = Sum(45)$_{1...12}$ = 1342.66 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.88	18.26	18.85	16.43	15.76	13.6	12.61	14.47	14.64	17.06	18.62	20.22	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	185.8	163.83	172.23	154.62	151.69	135.78	130.63	143.03	142.68	160.32	169.24	181.41	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	185.8	163.83	172.23	154.62	151.69	135.78	130.63	143.03	142.68	160.32	169.24	181.41	

Output from water heater (annual)$_{1…12}$ | 1891.27 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	83.56	74.15	79.05	72.49	72.22	66.23	65.22	69.34	68.52	75.09	77.35	82.1	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	107.65	107.65	107.65	107.65	107.65	107.65	107.65	107.65	107.65	107.65	107.65	107.65	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.23	15.3	12.44	9.42	7.04	5.94	6.42	8.35	11.21	14.23	16.61	17.7	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	188.51	190.47	185.54	175.04	161.8	149.35	141.03	139.07	144	154.5	167.74	180.19	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.77	33.77	33.77	33.77	33.77	33.77	33.77	33.77	33.77	33.77	33.77	33.77	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.12	-86.12	-86.12	-86.12	-86.12	-86.12	-86.12	-86.12	-86.12	-86.12	-86.12	-86.12	(71)

Water heating gains (Table 5)

(72)m=	112.31	110.34	106.25	100.68	97.07	91.98	87.66	93.2	95.17	100.93	107.43	110.35	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	376.35	374.41	362.53	343.44	324.21	305.57	293.41	298.92	308.67	327.95	350.08	366.55	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	4.8	x	10.63	x	0.63	x	0.7	=	15.6	(74)

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North	0.9x	0.77	x	5.44	x	10.63	x	0.63	x	0.7	=	17.68	(74)
North	0.9x	0.77	x	4.8	x	20.32	x	0.63	x	0.7	=	29.81	(74)
North	0.9x	0.77	x	5.44	x	20.32	x	0.63	x	0.7	=	33.78	(74)
North	0.9x	0.77	x	4.8	x	34.53	x	0.63	x	0.7	=	50.65	(74)
North	0.9x	0.77	x	5.44	x	34.53	x	0.63	x	0.7	=	57.41	(74)
North	0.9x	0.77	x	4.8	x	55.46	x	0.63	x	0.7	=	81.36	(74)
North	0.9x	0.77	x	5.44	x	55.46	x	0.63	x	0.7	=	92.21	(74)
North	0.9x	0.77	x	4.8	x	74.72	x	0.63	x	0.7	=	109.6	(74)
North	0.9x	0.77	x	5.44	x	74.72	x	0.63	x	0.7	=	124.22	(74)
North	0.9x	0.77	x	4.8	x	79.99	x	0.63	x	0.7	=	117.33	(74)
North	0.9x	0.77	x	5.44	x	79.99	x	0.63	x	0.7	=	132.98	(74)
North	0.9x	0.77	x	4.8	x	74.68	x	0.63	x	0.7	=	109.55	(74)
North	0.9x	0.77	x	5.44	x	74.68	x	0.63	x	0.7	=	124.15	(74)
North	0.9x	0.77	x	4.8	x	59.25	x	0.63	x	0.7	=	86.91	(74)
North	0.9x	0.77	x	5.44	x	59.25	x	0.63	x	0.7	=	98.5	(74)
North	0.9x	0.77	x	4.8	x	41.52	x	0.63	x	0.7	=	60.9	(74)
North	0.9x	0.77	x	5.44	x	41.52	x	0.63	x	0.7	=	69.02	(74)
North	0.9x	0.77	x	4.8	x	24.19	x	0.63	x	0.7	=	35.48	(74)
North	0.9x	0.77	x	5.44	x	24.19	x	0.63	x	0.7	=	40.22	(74)
North	0.9x	0.77	x	4.8	x	13.12	x	0.63	x	0.7	=	19.24	(74)
North	0.9x	0.77	x	5.44	x	13.12	x	0.63	x	0.7	=	21.81	(74)
North	0.9x	0.77	x	4.8	x	8.86	x	0.63	x	0.7	=	13	(74)
North	0.9x	0.77	x	5.44	x	8.86	x	0.63	x	0.7	=	14.74	(74)
East	0.9x	0.77	x	1.44	x	19.64	x	0.63	x	0.7	=	8.64	(76)
East	0.9x	0.77	x	1.44	x	38.42	x	0.63	x	0.7	=	16.91	(76)
East	0.9x	0.77	x	1.44	x	63.27	x	0.63	x	0.7	=	27.85	(76)
East	0.9x	0.77	x	1.44	x	92.28	x	0.63	x	0.7	=	40.61	(76)
East	0.9x	0.77	x	1.44	x	113.09	x	0.63	x	0.7	=	49.77	(76)
East	0.9x	0.77	x	1.44	x	115.77	x	0.63	x	0.7	=	50.95	(76)
East	0.9x	0.77	x	1.44	x	110.22	x	0.63	x	0.7	=	48.51	(76)
East	0.9x	0.77	x	1.44	x	94.68	x	0.63	x	0.7	=	41.67	(76)
East	0.9x	0.77	x	1.44	x	73.59	x	0.63	x	0.7	=	32.39	(76)
East	0.9x	0.77	x	1.44	x	45.59	x	0.63	x	0.7	=	20.06	(76)
East	0.9x	0.77	x	1.44	x	24.49	x	0.63	x	0.7	=	10.78	(76)
East	0.9x	0.77	x	1.44	x	16.15	x	0.63	x	0.7	=	7.11	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	41.92	80.5	135.91	214.19	283.59	301.26	282.2	227.08	162.31	95.76	51.83	34.85	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	418.27	454.91	498.43	557.63	607.8	606.83	575.61	525.99	470.98	423.71	401.91	401.39	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

TER WorkSheet: New dwelling design stage

(86)m=	1	1	0.99	0.96	0.87	0.69	0.52	0.59	0.85	0.98	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.89	20.01	20.23	20.55	20.83	20.96	20.99	20.99	20.89	20.55	20.17	19.87	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.02	20.03	20.03	20.04	20.04	20.05	20.05	20.05	20.05	20.04	20.04	20.03	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.95	0.82	0.6	0.41	0.47	0.78	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.55	18.72	19.05	19.51	19.87	20.03	20.05	20.05	19.95	19.51	18.97	18.53	(90)

fLA = Living area ÷ (4) = 0.35 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.01	19.17	19.46	19.87	20.2	20.35	20.38	20.37	20.28	19.87	19.38	18.99	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.01	19.17	19.46	19.87	20.2	20.35	20.38	20.37	20.28	19.87	19.38	18.99	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.94	0.83	0.63	0.45	0.51	0.8	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	416.34	451.35	489.45	526.23	506.4	382.38	258.62	269.85	377.5	407.76	398.32	399.9	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1046.39	1011.92	916.77	766.93	592.98	396.91	260.53	273.62	428.11	646.74	860.71	1041.48	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	468.76	376.71	317.92	173.3	64.42	0	0	0	0	177.8	332.92	477.33	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 2389.15 (98)

Space heating requirement in kWh/m²/year 36.04 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system 0 (201)

Fraction of space heat from main system(s) (202) = 1 – (201) = 1 (202)

Fraction of total heating from main system 1 (204) = (202) × [1 – (203)] = 1 (204)

Efficiency of main space heating system 1 93.5 (206)

Efficiency of secondary/supplementary heating system, % 0 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	468.76	376.71	317.92	173.3	64.42	0	0	0	0	177.8	332.92	477.33	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	501.34	402.9	340.02	185.35	68.89	0	0	0	0	190.16	356.06	510.51	

Total (kWh/year) =$Sum(211)_{1...5,10....12}$= 2555.24 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

Water heating

Output from water heater (calculated above)

185.8	163.83	172.23	154.62	151.69	135.78	130.63	143.03	142.68	160.32	169.24	181.41

Efficiency of water heater 79.8 (216)

(217)m=	87.18	86.97	86.43	85.12	82.71	79.8	79.8	79.8	79.8	85.09	86.59	87.28	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	213.12	188.39	199.27	181.66	183.39	170.15	163.7	179.24	178.8	188.42	195.45	207.85

Total = Sum(219a)$_{1...12}$ = 2249.44 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2555.24	
Water heating fuel used		2249.44	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	75	(231)
Electricity for lighting		304.21	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		5183.89	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	551.93	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	485.88	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1037.81	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	157.88	(268)
Total CO2, kg/year			sum of (265)…(271) =		1234.62	(272)

TER = 18.62 (273)

SAP Input

Property Details: Sample 8 (Top)

Address:	
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	26 July 2019
Date of certificate:	15 June 2022
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	498

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2022	
Floor Location:	Floor area:	Storey height:
Floor 0	70 m²	3 m
Living area:	26 m² (fraction 0.371)	
Front of dwelling faces:	Unspecified	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
DOOR	Manufacturer	Solid			Wood
W	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
N	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Balcony	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
DOOR	mm	0.7	0	1.4	2.4	1
W		0.7	0.4	1	2.72	1
N		0.7	0.4	1	4.16	1
Balcony		0.7	0.4	1	4.8	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
DOOR		INT	Worst case	0	0
W		W	West	0	0
N		N	North	0	0
Balcony		N	North	0	0

Overshading: More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
N	29.4	8.96	20.44	0.15	0	False	N/A
W	29.4	2.72	26.68	0.15	0	False	N/A
INT	14.1	2.4	11.7	0.16	0.43	False	N/A
Spandrel	2.4	0	2.4	0.35	0	False	N/A
E	17.1	0	17.1	0.15	0	False	N/A
Roof	70	0	70	0.11	0		N/A

Internal Elements

SAP Input

Party Elements

Thermal bridges:

Thermal bridges:	No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	3

Main heating system:

Main heating system:	Community heating schemes Heat source: Community heat pump heat from electric heat pump, heat fraction 1, efficiency 256 Piping>=1991, pre-insulated, low temp, variable flow Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Boiler interlock: Yes

Main heating Control:

Main heating Control:	Charging system linked to use of community heating, programmer and TRVs Control code: 2306

Secondary heating system:

Secondary heating system:	None

Water heating:

Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Flue Gas Heat Recovery System: Database (rev 498, product index 060036) Brand name: Worcester Model: Greenstar Xtra Model qualifier: 2015 Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	Photovoltaic 1 Installed Peak power: 0.6 Tilt of collector: 30° Overshading: None or very little Collector Orientation: South
Assess Zero Carbon Home:	No

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Sample 8 (Top)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	70	(1a) x	3	(2a) =	210	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	70	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	210	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	79.05	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1.4	=	3.36			(26)
Windows Type 1			2.72	x	1/[1/(1)+ 0.04]	=	2.62			(27)
Windows Type 2			4.16	x	1/[1/(1)+ 0.04]	=	4			(27)
Windows Type 3			4.8	x	1/[1/(1)+ 0.04]	=	4.62			(27)
Walls Type1	29.4	8.96	20.44	x	0.15	=	3.07			(29)
Walls Type2	29.4	2.72	26.68	x	0.15	=	4			(29)
Walls Type3	14.1	2.4	11.7	x	0.15	=	1.75			(29)
Walls Type4	2.4	0	2.4	x	0.35	=	0.84			(29)
Walls Type5	17.1	0	17.1	x	0.15	=	2.57			(29)
Roof	70	0	70	x	0.11	=	7.7			(30)
Total area of elements, m²			162.4							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	34.52	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	1726.48	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		24.36	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	58.88	(37)

DER WorkSheet: New dwelling design stage

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	18.52	18.3	18.08	16.98	16.76	15.65	15.65	15.43	16.09	16.76	17.2	17.64	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	77.4	77.18	76.96	75.85	75.63	74.53	74.53	74.31	74.97	75.63	76.07	76.52	

Average = Sum(39)$_{1...12}$ /12= 75.8 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.11	1.1	1.1	1.08	1.08	1.06	1.06	1.06	1.07	1.08	1.09	1.09	

Average = Sum(40)$_{1...12}$ /12= 1.08 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.25 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 87.55 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	96.3	92.8	89.3	85.79	82.29	78.79	78.79	82.29	85.79	89.3	92.8	96.3	

Total = Sum(44)$_{1...12}$ = 1050.55 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	142.81	124.9	128.89	112.37	107.82	93.04	86.22	98.93	100.12	116.67	127.36	138.3	

Total = Sum(45)$_{1...12}$ = 1377.43 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.42	18.74	19.33	16.86	16.17	13.96	12.93	14.84	15.02	17.5	19.1	20.75	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

DER WorkSheet: New dwelling design stage

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	198.09	174.83	184.17	165.86	163.1	146.53	141.49	154.21	153.61	171.95	180.85	193.58	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	18.35	16.34	16.79	14.86	14.3	12.43	11.52	13.19	13.34	15.37	16.62	17.85	(63) (G2)

Output from water heater

(64)m=	177.06	156.07	164.69	148.41	146.11	131.51	127.29	138.34	137.67	153.9	161.64	173.05	

Output from water heater (annual)$_{1…12}$ — 1815.73 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	91.71	81.47	87.08	80.16	80.07	73.73	72.89	77.12	76.08	83.02	85.14	90.21	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	112.31	112.31	112.31	112.31	112.31	112.31	112.31	112.31	112.31	112.31	112.31	112.31	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.7	16.61	13.51	10.23	7.64	6.45	6.97	9.06	12.17	15.45	18.03	19.22	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	197.3	199.34	194.19	183.2	169.34	156.31	147.6	145.55	150.71	161.7	175.56	188.59	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.23	34.23	34.23	34.23	34.23	34.23	34.23	34.23	34.23	34.23	34.23	34.23	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	(71)

Water heating gains (Table 5)

(72)m=	123.26	121.24	117.04	111.33	107.62	102.4	97.97	103.65	105.67	111.58	118.25	121.25	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	395.95	393.88	381.42	361.45	341.3	321.86	309.23	314.96	325.24	345.42	368.53	385.75	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	4.16	x	10.63	x	0.4	x	0.7	=	8.58	(74)
North	0.9x	0.77	x	4.8	x	10.63	x	0.4	x	0.7	=	9.9	(74)
North	0.9x	0.77	x	4.16	x	20.32	x	0.4	x	0.7	=	16.4	(74)
North	0.9x	0.77	x	4.8	x	20.32	x	0.4	x	0.7	=	18.93	(74)
North	0.9x	0.77	x	4.16	x	34.53	x	0.4	x	0.7	=	27.87	(74)
North	0.9x	0.77	x	4.8	x	34.53	x	0.4	x	0.7	=	32.16	(74)
North	0.9x	0.77	x	4.16	x	55.46	x	0.4	x	0.7	=	44.77	(74)
North	0.9x	0.77	x	4.8	x	55.46	x	0.4	x	0.7	=	51.66	(74)
North	0.9x	0.77	x	4.16	x	74.72	x	0.4	x	0.7	=	60.31	(74)
North	0.9x	0.77	x	4.8	x	74.72	x	0.4	x	0.7	=	69.59	(74)
North	0.9x	0.77	x	4.16	x	79.99	x	0.4	x	0.7	=	64.56	(74)
North	0.9x	0.77	x	4.8	x	79.99	x	0.4	x	0.7	=	74.5	(74)
North	0.9x	0.77	x	4.16	x	74.68	x	0.4	x	0.7	=	60.28	(74)
North	0.9x	0.77	x	4.8	x	74.68	x	0.4	x	0.7	=	69.55	(74)
North	0.9x	0.77	x	4.16	x	59.25	x	0.4	x	0.7	=	47.82	(74)
North	0.9x	0.77	x	4.8	x	59.25	x	0.4	x	0.7	=	55.18	(74)
North	0.9x	0.77	x	4.16	x	41.52	x	0.4	x	0.7	=	33.51	(74)
North	0.9x	0.77	x	4.8	x	41.52	x	0.4	x	0.7	=	38.67	(74)
North	0.9x	0.77	x	4.16	x	24.19	x	0.4	x	0.7	=	19.53	(74)
North	0.9x	0.77	x	4.8	x	24.19	x	0.4	x	0.7	=	22.53	(74)
North	0.9x	0.77	x	4.16	x	13.12	x	0.4	x	0.7	=	10.59	(74)
North	0.9x	0.77	x	4.8	x	13.12	x	0.4	x	0.7	=	12.22	(74)
North	0.9x	0.77	x	4.16	x	8.86	x	0.4	x	0.7	=	7.16	(74)
North	0.9x	0.77	x	4.8	x	8.86	x	0.4	x	0.7	=	8.26	(74)
West	0.9x	0.77	x	2.72	x	19.64	x	0.4	x	0.7	=	10.37	(80)
West	0.9x	0.77	x	2.72	x	38.42	x	0.4	x	0.7	=	20.28	(80)
West	0.9x	0.77	x	2.72	x	63.27	x	0.4	x	0.7	=	33.39	(80)
West	0.9x	0.77	x	2.72	x	92.28	x	0.4	x	0.7	=	48.7	(80)
West	0.9x	0.77	x	2.72	x	113.09	x	0.4	x	0.7	=	59.69	(80)
West	0.9x	0.77	x	2.72	x	115.77	x	0.4	x	0.7	=	61.1	(80)
West	0.9x	0.77	x	2.72	x	110.22	x	0.4	x	0.7	=	58.17	(80)
West	0.9x	0.77	x	2.72	x	94.68	x	0.4	x	0.7	=	49.97	(80)
West	0.9x	0.77	x	2.72	x	73.59	x	0.4	x	0.7	=	38.84	(80)
West	0.9x	0.77	x	2.72	x	45.59	x	0.4	x	0.7	=	24.06	(80)
West	0.9x	0.77	x	2.72	x	24.49	x	0.4	x	0.7	=	12.93	(80)
West	0.9x	0.77	x	2.72	x	16.15	x	0.4	x	0.7	=	8.52	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	28.85	55.61	93.43	145.13	189.59	200.16	188	152.97	111.02	66.12	35.73	23.94	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	424.8	449.49	474.85	506.58	530.89	522.02	497.24	467.94	436.26	411.53	404.27	409.69	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.93	0.8	0.63	0.69	0.9	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.83	19.92	20.13	20.43	20.72	20.92	20.98	20.97	20.83	20.48	20.11	19.81	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20	20	20	20.01	20.02	20.03	20.03	20.03	20.02	20.02	20.01	20.01	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.9	0.72	0.51	0.56	0.85	0.98	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.43	18.58	18.87	19.32	19.72	19.97	20.02	20.02	19.88	19.4	18.86	18.42	(90)

fLA = Living area ÷ (4) = | 0.37 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.95	19.08	19.34	19.73	20.09	20.32	20.38	20.37	20.23	19.8	19.32	18.93	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.95	19.08	19.34	19.73	20.09	20.32	20.38	20.37	20.23	19.8	19.32	18.93	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.99	0.97	0.91	0.75	0.55	0.61	0.86	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	423.17	446.89	469.38	490.63	480.76	389.94	275.64	285.54	376.52	400.66	401.39	408.38	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1133.7	1094.16	988.1	821.43	634.54	426.61	281.65	295.3	459.75	695.89	929.91	1127.45	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	528.64	434.97	385.93	238.18	114.42	0	0	0	0	219.65	380.53	534.99	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 2837.3 | (98)

Space heating requirement in kWh/m²/year | 40.53 | (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.
Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | 0 | (301)

Fraction of space heat from community system 1 – (301) = | 1 | (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump | 1 | (303a)

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Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		2837.3	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	2979.17	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		1815.73	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	1906.52	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	48.86	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		124.9	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	124.9	(331)
Energy for lighting (calculated in Appendix L)		330.25	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-518.17	(333)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		4822.66	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				256	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	990.5	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	25.36	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	1015.85	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				1015.85	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	64.82	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	171.4	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1			0.52	x 0.01 =	-268.93	(380)

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Total CO2, kg/year	sum of (376)…(382) =	983.14	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =	14.04	(384)
EI rating (section 14)		88.54	(385)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.5.51

Property Address: Sample 8 (Top)

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	70	(1a) x	3	(2a) =	210	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	70	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	210	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.1	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*		0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.35	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.29	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.37	0.37	0.36	0.32	0.32	0.28	0.28	0.27	0.29	0.32	0.33	0.34

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1	=	2.4			(26)
Windows Type 1			2.72	x1/[1/(1.4)+ 0.04]		=	3.61			(27)
Windows Type 2			4.16	x1/[1/(1.4)+ 0.04]		=	5.52			(27)
Windows Type 3			4.8	x1/[1/(1.4)+ 0.04]		=	6.36			(27)
Walls Type1	29.4	8.96	20.44	x	0.18	=	3.68			(29)
Walls Type2	29.4	2.72	26.68	x	0.18	=	4.8			(29)
Walls Type3	14.1	2.4	11.7	x	0.18	=	2.11			(29)
Walls Type4	2.4	0	2.4	x	0.18	=	0.43			(29)
Walls Type5	17.1	0	17.1	x	0.18	=	3.08			(29)
Roof	70	0	70	x	0.13	=	9.1			(30)
Total area of elements, m²			162.4							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 41.08 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 1726.48 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 8.12 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 49.2 (37)

TER WorkSheet: New dwelling design stage

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	39.5	39.31	39.13	38.26	38.1	37.34	37.34	37.2	37.63	38.1	38.43	38.77	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(39)m=	88.7	88.51	88.33	87.46	87.3	86.55	86.55	86.41	86.84	87.3	87.63	87.97	

Average = Sum(39)$_{1…12}$ /12= 87.46 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	1.27	1.26	1.26	1.25	1.25	1.24	1.24	1.23	1.24	1.25	1.25	1.26	

Average = Sum(40)$_{1…12}$ /12= 1.25 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.25 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 87.55 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	96.3	92.8	89.3	85.79	82.29	78.79	78.79	82.29	85.79	89.3	92.8	96.3	

Total = Sum(44)$_{1…12}$ = 1050.55 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	142.81	124.9	128.89	112.37	107.82	93.04	86.22	98.93	100.12	116.67	127.36	138.3	

Total = Sum(45)$_{1…12}$ = 1377.43 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	21.42	18.74	19.33	16.86	16.17	13.96	12.93	14.84	15.02	17.5	19.1	20.75	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	189.41	166.99	175.48	157.46	154.41	138.13	132.81	145.53	145.21	163.27	172.45	184.9	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	189.41	166.99	175.48	157.46	154.41	138.13	132.81	145.53	145.21	163.27	172.45	184.9	

Output from water heater (annual)$_{1...12}$ — 1926.05 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	84.76	75.2	80.13	73.44	73.13	67.01	65.94	70.17	69.36	76.07	78.42	83.26	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	112.31	112.31	112.31	112.31	112.31	112.31	112.31	112.31	112.31	112.31	112.31	112.31	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	18.2	16.17	13.15	9.95	7.44	6.28	6.79	8.82	11.84	15.04	17.55	18.71	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	197.3	199.34	194.19	183.2	169.34	156.31	147.6	145.55	150.71	161.7	175.56	188.59	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	34.23	34.23	34.23	34.23	34.23	34.23	34.23	34.23	34.23	34.23	34.23	34.23	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	(71)
Water heating gains (Table 5)													
(72)m=	113.93	111.9	107.7	101.99	98.29	93.07	88.63	94.32	96.34	102.24	108.92	111.91	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	389.12	387.11	374.73	354.84	334.76	315.35	302.71	308.39	318.58	338.67	361.72	378.9	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	4.16	x	10.63	x	0.63	x	0.7	=	13.52	(74)
North	0.9x	0.77	x	4.8	x	10.63	x	0.63	x	0.7	=	15.6	(74)
North	0.9x	0.77	x	4.16	x	20.32	x	0.63	x	0.7	=	25.84	(74)
North	0.9x	0.77	x	4.8	x	20.32	x	0.63	x	0.7	=	29.81	(74)
North	0.9x	0.77	x	4.16	x	34.53	x	0.63	x	0.7	=	43.9	(74)
North	0.9x	0.77	x	4.8	x	34.53	x	0.63	x	0.7	=	50.65	(74)
North	0.9x	0.77	x	4.16	x	55.46	x	0.63	x	0.7	=	70.51	(74)
North	0.9x	0.77	x	4.8	x	55.46	x	0.63	x	0.7	=	81.36	(74)
North	0.9x	0.77	x	4.16	x	74.72	x	0.63	x	0.7	=	94.99	(74)
North	0.9x	0.77	x	4.8	x	74.72	x	0.63	x	0.7	=	109.6	(74)
North	0.9x	0.77	x	4.16	x	79.99	x	0.63	x	0.7	=	101.69	(74)
North	0.9x	0.77	x	4.8	x	79.99	x	0.63	x	0.7	=	117.33	(74)
North	0.9x	0.77	x	4.16	x	74.68	x	0.63	x	0.7	=	94.94	(74)
North	0.9x	0.77	x	4.8	x	74.68	x	0.63	x	0.7	=	109.55	(74)
North	0.9x	0.77	x	4.16	x	59.25	x	0.63	x	0.7	=	75.32	(74)
North	0.9x	0.77	x	4.8	x	59.25	x	0.63	x	0.7	=	86.91	(74)
North	0.9x	0.77	x	4.16	x	41.52	x	0.63	x	0.7	=	52.78	(74)
North	0.9x	0.77	x	4.8	x	41.52	x	0.63	x	0.7	=	60.9	(74)
North	0.9x	0.77	x	4.16	x	24.19	x	0.63	x	0.7	=	30.75	(74)
North	0.9x	0.77	x	4.8	x	24.19	x	0.63	x	0.7	=	35.48	(74)
North	0.9x	0.77	x	4.16	x	13.12	x	0.63	x	0.7	=	16.68	(74)
North	0.9x	0.77	x	4.8	x	13.12	x	0.63	x	0.7	=	19.24	(74)
North	0.9x	0.77	x	4.16	x	8.86	x	0.63	x	0.7	=	11.27	(74)
North	0.9x	0.77	x	4.8	x	8.86	x	0.63	x	0.7	=	13	(74)
West	0.9x	0.77	x	2.72	x	19.64	x	0.63	x	0.7	=	16.33	(80)
West	0.9x	0.77	x	2.72	x	38.42	x	0.63	x	0.7	=	31.94	(80)
West	0.9x	0.77	x	2.72	x	63.27	x	0.63	x	0.7	=	52.6	(80)
West	0.9x	0.77	x	2.72	x	92.28	x	0.63	x	0.7	=	76.71	(80)
West	0.9x	0.77	x	2.72	x	113.09	x	0.63	x	0.7	=	94.01	(80)
West	0.9x	0.77	x	2.72	x	115.77	x	0.63	x	0.7	=	96.24	(80)
West	0.9x	0.77	x	2.72	x	110.22	x	0.63	x	0.7	=	91.62	(80)
West	0.9x	0.77	x	2.72	x	94.68	x	0.63	x	0.7	=	78.7	(80)
West	0.9x	0.77	x	2.72	x	73.59	x	0.63	x	0.7	=	61.17	(80)
West	0.9x	0.77	x	2.72	x	45.59	x	0.63	x	0.7	=	37.9	(80)
West	0.9x	0.77	x	2.72	x	24.49	x	0.63	x	0.7	=	20.36	(80)
West	0.9x	0.77	x	2.72	x	16.15	x	0.63	x	0.7	=	13.43	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.44	87.58	147.15	228.59	298.6	315.26	296.11	240.93	174.86	104.13	56.28	37.7	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	434.56	474.69	521.88	583.43	633.36	630.61	598.82	549.32	493.44	442.8	418	416.6	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.91	0.77	0.61	0.67	0.9	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.62	19.75	20	20.35	20.69	20.91	20.98	20.96	20.79	20.38	19.94	19.6	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.87	19.87	19.87	19.88	19.88	19.89	19.89	19.89	19.89	19.88	19.88	19.87	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.96	0.87	0.67	0.47	0.53	0.83	0.97	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.04	18.23	18.59	19.11	19.57	19.83	19.88	19.88	19.71	19.15	18.52	18.02	(90)

fLA = Living area ÷ (4) = | 0.37 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.63	18.79	19.11	19.57	19.98	20.23	20.29	20.28	20.11	19.61	19.05	18.61	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.63	18.79	19.11	19.57	19.98	20.23	20.29	20.28	20.11	19.61	19.05	18.61	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.96	0.87	0.71	0.52	0.59	0.85	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	432.62	471.22	513.72	557.68	554.1	445.04	311.51	321.98	418.44	429.37	414.62	415.07	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1271.15	1229.67	1113.98	933.26	723.24	487.18	319.26	335.28	522.1	786.17	1047.06	1267.35	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	623.86	509.67	446.59	270.41	125.84	0	0	0	0	265.46	455.35	634.09	

Total per year (kWh/year) = Sum(98)1...5,9...12 = | 3331.28 | (98)

Space heating requirement in kWh/m²/year | 47.59 | (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	623.86	509.67	446.59	270.41	125.84	0	0	0	0	265.46	455.35	634.09		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	667.23	545.1	477.63	289.21	134.59	0	0	0	0	283.91	487.01	678.17		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													3562.87	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Output from water heater (calculated above)	189.41	166.99	175.48	157.46	154.41	138.13	132.81	145.53	145.21	163.27	172.45	184.9		
Efficiency of water heater													79.8	(216)
(217)m=	87.76	87.6	87.2	86.24	84.27	79.8	79.8	79.8	79.8	86.1	87.29	87.84		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	215.82	190.62	201.24	182.57	183.23	173.1	166.43	182.37	181.96	189.62	197.57	210.49		
Total = Sum(219a)$_{1...12}$ =													2275.03	(219)

Annual totals

		kWh/year	kWh/year	
Space heating fuel used, main system 1			3562.87	
Water heating fuel used			2275.03	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			321.47	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			6234.37	(338)

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12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	769.58	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	491.41	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1260.99	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	166.84	(268)
Total CO2, kg/year			sum of (265)…(271) =		1466.76	(272)

TER =	20.95	(273)

SAP Input

Property Details: House Sample 1

Address:	
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	26 July 2019
Date of certificate:	15 June 2022
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	498

Property description:

Dwelling type:	House	
Detachment:	Mid-terrace	
Year Completed:	2019	
Floor Location:	Floor area:	Storey height:
Floor 0	129 m²	3 m
Living area:	30 m² (fraction 0.233)	
Front of dwelling faces:	Unspecified	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
DOOR	Manufacturer	Solid			Wood
N	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
S	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
DOOR	mm	0.7	0	1.4	2.4	1
N		0.7	0.4	1	12.3	1
S		0.7	0.4	1	10.3	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
DOOR		S	Worst case	0	0
N		N	North	0	0
S		S	South	0	0

Overshading: More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
<u>External Elements</u>							
N	42	12.3	29.7	0.15	0	False	N/A
S	44	12.7	31.3	0.15	0	False	N/A
Roof	46	0	46	0.11	0		N/A
Exposed	46			0.11			N/A
<u>Internal Elements</u>							
<u>Party Elements</u>							

Thermal bridges:

Thermal bridges: No information on thermal bridging (y=0.15) (y =0.15)

SAP Input

Ventilation:	
Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	3

Main heating system:	
Main heating system:	Community heating schemes Heat source: Community heat pump heat from electric heat pump, heat fraction 1, efficiency 256 Piping>=1991, pre-insulated, low temp, variable flow Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Boiler interlock: Yes

Main heating Control:	
Main heating Control:	Charging system linked to use of community heating, programmer and TRVs Control code: 2306

Secondary heating system:	
Secondary heating system:	None

Water heating:	
Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Flue Gas Heat Recovery System: Database (rev 498, product index 060036) Brand name: Worcester Model: Greenstar Xtra Model qualifier: 2015 Solar panel: False

Others:	
Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Zero Carbon Home: Asbestos data:	No

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.51

Property Address: House Sample 1

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	129	(1a) x	3	(2a) =	387	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	129	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		387	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0 ÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.05 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1.4	=	3.36			(26)
Windows Type 1			12.3	x	1/[1/(1)+ 0.04]	=	11.83			(27)
Windows Type 2			10.3	x	1/[1/(1)+ 0.04]	=	9.9			(27)
Floor			46	x	0.11	=	5.06			(28)
Walls Type1	42	12.3	29.7	x	0.15	=	4.46			(29)
Walls Type2	44	12.7	31.3	x	0.15	=	4.7			(29)
Roof	46	0	46	x	0.11	=	5.06			(30)
Total area of elements, m²			178							(31)

* *for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

** *include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 44.36 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 4718 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 26.7 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 71.06 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	34.14	33.73	33.32	31.29	30.88	28.85	28.85	28.44	29.66	30.88	31.7	32.51	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	105.2	104.79	104.39	102.35	101.94	99.91	99.91	99.5	100.72	101.94	102.76	103.57	

Average = Sum(39)$_{1…12}$ /12= 102.25 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.82	0.81	0.81	0.79	0.79	0.77	0.77	0.77	0.78	0.79	0.8	0.8

Average = Sum(40)$_{1...12}$ /12= 0.79 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.89 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 102.89 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	113.18	109.07	104.95	100.84	96.72	92.6	92.6	96.72	100.84	104.95	109.07	113.18

Total = Sum(44)$_{1...12}$ = 1234.72 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	167.85	146.8	151.48	132.07	126.72	109.35	101.33	116.28	117.67	137.13	149.69	162.55

Total = Sum(45)$_{1...12}$ = 1618.91 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	25.18	22.02	22.72	19.81	19.01	16.4	15.2	17.44	17.65	20.57	22.45	24.38	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	223.12	196.73	206.76	185.56	182	162.85	156.61	171.55	171.16	192.41	203.18	217.83	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	21.02	18.78	19.29	17.15	16.54	14.49	13.5	15.33	15.49	17.72	19.1	20.46	(63) (G2)

Output from water heater

(64)m=	199.43	175.52	184.79	165.81	162.77	145.76	140.43	153.55	153.08	172	181.49	194.68	

Output from water heater (annual)$_{1…12}$ 2029.31 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	100.03	88.75	94.59	86.71	86.36	79.15	77.91	82.88	81.92	89.82	92.57	98.27	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	144.62	144.62	144.62	144.62	144.62	144.62	144.62	144.62	144.62	144.62	144.62	144.62	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	27.82	24.71	20.09	15.21	11.37	9.6	10.37	13.48	18.1	22.98	26.82	28.59	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	296.51	299.59	291.83	275.33	254.49	234.91	221.83	218.75	226.5	243.01	263.85	283.43	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	37.46	37.46	37.46	37.46	37.46	37.46	37.46	37.46	37.46	37.46	37.46	37.46	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	(71)

Water heating gains (Table 5)

(72)m=	134.45	132.07	127.14	120.43	116.07	109.94	104.72	111.4	113.78	120.72	128.56	132.08	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	525.16	522.75	505.45	477.35	448.32	420.83	403.31	410.02	424.76	453.09	485.61	510.49	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	12.3	x	10.63	x	0.4	x	0.7	=	25.38	(74)
North	0.9x	0.77	x	12.3	x	20.32	x	0.4	x	0.7	=	48.5	(74)
North	0.9x	0.77	x	12.3	x	34.53	x	0.4	x	0.7	=	82.41	(74)
North	0.9x	0.77	x	12.3	x	55.46	x	0.4	x	0.7	=	132.38	(74)

North	0.9x	0.77	x	12.3	x	74.72	x	0.4	x	0.7	=	178.32	(74)
North	0.9x	0.77	x	12.3	x	79.99	x	0.4	x	0.7	=	190.9	(74)
North	0.9x	0.77	x	12.3	x	74.68	x	0.4	x	0.7	=	178.23	(74)
North	0.9x	0.77	x	12.3	x	59.25	x	0.4	x	0.7	=	141.4	(74)
North	0.9x	0.77	x	12.3	x	41.52	x	0.4	x	0.7	=	99.09	(74)
North	0.9x	0.77	x	12.3	x	24.19	x	0.4	x	0.7	=	57.73	(74)
North	0.9x	0.77	x	12.3	x	13.12	x	0.4	x	0.7	=	31.31	(74)
North	0.9x	0.77	x	12.3	x	8.86	x	0.4	x	0.7	=	21.16	(74)
South	0.9x	0.77	x	10.3	x	46.75	x	0.4	x	0.7	=	93.44	(78)
South	0.9x	0.77	x	10.3	x	76.57	x	0.4	x	0.7	=	153.03	(78)
South	0.9x	0.77	x	10.3	x	97.53	x	0.4	x	0.7	=	194.93	(78)
South	0.9x	0.77	x	10.3	x	110.23	x	0.4	x	0.7	=	220.32	(78)
South	0.9x	0.77	x	10.3	x	114.87	x	0.4	x	0.7	=	229.58	(78)
South	0.9x	0.77	x	10.3	x	110.55	x	0.4	x	0.7	=	220.94	(78)
South	0.9x	0.77	x	10.3	x	108.01	x	0.4	x	0.7	=	215.87	(78)
South	0.9x	0.77	x	10.3	x	104.89	x	0.4	x	0.7	=	209.64	(78)
South	0.9x	0.77	x	10.3	x	101.89	x	0.4	x	0.7	=	203.63	(78)
South	0.9x	0.77	x	10.3	x	82.59	x	0.4	x	0.7	=	165.06	(78)
South	0.9x	0.77	x	10.3	x	55.42	x	0.4	x	0.7	=	110.76	(78)
South	0.9x	0.77	x	10.3	x	40.4	x	0.4	x	0.7	=	80.74	(78)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	118.82	201.53	277.35	352.69	407.91	411.84	394.1	351.05	302.72	222.79	142.07	101.9	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	643.98	724.28	782.8	830.04	856.22	832.67	797.41	761.07	727.48	675.88	627.68	612.38	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.91	0.74	0.55	0.59	0.85	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.14	20.25	20.43	20.67	20.87	20.98	21	21	20.94	20.69	20.38	20.12	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.24	20.24	20.25	20.26	20.26	20.28	20.28	20.28	20.27	20.26	20.26	20.25	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.88	0.67	0.46	0.5	0.8	0.97	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.07	19.24	19.5	19.85	20.13	20.26	20.27	20.28	20.22	19.89	19.43	19.06	(90)

fLA = Living area ÷ (4) = | 0.23 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.32	19.47	19.71	20.04	20.3	20.43	20.44	20.44	20.39	20.08	19.65	19.3	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.32	19.47	19.71	20.04	20.3	20.43	20.44	20.44	20.39	20.08	19.65	19.3	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.97	0.88	0.68	0.48	0.53	0.81	0.97	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	643.03	721.7	775.18	801.93	755.87	566.92	382.69	400.15	586.34	657.23	625.28	611.73	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1579.6	1527.11	1379.34	1140.24	876.65	582.23	383.91	402.35	633.42	966.04	1289.51	1564.29	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	696.81	541.24	449.49	243.58	89.86	0	0	0	0	229.75	478.24	708.7	

Total per year (kWh/year) = Sum(98)1...5,9...12 = 3437.68 (98)

Space heating requirement in kWh/m²/year 26.65 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		3437.68	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	3609.56	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		2029.31	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	2130.78	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	57.4	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		230.17	(330a)

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warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	230.17	(331)
Energy for lighting (calculated in Appendix L)		491.27	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		6461.77	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				256	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	1163.76	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	29.79	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	1193.56	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				1193.56	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	119.46	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	254.97	(379)
Energy saving/generation technologies (333) to (334) as applicable						
Item 1		0.52		x 0.01 =	0	(380)
Total CO2, kg/year	sum of (376)…(382) =				1567.98	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				12.15	(384)
EI rating (section 14)					87.92	(385)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: House Sample 1

Address :

1. Overall dwelling dimensions:

	Area(m²)			**Av. Height(m)**			**Volume(m³)**	
Ground floor	129	(1a)	x	3	(2a)	=	387	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	129	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	387	(5)

2. Ventilation rate:

	main heating		**secondary heating**		**other**		**total**		**m³ per hour**	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							4	x 10 =	40	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40	÷ (5) =	0.1	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*		0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.35	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.38	0.37	0.33	0.32	0.29	0.29	0.28	0.3	0.32	0.34	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.55	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.55	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1	=	2.4			(26)
Windows Type 1			12.3	x1/[1/(1.4)+ 0.04]		=	16.31			(27)
Windows Type 2			10.3	x1/[1/(1.4)+ 0.04]		=	13.66			(27)
Floor			46	x	0.13	=	5.98			(28)
Walls Type1	42	12.3	29.7	x	0.18	=	5.35			(29)
Walls Type2	44	12.7	31.3	x	0.18	=	5.63			(29)
Roof	46	0	46	x	0.13	=	5.98			(30)
Total area of elements, m²			178							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 55.3 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 4718 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 8.9 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 64.2 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	73.22	72.86	72.5	70.83	70.51	69.05	69.05	68.78	69.62	70.51	71.15	71.81	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	137.42	137.06	136.7	135.03	134.71	133.26	133.26	132.99	133.82	134.71	135.35	136.01	

Average = Sum(39)$_{1…12}$ /12= 135.03 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.07	1.06	1.06	1.05	1.04	1.03	1.03	1.03	1.04	1.04	1.05	1.05

Average = Sum(40)$_{1...12}$ /12= 1.05 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.89 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 102.89 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	113.18	109.07	104.95	100.84	96.72	92.6	92.6	96.72	100.84	104.95	109.07	113.18	
										Total = Sum(44)$_{1...12}$ =		1234.72	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	167.85	146.8	151.48	132.07	126.72	109.35	101.33	116.28	117.67	137.13	149.69	162.55	
										Total = Sum(45)$_{1...12}$ =		1618.91	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	25.18	22.02	22.72	19.81	19.01	16.4	15.2	17.44	17.65	20.57	22.45	24.38	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	214.44	188.89	198.08	177.16	173.32	154.44	147.93	162.87	162.76	183.72	194.78	209.15	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	214.44	188.89	198.08	177.16	173.32	154.44	147.93	162.87	162.76	183.72	194.78	209.15	

Output from water heater (annual)1…12 | 2167.53 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	93.08	82.48	87.64	79.99	79.41	72.43	70.97	75.94	75.2	82.87	85.84	91.32	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	144.62	144.62	144.62	144.62	144.62	144.62	144.62	144.62	144.62	144.62	144.62	144.62	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	27.12	24.09	19.59	14.83	11.09	9.36	10.11	13.15	17.64	22.4	26.15	27.87	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	296.51	299.59	291.83	275.33	254.49	234.91	221.83	218.75	226.5	243.01	263.85	283.43	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	37.46	37.46	37.46	37.46	37.46	37.46	37.46	37.46	37.46	37.46	37.46	37.46	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	(71)
Water heating gains (Table 5)													
(72)m=	125.11	122.74	117.8	111.09	106.74	100.6	95.39	102.07	104.44	111.39	119.23	122.75	(72)
Total internal gains =						(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m							
(73)m=	518.13	515.8	498.61	470.64	441.7	414.25	396.71	403.35	417.97	446.18	478.61	503.43	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	12.3	x	10.63	x	0.63	x	0.7	=	39.97	(74)
North	0.9x	0.77	x	12.3	x	20.32	x	0.63	x	0.7	=	76.39	(74)
North	0.9x	0.77	x	12.3	x	34.53	x	0.63	x	0.7	=	129.8	(74)
North	0.9x	0.77	x	12.3	x	55.46	x	0.63	x	0.7	=	208.49	(74)

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North	0.9x	0.77	x	12.3	x	74.72	x	0.63	x	0.7	=	280.86	(74)
North	0.9x	0.77	x	12.3	x	79.99	x	0.63	x	0.7	=	300.67	(74)
North	0.9x	0.77	x	12.3	x	74.68	x	0.63	x	0.7	=	280.71	(74)
North	0.9x	0.77	x	12.3	x	59.25	x	0.63	x	0.7	=	222.71	(74)
North	0.9x	0.77	x	12.3	x	41.52	x	0.63	x	0.7	=	156.06	(74)
North	0.9x	0.77	x	12.3	x	24.19	x	0.63	x	0.7	=	90.93	(74)
North	0.9x	0.77	x	12.3	x	13.12	x	0.63	x	0.7	=	49.31	(74)
North	0.9x	0.77	x	12.3	x	8.86	x	0.63	x	0.7	=	33.32	(74)
South	0.9x	0.77	x	10.3	x	46.75	x	0.63	x	0.7	=	147.17	(78)
South	0.9x	0.77	x	10.3	x	76.57	x	0.63	x	0.7	=	241.02	(78)
South	0.9x	0.77	x	10.3	x	97.53	x	0.63	x	0.7	=	307.02	(78)
South	0.9x	0.77	x	10.3	x	110.23	x	0.63	x	0.7	=	347	(78)
South	0.9x	0.77	x	10.3	x	114.87	x	0.63	x	0.7	=	361.59	(78)
South	0.9x	0.77	x	10.3	x	110.55	x	0.63	x	0.7	=	347.98	(78)
South	0.9x	0.77	x	10.3	x	108.01	x	0.63	x	0.7	=	340	(78)
South	0.9x	0.77	x	10.3	x	104.89	x	0.63	x	0.7	=	330.19	(78)
South	0.9x	0.77	x	10.3	x	101.89	x	0.63	x	0.7	=	320.72	(78)
South	0.9x	0.77	x	10.3	x	82.59	x	0.63	x	0.7	=	259.96	(78)
South	0.9x	0.77	x	10.3	x	55.42	x	0.63	x	0.7	=	174.44	(78)
South	0.9x	0.77	x	10.3	x	40.4	x	0.63	x	0.7	=	127.17	(78)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	187.14	317.41	436.82	555.49	642.45	648.65	620.71	552.9	476.78	350.89	223.75	160.49	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	705.27	833.21	935.43	1026.13	1084.15	1062.91	1017.42	956.24	894.75	797.08	702.36	663.92	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.9	0.74	0.56	0.62	0.86	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.82	19.98	20.22	20.53	20.79	20.95	20.99	20.99	20.88	20.54	20.12	19.8	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.03	20.03	20.03	20.04	20.05	20.06	20.06	20.06	20.05	20.05	20.04	20.04	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.86	0.65	0.45	0.5	0.79	0.97	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.45	18.68	19.03	19.48	19.84	20.02	20.05	20.05	19.96	19.5	18.9	18.42	(90)

fLA = Living area ÷ (4) = | 0.23 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.77	18.99	19.31	19.72	20.06	20.24	20.27	20.27	20.17	19.74	19.18	18.74	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.77	18.99	19.31	19.72	20.06	20.24	20.27	20.27	20.17	19.74	19.18	18.74	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation factor for gains, hm:														
(94)m=	1	0.99	0.98	0.95	0.86	0.67	0.48	0.53	0.8	0.96	0.99	1		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	703.48	827.93	920.09	975.99	932.53	714.52	484.5	506.4	717.47	768.94	698.21	662.69		(95)
Monthly average external temperature from Table 8														
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]														
(97)m=	1988.51	1930.48	1750.57	1460.97	1126.15	751.27	489.13	514.44	812.62	1231.81	1635.57	1977.69		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	956.06	740.91	617.88	349.19	144.05	0	0	0	0	344.38	674.9	978.35		
Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =													4805.73	(98)
Space heating requirement in kWh/m²/year													37.25	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	956.06	740.91	617.88	349.19	144.05	0	0	0	0	344.38	674.9	978.35		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	1022.53	792.42	660.84	373.46	154.07	0	0	0	0	368.32	721.82	1046.37		
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													5139.82	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)

Water heating

Output from water heater (calculated above)														
	214.44	188.89	198.08	177.16	173.32	154.44	147.93	162.87	162.76	183.72	194.78	209.15		
Efficiency of water heater													79.8	(216)
(217)m=	88.33	88.1	87.65	86.59	84.33	79.8	79.8	79.8	79.8	86.47	87.86	88.41		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	242.77	214.4	226	204.59	205.53	193.54	185.37	204.1	203.96	212.48	221.69	236.56		
Total = Sum(219a)$_{1...12}$ =													2550.98	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		5139.82

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Water heating fuel used			2550.98	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			478.94	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			8244.74	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	1110.2	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	551.01	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1661.21	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	248.57	(268)
Total CO2, kg/year		sum of (265)…(271) =		1948.71	(272)
TER =				15.11	(273)

SAP Input

Property Details: House Sample 2

Address:	
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	26 July 2019
Date of certificate:	15 June 2022
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	498

Property description:

Dwelling type:	House
Detachment:	Mid-terrace
Year Completed:	2019

Floor Location:	Floor area:	Storey height:
Floor 0	129 m²	3 m

Living area:	30 m² (fraction 0.233)
Front of dwelling faces:	Unspecified

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
DOOR	Manufacturer	Solid			Wood
N	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
S	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
E	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
DOOR	mm	0.7	0	1.4	2.4	1
N		0.7	0.4	1	12.3	1
S		0.7	0.4	1	10.3	1
E		0.7	0.4	1	7	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
DOOR		S	Worst case	0	0
N		N	North	0	0
S		S	South	0	0
E		E	East	0	0

Overshading: More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
<u>External Elements</u>							
N	42	12.3	29.7	0.15	0	False	N/A
S	44	12.7	31.3	0.15	0	False	N/A
E	91	7	84	0.15	0	False	N/A
Roof	46	0	46	0.11	0		N/A
Exposed	46			0.11			N/A
<u>Internal Elements</u>							
<u>Party Elements</u>							

SAP Input

Thermal bridges:

Thermal bridges:	No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	3

Main heating system:

Main heating system:	Community heating schemes Heat source: Community heat pump heat from electric heat pump, heat fraction 1, efficiency 256 Piping>=1991, pre-insulated, low temp, variable flow Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Boiler interlock: Yes

Main heating Control:

Main heating Control:	Charging system linked to use of community heating, programmer and TRVs Control code: 2306

Secondary heating system:

Secondary heating system:	None

Water heating:

Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Flue Gas Heat Recovery System: Database (rev 498, product index 060036) Brand name: Worcester Model: Greenstar Xtra Model qualifier: 2015 Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Asbestos details:	
Zero Carbon Home:	No

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: House Sample 2

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	129	(1a) x	3	(2a) =	387	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	129	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		387	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.05 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.23	0.24	0.25	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1.4	=	3.36			(26)
Windows Type 1			12.3	x	1/[1/(1)+ 0.04]	=	11.83			(27)
Windows Type 2			10.3	x	1/[1/(1)+ 0.04]	=	9.9			(27)
Windows Type 3			7	x	1/[1/(1)+ 0.04]	=	6.73			(27)
Floor			46	x	0.11	=	5.06			(28)
Walls Type1	42	12.3	29.7	x	0.15	=	4.46			(29)
Walls Type2	44	12.7	31.3	x	0.15	=	4.7			(29)
Walls Type3	91	7	84	x	0.15	=	12.6			(29)
Roof	46	0	46	x	0.11	=	5.06			(30)
Total area of elements, m²			269							(31)

* *for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

** *include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 63.69 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5894 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 40.35 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 104.04 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

(38)m=	34.14	33.73	33.32	31.29	30.88	28.85	28.85	28.44	29.66	30.88	31.7	32.51	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	138.18	137.77	137.37	135.33	134.92	132.89	132.89	132.48	133.7	134.92	135.74	136.55	

Average = Sum(39)$_{1...12}$ /12= 135.23 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.07	1.07	1.06	1.05	1.05	1.03	1.03	1.03	1.04	1.05	1.05	1.06	

Average = Sum(40)$_{1...12}$ /12= 1.05 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.89 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 102.89 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	113.18	109.07	104.95	100.84	96.72	92.6	92.6	96.72	100.84	104.95	109.07	113.18

Total = Sum(44)$_{1...12}$ = 1234.72 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	167.85	146.8	151.48	132.07	126.72	109.35	101.33	116.28	117.67	137.13	149.69	162.55

Total = Sum(45)$_{1...12}$ = 1618.91 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	25.18	22.02	22.72	19.81	19.01	16.4	15.2	17.44	17.65	20.57	22.45	24.38	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	223.12	196.73	206.76	185.56	182	162.85	156.61	171.55	171.16	192.41	203.18	217.83	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	21.02	18.78	19.29	17.15	16.54	14.49	13.5	15.33	15.49	17.72	19.1	20.46	(63) (G2)

Output from water heater

(64)m=	199.43	175.52	184.79	165.81	162.77	145.76	140.43	153.55	153.08	172	181.49	194.68	

Output from water heater (annual)$_{1...12}$ | 2029.31 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	100.03	88.75	94.59	86.71	86.36	79.15	77.91	82.88	81.92	89.82	92.57	98.27	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	144.62	144.62	144.62	144.62	144.62	144.62	144.62	144.62	144.62	144.62	144.62	144.62	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	26.61	23.63	19.22	14.55	10.88	9.18	9.92	12.9	17.31	21.98	25.66	27.35	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	296.51	299.59	291.83	275.33	254.49	234.91	221.83	218.75	226.5	243.01	263.85	283.43	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	37.46	37.46	37.46	37.46	37.46	37.46	37.46	37.46	37.46	37.46	37.46	37.46	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	(71)

Water heating gains (Table 5)

(72)m=	134.45	132.07	127.14	120.43	116.07	109.94	104.72	111.4	113.78	120.72	128.56	132.08	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	523.96	521.68	504.58	476.69	447.82	420.41	402.86	409.43	423.98	452.1	484.45	509.25	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	12.3	x	10.63	x	0.4	x	0.7	=	25.38	(74)

North	0.9x	0.77	x	12.3	x	20.32	x	0.4	x	0.7	=	48.5	(74)
North	0.9x	0.77	x	12.3	x	34.53	x	0.4	x	0.7	=	82.41	(74)
North	0.9x	0.77	x	12.3	x	55.46	x	0.4	x	0.7	=	132.38	(74)
North	0.9x	0.77	x	12.3	x	74.72	x	0.4	x	0.7	=	178.32	(74)
North	0.9x	0.77	x	12.3	x	79.99	x	0.4	x	0.7	=	190.9	(74)
North	0.9x	0.77	x	12.3	x	74.68	x	0.4	x	0.7	=	178.23	(74)
North	0.9x	0.77	x	12.3	x	59.25	x	0.4	x	0.7	=	141.4	(74)
North	0.9x	0.77	x	12.3	x	41.52	x	0.4	x	0.7	=	99.09	(74)
North	0.9x	0.77	x	12.3	x	24.19	x	0.4	x	0.7	=	57.73	(74)
North	0.9x	0.77	x	12.3	x	13.12	x	0.4	x	0.7	=	31.31	(74)
North	0.9x	0.77	x	12.3	x	8.86	x	0.4	x	0.7	=	21.16	(74)
East	0.9x	0.77	x	7	x	19.64	x	0.4	x	0.7	=	26.68	(76)
East	0.9x	0.77	x	7	x	38.42	x	0.4	x	0.7	=	52.19	(76)
East	0.9x	0.77	x	7	x	63.27	x	0.4	x	0.7	=	85.94	(76)
East	0.9x	0.77	x	7	x	92.28	x	0.4	x	0.7	=	125.34	(76)
East	0.9x	0.77	x	7	x	113.09	x	0.4	x	0.7	=	153.61	(76)
East	0.9x	0.77	x	7	x	115.77	x	0.4	x	0.7	=	157.25	(76)
East	0.9x	0.77	x	7	x	110.22	x	0.4	x	0.7	=	149.71	(76)
East	0.9x	0.77	x	7	x	94.68	x	0.4	x	0.7	=	128.6	(76)
East	0.9x	0.77	x	7	x	73.59	x	0.4	x	0.7	=	99.95	(76)
East	0.9x	0.77	x	7	x	45.59	x	0.4	x	0.7	=	61.92	(76)
East	0.9x	0.77	x	7	x	24.49	x	0.4	x	0.7	=	33.26	(76)
East	0.9x	0.77	x	7	x	16.15	x	0.4	x	0.7	=	21.94	(76)
South	0.9x	0.77	x	10.3	x	46.75	x	0.4	x	0.7	=	93.44	(78)
South	0.9x	0.77	x	10.3	x	76.57	x	0.4	x	0.7	=	153.03	(78)
South	0.9x	0.77	x	10.3	x	97.53	x	0.4	x	0.7	=	194.93	(78)
South	0.9x	0.77	x	10.3	x	110.23	x	0.4	x	0.7	=	220.32	(78)
South	0.9x	0.77	x	10.3	x	114.87	x	0.4	x	0.7	=	229.58	(78)
South	0.9x	0.77	x	10.3	x	110.55	x	0.4	x	0.7	=	220.94	(78)
South	0.9x	0.77	x	10.3	x	108.01	x	0.4	x	0.7	=	215.87	(78)
South	0.9x	0.77	x	10.3	x	104.89	x	0.4	x	0.7	=	209.64	(78)
South	0.9x	0.77	x	10.3	x	101.89	x	0.4	x	0.7	=	203.63	(78)
South	0.9x	0.77	x	10.3	x	82.59	x	0.4	x	0.7	=	165.06	(78)
South	0.9x	0.77	x	10.3	x	55.42	x	0.4	x	0.7	=	110.76	(78)
South	0.9x	0.77	x	10.3	x	40.4	x	0.4	x	0.7	=	80.74	(78)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	145.49	253.72	363.29	478.03	561.52	569.09	543.81	479.64	402.67	284.71	175.33	123.83	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	669.45	775.4	867.87	954.73	1009.34	989.5	946.67	889.08	826.65	736.81	659.78	633.08	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(86)m=	1	1	0.99	0.98	0.92	0.78	0.6	0.66	0.89	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.79	19.93	20.16	20.48	20.76	20.94	20.99	20.98	20.86	20.5	20.09	19.77	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.02	20.03	20.03	20.04	20.05	20.06	20.06	20.06	20.05	20.05	20.04	20.03	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.89	0.69	0.48	0.54	0.83	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.4	18.61	18.95	19.41	19.79	20.01	20.05	20.05	19.93	19.44	18.85	18.38	(90)

fLA = Living area ÷ (4) = 0.23 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.72	18.92	19.23	19.66	20.02	20.23	20.27	20.27	20.15	19.69	19.14	18.7	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.72	18.92	19.23	19.66	20.02	20.23	20.27	20.27	20.15	19.69	19.14	18.7	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.96	0.89	0.71	0.51	0.56	0.84	0.97	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	668.11	771.82	857.43	918.83	893.77	701.16	481.51	501.71	691	717.54	656.83	632.14	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1992.68	1930.99	1748.8	1455.69	1122.33	748.03	487.79	512.45	808.65	1226.23	1633.75	1980.02	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	985.48	778.97	663.18	386.54	170.05	0	0	0	0	378.46	703.38	1002.82	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 5068.89 (98)

Space heating requirement in kWh/m²/year 39.29 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme. Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none	0	(301)
Fraction of space heat from community system 1 – (301) =	1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		5068.89	

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Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	5322.33	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		2029.31	
If DHW from community scheme:			
Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	2130.78	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	74.53	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f):			
mechanical ventilation - balanced, extract or positive input from outside		230.17	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	230.17	(331)
Energy for lighting (calculated in Appendix L)		469.94	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		8153.21	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				256	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	1511	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	38.68	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	1549.68	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				1549.68	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	119.46	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	243.9	(379)
Energy saving/generation technologies (333) to (334) as applicable						
Item 1		0.52		x 0.01 =	0	(380)
Total CO2, kg/year	sum of (376)…(382) =				1913.04	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				14.83	(384)
EI rating (section 14)					85.27	(385)

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User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version: Version: 1.0.5.51

Property Address: House Sample 2

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	129	(1a) x	3	(2a) =	387	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	129	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	387	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							4	x 10 =	40	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40	÷ (5) =	0.1	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.35	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.38	0.37	0.33	0.32	0.29	0.29	0.28	0.3	0.32	0.34	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.55	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.55	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.4	x	1	=	2.4			(26)
Windows Type 1			12.3	x1/[1/(1.4)+ 0.04]		=	16.31			(27)
Windows Type 2			10.3	x1/[1/(1.4)+ 0.04]		=	13.66			(27)
Windows Type 3			7	x1/[1/(1.4)+ 0.04]		=	9.28			(27)
Floor			46	x	0.13	=	5.98			(28)
Walls Type1	42	12.3	29.7	x	0.18	=	5.35			(29)
Walls Type2	44	12.7	31.3	x	0.18	=	5.63			(29)
Walls Type3	91	7	84	x	0.18	=	15.12			(29)
Roof	46	0	46	x	0.13	=	5.98			(30)
Total area of elements, m²			269							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 79.7 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5894 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 13.45 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 93.15 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(38)m=	73.22	72.86	72.5	70.83	70.51	69.05	69.05	68.78	69.62	70.51	71.15	71.81	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	166.37	166.01	165.65	163.98	163.66	162.21	162.21	161.94	162.77	163.66	164.3	164.96

Average = Sum(39)$_{1…12}$ /12= 163.98 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.29	1.29	1.28	1.27	1.27	1.26	1.26	1.26	1.26	1.27	1.27	1.28

Average = Sum(40)$_{1…12}$ /12= 1.27 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.89 (42)
 if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
 if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 102.89 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	113.18	109.07	104.95	100.84	96.72	92.6	92.6	96.72	100.84	104.95	109.07	113.18

Total = Sum(44)$_{1…12}$ = 1234.72 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	167.85	146.8	151.48	132.07	126.72	109.35	101.33	116.28	117.67	137.13	149.69	162.55

Total = Sum(45)$_{1…12}$ = 1618.91 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	25.18	22.02	22.72	19.81	19.01	16.4	15.2	17.44	17.65	20.57	22.45	24.38	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3												0	(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	214.44	188.89	198.08	177.16	173.32	154.44	147.93	162.87	162.76	183.72	194.78	209.15	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	214.44	188.89	198.08	177.16	173.32	154.44	147.93	162.87	162.76	183.72	194.78	209.15	

Output from water heater (annual)$_{1...12}$ 2167.53 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	93.08	82.48	87.64	79.99	79.41	72.43	70.97	75.94	75.2	82.87	85.84	91.32	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	144.62	144.62	144.62	144.62	144.62	144.62	144.62	144.62	144.62	144.62	144.62	144.62	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	26.43	23.48	19.09	14.46	10.81	9.12	9.86	12.81	17.2	21.84	25.49	27.17	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	296.51	299.59	291.83	275.33	254.49	234.91	221.83	218.75	226.5	243.01	263.85	283.43	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	37.46	37.46	37.46	37.46	37.46	37.46	37.46	37.46	37.46	37.46	37.46	37.46	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	-115.69	(71)

Water heating gains (Table 5)

(72)m=	125.11	122.74	117.8	111.09	106.74	100.6	95.39	102.07	104.44	111.39	119.23	122.75	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	517.44	515.19	498.12	470.26	441.42	414.02	396.46	403.01	417.53	445.62	477.94	502.73	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	12.3	x	10.63	x	0.63	x	0.7	=	39.97	(74)

North	0.9x	0.77	x	12.3	x	20.32	x	0.63	x	0.7	=	76.39	(74)
North	0.9x	0.77	x	12.3	x	34.53	x	0.63	x	0.7	=	129.8	(74)
North	0.9x	0.77	x	12.3	x	55.46	x	0.63	x	0.7	=	208.49	(74)
North	0.9x	0.77	x	12.3	x	74.72	x	0.63	x	0.7	=	280.86	(74)
North	0.9x	0.77	x	12.3	x	79.99	x	0.63	x	0.7	=	300.67	(74)
North	0.9x	0.77	x	12.3	x	74.68	x	0.63	x	0.7	=	280.71	(74)
North	0.9x	0.77	x	12.3	x	59.25	x	0.63	x	0.7	=	222.71	(74)
North	0.9x	0.77	x	12.3	x	41.52	x	0.63	x	0.7	=	156.06	(74)
North	0.9x	0.77	x	12.3	x	24.19	x	0.63	x	0.7	=	90.93	(74)
North	0.9x	0.77	x	12.3	x	13.12	x	0.63	x	0.7	=	49.31	(74)
North	0.9x	0.77	x	12.3	x	8.86	x	0.63	x	0.7	=	33.32	(74)
East	0.9x	0.77	x	7	x	19.64	x	0.63	x	0.7	=	42.02	(76)
East	0.9x	0.77	x	7	x	38.42	x	0.63	x	0.7	=	82.19	(76)
East	0.9x	0.77	x	7	x	63.27	x	0.63	x	0.7	=	135.36	(76)
East	0.9x	0.77	x	7	x	92.28	x	0.63	x	0.7	=	197.41	(76)
East	0.9x	0.77	x	7	x	113.09	x	0.63	x	0.7	=	241.94	(76)
East	0.9x	0.77	x	7	x	115.77	x	0.63	x	0.7	=	247.67	(76)
East	0.9x	0.77	x	7	x	110.22	x	0.63	x	0.7	=	235.79	(76)
East	0.9x	0.77	x	7	x	94.68	x	0.63	x	0.7	=	202.54	(76)
East	0.9x	0.77	x	7	x	73.59	x	0.63	x	0.7	=	157.43	(76)
East	0.9x	0.77	x	7	x	45.59	x	0.63	x	0.7	=	97.53	(76)
East	0.9x	0.77	x	7	x	24.49	x	0.63	x	0.7	=	52.39	(76)
East	0.9x	0.77	x	7	x	16.15	x	0.63	x	0.7	=	34.55	(76)
South	0.9x	0.77	x	10.3	x	46.75	x	0.63	x	0.7	=	147.17	(78)
South	0.9x	0.77	x	10.3	x	76.57	x	0.63	x	0.7	=	241.02	(78)
South	0.9x	0.77	x	10.3	x	97.53	x	0.63	x	0.7	=	307.02	(78)
South	0.9x	0.77	x	10.3	x	110.23	x	0.63	x	0.7	=	347	(78)
South	0.9x	0.77	x	10.3	x	114.87	x	0.63	x	0.7	=	361.59	(78)
South	0.9x	0.77	x	10.3	x	110.55	x	0.63	x	0.7	=	347.98	(78)
South	0.9x	0.77	x	10.3	x	108.01	x	0.63	x	0.7	=	340	(78)
South	0.9x	0.77	x	10.3	x	104.89	x	0.63	x	0.7	=	330.19	(78)
South	0.9x	0.77	x	10.3	x	101.89	x	0.63	x	0.7	=	320.72	(78)
South	0.9x	0.77	x	10.3	x	82.59	x	0.63	x	0.7	=	259.96	(78)
South	0.9x	0.77	x	10.3	x	55.42	x	0.63	x	0.7	=	174.44	(78)
South	0.9x	0.77	x	10.3	x	40.4	x	0.63	x	0.7	=	127.17	(78)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	229.15	399.6	572.18	752.9	884.39	896.32	856.5	755.44	634.21	448.42	276.14	195.04	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	746.6	914.79	1070.29	1223.16	1325.81	1310.34	1252.96	1158.45	1051.73	894.04	754.09	697.77	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

TER WorkSheet: New dwelling design stage

(86)m=	1	1	0.99	0.96	0.87	0.72	0.55	0.61	0.85	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.56	19.75	20.04	20.42	20.74	20.93	20.98	20.97	20.84	20.41	19.91	19.52	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.85	19.85	19.85	19.86	19.87	19.87	19.87	19.88	19.87	19.87	19.86	19.86	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.94	0.83	0.62	0.42	0.48	0.77	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.93	18.21	18.64	19.19	19.61	19.83	19.87	19.87	19.74	19.18	18.46	17.89	(90)

fLA = Living area ÷ (4) = 0.23 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.31	18.57	18.97	19.47	19.88	20.08	20.13	20.12	19.99	19.47	18.79	18.27	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.31	18.57	18.97	19.47	19.88	20.08	20.13	20.12	19.99	19.47	18.79	18.27	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.93	0.83	0.64	0.45	0.51	0.78	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	743.87	906.36	1044.68	1140.27	1096.14	837.17	564.22	589.06	824.38	855.43	748.05	695.88	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	2331.02	2269.53	2065.62	1733.86	1338.15	889.57	572.24	602.94	959.52	1451.16	1921.41	2321.29	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1180.84	916.05	759.57	427.39	180.06	0	0	0	0	443.22	844.81	1209.31	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 5961.26 (98)

Space heating requirement in kWh/m²/year 46.21 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	1180.84	916.05	759.57	427.39	180.06	0	0	0	0	443.22	844.81	1209.31	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	1262.93	979.73	812.38	457.1	192.57	0	0	0	0	474.04	903.54	1293.38	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 6375.67 (211)

TER WorkSheet: New dwelling design stage

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

Water heating

Output from water heater (calculated above)

	214.44	188.89	198.08	177.16	173.32	154.44	147.93	162.87	162.76	183.72	194.78	209.15

Efficiency of water heater 79.8 (216)

(217)m=	88.67	88.47	88.06	87.08	84.92	79.8	79.8	79.8	79.8	87.08	88.28	88.75	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	241.83	213.5	224.94	203.45	204.1	193.54	185.37	204.1	203.96	210.99	220.63	235.67

Total = Sum(219a)$_{1...12}$ = 2542.08 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		6375.67	
Water heating fuel used		2542.08	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	75	(231)
Electricity for lighting		466.84	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		9459.59	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	1377.15	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	549.09	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1926.24	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	242.29	(268)
Total CO2, kg/year			sum of (265)…(271) =		2207.45	(272)

TER = 17.11 (273)

A8 APPENDIX 8 – COMMERCIAL LEAN BRUKL CERTIFICATES

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name **Shell and Core**

St Clare Commercial

As designed

Date: Fri May 20 07:56:06 2022

Administrative information

Building Details

Address: LEAN, ,

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.14

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.14

BRUKL compliance check version: v5.6.b.0

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	17.8
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	17.8
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	13
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.17	0.17	SP000005:Surf[7]
Floor	0.25	0.22	0.22	SP000005:Surf[8]
Roof	0.25	0.18	0.18	SP00000B:Surf[10]
Windows***, roof windows, and rooflights	2.2	1.3	1.3	SP000005:Surf[0]
Personnel doors	2.2	-	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]

$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.

** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

*** Display windows and similar glazing are excluded from the U-value check.

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	5

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- VRF htg + clg

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	5.5	0	-	0.75
Standard value	0.91*	1	N/A	N/A	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

"No HWS in project, or hot water is provided by HVAC system"

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
00-Office Space 3	-	-	-	1.8	-	-	-	-	-	-	N/A
00-Office Space 2	-	-	-	1.8	-	-	-	-	-	-	N/A
00-Office Space 1	-	-	-	1.8	-	-	-	-	-	-	N/A
00-Meeting Room 4	-	-	-	1.8	-	-	-	-	-	-	N/A
00-Meeting Room 1	-	-	-	1.8	-	-	-	-	-	-	N/A
00-Meeting Room 2	-	-	-	1.8	-	-	-	-	-	-	N/A
00-Meeting Room 3	-	-	-	1.8	-	-	-	-	-	-	N/A
00-Circulation	-	-	-	1.8	-	-	-	-	-	-	N/A
00-Reception Area	-	-	-	1.8	-	-	-	-	-	-	N/A

Shell and core configuration

Zone	Assumed shell?
00-Office Space 3	NO
00-Office Space 2	NO
00-Office Space 1	NO
00-Meeting Room 4	NO
00-Meeting Room 1	NO
00-Meeting Room 2	NO
00-Meeting Room 3	NO
00-Circulation	NO

Shell and core configuration

Zone	Assumed shell?
00-Reception Area	NO

General lighting and display lighting

	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
00-Office Space 3	110	-	-	445
00-Office Space 2	110	-	-	699
00-Office Space 1	110	-	-	653
00-Meeting Room 4	110	-	-	268
00-Meeting Room 1	110	-	-	148
00-Meeting Room 2	110	-	-	207
00-Meeting Room 3	110	-	-	207
00-Circulation	-	110	-	100
00-Reception Area	-	110	110	173

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
00-Office Space 3	NO (-40.5%)	NO
00-Office Space 2	NO (-56.2%)	NO
00-Office Space 1	NO (-53.9%)	NO
00-Meeting Room 4	N/A	N/A
00-Meeting Room 1	N/A	N/A
00-Meeting Room 2	N/A	N/A
00-Meeting Room 3	N/A	N/A
00-Circulation	NO (-96.2%)	NO
00-Reception Area	NO (-58.8%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	576	576
External area [m^2]	931.8	931.8
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	5	3
Average conductance [W/K]	268.7	362.81
Average U-value [W/m^2K]	0.29	0.39
Alpha value* [%]	10	10

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
100	**B1 Offices and Workshop businesses**
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
	D1 Non-residential Institutions: Community/Day Centre
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	10.43	9.7
Cooling	3.3	7.27
Auxiliary	7.04	2.07
Lighting	9.35	20.57
Hot water	2.6	2.61
Equipment*	36.08	36.08
TOTAL**	**32.72**	**42.22**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	80.61	129.26
Primary energy* [kWh/m^2]	76.35	104.56
Total emissions [kg/m^2]	13	17.8

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	34.2	46.4	10.4	3.3	7	0.91	3.91	0.96	5.5
	Notional	30.1	99.2	9.7	7.3	2.1	0.86	3.79	----	----

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.13	00000000:Surf[1]
Floor	0.2	0.22	SP000005:Surf[8]
Roof	0.15	0.18	SP00000B:Surf[10]
Windows, roof windows, and rooflights	1.5	1.3	SP000005:Surf[0]
Personnel doors	1.5	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	Typical value	This building
$m^3/(h.m^2)$ at 50 Pa	5	5

A9 APPENDIX 9 – COMMERCIAL GREEN BRUKL CERTIFICATES

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name **Shell and Core**

St Clare Commercial

As designed

Date: Fri May 20 07:59:30 2022

Administrative information

Building Details

Address: GREEN HP PV, ,

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.14

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.14

BRUKL compliance check version: v5.6.b.0

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	17.6
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	17.6
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	9.3
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	Surface where the maximum value occurs*
Wall**	0.35	0.17	0.17	SP000005:Surf[7]
Floor	0.25	0.22	0.22	SP000005:Surf[8]
Roof	0.25	0.18	0.18	SP00000B:Surf[10]
Windows***, roof windows, and rooflights	2.2	1.3	1.3	SP000005:Surf[0]
Personnel doors	2.2	-	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m^{2}K)]
U_{a-Calc} = Calculated area-weighted average U-values [W/(m^{2}K)]
U_{i-Calc} = Calculated maximum individual element U-values [W/(m^{2}K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	5

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- VRF htg + clg

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3	5.5	0	-	0.75
Standard value	2.5*	1	N/A	N/A	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.

1- DHWS

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	-
Standard value	1	N/A

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
00-Office Space 3	-	-	-	1.8	-	-	-	-	-	-	N/A
00-Office Space 2	-	-	-	1.8	-	-	-	-	-	-	N/A
00-Office Space 1	-	-	-	1.8	-	-	-	-	-	-	N/A
00-Meeting Room 4	-	-	-	1.8	-	-	-	-	-	-	N/A
00-Meeting Room 1	-	-	-	1.8	-	-	-	-	-	-	N/A
00-Meeting Room 2	-	-	-	1.8	-	-	-	-	-	-	N/A
00-Meeting Room 3	-	-	-	1.8	-	-	-	-	-	-	N/A
00-Circulation	-	-	-	1.8	-	-	-	-	-	-	N/A
00-Reception Area	-	-	-	1.8	-	-	-	-	-	-	N/A

Shell and core configuration

Zone	Assumed shell?
00-Office Space 3	NO
00-Office Space 2	NO
00-Office Space 1	NO
00-Meeting Room 4	NO
00-Meeting Room 1	NO

Shell and core configuration

Zone	Assumed shell?
00-Meeting Room 2	NO
00-Meeting Room 3	NO
00-Circulation	NO
00-Reception Area	NO

General lighting and display lighting

	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
00-Office Space 3	110	-	-	445
00-Office Space 2	110	-	-	699
00-Office Space 1	110	-	-	653
00-Meeting Room 4	110	-	-	268
00-Meeting Room 1	110	-	-	148
00-Meeting Room 2	110	-	-	207
00-Meeting Room 3	110	-	-	207
00-Circulation	-	110	-	100
00-Reception Area	-	110	110	173

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
00-Office Space 3	NO (-40.5%)	NO
00-Office Space 2	NO (-56.2%)	NO
00-Office Space 1	NO (-53.9%)	NO
00-Meeting Room 4	N/A	N/A
00-Meeting Room 1	N/A	N/A
00-Meeting Room 2	N/A	N/A
00-Meeting Room 3	N/A	N/A
00-Circulation	NO (-96.2%)	NO
00-Reception Area	NO (-58.8%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	576	576
External area [m^2]	931.8	931.8
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	5	3
Average conductance [W/K]	268.7	362.81
Average U-value [W/m^2K]	0.29	0.39
Alpha value* [%]	10	10

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
100	**B1 Offices and Workshop businesses**
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
	D1 Non-residential Institutions: Community/Day Centre
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	3.17	3.27
Cooling	2.34	7.27
Auxiliary	7.04	2.07
Lighting	9.35	20.57
Hot water	2.37	2.61
Equipment*	36.08	36.08
TOTAL**	**24.28**	**35.79**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	6.37	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	80.61	129.26
Primary energy* [kWh/m^2]	74.53	102.2
Total emissions [kg/m^2]	9.3	17.6

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	34.2	46.4	3.2	2.3	7	3	5.5	3	5.5
	Notional	30.1	99.2	3.3	7.3	2.1	2.56	3.79	----	----

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	**$U_{i\text{-}Typ}$**	**$U_{i\text{-}Min}$**	**Surface where the minimum value occurs***
Wall	0.23	0.13	00000000:Surf[1]
Floor	0.2	0.22	SP000005:Surf[8]
Roof	0.15	0.18	SP00000B:Surf[10]
Windows, roof windows, and rooflights	1.5	1.3	SP000005:Surf[0]
Personnel doors	1.5	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)]

$U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	**Typical value**	**This building**
m³/(h.m²) at 50 Pa	5	5