Planning Application

Energy Assessment

Energy Statement

Howson Terrace

Richmond Hill

Richmond

London

Housing 21

Report No: PA-ES-HT-H21-21-01

Report Date: August 2021

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1. Project Details

Type of Application	Full Planning Application
Project Name	Howson Terrace
Project Address	Howson Terrace, Richmond Hill, Richmond, London
Project Description	Redevelopment of the existing sheltered housing block to provide a new building containing 28 no. retirement apartments.
Developer	Housing 21
Developer Address	Tricorn House, 51-53 Hagley Road, Birmingham, B16 8TP
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Report Issue Number	Date	Reason	Author
01	27/08/21	For Issue	MH
02			
03			

2. Executive Summary

This report considers the predicted energy and CO_2 demand for the proposed development at the Howson Terrace located in The London Borough of Richmond Upon Thames.

The report complies with the requirements at both national and local level, as set out in the National Planning Policy Framework (2019), The London Plan (2021), GLA Energy Assessment Guidance (2018), and the London Borough of Richmond Upon Thames Local Plan (2018).

The proposed site will be built under Part L 2013 (with 2016 amendments) of the Building Regulations and in line with the London Plan target to achieve a minimum 35% CO_2 reduction over the baseline using the new draft SAP10 carbon factors.

The development will reduce regulated CO_2 emissions by integrating a range of passive design and energy efficiency measures throughout the building. These measures include improving building fabric standards beyond the requirements of Part L of the Building Regulations. These measures enable the proposed scheme to go beyond Target Emission Rates (TER) and Target Fabric Energy Efficiency (TFEE) minimum standards via energy efficiency measures alone.

Following reduction of the energy demand, the strategy recommends the implementation of hot water heat pump cylinders to efficiently supply hot water to the residential dwellings. Space heating to the residential dwellings will be supplied through lor surface temperature electric panel heaters. In addition, the non-residential elements of the building will have their heating supplied through air source heat pump (ASHP) technology.

The regulated energy CO_2 savings expressed in terms of actual and percentage reduction after each stage of the energy hierarchy for residential and non-residential parts of the development are provided below.

Residential Element

Element	CO_2 - Regulated (tonnes/year)	CO_2 - Un-Regulated (tonnes/year)	Total (tonnes/year)
Residential Baseline	28.53	13.36	41.89
Be Lean	21.88	13.36	35.24
After Heat Network	15.37	13.36	28.73
Be Green	15.37	13.36	28.73

The proposed strategy has first reduced energy demand through fabric and energy efficiency measures. The overall Part L Fabric Energy Efficiency (FEE) performance has been reviewed for the 'be lean' position and compared to the baseline stage of the energy hierarchy. The improvement has been shown to be circa 17%.

Element	TFEE (kWH/m^2/year)	DFEE (kWH/m^2/year)	Improvement (%)
Residential Development Total	52.54	43.75	17

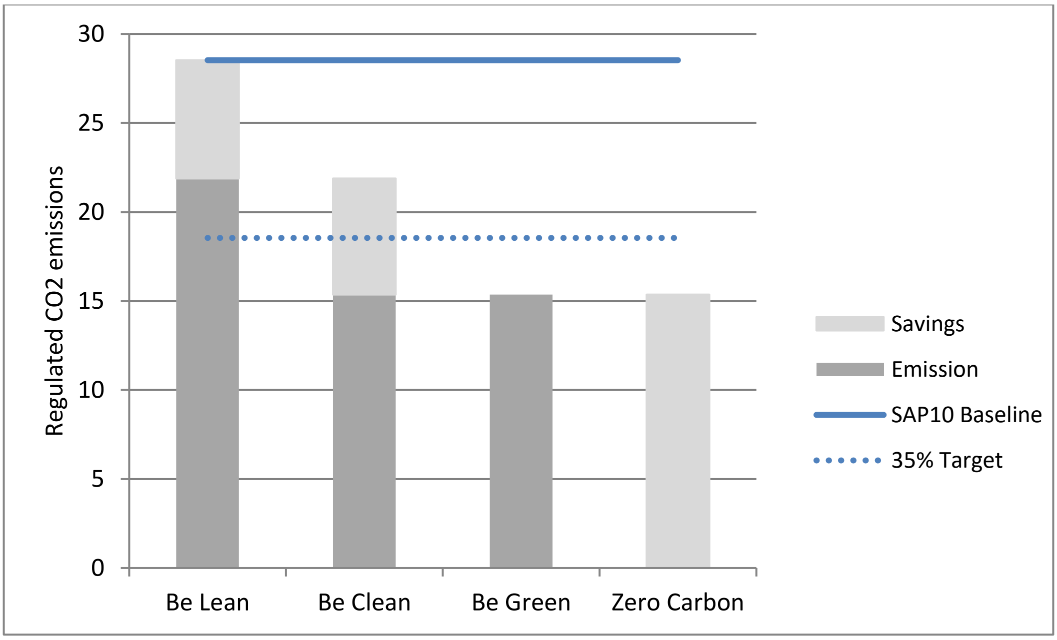
The proposed strategy shows that including unregulated energy the total CO_2 saved is calculated at 12.94 tonnes.

The CO_2 savings attributed to regulated energy only are summarised with the relative percentage improvements shown in the table below. The table shows that the 13.16 tonne saving in CO_2 is equivalent to a 46% reduction when compared to the baseline figure.

To achieve zero carbon a further reduction of circa 15.37 tonnes is required and this is to be met by a cash in lieu contribution payment based on a figure of £95 per tonne over a 30 year period.

	Regulated Energy CO_2 Saving	
	Tonnes per year	%
Be Lean	6.65	23
Be Clean after heat network	6.51	23
Be Green	0.00	0
Cumulative on-Site Savings	13.16	46
Carbon Shortfall	15.37	
	Tonnes CO_2	
Cumulative savings for offset payment	461.10	
Cash-in-lieu contribution	£43,804.50	

The overall reduction in regulated carbon emission to the residential units can be illustrated graphically as below.



Non-Residential Space

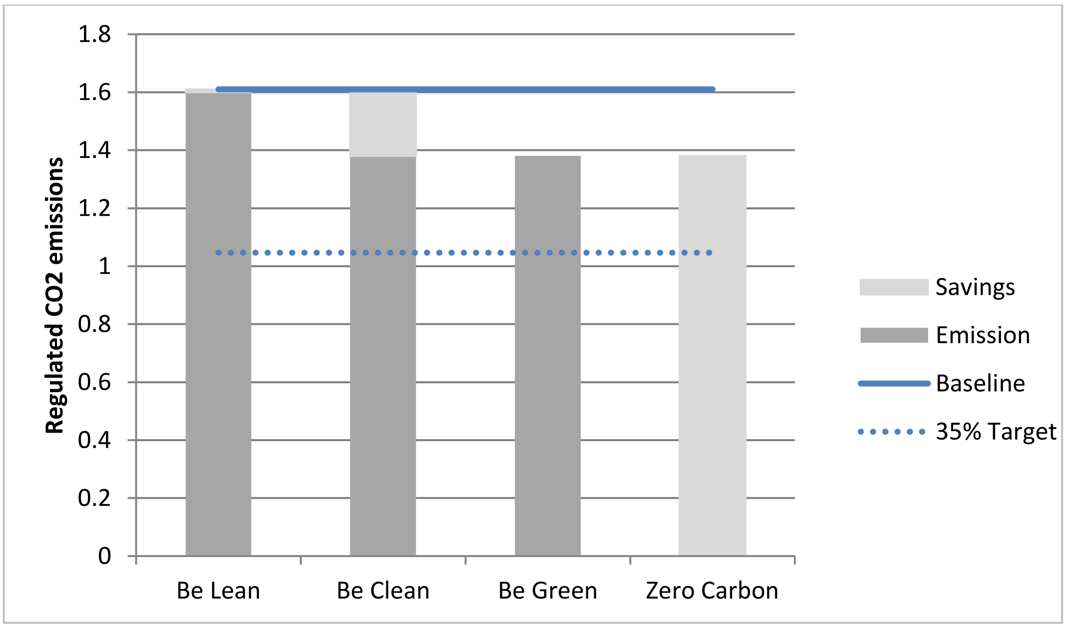
The proposed strategy for the non-residential communal areas shows that including unregulated energy the total CO_2 saved is circa 0.23 tonnes which is equivalent to a reduction of 14%.

Element	CO_2 - Regulated (tonnes/year)	CO_2 - Un-Regulated (tonnes/year)	Total (tonnes/year)
Non-Residential Baseline	1.61	4.45	6.06
After energy demand reductions	1.60	4.45	6.05
After Heat Network	1.38	4.45	5.83
Be Green	1.38	4.45	5.83

The CO_2 savings attributed to regulated energy only are summarised with the relative percentage improvements shown in the table below. This table shows that the 0.23 tonne saving in CO_2 is equivalent to a 14% reduction when compared to the baseline figure.

	Regulated Energy CO_2 Saving	
	Tonnes per year	%
Be Lean	0.01	1
Be Clean	0.22	14
Be Green	0.00	0
Cumulative on-Site Savings	0.23	14

The overall reduction in regulated carbon emission for the non-residential space can be illustrated graphically as below.



Site-Wide CO_2 Savings

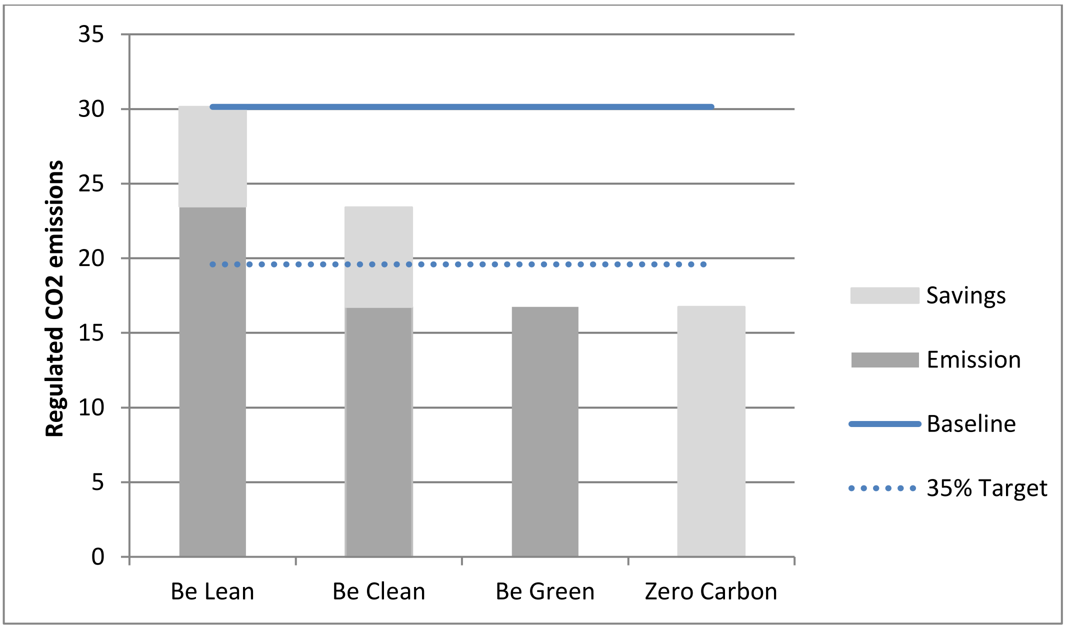
The summary of the overall CO_2 reduction site-wide after each stage of the energy hierarchy is summarised in the table below. The total CO_2 saved is circa 13 tonnes which is equivalent to a reduction of 28% when including un-regulated energy.

Element	CO_2 - Regulated (tonnes/year)	CO_2 - Un-Regulated (tonnes/year)	Total (tonnes/year)
Baseline	30.14	17.81	47.95
After energy demand reductions	23.48	17.81	41.29
After Heat Network	16.75	17.81	34.56
Be Green	16.75	17.81	34.56

The CO_2 savings attributed to regulated energy only are summarised with the relative percentage improvements shown in the table below. This table shows that the 13.39-tonne saving in CO_2 is equivalent to a 44% reduction when compared to the baseline figure. This is in excess of the 35% saving required by the London Plan Policy SI 2.

	Regulated Energy CO_2 Saving	
	Tonnes per year	%
Be Lean	6.66	22
Be Clean	6.73	22
Be Green	0.00	0
Cumulative on-Site Savings	13.39	44

The overall reduction in regulated carbon emission can be illustrated graphically as below.



Summary

The proposed energy strategy achieves and meets the following requirements:

- Complies with Part L 2013 building regulations (with 2016 amendments).
- Includes improved optimal building fabric improvements, energy efficient design of building services.
- Meets the TFEE minimum reduction requirements.
- Utilises heat pump technology through hot water heat pump cylinders within the residential dwellings.
- Utilises ASHP to supply heating to the non-residential element of the building.
- Achieves in excess of 35% regulated energy CO_2 emissions reduction on-site.
- Achieves Zero Carbon by making a cash in lieu contribution.

3. Introduction

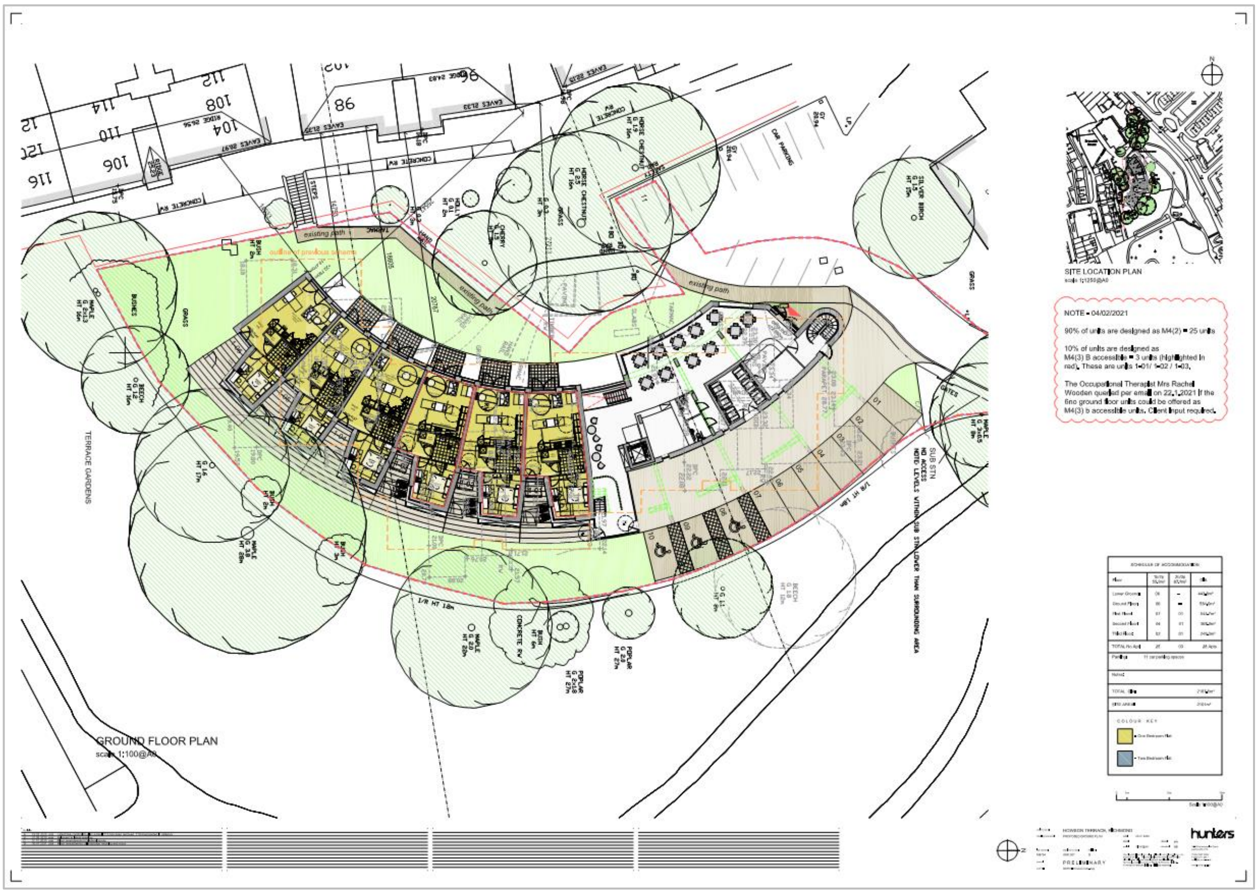
This report has been prepared by Abbey Consultants (Southern) Ltd, a specialist environmental and energy consultancy on behalf of Housing 21 in support of the Full Planning Application for the proposed development at Howson Terrace located in The London Borough of Richmond Upon Thames .

The proposed application is described as:

Redevelopment of the existing sheltered housing block to provide a new building containing 28 no. retirement apartments.

Figure 1 details the proposed site layout.

Figure 1: Proposed Site Plan (Ground Floor Level)



The report first establishes a baseline assessment of the energy demands and associated CO_2 emissions for the residential units and the non-residential floorspace.

It then follows The London Plan Energy Hierarchy approach of Be Lean, Be Clean, Be Green and Be Seen to enable the maximum viable reductions in Regulated CO_2 emissions to be achieved.

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

The report takes into consideration the layout, use and requirements for the development to recommend a strategy that integrates the most suitable technologies available that are commercially viable, whilst also achieving compliance with all policies applicable to this development.

4. Planning Policy

An effective planning system is required to contribute to achieving sustainable development.

Sustainable development is defined as having the following three overarching objectives which are interdependent and need to be pursued in mutually supportive ways: an economic objective, a social objective, and an environmental objective.

1. Economic objective – to help build a strong, responsive and competitive economy, by ensuring that sufficient land of the right types is available in the right places and at the right time to support growth, innovation and improved productivity; and by identifying and coordinating the provision of infrastructure;
2. Social objective – to support strong, vibrant and healthy communities, by ensuring that a sufficient number and range of homes can be provided to meet the needs of present and future generations; and by fostering a well-designed and safe built environment, with accessible services and open spaces that reflect current and future needs and support communities' health, social and cultural well-being; and
3. Environmental objective – to contribute to protecting and enhancing our natural, built and historic environment; including making effective use of land, helping to improve biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.

4.1 National Planning Policy Framework (NPPF) 2019

The NPPF sets out the Government's planning policies for England and how these are expected to be applied. It sets out the Government's requirements for the planning system only to the extent that it is relevant, proportionate and necessary to do so. It provides a framework within which local people and their accountable councils can produce their own distinctive local and neighbourhood plans, which reflect the needs and priorities of their communities.

Chapter 14 Meeting the challenge of climate change, flooding and coastal change

The following paragraphs set out the Government's position in response to reducing carbon emissions:

Paragraph 150: New development should be planned for in ways that:

a. 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
b. 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.

Paragraph 151. To help increase the use and supply of renewable and low carbon energy and heat, plans should:

a. 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);
b. consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and
c. 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.

Paragraph 153: In determining planning applications, local planning authorities should expect new development to:

a. comply with adopted Local Plan policies on local requirements for decentralised energy supply unless it can be demonstrated by the applicant, having regard to the type of development involved and its design, that this is not feasible or viable; and
b. take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption.

Paragraph 154: When determining planning applications for renewable and low carbon development, local planning authorities should:

a. not require applicants to demonstrate the overall need for renewable or low carbon energy, and recognise that even small-scale projects provide a valuable contribution to cutting greenhouse gas emissions; and approve the application if its impacts are (or can be made) acceptable. Once suitable areas for renewable and low carbon energy have been identified in plans, local planning authorities should expect subsequent applications for commercial scale projects outside these areas to demonstrate that the proposed location meets the criteria used in identifying suitable areas.

4.2 London Plan Policy

Greater London Authority

The London Plan

Adopted March 2021

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:

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

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.

D. Boroughs must establish and administer a carbon offset fund. Offset fund payments must be ring-fenced to implement projects that deliver carbon reductions. The operation of offset funds should be monitored and reported on annually.

E. Major development proposals should calculate and minimise carbon emissions from any other part of the development, including plant or equipment, that are not covered by Building Regulations, i.e. unregulated emissions.

F. Development proposals referable to the Mayor should calculate whole life-cycle carbon emissions through a nationally recognised Whole Life-Cycle Carbon Assessment and demonstrate actions taken to reduce life-cycle carbon emissions.

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 futureproofing 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:
    2. connect to local existing or planned heat networks
    3. use zero-emission or local secondary heat sources (in conjunction with heat pump, if required)
    4. 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)
    5. use ultra-low NOx gas boilers
    6. CHP and ultra-low NOx gas boiler communal or district heating systems should be designed to ensure that they meet the requirements in Part B of Policy SI 1 Improving air quality
    7. 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/ADE Code of Practice CP1 or equivalent.

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.

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 category 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.

4.3 Local Policy

London Borough of Richmond Upon Thames
Local Plan
Adopted July 2018

Policy LP 22

Sustainable Design and Construction

A. Developments will be required to achieve the highest standards of sustainable design and construction to mitigate the likely effects of climate change. Applicants will be required to complete the following:

 1. Development of 1 dwelling unit or more, or 100sqm or more of non-residential floorspace (including extensions) will be required to complete 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 of 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 non-residential buildings over 100sqm 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 efficient energy
 3. Be green: use renewable energy

Decentralised Energy Networks

A. 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 developments will be required to connect to existing DE networks 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 of 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

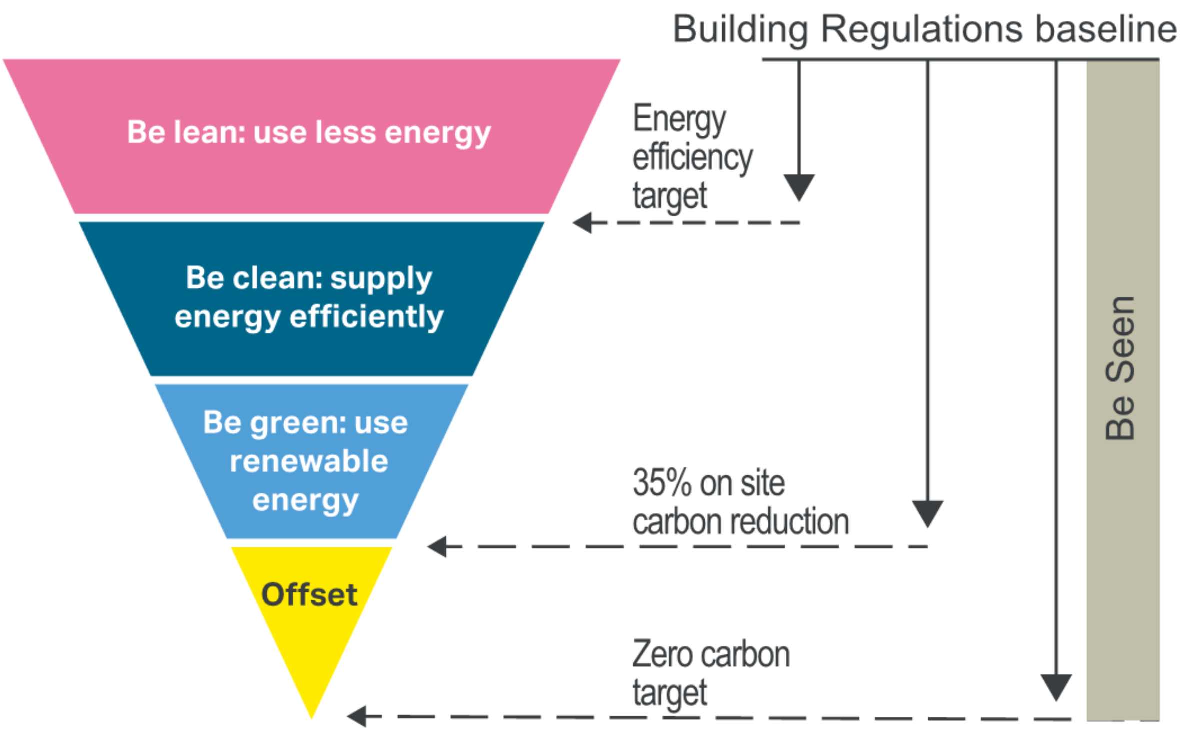
E. High standards of energy and water efficiency in existing developments will be supported wherever possible through retrofitting. Householder extensions and other development proposals that do not meet the thresholds set out in this policy are encouraged to complete and submit the Sustainable Construction 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.

5. Development Approach

The proposed energy strategy follows the London Plan Energy Hierarchy of Be Lean, Be Clean, Be Green and Be Seen to enable the maximum viable reductions in regulated and total CO_2 emissions over the baseline.

- Be Lean — Use less energy
- Be Clean — Supply energy efficiently
- Be Green — Use renewable energy systems
- Be Seen — Monitor, verify and report on energy performance

Figure 2: The London Plan energy hierarchy and associated targets



The proposed energy supply solutions aim to match energy profiles of the development ensuring effective use. The proposed solutions consider viability and flexibility of the scheme from both a technical and economic point of view by identifying best combination of energy efficiency measures as well as decentralised and renewable energy supply solutions.

Using these principles, Housing 21 aim to deliver the following objectives:

- Comply with the relevant regulatory requirements.
- To propose to reduce energy consumption and carbon dioxide emissions through passive and energy efficiency measures.
- Investigate the feasibility of connecting into an existing district heat network
- To propose to reduce energy consumption and carbon dioxide emissions further through the use of on-site renewable / LZC energy technologies.

5.1 CARBON FIGURES

From January 2019, in line with the latest GLA guidance, the results from these assessments will need be converted using the new draft SAP10 carbon emission factors through a carbon emissions reporting spreadsheet developed by the GLA. The outputs from this spreadsheet are used to demonstrate performance of the development against the new reduction targets.

The following carbon factors have been used in this assessment.

Table 1: Carbon factors

Fuel Type	SAP 2012 kgCO2/kWh	SAP 10 kgCO2/kWh
Natural Gas	0.216	0.210
Grid Electricity	0.519	0.233

The London Plan's Energy Hierarchy methodology requires separate energy assessments for the residential and non-residential floor space. The results from these separate assessments are combined to provide a predicted sitewide CO_2 emissions reduction.

5.2 RESIDENTIAL UNITS

Stroma's FSAP 2012 has been used to evaluate the CO_2 emissions on a representative sample of the residential dwellings. Using the mix of the development, the energy usage and CO_2 emissions for each dwelling are extrapolated on a weighted basis to evaluate the predicted energy and CO_2 performance for all the residential units.

FSAP has also used to estimate the unregulated energy use for appliances and cooking.

5.3 NON-RESIDENTIAL SPACE

An initial assessment of CO_2 performance of the non-residential unit is calculated using DesignBuilder software. DesignBuilder is an approved tool for calculating compliance with Part L2A which uses the standard National Calculation Methodology (NCM).

An assessment of the energy performance of the development considers regulated energy usage for different building services such as cooling, heating, lighting and ventilation. An estimate is also provided of unregulated electricity use (equipment) associated with computers, small power, and security systems, etc.

6. Baseline Energy Calculations

To assess CO_2 performance of the proposed energy strategy a baseline needs to be established. This section describes the approach taken to calculate the baseline for both residential and the non-residential elements of the development.

The total baseline emissions for the proposed development is defined as regulated CO_2 emissions covered by Building Regulations Part L as well as the unregulated CO_2 emissions not covered by Part L. However, the unregulated CO_2 emissions are to be excluded when compliance with planning policy is considered.

6.1 Residential Baseline

The regulated CO_2 emissions baseline has been established using Part L1A 2013 Target Emission Rate (TER of the sample of representative dwellings.

The TER using SAP 2012 carbon factors have then been adjusted using the new draft SAP10 carbon emission factors using the GLA carbon emissions reporting spreadsheet.

The following table provides the mix used to determine baseline CO_2 demand for the residential units.

Table 2: Residential mix

Type	Number
1 Bed End - GF	1
1 Bed End - TF	1
1 Bed Mid - GF	5
1 Bed Mid - MF	8
1 Bed Mid - EF	1
1 Bed Mid - TF	6
2 Bed - EF	1
2 Bed - MF	1
2 Bed - TF	1
1 Bed Var - EF	1
1 Bed Var - MF	1
1 Bed Var - TF	1
Total	28

The residential baseline CO_2 emissions including unregulated energy are summarised in the following table. SAP TER sheets are included in the appendices for reference.

Table 3: Residential baseline CO_2 emissions

	Regulated (CO_2 tonnes/year)	Unregulated (CO_2 tonnes/year)	Total (CO_2 tonnes/year)
Residential Baseline	28.53	13.36	41.89

6.2 NON-RESIDENTIAL BASELINE

The regulated CO_2 emissions baseline has been determined by using Part L2A 2013 Target Emission Rate (TER) of the sample of representative dwellings.

The TER using NCM 2012 carbon factors have then been adjusted using the new draft SAP10 carbon emission factors using the GLA carbon emissions reporting spreadsheet.

The following table provides the mix used to determine baseline CO_2 demand for the non-residential units.

Table 4: Non-Residential mix

Space Use	Area (m2)	No of Units
Residential Spaces	388.8	1

The non-residential baseline CO_2 emissions including unregulated energy are summarised in the following table. BRUKL TER sheets are included in the appendices for reference.

Table 5: Non-Residential baseline CO_2 emissions

	Regulated (CO_2 tonnes/year)	Unregulated (CO_2 tonnes/year)	Total (CO_2 tonnes/year)
Non-Residential Baseline	1.61	4.45	6.06

6.3 SITE WIDE BASELINE CO_2 EMISSIONS

The site wide CO_2 baseline is determined by combining the residential and non-residential baseline together and is summarised in the following table.

Table 6: Site wide total baseline

	Regulated (CO_2 tonnes/year)	Unregulated (CO_2 tonnes/year)	Total (CO_2 tonnes/year)
Total Site-Wide Baseline	30.14	17.81	47.95

7. Passive Design and Energy Efficient Measures - Be Lean

In accordance with the London Plan Energy Hierarchy, the energy demands of the development should be reduced as much as practically viable. The desire is to achieve Part L 2013 Building Regulations compliance before low carbon or renewable measures are introduced.

A range of measures to reduce CO_2 emissions and increase resilience to climate change are proposed in the building design, including good building fabric standards as well as energy efficient M&E systems and lighting.

7.1 Passive design - Residential

A mixed system approach for the ventilation is deemed most suitable due to the high energy efficiency requirements and CO_2 reduction target. The mixed system will utilise natural ventilation through openable windows, which will be supplemented by mechanical ventilation with heat recovery within the dwellings.

Openable windows and balcony doors are proposed but are not essential to provide a fresh air supply. The ventilation strategy will be reviewed and developed as the design progresses to ensure compliance with all the relevant regulations and standards and should certain dwellings be affected by noise issues and cannot open their windows enhanced mechanical ventilation will be introduced to reduce the risk of overheating. It is assumed in this scenario windows can still be opened albeit intermittently for purge ventilation.

The building incorporates passive design measures such as balconies which help to provide shading. The proposed glazed areas have been designed to maximise daylight and optimise solar gains. The glazing specification will be reviewed to ensure that they provide a balance between solar control and solar gain.

The GLA Domestic Overheating Checklist has been completed and is provided in Appendix B.

7.2 Building Fabric - Residential

To reduce demand for space heating, emphasis has been placed on providing a very high standard of fabric and reducing heat loss through the building envelope. Approved Document Part L1A 2013 sets out the limiting fabric parameters for each of the building elements. Each stated value represents the area-weighted average U-value. The following Table details the proposed U-values to be used in the described exposed element within the fabric of the development along with anticipated percentage improvements over the maximum allowable average weighted U-values in Part L1A 2013.

To further minimise heat loss through the building envelope, air leakage will be made a priority. The airtightness of the dwellings will be set to a level of 2.00 $m^3/h/m^2$.

Table 7: Proposed fabric U values Residential space

Element	Part L1A 2013 average allowable U Value	Proposed U Value	Improvement (%)
Ground Floor	0.22	0.13	41
Exposed Floor	0.22	0.13	41
External Walls	0.30	0.18	40
Party Wall	0.20	0.00	0
Roof – flat	0.20	0.11	45
Glazing U-Value	2.00	1.00	50

Door U-Value	2.00	1.00	50
Design Air Permeability	10	2	80

Using the specification detailed previously the overall Part L Fabric Energy Efficiency (FEE) performance has been reviewed for the ‘be lean’ position and compared to the baseline stage of the energy hierarchy. The results are shown in the following table.

Table 8: Residential FEE Performance

Element	TFEE (kWH/m^2/year)	DFEE (kWH/m^2/year)	Improvement (%)
Residential Development Total	52.54	43.75	17

7.3 Passive design – Non-Residential Space

Natural ventilation has been considered but is judged to be inappropriate due to the high energy efficiency requirements and CO_2 reduction target, and a mechanical/natural ventilation strategy to supply fresh is deemed to be more suitable.

As per the residential element the proposed glazed areas have been designed to maximise daylight and optimise solar gains. The glazing specification will be reviewed to ensure that they provide a balance between solar control and solar gain.

The GLA Domestic Overheating Checklist has been completed and is provided in Appendix B.

7.4 Building Fabric – Non-Residential Space

Approved Document Part L2A 2013 sets out the limiting fabric parameters for each of the building elements. Each stated value represents the area-weighted average U-value. The following Table details the proposed target U-values to be used within the fabric of the non-residential space.

Air leakage will also be made a priority and the airtightness of the non-residential space will be set to a level of 2m^3/h/m^2.

Table 9: Proposed fabric U Values – Non-residential space

Element	Part L2A 2013 average allowable U Value	Proposed U Value	Improvement (%)
Ground Floor	0.25	0.13	48
External Walls	0.30	0.18	40
Roof	0.20	0.11	45
Glazing U-Value	2.00	1.00	50
Airtightness	10	2	80

7.5 LIGHTING

A major energy demand within modern non-residential units is generally lighting. Specified lighting in these areas should be low wattage and designed to CIBSE Illuminance levels. Appropriate lighting controls are recommended where appropriate, such as PIRs and daylight dimmers, allowing light output to be automatically adjusted to suit prevailing conditions. Zoning of lighting circuits also allows greater benefit to be made of natural daylight in the areas where it is available, without compromising light levels further away from windows. Additionally, high frequency ballasts and control gear should be utilised where appropriate to further reduce energy demand.

7.6 COOLING

In order to prevent and mitigate any potential overheating risks and minimise excessive heat generation contributing to the urban heat island effect, in accordance with Policy SI 4 of the London Plan 2021, the following design strategies have been considered for inclusion within the development following the GLA cooling hierarchy.

Table 10: Cooling Hierarchy

Cooling Hierarchy	Design Strategy
Minimise internal heat generation through energy efficient design.	Energy efficient measures as per the list above in section 7.0.
Reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls.	Effective glazing to be provided with low G values and shading co-efficient to limit the effects of areas with large proportions of glazing. High performance internal blinds optional.
Manage the heat within the building through exposed internal thermal mass and high ceilings.	The majority residential nature of the development limits the feasibility due to the proposed floor levels and heights.
Passive ventilation.	Openable windows.
Mechanical ventilation.	Mechanical ventilation with high efficiency plate heat exchanger heat recovery units are to be installed.
Active cooling systems (ensuring they are the lowest carbon options).	None specified.

7.7 BE LEAN CO_2 SAVINGS RESIDENTIAL UNITS

Based on the proposed energy efficiency measures, the Dwelling Emission Rate (DER) for each representative dwelling provides an indication of the anticipated regulated CO_2 emissions. The DER reports for the sample dwellings have been provided in the appendices. The DER results of the SAP assessments from the representative dwellings for Be Lean have been extrapolated and converted using new draft SAP10 carbon emission factors through the GLA carbon emissions reporting spreadsheet to predict the residential regulated CO_2 emissions after the energy demand reduction.

Table 11: Residential CO_2 Savings (Be Lean)

Element	CO_2 - Regulated (tonnes/year)	CO_2 - Un-Regulated (tonnes/year)	Total (tonnes/year)
Residential Baseline	28.53	13.36	41.89
Be Lean	21.88	13.36	35.24
Saving	6.65	0.00	6.65
Improvement	23%	0%	16%

7.8 Be Lean CO_2 Savings Non-Residential Space

Based on the proposed energy efficiency measures for modelling purposes, the Building Emission Rate (BER) for the non-residential units has been calculated using DesignBuilder software using the standard National Calculation Methodology (NCM).

Table 12: Non-Residential CO_2 Savings (Be Lean)

Element	CO_2 - Regulated (tonnes/year)	CO_2 - Un-Regulated (tonnes/year)	Total (tonnes/year)
Residential Baseline	1.61	4.45	6.06
After energy demand reductions	1.60	4.45	6.05
Saving	0.01	0.00	0.01
Improvement	1%	0%	0%

7.9 Be Lean CO_2 Savings Site Wide

The site wide CO_2 savings is calculated by combining the residential and non-residential space. The site wide savings are summarised in the table below.

Table 13: Site wide CO_2 Savings (Be Lean)

Element	CO_2 - Regulated (tonnes/year)	CO_2 - Un-Regulated (tonnes/year)	Total (tonnes/year)
Baseline	30.14	17.81	47.95
After energy demand reductions	23.48	17.81	41.29
Saving	6.66	0.00	6.66
Improvement	22%	0%	14%

7.10 Energy Demand

Total delivered energy demand for the development has been assessed and is reported in the table below.

Table 14: Sitewide energy demand

Building Use	Energy demand following energy efficiency measure (MWh/year)						
	Space Heating	Hot Water	Lighting	Auxiliary	Cooling	Unregulated electricity	Unregulated Gas
Residential Total	44	45	7	6	0	57	0
Non-residential total	2	0	4	1	0	9	0

8. Heating Infrastructure (Be Clean)

Decentralised energy refers to energy that is generated off the main grid. This may include micro-renewables, heating and cooling. It can also refer to energy from waste plants, combined heat and power, district heating and cooling, as well as geothermal, biomass or solar energy. Decentralised Energy schemes can serve a single building or a whole community, even being built out across entire cities.

In line with the London Plan, Policy SI 3 Energy infrastructure, major development proposals within Heat Network Priority Areas should have a communal low-temperature heating system that adheres to the following:

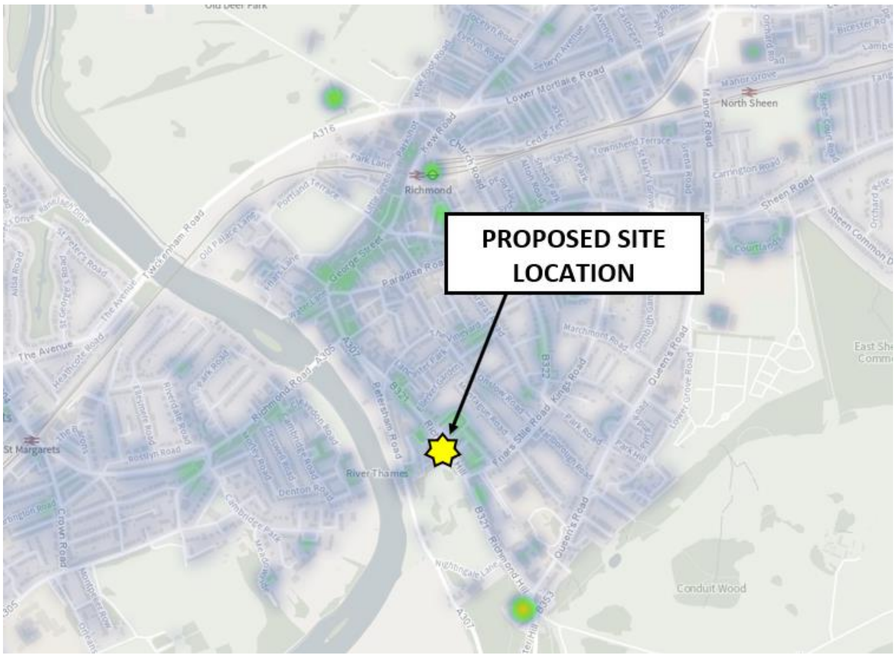
The heat source for the communal heating system should be selected in accordance with the following heating hierarchy:

1. Connect to local or existing planned heat networks
    a. Use zero-emission or local secondary heat sources (in conjunction with heat pump, if required)
    b. 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)
    c. 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 in Part B of Policy SI 1 Improving air quality.
3. Where a heat network is planned but not yet in existence the development should be designed for connection at a later date.

8.1 Connection to Existing District Heating Networks

Existing District Heating Networks have been investigated through the London Heat Map tool. The investigation has confirmed there are no existing, or proposed, district heating networks to which a connection is technically feasible. This is demonstrated in the figure below taken from the London Heat Map. A gas fuelled CHP and is not considered suitable as it does not take advantage of the decarbonised benefits of electricity. Furthermore, the proposed development has less than 800 dwellings, GLA Energy Assessment Guidance suggests that a connection with an ESCO wide heat network is unlikely to be a feasible option.

Figure 3: District Heating opportunities



8.2 Proposed Heating Strategy

The proposed development provides an opportunity for the heating strategy to be 'future proofed' by making the best use of low carbon and energy efficient generation using current and future technologies. The technologies which are proposed to be implemented into the heating strategy are detailed in the following section.

8.3 Hot Water Heat Pump Cylinders (Residential)

It is proposed that the residential dwellings will have their water heating supplied via hot water heat pump cylinders. This assessment has been based upon using the Dimplex Edel 200 litre cylinders. A technical datasheet for this product can be found in the appendices.

The heat pump cylinders will be housed in utility cupboards within the residential dwellings. The inner vessel of the cylinders is made from stainless steel with a heat pump mounted on top. The heat pump can produce hot water very efficiently as it extracts heat from external air supplied via insulated ductwork.

The space heating for the dwellings will be supplied via low surface temperature electric panel heaters. Therefore, the space and water heating will be fully electric. This will future proof the dwellings against the use of fossil fuels and supports the ongoing decarbonising of the grid.

8.4 Air Source Heat Pumps (Non-Residential)

Air Source Heat Pumps (ASHPs) extract heat from the external air and condense this energy to heat a smaller space within a dwelling or non-domestic building. A pump circulates a refrigerant through a coil to absorb energy from the air. This refrigerant is then compressed to raise its temperature which can then be used for space heating and domestic hot water.

It is proposed that the non-residential communal areas will have their heating supplied through the use of air source heat pumps. These units can either be fixed to an external wall or discreetly located on the roof space.

8.5 Residential CO_2 Savings After Heat Network (Be Clean)

Based on the proposed heating strategy previously detailed, the CO_2 emissions can be recalculated using the same methodology as described before for the residential units. The figures are summarised in the table below.

Table 15: Residential CO_2 Savings (Be Clean)

Element	CO_2 - Regulated (tonnes/year)	CO_2 - Un-Regulated (tonnes/year)	Total (tonnes/year)
Residential Baseline	28.53	13.36	41.89
Be Lean	21.88	13.36	35.24
After Heat Network	15.37	13.36	28.73

8.6 NON-RESIDENTIAL CO_2 SAVINGS AFTER HEAT NETWORK (BE CLEAN)

Based on the proposed use of ASHP, the CO_2 emissions can be recalculated using the same methodology as described before for the non-residential space. The figures are summarised in the table below.

Table 16: Non-Residential CO_2 Savings (Be Clean)

Element	CO_2 - Regulated (tonnes/year)	CO_2 - Un-Regulated (tonnes/year)	Total (tonnes/year)
Residential Baseline	1.61	4.45	6.06
After energy demand reductions	1.60	4.45	6.05
After Heat Network	1.38	4.45	5.83

8.7 SITE-WIDE CO_2 SAVINGS AFTER HEAT NETWORK (BE CLEAN)

The site wide CO_2 savings is calculated by combining the residential and non-residential space. The site wide savings are summarised in the table below.

Table 17: Site Wide CO_2 Savings (Be Clean)

Element	CO_2 - Regulated (tonnes/year)	CO_2 - Un-Regulated (tonnes/year)	Total (tonnes/year)
Baseline	30.14	17.81	47.95
After energy demand reductions	23.48	17.81	41.29
After Heat Network	16.75	17.81	34.56

9. Renewable Energy (Be Green)

In addition to the proposed low carbon heat pump technologies detailed in the previous section, the following low/zero carbon and renewable energy technologies have been considered for this scheme:

Wind Turbines

Wind turbines come in a variety of sizes and shapes. Turbines of 1 Kw can be installed to single house and large-scale turbines of 1-2 MW can be installed on a development to generate electricity to multiple dwellings and other buildings. In both instances the electricity generated can be used on site or exported to the grid. Vertical- or horizontal-axis turbines are available.

A roof-mounted 1 kW micro wind system costs up to £3,000. A 2.5 kW pole-mounted system costs between £9,900 and £19,000. A 6 kW pole-mounted system costs between £21,000 and £30,000 (taken from the Energy Saving Trust, TBC by supplier)

- Local average wind speed is a determining factor. A minimum average wind speed of 6 m/s is required.
- Noise considerations can be an issue dependent on density and build-up of the surrounding area.
- Buildings in the immediate area can disrupt wind speed and reduce performance of the system.
- Planning permission will be required along with suitable space to site the turbine, whether ground installed or roof mounted.

Wind turbines have been discounted due to concerns over reliable wind resources. The use of wind turbines is likely to present aesthetic as well as nuisance issues.

Biomass Boilers

Providing a heating system fuelled by plant-based materials such as wood, crops or food waste. Biomass boilers generate heat for space heating and domestic hot water through the combustion of biofuels, such as woodchip, wood pellets or potentially biofuel or bio diesel. Biomass is considered to be virtually zero carbon. They can be used on an individual scale or for multiple dwellings as part of a district-heating network. A back-up heat source should be provided as consistent delivery of fuel is necessary for continued operation.

Biomass is considered a technically-viable option for this development scheme as there are no apparent physical constraints on site in terms of installing biomass boilers or storing a sufficient supply.

- There are, however, concerns regarding a sustainable supply of biomass to the site.
- The capital installation cost would also be high which leads us to the conclusion that biomass would not be a commercially-viable option for this development scheme.

Individual Air Source Heat Pumps (ASHP)

Air Source Heat Pumps (ASHPs) extract heat from the external air and condense this energy to heat a smaller space within a dwelling or non-domestic building. A pump circulates a refrigerant through a coil to absorb energy from the air. This refrigerant is then compressed to raise its temperature which can then be used for space heating and domestic hot water.

They can feed either low-temperature radiators or underfloor heating and often have electric immersion heater back-up for the winter months.

As detailed in the previous section, the non-residential areas will have their heating supplied through ASHPs, and the residential dwellings will also utilise the heat pump technology through hot water heat pump cylinders.

Solar Thermal

Solar Thermal generates domestic hot water from the sun's radiation. Glycol circulates within either flat plate or evacuated tube panels, absorbing heat from the sun, and transferring this energy to a water cylinder. A well designed solar thermal system will account for 50-60% of a dwelling's annual hot water demand. Sizing the system to meet a higher demand will lead to excess heat generation in the summer months and overheating of the system.

Unsuitable for blocks of flats and has a low carbon reduction efficiency compared to photovoltaic systems. Solar hot water systems for flatted blocks are only suitable where a central boiler plant room is provided to accommodate a central thermal store.

Solar Photovoltaics (PV)

Solar Photovoltaics convert solar radiation into electricity which can be used on site or exported to the national grid. Solar energy could be a solution to reduce CO_2 emissions, however, PV is not considered a suitable option in this instance. The development site must also consider heritage issues and it is crucial to lessen the impact of the building in the context of the conservation area and the Grade II listed Terrace Gardens. The proposed green roof will support this objective, but this would be compromised if PV panels were to be installed. In addition, by maximising the energy efficiency of the building fabric and utilising the heat pump technology, compliance with the minimum on-site carbon reduction targets set out in London Plan Policy SI 2 can be achieved without the need for additional renewables.

9.1 Residential CO_2 Savings from Renewables

As detailed in the previous section no additional technologies have been added at the 'be green' stage. The figures following this stage of the energy hierarchy have been summarised for the residential element in the table below.

Table 18: Residential CO_2 Savings (Be Green)

Element	CO_2 - Regulated (tonnes/year)	CO_2 - Un-Regulated (tonnes/year)	Total (tonnes/year)
Residential Baseline	28.53	13.36	41.89
Be Lean	21.88	13.36	35.24
After Heat Network	15.37	13.36	28.73
Be Green	15.37	13.36	28.73

9.2 Non-Residential CO_2 savings from Renewables

The figures following the 'be green' stage of the energy hierarchy have been summarised for the non-residential element in the table below.

Table 19: Non-Residential CO_2 Savings (Be Green)

Element	CO_2 - Regulated (tonnes/year)	CO_2 - Un-Regulated (tonnes/year)	Total (tonnes/year)
Residential Baseline	1.61	4.45	6.06
After energy demand reductions	1.60	4.45	6.05
After Heat Network	1.38	4.45	5.83
Be Green	1.38	4.45	5.83

9.3 Site-Wide CO_2 Savings from Renewables

The updated site wide CO_2 savings have been calculated by combining the residential and non-residential space. The site wide savings are summarised in the table below.

Table 20: Site Wide CO_2 Savings (Be Green)

Element	CO_2 - Regulated (tonnes/year)	CO_2 - Un-Regulated (tonnes/year)	Total (tonnes/year)
Baseline	30.14	17.81	47.95
After energy demand reductions	23.48	17.81	41.29
After Heat Network	16.75	17.81	34.56
Be Green	16.75	17.81	34.56

10. Water Saving Measures

The following devices will be incorporated within each apartment:

- Water efficient taps.
- Water efficient cisterns.
- Low output showers.
- Flow restrictors to manage water pressures to achieve optimum levels.
- Water meters to all premises with guidance on water consumption and savings.

Housing 21 will be provided advice to the residents by through a comprehensive Homeowners Pack, detailing how to make optimum use of the devices installed around the home. Further, in marketing the scheme sustainable elements such as water reduction will be promoted.

The following specification or similar will be adopted on the development to ensure that the internal water use is reduced to a maximum of 105 litres per head per day in line with the requirements of London Plan Policy SI 5.

Table 21: Specification of flow rates and volumes for water using appliances

Water using Appliance	Comment
WC Cisterns	Dual Flush to be limited to maximum of 6/3
Baths	Capacity no greater than 190 litres
Basin taps	Flow rates to be no greater than 2.5 litres/minute
Kitchen taps	Flow rates to be no greater than 9 litres/minute
Shower	Flow rates to be no greater than 6 litres/minute
Water softener	Not to be installed
Washing Machine	Water usage to be limited to 17.16 Litres per KG
Dishwasher	Water Usage to be limited to 4.5 litres per place setting

Table 22: Water Calculations

Water Calculations - Apartments					
Installation Type	Unit	Capacity/ Flow Rate	Use Factor	Fixed use (l/p/day)	**Total Use (l/p/day)**
WC Single Flush	Volume (l)	0.00	4.42	0.00	0.00
WC Dual Flush	Full Flush (l)	6.00	1.46	0.00	8.76
	Pt Flush (l)	3.00	2.96	0.00	8.88
WC's (Multiple)	Volume (l)	0.00	4.42	0.00	0.00
Taps Exc. Kitchen	Flow Rate	2.50	1.58	1.58	5.53
Bath (shower present)	(l/s)	190.00	0.11	0.00	20.90
Shower (bath present)	(l/s)	8.00	4.37	0.00	34.96
Bath Only	(l)	0.00	0.50	0.00	0.00
Shower Only	(l/s)	0.00	5.60	0.00	0.00
Kitchen Taps	(l/s)	9.00	0.44	10.36	14.32
Washing Machines	(l/kgdry)	8.17	2.10	0.00	17.16
Dishwashers	(l/place)	1.25	3.60	0.00	4.50
Waste Disposal	(l/s)	0.00	3.08	0.00	0.00
Water Softener	(l/s)	0.00	1.00	0.00	0.00
Total Calculated Water Use (l/p/day)					**115.01**
Grey/Rain Water Reused (l)					0.00
Normalisation Factor	(Factor)				0.91
Total Internal Consumption (l/p/day)					**104.66**
External Water Use Allowance (l)					5.00
Total Consumption Part G (l/p/day)					**109.66**
Assesment Result					PASS

11. Summary and Conclusions

The energy strategy has followed the London Plan Hierarchy Be Lean, Be Clean, Be Green and Be Seen. The energy strategy proposed for the development can be summarised as below.

Table 23: Proposed Energy strategy - Residential Units

Element	Measure
Passive	Optimised design to enable controlled solar gain and improved direct and indirect natural lighting. Incorporation of balconies into the design to provide shading.
Fabric	Building fabric U values have been enhanced over and above those detailed with Part L1A 2013
Heating	Electric panel heaters
Hot Water	Hot water heat pump cylinders (Dimplex
Cooling	None
Ventilation	Mechanical ventilation System 4 Low DAP
Lighting	Energy efficient LED Lighting where applicable

Table 24: Proposed Energy Strategy Non-residential space

Element	Measure
Passive	Optimised design to enable controlled solar gain and improved direct and indirect natural lighting.
Fabric	Building fabric U values have been enhanced over and above those detailed with Part LA2013
Heating	ASHP to supply heating
Hot Water	None
Cooling	None
Ventilation	Mechanical ventilation System 4 Low DAP
Lighting	Energy efficient LED Lighting where applicable

11.1 Total Residential CO_2 Savings

The summary of the overall reduction in residential CO_2 emissions after each stage of the energy hierarchy is summarised in the table below.

Table 25: Summary Residential CO_2 Savings

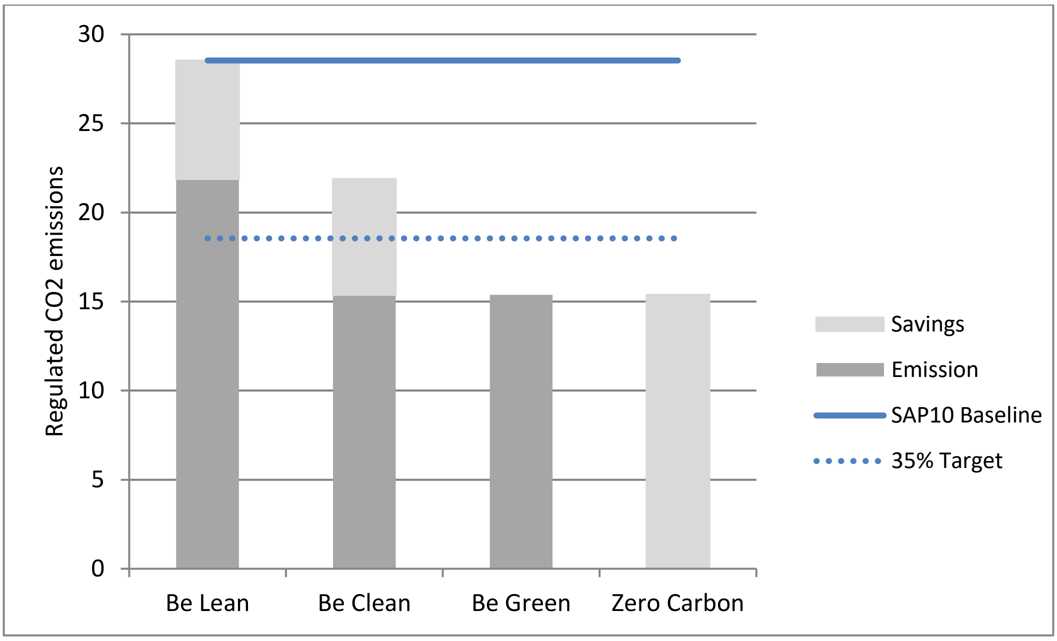
Element	CO_2 - Regulated (tonnes/year)	CO_2 - Un-Regulated (tonnes/year)	Total (tonnes/year)
Residential Baseline	28.53	13.36	41.89
Be Lean	21.88	13.36	35.24
After Heat Network	15.37	13.36	28.73
Be Green	15.37	13.36	28.73

The CO_2 savings attributed to regulated energy only are summarised with the relative percentage improvements shown in the table below.

Table 26: Summary Residential CO_2 percentage savings

	Regulated Energy CO_2 Saving	
	Tonnes per year	%
Be Lean	6.65	23
Be Clean after heat network	6.51	23
Be Green	0.00	0
Cumulative on-Site Savings	13.16	46
Carbon Shortfall	15.37	
	Tonnes CO_2	
Cumulative savings for offset payment	461.10	
Cash-in-lieu contribution	£43,804.50	

Figure 4: Residential reduction in regulated CO_2 emissions compared to Part L baseline emissions



11.2 TOTAL NON-RESIDENTIAL CO_2 SAVINGS

The summary of the overall CO_2 reduction in non-residential spaces after each stage of the energy hierarchy is summarised in the table below.

Table 27: Summary Non-Residential CO_2 Savings

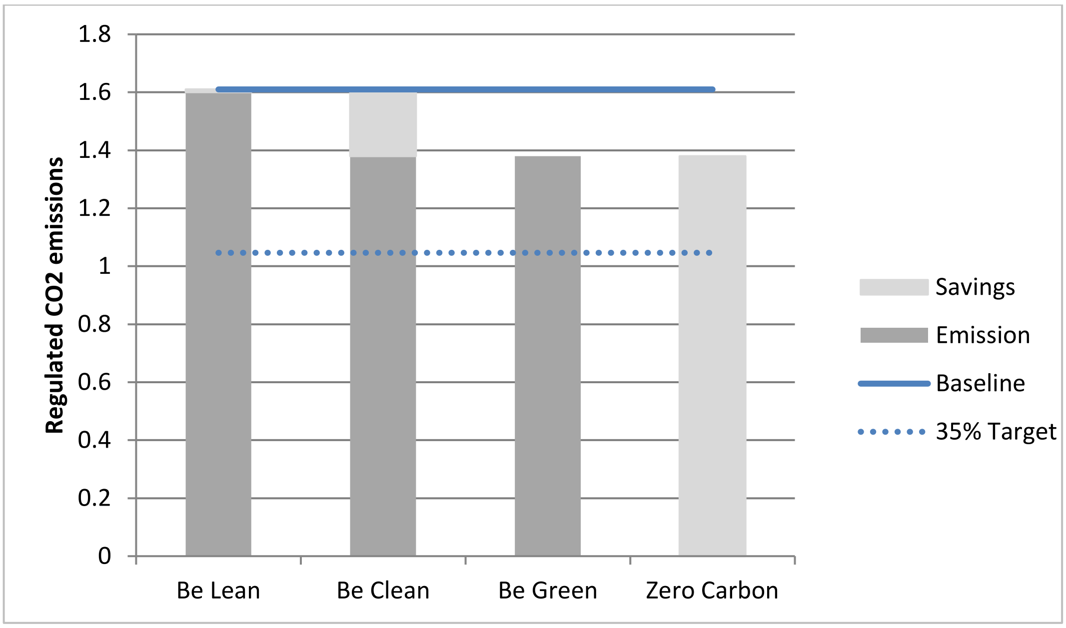
Element	CO_2 - Regulated (tonnes/year)	CO_2 - Un-Regulated (tonnes/year)	Total (tonnes/year)
Non-Residential Baseline	1.61	4.45	6.06
After energy demand reductions	1.60	4.45	6.05
After Heat Network	1.38	4.45	5.83
Be Green	1.38	4.45	5.83

The CO_2 savings attributed to regulated energy only are summarised with the relative percentage improvements shown in the table below.

Table 28: Summary Non-Residential CO_2 percentage savings

	Regulated Energy CO_2 Saving	
	Tonnes per year	%
Be Lean	0.01	1
Be Clean	0.22	14
Be Green	0.00	0
Cumulative on-Site Savings	0.23	14

Figure 5: Non-Residential reduction in regulated CO_2 emissions compared to Part L baseline emissions



11.3 Site-Wide CO_2 Savings

The summary of the overall CO_2 reduction site-wide after each stage of the energy hierarchy is summarised in the table below.

Table 29: Summary Site-wide CO_2 Savings

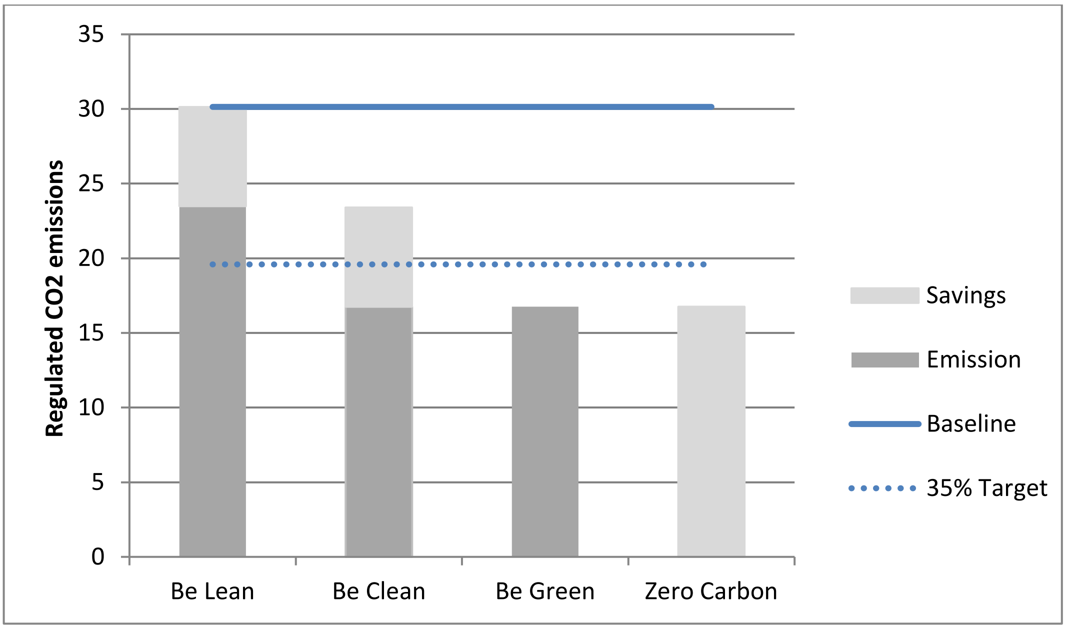
Element	CO_2 - Regulated (tonnes/year)	CO_2 - Un-Regulated (tonnes/year)	Total (tonnes/year)
Baseline	30.14	17.81	47.95
After energy demand reductions	23.48	17.81	41.29
After Heat Network	16.75	17.81	34.56
Be Green	16.75	17.81	34.56

The CO_2 savings attributed to regulated energy only are summarised with the relative percentage improvements shown in the table below.

Table 30: Summary Site-wide CO_2 percentage savings

	Regulated Energy CO_2 Saving	
	Tonnes per year	%
Be Lean	6.66	22
Be Clean	6.73	22
Be Green	0.00	0
Cumulative on-Site Savings	13.39	44

Figure 6: Site-wide reduction in regulated CO_2 emissions compared to Part L baseline emissions



The proposed energy strategy achieves and meets the following requirements:

- Complies with Part L 2013 building regulations (with 2016 amendments).
- Includes improved optimal building fabric improvements, energy efficient design of building services.
- Meets the TFEE minimum reduction requirements.
- Utilises heat pump technology through hot water heat pump cylinders within the residential dwellings.
- Utilises ASHP to supply heating to the non-residential element of the building.
- Achieves in excess of 35% regulated energy CO_2 emissions reduction on-site.
- Achieves Zero Carbon by making a cash in lieu contribution.

APPENDIX A - GLA ENERGY AND CO_2 SPREADSHEET OUTPUTS

The applicant should complete all the light blue cells including information on the modelled units, the area per unit, the number of units, the baseline energy consumption figures, the TER and the TFEE.

SAP 2012 CO_2 PERFORMANCE | SAP 10.0 CO_2 PERFORMANCE

DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

Unit identifier (e.g. plot number, dwelling type etc.)	Model total floor area (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK: Calculated TER 2012 ($kgCO_2 / m^2$)	VALIDATION CHECK: TER Worksheet TER 2012 ($kgCO_2 / m^2$)	REGULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - TER WORKSHEET: Space Heating	Fuel type Space Heating	Domestic Hot Water	Fuel type Domestic Hot Water	Lighting	Auxiliary	Cooling
	TER Worksheet (Row 4)				TER Worksheet (Row 273)	TER Worksheet (Row 211)		TER Worksheet (Row 219)		TER Worksheet (Row 232)	TER Worksheet (Row 231)	N / A
1 Bed End - GF	55.94	1	55.94	21.5	21.5	2748.6	Natural Gas	2013.9	Natural Gas	256.01	75	
1 Bed End - TF	55.94	1	55.94	24.0	24.0	3412.2	Natural Gas	2005.03	Natural Gas	256.01	75	
1 Bed Mid - GF	55.83	5	279.15	20.3	20.3	2434.02	Natural Gas	2017.2	Natural Gas	255.56	75	
1 Bed Mid - MF	55.83	8	446.64	17.9	17.9	1787.82	Natural Gas	2041.28	Natural Gas	255.56	75	
1 Bed Mid - EF	55.83	1	55.83	19.2	19.2	2156.22	Natural Gas	2022.66	Natural Gas	255.56	75	
1 Bed Mid - TF	55.83	6	334.98	22.2	22.2	2926.77	Natural Gas	2009.23	Natural Gas	255.56	75	
2 Bed - EF	67.05	1	67.05	18.8	18.8	2723.42	Natural Gas	2206.8	Natural Gas	299.64	75	
2 Bed - MF	67.05	1	67.05	16.7	16.7	2047.29	Natural Gas	2221.13	Natural Gas	299.64	75	
2 Bed - TF	67.05	1	67.05	21.1	21.1	3455.71	Natural Gas	2195.56	Natural Gas	299.64	75	
1 Bed Var - EF	54.08	1	54.08	20.7	20.7	2419.68	Natural Gas	1985.3	Natural Gas	248.46	75	
1 Bed Var - MF	54.08	1	54.08	19.3	19.3	2053.25	Natural Gas	1992.58	Natural Gas	248.46	75	
1 Bed Var - TF	54.08	1	54.08	24.2	24.2	3316.88	Natural Gas	1972.31	Natural Gas	248.46	75	
Sum	1,592	28	1,592	20.1	-	68,367	N/A	57,087	N/A	7,268	2,100	0

Unit identifier	SAP 2012: REGULATED CO_2 EMISSIONS PER UNIT ($kgCO_2$ p.a.): Space Heating	Domestic Hot Water	Lighting	Auxiliary	Cooling	2012 CO_2 emissions ($kgCO_2$ p.a.)	SAP 10.0: REGULATED CO_2 EMISSIONS PER UNIT: Space Heating	Domestic Hot Water	Lighting	Auxiliary	Cooling	SAP 10.0 CO_2 emissions ($kgCO_2$ p.a.)	Calculated TER SAP 10.0 ($kgCO_2 / m^2$)	DEMAND: Fabric Energy Efficiency (FEE): Target Fabric Energy Efficiency (TFEE) (kWh/m²)
1 Bed End - GF	594	435	133	39		1,200	577	423	60	17		1,077	19.3	59.1
1 Bed End - TF	737	433	133	39		1,342	717	421	60	17		1,215	21.7	72
1 Bed Mid - GF	526	436	133	39		1,133	511	424	60	17		1,012	18.1	53.2
1 Bed Mid - MF	386	441	133	39		999	375	429	60	17		881	15.8	40.9
1 Bed Mid - EF	466	437	133	39		1,074	453	425	60	17		955	17.1	47.9
1 Bed Mid - TF	632	434	133	39		1,238	615	422	60	17		1,114	19.9	62.7
2 Bed - EF	588	477	156	39		1,259	572	463	70	17		1,123	16.7	49.8
2 Bed - MF	442	480	156	39		1,116	430	466	70	17		984	14.7	39.1
2 Bed - TF	746	474	156	39		1,415	726	461	70	17		1,274	19.0	61.6
1 Bed Var - EF	523	429	129	39		1,119	508	417	58	17		1,000	18.5	54.5
1 Bed Var - MF	444	430	129	39		1,042	431	418	58	17		925	17.1	47.3
1 Bed Var - TF	716	426	129	39		1,310	697	414	58	17		1,186	21.9	72.4
Sum	14,767	12,331	3,772	1,090	0	31,960	14,357	11,988	1,693	489	0	28,528	17.9	52.54

NON-DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

Building Use	Model Area (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK: Calculated TER 2012 ($kgCO_2 / m^2$)	VALIDATION CHECK: BRUKL TER 2012 ($kgCO_2 / m^2$)	REGULATED ENERGY CONSUMPTION BY END USE (kWh/m² p.a.) TER - SOURCE: BRUKL OUTPUT: Space Heating (kWh/m² p.a.)	Fuel type Space Heating	Domestic Hot Water (kWh/m² p.a.)	Fuel type Domestic Hot Water	Lighting (kWh/m² p.a.)	Auxiliary (kWh/m² p.a.)	Cooling (kWh/m² p.a.)
Residential	338.8	1	338.8	10.5	10.3	12.28	Grid Electricity	0	Grid Electricity	6.58	0	0
Sum	339	1	339	10.5	-	4,160	N/A	0	N/A	2,229	0	0

Building Use	REGULATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m² p.a.) TER - SOURCE: BRUKL.INP or *SIM.CSV FILE: Natural Gas	Grid Electricity	Equipment			2012 CO_2 emissions ($kgCO_2$ p.a.)	REGULATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m² p.a.) - TER BRUKL: Natural Gas	Grid Electricity	Unregulated Grid Electricity			REGULATED CO_2 EMISSIONS: SAP10.0 CO_2 emissions ($kgCO_2$ p.a.)	BRUKL TER SAP10.0 ($kgCO_2 / m^2$)
	0.216 $kgCO_2$/kWh	0.519 $kgCO_2$/kWh	0.519 $kgCO_2$/kWh				0.210 $kgCO_2$/kWh	0.233 $kgCO_2$/kWh	0.233 $kgCO_2$/kWh				
Residential		20	13			3,572		20	13			1,604	4.7
Sum	0	6,882	4,448	N/A	N/A	3,572	0	6,882	4,448	N/A	N/A	1,604	4.7

SITE-WIDE ENERGY CONSUMPTION AND CO_2 ANALYSIS

Use	Total Area (m²)	Calculated TER 2012 ($kgCO_2 / m^2$)	-	REGULATED ENERGY CONSUMPTION: Space Heating (kWh p.a.)	N/A	Domestic Hot Water (kWh p.a.)	N/A	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)	REGULATED CO_2 EMISSIONS: 2012 CO_2 emissions ($kgCO_2$ p.a.)	REGULATED CO_2 EMISSIONS PER UNIT: SAP 10.0 CO_2 emissions ($kgCO_2$ p.a.)	Calculated TER SAP 10.0 ($kgCO_2 / m^2$)
Sum	1,931	18.4	-	72,527		57,087		9,497	2,100	0	35,532	30,131	15.6

The applicant should complete all the light blue cells including information on the 'be lean' energy consumption figures, the 'be lean' DER, the DFEE and the regulated energy demand of the 'be lean' scenario.

DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

Unit identifier (e.g. plot number, dwelling type etc.)	Model total floor area (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK: Calculated DER 2012 ($kgCO_2$ / m^2)	VALIDATION CHECK: DER Worksheet DER 2012 ($kgCO_2$ / m^2)	REGULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - 'BE LEAN' SAP DER WORKSHEET: Space Heating	Fuel type Space Heating	Domestic Hot Water (Heat Source 1)	Fuel type Domestic Hot Water	Secondary Heating system	Fuel type Space Heating	Lighting	Auxiliary	Cooling	
					DER Sheet (Row 384)	DER Sheet [(Row 307a) ÷ (Row 367a x 0.01)]	Select fuel type	DER Sheet [Row 310b ÷ (Row 367b x 0.01)]	Select fuel type	DER Sheet [Row 309]	Select fuel type	DER Sheet Row 332	DER Sheet (Row 313 + 331)	DER Sheet Row 315	
1 Bed End - GF	55.94	1	55.94	18.3	18.3	2001.13	Natural Gas	1577.48	Natural Gas			256.01	228.56		
1 Bed End - TF	55.94	1	55.94	18.7	18.7	2090.96	Natural Gas	1576.79	Natural Gas			256.01	228.56		
1 Bed Mid - GF	55.83	5	279.15	17.4	17.4	1749.32	Natural Gas	1577.51	Natural Gas			255.56	228.25		
1 Bed Mid - MF	55.83	8	446.64	14.8	14.8	1074.86	Natural Gas	1582.47	Natural Gas			255.56	228.25		
1 Bed Mid - EF	55.83	1	55.83	16.1	16.1	1409.89	Natural Gas	1579.65	Natural Gas			255.56	228.25		
1 Bed Mid - TF	55.83	6	334.98	17.8	17.8	1856.05	Natural Gas	1576.62	Natural Gas			255.56	228.25		
2 Bed - EF	67.05	1	67.05	15.7	15.7	1829.24	Natural Gas	1709.36	Natural Gas			299.64	259.05		
2 Bed - MF	67.05	1	67.05	13.7	13.7	1189.16	Natural Gas	1714.22	Natural Gas			299.64	259.05		
2 Bed - TF	67.05	1	67.05	16.8	16.8	2171.54	Natural Gas	1707.28	Natural Gas			299.64	259.05		
1 Bed Var - EF	54.08	1	54.08	17.7	17.7	1730.4	Natural Gas	1555.68	Natural Gas			248.46	223.45		
1 Bed Var - MF	54.08	1	54.08	16.3	16.3	1398.57	Natural Gas	1557.83	Natural Gas			248.46	223.45		
1 Bed Var - TF	54.08	1	54.08	19.1	19.1	2101.12	Natural Gas	1553.6	Natural Gas			248.46	223.45		
Sum	1,592	28	1,592	16.5	-	44,404	N/A	44,539	N/A	0	N/A	7,268	6,470	0	N/A

Unit identifier	SAP 2012 CO_2 PERFORMANCE — REGULATED CO_2 EMISSIONS PER UNIT ($kgCO_2$ p.a.): Space Heating CO_2 emissions ($kgCO_2$ p.a.)	Domestic Hot Water CO_2 emissions ($kgCO_2$ p.a.)	Lighting CO_2 emissions ($kgCO_2$ p.a.)	Auxiliary CO_2 emissions ($kgCO_2$ p.a.)	Cooling CO_2 emissions ($kgCO_2$ p.a.)	2012 CO_2 emissions ($kgCO_2$ p.a.)	SAP 10.0 CO_2 PERFORMANCE — REGULATED CO_2 EMISSIONS PER UNIT: Space Heating CO_2 emissions ($kgCO_2$ p.a.)	Domestic Hot Water CO_2 emissions ($kgCO_2$ p.a.)	Lighting CO_2 emissions ($kgCO_2$ p.a.)	Auxiliary CO_2 emissions ($kgCO_2$ p.a.)	Cooling CO_2 emissions ($kgCO_2$ p.a.)	Unregulated ($kgCO_2$ p.a.)	SAP 10.0 CO_2 emissions ($kgCO_2$ p.a.)	Calculated DER SAP 10.0 ($kgCO_2$ / m^2)	FEES — Fabric Energy Efficiency (FEE): Dwelling Fabric Energy Efficiency (DFEE) (kWh/m²)
1 Bed End - GF	432	341	133	119		1,024	420	331	60	53		471	864	15.5	51.6
1 Bed End - TF	452	341	133	119		1,044	439	331	60	53		471	883	15.8	51.9
1 Bed Mid - GF	378	341	133	118		970	367	331	60	53		470	811	14.5	47.6
1 Bed Mid - MF	232	342	133	118		825	226	332	60	53		470	671	12.0	35.9
1 Bed Mid - EF	305	341	133	118		897	296	332	60	53		470	741	13.3	41.6
1 Bed Mid - TF	401	341	133	118		993	390	331	60	53		470	834	14.9	48.2
2 Bed - EF	395	369	156	134		1,054	384	359	70	60		547	873	13.0	43
2 Bed - MF	257	370	156	134		917	250	360	70	60		547	740	11.0	34
2 Bed - TF	469	369	156	134		1,128	456	359	70	60		547	945	14.1	47
1 Bed Var - EF	374	336	129	116		955	363	327	58	52		458	800	14.8	47.8
1 Bed Var - MF	302	336	129	116		884	294	327	58	52		458	731	13.5	42.1
1 Bed Var - TF	454	336	129	116		1,034	441	326	58	52		458	877	16.2	53.4
Sum	9,591	9,620	3,772	3,358	0	26,341	9,325	9,353	1,693	1,507	0	13,363	21,879	13.7	43.75

NON-DOMESTIC ENERGY CONSUMPTION AND CO2 ANALYSIS

Building Use	Model Area (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK: Calculated BER 2012 ($kgCO_2$ / m^2)	BRUKL BER 2012 ($kgCO_2$ / m^2)	REGULATED ENERGY CONSUMPTION BY END USE (kWh/m² p.a.) 'BE LEAN' BER - SOURCE: BRUKL OUTPUT: Space Heating (kWh/m² p.a.)	Fuel type Space Heating	Domestic Hot Water (kWh/m² p.a.)	Fuel type Domestic Hot Water			Lighting (kWh/m² p.a.)	Auxiliary (kWh/m² p.a.)	Cooling (kWh/m² p.a.)
Residential	338.8	1	338.8	10.3	10.3	5.07	Grid Electricity	0	Grid Electricity			11.62	3.07	0
Sum	339	1	339	10.3	-	1,718	N/A	0	N/A	N/A	N/A	3,937	1,040	0

Building Use	REGULATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m² p.a.) 'BE LEAN' BER - SOURCE: BRUKL.INP or *SIM.CSV FILE: Natural Gas 0.216 $kgCO_2$/kWh	Grid Electricity 0.519 $kgCO_2$/kWh	Equipment 0.519 $kgCO_2$/kWh				2012 CO_2 emissions ($kgCO_2$ p.a.)	REGULATED CO_2 EMISSIONS PER UNIT: Natural Gas 0.210 $kgCO_2$/kWh	Grid Electricity 0.233 $kgCO_2$/kWh	Equipment 0.233 $kgCO_2$/kWh		SAP 10.0 CO_2 emissions ($kgCO_2$ p.a.)	BRUKL BER SAP 10.0 ($kgCO_2$ / m^2)	
Residential		20	13				3,473		20	13		1,559	4.6	N/A
Sum	0	6,691	4,448	N/A	N/A	N/A	3,473	0	6,691	4,448		1,559	4.6	

SITE-WIDE ENERGY CONSUMPTION AND CO2 ANALYSIS

Use	Total Area (m²)	Calculated BER 2012 ($kgCO_2$ / m^2)	-	REGULATED ENERGY CONSUMPTION: Space Heating (kWh p.a.)	N/A	Domestic Hot Water (kWh p.a.)	N/A	Secondary Heating System (kWh p.a.)	N/A	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)	REGULATED CO_2 EMISSIONS: 2012 CO_2 emissions ($kgCO_2$ p.a.)	REGULATED CO_2 EMISSIONS: SAP 10.0 CO_2 emissions ($kgCO_2$ p.a.)	Calculated BER SAP 10.0 ($kgCO_2$ / m^2)	N/A
Sum	1,931	15.4	-	46,122		44,539		0		11,204	7,510	0	29,814	23,438	12.1	

The applicant should complete all the light blue cells including information on the 'be clean' energy consumption figures and the 'be clean' DER.

SAP 2012 CO_2 PERFORMANCE | SAP 10.0 CO_2 PERFORMANCE

DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

Unit identifier (e.g. plot number, dwelling type etc.)	Model total floor area (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK: Calculated DER 2012 ($kgCO_2 / m^2$)	VALIDATION CHECK: DER Worksheet DER 2012 ($kgCO_2 / m^2$)	REGULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - 'BE CLEAN' SAP DER WORKSHEET: Space Heating (Heat Source 1)	Fuel type Space Heating	Domestic Hot Water (Heat Source 1)	Fuel type Domestic Hot Water	Space and Domestic Hot Water from CHP	Fuel type CHP	Total Electricity generated by CHP (-)	Secondary Heating system	Fuel type Secondary Heating	Lighting	Auxiliary	Cooling
										if applicable	if applicable	if applicable					
					DER Sheet (Row 384)	DER Sheet [Row 307b ÷ (Row 367b x 0.01)]	Select fuel type	DER Sheet [Row 310b ÷ (Row 367b x 0.01)]	Select fuel type	DER Sheet [(Row 307a + 310a) ÷ (Row 362 x	Select fuel type	DER Sheet [(Row 307a + 310a) × (Row 361 ÷ 362)]	DER Sheet [Row 309]	Select fuel type	DER Sheet Row 332	DER Sheet (Row 313 + 331)	DER Sheet Row 315
1 Bed End - GF	55.94	1	55.94	25.4	25.4	1880.51	Grid Electricity	444.26	Grid Electricity						256.0115607	153.56	
1 Bed End - TF	55.94	1	55.94	26.1	26.1	1956.38	Grid Electricity	444.26	Grid Electricity						256.0115607	153.56	
1 Bed Mid - GF	55.83	5	279.15	23.3	23.3	1648.44	Grid Electricity	443.92	Grid Electricity						255.5684008	153.25	
1 Bed Mid - MF	55.83	8	446.64	17.4	17.4	1020.58	Grid Electricity	443.92	Grid Electricity						255.5684008	153.25	
1 Bed Mid - EF	55.83	1	55.83	20.3	20.3	1331.91	Grid Electricity	443.92	Grid Electricity						255.5684008	153.25	
1 Bed Mid - TF	55.83	6	334.98	24.1	24.1	1739.86	Grid Electricity	443.92	Grid Electricity						255.5684008	153.25	
2 Bed - EF	67.05	1	67.05	20.8	20.8	1722.33	Grid Electricity	477.15	Grid Electricity						299.6339114	184.05	
2 Bed - MF	67.05	1	67.05	16.2	16.2	1128.57	Grid Electricity	477.15	Grid Electricity						299.6339114	184.05	
2 Bed - TF	67.05	1	67.05	23.2	23.2	2033.49	Grid Electricity	477.15	Grid Electricity						299.6339114	184.05	
1 Bed Var - EF	54.08	1	54.08	23.6	23.6	1627.12	Grid Electricity	438.43	Grid Electricity						248.4585742	148.45	
1 Bed Var - MF	54.08	1	54.08	20.7	20.7	1319.38	Grid Electricity	438.43	Grid Electricity						248.4585742	148.45	
1 Bed Var - TF	54.08	1	54.08	26.9	26.9	1965.27	Grid Electricity	438.43	Grid Electricity						248.4585742	148.45	
Sum	1,592	28	1,592	21.5	-	41,811	N/A	12,514	N/A	0	N/A	0	0	N/A	7,268	4,370	0

Unit identifier	SAP 2012 – REGULATED CO_2 EMISSIONS PER UNIT ($kgCO_2$ p.a.): Space Heating	Domestic Hot Water	Space Heating and DHW from CHP (if applicable)	Electricity generated by CHP (if applicable)	Lighting	Auxiliary	Cooling	2012 CO_2 emissions ($kgCO_2$ p.a.)	SAP 10.0 – REGULATED CO_2 EMISSIONS PER UNIT ($kgCO_2$ p.a.): Space Heating	Domestic Hot Water	Space Heating and DHW from CHP (if applicable)	Electricity generated by CHP (if applicable)	Lighting	Auxiliary	Cooling	SAP 10.0 CO_2 emissions ($kgCO_2$ p.a.)	Calculated DER SAP 10.0 ($kgCO_2 / m^2$)
1 Bed End - GF	976	231			133	80		1,419	438	104			60	36		637	11.4
1 Bed End - TF	1,015	231			133	80		1,458	456	104			60	36		655	11.7
1 Bed Mid - GF	856	230			133	80		1,298	384	103			60	36		583	10.4
1 Bed Mid - MF	530	230			133	80		972	238	103			60	36		436	7.8
1 Bed Mid - EF	691	230			133	80		1,134	310	103			60	36		509	9.1
1 Bed Mid - TF	903	230			133	80		1,346	405	103			60	36		604	10.8
2 Bed - EF	894	248			156	96		1,393	401	111			70	43		625	9.3
2 Bed - MF	586	248			156	96		1,084	263	111			70	43		487	7.3
2 Bed - TF	1,055	248			156	96		1,554	474	111			70	43		698	10.4
1 Bed Var - EF	844	228			129	77		1,278	379	102			58	35		574	10.6
1 Bed Var - MF	685	228			129	77		1,118	307	102			58	35		502	9.3
1 Bed Var - TF	1,020	228			129	77		1,454	458	102			58	35		653	12.1
Sum	21,700	6,495	0	0	3,772	2,268	0	34,234	9,742	2,916	0	0	1,693	1,018	0	15,369	9.7

NON-DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

Building Use	Model Area (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK: Calculated BER 2012 ($kgCO_2 / m^2$)	VALIDATION CHECK: BRUKL BER 2012 ($kgCO_2 / m^2$)	REGULATED ENERGY CONSUMPTION BY END USE (kWh/m² p.a.) 'BE CLEAN' BER - SOURCE: BRUKL OUTPUT: Space Heating (kWh/m² p.a.)	Fuel type Space Heating	Domestic Hot Water (kWh/m² p.a.)	Fuel type Domestic Hot Water			Electricity generated by CHP (-) if applicable			Lighting (kWh/m² p.a.)	Auxiliary (kWh/m² p.a.)	Cooling (kWh/m² p.a.)
Residential	338.8	1	338.8	9.1	9.1	2.83	Grid Electricity	0	Grid Electricity	N/A	N/A		N/A	N/A	11.62	3.07	0
Sum	339	1	339	9.1	-	959	N/A	0	N/A			0			3,937	1,040	0

Building Use	REGULATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m² p.a.) 'BE CLEAN' BER - SOURCE: BRUKL.INP or *SIM.CSV FILE: Natural Gas	Grid Electricity	Bespoke DH Factor	Electricity generated by CHP (-) if applicable	Equipment			2012 CO_2 emissions ($kgCO_2$ p.a.)	REGULATED CO_2 EMISSIONS PER UNIT: Natural Gas	Grid Electricity	Bespoke DH Factor	Electricity generated by CHP (-) if applicable	Equipment		SAP 10.0 CO_2 emissions ($kgCO_2$ p.a.)	BRUKL BER SAP10.0 ($kgCO_2 / m^2$)
	0.216 $kgCO_2$/kWh	0.519 $kgCO_2$/kWh	0.000 $kgCO_2$/kWh	0.519 $kgCO_2$/kWh	0.519 $kgCO_2$/kWh				0.210 $kgCO_2$/kWh	0.233 $kgCO_2$/kWh	0.000 $kgCO_2$/kWh	0.233 $kgCO_2$/kWh	0.233 $kgCO_2$/kWh			
Residential		18			13	N/A	N/A	3,081		18			13		1,383	4.1
Sum	0	5,936	0	0	4,448			3,081	0	5,936	0	0	4,448		1,383	4.1

SITE-WIDE ENERGY CONSUMPTION AND CO_2 ANALYSIS

Use	Total Area (m²)	Calculated BER 2012 ($kgCO_2 / m^2$)	-	REGULATED ENERGY CONSUMPTION: Space Heating (kWh p.a.)	N/A	Domestic Hot Water (kWh p.a.)	N/A	Space and Domestic Hot Water from CHP (kWh p.a.)	N/A	Electricity generated by CHP (kWh p.a.) if applicable	Secondary Heating System (kWh p.a.)	N/A	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)	REGULATED CO_2 EMISSIONS: 2012 CO_2 emissions ($kgCO_2$ p.a.)	REGULATED CO_2 EMISSIONS PER UNIT: SAP 10.0 CO_2 emissions ($kgCO_2$ p.a.)	Calculated BER SAP 10.0 ($kgCO_2 / m^2$)
Sum	1,931	19.3	-	42,770		12,514		0		0	0		11,205	5,410	0	37,315	16,752	8.7

The applicant should complete all the light blue cells including information on the 'be green' energy consumption figures and the 'be green' DER.

DOMESTIC ENERGY CONSUMPTION AND CO2 ANALYSIS

VALIDATION CHECK / REGULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - 'BE GREEN' SAP DER WORKSHEET

Unit identifier (e.g. plot number, dwelling type etc.)	Model total floor area (m²)	Number of units	Total area represented by model (m²)	Calculated DER 2012 ($kgCO_2 / m^2$)	DER Worksheet DER 2012 ($kgCO_2 / m^2$)	Space Heating (Heat Source 1)	Fuel type Space Heating	Domestic Hot Water (Heat Source 1)	Fuel type Domestic Hot Water	Space Heating (Heat source 2)	Fuel type Space Heating	Domestic Hot Water (Heat source 2)	Fuel type Domestic Hot Water	Space and Domestic Hot Water from CHP	Fuel type CHP	Total Electricity generated by CHP (-)	Secondary Heating system	Fuel type Secondary Heating	Electricity generated by renewable (-)	Lighting	Auxiliary	Cooling
										if applicable		if applicable		if applicable	if applicable	if applicable			if applicable			
					DER Sheet (Row 384)	DER Sheet [Row 307b ÷ (Row 367b x 0.01)]	Select fuel type	DER Sheet [Row 310b ÷ (Row 367b x 0.01)]	Select fuel type	DER Sheet [Row 307c ÷ (Row 367c x 0.01)]	Select fuel type	DER Sheet [Row 310c ÷ (Row 367c x 0.01)]	Select fuel type	DER Sheet [(Row 307a + 310a) ÷ (Row 362 x 0.01)]	Select fuel type	DER Sheet [(Row 307a + 310a) × (Row 361 ÷ 362)]	DER Sheet Row 309	Select fuel type	DER Sheet Row 333	DER Sheet Row 332	DER Sheet (Row 313 + 331)	DER Sheet Row 315
1 Bed End - GF	55.94	1	55.94	25.4	25.4	1880.51	Grid Electricity	444.26	Grid Electricity											256.0115607	153.56	
1 Bed End - TF	55.94	1	55.94	26.1	26.1	1956.38	Grid Electricity	444.26	Grid Electricity											256.0115607	153.56	
1 Bed Mid - GF	55.83	5	279.15	23.3	23.3	1648.44	Grid Electricity	443.92	Grid Electricity											255.5684008	153.25	
1 Bed Mid - MF	55.83	8	446.64	17.4	17.4	1020.58	Grid Electricity	443.92	Grid Electricity											255.5684008	153.25	
1 Bed Mid - EF	55.83	1	55.83	20.3	20.3	1331.91	Grid Electricity	443.92	Grid Electricity											255.5684008	153.25	
1 Bed Mid - TF	55.83	6	334.98	24.1	24.1	1739.86	Grid Electricity	443.92	Grid Electricity											255.5684008	153.25	
2 Bed - EF	67.05	1	67.05	20.8	20.8	1722.33	Grid Electricity	477.15	Grid Electricity											299.6339114	184.05	
2 Bed - MF	67.05	1	67.05	16.2	16.2	1128.57	Grid Electricity	477.15	Grid Electricity											299.6339114	184.05	
2 Bed - TF	67.05	1	67.05	23.2	23.2	2033.49	Grid Electricity	477.15	Grid Electricity											299.6339114	184.05	
1 Bed Var - EF	54.08	1	54.08	23.6	23.6	1627.12	Grid Electricity	438.43	Grid Electricity											248.4585742	148.45	
1 Bed Var - MF	54.08	1	54.08	20.7	20.7	1319.38	Grid Electricity	438.43	Grid Electricity											248.4585742	148.45	
1 Bed Var - TF	54.08	1	54.08	26.9	26.9	1965.27	Grid Electricity	438.43	Grid Electricity											248.4585742	148.45	
Sum	1,592	28	1,592	21.5	-	41,811	N/A	12,514	N/A	0	N/A	0	N/A	0	N/A	0	0	N/A	0	7,268	4,370	0

SAP 2012 CO_2 PERFORMANCE

REGULATED CO_2 EMISSIONS PER UNIT ($kgCO_2$ p.a.)

Unit identifier	Space Heating	Domestic Hot Water	Space Heating and DHW from CHP	Electricity generated by CHP	Electricity generated by renewable	Lighting	Auxiliary	Cooling		2012 CO_2 emissions ($kgCO_2$ p.a.)
			if applicable	if applicable	if applicable					
1 Bed End - GF	976	231				133	80			1,419
1 Bed End - TF	1,015	231				133	80			1,458
1 Bed Mid - GF	856	230				133	80			1,298
1 Bed Mid - MF	530	230				133	80			972
1 Bed Mid - EF	691	230				133	80			1,134
1 Bed Mid - TF	903	230				133	80			1,346
2 Bed - EF	894	248				156	96			1,393
2 Bed - MF	586	248				156	96			1,084
2 Bed - TF	1,055	248				156	96			1,554
1 Bed Var - EF	844	228				129	77			1,278
1 Bed Var - MF	685	228				129	77			1,118
1 Bed Var - TF	1,020	228				129	77			1,454
Sum	21,700	6,495	0	0	0	3,772	2,268	0	NA	34,234

SAP 10.0 CO_2 PERFORMANCE

REGULATED CO_2 EMISSIONS PER UNIT

Unit identifier	Space Heating	Domestic Hot Water	Space Heating and DHW from CHP	Electricity generated by CHP	Electricity generated by renewable	Lighting	Auxiliary	Cooling		SAP 10.0 CO_2 emissions ($kgCO_2$ p.a.)	Calculated DER SAP 10.0 ($kgCO_2 / m^2$)
			if applicable	if applicable	if applicable						
1 Bed End - GF	438	104				60	36			637	11.4
1 Bed End - TF	456	104				60	36			655	11.7
1 Bed Mid - GF	384	103				60	36			583	10.4
1 Bed Mid - MF	238	103				60	36			436	7.8
1 Bed Mid - EF	310	103				60	36			509	9.1
1 Bed Mid - TF	405	103				60	36			604	10.8
2 Bed - EF	401	111				70	43			625	9.3
2 Bed - MF	263	111				70	43			487	7.3
2 Bed - TF	474	111				70	43			698	10.4
1 Bed Var - EF	379	102				58	35			574	10.6
1 Bed Var - MF	307	102				58	35			502	9.3
1 Bed Var - TF	458	102				58	35			653	12.1
Sum	9,742	2,916	0	0	0	1,693	1,018	0	NA	15,369	9.7

NON-DOMESTIC ENERGY CONSUMPTION AND CO2 ANALYSIS

VALIDATION CHECK / REGULATED ENERGY CONSUMPTION BY END USE (kWh/m² p.a.) 'BE GREEN' BER - SOURCE: BRUKL OUTPUT

Use	Area per unit (m²)	Number of units	Total area represented by model (m²)	Calculated BER 2012 ($kgCO_2 / m^2$)	BRUKL BER 2012 ($kgCO_2 / m^2$)	Space Heating (kWh/m² p.a.)	Fuel type Space Heating	Domestic Hot Water (kWh/m² p.a.)	Fuel type Domestic Hot Water							Electricity generated by CHP (-)			Electricity generated by renewable technology (-)	Lighting (kWh/m² p.a.)	Auxiliary (kWh/m² p.a.)	Cooling (kWh/m² p.a.)
																if applicable			if applicable			
Residential	338.8	1	338.8	9.1	9.1	2.83	Grid Electricity	0	Grid Electricity	N/A	N/A	N/A	N/A	N/A	N/A		N/A	N/A		11.62	3.07	0
Sum	339	1	339	9.1	-	959	N/A	0	N/A							0			0	3,937	1,040	0

REGULATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m² p.a.) 'BE GREEN' BER - SOURCE: BRUKL.INP or *SIM.CSV FILE

Use	Natural Gas	Grid Electricity	Bespoke DH Factor	Electricity generated by CHP (-)	Electricity generated by renewable technology (-)	Enter Carbon Factor 1	Enter Carbon Factor 2	Enter Carbon Factor 3	Equipment	2012 CO_2 emissions ($kgCO_2$ p.a.)
				if applicable	if applicable					
	0.216 $kgCO_2$/kWh	0.519 $kgCO_2$/kWh	0.000 $kgCO_2$/kWh	0.519 $kgCO_2$/kWh	0.519 $kgCO_2$/kWh	0.000 $kgCO_2$/kWh	0.000 $kgCO_2$/kWh	0.000 $kgCO_2$/kWh	0.519 $kgCO_2$/kWh	
Residential		18								3,081
Sum	0	5,936	0	0	0	0	0	0	0	3,081

REGULATED CO_2 EMISSIONS PER UNIT

Use	Natural Gas	Grid Electricity	Bespoke DH Factor	Electricity generated by CHP (-)	Electricity generated by renewable technology (-)	Enter Carbon Factor 1	Enter Carbon Factor 2	Enter Carbon Factor 3	Equipment	SAP 10.0 CO_2 emissions	BRUKL BER SAP 10.0 ($kgCO_2 / m^2$)
				if applicable	if applicable						
	0.210 $kgCO_2$/kWh	0.233 $kgCO_2$/kWh	0.000 $kgCO_2$/kWh	0.233 $kgCO_2$/kWh	0.233 $kgCO_2$/kWh	0.000 $kgCO_2$/kWh	0.000 $kgCO_2$/kWh	0.000 $kgCO_2$/kWh	0.233 $kgCO_2$/kWh		
Residential		18								1,383	4.1
Sum	0	5,936	0	0	0	0	0	0	0	1,383	4.1

SITE-WIDE ENERGY CONSUMPTION AND CO2 ANALYSIS

REGULATED ENERGY CONSUMPTION

Use	Total Area (m²)	Calculated BER 2012 ($kgCO_2 / m^2$)	-	Space Heating (kWh p.a.)	N/A	Domestic Hot Water (kWh p.a.)	N/A	Space Heating (Heat source 2) (kWh p.a.)	N/A	Domestic Hot Water (Heat source 2) (kWh p.a.)	N/A	Space and Domestic Hot Water from CHP (kWh p.a.)	N/A	Electricity generated by CHP (kWh p.a.) if applicable	Secondary Heating system (kWh p.a.)	N/A	Electricity generated by renewable (kWh p.a.) if applicable	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)
Sum	1,931	19.3	-	42,770		12,514		0		0		0		0	0		0	11,205	5,410	0

Use	REGULATED CO_2 EMISSIONS: 2012 CO_2 emissions	N/A	REGULATED CO_2 EMISSIONS: SAP 10.0 CO_2 emissions	Calculated BER SAP 10.0 ($kgCO_2 / m^2$)
Sum	37,315		16,752	8.7

SAP 2012 Performance | SAP 10.0 Performance

Domestic

SAP 2012 Performance

Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for domestic buildings

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	32.0	29.8
After energy demand reduction (be lean)	26.3	29.8
After heat network connection (be clean)	34.2	29.8
After renewable energy (be green)	34.2	29.8

Table 2: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for domestic buildings

	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean: savings from energy demand reduction	5.6	18%
Be clean: savings from heat network	-7.9	-25%
Be green: savings from renewable energy	0.0	0%
Cumulative on site savings	**-2.3**	**-7%**
Annual savings from off-set payment	34.2	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**1,027**	-
Cash in-lieu contribution (£)	**97,568**	

*carbon price is based on GLA recommended price of £95 per tonne of carbon dioxide unless Local Planning Authority price is inputted in the 'Development Information' tab.

SAP 10.0 Performance

Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for domestic buildings

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	28.5	13.4
After energy demand reduction (be lean)	21.9	13.4
After heat network connection (be clean)	15.4	13.4
After renewable energy (be green)	15.4	13.4

Table 2: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for domestic buildings

	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean: Savings from energy demand reduction	6.6	23%
Be clean: Savings from heat network	6.5	23%
Be green: Savings from renewable energy	0.0	0%
Cumulative on site savings	**13.2**	**46%**
Annual savings from off-set payment	15.4	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**461**	-
Cash in-lieu contribution (£)	**43,802**	

*carbon price is based on GLA recommended price of £95 per tonne of carbon dioxide unless Local Planning Authority price is inputted in the 'Development Information' tab.

Non-domestic

SAP 2012 Performance

Table 3: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for non-domestic buildings

	Carbon Dioxide Emissions for non-domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	3.6	9.9
After energy demand reduction (be lean)	3.5	9.9
After heat network connection (be clean)	3.1	9.9
After renewable energy (be green)	3.1	9.9

Table 4: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for non-domestic buildings

	Regulated non-domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean: savings from energy demand reduction	0.1	3%
Be clean: savings from heat network	0.4	11%
Be green: savings from renewable energy	0.0	0%
Total Cumulative Savings	**0.5**	**14%**
Annual savings from off-set payment	3.1	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**92**	-
Cash in-lieu contribution (£)	**8,780**	

*carbon price is based on GLA recommended price of £95 per tonne of carbon dioxide unless Local Planning Authority price is inputted in the 'Development Information' tab.

SAP 10.0 Performance

Table 3: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for non-domestic buildings

	Carbon Dioxide Emissions for non-domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	1.6	4.5
After energy demand reduction (be lean)	1.6	4.5
After heat network connection (be clean)	1.4	4.5
After renewable energy (be green)	1.4	4.5

Table 4: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for non-domestic buildings

	Regulated non-domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean: savings from energy demand reduction	0.0	3%
Be clean: savings from heat network	0.2	11%
Be green: savings from renewable energy	0.0	0%
Total Cumulative Savings	**0.2**	**14%**
Annual savings from off-set payment	1.4	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**41**	-
Cash in-lieu contribution (£)*	**3,942**	

*carbon price is based on GLA recommended price of £95 per tonne of carbon dioxide unless Local Planning Authority price is inputted in the 'Development Information' tab.

SITE-WIDE

SAP 2012 Performance

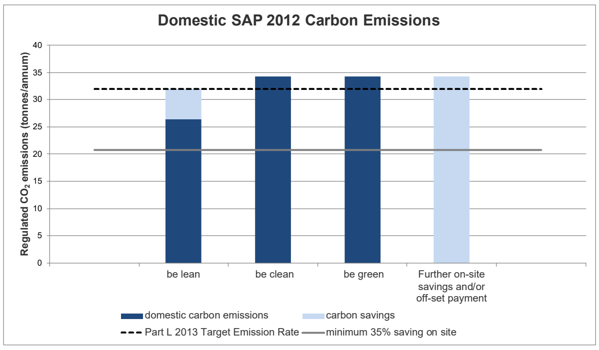
	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Part L 2013 baseline	35.5		
Be lean	29.8	5.7	16%
Be clean	37.3	-7.5	-21%
Be green	37.3	0.0	0%
Total Savings	-	-1.8	-5%
	-	**CO_2 savings off-set (Tonnes CO_2)**	-
Off-set	-	**1,119.4**	-

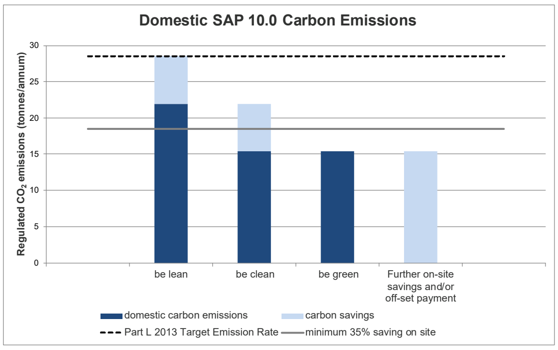
SAP 10.0 Performance

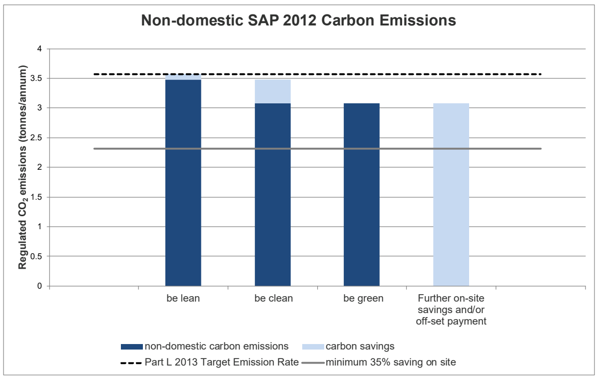
	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Part L 2013 baseline	30.1		
Be lean	23.4	6.7	22%
Be clean	16.8	6.7	22%
Be green	16.8	0.0	0%
Total Savings	-	13.4	44%
	-	**CO_2 savings off-set (Tonnes CO_2)**	-
Off-set	-	**502.6**	-

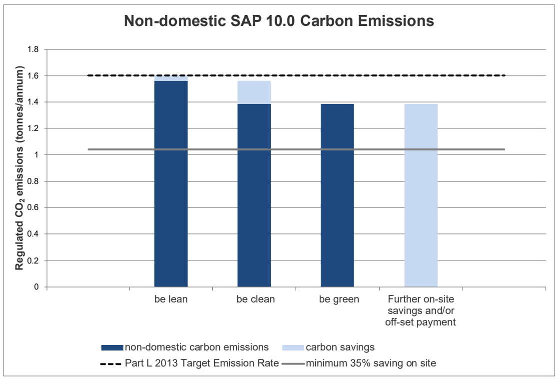
	Target Fabric Energy Efficiency (kWh/m²)	Dwelling Fabric Energy Efficiency (kWh/m²)	Improvement (%)
Development total	52.54	43.75	17%

	Area weighted non-domestic cooling demand (MJ/m²)	Total area weighted non-domestic cooling demand (MJ/year)
Actual		
Notional		









APPENDIX B - DOMESTIC OVERHEATING CHECKLIST

This checklist is intended to assist designers to identify potential overheating risk in residential accommodation early on in the design process and trigger the incorporation of passive measures within the building envelope and services design to mitigate overheating and reduce cooling demand in line with London Plan policy SI 4.

Section 1 - Site features affecting vulnerability to overheating		
Site location	Urban – within central London[32] or in a high density conurbation	No
	Peri-urban – on the suburban fringes of London[33]	Yes
Air quality and/or Noise sensitivity – are any of the following in the vicinity of buildings?	Busy roads / A roads	Yes
	Railways / Overground / DLR	Yes
	Airport / Flight path	Yes
	Industrial uses / waste facility	No
Proposed building use	Will any buildings be occupied by vulnerable people (e.g. elderly, disabled, young children)?	Yes
	Are residents likely to be at home during the day (e.g. students)?	Yes
Dwelling aspect	Are there any single aspect units?	No
Glazing ratio	Is the glazing ratio (glazing: internal floor area) greater than 25%?	Glazing = 543.6 m^2 Internal Floor Area = 2187 m^2 Glazing ratio = 24.8%
	If yes, is this to allow acceptable levels of daylighting?	N/A
Security - Are there any security issues that could limit opening of windows for ventilation?	Single storey ground floor units	Yes
	Vulnerable areas identified by the Police Architectural Liaison Officer	N/A
	Other	All flat entrances and windows to deck access will be PAS 24 or STS equivalent standard.

Section 2 - Design features implemented to mitigate overheating risk		Please respond
Landscaping	Will deciduous trees be provided for summer shading (to windows and pedestrian routes)?	Yes
	Will green roofs be provided?	Yes
	Will other green or blue infrastructure be provided around buildings for evaporative cooling?	Yes
Materials	Have high albedo (light colour) materials been specified?	Yes
Dwelling aspect	% of total units that are single aspect	0%
	% single aspect with N / NE / NW orientation	N/A
	% single aspect with E orientation	N/A
	% single aspect with S / SE / SW orientation	N/A
	% single aspect with W orientation	N/A
Glazing ratio - What is the glazing ratio (glazing; internal floor area) on each facade?	N / NE / NW	30.6m^2
	E	236.6m^2
	S / SE / SW	234.4m^2
	W	42m^2
Daylighting	What is the average daylight factor range?	Refer to Hydrock report
Window opening	Are windows openable?	Openable = 66% Not openable = 34%
Window opening	What is the average percentage of openable area for the windows?	As above
Window opening - What is the extent of the opening?	Fully openable	As above
	Limited (e.g. for security, safety, wind loading reasons)	As above
Security	Where there are security issues (e.g. ground floor flats) has an alternative night time natural ventilation method been provided (e.g. ventilation grates)?	MVHR to provide ventilation when windows closed

Appendix C – Hot Water Heat Pump Cylinder Details

Dimplex

Edel Hot Water Heat Pump

Product Description

The Edel range of heat pump cylinders comes in two sizes, 200L and 270L. The inner vessel is made from Stainless Steel with a Hot Water Heat Pump mounted on top. The heat pump can produce hot water very efficiently as it extracts heat from **external air supplied via insulated ductwork,** which is available as an accessory. Due to the high efficiencies, the cylinder reduces the Dwelling emissions in SAP making it possible to pass using electric space heating and the Edel cylinder.

Key Features

- The Edel heat pump consumes 5 times less electricity than standard electric water heaters
- Helps to pass Part L building of the regulations whilst specifying electric heating
- Compact unit with 630mm diameter with options of 200L or 270L storage
- Stainless steel tank with 5 year UK guarantee and no requirement for sacrificial anode
- Very quiet operation due to sound proof hood, variable speed fan and a high performance rotary compressor mounted on anti-vibration pads
- Patented high performance heat exchanger and defrost mode of operation in UK climates

Technical Details

Heat Pump Performance		***Edel 200 UK***	***Edel 270 UK***
Model Code		EDL200UK-630	EDL270UK-630
Nominal Volume	L	200	270
Air Operating Range	°C	-7 to +35	
Achievable Hot Water Temperature Via Heat Pump	°C	60	
Max. Electrical Power Input (Heat Pump AND Immersion)	W	700 + 1200 = 1900	
Max. Thermal Power Output From Heat Pump ONLY At 45°C	W	1300	
Max. Power Output From Heat Pump AND Immersion At 45°C	W	1300 + 1200 = 2500	
Air Flow	m^3/hr	320 to 400	
Sound Pressure Level At 2m	dB(A)	37 (Speed 1) / 40 (Speed 2)	
Refrigerant	/kg	R290/ 0.15	
Standing Heat Loss	kWh/24hr	1.61	1.77
Air Ducting Method		Separate inlet & outlet to exterior	
Heating Time From Cold (10°C)		7h15	9h48
Coefficient Of Performance		3.36	3.30
Dimensions and Connections			
Dimensions	mm	630 x H 1460	630 x H 1780
Weight With Packaging	kg	70	79
Weight Without Packaging	kg	56.5	63
Air Duct Diameter	mm	160	
Max. Ducting Pressure Drop		260Pa at minimum air flow rate of 320m^3/hr	
Water Connections	Inch	M 3/4"	
Condensate Tube	mm	18/24	
Electrical Supply		230V - 50Hz– 8A	
IP Rating		IPX4	
RCBO/MCB Type C	Amp	16	
Hot Water Cylinder			
Material		Stainless steel	
Insulation		45mm PU foam with PVC outer	
Refrigeration Heat Exchanger		Double walled separation from potable water	
Maximum Operating Pressure	bar	6	
Max. Condensate Production	L/h	0.3	
Integrated Electric Immersion	W	1200	
Max. Temperature with Immersion	°C	65	
Approvals			
Water Regulations		G3 KIWA approval to EN12897	
T&P Valve		Factory fitted	
Accessories		Inlet group, tundish expansion vessel	
Guarantee (UK)		5 years tank (2 years other parts)	

EDEL (Glen Dimplex Heating & Ventilation) Issue 1f Date 17/08/2020

Appendix D – SAP Calculations

Baseline

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: 1 Bed End - GF

Address : 1 Bed End - GF, London, TBC

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	55.94	(1a) x	2.5	(2a) =	139.85	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.94	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	139.85	(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) =	0.14	(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)	0.39	(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) =	0.33	(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

TER WorkSheet: New dwelling design stage

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

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.38	0.39

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=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

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

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(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			3.57	x	1.2	=	4.284			(26)
Windows Type 1			5.73	x1/[1/(1.4)+ 0.04]		=	7.6			(27)
Windows Type 2			2.96	x1/[1/(1.4)+ 0.04]		=	3.92			(27)
Windows Type 3			1.72	x1/[1/(1.4)+ 0.04]		=	2.28			(27)
Floor			55.94	x	0.13	=	7.2722			(28)
Walls	64.93	13.98	50.95	x	0.18	=	9.17			(29)
Total area of elements, m²			120.87							(31)
Party wall			19.92	x	0	=	0			(32)
Party ceiling			55.94							(32b)
Internal wall **			63.63							(32c)

** 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) = 34.53 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7558.07 (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 9.04 (36)

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

Total fabric heat loss (33) + (36) = 43.57 (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=	27.26	27.1	26.94	26.19	26.05	25.4	25.4	25.28	25.65	26.05	26.33	26.63	(38)

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

(39)m=	70.83	70.67	70.51	69.76	69.62	68.97	68.97	68.85	69.22	69.62	69.9	70.2	

Average = $Sum(39)_{1...12}$ /12= 69.76 (39)

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

(40)m=	1.27	1.26	1.26	1.25	1.24	1.23	1.23	1.23	1.24	1.24	1.25	1.25	

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 1.86 (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 78.49 (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=	86.34	83.2	80.06	76.92	73.78	70.64	70.64	73.78	76.92	80.06	83.2	86.34	

Total = $Sum(44)_{1...12}$ = 941.88 (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=	128.04	111.98	115.56	100.75	96.67	83.42	77.3	88.7	89.76	104.61	114.19	124	

Total = $Sum(45)_{1...12}$ = 1234.95 (45)

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

(46)m=	19.21	16.8	17.33	15.11	14.5	12.51	11.59	13.31	13.46	15.69	17.13	18.6	(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)

	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)

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

(61)m=	44	38.29	40.8	37.93	37.6	34.84	36	37.6	37.93	40.8	41.03	44	(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=	172.04	150.28	156.35	138.68	134.27	118.25	113.3	126.3	127.69	145.4	155.22	168	(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)

Output from water heater

(64)m=	172.04	150.28	156.35	138.68	134.27	118.25	113.3	126.3	127.69	145.4	155.22	168	

Output from water heater (annual) 1…12 | 1705.77 | (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=	53.57	46.81	48.62	42.98	41.54	36.45	34.7	38.89	39.33	44.98	48.22	52.23	(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=	93.24	93.24	93.24	93.24	93.24	93.24	93.24	93.24	93.24	93.24	93.24	93.24	(66)

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

(67)m=	14.5	12.88	10.47	7.93	5.93	5	5.41	7.03	9.43	11.97	13.98	14.9	(67)

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

(68)m=	162.6	164.29	160.04	150.99	139.56	128.82	121.65	119.96	124.21	133.26	144.69	155.43	(68)

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

(69)m=	32.32	32.32	32.32	32.32	32.32	32.32	32.32	32.32	32.32	32.32	32.32	32.32	(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=	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	(71)

Water heating gains (Table 5)

(72)m=	72.01	69.65	65.35	59.7	55.84	50.62	46.64	52.27	54.62	60.46	66.98	70.2	(72)

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

(73)m=	303.08	300.79	289.84	272.58	255.29	238.42	227.67	233.23	242.24	259.67	279.62	294.5	(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)	
Southeast	0.9x	0.77	x	2.96	x	36.79	x	0.63	x	0.7	=	33.28	(77)
Southeast	0.9x	0.77	x	2.96	x	62.67	x	0.63	x	0.7	=	56.7	(77)

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Southeast	0.9x	0.77	x	2.96	x	85.75	x	0.63	x	0.7	=	77.57	(77)
Southeast	0.9x	0.77	x	2.96	x	106.25	x	0.63	x	0.7	=	96.12	(77)
Southeast	0.9x	0.77	x	2.96	x	119.01	x	0.63	x	0.7	=	107.66	(77)
Southeast	0.9x	0.77	x	2.96	x	118.15	x	0.63	x	0.7	=	106.88	(77)
Southeast	0.9x	0.77	x	2.96	x	113.91	x	0.63	x	0.7	=	103.04	(77)
Southeast	0.9x	0.77	x	2.96	x	104.39	x	0.63	x	0.7	=	94.43	(77)
Southeast	0.9x	0.77	x	2.96	x	92.85	x	0.63	x	0.7	=	84	(77)
Southeast	0.9x	0.77	x	2.96	x	69.27	x	0.63	x	0.7	=	62.66	(77)
Southeast	0.9x	0.77	x	2.96	x	44.07	x	0.63	x	0.7	=	39.87	(77)
Southeast	0.9x	0.77	x	2.96	x	31.49	x	0.63	x	0.7	=	28.48	(77)
Southwest	0.9x	0.77	x	1.72	x	36.79		0.63	x	0.7	=	19.34	(79)
Southwest	0.9x	0.77	x	1.72	x	62.67		0.63	x	0.7	=	32.94	(79)
Southwest	0.9x	0.77	x	1.72	x	85.75		0.63	x	0.7	=	45.08	(79)
Southwest	0.9x	0.77	x	1.72	x	106.25		0.63	x	0.7	=	55.85	(79)
Southwest	0.9x	0.77	x	1.72	x	119.01		0.63	x	0.7	=	62.56	(79)
Southwest	0.9x	0.77	x	1.72	x	118.15		0.63	x	0.7	=	62.11	(79)
Southwest	0.9x	0.77	x	1.72	x	113.91		0.63	x	0.7	=	59.88	(79)
Southwest	0.9x	0.77	x	1.72	x	104.39		0.63	x	0.7	=	54.87	(79)
Southwest	0.9x	0.77	x	1.72	x	92.85		0.63	x	0.7	=	48.81	(79)
Southwest	0.9x	0.77	x	1.72	x	69.27		0.63	x	0.7	=	36.41	(79)
Southwest	0.9x	0.77	x	1.72	x	44.07		0.63	x	0.7	=	23.17	(79)
Southwest	0.9x	0.77	x	1.72	x	31.49		0.63	x	0.7	=	16.55	(79)
Northwest	0.9x	0.77	x	5.73	x	11.28	x	0.63	x	0.7	=	19.76	(81)
Northwest	0.9x	0.77	x	5.73	x	22.97	x	0.63	x	0.7	=	40.22	(81)
Northwest	0.9x	0.77	x	5.73	x	41.38	x	0.63	x	0.7	=	72.46	(81)
Northwest	0.9x	0.77	x	5.73	x	67.96	x	0.63	x	0.7	=	119	(81)
Northwest	0.9x	0.77	x	5.73	x	91.35	x	0.63	x	0.7	=	159.96	(81)
Northwest	0.9x	0.77	x	5.73	x	97.38	x	0.63	x	0.7	=	170.54	(81)
Northwest	0.9x	0.77	x	5.73	x	91.1	x	0.63	x	0.7	=	159.53	(81)
Northwest	0.9x	0.77	x	5.73	x	72.63	x	0.63	x	0.7	=	127.18	(81)
Northwest	0.9x	0.77	x	5.73	x	50.42	x	0.63	x	0.7	=	88.29	(81)
Northwest	0.9x	0.77	x	5.73	x	28.07	x	0.63	x	0.7	=	49.15	(81)
Northwest	0.9x	0.77	x	5.73	x	14.2	x	0.63	x	0.7	=	24.86	(81)
Northwest	0.9x	0.77	x	5.73	x	9.21	x	0.63	x	0.7	=	16.14	(81)

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

(83)m=	72.38	129.86	195.11	270.97	330.18	339.52	322.45	276.49	221.1	148.22	87.89	61.17	(83)

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

(84)m=	375.46	430.65	484.95	543.55	585.47	577.94	550.12	509.72	463.34	407.89	367.51	355.67	(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	0.99	0.98	0.95	0.86	0.7	0.54	0.6	0.84	0.97	0.99	1	(86)

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

(87)m=	19.67	19.83	20.1	20.46	20.77	20.94	20.99	20.98	20.85	20.46	20	19.64	(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	19.9	19.89	19.88	19.88	19.88	(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	0.6	0.41	0.47	0.76	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=	18.11	18.35	18.74	19.26	19.66	19.85	19.89	19.89	19.77	19.26	18.6	18.08	(90)

fLA = Living area ÷ (4) = 0.6 (91)

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

(92)m=	19.05	19.24	19.56	19.98	20.33	20.51	20.55	20.55	20.42	19.98	19.45	19.02	(92)

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

(93)m=	19.05	19.24	19.56	19.98	20.33	20.51	20.55	20.55	20.42	19.98	19.45	19.02	(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	0.84	0.66	0.49	0.54	0.8	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	373.41	426.05	473.18	508.14	489.18	381.17	267.53	277.15	371.41	390.1	363.68	354.14	(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=	1044.9	1013.63	921.02	773.13	600.6	407.51	272.48	285.37	437.77	653.3	862.97	1040.38	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	499.59	394.85	333.2	190.79	82.89	0	0	0	0	195.82	359.49	510.56	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2567.2 (98)

Space heating requirement in kWh/m²/year 45.89 (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		93.4	(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)													
	499.59	394.85	333.2	190.79	82.89	0	0	0	0	195.82	359.49	510.56	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	534.89	422.75	356.74	204.27	88.75	0	0	0	0	209.66	384.89	546.64	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2748.6 (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)

172.04	150.28	156.35	138.68	134.27	118.25	113.3	126.3	127.69	145.4	155.22	168

Efficiency of water heater 80.3 (216)

(217)m=	87.58	87.37	86.91	85.85	83.88	80.3	80.3	80.3	80.3	85.8	87.1	87.67	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	196.44	172	179.91	161.53	160.07	147.26	141.09	157.28	159.02	169.47	178.21	191.62

Total = Sum(219a)$_{1...12}$ = 2013.9 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2748.6	
Water heating fuel used			2013.9	
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			256.01	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			5093.51	(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	=	593.7	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	435	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1028.7	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	132.87	(268)
Total CO2, kg/year		sum of (265)…(271) =		1200.49	(272)

TER = 21.46 (273)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: 1 Bed End - TF

Address : 1 Bed End - TF, London, TBC

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	55.94	(1a) x	2.5	(2a) =	139.85	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.94	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	139.85	(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) =	0.14	(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)			0.39	(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) =	0.33	(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

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.38	0.39

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=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

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

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(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			3.57	x	1.2	=	4.284			(26)
Windows Type 1			5.73	x1/[1/(1.4)+ 0.04]		=	7.6			(27)
Windows Type 2			2.96	x1/[1/(1.4)+ 0.04]		=	3.92			(27)
Windows Type 3			1.72	x1/[1/(1.4)+ 0.04]		=	2.28			(27)
Walls	64.93	13.98	50.95	x	0.18	=	9.17			(29)
Roof	55.94	0	55.94	x	0.13	=	7.27			(30)
Total area of elements, m²			120.87							(31)
Party wall			19.92	x	0	=	0			(32)
Party floor			55.94							(32a)
Internal wall **			63.63							(32c)

** 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) = 34.53 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 4425.43 (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 19.75 (36)

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

Total fabric heat loss (33) + (36) = 54.27 (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=	27.26	27.1	26.94	26.19	26.05	25.4	25.4	25.28	25.65	26.05	26.33	26.63	(38)

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

(39)m=	81.54	81.37	81.21	80.46	80.32	79.67	79.67	79.55	79.92	80.32	80.61	80.9	

Average = $Sum(39)_{1...12}$ /12= 80.46 (39)

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

(40)m=	1.46	1.45	1.45	1.44	1.44	1.42	1.42	1.42	1.43	1.44	1.44	1.45	

Average = $Sum(40)_{1...12}$ /12= 1.44 (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 1.86 (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 78.49 (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=	86.34	83.2	80.06	76.92	73.78	70.64	70.64	73.78	76.92	80.06	83.2	86.34	

Total = $Sum(44)_{1...12}$ = 941.88 (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=	128.04	111.98	115.56	100.75	96.67	83.42	77.3	88.7	89.76	104.61	114.19	124	

Total = $Sum(45)_{1...12}$ = 1234.95 (45)

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

(46)m=	19.21	16.8	17.33	15.11	14.5	12.51	11.59	13.31	13.46	15.69	17.13	18.6	(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=	44	38.29	40.8	37.93	37.6	34.84	36	37.6	37.93	40.8	41.03	44	(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=	172.04	150.28	156.35	138.68	134.27	118.25	113.3	126.3	127.69	145.4	155.22	168	(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)

Output from water heater

(64)m=	172.04	150.28	156.35	138.68	134.27	118.25	113.3	126.3	127.69	145.4	155.22	168	

Output from water heater (annual)$_{1\ldots12}$ | 1705.77 | (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=	53.57	46.81	48.62	42.98	41.54	36.45	34.7	38.89	39.33	44.98	48.22	52.23	(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=	93.24	93.24	93.24	93.24	93.24	93.24	93.24	93.24	93.24	93.24	93.24	93.24	(66)

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

(67)m=	14.5	12.88	10.47	7.93	5.93	5	5.41	7.03	9.43	11.97	13.98	14.9	(67)

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

(68)m=	162.6	164.29	160.04	150.99	139.56	128.82	121.65	119.96	124.21	133.26	144.69	155.43	(68)

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

(69)m=	32.32	32.32	32.32	32.32	32.32	32.32	32.32	32.32	32.32	32.32	32.32	32.32	(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=	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	(71)

Water heating gains (Table 5)

(72)m=	72.01	69.65	65.35	59.7	55.84	50.62	46.64	52.27	54.62	60.46	66.98	70.2	(72)

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

(73)m=	303.08	300.79	289.84	272.58	255.29	238.42	227.67	233.23	242.24	259.67	279.62	294.5	(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)	
Southeast	0.9x	0.77	x	2.96	x	36.79	x	0.63	x	0.7	=	33.28	(77)
Southeast	0.9x	0.77	x	2.96	x	62.67	x	0.63	x	0.7	=	56.7	(77)

Southeast	0.9x	0.77	x	2.96	x	85.75	x	0.63	x	0.7	=	77.57	(77)
Southeast	0.9x	0.77	x	2.96	x	106.25	x	0.63	x	0.7	=	96.12	(77)
Southeast	0.9x	0.77	x	2.96	x	119.01	x	0.63	x	0.7	=	107.66	(77)
Southeast	0.9x	0.77	x	2.96	x	118.15	x	0.63	x	0.7	=	106.88	(77)
Southeast	0.9x	0.77	x	2.96	x	113.91	x	0.63	x	0.7	=	103.04	(77)
Southeast	0.9x	0.77	x	2.96	x	104.39	x	0.63	x	0.7	=	94.43	(77)
Southeast	0.9x	0.77	x	2.96	x	92.85	x	0.63	x	0.7	=	84	(77)
Southeast	0.9x	0.77	x	2.96	x	69.27	x	0.63	x	0.7	=	62.66	(77)
Southeast	0.9x	0.77	x	2.96	x	44.07	x	0.63	x	0.7	=	39.87	(77)
Southeast	0.9x	0.77	x	2.96	x	31.49	x	0.63	x	0.7	=	28.48	(77)
Southwest	0.9x	0.77	x	1.72	x	36.79		0.63	x	0.7	=	19.34	(79)
Southwest	0.9x	0.77	x	1.72	x	62.67		0.63	x	0.7	=	32.94	(79)
Southwest	0.9x	0.77	x	1.72	x	85.75		0.63	x	0.7	=	45.08	(79)
Southwest	0.9x	0.77	x	1.72	x	106.25		0.63	x	0.7	=	55.85	(79)
Southwest	0.9x	0.77	x	1.72	x	119.01		0.63	x	0.7	=	62.56	(79)
Southwest	0.9x	0.77	x	1.72	x	118.15		0.63	x	0.7	=	62.11	(79)
Southwest	0.9x	0.77	x	1.72	x	113.91		0.63	x	0.7	=	59.88	(79)
Southwest	0.9x	0.77	x	1.72	x	104.39		0.63	x	0.7	=	54.87	(79)
Southwest	0.9x	0.77	x	1.72	x	92.85		0.63	x	0.7	=	48.81	(79)
Southwest	0.9x	0.77	x	1.72	x	69.27		0.63	x	0.7	=	36.41	(79)
Southwest	0.9x	0.77	x	1.72	x	44.07		0.63	x	0.7	=	23.17	(79)
Southwest	0.9x	0.77	x	1.72	x	31.49		0.63	x	0.7	=	16.55	(79)
Northwest	0.9x	0.77	x	5.73	x	11.28	x	0.63	x	0.7	=	19.76	(81)
Northwest	0.9x	0.77	x	5.73	x	22.97	x	0.63	x	0.7	=	40.22	(81)
Northwest	0.9x	0.77	x	5.73	x	41.38	x	0.63	x	0.7	=	72.46	(81)
Northwest	0.9x	0.77	x	5.73	x	67.96	x	0.63	x	0.7	=	119	(81)
Northwest	0.9x	0.77	x	5.73	x	91.35	x	0.63	x	0.7	=	159.96	(81)
Northwest	0.9x	0.77	x	5.73	x	97.38	x	0.63	x	0.7	=	170.54	(81)
Northwest	0.9x	0.77	x	5.73	x	91.1	x	0.63	x	0.7	=	159.53	(81)
Northwest	0.9x	0.77	x	5.73	x	72.63	x	0.63	x	0.7	=	127.18	(81)
Northwest	0.9x	0.77	x	5.73	x	50.42	x	0.63	x	0.7	=	88.29	(81)
Northwest	0.9x	0.77	x	5.73	x	28.07	x	0.63	x	0.7	=	49.15	(81)
Northwest	0.9x	0.77	x	5.73	x	14.2	x	0.63	x	0.7	=	24.86	(81)
Northwest	0.9x	0.77	x	5.73	x	9.21	x	0.63	x	0.7	=	16.14	(81)

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

(83)m=	72.38	129.86	195.11	270.97	330.18	339.52	322.45	276.49	221.1	148.22	87.89	61.17	(83)

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

(84)m=	375.46	430.65	484.95	543.55	585.47	577.94	550.12	509.72	463.34	407.89	367.51	355.67	(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	0.99	0.99	0.96	0.89	0.76	0.6	0.66	0.87	0.97	0.99	1	(86)

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

(87)m=	19.43	19.6	19.89	20.28	20.64	20.88	20.97	20.95	20.76	20.3	19.8	19.4	(87)

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

(88)m=	19.72	19.72	19.72	19.73	19.74	19.74	19.74	19.75	19.74	19.74	19.73	19.73	(88)

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

(89)m=	1	0.99	0.98	0.94	0.85	0.65	0.45	0.51	0.8	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=	17.66	17.91	18.33	18.9	19.38	19.67	19.73	19.73	19.55	18.94	18.2	17.62	(90)

fLA = Living area ÷ (4) = 0.6 (91)

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

(92)m=	18.73	18.93	19.27	19.73	20.14	20.4	20.48	20.47	20.28	19.76	19.16	18.7	(92)

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

(93)m=	18.73	18.93	19.27	19.73	20.14	20.4	20.48	20.47	20.28	19.76	19.16	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=	0.99	0.99	0.98	0.94	0.86	0.71	0.54	0.6	0.83	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	373.29	426.08	474.04	513.04	505.23	410.34	296.69	304.65	386.57	392.13	363.7	354.02	(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=	1176.46	1141.35	1036.97	871.5	678.2	462.16	308.94	323.42	494.21	735.78	972.52	1172.74	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	597.56	480.67	418.82	258.09	128.69	0	0	0	0	255.68	438.35	609.13	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3187 (98)

Space heating requirement in kWh/m²/year 56.97 (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)													
	597.56	480.67	418.82	258.09	128.69	0	0	0	0	255.68	438.35	609.13	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	639.79	514.63	448.42	276.33	137.78	0	0	0	0	273.75	469.33	652.17	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 3412.2 (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)

	172.04	150.28	156.35	138.68	134.27	118.25	113.3	126.3	127.69	145.4	155.22	168		
Efficiency of water heater													80.3	(216)
(217)m=	87.93	87.77	87.41	86.59	84.94	80.3	80.3	80.3	80.3	86.46	87.52	88.01		(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	195.66	171.22	178.87	160.15	158.06	147.26	141.09	157.28	159.02	168.18	177.35	190.89		
Total = Sum(219a)$_{1...12}$ =													2005.03	(219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		3412.2	
Water heating fuel used		2005.03	
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		256.01	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		5748.24	(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	=	737.04	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	433.09	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1170.12	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	132.87	(268)
Total CO2, kg/year		sum of (265)…(271) =		1341.92	(272)

TER =	23.99	(273)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.5.41

Property Address: 1 Bed Mid - EF

Address : 1 Bed Mid - EF, London, TBC

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	55.83	(1a) x	2.5	(2a) =	139.58	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.83	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	139.58	(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) =	0.14	(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)	0.39	(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) =	0.33	(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

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.38	0.39

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=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

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

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(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			3.57	x	1.2	=	4.284			(26)
Windows Type 1			5.71	x1/[1/(1.4)+ 0.04]		=	7.57			(27)
Windows Type 2			2.95	x1/[1/(1.4)+ 0.04]		=	3.91			(27)
Windows Type 3			1.72	x1/[1/(1.4)+ 0.04]		=	2.28			(27)
Floor			13.85	x	0.13	=	1.8005			(28)
Walls	44.98	13.95	31.03	x	0.18	=	5.59			(29)
Total area of elements, m²			58.83							(31)
Party wall			39.86	x	0	=	0			(32)
Party floor			41.98							(32a)
Party ceiling			55.83							(32b)
Internal wall **			63.71							(32c)

** 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) = 25.43 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6197.86 (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 8.78 (36)

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

Total fabric heat loss (33) + (36) = 34.21 (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=	27.21	27.05	26.89	26.14	26	25.35	25.35	25.23	25.6	26	26.29	26.58	(38)

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

(39)m=	61.42	61.26	61.1	60.35	60.21	59.56	59.56	59.44	59.81	60.21	60.5	60.79	

Average = Sum(39)$_{1…12}$ /12= 60.35 (39)

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

(40)m=	1.1	1.1	1.09	1.08	1.08	1.07	1.07	1.06	1.07	1.08	1.08	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 1.86 (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 78.41 (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=	86.26	83.12	79.98	76.85	73.71	70.57	70.57	73.71	76.85	79.98	83.12	86.26	

Total = Sum(44)$_{1…12}$ = 940.97 (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=	127.91	111.87	115.44	100.65	96.57	83.34	77.22	88.61	89.67	104.5	114.07	123.88	

Total = Sum(45)$_{1…12}$ = 1233.75 (45)

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

(46)m=	19.19	16.78	17.32	15.1	14.49	12.5	11.58	13.29	13.45	15.68	17.11	18.58	(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)

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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=	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=	43.95	38.26	40.76	37.9	37.56	34.8	35.96	37.56	37.9	40.76	40.99	43.95	(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=	171.87	150.13	156.2	138.54	134.13	118.14	113.19	126.18	127.57	145.26	155.06	167.83	(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)

Output from water heater

(64)m=	171.87	150.13	156.2	138.54	134.13	118.14	113.19	126.18	127.57	145.26	155.06	167.83

Output from water heater (annual)$_{1...12}$ | 1704.11 | (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=	53.52	46.76	48.57	42.94	41.5	36.41	34.67	38.85	39.29	44.94	48.18	52.18	(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=	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	(66)

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

(67)m=	14.47	12.85	10.45	7.91	5.92	4.99	5.4	7.01	9.41	11.95	13.95	14.87	(67)

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

(68)m=	162.32	164.01	159.76	150.73	139.32	128.6	121.44	119.75	124	133.03	144.44	155.16	(68)

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

(69)m=	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	(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=	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	(71)

Water heating gains (Table 5)

(72)m=	71.94	69.59	65.29	59.64	55.78	50.57	46.6	52.22	54.57	60.4	66.91	70.13	(72)

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

(73)m=	302.65	300.37	289.43	272.2	254.94	238.09	227.35	232.91	241.9	259.31	279.23	294.09	(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)

Southeast	0.9x	0.77	x	2.95	x	36.79	x	0.63	x	0.7	=	33.17	(77)
Southeast	0.9x	0.77	x	2.95	x	62.67	x	0.63	x	0.7	=	56.5	(77)
Southeast	0.9x	0.77	x	2.95	x	85.75	x	0.63	x	0.7	=	77.31	(77)
Southeast	0.9x	0.77	x	2.95	x	106.25	x	0.63	x	0.7	=	95.79	(77)
Southeast	0.9x	0.77	x	2.95	x	119.01	x	0.63	x	0.7	=	107.3	(77)
Southeast	0.9x	0.77	x	2.95	x	118.15	x	0.63	x	0.7	=	106.52	(77)
Southeast	0.9x	0.77	x	2.95	x	113.91	x	0.63	x	0.7	=	102.7	(77)
Southeast	0.9x	0.77	x	2.95	x	104.39	x	0.63	x	0.7	=	94.11	(77)
Southeast	0.9x	0.77	x	2.95	x	92.85	x	0.63	x	0.7	=	83.71	(77)
Southeast	0.9x	0.77	x	2.95	x	69.27	x	0.63	x	0.7	=	62.45	(77)
Southeast	0.9x	0.77	x	2.95	x	44.07	x	0.63	x	0.7	=	39.73	(77)
Southeast	0.9x	0.77	x	2.95	x	31.49	x	0.63	x	0.7	=	28.39	(77)
Southwest	0.9x	0.77	x	1.72	x	36.79		0.63	x	0.7	=	19.34	(79)
Southwest	0.9x	0.77	x	1.72	x	62.67		0.63	x	0.7	=	32.94	(79)
Southwest	0.9x	0.77	x	1.72	x	85.75		0.63	x	0.7	=	45.08	(79)
Southwest	0.9x	0.77	x	1.72	x	106.25		0.63	x	0.7	=	55.85	(79)
Southwest	0.9x	0.77	x	1.72	x	119.01		0.63	x	0.7	=	62.56	(79)
Southwest	0.9x	0.77	x	1.72	x	118.15		0.63	x	0.7	=	62.11	(79)
Southwest	0.9x	0.77	x	1.72	x	113.91		0.63	x	0.7	=	59.88	(79)
Southwest	0.9x	0.77	x	1.72	x	104.39		0.63	x	0.7	=	54.87	(79)
Southwest	0.9x	0.77	x	1.72	x	92.85		0.63	x	0.7	=	48.81	(79)
Southwest	0.9x	0.77	x	1.72	x	69.27		0.63	x	0.7	=	36.41	(79)
Southwest	0.9x	0.77	x	1.72	x	44.07		0.63	x	0.7	=	23.17	(79)
Southwest	0.9x	0.77	x	1.72	x	31.49		0.63	x	0.7	=	16.55	(79)
Northwest	0.9x	0.77	x	5.71	x	11.28	x	0.63	x	0.7	=	19.69	(81)
Northwest	0.9x	0.77	x	5.71	x	22.97	x	0.63	x	0.7	=	40.08	(81)
Northwest	0.9x	0.77	x	5.71	x	41.38	x	0.63	x	0.7	=	72.21	(81)
Northwest	0.9x	0.77	x	5.71	x	67.96	x	0.63	x	0.7	=	118.59	(81)
Northwest	0.9x	0.77	x	5.71	x	91.35	x	0.63	x	0.7	=	159.4	(81)
Northwest	0.9x	0.77	x	5.71	x	97.38	x	0.63	x	0.7	=	169.94	(81)
Northwest	0.9x	0.77	x	5.71	x	91.1	x	0.63	x	0.7	=	158.98	(81)
Northwest	0.9x	0.77	x	5.71	x	72.63	x	0.63	x	0.7	=	126.74	(81)
Northwest	0.9x	0.77	x	5.71	x	50.42	x	0.63	x	0.7	=	87.99	(81)
Northwest	0.9x	0.77	x	5.71	x	28.07	x	0.63	x	0.7	=	48.98	(81)
Northwest	0.9x	0.77	x	5.71	x	14.2	x	0.63	x	0.7	=	24.77	(81)
Northwest	0.9x	0.77	x	5.71	x	9.21	x	0.63	x	0.7	=	16.08	(81)

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

(83)m=	72.2	129.53	194.6	270.23	329.26	338.57	321.55	275.72	220.51	147.84	87.67	61.02	(83)

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

(84)m=	374.85	429.9	484.02	542.43	584.2	576.65	548.9	508.64	462.41	407.15	366.9	355.11	(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	0.82	0.63	0.47	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=	19.89	20.05	20.3	20.62	20.86	20.97	21	20.99	20.92	20.6	20.19	19.87	(87)

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

(88)m=	20	20	20.01	20.02	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	0.99	0.97	0.92	0.77	0.55	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=	18.53	18.76	19.12	19.58	19.89	20.01	20.03	20.03	19.96	19.56	18.97	18.5	(90)

fLA = Living area ÷ (4) = 0.6 (91)

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

(92)m=	19.35	19.54	19.83	20.21	20.48	20.59	20.61	20.61	20.54	20.19	19.71	19.32	(92)

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

(93)m=	19.35	19.54	19.83	20.21	20.48	20.59	20.61	20.61	20.54	20.19	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	0.99	0.97	0.92	0.8	0.6	0.43	0.49	0.76	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	372.82	425.02	470.6	499.13	465.15	345.88	237.31	247.3	349.67	385.89	362.84	353.63	(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=	924.57	896.73	814.73	682.53	528.58	356.9	238.91	250.19	385.19	577.35	762.6	919.32	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	410.5	316.99	256.03	132.05	47.2	0	0	0	0	142.45	287.83	420.88	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2013.91 (98)

Space heating requirement in kWh/m²/year 36.07 (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		93.4	(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)													
	410.5	316.99	256.03	132.05	47.2	0	0	0	0	142.45	287.83	420.88	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	439.5	339.39	274.12	141.38	50.53	0	0	0	0	152.51	308.17	450.62	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2156.22 (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)

171.87	150.13	156.2	138.54	134.13	118.14	113.19	126.18	127.57	145.26	155.06	167.83

Efficiency of water heater 80.3 (216)

(217)m=	87.16	86.89	86.29	84.93	82.71	80.3	80.3	80.3	80.3	85	86.59	87.27	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	197.18	172.79	181.03	163.13	162.18	147.12	140.95	157.13	158.87	170.89	179.09	192.31

Total = Sum(219a)$_{1...12}$ = 2022.66 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2156.22	
Water heating fuel used		2022.66	
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		255.56	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		4509.45	(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	=	465.74	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	436.9	(264)
Space and water heating	(261) + (262) + (263) + (264) =			902.64	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	132.64	(268)
Total CO2, kg/year		sum of (265)…(271) =		1074.2	(272)

TER = 19.24 (273)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.41

Property Address: 1 Bed Mid - GF

Address : 1 Bed Mid - GF, London, TBC

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	55.83	(1a) x	2.5	(2a) =	139.58	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.83	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	139.58	(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) =	0.14	(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)	0.39	(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) =	0.33	(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

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.38	0.39

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=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

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

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(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			3.57	x	1.2	=	4.284			(26)
Windows Type 1			5.71	x1/[1/(1.4)+ 0.04]		=	7.57			(27)
Windows Type 2			2.95	x1/[1/(1.4)+ 0.04]		=	3.91			(27)
Windows Type 3			1.72	x1/[1/(1.4)+ 0.04]		=	2.28			(27)
Floor			55.83	x	0.13	=	7.2579			(28)
Walls	44.98	13.95	31.03	x	0.18	=	5.59			(29)
Total area of elements, m²			100.81							(31)
Party wall			39.86	x	0	=	0			(32)
Party ceiling			55.83							(32b)
Internal wall **			63.71							(32c)

** 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) = 30.89 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7667.16 (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 7.69 (36)

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

Total fabric heat loss (33) + (36) = 38.58 (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=	27.21	27.05	26.89	26.14	26	25.35	25.35	25.23	25.6	26	26.29	26.58	(38)

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

(39)m=	65.79	65.63	65.47	64.72	64.58	63.93	63.93	63.81	64.18	64.58	64.87	65.16	

Average = Sum(39)$_{1...12}$ /12= 64.72 (39)

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

(40)m=	1.18	1.18	1.17	1.16	1.16	1.15	1.15	1.14	1.15	1.16	1.16	1.17	

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 1.86 (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 78.41 (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=	86.26	83.12	79.98	76.85	73.71	70.57	70.57	73.71	76.85	79.98	83.12	86.26	

Total = Sum(44)$_{1...12}$ = 940.97 (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=	127.91	111.87	115.44	100.65	96.57	83.34	77.22	88.61	89.67	104.5	114.07	123.88	

Total = Sum(45)$_{1...12}$ = 1233.75 (45)

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

(46)m=	19.19	16.78	17.32	15.1	14.49	12.5	11.58	13.29	13.45	15.68	17.11	18.58	(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=	43.95	38.26	40.76	37.9	37.56	34.8	35.96	37.56	37.9	40.76	40.99	43.95	(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=	171.87	150.13	156.2	138.54	134.13	118.14	113.19	126.18	127.57	145.26	155.06	167.83	(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)

Output from water heater

(64)m=	171.87	150.13	156.2	138.54	134.13	118.14	113.19	126.18	127.57	145.26	155.06	167.83	

Output from water heater (annual)$_{1...12}$ | 1704.11 | (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=	53.52	46.76	48.57	42.94	41.5	36.41	34.67	38.85	39.29	44.94	48.18	52.18	(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=	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	(66)

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

(67)m=	14.47	12.85	10.45	7.91	5.92	4.99	5.4	7.01	9.41	11.95	13.95	14.87	(67)

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

(68)m=	162.32	164.01	159.76	150.73	139.32	128.6	121.44	119.75	124	133.03	144.44	155.16	(68)

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

(69)m=	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	(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=	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	(71)

Water heating gains (Table 5)

(72)m=	71.94	69.59	65.29	59.64	55.78	50.57	46.6	52.22	54.57	60.4	66.91	70.13	(72)

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

(73)m=	302.65	300.37	289.43	272.2	254.94	238.09	227.35	232.91	241.9	259.31	279.23	294.09	(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)	
Southeast 0.9x	0.77	x	2.95	x	36.79	x	0.63	x	0.7	=	33.17	(77)
Southeast 0.9x	0.77	x	2.95	x	62.67	x	0.63	x	0.7	=	56.5	(77)

Southeast	0.9x	0.77	x	2.95	x	85.75	x	0.63	x	0.7	=	77.31	(77)
Southeast	0.9x	0.77	x	2.95	x	106.25	x	0.63	x	0.7	=	95.79	(77)
Southeast	0.9x	0.77	x	2.95	x	119.01	x	0.63	x	0.7	=	107.3	(77)
Southeast	0.9x	0.77	x	2.95	x	118.15	x	0.63	x	0.7	=	106.52	(77)
Southeast	0.9x	0.77	x	2.95	x	113.91	x	0.63	x	0.7	=	102.7	(77)
Southeast	0.9x	0.77	x	2.95	x	104.39	x	0.63	x	0.7	=	94.11	(77)
Southeast	0.9x	0.77	x	2.95	x	92.85	x	0.63	x	0.7	=	83.71	(77)
Southeast	0.9x	0.77	x	2.95	x	69.27	x	0.63	x	0.7	=	62.45	(77)
Southeast	0.9x	0.77	x	2.95	x	44.07	x	0.63	x	0.7	=	39.73	(77)
Southeast	0.9x	0.77	x	2.95	x	31.49	x	0.63	x	0.7	=	28.39	(77)
Southwest	0.9x	0.77	x	1.72	x	36.79		0.63	x	0.7	=	19.34	(79)
Southwest	0.9x	0.77	x	1.72	x	62.67		0.63	x	0.7	=	32.94	(79)
Southwest	0.9x	0.77	x	1.72	x	85.75		0.63	x	0.7	=	45.08	(79)
Southwest	0.9x	0.77	x	1.72	x	106.25		0.63	x	0.7	=	55.85	(79)
Southwest	0.9x	0.77	x	1.72	x	119.01		0.63	x	0.7	=	62.56	(79)
Southwest	0.9x	0.77	x	1.72	x	118.15		0.63	x	0.7	=	62.11	(79)
Southwest	0.9x	0.77	x	1.72	x	113.91		0.63	x	0.7	=	59.88	(79)
Southwest	0.9x	0.77	x	1.72	x	104.39		0.63	x	0.7	=	54.87	(79)
Southwest	0.9x	0.77	x	1.72	x	92.85		0.63	x	0.7	=	48.81	(79)
Southwest	0.9x	0.77	x	1.72	x	69.27		0.63	x	0.7	=	36.41	(79)
Southwest	0.9x	0.77	x	1.72	x	44.07		0.63	x	0.7	=	23.17	(79)
Southwest	0.9x	0.77	x	1.72	x	31.49		0.63	x	0.7	=	16.55	(79)
Northwest	0.9x	0.77	x	5.71	x	11.28	x	0.63	x	0.7	=	19.69	(81)
Northwest	0.9x	0.77	x	5.71	x	22.97	x	0.63	x	0.7	=	40.08	(81)
Northwest	0.9x	0.77	x	5.71	x	41.38	x	0.63	x	0.7	=	72.21	(81)
Northwest	0.9x	0.77	x	5.71	x	67.96	x	0.63	x	0.7	=	118.59	(81)
Northwest	0.9x	0.77	x	5.71	x	91.35	x	0.63	x	0.7	=	159.4	(81)
Northwest	0.9x	0.77	x	5.71	x	97.38	x	0.63	x	0.7	=	169.94	(81)
Northwest	0.9x	0.77	x	5.71	x	91.1	x	0.63	x	0.7	=	158.98	(81)
Northwest	0.9x	0.77	x	5.71	x	72.63	x	0.63	x	0.7	=	126.74	(81)
Northwest	0.9x	0.77	x	5.71	x	50.42	x	0.63	x	0.7	=	87.99	(81)
Northwest	0.9x	0.77	x	5.71	x	28.07	x	0.63	x	0.7	=	48.98	(81)
Northwest	0.9x	0.77	x	5.71	x	14.2	x	0.63	x	0.7	=	24.77	(81)
Northwest	0.9x	0.77	x	5.71	x	9.21	x	0.63	x	0.7	=	16.08	(81)

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

(83)m=	72.2	129.53	194.6	270.23	329.26	338.57	321.55	275.72	220.51	147.84	87.67	61.02	(83)

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

(84)m=	374.85	429.9	484.02	542.43	584.2	576.65	548.9	508.64	462.41	407.15	366.9	355.11	(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	0.84	0.67	0.5	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=	19.79	19.95	20.21	20.55	20.82	20.96	20.99	20.99	20.89	20.53	20.1	19.76	(87)

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

(88)m=	19.94	19.94	19.94	19.95	19.95	19.96	19.96	19.97	19.96	19.95	19.95	19.95	(88)

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

(89)m=	1	0.99	0.98	0.93	0.79	0.58	0.39	0.44	0.74	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=	18.33	18.56	18.94	19.43	19.78	19.94	19.96	19.96	19.87	19.42	18.79	18.3	(90)

fLA = Living area ÷ (4) = 0.6 (91)

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

(92)m=	19.21	19.4	19.7	20.1	20.41	20.55	20.58	20.58	20.49	20.09	19.58	19.18	(92)

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

(93)m=	19.21	19.4	19.7	20.1	20.41	20.55	20.58	20.58	20.49	20.09	19.58	19.18	(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	0.93	0.82	0.63	0.46	0.51	0.78	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	372.83	425.2	471.55	503.51	477.4	363.33	251.79	261.74	360.74	387.83	362.99	353.62	(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=	980.91	951.48	864.53	725.04	562.44	380.68	254.66	266.71	409.93	612.98	809.63	976.02	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	452.42	353.66	292.38	159.5	63.27	0	0	0	0	167.51	321.58	463.07	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2273.38 (98)

Space heating requirement in kWh/m²/year 40.72 (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)													
	452.42	353.66	292.38	159.5	63.27	0	0	0	0	167.51	321.58	463.07	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	484.39	378.65	313.04	170.77	67.74	0	0	0	0	179.35	344.31	495.79	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2434.02 (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)

	171.87	150.13	156.2	138.54	134.13	118.14	113.19	126.18	127.57	145.26	155.06	167.83		
Efficiency of water heater													80.3	(216)
(217)m=	87.37	87.13	86.61	85.41	83.28	80.3	80.3	80.3	80.3	85.41	86.85	87.47		(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	196.7	172.3	180.36	162.22	161.06	147.12	140.95	157.13	158.87	170.08	178.55	191.87		
								Total = Sum(219a)$_{1...12}$ =					2017.2	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2434.02	
Water heating fuel used			2017.2	
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			255.56	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			4781.79	(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	=	525.75	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	435.72	(264)
Space and water heating	(261) + (262) + (263) + (264) =			961.46	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	132.64	(268)
Total CO2, kg/year		sum of (265)…(271) =		1133.03	(272)

TER =	20.29	(273)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: 1 Bed Mid - MF

Address : 1 Bed Mid - MF, London, TBC

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	55.83	(1a) x	2.5	(2a) =	139.58	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.83	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	139.58	(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) =	0.14	(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)	0.39	(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) =	0.33	(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

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.38	0.39

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=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

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

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(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			3.57	x	1.2	=	4.284			(26)
Windows Type 1			5.71	x1/[1/(1.4)+ 0.04]		=	7.57			(27)
Windows Type 2			2.95	x1/[1/(1.4)+ 0.04]		=	3.91			(27)
Windows Type 3			1.72	x1/[1/(1.4)+ 0.04]		=	2.28			(27)
Walls	44.98	13.95	31.03	x	0.18	=	5.59			(29)
Total area of elements, m²			44.98							(31)
Party wall			39.86	x	0	=	0			(32)
Party floor			55.83							(32a)
Party ceiling			55.83							(32b)
Internal wall **			63.71							(32c)

** 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) = 23.63 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5713.11 (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 4.8 (36)

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

Total fabric heat loss (33) + (36) = 28.43 (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=	27.21	27.05	26.89	26.14	26	25.35	25.35	25.23	25.6	26	26.29	26.58	(38)

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

(39)m=	55.64	55.48	55.32	54.57	54.43	53.78	53.78	53.66	54.03	54.43	54.71	55.01	

Average = Sum(39)$_{1\ldots12}$ /12= 54.57 (39)

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

(40)m=	1	0.99	0.99	0.98	0.97	0.96	0.96	0.96	0.97	0.97	0.98	0.99	

Average = Sum(40)$_{1\ldots12}$ /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 1.86 (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 78.41 (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=	86.26	83.12	79.98	76.85	73.71	70.57	70.57	73.71	76.85	79.98	83.12	86.26

Total = Sum(44)$_{1\ldots12}$ = 940.97 (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=	127.91	111.87	115.44	100.65	96.57	83.34	77.22	88.61	89.67	104.5	114.07	123.88

Total = Sum(45)$_{1\ldots12}$ = 1233.75 (45)

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

(46)m=	19.19	16.78	17.32	15.1	14.49	12.5	11.58	13.29	13.45	15.68	17.11	18.58	(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=	43.95	38.26	40.76	37.9	37.56	34.8	35.96	37.56	37.9	40.76	40.99	43.95	(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=	171.87	150.13	156.2	138.54	134.13	118.14	113.19	126.18	127.57	145.26	155.06	167.83	(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)

Output from water heater

(64)m=	171.87	150.13	156.2	138.54	134.13	118.14	113.19	126.18	127.57	145.26	155.06	167.83

Output from water heater (annual)$_{1...12}$ | 1704.11 | (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=	53.52	46.76	48.57	42.94	41.5	36.41	34.67	38.85	39.29	44.94	48.18	52.18	(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=	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	(66)

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

(67)m=	14.47	12.85	10.45	7.91	5.92	4.99	5.4	7.01	9.41	11.95	13.95	14.87	(67)

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

(68)m=	162.32	164.01	159.76	150.73	139.32	128.6	121.44	119.75	124	133.03	144.44	155.16	(68)

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

(69)m=	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	(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=	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	(71)

Water heating gains (Table 5)

(72)m=	71.94	69.59	65.29	59.64	55.78	50.57	46.6	52.22	54.57	60.4	66.91	70.13	(72)

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

(73)m=	302.65	300.37	289.43	272.2	254.94	238.09	227.35	232.91	241.9	259.31	279.23	294.09	(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)	
Southeast	0.9x	0.77	x	2.95	x	36.79	x	0.63	x	0.7	=	33.17	(77)
Southeast	0.9x	0.77	x	2.95	x	62.67	x	0.63	x	0.7	=	56.5	(77)

Southeast	0.9x	0.77	x	2.95	x	85.75	x	0.63	x	0.7	=	77.31	(77)
Southeast	0.9x	0.77	x	2.95	x	106.25	x	0.63	x	0.7	=	95.79	(77)
Southeast	0.9x	0.77	x	2.95	x	119.01	x	0.63	x	0.7	=	107.3	(77)
Southeast	0.9x	0.77	x	2.95	x	118.15	x	0.63	x	0.7	=	106.52	(77)
Southeast	0.9x	0.77	x	2.95	x	113.91	x	0.63	x	0.7	=	102.7	(77)
Southeast	0.9x	0.77	x	2.95	x	104.39	x	0.63	x	0.7	=	94.11	(77)
Southeast	0.9x	0.77	x	2.95	x	92.85	x	0.63	x	0.7	=	83.71	(77)
Southeast	0.9x	0.77	x	2.95	x	69.27	x	0.63	x	0.7	=	62.45	(77)
Southeast	0.9x	0.77	x	2.95	x	44.07	x	0.63	x	0.7	=	39.73	(77)
Southeast	0.9x	0.77	x	2.95	x	31.49	x	0.63	x	0.7	=	28.39	(77)
Southwest	0.9x	0.77	x	1.72	x	36.79		0.63	x	0.7	=	19.34	(79)
Southwest	0.9x	0.77	x	1.72	x	62.67		0.63	x	0.7	=	32.94	(79)
Southwest	0.9x	0.77	x	1.72	x	85.75		0.63	x	0.7	=	45.08	(79)
Southwest	0.9x	0.77	x	1.72	x	106.25		0.63	x	0.7	=	55.85	(79)
Southwest	0.9x	0.77	x	1.72	x	119.01		0.63	x	0.7	=	62.56	(79)
Southwest	0.9x	0.77	x	1.72	x	118.15		0.63	x	0.7	=	62.11	(79)
Southwest	0.9x	0.77	x	1.72	x	113.91		0.63	x	0.7	=	59.88	(79)
Southwest	0.9x	0.77	x	1.72	x	104.39		0.63	x	0.7	=	54.87	(79)
Southwest	0.9x	0.77	x	1.72	x	92.85		0.63	x	0.7	=	48.81	(79)
Southwest	0.9x	0.77	x	1.72	x	69.27		0.63	x	0.7	=	36.41	(79)
Southwest	0.9x	0.77	x	1.72	x	44.07		0.63	x	0.7	=	23.17	(79)
Southwest	0.9x	0.77	x	1.72	x	31.49		0.63	x	0.7	=	16.55	(79)
Northwest	0.9x	0.77	x	5.71	x	11.28	x	0.63	x	0.7	=	19.69	(81)
Northwest	0.9x	0.77	x	5.71	x	22.97	x	0.63	x	0.7	=	40.08	(81)
Northwest	0.9x	0.77	x	5.71	x	41.38	x	0.63	x	0.7	=	72.21	(81)
Northwest	0.9x	0.77	x	5.71	x	67.96	x	0.63	x	0.7	=	118.59	(81)
Northwest	0.9x	0.77	x	5.71	x	91.35	x	0.63	x	0.7	=	159.4	(81)
Northwest	0.9x	0.77	x	5.71	x	97.38	x	0.63	x	0.7	=	169.94	(81)
Northwest	0.9x	0.77	x	5.71	x	91.1	x	0.63	x	0.7	=	158.98	(81)
Northwest	0.9x	0.77	x	5.71	x	72.63	x	0.63	x	0.7	=	126.74	(81)
Northwest	0.9x	0.77	x	5.71	x	50.42	x	0.63	x	0.7	=	87.99	(81)
Northwest	0.9x	0.77	x	5.71	x	28.07	x	0.63	x	0.7	=	48.98	(81)
Northwest	0.9x	0.77	x	5.71	x	14.2	x	0.63	x	0.7	=	24.77	(81)
Northwest	0.9x	0.77	x	5.71	x	9.21	x	0.63	x	0.7	=	16.08	(81)

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

(83)m=	72.2	129.53	194.6	270.23	329.26	338.57	321.55	275.72	220.51	147.84	87.67	61.02	(83)

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

(84)m=	374.85	429.9	484.02	542.43	584.2	576.65	548.9	508.64	462.41	407.15	366.9	355.11	(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	0.99	0.98	0.92	0.78	0.58	0.43	0.48	0.75	0.95	0.99	1	(86)

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

(87)m=	20.04	20.19	20.43	20.72	20.92	20.99	21	21	20.95	20.69	20.31	20.01	(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	20.12	20.11	20.1	20.1	20.1	(88)

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

(89)m=	1	0.99	0.97	0.9	0.73	0.51	0.34	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=	18.81	19.03	19.37	19.79	20.03	20.11	20.11	20.11	20.08	19.75	19.21	18.77	(90)

fLA = Living area ÷ (4) = | 0.6 | (91)

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

(92)m=	19.55	19.73	20.01	20.35	20.56	20.64	20.65	20.65	20.6	20.32	19.88	19.52	(92)

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

(93)m=	19.55	19.73	20.01	20.35	20.56	20.64	20.65	20.65	20.6	20.32	19.88	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=	0.99	0.99	0.97	0.9	0.76	0.55	0.4	0.45	0.72	0.94	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	372.77	424.62	468.67	490.7	443.91	319.57	217.05	226.7	331.03	382.04	362.49	353.61	(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=	848.5	822.8	747.4	624.84	482.49	324.73	217.67	227.88	351.46	529.03	699.05	842.79	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	353.94	267.58	207.37	96.59	28.71	0	0	0	0	109.36	242.33	363.95	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 1669.82 | (98)

Space heating requirement in kWh/m²/year | 29.91 | (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)													
	353.94	267.58	207.37	96.59	28.71	0	0	0	0	109.36	242.33	363.95	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	378.95	286.49	222.03	103.41	30.74	0	0	0	0	117.09	259.45	389.67	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= | 1787.82 | (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)

171.87	150.13	156.2	138.54	134.13	118.14	113.19	126.18	127.57	145.26	155.06	167.83

Efficiency of water heater 80.3 (216)

(217)m=	86.83	86.49	85.77	84.16	81.91	80.3	80.3	80.3	80.3	84.35	86.17	86.95

(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	197.94	173.58	182.13	164.61	163.75	147.12	140.95	157.13	158.87	172.22	179.95	193.03

Total = Sum(219a)$_{1...12}$ = 2031.28 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		1787.82	
Water heating fuel used		2031.28	
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		255.56	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		4149.66	(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	=	386.17	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	438.76	(264)
Space and water heating	(261) + (262) + (263) + (264) =				824.92	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	132.64	(268)
Total CO2, kg/year			sum of (265)…(271) =		996.49	(272)

TER = 17.85 (273)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: 1 Bed Mid - TF

Address : 1 Bed Mid - TF, London, TBC

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	55.83	(1a) x	2.5	(2a) =	139.58	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.83	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	139.58	(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) =	0.14	(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)	0.39	(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) =	0.33	(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

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.38	0.39

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=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

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

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(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			3.57	x	1.2	=	4.284			(26)
Windows Type 1			5.71	x1/[1/(1.4)+ 0.04]		=	7.57			(27)
Windows Type 2			2.95	x1/[1/(1.4)+ 0.04]		=	3.91			(27)
Windows Type 3			1.72	x1/[1/(1.4)+ 0.04]		=	2.28			(27)
Walls	44.98	13.95	31.03	x	0.18	=	5.59			(29)
Roof	55.83	0	55.83	x	0.13	=	7.26			(30)
Total area of elements, m²			100.81							(31)
Party wall			39.86	x	0	=	0			(32)
Party floor			55.83							(32a)
Internal wall **			63.71							(32c)

** 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) =	30.89	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	4540.68	(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		15.52	(36)
if details of thermal bridging are not known (36) = 0.05 x (31)			
Total fabric heat loss	(33) + (36) =	46.41	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.21	27.05	26.89	26.14	26	25.35	25.35	25.23	25.6	26	26.29	26.58	(38)

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

(39)m=	73.63	73.46	73.31	72.56	72.42	71.77	71.77	71.65	72.02	72.42	72.7	73	

Average = Sum(39)$_{1...12}$ /12= 72.56 (39)

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

(40)m=	1.32	1.32	1.31	1.3	1.3	1.29	1.29	1.28	1.29	1.3	1.3	1.31	

Average = Sum(40)$_{1...12}$ /12= 1.3 (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 1.86 (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 78.41 (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=	86.26	83.12	79.98	76.85	73.71	70.57	70.57	73.71	76.85	79.98	83.12	86.26

Total = Sum(44)$_{1...12}$ = 940.97 (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=	127.91	111.87	115.44	100.65	96.57	83.34	77.22	88.61	89.67	104.5	114.07	123.88

Total = Sum(45)$_{1...12}$ = 1233.75 (45)

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

(46)m=	19.19	16.78	17.32	15.1	14.49	12.5	11.58	13.29	13.45	15.68	17.11	18.58	(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=	43.95	38.26	40.76	37.9	37.56	34.8	35.96	37.56	37.9	40.76	40.99	43.95	(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=	171.87	150.13	156.2	138.54	134.13	118.14	113.19	126.18	127.57	145.26	155.06	167.83	(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)

Output from water heater

(64)m=	171.87	150.13	156.2	138.54	134.13	118.14	113.19	126.18	127.57	145.26	155.06	167.83	

Output from water heater (annual)$_{1...12}$ | 1704.11 | (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=	53.52	46.76	48.57	42.94	41.5	36.41	34.67	38.85	39.29	44.94	48.18	52.18	(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=	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	(66)

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

(67)m=	14.47	12.85	10.45	7.91	5.92	4.99	5.4	7.01	9.41	11.95	13.95	14.87	(67)

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

(68)m=	162.32	164.01	159.76	150.73	139.32	128.6	121.44	119.75	124	133.03	144.44	155.16	(68)

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

(69)m=	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	(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=	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	(71)

Water heating gains (Table 5)

(72)m=	71.94	69.59	65.29	59.64	55.78	50.57	46.6	52.22	54.57	60.4	66.91	70.13	(72)

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

(73)m=	302.65	300.37	289.43	272.2	254.94	238.09	227.35	232.91	241.9	259.31	279.23	294.09	(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)	
Southeast 0.9x	0.77	x	2.95	x	36.79	x	0.63	x	0.7	=	33.17	(77)
Southeast 0.9x	0.77	x	2.95	x	62.67	x	0.63	x	0.7	=	56.5	(77)

Southeast	0.9x	0.77	x	2.95	x	85.75	x	0.63	x	0.7	=	77.31	(77)
Southeast	0.9x	0.77	x	2.95	x	106.25	x	0.63	x	0.7	=	95.79	(77)
Southeast	0.9x	0.77	x	2.95	x	119.01	x	0.63	x	0.7	=	107.3	(77)
Southeast	0.9x	0.77	x	2.95	x	118.15	x	0.63	x	0.7	=	106.52	(77)
Southeast	0.9x	0.77	x	2.95	x	113.91	x	0.63	x	0.7	=	102.7	(77)
Southeast	0.9x	0.77	x	2.95	x	104.39	x	0.63	x	0.7	=	94.11	(77)
Southeast	0.9x	0.77	x	2.95	x	92.85	x	0.63	x	0.7	=	83.71	(77)
Southeast	0.9x	0.77	x	2.95	x	69.27	x	0.63	x	0.7	=	62.45	(77)
Southeast	0.9x	0.77	x	2.95	x	44.07	x	0.63	x	0.7	=	39.73	(77)
Southeast	0.9x	0.77	x	2.95	x	31.49	x	0.63	x	0.7	=	28.39	(77)
Southwest	0.9x	0.77	x	1.72	x	36.79		0.63	x	0.7	=	19.34	(79)
Southwest	0.9x	0.77	x	1.72	x	62.67		0.63	x	0.7	=	32.94	(79)
Southwest	0.9x	0.77	x	1.72	x	85.75		0.63	x	0.7	=	45.08	(79)
Southwest	0.9x	0.77	x	1.72	x	106.25		0.63	x	0.7	=	55.85	(79)
Southwest	0.9x	0.77	x	1.72	x	119.01		0.63	x	0.7	=	62.56	(79)
Southwest	0.9x	0.77	x	1.72	x	118.15		0.63	x	0.7	=	62.11	(79)
Southwest	0.9x	0.77	x	1.72	x	113.91		0.63	x	0.7	=	59.88	(79)
Southwest	0.9x	0.77	x	1.72	x	104.39		0.63	x	0.7	=	54.87	(79)
Southwest	0.9x	0.77	x	1.72	x	92.85		0.63	x	0.7	=	48.81	(79)
Southwest	0.9x	0.77	x	1.72	x	69.27		0.63	x	0.7	=	36.41	(79)
Southwest	0.9x	0.77	x	1.72	x	44.07		0.63	x	0.7	=	23.17	(79)
Southwest	0.9x	0.77	x	1.72	x	31.49		0.63	x	0.7	=	16.55	(79)
Northwest	0.9x	0.77	x	5.71	x	11.28	x	0.63	x	0.7	=	19.69	(81)
Northwest	0.9x	0.77	x	5.71	x	22.97	x	0.63	x	0.7	=	40.08	(81)
Northwest	0.9x	0.77	x	5.71	x	41.38	x	0.63	x	0.7	=	72.21	(81)
Northwest	0.9x	0.77	x	5.71	x	67.96	x	0.63	x	0.7	=	118.59	(81)
Northwest	0.9x	0.77	x	5.71	x	91.35	x	0.63	x	0.7	=	159.4	(81)
Northwest	0.9x	0.77	x	5.71	x	97.38	x	0.63	x	0.7	=	169.94	(81)
Northwest	0.9x	0.77	x	5.71	x	91.1	x	0.63	x	0.7	=	158.98	(81)
Northwest	0.9x	0.77	x	5.71	x	72.63	x	0.63	x	0.7	=	126.74	(81)
Northwest	0.9x	0.77	x	5.71	x	50.42	x	0.63	x	0.7	=	87.99	(81)
Northwest	0.9x	0.77	x	5.71	x	28.07	x	0.63	x	0.7	=	48.98	(81)
Northwest	0.9x	0.77	x	5.71	x	14.2	x	0.63	x	0.7	=	24.77	(81)
Northwest	0.9x	0.77	x	5.71	x	9.21	x	0.63	x	0.7	=	16.08	(81)

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

(83)m=	72.2	129.53	194.6	270.23	329.26	338.57	321.55	275.72	220.51	147.84	87.67	61.02	(83)

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

(84)m=	374.85	429.9	484.02	542.43	584.2	576.65	548.9	508.64	462.41	407.15	366.9	355.11	(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	0.99	0.98	0.95	0.87	0.72	0.56	0.61	0.85	0.97	0.99	1	(86)

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

(87)m=	19.6	19.77	20.04	20.41	20.73	20.93	20.98	20.97	20.83	20.41	19.94	19.57	(87)

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

(88)m=	19.83	19.83	19.83	19.84	19.84	19.85	19.85	19.85	19.85	19.84	19.84	19.83	(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	0.62	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=	17.99	18.22	18.63	19.16	19.58	19.8	19.85	19.84	19.71	19.17	18.49	17.95	(90)

fLA = Living area ÷ (4) = 0.6 (91)

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

(92)m=	18.96	19.15	19.48	19.91	20.28	20.48	20.53	20.52	20.39	19.92	19.37	18.93	(92)

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

(93)m=	18.96	19.15	19.48	19.91	20.28	20.48	20.53	20.52	20.39	19.92	19.37	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=	0.99	0.99	0.98	0.94	0.84	0.68	0.5	0.56	0.81	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	372.78	425.33	472.59	508.77	493.43	389.44	275.57	284.82	375.61	390.09	363.1	353.55	(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=	1079.5	1047.22	951.52	799.05	621.12	422.01	282.14	295.46	452.73	675.03	891.8	1075.2	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	525.8	417.91	356.33	209	95	0	0	0	0	212	380.67	536.91	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2733.61 (98)

Space heating requirement in kWh/m²/year 48.96 (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)													
	525.8	417.91	356.33	209	95	0	0	0	0	212	380.67	536.91	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	562.96	447.44	381.5	223.76	101.71	0	0	0	0	226.98	407.57	574.85	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2926.77 (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)

	171.87	150.13	156.2	138.54	134.13	118.14	113.19	126.18	127.57	145.26	155.06	167.83

Efficiency of water heater 80.3 (216)

(217)m=	87.68	87.49	87.06	86.08	84.2	80.3	80.3	80.3	80.3	86	87.22	87.77	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	196.01	171.6	179.41	160.94	159.3	147.12	140.95	157.13	158.87	168.91	177.78	191.22

Total = Sum(219a)$_{1...12}$ = 2009.23 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2926.77	
Water heating fuel used		2009.23	
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		255.56	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		5266.57	(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	=	632.18	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	433.99	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1066.18	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	132.64	(268)
Total CO2, kg/year		sum of (265)…(271) =		1237.74	(272)

TER = 22.17 (273)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: 1 Bed Var - EF

Address : 1 Bed Var - EF, London, TBC

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	54.08	(1a) x	2.5	(2a) =	135.2	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	54.08	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	135.2	(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) =	0.15	(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)	0.4	(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) =	0.34	(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

TER WorkSheet: New dwelling design stage

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

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.34	0.36	0.38	0.4

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=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

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

(25)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(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			3.57	x	1.2	=	4.284			(26)
Windows Type 1			1.24	x1/[1/(1.4)+ 0.04]		=	1.64			(27)
Windows Type 2			4.17	x1/[1/(1.4)+ 0.04]		=	5.53			(27)
Windows Type 3			0.72	x1/[1/(1.4)+ 0.04]		=	0.95			(27)
Windows Type 4			3.82	x1/[1/(1.4)+ 0.04]		=	5.06			(27)
Floor			13.85	x	0.13	=	1.8005			(28)
Walls	62.5	13.52	48.98	x	0.18	=	8.82			(29)
Total area of elements, m²			76.35							(31)
Party wall			19.77	x	0	=	0			(32)
Party floor			40.23							(32a)
Party ceiling			54.08							(32b)
Internal wall **			63.3							(32c)

** 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) = 28.09 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5921.17 (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 10.35 (36)

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

TER WorkSheet: New dwelling design stage

Total fabric heat loss	(33) + (36) =	38.45	(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=	26.46	26.3	26.14	25.4	25.26	24.61	24.61	24.49	24.86	25.26	25.54	25.83	(38)

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

(39)m=	64.9	64.74	64.58	63.84	63.7	63.06	63.06	62.94	63.31	63.7	63.98	64.28	

Average = $Sum(39)_{1...12}$ /12= 63.84 (39)

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

(40)m=	1.2	1.2	1.19	1.18	1.18	1.17	1.17	1.16	1.17	1.18	1.18	1.19	

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 1.81 (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 77.2 (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=	84.92	81.83	78.74	75.65	72.56	69.48	69.48	72.56	75.65	78.74	81.83	84.92	

Total = $Sum(44)_{1...12}$ = 926.35 (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=	125.93	110.14	113.65	99.08	95.07	82.04	76.02	87.24	88.28	102.88	112.3	121.95	

Total = $Sum(45)_{1...12}$ = 1214.59 (45)

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

(46)m=	18.89	16.52	17.05	14.86	14.26	12.31	11.4	13.09	13.24	15.43	16.85	18.29	(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=	43.27	37.66	40.12	37.31	36.98	34.26	35.4	36.98	37.31	40.12	40.35	43.27	(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=	169.2	147.8	153.78	136.39	132.05	116.3	111.43	124.22	125.59	143.01	152.66	165.23	(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)

Output from water heater

(64)m=	169.2	147.8	153.78	136.39	132.05	116.3	111.43	124.22	125.59	143.01	152.66	165.23	

Output from water heater (annual)$_{1…12}$ 1677.64 (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=	52.69	46.04	47.82	42.27	40.86	35.84	34.13	38.25	38.68	44.24	47.43	51.37	(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=	90.52	90.52	90.52	90.52	90.52	90.52	90.52	90.52	90.52	90.52	90.52	90.52	(66)

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

(67)m=	14.07	12.5	10.16	7.69	5.75	4.86	5.25	6.82	9.15	11.62	13.56	14.46	(67)

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

(68)m=	157.81	159.45	155.32	146.54	135.45	125.02	118.06	116.42	120.55	129.34	140.43	150.85	(68)

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

(69)m=	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	(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=	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	(71)

Water heating gains (Table 5)

(72)m=	70.82	68.51	64.27	58.71	54.91	49.78	45.87	51.41	53.72	59.46	65.87	69.04	(72)

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

(73)m=	295.85	293.61	282.91	266.1	249.27	232.82	222.34	227.81	236.58	253.57	273.02	287.51	(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)	
Northeast	0.9x	0.77	x	1.24	x	11.28	x	0.63	x	0.7	=	4.28	(75)
Northeast	0.9x	0.77	x	1.24	x	22.97	x	0.63	x	0.7	=	8.7	(75)
Northeast	0.9x	0.77	x	1.24	x	41.38	x	0.63	x	0.7	=	15.68	(75)
Northeast	0.9x	0.77	x	1.24	x	67.96	x	0.63	x	0.7	=	25.75	(75)
Northeast	0.9x	0.77	x	1.24	x	91.35	x	0.63	x	0.7	=	34.62	(75)
Northeast	0.9x	0.77	x	1.24	x	97.38	x	0.63	x	0.7	=	36.9	(75)
Northeast	0.9x	0.77	x	1.24	x	91.1	x	0.63	x	0.7	=	34.52	(75)
Northeast	0.9x	0.77	x	1.24	x	72.63	x	0.63	x	0.7	=	27.52	(75)
Northeast	0.9x	0.77	x	1.24	x	50.42	x	0.63	x	0.7	=	19.11	(75)
Northeast	0.9x	0.77	x	1.24	x	28.07	x	0.63	x	0.7	=	10.64	(75)
Northeast	0.9x	0.77	x	1.24	x	14.2	x	0.63	x	0.7	=	5.38	(75)
Northeast	0.9x	0.77	x	1.24	x	9.21	x	0.63	x	0.7	=	3.49	(75)
Southeast	0.9x	0.77	x	0.72	x	36.79	x	0.63	x	0.7	=	8.1	(77)
Southeast	0.9x	0.77	x	0.72	x	62.67	x	0.63	x	0.7	=	13.79	(77)
Southeast	0.9x	0.77	x	0.72	x	85.75	x	0.63	x	0.7	=	18.87	(77)
Southeast	0.9x	0.77	x	0.72	x	106.25	x	0.63	x	0.7	=	23.38	(77)
Southeast	0.9x	0.77	x	0.72	x	119.01	x	0.63	x	0.7	=	26.19	(77)
Southeast	0.9x	0.77	x	0.72	x	118.15	x	0.63	x	0.7	=	26	(77)
Southeast	0.9x	0.77	x	0.72	x	113.91	x	0.63	x	0.7	=	25.06	(77)
Southeast	0.9x	0.77	x	0.72	x	104.39	x	0.63	x	0.7	=	22.97	(77)
Southeast	0.9x	0.77	x	0.72	x	92.85	x	0.63	x	0.7	=	20.43	(77)
Southeast	0.9x	0.77	x	0.72	x	69.27	x	0.63	x	0.7	=	15.24	(77)
Southeast	0.9x	0.77	x	0.72	x	44.07	x	0.63	x	0.7	=	9.7	(77)
Southeast	0.9x	0.77	x	0.72	x	31.49	x	0.63	x	0.7	=	6.93	(77)
Southwest	0.9x	0.77	x	3.82	x	36.79		0.63	x	0.7	=	42.95	(79)
Southwest	0.9x	0.77	x	3.82	x	62.67		0.63	x	0.7	=	73.17	(79)
Southwest	0.9x	0.77	x	3.82	x	85.75		0.63	x	0.7	=	100.11	(79)
Southwest	0.9x	0.77	x	3.82	x	106.25		0.63	x	0.7	=	124.04	(79)
Southwest	0.9x	0.77	x	3.82	x	119.01		0.63	x	0.7	=	138.94	(79)
Southwest	0.9x	0.77	x	3.82	x	118.15		0.63	x	0.7	=	137.93	(79)
Southwest	0.9x	0.77	x	3.82	x	113.91		0.63	x	0.7	=	132.98	(79)
Southwest	0.9x	0.77	x	3.82	x	104.39		0.63	x	0.7	=	121.87	(79)
Southwest	0.9x	0.77	x	3.82	x	92.85		0.63	x	0.7	=	108.4	(79)
Southwest	0.9x	0.77	x	3.82	x	69.27		0.63	x	0.7	=	80.87	(79)
Southwest	0.9x	0.77	x	3.82	x	44.07		0.63	x	0.7	=	51.45	(79)
Southwest	0.9x	0.77	x	3.82	x	31.49		0.63	x	0.7	=	36.76	(79)
Northwest	0.9x	0.77	x	4.17	x	11.28	x	0.63	x	0.7	=	14.38	(81)
Northwest	0.9x	0.77	x	4.17	x	22.97	x	0.63	x	0.7	=	29.27	(81)
Northwest	0.9x	0.77	x	4.17	x	41.38	x	0.63	x	0.7	=	52.73	(81)

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Northwest	0.9x	0.77	x	4.17	x	67.96	x	0.63	x	0.7	=	86.6	(81)
Northwest	0.9x	0.77	x	4.17	x	91.35	x	0.63	x	0.7	=	116.41	(81)
Northwest	0.9x	0.77	x	4.17	x	97.38	x	0.63	x	0.7	=	124.11	(81)
Northwest	0.9x	0.77	x	4.17	x	91.1	x	0.63	x	0.7	=	116.1	(81)
Northwest	0.9x	0.77	x	4.17	x	72.63	x	0.63	x	0.7	=	92.56	(81)
Northwest	0.9x	0.77	x	4.17	x	50.42	x	0.63	x	0.7	=	64.26	(81)
Northwest	0.9x	0.77	x	4.17	x	28.07	x	0.63	x	0.7	=	35.77	(81)
Northwest	0.9x	0.77	x	4.17	x	14.2	x	0.63	x	0.7	=	18.09	(81)
Northwest	0.9x	0.77	x	4.17	x	9.21	x	0.63	x	0.7	=	11.74	(81)

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

(83)m=	69.71	124.93	187.39	259.78	316.15	324.94	308.67	264.92	212.19	142.51	84.62	58.92	(83)

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

(84)m=	365.56	418.54	470.31	525.88	565.42	557.76	531.01	492.73	448.78	396.09	357.64	346.43	(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	0.68	0.51	0.57	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=	19.76	19.92	20.18	20.53	20.81	20.95	20.99	20.98	20.88	20.52	20.08	19.73	(87)

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

(88)m=	19.92	19.92	19.92	19.94	19.94	19.95	19.95	19.95	19.94	19.94	19.93	19.93	(88)

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

(89)m=	1	0.99	0.98	0.93	0.8	0.58	0.4	0.45	0.74	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=	18.28	18.52	18.9	19.39	19.75	19.92	19.94	19.94	19.85	19.39	18.75	18.25	(90)

fLA = Living area ÷ (4) = 0.6 (91)

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

(92)m=	19.16	19.35	19.66	20.07	20.38	20.54	20.57	20.56	20.47	20.06	19.54	19.13	(92)

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

(93)m=	19.16	19.35	19.66	20.07	20.38	20.54	20.57	20.56	20.47	20.06	19.54	19.13	(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	0.93	0.82	0.64	0.47	0.52	0.78	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	363.52	413.89	458.22	488.91	464.79	355.63	247.03	256.65	351.99	377.39	353.74	344.92	(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=	964.71	935.71	850.09	712.82	553.02	374.31	250.21	262.07	402.96	602.61	796.13	959.87	(97)

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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(98)m=	447.29	350.66	291.55	161.22	65.64	0	0	0	0	167.57	318.52	457.53		
Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =													2259.98	(98)
Space heating requirement in kWh/m²/year													41.79	(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)	447.29	350.66	291.55	161.22	65.64	0	0	0	0	167.57	318.52	457.53		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	478.9	375.44	312.15	172.61	70.28	0	0	0	0	179.41	341.03	489.86		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													2419.68	(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)	169.2	147.8	153.78	136.39	132.05	116.3	111.43	124.22	125.59	143.01	152.66	165.23		
Efficiency of water heater													80.3	(216)
(217)m=	87.38	87.15	86.64	85.47	83.39	80.3	80.3	80.3	80.3	85.45	86.86	87.48		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	193.63	169.59	177.49	159.57	158.35	144.84	138.76	154.69	156.4	167.35	175.75	188.87		
Total = Sum(219a)$_{1...12}$ =													1985.3	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2419.68	
Water heating fuel used			1985.3	
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			248.46	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			4728.44	(338)

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

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	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	522.65	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	428.82	(264)
Space and water heating	(261) + (262) + (263) + (264) =				951.48	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	128.95	(268)
Total CO2, kg/year			sum of (265)…(271) =		1119.35	(272)

TER = 20.7 (273)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.41

Property Address: 1 Bed Var - MF

Address : 1 Bed Var - MF, London, TBC

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	54.08	(1a) x	2.5	(2a) =	135.2	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	54.08	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	135.2	(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) =	0.15	(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)	0.4	(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) =	0.34	(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

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.34	0.36	0.38	0.4

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=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

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

(25)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(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			3.57	x	1.2	=	4.284			(26)
Windows Type 1			1.24	x1/[1/(1.4)+ 0.04]		=	1.64			(27)
Windows Type 2			4.17	x1/[1/(1.4)+ 0.04]		=	5.53			(27)
Windows Type 3			0.72	x1/[1/(1.4)+ 0.04]		=	0.95			(27)
Windows Type 4			3.82	x1/[1/(1.4)+ 0.04]		=	5.06			(27)
Walls	62.5	13.52	48.98	x	0.18	=	8.82			(29)
Total area of elements, m²			62.5							(31)
Party wall			19.77	x	0	=	0			(32)
Party floor			54.08							(32a)
Party ceiling			54.08							(32b)
Internal wall **			63.3							(32c)

** 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) = 26.29 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5436.42 (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 6.37 (36)

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

Total fabric heat loss (33) + (36) = 32.67 (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=	26.46	26.3	26.14	25.4	25.26	24.61	24.61	24.49	24.86	25.26	25.54	25.83	(38)

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

(39)m=	59.12	58.96	58.8	58.06	57.92	57.28	57.28	57.16	57.53	57.92	58.2	58.5	

Average = Sum(39)$_{1...12}$ /12= 58.06 (39)

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

(40)m=	1.09	1.09	1.09	1.07	1.07	1.06	1.06	1.06	1.06	1.07	1.08	1.08	

Average = Sum(40)$_{1...12}$ /12= 1.07 (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 1.81 (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 77.2 (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=	84.92	81.83	78.74	75.65	72.56	69.48	69.48	72.56	75.65	78.74	81.83	84.92	

Total = Sum(44)$_{1...12}$ = 926.35 (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=	125.93	110.14	113.65	99.08	95.07	82.04	76.02	87.24	88.28	102.88	112.3	121.95	

Total = Sum(45)$_{1...12}$ = 1214.59 (45)

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

(46)m=	18.89	16.52	17.05	14.86	14.26	12.31	11.4	13.09	13.24	15.43	16.85	18.29	(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=	43.27	37.66	40.12	37.31	36.98	34.26	35.4	36.98	37.31	40.12	40.35	43.27	(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=	169.2	147.8	153.78	136.39	132.05	116.3	111.43	124.22	125.59	143.01	152.66	165.23	(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)

Output from water heater

(64)m=	169.2	147.8	153.78	136.39	132.05	116.3	111.43	124.22	125.59	143.01	152.66	165.23

Output from water heater (annual)$_{1...12}$ — 1677.64 (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=	52.69	46.04	47.82	42.27	40.86	35.84	34.13	38.25	38.68	44.24	47.43	51.37	(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=	90.52	90.52	90.52	90.52	90.52	90.52	90.52	90.52	90.52	90.52	90.52	90.52	(66)

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

(67)m=	14.07	12.5	10.16	7.69	5.75	4.86	5.25	6.82	9.15	11.62	13.56	14.46	(67)

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

(68)m=	157.81	159.45	155.32	146.54	135.45	125.02	118.06	116.42	120.55	129.34	140.43	150.85	(68)

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

(69)m=	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	(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=	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	(71)

Water heating gains (Table 5)

(72)m=	70.82	68.51	64.27	58.71	54.91	49.78	45.87	51.41	53.72	59.46	65.87	69.04	(72)

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

(73)m=	295.85	293.61	282.91	266.1	249.27	232.82	222.34	227.81	236.58	253.57	273.02	287.51	(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)

Northeast	0.9x	0.77	x	1.24	x	11.28	x	0.63	x	0.7	=	4.28	(75)
Northeast	0.9x	0.77	x	1.24	x	22.97	x	0.63	x	0.7	=	8.7	(75)
Northeast	0.9x	0.77	x	1.24	x	41.38	x	0.63	x	0.7	=	15.68	(75)
Northeast	0.9x	0.77	x	1.24	x	67.96	x	0.63	x	0.7	=	25.75	(75)
Northeast	0.9x	0.77	x	1.24	x	91.35	x	0.63	x	0.7	=	34.62	(75)
Northeast	0.9x	0.77	x	1.24	x	97.38	x	0.63	x	0.7	=	36.9	(75)
Northeast	0.9x	0.77	x	1.24	x	91.1	x	0.63	x	0.7	=	34.52	(75)
Northeast	0.9x	0.77	x	1.24	x	72.63	x	0.63	x	0.7	=	27.52	(75)
Northeast	0.9x	0.77	x	1.24	x	50.42	x	0.63	x	0.7	=	19.11	(75)
Northeast	0.9x	0.77	x	1.24	x	28.07	x	0.63	x	0.7	=	10.64	(75)
Northeast	0.9x	0.77	x	1.24	x	14.2	x	0.63	x	0.7	=	5.38	(75)
Northeast	0.9x	0.77	x	1.24	x	9.21	x	0.63	x	0.7	=	3.49	(75)
Southeast	0.9x	0.77	x	0.72	x	36.79	x	0.63	x	0.7	=	8.1	(77)
Southeast	0.9x	0.77	x	0.72	x	62.67	x	0.63	x	0.7	=	13.79	(77)
Southeast	0.9x	0.77	x	0.72	x	85.75	x	0.63	x	0.7	=	18.87	(77)
Southeast	0.9x	0.77	x	0.72	x	106.25	x	0.63	x	0.7	=	23.38	(77)
Southeast	0.9x	0.77	x	0.72	x	119.01	x	0.63	x	0.7	=	26.19	(77)
Southeast	0.9x	0.77	x	0.72	x	118.15	x	0.63	x	0.7	=	26	(77)
Southeast	0.9x	0.77	x	0.72	x	113.91	x	0.63	x	0.7	=	25.06	(77)
Southeast	0.9x	0.77	x	0.72	x	104.39	x	0.63	x	0.7	=	22.97	(77)
Southeast	0.9x	0.77	x	0.72	x	92.85	x	0.63	x	0.7	=	20.43	(77)
Southeast	0.9x	0.77	x	0.72	x	69.27	x	0.63	x	0.7	=	15.24	(77)
Southeast	0.9x	0.77	x	0.72	x	44.07	x	0.63	x	0.7	=	9.7	(77)
Southeast	0.9x	0.77	x	0.72	x	31.49	x	0.63	x	0.7	=	6.93	(77)
Southwest	0.9x	0.77	x	3.82	x	36.79		0.63	x	0.7	=	42.95	(79)
Southwest	0.9x	0.77	x	3.82	x	62.67		0.63	x	0.7	=	73.17	(79)
Southwest	0.9x	0.77	x	3.82	x	85.75		0.63	x	0.7	=	100.11	(79)
Southwest	0.9x	0.77	x	3.82	x	106.25		0.63	x	0.7	=	124.04	(79)
Southwest	0.9x	0.77	x	3.82	x	119.01		0.63	x	0.7	=	138.94	(79)
Southwest	0.9x	0.77	x	3.82	x	118.15		0.63	x	0.7	=	137.93	(79)
Southwest	0.9x	0.77	x	3.82	x	113.91		0.63	x	0.7	=	132.98	(79)
Southwest	0.9x	0.77	x	3.82	x	104.39		0.63	x	0.7	=	121.87	(79)
Southwest	0.9x	0.77	x	3.82	x	92.85		0.63	x	0.7	=	108.4	(79)
Southwest	0.9x	0.77	x	3.82	x	69.27		0.63	x	0.7	=	80.87	(79)
Southwest	0.9x	0.77	x	3.82	x	44.07		0.63	x	0.7	=	51.45	(79)
Southwest	0.9x	0.77	x	3.82	x	31.49		0.63	x	0.7	=	36.76	(79)
Northwest	0.9x	0.77	x	4.17	x	11.28	x	0.63	x	0.7	=	14.38	(81)
Northwest	0.9x	0.77	x	4.17	x	22.97	x	0.63	x	0.7	=	29.27	(81)
Northwest	0.9x	0.77	x	4.17	x	41.38	x	0.63	x	0.7	=	52.73	(81)
Northwest	0.9x	0.77	x	4.17	x	67.96	x	0.63	x	0.7	=	86.6	(81)
Northwest	0.9x	0.77	x	4.17	x	91.35	x	0.63	x	0.7	=	116.41	(81)

Northwest 0.9x	0.77	x	4.17	x	97.38	x	0.63	x	0.7	=	124.11	(81)
Northwest 0.9x	0.77	x	4.17	x	91.1	x	0.63	x	0.7	=	116.1	(81)
Northwest 0.9x	0.77	x	4.17	x	72.63	x	0.63	x	0.7	=	92.56	(81)
Northwest 0.9x	0.77	x	4.17	x	50.42	x	0.63	x	0.7	=	64.26	(81)
Northwest 0.9x	0.77	x	4.17	x	28.07	x	0.63	x	0.7	=	35.77	(81)
Northwest 0.9x	0.77	x	4.17	x	14.2	x	0.63	x	0.7	=	18.09	(81)
Northwest 0.9x	0.77	x	4.17	x	9.21	x	0.63	x	0.7	=	11.74	(81)

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

(83)m=	69.71	124.93	187.39	259.78	316.15	324.94	308.67	264.92	212.19	142.51	84.62	58.92	(83)

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

(84)m=	365.56	418.54	470.31	525.88	565.42	557.76	531.01	492.73	448.78	396.09	357.64	346.43	(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	0.82	0.63	0.47	0.52	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=	19.91	20.06	20.31	20.63	20.87	20.97	21	20.99	20.92	20.61	20.2	19.88	(87)

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

(88)m=	20.01	20.01	20.01	20.02	20.02	20.03	20.03	20.04	20.03	20.02	20.02	20.02	(88)

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

(89)m=	1	0.99	0.97	0.91	0.77	0.55	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=	18.55	18.78	19.14	19.6	19.9	20.02	20.03	20.03	19.97	19.58	18.99	18.52	(90)

fLA = Living area ÷ (4) = 0.6 (91)

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

(92)m=	19.36	19.55	19.84	20.21	20.48	20.59	20.61	20.61	20.54	20.19	19.71	19.33	(92)

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

(93)m=	19.36	19.55	19.84	20.21	20.48	20.59	20.61	20.61	20.54	20.19	19.71	19.33	(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	0.92	0.79	0.6	0.43	0.48	0.75	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	363.51	413.66	456.98	483.21	448.92	332.86	228.05	237.73	337.52	374.82	353.54	344.94	(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=	890.43	863.54	784.45	656.81	508.43	343.01	229.5	240.35	370.38	555.66	734.14	885.13	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	392.02	302.32	243.64	124.99	44.28	0	0	0	0	134.55	274.03	401.9	(98)

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	1917.73	(98)
Space heating requirement in kWh/m²/year	35.46	(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		93.4	(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)	392.02	302.32	243.64	124.99	44.28	0	0	0	0	134.55	274.03	401.9		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	419.73	323.68	260.86	133.82	47.41	0	0	0	0	144.05	293.4	430.3		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													2053.25	(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)	169.2	147.8	153.78	136.39	132.05	116.3	111.43	124.22	125.59	143.01	152.66	165.23		
Efficiency of water heater													80.3	(216)
(217)m=	87.1	86.81	86.2	84.83	82.62	80.3	80.3	80.3	80.3	84.9	86.51	87.2		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	194.26	170.25	178.39	160.78	159.83	144.84	138.76	154.69	156.4	168.44	176.47	189.47		
Total = Sum(219a)$_{1...12}$ =													1992.58	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2053.25	
Water heating fuel used			1992.58	
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			248.46	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			4369.29	(338)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh	**Emissions** kg CO2/year

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Space heating (main system 1)	(211) x	0.216	=	443.5	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	430.4	(264)
Space and water heating	(261) + (262) + (263) + (264) =			873.9	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	128.95	(268)
Total CO2, kg/year		sum of (265)…(271) =		1041.78	(272)

TER = 19.26 (273)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: 1 Bed Var - TF

Address : 1 Bed Var - TF, London, TBC

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	54.08	(1a) x	2.5	(2a) =	135.2	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	54.08	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	135.2	(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) =	0.15	(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)	0.4	(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) =	0.34	(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

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.34	0.36	0.38	0.4

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=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

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

(25)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(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			3.57	x	1.2	=	4.284			(26)
Windows Type 1			1.24	x1/[1/(1.4)+ 0.04]		=	1.64			(27)
Windows Type 2			4.17	x1/[1/(1.4)+ 0.04]		=	5.53			(27)
Windows Type 3			0.72	x1/[1/(1.4)+ 0.04]		=	0.95			(27)
Windows Type 4			3.82	x1/[1/(1.4)+ 0.04]		=	5.06			(27)
Walls	62.5	13.52	48.98	x	0.18	=	8.82			(29)
Roof	54.08	0	54.08	x	0.13	=	7.03			(30)
Total area of elements, m²			116.58							(31)
Party wall			19.77	x	0	=	0			(32)
Party floor			54.08							(32a)
Internal wall **			63.3							(32c)

** 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) = 33.32 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 4300.74 (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 19.57 (36)

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

Total fabric heat loss (33) + (36) = 52.89 (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=	26.46	26.3	26.14	25.4	25.26	24.61	24.61	24.49	24.86	25.26	25.54	25.83	(38)

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

(39)m=	79.35	79.19	79.03	78.29	78.15	77.51	77.51	77.39	77.75	78.15	78.43	78.73	

Average = Sum(39)$_{1...12}$ /12= 78.29 (39)

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

(40)m=	1.47	1.46	1.46	1.45	1.45	1.43	1.43	1.43	1.44	1.45	1.45	1.46	

Average = Sum(40)$_{1...12}$ /12= 1.45 (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 1.81 (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 77.2 (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=	84.92	81.83	78.74	75.65	72.56	69.48	69.48	72.56	75.65	78.74	81.83	84.92	

Total = Sum(44)$_{1...12}$ = 926.35 (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=	125.93	110.14	113.65	99.08	95.07	82.04	76.02	87.24	88.28	102.88	112.3	121.95	

Total = Sum(45)$_{1...12}$ = 1214.59 (45)

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

(46)m=	18.89	16.52	17.05	14.86	14.26	12.31	11.4	13.09	13.24	15.43	16.85	18.29	(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=	43.27	37.66	40.12	37.31	36.98	34.26	35.4	36.98	37.31	40.12	40.35	43.27	(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=	169.2	147.8	153.78	136.39	132.05	116.3	111.43	124.22	125.59	143.01	152.66	165.23	(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)

Output from water heater

(64)m=	169.2	147.8	153.78	136.39	132.05	116.3	111.43	124.22	125.59	143.01	152.66	165.23

Output from water heater (annual)$_{1...12}$ | 1677.64 | (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=	52.69	46.04	47.82	42.27	40.86	35.84	34.13	38.25	38.68	44.24	47.43	51.37	(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=	90.52	90.52	90.52	90.52	90.52	90.52	90.52	90.52	90.52	90.52	90.52	90.52	(66)

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

(67)m=	14.07	12.5	10.16	7.69	5.75	4.86	5.25	6.82	9.15	11.62	13.56	14.46	(67)

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

(68)m=	157.81	159.45	155.32	146.54	135.45	125.02	118.06	116.42	120.55	129.34	140.43	150.85	(68)

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

(69)m=	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	(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=	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	(71)

Water heating gains (Table 5)

(72)m=	70.82	68.51	64.27	58.71	54.91	49.78	45.87	51.41	53.72	59.46	65.87	69.04	(72)

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

(73)m=	295.85	293.61	282.91	266.1	249.27	232.82	222.34	227.81	236.58	253.57	273.02	287.51	(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)

Northeast	0.9x	0.77	x	1.24	x	11.28	x	0.63	x	0.7	=	4.28	(75)
Northeast	0.9x	0.77	x	1.24	x	22.97	x	0.63	x	0.7	=	8.7	(75)
Northeast	0.9x	0.77	x	1.24	x	41.38	x	0.63	x	0.7	=	15.68	(75)
Northeast	0.9x	0.77	x	1.24	x	67.96	x	0.63	x	0.7	=	25.75	(75)
Northeast	0.9x	0.77	x	1.24	x	91.35	x	0.63	x	0.7	=	34.62	(75)
Northeast	0.9x	0.77	x	1.24	x	97.38	x	0.63	x	0.7	=	36.9	(75)
Northeast	0.9x	0.77	x	1.24	x	91.1	x	0.63	x	0.7	=	34.52	(75)
Northeast	0.9x	0.77	x	1.24	x	72.63	x	0.63	x	0.7	=	27.52	(75)
Northeast	0.9x	0.77	x	1.24	x	50.42	x	0.63	x	0.7	=	19.11	(75)
Northeast	0.9x	0.77	x	1.24	x	28.07	x	0.63	x	0.7	=	10.64	(75)
Northeast	0.9x	0.77	x	1.24	x	14.2	x	0.63	x	0.7	=	5.38	(75)
Northeast	0.9x	0.77	x	1.24	x	9.21	x	0.63	x	0.7	=	3.49	(75)
Southeast	0.9x	0.77	x	0.72	x	36.79	x	0.63	x	0.7	=	8.1	(77)
Southeast	0.9x	0.77	x	0.72	x	62.67	x	0.63	x	0.7	=	13.79	(77)
Southeast	0.9x	0.77	x	0.72	x	85.75	x	0.63	x	0.7	=	18.87	(77)
Southeast	0.9x	0.77	x	0.72	x	106.25	x	0.63	x	0.7	=	23.38	(77)
Southeast	0.9x	0.77	x	0.72	x	119.01	x	0.63	x	0.7	=	26.19	(77)
Southeast	0.9x	0.77	x	0.72	x	118.15	x	0.63	x	0.7	=	26	(77)
Southeast	0.9x	0.77	x	0.72	x	113.91	x	0.63	x	0.7	=	25.06	(77)
Southeast	0.9x	0.77	x	0.72	x	104.39	x	0.63	x	0.7	=	22.97	(77)
Southeast	0.9x	0.77	x	0.72	x	92.85	x	0.63	x	0.7	=	20.43	(77)
Southeast	0.9x	0.77	x	0.72	x	69.27	x	0.63	x	0.7	=	15.24	(77)
Southeast	0.9x	0.77	x	0.72	x	44.07	x	0.63	x	0.7	=	9.7	(77)
Southeast	0.9x	0.77	x	0.72	x	31.49	x	0.63	x	0.7	=	6.93	(77)
Southwest	0.9x	0.77	x	3.82	x	36.79		0.63	x	0.7	=	42.95	(79)
Southwest	0.9x	0.77	x	3.82	x	62.67		0.63	x	0.7	=	73.17	(79)
Southwest	0.9x	0.77	x	3.82	x	85.75		0.63	x	0.7	=	100.11	(79)
Southwest	0.9x	0.77	x	3.82	x	106.25		0.63	x	0.7	=	124.04	(79)
Southwest	0.9x	0.77	x	3.82	x	119.01		0.63	x	0.7	=	138.94	(79)
Southwest	0.9x	0.77	x	3.82	x	118.15		0.63	x	0.7	=	137.93	(79)
Southwest	0.9x	0.77	x	3.82	x	113.91		0.63	x	0.7	=	132.98	(79)
Southwest	0.9x	0.77	x	3.82	x	104.39		0.63	x	0.7	=	121.87	(79)
Southwest	0.9x	0.77	x	3.82	x	92.85		0.63	x	0.7	=	108.4	(79)
Southwest	0.9x	0.77	x	3.82	x	69.27		0.63	x	0.7	=	80.87	(79)
Southwest	0.9x	0.77	x	3.82	x	44.07		0.63	x	0.7	=	51.45	(79)
Southwest	0.9x	0.77	x	3.82	x	31.49		0.63	x	0.7	=	36.76	(79)
Northwest	0.9x	0.77	x	4.17	x	11.28	x	0.63	x	0.7	=	14.38	(81)
Northwest	0.9x	0.77	x	4.17	x	22.97	x	0.63	x	0.7	=	29.27	(81)
Northwest	0.9x	0.77	x	4.17	x	41.38	x	0.63	x	0.7	=	52.73	(81)
Northwest	0.9x	0.77	x	4.17	x	67.96	x	0.63	x	0.7	=	86.6	(81)
Northwest	0.9x	0.77	x	4.17	x	91.35	x	0.63	x	0.7	=	116.41	(81)

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Northwest	0.9x	0.77	x	4.17	x	97.38	x	0.63	x	0.7	=	124.11	(81)
Northwest	0.9x	0.77	x	4.17	x	91.1	x	0.63	x	0.7	=	116.1	(81)
Northwest	0.9x	0.77	x	4.17	x	72.63	x	0.63	x	0.7	=	92.56	(81)
Northwest	0.9x	0.77	x	4.17	x	50.42	x	0.63	x	0.7	=	64.26	(81)
Northwest	0.9x	0.77	x	4.17	x	28.07	x	0.63	x	0.7	=	35.77	(81)
Northwest	0.9x	0.77	x	4.17	x	14.2	x	0.63	x	0.7	=	18.09	(81)
Northwest	0.9x	0.77	x	4.17	x	9.21	x	0.63	x	0.7	=	11.74	(81)

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

(83)m=	69.71	124.93	187.39	259.78	316.15	324.94	308.67	264.92	212.19	142.51	84.62	58.92	(83)

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

(84)m=	365.56	418.54	470.31	525.88	565.42	557.76	531.01	492.73	448.78	396.09	357.64	346.43	(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	0.89	0.76	0.6	0.66	0.87	0.97	0.99	1	(86)

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

(87)m=	19.42	19.59	19.88	20.27	20.64	20.88	20.97	20.95	20.76	20.3	19.79	19.39	(87)

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

(88)m=	19.71	19.71	19.72	19.73	19.73	19.74	19.74	19.74	19.73	19.73	19.72	19.72	(88)

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

(89)m=	1	0.99	0.98	0.94	0.85	0.65	0.45	0.51	0.8	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=	17.65	17.89	18.31	18.88	19.37	19.66	19.73	19.72	19.54	18.93	18.19	17.61	(90)

fLA = Living area ÷ (4) = 0.6 (91)

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

(92)m=	18.71	18.9	19.25	19.71	20.12	20.39	20.47	20.45	20.27	19.74	19.14	18.67	(92)

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

(93)m=	18.71	18.9	19.25	19.71	20.12	20.39	20.47	20.45	20.27	19.74	19.14	18.67	(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	0.94	0.86	0.71	0.54	0.6	0.83	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	363.37	413.99	459.62	496.37	488.47	397.13	287.36	295.07	374.42	380.59	353.83	344.76	(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=	1143.08	1108.88	1007.32	846.29	658.4	448.47	299.57	313.64	479.65	714.53	944.69	1139.34	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	580.1	466.97	407.49	251.94	126.43	0	0	0	0	248.45	425.42	591.16	(98)

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	3097.96	(98)
Space heating requirement in kWh/m²/year	57.28	(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)	580.1	466.97	407.49	251.94	126.43	0	0	0	0	248.45	425.42	591.16		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	621.09	499.97	436.29	269.74	135.36	0	0	0	0	266.01	455.48	632.94		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													3316.88	(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)	169.2	147.8	153.78	136.39	132.05	116.3	111.43	124.22	125.59	143.01	152.66	165.23		
Efficiency of water heater													80.3	(216)
(217)m=	87.9	87.75	87.39	86.58	84.94	80.3	80.3	80.3	80.3	86.43	87.49	87.98		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	192.48	168.44	175.97	157.54	155.46	144.84	138.76	154.69	156.4	165.46	174.48	187.79		
Total = Sum(219a)$_{1...12}$ =													1972.31	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3316.88	
Water heating fuel used			1972.31	
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			248.46	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			5612.65	(338)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh	**Emissions** kg CO2/year

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Space heating (main system 1)	(211) x	0.216	=	716.45	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	426.02	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1142.47	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	128.95	(268)
Total CO2, kg/year		sum of (265)…(271) =		1310.34	(272)

TER = 24.23 (273)

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User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.5.41

Property Address: 2 Bed - EF

Address : 2 Bed - EF, London, TBC

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67.05	(1a) x	2.5	(2a) =	167.63	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67.05	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	167.63	(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		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.31	(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

0.4	0.39	0.38	0.35	0.34	0.3	0.3	0.29	0.31	0.34	0.35	0.37

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=	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(24d)

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

(25)m=	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(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			3.57	x	1.2	=	4.284			(26)
Windows Type 1			1.81	x1/[1/(1.4)+ 0.04]		=	2.4			(27)
Windows Type 2			2.1	x1/[1/(1.4)+ 0.04]		=	2.78			(27)
Windows Type 3			1.05	x1/[1/(1.4)+ 0.04]		=	1.39			(27)
Windows Type 4			7.35	x1/[1/(1.4)+ 0.04]		=	9.74			(27)
Floor			24.59	x	0.13	=	3.1967			(28)
Walls	58.81	15.88	42.93	x	0.18	=	7.73			(29)
Total area of elements, m²			83.4							(31)
Party wall			50.53	x	0	=	0			(32)
Party floor			42.46							(32a)
Party ceiling			67.05							(32b)
Internal wall **			87.34							(32c)

** 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) = 31.53 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7951.83 (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 13.37 (36)

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

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Total fabric heat loss	(33) + (36) =	44.9	(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=	32.09	31.92	31.75	30.96	30.81	30.12	30.12	29.99	30.38	30.81	31.11	31.42	(38)

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

(39)m=	76.99	76.82	76.65	75.86	75.71	75.02	75.02	74.89	75.28	75.71	76.01	76.32	

Average = Sum(39)$_{1...12}$ /12= 75.85 (39)

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

(40)m=	1.15	1.15	1.14	1.13	1.13	1.12	1.12	1.12	1.12	1.13	1.13	1.14	

Average = Sum(40)$_{1...12}$ /12= 1.13 (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 85.8 (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=	94.37	90.94	87.51	84.08	80.65	77.22	77.22	80.65	84.08	87.51	90.94	94.37	

Total = Sum(44)$_{1...12}$ = 1029.54 (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=	139.96	122.41	126.31	110.12	105.66	91.18	84.49	96.96	98.11	114.34	124.81	135.54	

Total = Sum(45)$_{1...12}$ = 1349.89 (45)

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

(46)m=	20.99	18.36	18.95	16.52	15.85	13.68	12.67	14.54	14.72	17.15	18.72	20.33	(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)

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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=	48.09	41.86	44.59	41.46	41.1	38.08	39.35	41.1	41.46	44.59	44.85	48.09	(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=	188.05	164.26	170.91	151.59	146.76	129.26	123.84	138.05	139.58	158.94	169.66	183.63	(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)

Output from water heater

(64)m=	188.05	164.26	170.91	151.59	146.76	129.26	123.84	138.05	139.58	158.94	169.66	183.63	

Output from water heater (annual)$_{1...12}$ 1864.52 (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=	58.56	51.16	53.15	46.98	45.41	39.84	37.93	42.51	42.99	49.17	52.71	57.09	(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=	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	(66)

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

(67)m=	16.97	15.07	12.26	9.28	6.94	5.86	6.33	8.22	11.04	14.02	16.36	17.44	(67)

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

(68)m=	190.32	192.29	187.31	176.72	163.35	150.78	142.38	140.4	145.38	155.98	169.35	181.92	(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=	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	(71)

Water heating gains (Table 5)

(72)m=	78.71	76.14	71.43	65.25	61.03	55.33	50.98	57.14	59.71	66.09	73.21	76.73	(72)

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

(73)m=	344.58	342.09	329.59	309.84	289.9	270.55	258.27	264.35	274.71	294.66	317.51	334.68	(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)	
Northeast	0.9x	0.77	x	1.81	x	11.28	x	0.63	x	0.7	=	6.24	(75)
Northeast	0.9x	0.77	x	1.81	x	22.97	x	0.63	x	0.7	=	12.7	(75)
Northeast	0.9x	0.77	x	1.81	x	41.38	x	0.63	x	0.7	=	22.89	(75)
Northeast	0.9x	0.77	x	1.81	x	67.96	x	0.63	x	0.7	=	37.59	(75)
Northeast	0.9x	0.77	x	1.81	x	91.35	x	0.63	x	0.7	=	50.53	(75)
Northeast	0.9x	0.77	x	1.81	x	97.38	x	0.63	x	0.7	=	53.87	(75)
Northeast	0.9x	0.77	x	1.81	x	91.1	x	0.63	x	0.7	=	50.39	(75)
Northeast	0.9x	0.77	x	1.81	x	72.63	x	0.63	x	0.7	=	40.17	(75)
Northeast	0.9x	0.77	x	1.81	x	50.42	x	0.63	x	0.7	=	27.89	(75)
Northeast	0.9x	0.77	x	1.81	x	28.07	x	0.63	x	0.7	=	15.53	(75)
Northeast	0.9x	0.77	x	1.81	x	14.2	x	0.63	x	0.7	=	7.85	(75)
Northeast	0.9x	0.77	x	1.81	x	9.21	x	0.63	x	0.7	=	5.1	(75)
Southeast	0.9x	0.77	x	1.05	x	36.79	x	0.63	x	0.7	=	11.81	(77)
Southeast	0.9x	0.77	x	1.05	x	62.67	x	0.63	x	0.7	=	20.11	(77)
Southeast	0.9x	0.77	x	1.05	x	85.75	x	0.63	x	0.7	=	27.52	(77)
Southeast	0.9x	0.77	x	1.05	x	106.25	x	0.63	x	0.7	=	34.1	(77)
Southeast	0.9x	0.77	x	1.05	x	119.01	x	0.63	x	0.7	=	38.19	(77)
Southeast	0.9x	0.77	x	1.05	x	118.15	x	0.63	x	0.7	=	37.91	(77)
Southeast	0.9x	0.77	x	1.05	x	113.91	x	0.63	x	0.7	=	36.55	(77)
Southeast	0.9x	0.77	x	1.05	x	104.39	x	0.63	x	0.7	=	33.5	(77)
Southeast	0.9x	0.77	x	1.05	x	92.85	x	0.63	x	0.7	=	29.8	(77)
Southeast	0.9x	0.77	x	1.05	x	69.27	x	0.63	x	0.7	=	22.23	(77)
Southeast	0.9x	0.77	x	1.05	x	44.07	x	0.63	x	0.7	=	14.14	(77)
Southeast	0.9x	0.77	x	1.05	x	31.49	x	0.63	x	0.7	=	10.1	(77)
Southwest	0.9x	0.77	x	7.35	x	36.79		0.63	x	0.7	=	82.65	(79)
Southwest	0.9x	0.77	x	7.35	x	62.67		0.63	x	0.7	=	140.78	(79)
Southwest	0.9x	0.77	x	7.35	x	85.75		0.63	x	0.7	=	192.62	(79)
Southwest	0.9x	0.77	x	7.35	x	106.25		0.63	x	0.7	=	238.67	(79)
Southwest	0.9x	0.77	x	7.35	x	119.01		0.63	x	0.7	=	267.33	(79)
Southwest	0.9x	0.77	x	7.35	x	118.15		0.63	x	0.7	=	265.4	(79)
Southwest	0.9x	0.77	x	7.35	x	113.91		0.63	x	0.7	=	255.87	(79)
Southwest	0.9x	0.77	x	7.35	x	104.39		0.63	x	0.7	=	234.49	(79)
Southwest	0.9x	0.77	x	7.35	x	92.85		0.63	x	0.7	=	208.57	(79)
Southwest	0.9x	0.77	x	7.35	x	69.27		0.63	x	0.7	=	155.59	(79)
Southwest	0.9x	0.77	x	7.35	x	44.07		0.63	x	0.7	=	98.99	(79)
Southwest	0.9x	0.77	x	7.35	x	31.49		0.63	x	0.7	=	70.73	(79)
Northwest	0.9x	0.77	x	2.1	x	11.28	x	0.63	x	0.7	=	7.24	(81)
Northwest	0.9x	0.77	x	2.1	x	22.97	x	0.63	x	0.7	=	14.74	(81)
Northwest	0.9x	0.77	x	2.1	x	41.38	x	0.63	x	0.7	=	26.56	(81)

Northwest	0.9x	0.77	x	2.1	x	67.96	x	0.63	x	0.7	=	43.61	(81)
Northwest	0.9x	0.77	x	2.1	x	91.35	x	0.63	x	0.7	=	58.62	(81)
Northwest	0.9x	0.77	x	2.1	x	97.38	x	0.63	x	0.7	=	62.5	(81)
Northwest	0.9x	0.77	x	2.1	x	91.1	x	0.63	x	0.7	=	58.47	(81)
Northwest	0.9x	0.77	x	2.1	x	72.63	x	0.63	x	0.7	=	46.61	(81)
Northwest	0.9x	0.77	x	2.1	x	50.42	x	0.63	x	0.7	=	32.36	(81)
Northwest	0.9x	0.77	x	2.1	x	28.07	x	0.63	x	0.7	=	18.01	(81)
Northwest	0.9x	0.77	x	2.1	x	14.2	x	0.63	x	0.7	=	9.11	(81)
Northwest	0.9x	0.77	x	2.1	x	9.21	x	0.63	x	0.7	=	5.91	(81)

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

(83)m=	107.94	188.34	269.59	353.97	414.67	419.68	401.28	354.77	298.61	211.36	130.1	91.84	(83)

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

(84)m=	452.51	530.42	599.18	663.8	704.57	690.23	659.56	619.13	573.33	506.02	447.61	426.52	(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	0.84	0.66	0.49	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	20	20.26	20.59	20.84	20.96	20.99	20.99	20.91	20.58	20.14	19.8	(87)

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

(88)m=	19.96	19.96	19.97	19.98	19.98	19.99	19.99	19.99	19.98	19.98	19.97	19.97	(88)

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

(89)m=	1	0.99	0.97	0.92	0.78	0.57	0.38	0.43	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=	18.41	18.67	19.04	19.5	19.82	19.96	19.98	19.98	19.91	19.5	18.87	18.37	(90)

fLA = Living area ÷ (4) = | 0.54 | (91)

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

(92)m=	19.17	19.38	19.7	20.08	20.37	20.5	20.52	20.52	20.45	20.07	19.55	19.13	(92)

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

(93)m=	19.17	19.38	19.7	20.08	20.37	20.5	20.52	20.52	20.45	20.07	19.55	19.13	(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	0.92	0.8	0.62	0.44	0.49	0.75	0.94	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	449.94	523.71	581.06	610.37	567.12	425.21	291.77	304.3	431.23	477.47	442.31	424.68	(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=	1144.92	1112.46	1011.47	848.11	656.13	442.52	294.37	308.67	477.74	717.28	946.35	1139.77	(97)

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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(98)m=	517.06	395.64	320.23	171.18	66.22	0	0	0	0	178.41	362.91	532.02		
Total per year (kWh/year) = Sum(98)1...5,9...12 =													2543.67	(98)

Space heating requirement in kWh/m²/year | 37.94 | (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)	517.06	395.64	320.23	171.18	66.22	0	0	0	0	178.41	362.91	532.02		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	553.6	423.59	342.86	183.27	70.9	0	0	0	0	191.02	388.55	569.62		(211)
Total (kWh/year) =Sum(211)1...5,10....12=													2723.42	(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)	188.05	164.26	170.91	151.59	146.76	129.26	123.84	138.05	139.58	158.94	169.66	183.63		
Efficiency of water heater													80.3	(216)
(217)m=	87.47	87.18	86.61	85.36	83.19	80.3	80.3	80.3	80.3	85.34	86.92	87.57		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	214.99	188.41	197.33	177.59	176.42	160.97	154.22	171.92	173.82	186.23	195.2	209.69		
Total = Sum(219a)1...12 =													2206.8	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2723.42	
Water heating fuel used			2206.8	
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			299.64	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			5304.85	(338)

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

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	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	588.26	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	476.67	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1064.93	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	155.51	(268)
Total CO2, kg/year			sum of (265)…(271) =		1259.36	(272)

TER = 18.78 (273)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.5.41

Property Address: 2 Bed - MF

Address : 2 Bed - MF, London, TBC

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67.05	(1a) x	2.5	(2a) =	167.63	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67.05	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	167.63	(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		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.31	(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

0.4	0.39	0.38	0.35	0.34	0.3	0.3	0.29	0.31	0.34	0.35	0.37

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=	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(24d)

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

(25)m=	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(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			3.57	x	1.2	=	4.284			(26)
Windows Type 1			1.81	x1/[1/(1.4)+ 0.04]		=	2.4			(27)
Windows Type 2			2.1	x1/[1/(1.4)+ 0.04]		=	2.78			(27)
Windows Type 3			1.05	x1/[1/(1.4)+ 0.04]		=	1.39			(27)
Windows Type 4			7.35	x1/[1/(1.4)+ 0.04]		=	9.74			(27)
Walls	58.81	15.88	42.93	x	0.18	=	7.73			(29)
Total area of elements, m²			58.81							(31)
Party wall			50.53	x	0	=	0			(32)
Party floor			67.05							(32a)
Party ceiling			67.05							(32b)
Internal wall **			87.34							(32c)

** 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) =	28.33	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	7091.18	(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		5.75	(36)

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

Total fabric heat loss	(33) + (36) =	34.09	(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=	32.09	31.92	31.75	30.96	30.81	30.12	30.12	29.99	30.38	30.81	31.11	31.42	(38)

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

(39)m=	66.17	66	65.83	65.04	64.89	64.2	64.2	64.08	64.47	64.89	65.19	65.51	

Average = Sum(39)$_{1…12}$ /12= 65.04 (39)

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

(40)m=	0.99	0.98	0.98	0.97	0.97	0.96	0.96	0.96	0.96	0.97	0.97	0.98	

Average = Sum(40)$_{1…12}$ /12= 0.97 (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 85.8 (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=	94.37	90.94	87.51	84.08	80.65	77.22	77.22	80.65	84.08	87.51	90.94	94.37	

Total = Sum(44)$_{1…12}$ = 1029.54 (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=	139.96	122.41	126.31	110.12	105.66	91.18	84.49	96.96	98.11	114.34	124.81	135.54	

Total = Sum(45)$_{1…12}$ = 1349.89 (45)

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

(46)m=	20.99	18.36	18.95	16.52	15.85	13.68	12.67	14.54	14.72	17.15	18.72	20.33	(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)

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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=	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=	48.09	41.86	44.59	41.46	41.1	38.08	39.35	41.1	41.46	44.59	44.85	48.09	(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=	188.05	164.26	170.91	151.59	146.76	129.26	123.84	138.05	139.58	158.94	169.66	183.63	(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)

Output from water heater

(64)m=	188.05	164.26	170.91	151.59	146.76	129.26	123.84	138.05	139.58	158.94	169.66	183.63

Output from water heater (annual)$_{1...12}$ | 1864.52 | (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=	58.56	51.16	53.15	46.98	45.41	39.84	37.93	42.51	42.99	49.17	52.71	57.09	(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=	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	(66)

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

(67)m=	16.97	15.07	12.26	9.28	6.94	5.86	6.33	8.22	11.04	14.02	16.36	17.44	(67)

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

(68)m=	190.32	192.29	187.31	176.72	163.35	150.78	142.38	140.4	145.38	155.98	169.35	181.92	(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=	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	(71)

Water heating gains (Table 5)

(72)m=	78.71	76.14	71.43	65.25	61.03	55.33	50.98	57.14	59.71	66.09	73.21	76.73	(72)

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

(73)m=	344.58	342.09	329.59	309.84	289.9	270.55	258.27	264.35	274.71	294.66	317.51	334.68	(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)

Northeast	0.9x	0.77	x	1.81	x	11.28	x	0.63	x	0.7	=	6.24	(75)
Northeast	0.9x	0.77	x	1.81	x	22.97	x	0.63	x	0.7	=	12.7	(75)
Northeast	0.9x	0.77	x	1.81	x	41.38	x	0.63	x	0.7	=	22.89	(75)
Northeast	0.9x	0.77	x	1.81	x	67.96	x	0.63	x	0.7	=	37.59	(75)
Northeast	0.9x	0.77	x	1.81	x	91.35	x	0.63	x	0.7	=	50.53	(75)
Northeast	0.9x	0.77	x	1.81	x	97.38	x	0.63	x	0.7	=	53.87	(75)
Northeast	0.9x	0.77	x	1.81	x	91.1	x	0.63	x	0.7	=	50.39	(75)
Northeast	0.9x	0.77	x	1.81	x	72.63	x	0.63	x	0.7	=	40.17	(75)
Northeast	0.9x	0.77	x	1.81	x	50.42	x	0.63	x	0.7	=	27.89	(75)
Northeast	0.9x	0.77	x	1.81	x	28.07	x	0.63	x	0.7	=	15.53	(75)
Northeast	0.9x	0.77	x	1.81	x	14.2	x	0.63	x	0.7	=	7.85	(75)
Northeast	0.9x	0.77	x	1.81	x	9.21	x	0.63	x	0.7	=	5.1	(75)
Southeast	0.9x	0.77	x	1.05	x	36.79	x	0.63	x	0.7	=	11.81	(77)
Southeast	0.9x	0.77	x	1.05	x	62.67	x	0.63	x	0.7	=	20.11	(77)
Southeast	0.9x	0.77	x	1.05	x	85.75	x	0.63	x	0.7	=	27.52	(77)
Southeast	0.9x	0.77	x	1.05	x	106.25	x	0.63	x	0.7	=	34.1	(77)
Southeast	0.9x	0.77	x	1.05	x	119.01	x	0.63	x	0.7	=	38.19	(77)
Southeast	0.9x	0.77	x	1.05	x	118.15	x	0.63	x	0.7	=	37.91	(77)
Southeast	0.9x	0.77	x	1.05	x	113.91	x	0.63	x	0.7	=	36.55	(77)
Southeast	0.9x	0.77	x	1.05	x	104.39	x	0.63	x	0.7	=	33.5	(77)
Southeast	0.9x	0.77	x	1.05	x	92.85	x	0.63	x	0.7	=	29.8	(77)
Southeast	0.9x	0.77	x	1.05	x	69.27	x	0.63	x	0.7	=	22.23	(77)
Southeast	0.9x	0.77	x	1.05	x	44.07	x	0.63	x	0.7	=	14.14	(77)
Southeast	0.9x	0.77	x	1.05	x	31.49	x	0.63	x	0.7	=	10.1	(77)
Southwest	0.9x	0.77	x	7.35	x	36.79		0.63	x	0.7	=	82.65	(79)
Southwest	0.9x	0.77	x	7.35	x	62.67		0.63	x	0.7	=	140.78	(79)
Southwest	0.9x	0.77	x	7.35	x	85.75		0.63	x	0.7	=	192.62	(79)
Southwest	0.9x	0.77	x	7.35	x	106.25		0.63	x	0.7	=	238.67	(79)
Southwest	0.9x	0.77	x	7.35	x	119.01		0.63	x	0.7	=	267.33	(79)
Southwest	0.9x	0.77	x	7.35	x	118.15		0.63	x	0.7	=	265.4	(79)
Southwest	0.9x	0.77	x	7.35	x	113.91		0.63	x	0.7	=	255.87	(79)
Southwest	0.9x	0.77	x	7.35	x	104.39		0.63	x	0.7	=	234.49	(79)
Southwest	0.9x	0.77	x	7.35	x	92.85		0.63	x	0.7	=	208.57	(79)
Southwest	0.9x	0.77	x	7.35	x	69.27		0.63	x	0.7	=	155.59	(79)
Southwest	0.9x	0.77	x	7.35	x	44.07		0.63	x	0.7	=	98.99	(79)
Southwest	0.9x	0.77	x	7.35	x	31.49		0.63	x	0.7	=	70.73	(79)
Northwest	0.9x	0.77	x	2.1	x	11.28	x	0.63	x	0.7	=	7.24	(81)
Northwest	0.9x	0.77	x	2.1	x	22.97	x	0.63	x	0.7	=	14.74	(81)
Northwest	0.9x	0.77	x	2.1	x	41.38	x	0.63	x	0.7	=	26.56	(81)
Northwest	0.9x	0.77	x	2.1	x	67.96	x	0.63	x	0.7	=	43.61	(81)
Northwest	0.9x	0.77	x	2.1	x	91.35	x	0.63	x	0.7	=	58.62	(81)

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Northwest	0.9x	0.77	x	2.1	x	97.38	x	0.63	x	0.7	=	62.5	(81)
Northwest	0.9x	0.77	x	2.1	x	91.1	x	0.63	x	0.7	=	58.47	(81)
Northwest	0.9x	0.77	x	2.1	x	72.63	x	0.63	x	0.7	=	46.61	(81)
Northwest	0.9x	0.77	x	2.1	x	50.42	x	0.63	x	0.7	=	32.36	(81)
Northwest	0.9x	0.77	x	2.1	x	28.07	x	0.63	x	0.7	=	18.01	(81)
Northwest	0.9x	0.77	x	2.1	x	14.2	x	0.63	x	0.7	=	9.11	(81)
Northwest	0.9x	0.77	x	2.1	x	9.21	x	0.63	x	0.7	=	5.91	(81)

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

(83)m=	107.94	188.34	269.59	353.97	414.67	419.68	401.28	354.77	298.61	211.36	130.1	91.84	(83)

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

(84)m=	452.51	530.42	599.18	663.8	704.57	690.23	659.56	619.13	573.33	506.02	447.61	426.52	(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	0.78	0.58	0.43	0.47	0.73	0.94	0.99	1	(86)

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

(87)m=	20.06	20.22	20.46	20.74	20.92	20.99	21	21	20.96	20.71	20.33	20.02	(87)

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

(88)m=	20.09	20.1	20.1	20.11	20.11	20.12	20.12	20.12	20.12	20.11	20.11	20.1	(88)

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

(89)m=	1	0.99	0.96	0.89	0.73	0.51	0.34	0.38	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=	18.84	19.08	19.43	19.81	20.04	20.11	20.12	20.12	20.09	19.79	19.25	18.8	(90)

fLA = Living area ÷ (4) = 0.54 (91)

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

(92)m=	19.49	19.69	19.98	20.31	20.51	20.58	20.59	20.59	20.55	20.29	19.83	19.45	(92)

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

(93)m=	19.49	19.69	19.98	20.31	20.51	20.58	20.59	20.59	20.55	20.29	19.83	19.45	(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	0.96	0.9	0.75	0.55	0.39	0.43	0.69	0.93	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	449.85	522.83	576.98	594.38	529.25	378.31	255.51	267.27	396.14	469.48	441.63	424.67	(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=	1005.13	976.42	887.53	742.08	571.76	383.98	256.14	268.43	416.07	628.55	829.7	999.19	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	413.13	304.81	231.05	106.35	31.63	0	0	0	0	118.35	279.41	427.45	

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	1912.17	(98)
Space heating requirement in kWh/m²/year	28.52	(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)	413.13	304.81	231.05	106.35	31.63	0	0	0	0	118.35	279.41	427.45		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	442.32	326.35	247.38	113.86	33.86	0	0	0	0	126.71	299.16	457.65		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													2047.29	(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)	188.05	164.26	170.91	151.59	146.76	129.26	123.84	138.05	139.58	158.94	169.66	183.63		
Efficiency of water heater													80.3	(216)
(217)m=	86.98	86.59	85.81	84.18	81.92	80.3	80.3	80.3	80.3	84.32	86.3	87.11		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	216.2	189.71	199.17	180.08	179.15	160.97	154.22	171.92	173.82	188.49	196.6	210.81		
Total = Sum(219a)$_{1...12}$ =													2221.13	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2047.29	
Water heating fuel used			2221.13	
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			299.64	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			4643.07	(338)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh	**Emissions** kg CO2/year

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Space heating (main system 1)	(211) x	0.216	=	442.21 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.216	=	479.76 (264)
Space and water heating	(261) + (262) + (263) + (264) =			921.98 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93 (267)
Electricity for lighting	(232) x	0.519	=	155.51 (268)
Total CO2, kg/year		sum of (265)…(271) =		1116.42 (272)

TER = 16.65 (273)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: 2 Bed - TF

Address : 2 Bed - TF, London, TBC

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67.05	(1a) x	2.5	(2a) =	167.63	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67.05	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		167.63	(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		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.31	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

Wind Factor (22a)m = (22)m ÷ 4

	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
(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

0.4	0.39	0.38	0.35	0.34	0.3	0.3	0.29	0.31	0.34	0.35	0.37

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=	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(24d)

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

(25)m=	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(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			3.57	x	1.2	=	4.284			(26)
Windows Type 1			1.81	x1/[1/(1.4)+ 0.04]		=	2.4			(27)
Windows Type 2			2.1	x1/[1/(1.4)+ 0.04]		=	2.78			(27)
Windows Type 3			1.05	x1/[1/(1.4)+ 0.04]		=	1.39			(27)
Windows Type 4			7.35	x1/[1/(1.4)+ 0.04]		=	9.74			(27)
Walls	58.81	15.88	42.93	x	0.18	=	7.73			(29)
Roof	67.05	0	67.05	x	0.13	=	8.72			(30)
Total area of elements, m²			125.86							(31)
Party wall			50.53	x	0	=	0			(32)
Party floor			67.05							(32a)
Internal wall **			87.34							(32c)

** 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) = 37.05 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5683.13 (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 19.7 (36)

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

Total fabric heat loss (33) + (36) = 56.75 (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=	32.09	31.92	31.75	30.96	30.81	30.12	30.12	29.99	30.38	30.81	31.11	31.42	(38)

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

(39)m=	88.84	88.67	88.5	87.71	87.56	86.87	86.87	86.74	87.14	87.56	87.86	88.17	

Average = Sum(39)$_{1...12}$ /12= 87.71 (39)

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

(40)m=	1.32	1.32	1.32	1.31	1.31	1.3	1.3	1.29	1.3	1.31	1.31	1.32	

Average = Sum(40)$_{1...12}$ /12= 1.31 (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 85.8 (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=	94.37	90.94	87.51	84.08	80.65	77.22	77.22	80.65	84.08	87.51	90.94	94.37	

Total = Sum(44)$_{1...12}$ = 1029.54 (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=	139.96	122.41	126.31	110.12	105.66	91.18	84.49	96.96	98.11	114.34	124.81	135.54	

Total = Sum(45)$_{1...12}$ = 1349.89 (45)

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

(46)m=	20.99	18.36	18.95	16.52	15.85	13.68	12.67	14.54	14.72	17.15	18.72	20.33	(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=	48.09	41.86	44.59	41.46	41.1	38.08	39.35	41.1	41.46	44.59	44.85	48.09	(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=	188.05	164.26	170.91	151.59	146.76	129.26	123.84	138.05	139.58	158.94	169.66	183.63	(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)

Output from water heater

(64)m=	188.05	164.26	170.91	151.59	146.76	129.26	123.84	138.05	139.58	158.94	169.66	183.63

Output from water heater (annual)$_{1...12}$ | 1864.52 | (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=	58.56	51.16	53.15	46.98	45.41	39.84	37.93	42.51	42.99	49.17	52.71	57.09	(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=	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	(66)

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

(67)m=	16.97	15.07	12.26	9.28	6.94	5.86	6.33	8.22	11.04	14.02	16.36	17.44	(67)

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

(68)m=	190.32	192.29	187.31	176.72	163.35	150.78	142.38	140.4	145.38	155.98	169.35	181.92	(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=	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	(71)

Water heating gains (Table 5)

(72)m=	78.71	76.14	71.43	65.25	61.03	55.33	50.98	57.14	59.71	66.09	73.21	76.73	(72)

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

(73)m=	344.58	342.09	329.59	309.84	289.9	270.55	258.27	264.35	274.71	294.66	317.51	334.68	(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)

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Northeast	0.9x	0.77	x	1.81	x	11.28	x	0.63	x	0.7	=	6.24	(75)
Northeast	0.9x	0.77	x	1.81	x	22.97	x	0.63	x	0.7	=	12.7	(75)
Northeast	0.9x	0.77	x	1.81	x	41.38	x	0.63	x	0.7	=	22.89	(75)
Northeast	0.9x	0.77	x	1.81	x	67.96	x	0.63	x	0.7	=	37.59	(75)
Northeast	0.9x	0.77	x	1.81	x	91.35	x	0.63	x	0.7	=	50.53	(75)
Northeast	0.9x	0.77	x	1.81	x	97.38	x	0.63	x	0.7	=	53.87	(75)
Northeast	0.9x	0.77	x	1.81	x	91.1	x	0.63	x	0.7	=	50.39	(75)
Northeast	0.9x	0.77	x	1.81	x	72.63	x	0.63	x	0.7	=	40.17	(75)
Northeast	0.9x	0.77	x	1.81	x	50.42	x	0.63	x	0.7	=	27.89	(75)
Northeast	0.9x	0.77	x	1.81	x	28.07	x	0.63	x	0.7	=	15.53	(75)
Northeast	0.9x	0.77	x	1.81	x	14.2	x	0.63	x	0.7	=	7.85	(75)
Northeast	0.9x	0.77	x	1.81	x	9.21	x	0.63	x	0.7	=	5.1	(75)
Southeast	0.9x	0.77	x	1.05	x	36.79	x	0.63	x	0.7	=	11.81	(77)
Southeast	0.9x	0.77	x	1.05	x	62.67	x	0.63	x	0.7	=	20.11	(77)
Southeast	0.9x	0.77	x	1.05	x	85.75	x	0.63	x	0.7	=	27.52	(77)
Southeast	0.9x	0.77	x	1.05	x	106.25	x	0.63	x	0.7	=	34.1	(77)
Southeast	0.9x	0.77	x	1.05	x	119.01	x	0.63	x	0.7	=	38.19	(77)
Southeast	0.9x	0.77	x	1.05	x	118.15	x	0.63	x	0.7	=	37.91	(77)
Southeast	0.9x	0.77	x	1.05	x	113.91	x	0.63	x	0.7	=	36.55	(77)
Southeast	0.9x	0.77	x	1.05	x	104.39	x	0.63	x	0.7	=	33.5	(77)
Southeast	0.9x	0.77	x	1.05	x	92.85	x	0.63	x	0.7	=	29.8	(77)
Southeast	0.9x	0.77	x	1.05	x	69.27	x	0.63	x	0.7	=	22.23	(77)
Southeast	0.9x	0.77	x	1.05	x	44.07	x	0.63	x	0.7	=	14.14	(77)
Southeast	0.9x	0.77	x	1.05	x	31.49	x	0.63	x	0.7	=	10.1	(77)
Southwest	0.9x	0.77	x	7.35	x	36.79		0.63	x	0.7	=	82.65	(79)
Southwest	0.9x	0.77	x	7.35	x	62.67		0.63	x	0.7	=	140.78	(79)
Southwest	0.9x	0.77	x	7.35	x	85.75		0.63	x	0.7	=	192.62	(79)
Southwest	0.9x	0.77	x	7.35	x	106.25		0.63	x	0.7	=	238.67	(79)
Southwest	0.9x	0.77	x	7.35	x	119.01		0.63	x	0.7	=	267.33	(79)
Southwest	0.9x	0.77	x	7.35	x	118.15		0.63	x	0.7	=	265.4	(79)
Southwest	0.9x	0.77	x	7.35	x	113.91		0.63	x	0.7	=	255.87	(79)
Southwest	0.9x	0.77	x	7.35	x	104.39		0.63	x	0.7	=	234.49	(79)
Southwest	0.9x	0.77	x	7.35	x	92.85		0.63	x	0.7	=	208.57	(79)
Southwest	0.9x	0.77	x	7.35	x	69.27		0.63	x	0.7	=	155.59	(79)
Southwest	0.9x	0.77	x	7.35	x	44.07		0.63	x	0.7	=	98.99	(79)
Southwest	0.9x	0.77	x	7.35	x	31.49		0.63	x	0.7	=	70.73	(79)
Northwest	0.9x	0.77	x	2.1	x	11.28	x	0.63	x	0.7	=	7.24	(81)
Northwest	0.9x	0.77	x	2.1	x	22.97	x	0.63	x	0.7	=	14.74	(81)
Northwest	0.9x	0.77	x	2.1	x	41.38	x	0.63	x	0.7	=	26.56	(81)
Northwest	0.9x	0.77	x	2.1	x	67.96	x	0.63	x	0.7	=	43.61	(81)
Northwest	0.9x	0.77	x	2.1	x	91.35	x	0.63	x	0.7	=	58.62	(81)

Northwest 0.9x	0.77	x	2.1	x	97.38	x	0.63	x	0.7	=	62.5	(81)
Northwest 0.9x	0.77	x	2.1	x	91.1	x	0.63	x	0.7	=	58.47	(81)
Northwest 0.9x	0.77	x	2.1	x	72.63	x	0.63	x	0.7	=	46.61	(81)
Northwest 0.9x	0.77	x	2.1	x	50.42	x	0.63	x	0.7	=	32.36	(81)
Northwest 0.9x	0.77	x	2.1	x	28.07	x	0.63	x	0.7	=	18.01	(81)
Northwest 0.9x	0.77	x	2.1	x	14.2	x	0.63	x	0.7	=	9.11	(81)
Northwest 0.9x	0.77	x	2.1	x	9.21	x	0.63	x	0.7	=	5.91	(81)

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

(83)m=	107.94	188.34	269.59	353.97	414.67	419.68	401.28	354.77	298.61	211.36	130.1	91.84	(83)

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

(84)m=	452.51	530.42	599.18	663.8	704.57	690.23	659.56	619.13	573.33	506.02	447.61	426.52	(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	0.87	0.72	0.56	0.61	0.84	0.97	0.99	1	(86)

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

(87)m=	19.6	19.78	20.06	20.42	20.73	20.92	20.98	20.97	20.84	20.43	19.94	19.56	(87)

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

(88)m=	19.82	19.82	19.83	19.83	19.84	19.84	19.84	19.85	19.84	19.84	19.83	19.83	(88)

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

(89)m=	1	0.99	0.98	0.93	0.82	0.62	0.42	0.47	0.76	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=	17.98	18.24	18.64	19.16	19.57	19.79	19.84	19.83	19.71	19.18	18.49	17.93	(90)

fLA = Living area ÷ (4) = | 0.54 | (91)

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

(92)m=	18.84	19.06	19.4	19.83	20.19	20.4	20.45	20.44	20.31	19.85	19.27	18.81	(92)

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

(93)m=	18.84	19.06	19.4	19.83	20.19	20.4	20.45	20.44	20.31	19.85	19.27	18.81	(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	0.93	0.84	0.67	0.5	0.55	0.8	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	449.87	524.03	583.14	619.54	592.56	464.68	326.88	338.97	456.38	481.85	442.54	424.59	(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=	1292.13	1255.61	1141.61	958.74	743.58	503.61	334.43	350.73	541.48	809.88	1068.93	1287.81	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	626.64	491.62	415.5	244.22	112.36	0	0	0	0	244.05	451.01	642.23	

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	3227.63	(98)
Space heating requirement in kWh/m²/year	48.14	(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)	626.64	491.62	415.5	244.22	112.36	0	0	0	0	244.05	451.01	642.23		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	670.92	526.36	444.86	261.48	120.3	0	0	0	0	261.3	482.88	687.62		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													3455.71	(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)	188.05	164.26	170.91	151.59	146.76	129.26	123.84	138.05	139.58	158.94	169.66	183.63		
Efficiency of water heater													80.3	(216)
(217)m=	87.85	87.64	87.2	86.25	84.39	80.3	80.3	80.3	80.3	86.13	87.4	87.94		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	214.06	187.43	195.99	175.76	173.91	160.97	154.22	171.92	173.82	184.54	194.13	208.81		
Total = Sum(219a)$_{1...12}$ =													2195.56	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3455.71	
Water heating fuel used			2195.56	
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			299.64	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			6025.91	(338)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh	**Emissions** kg CO2/year

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Space heating (main system 1)	(211) x	0.216	=	746.43	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	474.24	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1220.67	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	155.51	(268)
Total CO2, kg/year		sum of (265)…(271) =		1415.11	(272)

TER = 21.11 (273)

Be Lean

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.41

Property Address: 1 Bed End - GF

Address : 1 Bed End - GF, London, TBC

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	55.94	(1a) x	2.5	(2a) =	139.85	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.94	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	139.85	(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		2	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.1	(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) =	0.08	(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

0.11	0.11	0.1	0.09	0.09	0.08	0.08	0.08	0.08	0.09	0.1	0.1

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) = 75.65 (23c)

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

(24a)m=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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			3.57	x	1	=	3.57			(26)
Windows Type 1			7.35	x	1/[1/(1)+ 0.04]	=	7.07			(27)
Windows Type 2			3.8	x	1/[1/(1)+ 0.04]	=	3.65			(27)
Windows Type 3			2.21	x	1/[1/(1)+ 0.04]	=	2.13			(27)
Floor			55.94	x	0.13	=	7.2722	75	4195.5	(28)
Walls	64.93	16.93	48	x	0.18	=	8.64	14	672	(29)
Total area of elements, m²			120.87							(31)
Party wall			19.92	x	0	=	0	20	398.4	(32)
Party ceiling			55.94					30	1678.2	(32b)
Internal wall **			63.63					9	572.67	(32c)

** 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) = 32.33 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7516.77 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 134.37 (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 11.84 (36)

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

Total fabric heat loss (33) + (36) = 44.17 (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=	10.62	10.52	10.42	9.93	9.84	9.35	9.35	9.25	9.54	9.84	10.03	10.23	(38)

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

(39)m=	54.79	54.69	54.59	54.1	54.01	53.52	53.52	53.42	53.71	54.01	54.2	54.4	

Average = Sum(39)$_{1...12}$ /12= 54.08 (39)

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

(40)m=	0.98	0.98	0.98	0.97	0.97	0.96	0.96	0.95	0.96	0.97	0.97	0.97	

Average = Sum(40)$_{1...12}$ /12= 0.97 (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 1.86 (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 78.49 (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=	86.34	83.2	80.06	76.92	73.78	70.64	70.64	73.78	76.92	80.06	83.2	86.34	

Total = Sum(44)$_{1...12}$ = 941.88 (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=	128.04	111.98	115.56	100.75	96.67	83.42	77.3	88.7	89.76	104.61	114.19	124	

Total = Sum(45)$_{1...12}$ = 1234.95 (45)

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

(46)m=	19.21	16.8	17.33	15.11	14.5	12.51	11.59	13.31	13.46	15.69	17.13	18.6	(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=	14.02	12.65	13.98	13.5	13.93	13.45	13.89	13.91	13.48	13.96	13.54	14.01	(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=	142.06	124.63	129.54	114.24	110.59	96.87	91.19	102.61	103.24	118.56	127.73	138.01	(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)

Output from water heater

(64)m=	142.06	124.63	129.54	114.24	110.59	96.87	91.19	102.61	103.24	118.56	127.73	138.01

Output from water heater (annual)$_{1...12}$ | 1399.28 | (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=	46.08	40.4	41.92	36.87	35.62	31.1	29.17	32.97	33.21	38.27	41.35	44.73	(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=	93.24	93.24	93.24	93.24	93.24	93.24	93.24	93.24	93.24	93.24	93.24	93.24	(66)

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

(67)m=	14.5	12.88	10.47	7.93	5.93	5	5.41	7.03	9.43	11.97	13.98	14.9	(67)

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

(68)m=	162.6	164.29	160.04	150.99	139.56	128.82	121.65	119.96	124.21	133.26	144.69	155.43	(68)

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

(69)m=	32.32	32.32	32.32	32.32	32.32	32.32	32.32	32.32	32.32	32.32	32.32	32.32	(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=	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	(71)

Water heating gains (Table 5)

(72)m=	61.93	60.11	56.34	51.21	47.88	43.19	39.21	44.32	46.13	51.44	57.43	60.12	(72)

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

(73)m=	293.01	291.25	280.82	264.1	247.34	230.99	220.24	225.28	233.75	250.65	270.07	284.43	(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)	
Southeast	0.9x	0.77	x	3.8	x	36.79	x	0.3	x	0.7	=	20.35	(77)
Southeast	0.9x	0.77	x	3.8	x	62.67	x	0.3	x	0.7	=	34.66	(77)

Southeast	0.9x	0.77	x	3.8	x	85.75	x	0.3	x	0.7	=	47.42	(77)
Southeast	0.9x	0.77	x	3.8	x	106.25	x	0.3	x	0.7	=	58.76	(77)
Southeast	0.9x	0.77	x	3.8	x	119.01	x	0.3	x	0.7	=	65.81	(77)
Southeast	0.9x	0.77	x	3.8	x	118.15	x	0.3	x	0.7	=	65.34	(77)
Southeast	0.9x	0.77	x	3.8	x	113.91	x	0.3	x	0.7	=	62.99	(77)
Southeast	0.9x	0.77	x	3.8	x	104.39	x	0.3	x	0.7	=	57.73	(77)
Southeast	0.9x	0.77	x	3.8	x	92.85	x	0.3	x	0.7	=	51.35	(77)
Southeast	0.9x	0.77	x	3.8	x	69.27	x	0.3	x	0.7	=	38.31	(77)
Southeast	0.9x	0.77	x	3.8	x	44.07	x	0.3	x	0.7	=	24.37	(77)
Southeast	0.9x	0.77	x	3.8	x	31.49	x	0.3	x	0.7	=	17.41	(77)
Southwest	0.9x	0.77	x	2.21	x	36.79		0.3	x	0.7	=	11.83	(79)
Southwest	0.9x	0.77	x	2.21	x	62.67		0.3	x	0.7	=	20.16	(79)
Southwest	0.9x	0.77	x	2.21	x	85.75		0.3	x	0.7	=	27.58	(79)
Southwest	0.9x	0.77	x	2.21	x	106.25		0.3	x	0.7	=	34.17	(79)
Southwest	0.9x	0.77	x	2.21	x	119.01		0.3	x	0.7	=	38.28	(79)
Southwest	0.9x	0.77	x	2.21	x	118.15		0.3	x	0.7	=	38	(79)
Southwest	0.9x	0.77	x	2.21	x	113.91		0.3	x	0.7	=	36.64	(79)
Southwest	0.9x	0.77	x	2.21	x	104.39		0.3	x	0.7	=	33.57	(79)
Southwest	0.9x	0.77	x	2.21	x	92.85		0.3	x	0.7	=	29.86	(79)
Southwest	0.9x	0.77	x	2.21	x	69.27		0.3	x	0.7	=	22.28	(79)
Southwest	0.9x	0.77	x	2.21	x	44.07		0.3	x	0.7	=	14.17	(79)
Southwest	0.9x	0.77	x	2.21	x	31.49		0.3	x	0.7	=	10.13	(79)
Northwest	0.9x	0.77	x	7.35	x	11.28	x	0.3	x	0.7	=	12.07	(81)
Northwest	0.9x	0.77	x	7.35	x	22.97	x	0.3	x	0.7	=	24.57	(81)
Northwest	0.9x	0.77	x	7.35	x	41.38	x	0.3	x	0.7	=	44.26	(81)
Northwest	0.9x	0.77	x	7.35	x	67.96	x	0.3	x	0.7	=	72.69	(81)
Northwest	0.9x	0.77	x	7.35	x	91.35	x	0.3	x	0.7	=	97.71	(81)
Northwest	0.9x	0.77	x	7.35	x	97.38	x	0.3	x	0.7	=	104.17	(81)
Northwest	0.9x	0.77	x	7.35	x	91.1	x	0.3	x	0.7	=	97.45	(81)
Northwest	0.9x	0.77	x	7.35	x	72.63	x	0.3	x	0.7	=	77.69	(81)
Northwest	0.9x	0.77	x	7.35	x	50.42	x	0.3	x	0.7	=	53.93	(81)
Northwest	0.9x	0.77	x	7.35	x	28.07	x	0.3	x	0.7	=	30.02	(81)
Northwest	0.9x	0.77	x	7.35	x	14.2	x	0.3	x	0.7	=	15.19	(81)
Northwest	0.9x	0.77	x	7.35	x	9.21	x	0.3	x	0.7	=	9.86	(81)

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

(83)m=	44.25	79.38	119.26	165.62	201.8	207.51	197.07	168.99	135.14	90.61	53.73	37.4	(83)

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

(84)m=	337.26	370.64	400.09	429.72	449.14	438.5	417.31	394.26	368.89	341.26	323.8	321.82	(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=	0.98	0.97	0.95	0.91	0.82	0.68	0.53	0.58	0.78	0.93	0.97	0.98	(86)

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

(87)m=	19.37	19.55	19.86	20.26	20.63	20.87	20.96	20.95	20.77	20.31	19.77	19.33	(87)

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

(88)m=	20.1	20.1	20.1	20.11	20.11	20.12	20.12	20.12	20.12	20.11	20.11	20.11	(88)

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

(89)m=	0.98	0.97	0.95	0.89	0.79	0.61	0.44	0.48	0.73	0.91	0.97	0.98	(89)

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

(90)m=	17.92	18.17	18.62	19.2	19.7	20.01	20.09	20.09	19.89	19.28	18.5	17.86	(90)

fLA = Living area ÷ (4) = | 0.6 | (91)

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

(92)m=	18.8	19.01	19.37	19.84	20.26	20.53	20.62	20.61	20.42	19.9	19.27	18.75	(92)

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

(93)m=	18.65	18.86	19.22	19.69	20.11	20.38	20.47	20.46	20.27	19.75	19.12	18.6	(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=	0.97	0.96	0.93	0.88	0.79	0.63	0.48	0.52	0.74	0.9	0.96	0.97	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	327.42	355.34	373.99	379.38	352.97	276.84	198.26	204.59	272.51	306.88	309.79	313.69	(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=	786.03	763.24	694.19	583.87	454.17	309.26	206.95	216.61	331.57	494.31	651.55	783.35	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	341.21	274.11	238.23	147.23	75.3	0	0	0	0	139.45	246.07	349.43	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 1811.03 | (98)

Space heating requirement in kWh/m²/year | 32.37 | (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		90.5	(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)													
	341.21	274.11	238.23	147.23	75.3	0	0	0	0	139.45	246.07	349.43	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	377.03	302.89	263.24	162.69	83.2	0	0	0	0	154.09	271.9	386.11	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= | 2001.13 | (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)

142.06	124.63	129.54	114.24	110.59	96.87	91.19	102.61	103.24	118.56	127.73	138.01

Efficiency of water heater 87.3 (216)

(217)m=	89.54	89.47	89.35	89.07	88.57	87.3	87.3	87.3	87.3	89	89.38	89.57

(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	158.66	139.29	144.98	128.26	124.87	110.96	104.45	117.54	118.26	133.22	142.9	154.08

Total = Sum(219a)$_{1...12}$ = 1577.48 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2001.13	
Water heating fuel used		1577.48	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	153.56		(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) =	228.56	(231)
Electricity for lighting		256.01	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		4063.17	(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	=	432.24	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	340.73	(264)
Space and water heating	(261) + (262) + (263) + (264) =			772.98	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	118.62	(267)
Electricity for lighting	(232) x	0.519	=	132.87	(268)
Total CO2, kg/year		sum of (265)…(271) =		1024.47	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		18.31	(273)
EI rating (section 14)				86	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: 1 Bed End - TF

Address : 1 Bed End - TF, London, TBC

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	55.94	(1a) x	2.5	(2a) =	139.85	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.94	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	139.85	(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		2	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.1	(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) =	0.08	(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

0.11	0.11	0.1	0.09	0.09	0.08	0.08	0.08	0.08	0.09	0.1	0.1

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) = 75.65 (23c)

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

(24a)m=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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			3.57	x	1	=	3.57			(26)
Windows Type 1			7.35	x	1/[1/(1)+ 0.04]	=	7.07			(27)
Windows Type 2			3.8	x	1/[1/(1)+ 0.04]	=	3.65			(27)
Windows Type 3			2.21	x	1/[1/(1)+ 0.04]	=	2.13			(27)
Walls	64.93	16.93	48	x	0.18	=	8.64	14	672	(29)
Roof	55.94	0	55.94	x	0.11	=	6.15	9	503.46	(30)
Total area of elements, m²			120.87							(31)
Party wall			19.92	x	0	=	0	20	398.4	(32)
Party floor			55.94					40	2237.6	(32a)
Internal wall **			63.63					9	572.67	(32c)

** 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) = 31.21 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 4384.13 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 78.37 (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 15.6 (36)

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

Total fabric heat loss (33) + (36) = 46.8 (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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	10.62	10.52	10.42	9.93	9.84	9.35	9.35	9.25	9.54	9.84	10.03	10.23	(38)

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

(39)m=	57.43	57.33	57.23	56.74	56.64	56.15	56.15	56.05	56.35	56.64	56.84	57.03	

Average = $\text{Sum}(39)_{1...12}$ /12= 56.71 (39)

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

(40)m=	1.03	1.02	1.02	1.01	1.01	1	1	1	1.01	1.01	1.02	1.02	

Average = $\text{Sum}(40)_{1...12}$ /12= 1.01 (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 1.86 (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 78.49 (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=	86.34	83.2	80.06	76.92	73.78	70.64	70.64	73.78	76.92	80.06	83.2	86.34	

Total = $\text{Sum}(44)_{1...12}$ = 941.88 (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=	128.04	111.98	115.56	100.75	96.67	83.42	77.3	88.7	89.76	104.61	114.19	124	

Total = $\text{Sum}(45)_{1...12}$ = 1234.95 (45)

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

(46)m=	19.21	16.8	17.33	15.11	14.5	12.51	11.59	13.31	13.46	15.69	17.13	18.6	(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=	14.02	12.65	13.98	13.5	13.93	13.45	13.89	13.91	13.48	13.96	13.54	14.01	(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=	142.06	124.63	129.54	114.24	110.59	96.87	91.19	102.61	103.24	118.56	127.73	138.01	(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)

Output from water heater

(64)m=	142.06	124.63	129.54	114.24	110.59	96.87	91.19	102.61	103.24	118.56	127.73	138.01

Output from water heater (annual)$_{1…12}$	1399.28	(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=	46.08	40.4	41.92	36.87	35.62	31.1	29.17	32.97	33.21	38.27	41.35	44.73	(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=	93.24	93.24	93.24	93.24	93.24	93.24	93.24	93.24	93.24	93.24	93.24	93.24	(66)

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

(67)m=	14.5	12.88	10.47	7.93	5.93	5	5.41	7.03	9.43	11.97	13.98	14.9	(67)

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

(68)m=	162.6	164.29	160.04	150.99	139.56	128.82	121.65	119.96	124.21	133.26	144.69	155.43	(68)

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

(69)m=	32.32	32.32	32.32	32.32	32.32	32.32	32.32	32.32	32.32	32.32	32.32	32.32	(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=	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	(71)

Water heating gains (Table 5)

(72)m=	61.93	60.11	56.34	51.21	47.88	43.19	39.21	44.32	46.13	51.44	57.43	60.12	(72)

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

(73)m=	293.01	291.25	280.82	264.1	247.34	230.99	220.24	225.28	233.75	250.65	270.07	284.43	(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)	
Southeast	0.9x	0.77	x	3.8	x	36.79	x	0.3	x	0.7	=	20.35	(77)
Southeast	0.9x	0.77	x	3.8	x	62.67	x	0.3	x	0.7	=	34.66	(77)

Southeast	0.9x	0.77	x	3.8	x	85.75	x	0.3	x	0.7	=	47.42	(77)
Southeast	0.9x	0.77	x	3.8	x	106.25	x	0.3	x	0.7	=	58.76	(77)
Southeast	0.9x	0.77	x	3.8	x	119.01	x	0.3	x	0.7	=	65.81	(77)
Southeast	0.9x	0.77	x	3.8	x	118.15	x	0.3	x	0.7	=	65.34	(77)
Southeast	0.9x	0.77	x	3.8	x	113.91	x	0.3	x	0.7	=	62.99	(77)
Southeast	0.9x	0.77	x	3.8	x	104.39	x	0.3	x	0.7	=	57.73	(77)
Southeast	0.9x	0.77	x	3.8	x	92.85	x	0.3	x	0.7	=	51.35	(77)
Southeast	0.9x	0.77	x	3.8	x	69.27	x	0.3	x	0.7	=	38.31	(77)
Southeast	0.9x	0.77	x	3.8	x	44.07	x	0.3	x	0.7	=	24.37	(77)
Southeast	0.9x	0.77	x	3.8	x	31.49	x	0.3	x	0.7	=	17.41	(77)
Southwest	0.9x	0.77	x	2.21	x	36.79		0.3	x	0.7	=	11.83	(79)
Southwest	0.9x	0.77	x	2.21	x	62.67		0.3	x	0.7	=	20.16	(79)
Southwest	0.9x	0.77	x	2.21	x	85.75		0.3	x	0.7	=	27.58	(79)
Southwest	0.9x	0.77	x	2.21	x	106.25		0.3	x	0.7	=	34.17	(79)
Southwest	0.9x	0.77	x	2.21	x	119.01		0.3	x	0.7	=	38.28	(79)
Southwest	0.9x	0.77	x	2.21	x	118.15		0.3	x	0.7	=	38	(79)
Southwest	0.9x	0.77	x	2.21	x	113.91		0.3	x	0.7	=	36.64	(79)
Southwest	0.9x	0.77	x	2.21	x	104.39		0.3	x	0.7	=	33.57	(79)
Southwest	0.9x	0.77	x	2.21	x	92.85		0.3	x	0.7	=	29.86	(79)
Southwest	0.9x	0.77	x	2.21	x	69.27		0.3	x	0.7	=	22.28	(79)
Southwest	0.9x	0.77	x	2.21	x	44.07		0.3	x	0.7	=	14.17	(79)
Southwest	0.9x	0.77	x	2.21	x	31.49		0.3	x	0.7	=	10.13	(79)
Northwest	0.9x	0.77	x	7.35	x	11.28	x	0.3	x	0.7	=	12.07	(81)
Northwest	0.9x	0.77	x	7.35	x	22.97	x	0.3	x	0.7	=	24.57	(81)
Northwest	0.9x	0.77	x	7.35	x	41.38	x	0.3	x	0.7	=	44.26	(81)
Northwest	0.9x	0.77	x	7.35	x	67.96	x	0.3	x	0.7	=	72.69	(81)
Northwest	0.9x	0.77	x	7.35	x	91.35	x	0.3	x	0.7	=	97.71	(81)
Northwest	0.9x	0.77	x	7.35	x	97.38	x	0.3	x	0.7	=	104.17	(81)
Northwest	0.9x	0.77	x	7.35	x	91.1	x	0.3	x	0.7	=	97.45	(81)
Northwest	0.9x	0.77	x	7.35	x	72.63	x	0.3	x	0.7	=	77.69	(81)
Northwest	0.9x	0.77	x	7.35	x	50.42	x	0.3	x	0.7	=	53.93	(81)
Northwest	0.9x	0.77	x	7.35	x	28.07	x	0.3	x	0.7	=	30.02	(81)
Northwest	0.9x	0.77	x	7.35	x	14.2	x	0.3	x	0.7	=	15.19	(81)
Northwest	0.9x	0.77	x	7.35	x	9.21	x	0.3	x	0.7	=	9.86	(81)

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

(83)m=	44.25	79.38	119.26	165.62	201.8	207.51	197.07	168.99	135.14	90.61	53.73	37.4	(83)

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

(84)m=	337.26	370.64	400.09	429.72	449.14	438.5	417.31	394.26	368.89	341.26	323.8	321.82	(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=	0.95	0.93	0.9	0.85	0.76	0.64	0.51	0.55	0.73	0.87	0.93	0.95	(86)

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

(87)m=	18.53	18.77	19.19	19.75	20.28	20.69	20.87	20.84	20.53	19.86	19.1	18.48	(87)

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

(88)m=	20.06	20.06	20.06	20.07	20.07	20.08	20.08	20.08	20.08	20.07	20.07	20.07	(88)

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

(89)m=	0.94	0.92	0.89	0.83	0.73	0.58	0.43	0.47	0.68	0.85	0.92	0.95	(89)

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

(90)m=	16.74	17.08	17.69	18.5	19.23	19.77	19.98	19.95	19.58	18.66	17.57	16.66	(90)

fLA = Living area ÷ (4) = 0.6 (91)

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

(92)m=	17.82	18.1	18.59	19.25	19.87	20.32	20.52	20.49	20.15	19.39	18.5	17.76	(92)

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

(93)m=	17.67	17.95	18.44	19.1	19.72	20.17	20.37	20.34	20	19.24	18.35	17.61	(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=	0.92	0.9	0.86	0.8	0.71	0.58	0.45	0.49	0.67	0.82	0.9	0.93	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	309.62	332.93	345.99	345.92	320.09	255.78	189.61	193.58	247.86	280.72	289.87	297.69	(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=	767.66	747.96	683.49	578.99	454.15	312.88	211.5	220.73	332.67	489.23	639.18	764.56	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	340.78	278.9	251.1	167.81	99.75	0	0	0	0	155.13	251.51	347.35	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1892.32 (98)

Space heating requirement in kWh/m²/year 33.83 (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		90.5	(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)													
	340.78	278.9	251.1	167.81	99.75	0	0	0	0	155.13	251.51	347.35	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	376.55	308.17	277.46	185.43	110.22	0	0	0	0	171.42	277.91	383.82	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2090.96 (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)

142.06	124.63	129.54	114.24	110.59	96.87	91.19	102.61	103.24	118.56	127.73	138.01

Efficiency of water heater 87.3 (216)

(217)m=	89.53	89.49	89.38	89.18	88.79	87.3	87.3	87.3	87.3	89.09	89.4	89.57

(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	158.67	139.27	144.92	128.11	124.56	110.96	104.45	117.54	118.26	133.09	142.88	154.09

Total = Sum(219a)$_{1...12}$ = 1576.79 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2090.96	
Water heating fuel used		1576.79	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	153.56		(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) =	228.56	(231)
Electricity for lighting		256.01	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		4152.32	(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	=	451.65	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	340.59	(264)
Space and water heating	(261) + (262) + (263) + (264) =			792.24	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	118.62	(267)
Electricity for lighting	(232) x	0.519	=	132.87	(268)
Total CO2, kg/year		sum of (265)…(271) =		1043.72	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		18.66	(273)
EI rating (section 14)				86	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version: Version: 1.0.5.41

Property Address: 1 Bed Mid - EF

Address : 1 Bed Mid - EF, London, TBC

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	55.83	(1a) x	2.5	(2a) =	139.58	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.83	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	139.58	(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		2	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.1	(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) =	0.08	(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

0.11	0.11	0.1	0.09	0.09	0.08	0.08	0.08	0.08	0.09	0.1	0.1

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) = 75.65 (23c)

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

(24a)m=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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			3.57	x	1	=	3.57			(26)
Windows Type 1			7.35	x	1/[1/(1)+ 0.04]	=	7.07			(27)
Windows Type 2			3.8	x	1/[1/(1)+ 0.04]	=	3.65			(27)
Windows Type 3			2.21	x	1/[1/(1)+ 0.04]	=	2.13			(27)
Floor			13.85	x	0.13	=	1.8005	75	1038.75	(28)
Walls	44.98	16.93	28.05	x	0.18	=	5.05	14	392.7	(29)
Total area of elements, m²			58.83							(31)
Party wall			39.86	x	0	=	0	20	797.2	(32)
Party floor			41.98					40	1679.2	(32a)
Party ceiling			55.83					30	1674.9	(32b)
Internal wall **			63.71					9	573.39	(32c)

** 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) = 23.27 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6156.14 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 110.27 (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 11.09 (36)

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

Total fabric heat loss (33) + (36) = 34.36 (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=	10.6	10.5	10.4	9.91	9.82	9.33	9.33	9.23	9.52	9.82	10.01	10.21	(38)

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

(39)m=	44.96	44.86	44.76	44.27	44.17	43.68	43.68	43.59	43.88	44.17	44.37	44.57	

Average = Sum(39)$_{1…12}$ /12= 44.25 (39)

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

(40)m=	0.81	0.8	0.8	0.79	0.79	0.78	0.78	0.78	0.79	0.79	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 1.86 (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 78.41 (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=	86.26	83.12	79.98	76.85	73.71	70.57	70.57	73.71	76.85	79.98	83.12	86.26

Total = Sum(44)$_{1…12}$ = 940.97 (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=	127.91	111.87	115.44	100.65	96.57	83.34	77.22	88.61	89.67	104.5	114.07	123.88

Total = Sum(45)$_{1…12}$ = 1233.75 (45)

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

(46)m=	19.19	16.78	17.32	15.1	14.49	12.5	11.58	13.29	13.45	15.68	17.11	18.58	(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=	14.02	12.65	13.98	13.5	13.93	13.45	13.89	13.91	13.48	13.96	13.54	14.01	(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=	141.94	124.52	129.42	114.15	110.5	96.79	91.11	102.53	103.15	118.46	127.62	137.89	(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)

Output from water heater

(64)m=	141.94	124.52	129.42	114.15	110.5	96.79	91.11	102.53	103.15	118.46	127.62	137.89

Output from water heater (annual)$_{1...12}$ | 1398.07 | (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=	46.04	40.36	41.88	36.84	35.59	31.07	29.15	32.94	33.19	38.24	41.31	44.69	(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=	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	(66)

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

(67)m=	14.47	12.85	10.45	7.91	5.92	4.99	5.4	7.01	9.41	11.95	13.95	14.87	(67)

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

(68)m=	162.32	164.01	159.76	150.73	139.32	128.6	121.44	119.75	124	133.03	144.44	155.16	(68)

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

(69)m=	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	(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=	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	(71)

Water heating gains (Table 5)

(72)m=	61.88	60.06	56.29	51.17	47.84	43.16	39.18	44.28	46.09	51.39	57.38	60.07	(72)

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

(73)m=	292.59	290.84	280.43	263.73	247	230.67	219.93	224.97	233.43	250.3	269.7	284.03	(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)

Southeast	0.9x	0.77	x	3.8	x	36.79	x	0.3	x	0.7	=	20.35	(77)
Southeast	0.9x	0.77	x	3.8	x	62.67	x	0.3	x	0.7	=	34.66	(77)
Southeast	0.9x	0.77	x	3.8	x	85.75	x	0.3	x	0.7	=	47.42	(77)
Southeast	0.9x	0.77	x	3.8	x	106.25	x	0.3	x	0.7	=	58.76	(77)
Southeast	0.9x	0.77	x	3.8	x	119.01	x	0.3	x	0.7	=	65.81	(77)
Southeast	0.9x	0.77	x	3.8	x	118.15	x	0.3	x	0.7	=	65.34	(77)
Southeast	0.9x	0.77	x	3.8	x	113.91	x	0.3	x	0.7	=	62.99	(77)
Southeast	0.9x	0.77	x	3.8	x	104.39	x	0.3	x	0.7	=	57.73	(77)
Southeast	0.9x	0.77	x	3.8	x	92.85	x	0.3	x	0.7	=	51.35	(77)
Southeast	0.9x	0.77	x	3.8	x	69.27	x	0.3	x	0.7	=	38.31	(77)
Southeast	0.9x	0.77	x	3.8	x	44.07	x	0.3	x	0.7	=	24.37	(77)
Southeast	0.9x	0.77	x	3.8	x	31.49	x	0.3	x	0.7	=	17.41	(77)
Southwest	0.9x	0.77	x	2.21	x	36.79		0.3	x	0.7	=	11.83	(79)
Southwest	0.9x	0.77	x	2.21	x	62.67		0.3	x	0.7	=	20.16	(79)
Southwest	0.9x	0.77	x	2.21	x	85.75		0.3	x	0.7	=	27.58	(79)
Southwest	0.9x	0.77	x	2.21	x	106.25		0.3	x	0.7	=	34.17	(79)
Southwest	0.9x	0.77	x	2.21	x	119.01		0.3	x	0.7	=	38.28	(79)
Southwest	0.9x	0.77	x	2.21	x	118.15		0.3	x	0.7	=	38	(79)
Southwest	0.9x	0.77	x	2.21	x	113.91		0.3	x	0.7	=	36.64	(79)
Southwest	0.9x	0.77	x	2.21	x	104.39		0.3	x	0.7	=	33.57	(79)
Southwest	0.9x	0.77	x	2.21	x	92.85		0.3	x	0.7	=	29.86	(79)
Southwest	0.9x	0.77	x	2.21	x	69.27		0.3	x	0.7	=	22.28	(79)
Southwest	0.9x	0.77	x	2.21	x	44.07		0.3	x	0.7	=	14.17	(79)
Southwest	0.9x	0.77	x	2.21	x	31.49		0.3	x	0.7	=	10.13	(79)
Northwest	0.9x	0.77	x	7.35	x	11.28	x	0.3	x	0.7	=	12.07	(81)
Northwest	0.9x	0.77	x	7.35	x	22.97	x	0.3	x	0.7	=	24.57	(81)
Northwest	0.9x	0.77	x	7.35	x	41.38	x	0.3	x	0.7	=	44.26	(81)
Northwest	0.9x	0.77	x	7.35	x	67.96	x	0.3	x	0.7	=	72.69	(81)
Northwest	0.9x	0.77	x	7.35	x	91.35	x	0.3	x	0.7	=	97.71	(81)
Northwest	0.9x	0.77	x	7.35	x	97.38	x	0.3	x	0.7	=	104.17	(81)
Northwest	0.9x	0.77	x	7.35	x	91.1	x	0.3	x	0.7	=	97.45	(81)
Northwest	0.9x	0.77	x	7.35	x	72.63	x	0.3	x	0.7	=	77.69	(81)
Northwest	0.9x	0.77	x	7.35	x	50.42	x	0.3	x	0.7	=	53.93	(81)
Northwest	0.9x	0.77	x	7.35	x	28.07	x	0.3	x	0.7	=	30.02	(81)
Northwest	0.9x	0.77	x	7.35	x	14.2	x	0.3	x	0.7	=	15.19	(81)
Northwest	0.9x	0.77	x	7.35	x	9.21	x	0.3	x	0.7	=	9.86	(81)

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

(83)m=	44.25	79.38	119.26	165.62	201.8	207.51	197.07	168.99	135.14	90.61	53.73	37.4	(83)

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

(84)m=	336.84	370.23	399.69	429.35	448.8	438.18	417.01	393.96	368.57	340.91	323.43	321.42	(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=	0.97	0.95	0.92	0.86	0.75	0.59	0.45	0.49	0.7	0.88	0.95	0.97	(86)

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

(87)m=	19.56	19.74	20.05	20.43	20.74	20.92	20.98	20.97	20.85	20.46	19.94	19.51	(87)

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

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

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

(89)m=	0.96	0.95	0.91	0.84	0.71	0.53	0.38	0.42	0.65	0.86	0.94	0.97	(89)

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

(90)m=	18.29	18.57	19	19.55	19.96	20.19	20.25	20.25	20.11	19.59	18.86	18.24	(90)

fLA = Living area ÷ (4) = 0.6 (91)

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

(92)m=	19.06	19.28	19.63	20.08	20.43	20.63	20.69	20.68	20.55	20.11	19.52	19.01	(92)

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

(93)m=	18.91	19.13	19.48	19.93	20.28	20.48	20.54	20.53	20.4	19.96	19.37	18.86	(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=	0.95	0.93	0.9	0.83	0.71	0.55	0.4	0.44	0.66	0.85	0.93	0.96	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	320.57	345.54	359.22	355.8	319.37	240.07	167.91	174.2	243.1	289.88	300.86	307.79	(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=	656.63	638.17	581.1	488.29	379.13	257.01	172.13	180.14	276.64	413.66	544.25	653.22	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	250.03	196.65	165.08	95.4	44.47	0	0	0	0	92.1	175.24	257	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1275.95 (98)

Space heating requirement in kWh/m²/year 22.85 (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		90.5	(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)													
	250.03	196.65	165.08	95.4	44.47	0	0	0	0	92.1	175.24	257	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	276.28	217.29	182.41	105.41	49.13	0	0	0	0	101.76	193.63	283.97	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1409.89 (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)

141.94	124.52	129.42	114.15	110.5	96.79	91.11	102.53	103.15	118.46	127.62	137.89

Efficiency of water heater 87.3 (216)

(217)m=	89.31	89.23	89.07	88.73	88.19	87.3	87.3	87.3	87.3	88.67	89.12	89.36	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	158.92	139.55	145.31	128.65	125.29	110.87	104.36	117.44	118.16	133.6	143.19	154.32

Total = Sum(219a)$_{1...12}$ = 1579.65 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		1409.89	
Water heating fuel used		1579.65	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	153.25		(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) =	228.25	(231)
Electricity for lighting		255.56	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		3473.35	(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	=	304.54	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	341.2	(264)
Space and water heating	(261) + (262) + (263) + (264) =			645.74	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	118.46	(267)
Electricity for lighting	(232) x	0.519	=	132.64	(268)
Total CO2, kg/year		sum of (265)…(271) =		896.84	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		16.06	(273)
EI rating (section 14)				88	(274)

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User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version: Version: 1.0.5.41

Property Address: 1 Bed Mid - GF

Address : 1 Bed Mid - GF, London, TBC

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	55.83	(1a)	x	2.5	(2a)	=	139.58	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.83	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			139.58	(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		2	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.1	(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) =	0.08	(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

0.11	0.11	0.1	0.09	0.09	0.08	0.08	0.08	0.08	0.09	0.1	0.1

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) = 75.65 (23c)

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

(24a)m=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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			3.57	x	1	=	3.57			(26)
Windows Type 1			7.35	x	1/[1/(1)+ 0.04]	=	7.07			(27)
Windows Type 2			3.8	x	1/[1/(1)+ 0.04]	=	3.65			(27)
Windows Type 3			2.21	x	1/[1/(1)+ 0.04]	=	2.13			(27)
Floor			55.83	x	0.13	=	7.2579	75	4187.25	(28)
Walls	44.98	16.93	28.05	x	0.18	=	5.05	14	392.7	(29)
Total area of elements, m²			100.81							(31)
Party wall			39.86	x	0	=	0	20	797.2	(32)
Party ceiling			55.83					30	1674.9	(32b)
Internal wall **			63.71					9	573.39	(32c)

** 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) = 28.72 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7625.44 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 136.58 (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 11.28 (36)

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

Total fabric heat loss (33) + (36) = 40 (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=	10.6	10.5	10.4	9.91	9.82	9.33	9.33	9.23	9.52	9.82	10.01	10.21	(38)

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

(39)m=	50.6	50.51	50.41	49.92	49.82	49.33	49.33	49.23	49.53	49.82	50.02	50.21	

Average = $Sum(39)_{1...12}$ /12= 49.89 (39)

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

(40)m=	0.91	0.9	0.9	0.89	0.89	0.88	0.88	0.88	0.89	0.89	0.9	0.9

Average = $Sum(40)_{1...12}$ /12= 0.89 (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 1.86 (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 78.41 (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=	86.26	83.12	79.98	76.85	73.71	70.57	70.57	73.71	76.85	79.98	83.12	86.26

Total = $Sum(44)_{1...12}$ = 940.97 (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=	127.91	111.87	115.44	100.65	96.57	83.34	77.22	88.61	89.67	104.5	114.07	123.88

Total = $Sum(45)_{1...12}$ = 1233.75 (45)

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

(46)m=	19.19	16.78	17.32	15.1	14.49	12.5	11.58	13.29	13.45	15.68	17.11	18.58	(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=	14.02	12.65	13.98	13.5	13.93	13.45	13.89	13.91	13.48	13.96	13.54	14.01	(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=	141.94	124.52	129.42	114.15	110.5	96.79	91.11	102.53	103.15	118.46	127.62	137.89	(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)

Output from water heater

(64)m=	141.94	124.52	129.42	114.15	110.5	96.79	91.11	102.53	103.15	118.46	127.62	137.89

Output from water heater (annual)$_{1...12}$ | 1398.07 | (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=	46.04	40.36	41.88	36.84	35.59	31.07	29.15	32.94	33.19	38.24	41.31	44.69	(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=	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	(66)

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

(67)m=	14.47	12.85	10.45	7.91	5.92	4.99	5.4	7.01	9.41	11.95	13.95	14.87	(67)

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

(68)m=	162.32	164.01	159.76	150.73	139.32	128.6	121.44	119.75	124	133.03	144.44	155.16	(68)

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

(69)m=	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	(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=	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	(71)

Water heating gains (Table 5)

(72)m=	61.88	60.06	56.29	51.17	47.84	43.16	39.18	44.28	46.09	51.39	57.38	60.07	(72)

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

(73)m=	292.59	290.84	280.43	263.73	247	230.67	219.93	224.97	233.43	250.3	269.7	284.03	(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)	
Southeast	0.9x	0.77	x	3.8	x	36.79	x	0.3	x	0.7	=	20.35	(77)
Southeast	0.9x	0.77	x	3.8	x	62.67	x	0.3	x	0.7	=	34.66	(77)

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Southeast	0.9x	0.77	x	3.8	x	85.75	x	0.3	x	0.7	=	47.42	(77)
Southeast	0.9x	0.77	x	3.8	x	106.25	x	0.3	x	0.7	=	58.76	(77)
Southeast	0.9x	0.77	x	3.8	x	119.01	x	0.3	x	0.7	=	65.81	(77)
Southeast	0.9x	0.77	x	3.8	x	118.15	x	0.3	x	0.7	=	65.34	(77)
Southeast	0.9x	0.77	x	3.8	x	113.91	x	0.3	x	0.7	=	62.99	(77)
Southeast	0.9x	0.77	x	3.8	x	104.39	x	0.3	x	0.7	=	57.73	(77)
Southeast	0.9x	0.77	x	3.8	x	92.85	x	0.3	x	0.7	=	51.35	(77)
Southeast	0.9x	0.77	x	3.8	x	69.27	x	0.3	x	0.7	=	38.31	(77)
Southeast	0.9x	0.77	x	3.8	x	44.07	x	0.3	x	0.7	=	24.37	(77)
Southeast	0.9x	0.77	x	3.8	x	31.49	x	0.3	x	0.7	=	17.41	(77)
Southwest	0.9x	0.77	x	2.21	x	36.79		0.3	x	0.7	=	11.83	(79)
Southwest	0.9x	0.77	x	2.21	x	62.67		0.3	x	0.7	=	20.16	(79)
Southwest	0.9x	0.77	x	2.21	x	85.75		0.3	x	0.7	=	27.58	(79)
Southwest	0.9x	0.77	x	2.21	x	106.25		0.3	x	0.7	=	34.17	(79)
Southwest	0.9x	0.77	x	2.21	x	119.01		0.3	x	0.7	=	38.28	(79)
Southwest	0.9x	0.77	x	2.21	x	118.15		0.3	x	0.7	=	38	(79)
Southwest	0.9x	0.77	x	2.21	x	113.91		0.3	x	0.7	=	36.64	(79)
Southwest	0.9x	0.77	x	2.21	x	104.39		0.3	x	0.7	=	33.57	(79)
Southwest	0.9x	0.77	x	2.21	x	92.85		0.3	x	0.7	=	29.86	(79)
Southwest	0.9x	0.77	x	2.21	x	69.27		0.3	x	0.7	=	22.28	(79)
Southwest	0.9x	0.77	x	2.21	x	44.07		0.3	x	0.7	=	14.17	(79)
Southwest	0.9x	0.77	x	2.21	x	31.49		0.3	x	0.7	=	10.13	(79)
Northwest	0.9x	0.77	x	7.35	x	11.28	x	0.3	x	0.7	=	12.07	(81)
Northwest	0.9x	0.77	x	7.35	x	22.97	x	0.3	x	0.7	=	24.57	(81)
Northwest	0.9x	0.77	x	7.35	x	41.38	x	0.3	x	0.7	=	44.26	(81)
Northwest	0.9x	0.77	x	7.35	x	67.96	x	0.3	x	0.7	=	72.69	(81)
Northwest	0.9x	0.77	x	7.35	x	91.35	x	0.3	x	0.7	=	97.71	(81)
Northwest	0.9x	0.77	x	7.35	x	97.38	x	0.3	x	0.7	=	104.17	(81)
Northwest	0.9x	0.77	x	7.35	x	91.1	x	0.3	x	0.7	=	97.45	(81)
Northwest	0.9x	0.77	x	7.35	x	72.63	x	0.3	x	0.7	=	77.69	(81)
Northwest	0.9x	0.77	x	7.35	x	50.42	x	0.3	x	0.7	=	53.93	(81)
Northwest	0.9x	0.77	x	7.35	x	28.07	x	0.3	x	0.7	=	30.02	(81)
Northwest	0.9x	0.77	x	7.35	x	14.2	x	0.3	x	0.7	=	15.19	(81)
Northwest	0.9x	0.77	x	7.35	x	9.21	x	0.3	x	0.7	=	9.86	(81)

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

(83)m=	44.25	79.38	119.26	165.62	201.8	207.51	197.07	168.99	135.14	90.61	53.73	37.4	(83)

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

(84)m=	336.84	370.23	399.69	429.35	448.8	438.18	417.01	393.96	368.57	340.91	323.43	321.42	(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=	0.98	0.97	0.95	0.9	0.81	0.65	0.5	0.54	0.76	0.92	0.97	0.98	(86)

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

(87)m=	19.55	19.72	20.01	20.39	20.71	20.91	20.98	20.97	20.83	20.42	19.92	19.51	(87)

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

(88)m=	20.16	20.16	20.17	20.17	20.17	20.18	20.18	20.18	20.18	20.17	20.17	20.17	(88)

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

(89)m=	0.98	0.97	0.94	0.88	0.77	0.59	0.41	0.46	0.71	0.9	0.96	0.98	(89)

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

(90)m=	18.21	18.46	18.88	19.41	19.85	20.1	20.17	20.16	20.01	19.47	18.76	18.16	(90)

fLA = Living area ÷ (4) = 0.6 (91)

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

(92)m=	19.02	19.22	19.56	20	20.37	20.59	20.65	20.65	20.5	20.05	19.46	18.97	(92)

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

(93)m=	18.87	19.07	19.41	19.85	20.22	20.44	20.5	20.5	20.35	19.9	19.31	18.82	(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=	0.97	0.96	0.93	0.88	0.77	0.61	0.45	0.49	0.72	0.89	0.96	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	327.22	354.94	372.95	376.29	345.82	265.66	187.23	193.99	265.33	304.94	309.38	313.53	(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=	737.21	715.71	650.82	546.72	424.54	288.13	192.6	201.66	309.74	463.09	610.68	734.3	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	305.03	242.44	206.73	122.71	58.57	0	0	0	0	117.67	216.93	313.06	

Total per year (kWh/year) = Sum(98)1...5,9...12 = 1583.13 (98)

Space heating requirement in kWh/m²/year 28.36 (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		90.5	(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)													
	305.03	242.44	206.73	122.71	58.57	0	0	0	0	117.67	216.93	313.06	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	337.05	267.89	228.44	135.59	64.71	0	0	0	0	130.02	239.71	345.92	

Total (kWh/year) =Sum(211)1...5,10...12= 1749.32 (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)

141.94	124.52	129.42	114.15	110.5	96.79	91.11	102.53	103.15	118.46	127.62	137.89

Efficiency of water heater 87.3 (216)

(217)m=	89.46	89.39	89.24	88.93	88.38	87.3	87.3	87.3	87.3	88.87	89.29	89.5	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	158.66	139.31	145.03	128.36	125.03	110.87	104.36	117.44	118.16	133.3	142.93	154.07

Total = Sum(219a)$_{1...12}$ = 1577.51 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		1749.32	
Water heating fuel used		1577.51	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	153.25		(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) =	228.25	(231)
Electricity for lighting		255.56	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		3810.65	(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	=	377.85	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	340.74	(264)
Space and water heating	(261) + (262) + (263) + (264) =			718.6	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	118.46	(267)
Electricity for lighting	(232) x	0.519	=	132.64	(268)
Total CO2, kg/year		sum of (265)…(271) =		969.7	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		17.37	(273)
EI rating (section 14)				87	(274)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: 1 Bed Mid - MF

Address : 1 Bed Mid - MF, London, TBC

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	55.83	(1a) x	2.5	(2a) =	139.58	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.83	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	139.58	(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		2	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.1	(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) =	0.08	(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

0.11	0.11	0.1	0.09	0.09	0.08	0.08	0.08	0.08	0.09	0.1	0.1

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) = 75.65 (23c)

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

(24a)m=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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			3.57	x	1	=	3.57			(26)
Windows Type 1			7.35	x	1/[1/(1)+ 0.04]	=	7.07			(27)
Windows Type 2			3.8	x	1/[1/(1)+ 0.04]	=	3.65			(27)
Windows Type 3			2.21	x	1/[1/(1)+ 0.04]	=	2.13			(27)
Walls	44.98	16.93	28.05	x	0.18	=	5.05	14	392.7	(29)
Total area of elements, m²			44.98							(31)
Party wall			39.86	x	0	=	0	20	797.2	(32)
Party floor			55.83					40	2233.2	(32a)
Party ceiling			55.83					30	1674.9	(32b)
Internal wall **			63.71					9	573.39	(32c)

** 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) = 21.47 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5671.39 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 101.58 (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 7.11 (36)

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

Total fabric heat loss (33) + (36) = 28.58 (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=	10.6	10.5	10.4	9.91	9.82	9.33	9.33	9.23	9.52	9.82	10.01	10.21	(38)

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

(39)m=	39.18	39.08	38.98	38.49	38.39	37.9	37.9	37.81	38.1	38.39	38.59	38.78

Average = Sum(39)$_{1...12}$ /12= 38.47 (39)

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

(40)m=	0.7	0.7	0.7	0.69	0.69	0.68	0.68	0.68	0.68	0.69	0.69	0.69

Average = Sum(40)$_{1...12}$ /12= 0.69 (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 1.86 (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 78.41 (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=	86.26	83.12	79.98	76.85	73.71	70.57	70.57	73.71	76.85	79.98	83.12	86.26

Total = Sum(44)$_{1...12}$ = 940.97 (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=	127.91	111.87	115.44	100.65	96.57	83.34	77.22	88.61	89.67	104.5	114.07	123.88

Total = Sum(45)$_{1...12}$ = 1233.75 (45)

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

(46)m=	19.19	16.78	17.32	15.1	14.49	12.5	11.58	13.29	13.45	15.68	17.11	18.58	(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=	14.02	12.65	13.98	13.5	13.93	13.45	13.89	13.91	13.48	13.96	13.54	14.01	(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=	141.94	124.52	129.42	114.15	110.5	96.79	91.11	102.53	103.15	118.46	127.62	137.89	(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)

Output from water heater

(64)m=	141.94	124.52	129.42	114.15	110.5	96.79	91.11	102.53	103.15	118.46	127.62	137.89

Output from water heater (annual)$_{1...12}$ | 1398.07 | (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=	46.04	40.36	41.88	36.84	35.59	31.07	29.15	32.94	33.19	38.24	41.31	44.69	(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=	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	(66)

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

(67)m=	14.47	12.85	10.45	7.91	5.92	4.99	5.4	7.01	9.41	11.95	13.95	14.87	(67)

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

(68)m=	162.32	164.01	159.76	150.73	139.32	128.6	121.44	119.75	124	133.03	144.44	155.16	(68)

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

(69)m=	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	(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=	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	(71)

Water heating gains (Table 5)

(72)m=	61.88	60.06	56.29	51.17	47.84	43.16	39.18	44.28	46.09	51.39	57.38	60.07	(72)

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

(73)m=	292.59	290.84	280.43	263.73	247	230.67	219.93	224.97	233.43	250.3	269.7	284.03	(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)	
Southeast	0.9x	0.77	x	3.8	x	36.79	x	0.3	x	0.7	=	20.35	(77)
Southeast	0.9x	0.77	x	3.8	x	62.67	x	0.3	x	0.7	=	34.66	(77)

Southeast	0.9x	0.77	x	3.8	x	85.75	x	0.3	x	0.7	=	47.42	(77)
Southeast	0.9x	0.77	x	3.8	x	106.25	x	0.3	x	0.7	=	58.76	(77)
Southeast	0.9x	0.77	x	3.8	x	119.01	x	0.3	x	0.7	=	65.81	(77)
Southeast	0.9x	0.77	x	3.8	x	118.15	x	0.3	x	0.7	=	65.34	(77)
Southeast	0.9x	0.77	x	3.8	x	113.91	x	0.3	x	0.7	=	62.99	(77)
Southeast	0.9x	0.77	x	3.8	x	104.39	x	0.3	x	0.7	=	57.73	(77)
Southeast	0.9x	0.77	x	3.8	x	92.85	x	0.3	x	0.7	=	51.35	(77)
Southeast	0.9x	0.77	x	3.8	x	69.27	x	0.3	x	0.7	=	38.31	(77)
Southeast	0.9x	0.77	x	3.8	x	44.07	x	0.3	x	0.7	=	24.37	(77)
Southeast	0.9x	0.77	x	3.8	x	31.49	x	0.3	x	0.7	=	17.41	(77)
Southwest	0.9x	0.77	x	2.21	x	36.79		0.3	x	0.7	=	11.83	(79)
Southwest	0.9x	0.77	x	2.21	x	62.67		0.3	x	0.7	=	20.16	(79)
Southwest	0.9x	0.77	x	2.21	x	85.75		0.3	x	0.7	=	27.58	(79)
Southwest	0.9x	0.77	x	2.21	x	106.25		0.3	x	0.7	=	34.17	(79)
Southwest	0.9x	0.77	x	2.21	x	119.01		0.3	x	0.7	=	38.28	(79)
Southwest	0.9x	0.77	x	2.21	x	118.15		0.3	x	0.7	=	38	(79)
Southwest	0.9x	0.77	x	2.21	x	113.91		0.3	x	0.7	=	36.64	(79)
Southwest	0.9x	0.77	x	2.21	x	104.39		0.3	x	0.7	=	33.57	(79)
Southwest	0.9x	0.77	x	2.21	x	92.85		0.3	x	0.7	=	29.86	(79)
Southwest	0.9x	0.77	x	2.21	x	69.27		0.3	x	0.7	=	22.28	(79)
Southwest	0.9x	0.77	x	2.21	x	44.07		0.3	x	0.7	=	14.17	(79)
Southwest	0.9x	0.77	x	2.21	x	31.49		0.3	x	0.7	=	10.13	(79)
Northwest	0.9x	0.77	x	7.35	x	11.28	x	0.3	x	0.7	=	12.07	(81)
Northwest	0.9x	0.77	x	7.35	x	22.97	x	0.3	x	0.7	=	24.57	(81)
Northwest	0.9x	0.77	x	7.35	x	41.38	x	0.3	x	0.7	=	44.26	(81)
Northwest	0.9x	0.77	x	7.35	x	67.96	x	0.3	x	0.7	=	72.69	(81)
Northwest	0.9x	0.77	x	7.35	x	91.35	x	0.3	x	0.7	=	97.71	(81)
Northwest	0.9x	0.77	x	7.35	x	97.38	x	0.3	x	0.7	=	104.17	(81)
Northwest	0.9x	0.77	x	7.35	x	91.1	x	0.3	x	0.7	=	97.45	(81)
Northwest	0.9x	0.77	x	7.35	x	72.63	x	0.3	x	0.7	=	77.69	(81)
Northwest	0.9x	0.77	x	7.35	x	50.42	x	0.3	x	0.7	=	53.93	(81)
Northwest	0.9x	0.77	x	7.35	x	28.07	x	0.3	x	0.7	=	30.02	(81)
Northwest	0.9x	0.77	x	7.35	x	14.2	x	0.3	x	0.7	=	15.19	(81)
Northwest	0.9x	0.77	x	7.35	x	9.21	x	0.3	x	0.7	=	9.86	(81)

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

(83)m=	44.25	79.38	119.26	165.62	201.8	207.51	197.07	168.99	135.14	90.61	53.73	37.4	(83)

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

(84)m=	336.84	370.23	399.69	429.35	448.8	438.18	417.01	393.96	368.57	340.91	323.43	321.42	(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

DER WorkSheet: New dwelling design stage

(86)m=	0.96	0.94	0.9	0.82	0.69	0.53	0.39	0.43	0.64	0.85	0.93	0.96	(86)

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

(87)m=	19.76	19.94	20.23	20.57	20.82	20.95	20.99	20.98	20.9	20.58	20.12	19.71	(87)

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

(88)m=	20.34	20.34	20.34	20.35	20.35	20.36	20.36	20.36	20.36	20.35	20.35	20.35	(88)

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

(89)m=	0.95	0.93	0.89	0.8	0.66	0.48	0.34	0.37	0.6	0.82	0.92	0.96	(89)

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

(90)m=	18.65	18.92	19.33	19.81	20.15	20.31	20.35	20.35	20.25	19.84	19.18	18.59	(90)

fLA = Living area ÷ (4) = | 0.6 | (91)

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

(92)m=	19.32	19.53	19.87	20.27	20.56	20.7	20.74	20.73	20.64	20.29	19.75	19.27	(92)

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

(93)m=	19.17	19.38	19.72	20.12	20.41	20.55	20.59	20.58	20.49	20.14	19.6	19.12	(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=	0.94	0.92	0.87	0.79	0.66	0.49	0.36	0.39	0.61	0.82	0.91	0.95	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	316.34	339.23	349.33	339.53	296.52	216.18	148.94	155.02	223.33	278.19	295.03	304.19	(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=	582.41	566.04	515.3	431.85	334.23	225.52	151.05	158.07	243.58	366.14	482.19	578.63	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	197.96	152.42	123.48	66.47	28.06	0	0	0	0	65.43	134.76	204.18	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 972.75 | (98)

Space heating requirement in kWh/m²/year | 17.42 | (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		90.5	(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)													
	197.96	152.42	123.48	66.47	28.06	0	0	0	0	65.43	134.76	204.18	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	218.74	168.42	136.44	73.45	31	0	0	0	0	72.3	148.9	225.62	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= | 1074.86 | (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)

	141.94	124.52	129.42	114.15	110.5	96.79	91.11	102.53	103.15	118.46	127.62	137.89		
Efficiency of water heater													87.3	(216)
(217)m=	89.14	89.03	88.83	88.45	87.93	87.3	87.3	87.3	87.3	88.41	88.91	89.18		(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	159.24	139.86	145.69	129.05	125.67	110.87	104.36	117.44	118.16	133.99	143.53	154.62		
								Total = Sum(219a)$_{1...12}$ =					1582.47	(219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		1074.86	
Water heating fuel used		1582.47	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	153.25		(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) =		228.25	(231)
Electricity for lighting		255.56	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		3141.15	(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	=	232.17	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	341.81	(264)
Space and water heating	(261) + (262) + (263) + (264) =			573.98	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	118.46	(267)
Electricity for lighting	(232) x	0.519	=	132.64	(268)
Total CO2, kg/year		sum of (265)…(271) =		825.08	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		14.78	(273)
EI rating (section 14)				89	(274)

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User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version: Version: 1.0.5.41

Property Address: 1 Bed Mid - TF

Address : 1 Bed Mid - TF, London, TBC

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	55.83	(1a) x	2.5	(2a) =	139.58	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.83	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	139.58	(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		2	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.1	(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) =	0.08	(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

0.11	0.11	0.1	0.09	0.09	0.08	0.08	0.08	0.08	0.09	0.1	0.1

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) = 75.65 (23c)

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

(24a)m=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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			3.57	x	1	=	3.57			(26)
Windows Type 1			7.35	x	1/[1/(1)+ 0.04]	=	7.07			(27)
Windows Type 2			3.8	x	1/[1/(1)+ 0.04]	=	3.65			(27)
Windows Type 3			2.21	x	1/[1/(1)+ 0.04]	=	2.13			(27)
Walls	44.98	16.93	28.05	x	0.18	=	5.05	14	392.7	(29)
Roof	55.83	0	55.83	x	0.11	=	6.14	9	502.47	(30)
Total area of elements, m²			100.81							(31)
Party wall			39.86	x	0	=	0	20	797.2	(32)
Party floor			55.83					40	2233.2	(32a)
Internal wall **			63.71					9	573.39	(32c)

** 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) = 27.61 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 4498.96 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 80.58 (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 14.72 (36)

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

Total fabric heat loss (33) + (36) = 42.32 (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

DER WorkSheet: New dwelling design stage

(38)m=	10.6	10.5	10.4	9.91	9.82	9.33	9.33	9.23	9.52	9.82	10.01	10.21	(38)

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

(39)m=	52.92	52.82	52.73	52.24	52.14	51.65	51.65	51.55	51.84	52.14	52.33	52.53

Average = Sum(39)$_{1...12}$ /12= 52.21 (39)

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

(40)m=	0.95	0.95	0.94	0.94	0.93	0.93	0.93	0.92	0.93	0.93	0.94	0.94

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 1.86 (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 78.41 (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=	86.26	83.12	79.98	76.85	73.71	70.57	70.57	73.71	76.85	79.98	83.12	86.26

Total = Sum(44)$_{1...12}$ = 940.97 (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=	127.91	111.87	115.44	100.65	96.57	83.34	77.22	88.61	89.67	104.5	114.07	123.88

Total = Sum(45)$_{1...12}$ = 1233.75 (45)

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

(46)m=	19.19	16.78	17.32	15.1	14.49	12.5	11.58	13.29	13.45	15.68	17.11	18.58	(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=	14.02	12.65	13.98	13.5	13.93	13.45	13.89	13.91	13.48	13.96	13.54	14.01	(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=	141.94	124.52	129.42	114.15	110.5	96.79	91.11	102.53	103.15	118.46	127.62	137.89	(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)

Output from water heater

(64)m=	141.94	124.52	129.42	114.15	110.5	96.79	91.11	102.53	103.15	118.46	127.62	137.89

Output from water heater (annual)$_{1...12}$ | 1398.07 | (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=	46.04	40.36	41.88	36.84	35.59	31.07	29.15	32.94	33.19	38.24	41.31	44.69	(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=	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	(66)

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

(67)m=	14.47	12.85	10.45	7.91	5.92	4.99	5.4	7.01	9.41	11.95	13.95	14.87	(67)

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

(68)m=	162.32	164.01	159.76	150.73	139.32	128.6	121.44	119.75	124	133.03	144.44	155.16	(68)

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

(69)m=	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	(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=	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	(71)

Water heating gains (Table 5)

(72)m=	61.88	60.06	56.29	51.17	47.84	43.16	39.18	44.28	46.09	51.39	57.38	60.07	(72)

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

(73)m=	292.59	290.84	280.43	263.73	247	230.67	219.93	224.97	233.43	250.3	269.7	284.03	(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)	
Southeast	0.9x	0.77	x	3.8	x	36.79	x	0.3	x	0.7	=	20.35	(77)
Southeast	0.9x	0.77	x	3.8	x	62.67	x	0.3	x	0.7	=	34.66	(77)

Southeast	0.9x	0.77	x	3.8	x	85.75	x	0.3	x	0.7	=	47.42	(77)
Southeast	0.9x	0.77	x	3.8	x	106.25	x	0.3	x	0.7	=	58.76	(77)
Southeast	0.9x	0.77	x	3.8	x	119.01	x	0.3	x	0.7	=	65.81	(77)
Southeast	0.9x	0.77	x	3.8	x	118.15	x	0.3	x	0.7	=	65.34	(77)
Southeast	0.9x	0.77	x	3.8	x	113.91	x	0.3	x	0.7	=	62.99	(77)
Southeast	0.9x	0.77	x	3.8	x	104.39	x	0.3	x	0.7	=	57.73	(77)
Southeast	0.9x	0.77	x	3.8	x	92.85	x	0.3	x	0.7	=	51.35	(77)
Southeast	0.9x	0.77	x	3.8	x	69.27	x	0.3	x	0.7	=	38.31	(77)
Southeast	0.9x	0.77	x	3.8	x	44.07	x	0.3	x	0.7	=	24.37	(77)
Southeast	0.9x	0.77	x	3.8	x	31.49	x	0.3	x	0.7	=	17.41	(77)
Southwest	0.9x	0.77	x	2.21	x	36.79		0.3	x	0.7	=	11.83	(79)
Southwest	0.9x	0.77	x	2.21	x	62.67		0.3	x	0.7	=	20.16	(79)
Southwest	0.9x	0.77	x	2.21	x	85.75		0.3	x	0.7	=	27.58	(79)
Southwest	0.9x	0.77	x	2.21	x	106.25		0.3	x	0.7	=	34.17	(79)
Southwest	0.9x	0.77	x	2.21	x	119.01		0.3	x	0.7	=	38.28	(79)
Southwest	0.9x	0.77	x	2.21	x	118.15		0.3	x	0.7	=	38	(79)
Southwest	0.9x	0.77	x	2.21	x	113.91		0.3	x	0.7	=	36.64	(79)
Southwest	0.9x	0.77	x	2.21	x	104.39		0.3	x	0.7	=	33.57	(79)
Southwest	0.9x	0.77	x	2.21	x	92.85		0.3	x	0.7	=	29.86	(79)
Southwest	0.9x	0.77	x	2.21	x	69.27		0.3	x	0.7	=	22.28	(79)
Southwest	0.9x	0.77	x	2.21	x	44.07		0.3	x	0.7	=	14.17	(79)
Southwest	0.9x	0.77	x	2.21	x	31.49		0.3	x	0.7	=	10.13	(79)
Northwest	0.9x	0.77	x	7.35	x	11.28	x	0.3	x	0.7	=	12.07	(81)
Northwest	0.9x	0.77	x	7.35	x	22.97	x	0.3	x	0.7	=	24.57	(81)
Northwest	0.9x	0.77	x	7.35	x	41.38	x	0.3	x	0.7	=	44.26	(81)
Northwest	0.9x	0.77	x	7.35	x	67.96	x	0.3	x	0.7	=	72.69	(81)
Northwest	0.9x	0.77	x	7.35	x	91.35	x	0.3	x	0.7	=	97.71	(81)
Northwest	0.9x	0.77	x	7.35	x	97.38	x	0.3	x	0.7	=	104.17	(81)
Northwest	0.9x	0.77	x	7.35	x	91.1	x	0.3	x	0.7	=	97.45	(81)
Northwest	0.9x	0.77	x	7.35	x	72.63	x	0.3	x	0.7	=	77.69	(81)
Northwest	0.9x	0.77	x	7.35	x	50.42	x	0.3	x	0.7	=	53.93	(81)
Northwest	0.9x	0.77	x	7.35	x	28.07	x	0.3	x	0.7	=	30.02	(81)
Northwest	0.9x	0.77	x	7.35	x	14.2	x	0.3	x	0.7	=	15.19	(81)
Northwest	0.9x	0.77	x	7.35	x	9.21	x	0.3	x	0.7	=	9.86	(81)

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

(83)m=	44.25	79.38	119.26	165.62	201.8	207.51	197.07	168.99	135.14	90.61	53.73	37.4	(83)

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

(84)m=	336.84	370.23	399.69	429.35	448.8	438.18	417.01	393.96	368.57	340.91	323.43	321.42	(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=	0.95	0.93	0.9	0.84	0.75	0.62	0.49	0.53	0.71	0.86	0.93	0.95	(86)

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

(87)m=	18.78	19.01	19.41	19.93	20.41	20.76	20.91	20.88	20.62	20.02	19.31	18.72	(87)

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

(88)m=	20.13	20.13	20.13	20.14	20.14	20.15	20.15	20.15	20.14	20.14	20.14	20.13	(88)

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

(89)m=	0.94	0.92	0.89	0.82	0.71	0.56	0.41	0.45	0.66	0.84	0.92	0.95	(89)

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

(90)m=	17.13	17.46	18.03	18.78	19.45	19.9	20.07	20.05	19.74	18.92	17.91	17.05	(90)

fLA = Living area ÷ (4) = 0.6 (91)

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

(92)m=	18.12	18.39	18.86	19.48	20.03	20.42	20.58	20.55	20.27	19.58	18.75	18.06	(92)

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

(93)m=	17.97	18.24	18.71	19.33	19.88	20.27	20.43	20.4	20.12	19.43	18.6	17.91	(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=	0.92	0.9	0.86	0.8	0.7	0.57	0.44	0.47	0.66	0.82	0.9	0.93	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	309.94	333.07	345.58	344.05	315.68	248.64	181.74	186.3	243.44	279.58	289.93	298.04	(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=	723.53	704.8	643.83	544.67	426.47	292.82	197.57	206.33	312.21	460.48	602.04	720.27	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	307.71	249.8	221.9	144.44	82.42	0	0	0	0	134.58	224.72	314.14	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1679.72 (98)

Space heating requirement in kWh/m²/year 30.09 (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		90.5	(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)													
	307.71	249.8	221.9	144.44	82.42	0	0	0	0	134.58	224.72	314.14	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	340.01	276.03	245.2	159.6	91.08	0	0	0	0	148.71	248.31	347.12	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1856.05 (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)

141.94	124.52	129.42	114.15	110.5	96.79	91.11	102.53	103.15	118.46	127.62	137.89

Efficiency of water heater 87.3 (216)

(217)m=	89.46	89.41	89.29	89.06	88.64	87.3	87.3	87.3	87.3	88.97	89.31	89.5	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	158.65	139.27	144.94	128.17	124.66	110.87	104.36	117.44	118.16	133.14	142.88	154.07

Total = Sum(219a)$_{1...12}$ = 1576.62 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1856.05	
Water heating fuel used			1576.62	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		153.25		(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) =		228.25	(231)
Electricity for lighting			255.56	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			3916.49	(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	=	400.91	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	340.55	(264)
Space and water heating	(261) + (262) + (263) + (264) =			741.46	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	118.46	(267)
Electricity for lighting	(232) x	0.519	=	132.64	(268)
Total CO2, kg/year		sum of (265)…(271) =		992.56	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		17.78	(273)
EI rating (section 14)				87	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.41

Property Address: 1 Bed Var - EF

Address : 1 Bed Var - EF, London, TBC

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	54.08	(1a) x	2.5	(2a) =	135.2	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	54.08	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		135.2	(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		2	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.1	(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) =	0.08	(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

0.11	0.11	0.1	0.09	0.09	0.08	0.08	0.08	0.08	0.09	0.1	0.1

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) = 75.65 (23c)

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

(24a)m=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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			3.57	x	1	=	3.57			(26)
Windows Type 1			1.81	x	1/[1/(1)+ 0.04]	=	1.74			(27)
Windows Type 2			6.09	x	1/[1/(1)+ 0.04]	=	5.86			(27)
Windows Type 3			1.05	x	1/[1/(1)+ 0.04]	=	1.01			(27)
Windows Type 4			5.57	x	1/[1/(1)+ 0.04]	=	5.36			(27)
Floor			13.85	x	0.13	=	1.8005	75	1038.75	(28)
Walls	62.5	18.09	44.41	x	0.18	=	7.99	14	621.74	(29)
Total area of elements, m²			76.35							(31)
Party wall			19.77	x	0	=	0	20	395.4	(32)
Party floor			40.23					40	1609.2	(32a)
Party ceiling			54.08					30	1622.4	(32b)
Internal wall **			63.3					9	569.7	(32c)

** 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) = 27.33 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5857.19 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 108.31 (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 (36)

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

DER WorkSheet: New dwelling design stage

Total fabric heat loss	(33) + (36) =	40.33	(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=	10.27	10.17	10.08	9.6	9.51	9.03	9.03	8.94	9.22	9.51	9.7	9.89	(38)

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

(39)m=	50.59	50.5	50.41	49.93	49.84	49.36	49.36	49.27	49.55	49.84	50.03	50.22	

Average = $Sum(39)_{1...12}$ /12= 49.91 (39)

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

(40)m=	0.94	0.93	0.93	0.92	0.92	0.91	0.91	0.91	0.92	0.92	0.93	0.93	

Average = $Sum(40)_{1...12}$ /12= 0.92 (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 1.81 (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 77.2 (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=	84.92	81.83	78.74	75.65	72.56	69.48	69.48	72.56	75.65	78.74	81.83	84.92	

Total = $Sum(44)_{1...12}$ = 926.35 (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=	125.93	110.14	113.65	99.08	95.07	82.04	76.02	87.24	88.28	102.88	112.3	121.95	

Total = $Sum(45)_{1...12}$ = 1214.59 (45)

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

(46)m=	18.89	16.52	17.05	14.86	14.26	12.31	11.4	13.09	13.24	15.43	16.85	18.29	(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=	14.01	12.64	13.97	13.49	13.92	13.45	13.88	13.91	13.47	13.95	13.53	14.01	(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=	139.94	122.78	127.62	112.58	109	95.49	89.91	101.15	101.75	116.83	125.84	135.96	(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)

Output from water heater

(64)m=	139.94	122.78	127.62	112.58	109	95.49	89.91	101.15	101.75	116.83	125.84	135.96	

Output from water heater (annual)$_{1...12}$ | 1378.84 | (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=	45.37	39.78	41.28	36.32	35.09	30.64	28.75	32.48	32.72	37.7	40.72	44.05	(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=	90.52	90.52	90.52	90.52	90.52	90.52	90.52	90.52	90.52	90.52	90.52	90.52	(66)

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

(67)m=	14.07	12.5	10.16	7.69	5.75	4.86	5.25	6.82	9.15	11.62	13.56	14.46	(67)

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

(68)m=	157.81	159.45	155.32	146.54	135.45	125.02	118.06	116.42	120.55	129.34	140.43	150.85	(68)

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

(69)m=	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	(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=	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	(71)

Water heating gains (Table 5)

(72)m=	60.99	59.2	55.49	50.44	47.17	42.56	38.64	43.66	45.45	50.67	56.56	59.21	(72)

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

(73)m=	286.02	284.3	274.13	257.83	241.52	225.59	215.1	220.06	228.31	244.78	263.71	277.67	(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)	
Northeast	0.9x	0.77	x	1.81	x	11.28	x	0.3	x	0.7	=	2.97	(75)
Northeast	0.9x	0.77	x	1.81	x	22.97	x	0.3	x	0.7	=	6.05	(75)
Northeast	0.9x	0.77	x	1.81	x	41.38	x	0.3	x	0.7	=	10.9	(75)
Northeast	0.9x	0.77	x	1.81	x	67.96	x	0.3	x	0.7	=	17.9	(75)
Northeast	0.9x	0.77	x	1.81	x	91.35	x	0.3	x	0.7	=	24.06	(75)
Northeast	0.9x	0.77	x	1.81	x	97.38	x	0.3	x	0.7	=	25.65	(75)
Northeast	0.9x	0.77	x	1.81	x	91.1	x	0.3	x	0.7	=	24	(75)
Northeast	0.9x	0.77	x	1.81	x	72.63	x	0.3	x	0.7	=	19.13	(75)
Northeast	0.9x	0.77	x	1.81	x	50.42	x	0.3	x	0.7	=	13.28	(75)
Northeast	0.9x	0.77	x	1.81	x	28.07	x	0.3	x	0.7	=	7.39	(75)
Northeast	0.9x	0.77	x	1.81	x	14.2	x	0.3	x	0.7	=	3.74	(75)
Northeast	0.9x	0.77	x	1.81	x	9.21	x	0.3	x	0.7	=	2.43	(75)
Southeast	0.9x	0.77	x	1.05	x	36.79	x	0.3	x	0.7	=	5.62	(77)
Southeast	0.9x	0.77	x	1.05	x	62.67	x	0.3	x	0.7	=	9.58	(77)
Southeast	0.9x	0.77	x	1.05	x	85.75	x	0.3	x	0.7	=	13.1	(77)
Southeast	0.9x	0.77	x	1.05	x	106.25	x	0.3	x	0.7	=	16.24	(77)
Southeast	0.9x	0.77	x	1.05	x	119.01	x	0.3	x	0.7	=	18.19	(77)
Southeast	0.9x	0.77	x	1.05	x	118.15	x	0.3	x	0.7	=	18.05	(77)
Southeast	0.9x	0.77	x	1.05	x	113.91	x	0.3	x	0.7	=	17.41	(77)
Southeast	0.9x	0.77	x	1.05	x	104.39	x	0.3	x	0.7	=	15.95	(77)
Southeast	0.9x	0.77	x	1.05	x	92.85	x	0.3	x	0.7	=	14.19	(77)
Southeast	0.9x	0.77	x	1.05	x	69.27	x	0.3	x	0.7	=	10.58	(77)
Southeast	0.9x	0.77	x	1.05	x	44.07	x	0.3	x	0.7	=	6.73	(77)
Southeast	0.9x	0.77	x	1.05	x	31.49	x	0.3	x	0.7	=	4.81	(77)
Southwest	0.9x	0.77	x	5.57	x	36.79		0.3	x	0.7	=	29.83	(79)
Southwest	0.9x	0.77	x	5.57	x	62.67		0.3	x	0.7	=	50.8	(79)
Southwest	0.9x	0.77	x	5.57	x	85.75		0.3	x	0.7	=	69.51	(79)
Southwest	0.9x	0.77	x	5.57	x	106.25		0.3	x	0.7	=	86.13	(79)
Southwest	0.9x	0.77	x	5.57	x	119.01		0.3	x	0.7	=	96.47	(79)
Southwest	0.9x	0.77	x	5.57	x	118.15		0.3	x	0.7	=	95.77	(79)
Southwest	0.9x	0.77	x	5.57	x	113.91		0.3	x	0.7	=	92.34	(79)
Southwest	0.9x	0.77	x	5.57	x	104.39		0.3	x	0.7	=	84.62	(79)
Southwest	0.9x	0.77	x	5.57	x	92.85		0.3	x	0.7	=	75.27	(79)
Southwest	0.9x	0.77	x	5.57	x	69.27		0.3	x	0.7	=	56.15	(79)
Southwest	0.9x	0.77	x	5.57	x	44.07		0.3	x	0.7	=	35.72	(79)
Southwest	0.9x	0.77	x	5.57	x	31.49		0.3	x	0.7	=	25.52	(79)
Northwest	0.9x	0.77	x	6.09	x	11.28	x	0.3	x	0.7	=	10	(81)
Northwest	0.9x	0.77	x	6.09	x	22.97	x	0.3	x	0.7	=	20.35	(81)
Northwest	0.9x	0.77	x	6.09	x	41.38	x	0.3	x	0.7	=	36.67	(81)

Northwest	0.9x	0.77	x	6.09	x	67.96	x	0.3	x	0.7	=	60.23	(81)
Northwest	0.9x	0.77	x	6.09	x	91.35	x	0.3	x	0.7	=	80.96	(81)
Northwest	0.9x	0.77	x	6.09	x	97.38	x	0.3	x	0.7	=	86.31	(81)
Northwest	0.9x	0.77	x	6.09	x	91.1	x	0.3	x	0.7	=	80.74	(81)
Northwest	0.9x	0.77	x	6.09	x	72.63	x	0.3	x	0.7	=	64.37	(81)
Northwest	0.9x	0.77	x	6.09	x	50.42	x	0.3	x	0.7	=	44.69	(81)
Northwest	0.9x	0.77	x	6.09	x	28.07	x	0.3	x	0.7	=	24.88	(81)
Northwest	0.9x	0.77	x	6.09	x	14.2	x	0.3	x	0.7	=	12.58	(81)
Northwest	0.9x	0.77	x	6.09	x	9.21	x	0.3	x	0.7	=	8.17	(81)

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

(83)m=	48.42	86.78	130.19	180.49	219.68	225.79	214.48	184.07	147.42	99	58.78	40.93	(83)

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

(84)m=	334.44	371.08	404.31	438.32	461.2	451.38	429.58	404.13	375.73	343.78	322.49	318.6	(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=	0.97	0.95	0.92	0.87	0.76	0.61	0.48	0.52	0.72	0.89	0.95	0.97	(86)

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

(87)m=	19.23	19.44	19.79	20.24	20.62	20.87	20.96	20.94	20.76	20.28	19.68	19.19	(87)

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

(88)m=	20.14	20.14	20.14	20.15	20.15	20.16	20.16	20.16	20.15	20.15	20.15	20.14	(88)

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

(89)m=	0.96	0.95	0.91	0.84	0.72	0.55	0.39	0.44	0.67	0.87	0.94	0.97	(89)

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

(90)m=	17.76	18.06	18.56	19.19	19.72	20.03	20.13	20.12	19.91	19.26	18.41	17.69	(90)

fLA = Living area ÷ (4) = | 0.6 | (91)

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

(92)m=	18.64	18.88	19.29	19.82	20.25	20.53	20.62	20.61	20.42	19.87	19.17	18.58	(92)

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

(93)m=	18.49	18.73	19.14	19.67	20.1	20.38	20.47	20.46	20.27	19.72	19.02	18.43	(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=	0.95	0.93	0.9	0.83	0.72	0.57	0.43	0.47	0.68	0.85	0.93	0.96	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	317.54	345.48	362.81	364.43	333.34	256.95	182.85	188.73	254.68	293.63	299.59	304.36	(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=	717.83	698.64	637.26	537.53	418.87	285.29	191.08	199.92	305.68	454.34	596.15	714.75	(97)

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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(98)m=	297.82	237.32	204.19	124.63	63.63	0	0	0	0	119.57	213.53	305.33

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1566.01 (98)

Space heating requirement in kWh/m²/year 28.96 (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 90.5 (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)	297.82	237.32	204.19	124.63	63.63	0	0	0	0	119.57	213.53	305.33	
(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)	329.08	262.23	225.62	137.71	70.31	0	0	0	0	132.12	235.94	337.38	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1730.4 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(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)	139.94	122.78	127.62	112.58	109	95.49	89.91	101.15	101.75	116.83	125.84	135.96

Efficiency of water heater 87.3 (216)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(217)m=	89.45	89.38	89.24	88.95	88.45	87.3	87.3	87.3	87.3	88.89	89.29	89.49

(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(219)m=	156.44	137.36	143.01	126.56	123.22	109.38	102.99	115.86	116.56	131.44	140.94	151.93

Total = Sum(219a)$_{1...12}$ = 1555.68 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		1730.4	
Water heating fuel used		1555.68	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	148.45		(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) =		223.45	(231)
Electricity for lighting		248.46	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		3757.99	(338)

DER WorkSheet: New dwelling design stage

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	=	373.77	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	336.03	(264)
Space and water heating	(261) + (262) + (263) + (264) =				709.79	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	115.97	(267)
Electricity for lighting	(232)	x	0.519	=	128.95	(268)
Total CO2, kg/year			sum of (265)…(271) =		954.71	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		17.65	(273)
EI rating (section 14)					87	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version: Version: 1.0.5.41

Property Address: 1 Bed Var - MF

Address : 1 Bed Var - MF, London, TBC

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	54.08	(1a) x	2.5	(2a) =	135.2	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	54.08	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	135.2	(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		2	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.1	(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) =	0.08	(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

0.11	0.11	0.1	0.09	0.09	0.08	0.08	0.08	0.08	0.09	0.1	0.1

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) =	75.65	(23c)

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

(24a)m=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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			3.57	x	1	=	3.57			(26)
Windows Type 1			1.81	x	1/[1/(1)+ 0.04]	=	1.74			(27)
Windows Type 2			6.09	x	1/[1/(1)+ 0.04]	=	5.86			(27)
Windows Type 3			1.05	x	1/[1/(1)+ 0.04]	=	1.01			(27)
Windows Type 4			5.57	x	1/[1/(1)+ 0.04]	=	5.36			(27)
Walls	62.5	18.09	44.41	x	0.18	=	7.99	14	621.74	(29)
Total area of elements, m²			62.5							(31)
Party wall			19.77	x	0	=	0	20	395.4	(32)
Party floor			54.08					40	2163.2	(32a)
Party ceiling			54.08					30	1622.4	(32b)
Internal wall **			63.3					9	569.7	(32c)

** 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) =	25.53	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	5372.44	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	= (34) ÷ (4) =	99.34	(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		9.02	(36)

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

Total fabric heat loss	(33) + (36) =	34.55	(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=	10.27	10.17	10.08	9.6	9.51	9.03	9.03	8.94	9.22	9.51	9.7	9.89	(38)

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

(39)m=	44.81	44.72	44.63	44.15	44.06	43.58	43.58	43.49	43.77	44.06	44.25	44.44	

Average = Sum(39)$_{1\ldots12}$ /12= 44.13 (39)

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

(40)m=	0.83	0.83	0.83	0.82	0.81	0.81	0.81	0.8	0.81	0.81	0.82	0.82	

Average = Sum(40)$_{1\ldots12}$ /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 1.81 (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 77.2 (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=	84.92	81.83	78.74	75.65	72.56	69.48	69.48	72.56	75.65	78.74	81.83	84.92	

Total = Sum(44)$_{1\ldots12}$ = 926.35 (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=	125.93	110.14	113.65	99.08	95.07	82.04	76.02	87.24	88.28	102.88	112.3	121.95	

Total = Sum(45)$_{1\ldots12}$ = 1214.59 (45)

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

(46)m=	18.89	16.52	17.05	14.86	14.26	12.31	11.4	13.09	13.24	15.43	16.85	18.29	(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=	14.01	12.64	13.97	13.49	13.92	13.45	13.88	13.91	13.47	13.95	13.53	14.01	(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=	139.94	122.78	127.62	112.58	109	95.49	89.91	101.15	101.75	116.83	125.84	135.96	(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)

Output from water heater

(64)m=	139.94	122.78	127.62	112.58	109	95.49	89.91	101.15	101.75	116.83	125.84	135.96

Output from water heater (annual)$_{1...12}$ | 1378.84 | (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=	45.37	39.78	41.28	36.32	35.09	30.64	28.75	32.48	32.72	37.7	40.72	44.05	(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=	90.52	90.52	90.52	90.52	90.52	90.52	90.52	90.52	90.52	90.52	90.52	90.52	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	14.07	12.5	10.16	7.69	5.75	4.86	5.25	6.82	9.15	11.62	13.56	14.46	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	157.81	159.45	155.32	146.54	135.45	125.02	118.06	116.42	120.55	129.34	140.43	150.85	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	(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=	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	(71)
Water heating gains (Table 5)													
(72)m=	60.99	59.2	55.49	50.44	47.17	42.56	38.64	43.66	45.45	50.67	56.56	59.21	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	286.02	284.3	274.13	257.83	241.52	225.59	215.1	220.06	228.31	244.78	263.71	277.67	(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)

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Northeast	0.9x	0.77	x	1.81	x	11.28	x	0.3	x	0.7	=	2.97	(75)
Northeast	0.9x	0.77	x	1.81	x	22.97	x	0.3	x	0.7	=	6.05	(75)
Northeast	0.9x	0.77	x	1.81	x	41.38	x	0.3	x	0.7	=	10.9	(75)
Northeast	0.9x	0.77	x	1.81	x	67.96	x	0.3	x	0.7	=	17.9	(75)
Northeast	0.9x	0.77	x	1.81	x	91.35	x	0.3	x	0.7	=	24.06	(75)
Northeast	0.9x	0.77	x	1.81	x	97.38	x	0.3	x	0.7	=	25.65	(75)
Northeast	0.9x	0.77	x	1.81	x	91.1	x	0.3	x	0.7	=	24	(75)
Northeast	0.9x	0.77	x	1.81	x	72.63	x	0.3	x	0.7	=	19.13	(75)
Northeast	0.9x	0.77	x	1.81	x	50.42	x	0.3	x	0.7	=	13.28	(75)
Northeast	0.9x	0.77	x	1.81	x	28.07	x	0.3	x	0.7	=	7.39	(75)
Northeast	0.9x	0.77	x	1.81	x	14.2	x	0.3	x	0.7	=	3.74	(75)
Northeast	0.9x	0.77	x	1.81	x	9.21	x	0.3	x	0.7	=	2.43	(75)
Southeast	0.9x	0.77	x	1.05	x	36.79	x	0.3	x	0.7	=	5.62	(77)
Southeast	0.9x	0.77	x	1.05	x	62.67	x	0.3	x	0.7	=	9.58	(77)
Southeast	0.9x	0.77	x	1.05	x	85.75	x	0.3	x	0.7	=	13.1	(77)
Southeast	0.9x	0.77	x	1.05	x	106.25	x	0.3	x	0.7	=	16.24	(77)
Southeast	0.9x	0.77	x	1.05	x	119.01	x	0.3	x	0.7	=	18.19	(77)
Southeast	0.9x	0.77	x	1.05	x	118.15	x	0.3	x	0.7	=	18.05	(77)
Southeast	0.9x	0.77	x	1.05	x	113.91	x	0.3	x	0.7	=	17.41	(77)
Southeast	0.9x	0.77	x	1.05	x	104.39	x	0.3	x	0.7	=	15.95	(77)
Southeast	0.9x	0.77	x	1.05	x	92.85	x	0.3	x	0.7	=	14.19	(77)
Southeast	0.9x	0.77	x	1.05	x	69.27	x	0.3	x	0.7	=	10.58	(77)
Southeast	0.9x	0.77	x	1.05	x	44.07	x	0.3	x	0.7	=	6.73	(77)
Southeast	0.9x	0.77	x	1.05	x	31.49	x	0.3	x	0.7	=	4.81	(77)
Southwest	0.9x	0.77	x	5.57	x	36.79		0.3	x	0.7	=	29.83	(79)
Southwest	0.9x	0.77	x	5.57	x	62.67		0.3	x	0.7	=	50.8	(79)
Southwest	0.9x	0.77	x	5.57	x	85.75		0.3	x	0.7	=	69.51	(79)
Southwest	0.9x	0.77	x	5.57	x	106.25		0.3	x	0.7	=	86.13	(79)
Southwest	0.9x	0.77	x	5.57	x	119.01		0.3	x	0.7	=	96.47	(79)
Southwest	0.9x	0.77	x	5.57	x	118.15		0.3	x	0.7	=	95.77	(79)
Southwest	0.9x	0.77	x	5.57	x	113.91		0.3	x	0.7	=	92.34	(79)
Southwest	0.9x	0.77	x	5.57	x	104.39		0.3	x	0.7	=	84.62	(79)
Southwest	0.9x	0.77	x	5.57	x	92.85		0.3	x	0.7	=	75.27	(79)
Southwest	0.9x	0.77	x	5.57	x	69.27		0.3	x	0.7	=	56.15	(79)
Southwest	0.9x	0.77	x	5.57	x	44.07		0.3	x	0.7	=	35.72	(79)
Southwest	0.9x	0.77	x	5.57	x	31.49		0.3	x	0.7	=	25.52	(79)
Northwest	0.9x	0.77	x	6.09	x	11.28	x	0.3	x	0.7	=	10	(81)
Northwest	0.9x	0.77	x	6.09	x	22.97	x	0.3	x	0.7	=	20.35	(81)
Northwest	0.9x	0.77	x	6.09	x	41.38	x	0.3	x	0.7	=	36.67	(81)
Northwest	0.9x	0.77	x	6.09	x	67.96	x	0.3	x	0.7	=	60.23	(81)
Northwest	0.9x	0.77	x	6.09	x	91.35	x	0.3	x	0.7	=	80.96	(81)

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Northwest 0.9x	0.77	x	6.09	x	97.38	x	0.3	x	0.7	=	86.31	(81)
Northwest 0.9x	0.77	x	6.09	x	91.1	x	0.3	x	0.7	=	80.74	(81)
Northwest 0.9x	0.77	x	6.09	x	72.63	x	0.3	x	0.7	=	64.37	(81)
Northwest 0.9x	0.77	x	6.09	x	50.42	x	0.3	x	0.7	=	44.69	(81)
Northwest 0.9x	0.77	x	6.09	x	28.07	x	0.3	x	0.7	=	24.88	(81)
Northwest 0.9x	0.77	x	6.09	x	14.2	x	0.3	x	0.7	=	12.58	(81)
Northwest 0.9x	0.77	x	6.09	x	9.21	x	0.3	x	0.7	=	8.17	(81)

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

(83)m=	48.42	86.78	130.19	180.49	219.68	225.79	214.48	184.07	147.42	99	58.78	40.93	(83)

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

(84)m=	334.44	371.08	404.31	438.32	461.2	451.38	429.58	404.13	375.73	343.78	322.49	318.6	(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=	0.96	0.94	0.9	0.83	0.72	0.56	0.43	0.47	0.68	0.86	0.94	0.96	(86)

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

(87)m=	19.4	19.61	19.95	20.37	20.71	20.91	20.97	20.96	20.82	20.39	19.83	19.35	(87)

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

(88)m=	20.23	20.23	20.23	20.24	20.24	20.25	20.25	20.25	20.25	20.24	20.24	20.23	(88)

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

(89)m=	0.95	0.93	0.89	0.81	0.68	0.51	0.36	0.4	0.63	0.84	0.93	0.96	(89)

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

(90)m=	18.07	18.37	18.85	19.45	19.9	20.16	20.23	20.22	20.06	19.49	18.69	18	(90)

fLA = Living area ÷ (4) = 0.6 (91)

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

(92)m=	18.86	19.11	19.51	20	20.38	20.6	20.67	20.66	20.51	20.03	19.37	18.81	(92)

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

(93)m=	18.71	18.96	19.36	19.85	20.23	20.45	20.52	20.51	20.36	19.88	19.22	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=	0.94	0.92	0.88	0.8	0.68	0.52	0.39	0.42	0.63	0.83	0.91	0.95	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	313.78	339.96	354.39	350.99	314.45	236.43	165.77	171.74	238.44	284.17	294.63	301.14	(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=	645.85	628.78	573.69	483.26	375.83	255.09	170.86	178.78	274.15	408.74	536.18	642.41	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	247.06	194.08	163.16	95.23	45.67	0	0	0	0	92.68	173.92	253.9	(98)

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	1265.71	(98)
Space heating requirement in kWh/m²/year	23.4	(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		90.5	(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)	247.06	194.08	163.16	95.23	45.67	0	0	0	0	92.68	173.92	253.9		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	272.99	214.46	180.29	105.23	50.46	0	0	0	0	102.41	192.17	280.55		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													1398.57	(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)	139.94	122.78	127.62	112.58	109	95.49	89.91	101.15	101.75	116.83	125.84	135.96		
Efficiency of water heater													87.3	(216)
(217)m=	89.32	89.23	89.07	88.74	88.22	87.3	87.3	87.3	87.3	88.69	89.13	89.36		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	156.68	137.59	143.29	126.86	123.55	109.38	102.99	115.86	116.56	131.74	141.19	152.15		
Total = Sum(219a)$_{1...12}$ =													1557.83	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1398.57	
Water heating fuel used			1557.83	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		148.45		(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) =		223.45	(231)
Electricity for lighting			248.46	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			3428.31	(338)

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

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	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	302.09	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	336.49	(264)
Space and water heating	(261) + (262) + (263) + (264) =				638.58	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	115.97	(267)
Electricity for lighting	(232)	x	0.519	=	128.95	(268)
Total CO2, kg/year			sum of (265)…(271) =		883.51	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		16.34	(273)
EI rating (section 14)					88	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.41

Property Address: 1 Bed Var - TF

Address : 1 Bed Var - TF, London, TBC

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	54.08	(1a) x	2.5	(2a) =	135.2	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	54.08	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	135.2	(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		2	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.1	(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) =	0.08	(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

0.11	0.11	0.1	0.09	0.09	0.08	0.08	0.08	0.08	0.09	0.1	0.1

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) = 75.65 (23c)

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

(24a)m=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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			3.57	x	1	=	3.57			(26)
Windows Type 1			1.81	x	1/[1/(1)+ 0.04]	=	1.74			(27)
Windows Type 2			6.09	x	1/[1/(1)+ 0.04]	=	5.86			(27)
Windows Type 3			1.05	x	1/[1/(1)+ 0.04]	=	1.01			(27)
Windows Type 4			5.57	x	1/[1/(1)+ 0.04]	=	5.36			(27)
Walls	62.5	18.09	44.41	x	0.18	=	7.99	14	621.74	(29)
Roof	54.08	0	54.08	x	0.11	=	5.95	9	486.72	(30)
Total area of elements, m²			116.58							(31)
Party wall			19.77	x	0	=	0	20	395.4	(32)
Party floor			54.08					40	2163.2	(32a)
Internal wall **			63.3					9	569.7	(32c)

** 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) = 31.47 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 4236.76 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 78.34 (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 16.17 (36)

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

Total fabric heat loss (33) + (36) = 47.64 (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=	10.27	10.17	10.08	9.6	9.51	9.03	9.03	8.94	9.22	9.51	9.7	9.89	(38)

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

(39)m=	57.91	57.82	57.72	57.25	57.15	56.68	56.68	56.58	56.87	57.15	57.34	57.53	

Average = Sum(39)$_{1\ldots12}$ /12= 57.22 (39)

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

(40)m=	1.07	1.07	1.07	1.06	1.06	1.05	1.05	1.05	1.05	1.06	1.06	1.06	

Average = Sum(40)$_{1\ldots12}$ /12= 1.06 (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 1.81 (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 77.2 (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=	84.92	81.83	78.74	75.65	72.56	69.48	69.48	72.56	75.65	78.74	81.83	84.92	

Total = Sum(44)$_{1\ldots12}$ = 926.35 (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=	125.93	110.14	113.65	99.08	95.07	82.04	76.02	87.24	88.28	102.88	112.3	121.95	

Total = Sum(45)$_{1\ldots12}$ = 1214.59 (45)

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

(46)m=	18.89	16.52	17.05	14.86	14.26	12.31	11.4	13.09	13.24	15.43	16.85	18.29	(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)

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=	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=	14.01	12.64	13.97	13.49	13.92	13.45	13.88	13.91	13.47	13.95	13.53	14.01	(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=	139.94	122.78	127.62	112.58	109	95.49	89.91	101.15	101.75	116.83	125.84	135.96	(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)

Output from water heater

(64)m=	139.94	122.78	127.62	112.58	109	95.49	89.91	101.15	101.75	116.83	125.84	135.96	

Output from water heater (annual)$_{1…12}$ | 1378.84 | (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=	45.37	39.78	41.28	36.32	35.09	30.64	28.75	32.48	32.72	37.7	40.72	44.05	(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=	90.52	90.52	90.52	90.52	90.52	90.52	90.52	90.52	90.52	90.52	90.52	90.52	(66)

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

(67)m=	14.07	12.5	10.16	7.69	5.75	4.86	5.25	6.82	9.15	11.62	13.56	14.46	(67)

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

(68)m=	157.81	159.45	155.32	146.54	135.45	125.02	118.06	116.42	120.55	129.34	140.43	150.85	(68)

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

(69)m=	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	(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=	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	(71)

Water heating gains (Table 5)

(72)m=	60.99	59.2	55.49	50.44	47.17	42.56	38.64	43.66	45.45	50.67	56.56	59.21	(72)

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

(73)m=	286.02	284.3	274.13	257.83	241.52	225.59	215.1	220.06	228.31	244.78	263.71	277.67	(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)

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Northeast	0.9x	0.77	x	1.81	x	11.28	x	0.3	x	0.7	=	2.97	(75)
Northeast	0.9x	0.77	x	1.81	x	22.97	x	0.3	x	0.7	=	6.05	(75)
Northeast	0.9x	0.77	x	1.81	x	41.38	x	0.3	x	0.7	=	10.9	(75)
Northeast	0.9x	0.77	x	1.81	x	67.96	x	0.3	x	0.7	=	17.9	(75)
Northeast	0.9x	0.77	x	1.81	x	91.35	x	0.3	x	0.7	=	24.06	(75)
Northeast	0.9x	0.77	x	1.81	x	97.38	x	0.3	x	0.7	=	25.65	(75)
Northeast	0.9x	0.77	x	1.81	x	91.1	x	0.3	x	0.7	=	24	(75)
Northeast	0.9x	0.77	x	1.81	x	72.63	x	0.3	x	0.7	=	19.13	(75)
Northeast	0.9x	0.77	x	1.81	x	50.42	x	0.3	x	0.7	=	13.28	(75)
Northeast	0.9x	0.77	x	1.81	x	28.07	x	0.3	x	0.7	=	7.39	(75)
Northeast	0.9x	0.77	x	1.81	x	14.2	x	0.3	x	0.7	=	3.74	(75)
Northeast	0.9x	0.77	x	1.81	x	9.21	x	0.3	x	0.7	=	2.43	(75)
Southeast	0.9x	0.77	x	1.05	x	36.79	x	0.3	x	0.7	=	5.62	(77)
Southeast	0.9x	0.77	x	1.05	x	62.67	x	0.3	x	0.7	=	9.58	(77)
Southeast	0.9x	0.77	x	1.05	x	85.75	x	0.3	x	0.7	=	13.1	(77)
Southeast	0.9x	0.77	x	1.05	x	106.25	x	0.3	x	0.7	=	16.24	(77)
Southeast	0.9x	0.77	x	1.05	x	119.01	x	0.3	x	0.7	=	18.19	(77)
Southeast	0.9x	0.77	x	1.05	x	118.15	x	0.3	x	0.7	=	18.05	(77)
Southeast	0.9x	0.77	x	1.05	x	113.91	x	0.3	x	0.7	=	17.41	(77)
Southeast	0.9x	0.77	x	1.05	x	104.39	x	0.3	x	0.7	=	15.95	(77)
Southeast	0.9x	0.77	x	1.05	x	92.85	x	0.3	x	0.7	=	14.19	(77)
Southeast	0.9x	0.77	x	1.05	x	69.27	x	0.3	x	0.7	=	10.58	(77)
Southeast	0.9x	0.77	x	1.05	x	44.07	x	0.3	x	0.7	=	6.73	(77)
Southeast	0.9x	0.77	x	1.05	x	31.49	x	0.3	x	0.7	=	4.81	(77)
Southwest	0.9x	0.77	x	5.57	x	36.79		0.3	x	0.7	=	29.83	(79)
Southwest	0.9x	0.77	x	5.57	x	62.67		0.3	x	0.7	=	50.8	(79)
Southwest	0.9x	0.77	x	5.57	x	85.75		0.3	x	0.7	=	69.51	(79)
Southwest	0.9x	0.77	x	5.57	x	106.25		0.3	x	0.7	=	86.13	(79)
Southwest	0.9x	0.77	x	5.57	x	119.01		0.3	x	0.7	=	96.47	(79)
Southwest	0.9x	0.77	x	5.57	x	118.15		0.3	x	0.7	=	95.77	(79)
Southwest	0.9x	0.77	x	5.57	x	113.91		0.3	x	0.7	=	92.34	(79)
Southwest	0.9x	0.77	x	5.57	x	104.39		0.3	x	0.7	=	84.62	(79)
Southwest	0.9x	0.77	x	5.57	x	92.85		0.3	x	0.7	=	75.27	(79)
Southwest	0.9x	0.77	x	5.57	x	69.27		0.3	x	0.7	=	56.15	(79)
Southwest	0.9x	0.77	x	5.57	x	44.07		0.3	x	0.7	=	35.72	(79)
Southwest	0.9x	0.77	x	5.57	x	31.49		0.3	x	0.7	=	25.52	(79)
Northwest	0.9x	0.77	x	6.09	x	11.28	x	0.3	x	0.7	=	10	(81)
Northwest	0.9x	0.77	x	6.09	x	22.97	x	0.3	x	0.7	=	20.35	(81)
Northwest	0.9x	0.77	x	6.09	x	41.38	x	0.3	x	0.7	=	36.67	(81)
Northwest	0.9x	0.77	x	6.09	x	67.96	x	0.3	x	0.7	=	60.23	(81)
Northwest	0.9x	0.77	x	6.09	x	91.35	x	0.3	x	0.7	=	80.96	(81)

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Northwest	0.9x	0.77	x	6.09	x	97.38	x	0.3	x	0.7	=	86.31	(81)
Northwest	0.9x	0.77	x	6.09	x	91.1	x	0.3	x	0.7	=	80.74	(81)
Northwest	0.9x	0.77	x	6.09	x	72.63	x	0.3	x	0.7	=	64.37	(81)
Northwest	0.9x	0.77	x	6.09	x	50.42	x	0.3	x	0.7	=	44.69	(81)
Northwest	0.9x	0.77	x	6.09	x	28.07	x	0.3	x	0.7	=	24.88	(81)
Northwest	0.9x	0.77	x	6.09	x	14.2	x	0.3	x	0.7	=	12.58	(81)
Northwest	0.9x	0.77	x	6.09	x	9.21	x	0.3	x	0.7	=	8.17	(81)

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

(83)m=	48.42	86.78	130.19	180.49	219.68	225.79	214.48	184.07	147.42	99	58.78	40.93	(83)

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

(84)m=	334.44	371.08	404.31	438.32	461.2	451.38	429.58	404.13	375.73	343.78	322.49	318.6	(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=	0.94	0.93	0.9	0.84	0.75	0.62	0.5	0.54	0.72	0.86	0.93	0.95	(86)

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

(87)m=	18.45	18.7	19.14	19.72	20.27	20.68	20.87	20.83	20.52	19.83	19.04	18.39	(87)

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

(88)m=	20.02	20.03	20.03	20.03	20.04	20.04	20.04	20.04	20.04	20.04	20.03	20.03	(88)

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

(89)m=	0.94	0.92	0.89	0.82	0.71	0.56	0.41	0.45	0.67	0.84	0.92	0.94	(89)

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

(90)m=	16.6	16.96	17.59	18.43	19.19	19.73	19.94	19.91	19.53	18.59	17.46	16.52	(90)

fLA = Living area ÷ (4) = 0.6 (91)

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

(92)m=	17.7	18	18.52	19.2	19.83	20.3	20.49	20.46	20.12	19.33	18.4	17.63	(92)

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

(93)m=	17.55	17.85	18.37	19.05	19.68	20.15	20.34	20.31	19.97	19.18	18.25	17.48	(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=	0.91	0.89	0.86	0.79	0.7	0.57	0.44	0.48	0.66	0.82	0.89	0.92	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	305.99	331.53	346.75	348.36	322.72	257.28	190.15	194.01	248.52	280.37	287.38	293.8	(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=	767.27	748.49	684.91	581.2	456.29	314.3	212.13	221.39	333.8	490.2	639.38	764.19	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	343.19	280.2	251.59	167.65	99.38	0	0	0	0	156.11	253.44	349.97	(98)

DER WorkSheet: New dwelling design stage

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	1901.52	(98)
Space heating requirement in kWh/m²/year	35.16	(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		90.5	(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)	343.19	280.2	251.59	167.65	99.38	0	0	0	0	156.11	253.44	349.97		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	379.22	309.61	278	185.24	109.81	0	0	0	0	172.5	280.04	386.7		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													2101.12	(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)	139.94	122.78	127.62	112.58	109	95.49	89.91	101.15	101.75	116.83	125.84	135.96		
Efficiency of water heater													87.3	(216)
(217)m=	89.55	89.5	89.4	89.19	88.8	87.3	87.3	87.3	87.3	89.1	89.41	89.58		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	156.27	137.18	142.76	126.23	122.75	109.38	102.99	115.86	116.56	131.12	140.74	151.77		
Total = Sum(219a)$_{1...12}$ =													1553.6	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2101.12	
Water heating fuel used			1553.6	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		148.45		(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) =		223.45	(231)
Electricity for lighting			248.46	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			4126.64	(338)

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

DER WorkSheet: New dwelling design stage

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	453.84	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	335.58	(264)
Space and water heating	(261) + (262) + (263) + (264) =			789.42	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	115.97	(267)
Electricity for lighting	(232) x	0.519	=	128.95	(268)
Total CO2, kg/year		sum of (265)…(271) =		1034.34	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		19.13	(273)
EI rating (section 14)				86	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: 2 Bed - EF

Address : 2 Bed - EF, London, TBC

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67.05	(1a) x	2.5	(2a) =	167.63	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67.05	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		167.63	(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		2	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.1	(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) =	0.08	(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

0.11	0.11	0.1	0.09	0.09	0.08	0.08	0.08	0.08	0.09	0.1	0.1

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) = 75.65 (23c)

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

(24a)m=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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			3.57	x	1	=	3.57			(26)
Windows Type 1			1.81	x	1/[1/(1)+ 0.04]	=	1.74			(27)
Windows Type 2			2.1	x	1/[1/(1)+ 0.04]	=	2.02			(27)
Windows Type 3			1.05	x	1/[1/(1)+ 0.04]	=	1.01			(27)
Windows Type 4			7.35	x	1/[1/(1)+ 0.04]	=	7.07			(27)
Floor			24.59	x	0.13	=	3.1967	75	1844.25	(28)
Walls	58.81	15.88	42.93	x	0.18	=	7.73	14	601.02	(29)
Total area of elements, m²			83.4							(31)
Party wall			50.53	x	0	=	0	20	1010.6	(32)
Party floor			42.46					40	1698.4	(32a)
Party ceiling			67.05					30	2011.5	(32b)
Internal wall **			87.34					9	786.0599	(32c)

** 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) = 26.33 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7951.83 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 118.6 (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 15.91 (36)

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

Total fabric heat loss	(33) + (36) =	42.24	(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=	12.73	12.61	12.49	11.91	11.79	11.2	11.2	11.08	11.44	11.79	12.02	12.26	(38)

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

(39)m=	54.97	54.85	54.73	54.15	54.03	53.44	53.44	53.32	53.68	54.03	54.26	54.5	

Average = Sum(39)$_{1...12}$ /12= 54.12 (39)

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

(40)m=	0.82	0.82	0.82	0.81	0.81	0.8	0.8	0.8	0.8	0.81	0.81	0.81	

Average = Sum(40)$_{1...12}$ /12= 0.81 (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 85.8 (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=	94.37	90.94	87.51	84.08	80.65	77.22	77.22	80.65	84.08	87.51	90.94	94.37	

Total = Sum(44)$_{1...12}$ = 1029.54 (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=	139.96	122.41	126.31	110.12	105.66	91.18	84.49	96.96	98.11	114.34	124.81	135.54	

Total = Sum(45)$_{1...12}$ = 1349.89 (45)

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

(46)m=	20.99	18.36	18.95	16.52	15.85	13.68	12.67	14.54	14.72	17.15	18.72	20.33	(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=	14.07	12.69	14.02	13.54	13.96	13.48	13.91	13.94	13.51	14	13.59	14.06	(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=	154.03	135.1	140.33	123.66	119.63	104.66	98.4	110.9	111.62	128.34	138.4	149.6	(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)

Output from water heater

(64)m=	154.03	135.1	140.33	123.66	119.63	104.66	98.4	110.9	111.62	128.34	138.4	149.6	

Output from water heater (annual)$_{1...12}$ 1514.67 (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=	50.05	43.87	45.5	40	38.62	33.69	31.57	35.72	36	41.52	44.9	48.58	(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=	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	(66)

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

(67)m=	16.97	15.07	12.26	9.28	6.94	5.86	6.33	8.22	11.04	14.02	16.36	17.44	(67)

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

(68)m=	190.32	192.29	187.31	176.72	163.35	150.78	142.38	140.4	145.38	155.98	169.35	181.92	(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=	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	(71)

Water heating gains (Table 5)

(72)m=	67.28	65.29	61.16	55.55	51.91	46.79	42.44	48.02	50	55.8	62.36	65.3	(72)

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

(73)m=	333.15	331.23	319.32	300.14	280.78	262.01	249.73	255.23	265.01	284.38	306.65	323.24	(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)	
Northeast	0.9x	0.77	x	1.81	x	11.28	x	0.3	x	0.7	=	2.97	(75)
Northeast	0.9x	0.77	x	1.81	x	22.97	x	0.3	x	0.7	=	6.05	(75)
Northeast	0.9x	0.77	x	1.81	x	41.38	x	0.3	x	0.7	=	10.9	(75)
Northeast	0.9x	0.77	x	1.81	x	67.96	x	0.3	x	0.7	=	17.9	(75)
Northeast	0.9x	0.77	x	1.81	x	91.35	x	0.3	x	0.7	=	24.06	(75)
Northeast	0.9x	0.77	x	1.81	x	97.38	x	0.3	x	0.7	=	25.65	(75)
Northeast	0.9x	0.77	x	1.81	x	91.1	x	0.3	x	0.7	=	24	(75)
Northeast	0.9x	0.77	x	1.81	x	72.63	x	0.3	x	0.7	=	19.13	(75)
Northeast	0.9x	0.77	x	1.81	x	50.42	x	0.3	x	0.7	=	13.28	(75)
Northeast	0.9x	0.77	x	1.81	x	28.07	x	0.3	x	0.7	=	7.39	(75)
Northeast	0.9x	0.77	x	1.81	x	14.2	x	0.3	x	0.7	=	3.74	(75)
Northeast	0.9x	0.77	x	1.81	x	9.21	x	0.3	x	0.7	=	2.43	(75)
Southeast	0.9x	0.77	x	1.05	x	36.79	x	0.3	x	0.7	=	5.62	(77)
Southeast	0.9x	0.77	x	1.05	x	62.67	x	0.3	x	0.7	=	9.58	(77)
Southeast	0.9x	0.77	x	1.05	x	85.75	x	0.3	x	0.7	=	13.1	(77)
Southeast	0.9x	0.77	x	1.05	x	106.25	x	0.3	x	0.7	=	16.24	(77)
Southeast	0.9x	0.77	x	1.05	x	119.01	x	0.3	x	0.7	=	18.19	(77)
Southeast	0.9x	0.77	x	1.05	x	118.15	x	0.3	x	0.7	=	18.05	(77)
Southeast	0.9x	0.77	x	1.05	x	113.91	x	0.3	x	0.7	=	17.41	(77)
Southeast	0.9x	0.77	x	1.05	x	104.39	x	0.3	x	0.7	=	15.95	(77)
Southeast	0.9x	0.77	x	1.05	x	92.85	x	0.3	x	0.7	=	14.19	(77)
Southeast	0.9x	0.77	x	1.05	x	69.27	x	0.3	x	0.7	=	10.58	(77)
Southeast	0.9x	0.77	x	1.05	x	44.07	x	0.3	x	0.7	=	6.73	(77)
Southeast	0.9x	0.77	x	1.05	x	31.49	x	0.3	x	0.7	=	4.81	(77)
Southwest	0.9x	0.77	x	7.35	x	36.79		0.3	x	0.7	=	39.36	(79)
Southwest	0.9x	0.77	x	7.35	x	62.67		0.3	x	0.7	=	67.04	(79)
Southwest	0.9x	0.77	x	7.35	x	85.75		0.3	x	0.7	=	91.72	(79)
Southwest	0.9x	0.77	x	7.35	x	106.25		0.3	x	0.7	=	113.65	(79)
Southwest	0.9x	0.77	x	7.35	x	119.01		0.3	x	0.7	=	127.3	(79)
Southwest	0.9x	0.77	x	7.35	x	118.15		0.3	x	0.7	=	126.38	(79)
Southwest	0.9x	0.77	x	7.35	x	113.91		0.3	x	0.7	=	121.84	(79)
Southwest	0.9x	0.77	x	7.35	x	104.39		0.3	x	0.7	=	111.66	(79)
Southwest	0.9x	0.77	x	7.35	x	92.85		0.3	x	0.7	=	99.32	(79)
Southwest	0.9x	0.77	x	7.35	x	69.27		0.3	x	0.7	=	74.09	(79)
Southwest	0.9x	0.77	x	7.35	x	44.07		0.3	x	0.7	=	47.14	(79)
Southwest	0.9x	0.77	x	7.35	x	31.49		0.3	x	0.7	=	33.68	(79)
Northwest	0.9x	0.77	x	2.1	x	11.28	x	0.3	x	0.7	=	3.45	(81)
Northwest	0.9x	0.77	x	2.1	x	22.97	x	0.3	x	0.7	=	7.02	(81)
Northwest	0.9x	0.77	x	2.1	x	41.38	x	0.3	x	0.7	=	12.65	(81)

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Northwest 0.9x	0.77	x	2.1	x	67.96	x	0.3	x	0.7	=	20.77	(81)
Northwest 0.9x	0.77	x	2.1	x	91.35	x	0.3	x	0.7	=	27.92	(81)
Northwest 0.9x	0.77	x	2.1	x	97.38	x	0.3	x	0.7	=	29.76	(81)
Northwest 0.9x	0.77	x	2.1	x	91.1	x	0.3	x	0.7	=	27.84	(81)
Northwest 0.9x	0.77	x	2.1	x	72.63	x	0.3	x	0.7	=	22.2	(81)
Northwest 0.9x	0.77	x	2.1	x	50.42	x	0.3	x	0.7	=	15.41	(81)
Northwest 0.9x	0.77	x	2.1	x	28.07	x	0.3	x	0.7	=	8.58	(81)
Northwest 0.9x	0.77	x	2.1	x	14.2	x	0.3	x	0.7	=	4.34	(81)
Northwest 0.9x	0.77	x	2.1	x	9.21	x	0.3	x	0.7	=	2.82	(81)

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

(83)m=	51.4	89.68	128.37	168.56	197.46	199.85	191.09	168.94	142.2	100.65	61.95	43.74	(83)

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

(84)m=	384.54	420.92	447.69	468.69	478.24	461.85	440.81	424.17	407.2	385.03	368.6	366.98	(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=	0.98	0.96	0.94	0.9	0.81	0.66	0.51	0.54	0.75	0.91	0.96	0.98	(86)

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

(87)m=	19.55	19.72	20.01	20.37	20.69	20.9	20.97	20.96	20.83	20.43	19.93	19.51	(87)

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

(88)m=	20.24	20.24	20.24	20.25	20.25	20.26	20.26	20.26	20.25	20.25	20.25	20.24	(88)

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

(89)m=	0.97	0.96	0.93	0.88	0.77	0.6	0.43	0.47	0.7	0.89	0.96	0.98	(89)

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

(90)m=	18.27	18.53	18.93	19.45	19.89	20.16	20.24	20.23	20.07	19.54	18.83	18.22	(90)

fLA = Living area ÷ (4) = | 0.54 | (91)

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

(92)m=	18.96	19.17	19.51	19.94	20.32	20.55	20.63	20.62	20.48	20.02	19.42	18.91	(92)

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

(93)m=	18.81	19.02	19.36	19.79	20.17	20.4	20.48	20.47	20.33	19.87	19.27	18.76	(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=	0.96	0.95	0.92	0.87	0.77	0.61	0.46	0.49	0.71	0.88	0.95	0.97	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	370.47	399.35	412.83	406.88	368.49	283.31	200.65	208.2	287.2	338.02	348.64	355.31	(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=	797.38	774.36	703.75	589.87	457.43	310.22	207.29	217.09	334.22	500.75	660.27	793.51	(97)

DER WorkSheet: New dwelling design stage

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(98)m=	317.62	252.01	216.44	131.75	66.17	0	0	0	0	121.07	224.38	326.02		

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1655.46 (98)

Space heating requirement in kWh/m²/year 24.69 (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		90.5	(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)	317.62	252.01	216.44	131.75	66.17	0	0	0	0	121.07	224.38	326.02		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	350.97	278.46	239.17	145.58	73.12	0	0	0	0	133.78	247.93	360.24		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													1829.24	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	154.03	135.1	140.33	123.66	119.63	104.66	98.4	110.9	111.62	128.34	138.4	149.6		
Efficiency of water heater													87.3	(216)
(217)m=	89.43	89.36	89.21	88.92	88.41	87.3	87.3	87.3	87.3	88.82	89.25	89.47		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	172.23	151.19	157.3	139.06	135.3	119.89	112.72	127.03	127.86	144.49	155.06	167.21		
Total = Sum(219a)$_{1...12}$ =													1709.36	(219)

Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			1829.24	
Water heating fuel used			1709.36	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		184.05		(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) =		259.05	(231)
Electricity for lighting			299.64	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			4097.29	(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	=	395.12	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	369.22	(264)
Space and water heating	(261) + (262) + (263) + (264) =				764.34	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	134.45	(267)
Electricity for lighting	(232)	x	0.519	=	155.51	(268)
Total CO2, kg/year			sum of (265)…(271) =		1054.3	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		15.72	(273)
EI rating (section 14)					87	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version: Version: 1.0.5.41

Property Address: 2 Bed - MF

Address : 2 Bed - MF, London, TBC

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67.05	(1a) x	2.5	(2a) =	167.63	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67.05	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	167.63	(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		2	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.1	(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) =	0.08	(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

0.11	0.11	0.1	0.09	0.09	0.08	0.08	0.08	0.08	0.09	0.1	0.1

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) = 75.65 (23c)

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

(24a)m=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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			3.57	x	1	=	3.57			(26)
Windows Type 1			1.81	x	1/[1/(1)+ 0.04]	=	1.74			(27)
Windows Type 2			2.1	x	1/[1/(1)+ 0.04]	=	2.02			(27)
Windows Type 3			1.05	x	1/[1/(1)+ 0.04]	=	1.01			(27)
Windows Type 4			7.35	x	1/[1/(1)+ 0.04]	=	7.07			(27)
Walls	58.81	15.88	42.93	x	0.18	=	7.73	14	601.02	(29)
Total area of elements, m²			58.81							(31)
Party wall			50.53	x	0	=	0	20	1010.6	(32)
Party floor			67.05					40	2682	(32a)
Party ceiling			67.05					30	2011.5	(32b)
Internal wall **			87.34					9	786.0599	(32c)

** 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) = 23.13 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7091.18 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 105.76 (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 8.29 (36)

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

Total fabric heat loss (33) + (36) = 31.42 (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=	12.73	12.61	12.49	11.91	11.79	11.2	11.2	11.08	11.44	11.79	12.02	12.26	(38)

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

(39)m=	44.15	44.04	43.92	43.33	43.21	42.63	42.63	42.51	42.86	43.21	43.45	43.68	

Average = Sum(39)$_{1\ldots12}$ /12= 43.3 (39)

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

(40)m=	0.66	0.66	0.66	0.65	0.64	0.64	0.64	0.63	0.64	0.64	0.65	0.65	

Average = Sum(40)$_{1\ldots12}$ /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 85.8 (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=	94.37	90.94	87.51	84.08	80.65	77.22	77.22	80.65	84.08	87.51	90.94	94.37	

Total = Sum(44)$_{1\ldots12}$ = 1029.54 (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=	139.96	122.41	126.31	110.12	105.66	91.18	84.49	96.96	98.11	114.34	124.81	135.54	

Total = Sum(45)$_{1\ldots12}$ = 1349.89 (45)

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

(46)m=	20.99	18.36	18.95	16.52	15.85	13.68	12.67	14.54	14.72	17.15	18.72	20.33	(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=	14.07	12.69	14.02	13.54	13.96	13.48	13.91	13.94	13.51	14	13.59	14.06	(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=	154.03	135.1	140.33	123.66	119.63	104.66	98.4	110.9	111.62	128.34	138.4	149.6	(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)

Output from water heater

(64)m=	154.03	135.1	140.33	123.66	119.63	104.66	98.4	110.9	111.62	128.34	138.4	149.6

Output from water heater (annual)$_{1...12}$ | 1514.67 | (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=	50.05	43.87	45.5	40	38.62	33.69	31.57	35.72	36	41.52	44.9	48.58	(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=	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	(66)

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

(67)m=	16.97	15.07	12.26	9.28	6.94	5.86	6.33	8.22	11.04	14.02	16.36	17.44	(67)

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

(68)m=	190.32	192.29	187.31	176.72	163.35	150.78	142.38	140.4	145.38	155.98	169.35	181.92	(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=	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	(71)

Water heating gains (Table 5)

(72)m=	67.28	65.29	61.16	55.55	51.91	46.79	42.44	48.02	50	55.8	62.36	65.3	(72)

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

(73)m=	333.15	331.23	319.32	300.14	280.78	262.01	249.73	255.23	265.01	284.38	306.65	323.24	(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)

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Northeast	0.9x	0.77	x	1.81	x	11.28	x	0.3	x	0.7	=	2.97	(75)
Northeast	0.9x	0.77	x	1.81	x	22.97	x	0.3	x	0.7	=	6.05	(75)
Northeast	0.9x	0.77	x	1.81	x	41.38	x	0.3	x	0.7	=	10.9	(75)
Northeast	0.9x	0.77	x	1.81	x	67.96	x	0.3	x	0.7	=	17.9	(75)
Northeast	0.9x	0.77	x	1.81	x	91.35	x	0.3	x	0.7	=	24.06	(75)
Northeast	0.9x	0.77	x	1.81	x	97.38	x	0.3	x	0.7	=	25.65	(75)
Northeast	0.9x	0.77	x	1.81	x	91.1	x	0.3	x	0.7	=	24	(75)
Northeast	0.9x	0.77	x	1.81	x	72.63	x	0.3	x	0.7	=	19.13	(75)
Northeast	0.9x	0.77	x	1.81	x	50.42	x	0.3	x	0.7	=	13.28	(75)
Northeast	0.9x	0.77	x	1.81	x	28.07	x	0.3	x	0.7	=	7.39	(75)
Northeast	0.9x	0.77	x	1.81	x	14.2	x	0.3	x	0.7	=	3.74	(75)
Northeast	0.9x	0.77	x	1.81	x	9.21	x	0.3	x	0.7	=	2.43	(75)
Southeast	0.9x	0.77	x	1.05	x	36.79	x	0.3	x	0.7	=	5.62	(77)
Southeast	0.9x	0.77	x	1.05	x	62.67	x	0.3	x	0.7	=	9.58	(77)
Southeast	0.9x	0.77	x	1.05	x	85.75	x	0.3	x	0.7	=	13.1	(77)
Southeast	0.9x	0.77	x	1.05	x	106.25	x	0.3	x	0.7	=	16.24	(77)
Southeast	0.9x	0.77	x	1.05	x	119.01	x	0.3	x	0.7	=	18.19	(77)
Southeast	0.9x	0.77	x	1.05	x	118.15	x	0.3	x	0.7	=	18.05	(77)
Southeast	0.9x	0.77	x	1.05	x	113.91	x	0.3	x	0.7	=	17.41	(77)
Southeast	0.9x	0.77	x	1.05	x	104.39	x	0.3	x	0.7	=	15.95	(77)
Southeast	0.9x	0.77	x	1.05	x	92.85	x	0.3	x	0.7	=	14.19	(77)
Southeast	0.9x	0.77	x	1.05	x	69.27	x	0.3	x	0.7	=	10.58	(77)
Southeast	0.9x	0.77	x	1.05	x	44.07	x	0.3	x	0.7	=	6.73	(77)
Southeast	0.9x	0.77	x	1.05	x	31.49	x	0.3	x	0.7	=	4.81	(77)
Southwest	0.9x	0.77	x	7.35	x	36.79		0.3	x	0.7	=	39.36	(79)
Southwest	0.9x	0.77	x	7.35	x	62.67		0.3	x	0.7	=	67.04	(79)
Southwest	0.9x	0.77	x	7.35	x	85.75		0.3	x	0.7	=	91.72	(79)
Southwest	0.9x	0.77	x	7.35	x	106.25		0.3	x	0.7	=	113.65	(79)
Southwest	0.9x	0.77	x	7.35	x	119.01		0.3	x	0.7	=	127.3	(79)
Southwest	0.9x	0.77	x	7.35	x	118.15		0.3	x	0.7	=	126.38	(79)
Southwest	0.9x	0.77	x	7.35	x	113.91		0.3	x	0.7	=	121.84	(79)
Southwest	0.9x	0.77	x	7.35	x	104.39		0.3	x	0.7	=	111.66	(79)
Southwest	0.9x	0.77	x	7.35	x	92.85		0.3	x	0.7	=	99.32	(79)
Southwest	0.9x	0.77	x	7.35	x	69.27		0.3	x	0.7	=	74.09	(79)
Southwest	0.9x	0.77	x	7.35	x	44.07		0.3	x	0.7	=	47.14	(79)
Southwest	0.9x	0.77	x	7.35	x	31.49		0.3	x	0.7	=	33.68	(79)
Northwest	0.9x	0.77	x	2.1	x	11.28	x	0.3	x	0.7	=	3.45	(81)
Northwest	0.9x	0.77	x	2.1	x	22.97	x	0.3	x	0.7	=	7.02	(81)
Northwest	0.9x	0.77	x	2.1	x	41.38	x	0.3	x	0.7	=	12.65	(81)
Northwest	0.9x	0.77	x	2.1	x	67.96	x	0.3	x	0.7	=	20.77	(81)
Northwest	0.9x	0.77	x	2.1	x	91.35	x	0.3	x	0.7	=	27.92	(81)

Northwest 0.9x	0.77	x	2.1	x	97.38	x	0.3	x	0.7	=	29.76	(81)
Northwest 0.9x	0.77	x	2.1	x	91.1	x	0.3	x	0.7	=	27.84	(81)
Northwest 0.9x	0.77	x	2.1	x	72.63	x	0.3	x	0.7	=	22.2	(81)
Northwest 0.9x	0.77	x	2.1	x	50.42	x	0.3	x	0.7	=	15.41	(81)
Northwest 0.9x	0.77	x	2.1	x	28.07	x	0.3	x	0.7	=	8.58	(81)
Northwest 0.9x	0.77	x	2.1	x	14.2	x	0.3	x	0.7	=	4.34	(81)
Northwest 0.9x	0.77	x	2.1	x	9.21	x	0.3	x	0.7	=	2.82	(81)

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

(83)m=	51.4	89.68	128.37	168.56	197.46	199.85	191.09	168.94	142.2	100.65	61.95	43.74	(83)

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

(84)m=	384.54	420.92	447.69	468.69	478.24	461.85	440.81	424.17	407.2	385.03	368.6	366.98	(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=	0.96	0.94	0.91	0.84	0.73	0.56	0.42	0.45	0.66	0.86	0.94	0.97	(86)

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

(87)m=	19.87	20.04	20.29	20.6	20.83	20.96	20.99	20.99	20.91	20.63	20.2	19.83	(87)

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

(88)m=	20.38	20.38	20.38	20.39	20.39	20.4	20.4	20.4	20.39	20.39	20.39	20.38	(88)

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

(89)m=	0.96	0.94	0.9	0.82	0.7	0.51	0.36	0.4	0.61	0.84	0.93	0.96	(89)

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

(90)m=	18.84	19.08	19.45	19.88	20.19	20.36	20.39	20.39	20.31	19.93	19.33	18.78	(90)

fLA = Living area ÷ (4) = 0.54 (91)

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

(92)m=	19.39	19.6	19.9	20.27	20.54	20.68	20.71	20.71	20.63	20.31	19.8	19.34	(92)

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

(93)m=	19.24	19.45	19.75	20.12	20.39	20.53	20.56	20.56	20.48	20.16	19.65	19.19	(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=	0.95	0.93	0.89	0.82	0.69	0.52	0.38	0.41	0.62	0.83	0.92	0.95	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	364.38	389.98	398.01	382.23	332.27	242.41	166.75	173.85	252.96	319.03	339.85	350.21	(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=	659.58	640.54	582	486.06	375.32	252.65	168.84	176.76	273.53	412.99	545.2	654.99	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	219.63	168.37	136.89	74.76	32.03	0	0	0	0	69.9	147.86	226.75	

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	1076.19	(98)
Space heating requirement in kWh/m²/year	16.05	(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		90.5	(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)	219.63	168.37	136.89	74.76	32.03	0	0	0	0	69.9	147.86	226.75		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	242.69	186.05	151.26	82.6	35.39	0	0	0	0	77.24	163.38	250.56		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													1189.16	(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)	154.03	135.1	140.33	123.66	119.63	104.66	98.4	110.9	111.62	128.34	138.4	149.6		
Efficiency of water heater													87.3	(216)
(217)m=	89.15	89.05	88.85	88.48	87.96	87.3	87.3	87.3	87.3	88.4	88.92	89.2		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	172.77	151.72	157.94	139.76	136	119.89	112.72	127.03	127.86	145.18	155.64	167.72		
Total = Sum(219a)$_{1...12}$ =													1714.22	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1189.16	
Water heating fuel used			1714.22	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		184.05		(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) =		259.05	(231)
Electricity for lighting			299.64	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			3462.07	(338)

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

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	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	256.86	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	370.27	(264)
Space and water heating	(261) + (262) + (263) + (264) =				627.13	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	134.45	(267)
Electricity for lighting	(232)	x	0.519	=	155.51	(268)
Total CO2, kg/year			sum of (265)…(271) =		917.09	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		13.68	(273)
EI rating (section 14)					89	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: 2 Bed - TF

Address : 2 Bed - TF, London, TBC

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67.05	(1a) x	2.5	(2a) =	167.63	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67.05	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	167.63	(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		2	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.1	(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) =	0.08	(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

DER WorkSheet: New dwelling design stage

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

0.11	0.11	0.1	0.09	0.09	0.08	0.08	0.08	0.08	0.09	0.1	0.1

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) =	75.65	(23c)

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

(24a)m=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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			3.57	x	1	=	3.57			(26)
Windows Type 1			1.81	x	1/[1/(1)+ 0.04]	=	1.74			(27)
Windows Type 2			2.1	x	1/[1/(1)+ 0.04]	=	2.02			(27)
Windows Type 3			1.05	x	1/[1/(1)+ 0.04]	=	1.01			(27)
Windows Type 4			7.35	x	1/[1/(1)+ 0.04]	=	7.07			(27)
Walls	58.81	15.88	42.93	x	0.18	=	7.73	14	601.02	(29)
Roof	67.05	0	67.05	x	0.11	=	7.38	9	603.45	(30)
Total area of elements, m²			125.86							(31)
Party wall			50.53	x	0	=	0	20	1010.6	(32)
Party floor			67.05					40	2682	(32a)
Internal wall **			87.34					9	786.0599	(32c)

** 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) =	30.51	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	5683.13	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	= (34) ÷ (4) =	84.76	(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		18.08	(36)

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

Total fabric heat loss	(33) + (36) =	48.59	(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=	12.73	12.61	12.49	11.91	11.79	11.2	11.2	11.08	11.44	11.79	12.02	12.26	(38)

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

(39)m=	61.32	61.2	61.08	60.5	60.38	59.79	59.79	59.67	60.03	60.38	60.61	60.85	

Average = Sum(39)$_{1…12}$ /12= 60.47 (39)

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

(40)m=	0.91	0.91	0.91	0.9	0.9	0.89	0.89	0.89	0.9	0.9	0.9	0.91	

Average = Sum(40)$_{1…12}$ /12= 0.9 (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 85.8 (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=	94.37	90.94	87.51	84.08	80.65	77.22	77.22	80.65	84.08	87.51	90.94	94.37	

Total = Sum(44)$_{1…12}$ = 1029.54 (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=	139.96	122.41	126.31	110.12	105.66	91.18	84.49	96.96	98.11	114.34	124.81	135.54	

Total = Sum(45)$_{1…12}$ = 1349.89 (45)

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

(46)m=	20.99	18.36	18.95	16.52	15.85	13.68	12.67	14.54	14.72	17.15	18.72	20.33	(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=	14.07	12.69	14.02	13.54	13.96	13.48	13.91	13.94	13.51	14	13.59	14.06	(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=	154.03	135.1	140.33	123.66	119.63	104.66	98.4	110.9	111.62	128.34	138.4	149.6	(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)

Output from water heater

(64)m=	154.03	135.1	140.33	123.66	119.63	104.66	98.4	110.9	111.62	128.34	138.4	149.6

Output from water heater (annual)$_{1...12}$ | 1514.67 | (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=	50.05	43.87	45.5	40	38.62	33.69	31.57	35.72	36	41.52	44.9	48.58	(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=	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	(66)

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

(67)m=	16.97	15.07	12.26	9.28	6.94	5.86	6.33	8.22	11.04	14.02	16.36	17.44	(67)

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

(68)m=	190.32	192.29	187.31	176.72	163.35	150.78	142.38	140.4	145.38	155.98	169.35	181.92	(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=	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	(71)

Water heating gains (Table 5)

(72)m=	67.28	65.29	61.16	55.55	51.91	46.79	42.44	48.02	50	55.8	62.36	65.3	(72)

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

(73)m=	333.15	331.23	319.32	300.14	280.78	262.01	249.73	255.23	265.01	284.38	306.65	323.24	(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)

Northeast	0.9x	0.77	x	1.81	x	11.28	x	0.3	x	0.7	=	2.97	(75)
Northeast	0.9x	0.77	x	1.81	x	22.97	x	0.3	x	0.7	=	6.05	(75)
Northeast	0.9x	0.77	x	1.81	x	41.38	x	0.3	x	0.7	=	10.9	(75)
Northeast	0.9x	0.77	x	1.81	x	67.96	x	0.3	x	0.7	=	17.9	(75)
Northeast	0.9x	0.77	x	1.81	x	91.35	x	0.3	x	0.7	=	24.06	(75)
Northeast	0.9x	0.77	x	1.81	x	97.38	x	0.3	x	0.7	=	25.65	(75)
Northeast	0.9x	0.77	x	1.81	x	91.1	x	0.3	x	0.7	=	24	(75)
Northeast	0.9x	0.77	x	1.81	x	72.63	x	0.3	x	0.7	=	19.13	(75)
Northeast	0.9x	0.77	x	1.81	x	50.42	x	0.3	x	0.7	=	13.28	(75)
Northeast	0.9x	0.77	x	1.81	x	28.07	x	0.3	x	0.7	=	7.39	(75)
Northeast	0.9x	0.77	x	1.81	x	14.2	x	0.3	x	0.7	=	3.74	(75)
Northeast	0.9x	0.77	x	1.81	x	9.21	x	0.3	x	0.7	=	2.43	(75)
Southeast	0.9x	0.77	x	1.05	x	36.79	x	0.3	x	0.7	=	5.62	(77)
Southeast	0.9x	0.77	x	1.05	x	62.67	x	0.3	x	0.7	=	9.58	(77)
Southeast	0.9x	0.77	x	1.05	x	85.75	x	0.3	x	0.7	=	13.1	(77)
Southeast	0.9x	0.77	x	1.05	x	106.25	x	0.3	x	0.7	=	16.24	(77)
Southeast	0.9x	0.77	x	1.05	x	119.01	x	0.3	x	0.7	=	18.19	(77)
Southeast	0.9x	0.77	x	1.05	x	118.15	x	0.3	x	0.7	=	18.05	(77)
Southeast	0.9x	0.77	x	1.05	x	113.91	x	0.3	x	0.7	=	17.41	(77)
Southeast	0.9x	0.77	x	1.05	x	104.39	x	0.3	x	0.7	=	15.95	(77)
Southeast	0.9x	0.77	x	1.05	x	92.85	x	0.3	x	0.7	=	14.19	(77)
Southeast	0.9x	0.77	x	1.05	x	69.27	x	0.3	x	0.7	=	10.58	(77)
Southeast	0.9x	0.77	x	1.05	x	44.07	x	0.3	x	0.7	=	6.73	(77)
Southeast	0.9x	0.77	x	1.05	x	31.49	x	0.3	x	0.7	=	4.81	(77)
Southwest	0.9x	0.77	x	7.35	x	36.79		0.3	x	0.7	=	39.36	(79)
Southwest	0.9x	0.77	x	7.35	x	62.67		0.3	x	0.7	=	67.04	(79)
Southwest	0.9x	0.77	x	7.35	x	85.75		0.3	x	0.7	=	91.72	(79)
Southwest	0.9x	0.77	x	7.35	x	106.25		0.3	x	0.7	=	113.65	(79)
Southwest	0.9x	0.77	x	7.35	x	119.01		0.3	x	0.7	=	127.3	(79)
Southwest	0.9x	0.77	x	7.35	x	118.15		0.3	x	0.7	=	126.38	(79)
Southwest	0.9x	0.77	x	7.35	x	113.91		0.3	x	0.7	=	121.84	(79)
Southwest	0.9x	0.77	x	7.35	x	104.39		0.3	x	0.7	=	111.66	(79)
Southwest	0.9x	0.77	x	7.35	x	92.85		0.3	x	0.7	=	99.32	(79)
Southwest	0.9x	0.77	x	7.35	x	69.27		0.3	x	0.7	=	74.09	(79)
Southwest	0.9x	0.77	x	7.35	x	44.07		0.3	x	0.7	=	47.14	(79)
Southwest	0.9x	0.77	x	7.35	x	31.49		0.3	x	0.7	=	33.68	(79)
Northwest	0.9x	0.77	x	2.1	x	11.28	x	0.3	x	0.7	=	3.45	(81)
Northwest	0.9x	0.77	x	2.1	x	22.97	x	0.3	x	0.7	=	7.02	(81)
Northwest	0.9x	0.77	x	2.1	x	41.38	x	0.3	x	0.7	=	12.65	(81)
Northwest	0.9x	0.77	x	2.1	x	67.96	x	0.3	x	0.7	=	20.77	(81)
Northwest	0.9x	0.77	x	2.1	x	91.35	x	0.3	x	0.7	=	27.92	(81)

Northwest	0.9x	0.77	x	2.1	x	97.38	x	0.3	x	0.7	=	29.76	(81)
Northwest	0.9x	0.77	x	2.1	x	91.1	x	0.3	x	0.7	=	27.84	(81)
Northwest	0.9x	0.77	x	2.1	x	72.63	x	0.3	x	0.7	=	22.2	(81)
Northwest	0.9x	0.77	x	2.1	x	50.42	x	0.3	x	0.7	=	15.41	(81)
Northwest	0.9x	0.77	x	2.1	x	28.07	x	0.3	x	0.7	=	8.58	(81)
Northwest	0.9x	0.77	x	2.1	x	14.2	x	0.3	x	0.7	=	4.34	(81)
Northwest	0.9x	0.77	x	2.1	x	9.21	x	0.3	x	0.7	=	2.82	(81)

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

(83)m=	51.4	89.68	128.37	168.56	197.46	199.85	191.09	168.94	142.2	100.65	61.95	43.74	(83)

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

(84)m=	384.54	420.92	447.69	468.69	478.24	461.85	440.81	424.17	407.2	385.03	368.6	366.98	(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=	0.96	0.94	0.92	0.87	0.79	0.66	0.53	0.56	0.74	0.88	0.94	0.96	(86)

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

(87)m=	18.88	19.1	19.47	19.95	20.4	20.75	20.9	20.88	20.63	20.06	19.39	18.83	(87)

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

(88)m=	20.16	20.16	20.16	20.17	20.17	20.17	20.17	20.18	20.17	20.17	20.16	20.16	(88)

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

(89)m=	0.95	0.93	0.91	0.85	0.76	0.61	0.45	0.48	0.69	0.86	0.93	0.96	(89)

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

(90)m=	17.29	17.6	18.13	18.83	19.46	19.92	20.1	20.08	19.78	19	18.03	17.22	(90)

fLA = Living area ÷ (4) = 0.54 (91)

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

(92)m=	18.14	18.4	18.85	19.43	19.96	20.36	20.53	20.51	20.24	19.57	18.76	18.09	(92)

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

(93)m=	17.99	18.25	18.7	19.28	19.81	20.21	20.38	20.36	20.09	19.42	18.61	17.94	(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=	0.93	0.91	0.88	0.83	0.74	0.61	0.47	0.5	0.69	0.84	0.91	0.94	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	358.11	384.22	395.15	388.46	354.66	281.28	207.01	212.91	279.4	322.67	335.19	344.15	(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=	839.64	817.27	744.93	627.75	489.89	335.68	225.96	236.27	359.29	532.34	697.77	835.79	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	358.26	291.01	260.24	172.29	100.61	0	0	0	0	156	261.06	365.78	(98)

DER WorkSheet: New dwelling design stage

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	1965.24	(98)
Space heating requirement in kWh/m²/year	29.31	(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		90.5	(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)	358.26	291.01	260.24	172.29	100.61	0	0	0	0	156	261.06	365.78		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	395.87	321.56	287.56	190.37	111.17	0	0	0	0	172.37	288.46	404.18		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													2171.54	(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)	154.03	135.1	140.33	123.66	119.63	104.66	98.4	110.9	111.62	128.34	138.4	149.6		
Efficiency of water heater													87.3	(216)
(217)m=	89.51	89.46	89.35	89.13	88.73	87.3	87.3	87.3	87.3	89.03	89.37	89.55		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	172.07	151.01	157.06	138.73	134.81	119.89	112.72	127.03	127.86	144.16	154.87	167.07		
Total = Sum(219a)$_{1...12}$ =													1707.28	(219)

Annual totals

		kWh/year	kWh/year	
Space heating fuel used, main system 1			2171.54	
Water heating fuel used			1707.28	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		184.05		(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) =		259.05	(231)
Electricity for lighting			299.64	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			4437.51	(338)

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

DER WorkSheet: New dwelling design stage

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x		0.216	=	469.05	(261)
Space heating (secondary)	(215) x		0.519	=	0	(263)
Water heating	(219) x		0.216	=	368.77	(264)
Space and water heating	(261) + (262) + (263) + (264) =				837.83	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	134.45	(267)
Electricity for lighting	(232) x		0.519	=	155.51	(268)
Total CO2, kg/year		sum of (265)…(271) =			1127.79	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =			16.82	(273)
EI rating (section 14)					87	(274)

Be Clean

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**

Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.41

Property Address: 1 Bed End - GF

Address : 1 Bed End - GF, London, TBC

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	55.94	(1a)	x	2.5	(2a)	=	139.85	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.94	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	139.85	(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		2	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.1	(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) =	0.08	(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

0.11	0.11	0.1	0.09	0.09	0.08	0.08	0.08	0.08	0.09	0.1	0.1

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) =	75.65	(23c)

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

(24a)m=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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			3.57	x	1	=	3.57			(26)
Windows Type 1			7.35	x	1/[1/(1)+ 0.04]	=	7.07			(27)
Windows Type 2			3.8	x	1/[1/(1)+ 0.04]	=	3.65			(27)
Windows Type 3			2.21	x	1/[1/(1)+ 0.04]	=	2.13			(27)
Floor			55.94	x	0.13	=	7.2722	75	4195.5	(28)
Walls	64.93	16.93	48	x	0.18	=	8.64	14	672	(29)
Total area of elements, m²			120.87							(31)
Party wall			19.92	x	0	=	0	20	398.4	(32)
Party ceiling			55.94					30	1678.2	(32b)
Internal wall **			63.63					9	572.67	(32c)

** 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) =	32.33	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	7516.77	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	= (34) ÷ (4) =	134.37	(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		11.84	(36)

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

Total fabric heat loss	(33) + (36) =	44.17	(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=	10.62	10.52	10.42	9.93	9.84	9.35	9.35	9.25	9.54	9.84	10.03	10.23	(38)

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

(39)m=	54.79	54.69	54.59	54.1	54.01	53.52	53.52	53.42	53.71	54.01	54.2	54.4	

Average = Sum(39)$_{1...12}$ /12= 54.08 (39)

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

(40)m=	0.98	0.98	0.98	0.97	0.97	0.96	0.96	0.95	0.96	0.97	0.97	0.97

Average = Sum(40)$_{1...12}$ /12= 0.97 (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 1.86 (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 78.49 (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=	86.34	83.2	80.06	76.92	73.78	70.64	70.64	73.78	76.92	80.06	83.2	86.34

Total = Sum(44)$_{1...12}$ = 941.88 (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=	128.04	111.98	115.56	100.75	96.67	83.42	77.3	88.7	89.76	104.61	114.19	124

Total = Sum(45)$_{1...12}$ = 1234.95 (45)

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

(46)m=	19.21	16.8	17.33	15.11	14.5	12.51	11.59	13.31	13.46	15.69	17.13	18.6	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 201 (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): 0.54 (48)

Temperature factor from Table 2b 0.8694 (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) 0.87 (55)

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

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95	(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=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95	(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=	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=	154.99	136.33	142.51	126.83	123.62	109.5	104.25	115.65	115.84	131.56	140.27	150.95	(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=	154.99	136.33	142.51	126.83	123.62	109.5	104.25	115.65	115.84	131.56	140.27	150.95	

Output from water heater (annual)$_{1...12}$ | 1552.29 | (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=	42.57	37.23	38.42	33.5	32.14	27.74	25.7	29.49	29.85	34.78	37.97	41.23	(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=	93.24	93.24	93.24	93.24	93.24	93.24	93.24	93.24	93.24	93.24	93.24	93.24	(66)

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

(67)m=	14.5	12.88	10.47	7.93	5.93	5	5.41	7.03	9.43	11.97	13.98	14.9	(67)

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

(68)m=	162.6	164.29	160.04	150.99	139.56	128.82	121.65	119.96	124.21	133.26	144.69	155.43	(68)

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

(69)m=	32.32	32.32	32.32	32.32	32.32	32.32	32.32	32.32	32.32	32.32	32.32	32.32	(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=	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	(71)

Water heating gains (Table 5)

(72)m=	57.22	55.41	51.64	46.52	43.2	38.52	34.54	39.64	41.45	46.75	52.73	55.42	(72)

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

(73)m=	285.29	283.55	273.13	256.41	239.66	223.32	212.57	217.6	226.07	242.96	262.37	276.72	(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)	
Southeast	0.9x	0.77	x	3.8	x	36.79	x	0.3	x	0.7	=	20.35	(77)

DRAFT

Southeast	0.9x	0.77	x	3.8	x	62.67	x	0.3	x	0.7	=	34.66	(77)
Southeast	0.9x	0.77	x	3.8	x	85.75	x	0.3	x	0.7	=	47.42	(77)
Southeast	0.9x	0.77	x	3.8	x	106.25	x	0.3	x	0.7	=	58.76	(77)
Southeast	0.9x	0.77	x	3.8	x	119.01	x	0.3	x	0.7	=	65.81	(77)
Southeast	0.9x	0.77	x	3.8	x	118.15	x	0.3	x	0.7	=	65.34	(77)
Southeast	0.9x	0.77	x	3.8	x	113.91	x	0.3	x	0.7	=	62.99	(77)
Southeast	0.9x	0.77	x	3.8	x	104.39	x	0.3	x	0.7	=	57.73	(77)
Southeast	0.9x	0.77	x	3.8	x	92.85	x	0.3	x	0.7	=	51.35	(77)
Southeast	0.9x	0.77	x	3.8	x	69.27	x	0.3	x	0.7	=	38.31	(77)
Southeast	0.9x	0.77	x	3.8	x	44.07	x	0.3	x	0.7	=	24.37	(77)
Southeast	0.9x	0.77	x	3.8	x	31.49	x	0.3	x	0.7	=	17.41	(77)
Southwest	0.9x	0.77	x	2.21	x	36.79		0.3	x	0.7	=	11.83	(79)
Southwest	0.9x	0.77	x	2.21	x	62.67		0.3	x	0.7	=	20.16	(79)
Southwest	0.9x	0.77	x	2.21	x	85.75		0.3	x	0.7	=	27.58	(79)
Southwest	0.9x	0.77	x	2.21	x	106.25		0.3	x	0.7	=	34.17	(79)
Southwest	0.9x	0.77	x	2.21	x	119.01		0.3	x	0.7	=	38.28	(79)
Southwest	0.9x	0.77	x	2.21	x	118.15		0.3	x	0.7	=	38	(79)
Southwest	0.9x	0.77	x	2.21	x	113.91		0.3	x	0.7	=	36.64	(79)
Southwest	0.9x	0.77	x	2.21	x	104.39		0.3	x	0.7	=	33.57	(79)
Southwest	0.9x	0.77	x	2.21	x	92.85		0.3	x	0.7	=	29.86	(79)
Southwest	0.9x	0.77	x	2.21	x	69.27		0.3	x	0.7	=	22.28	(79)
Southwest	0.9x	0.77	x	2.21	x	44.07		0.3	x	0.7	=	14.17	(79)
Southwest	0.9x	0.77	x	2.21	x	31.49		0.3	x	0.7	=	10.13	(79)
Northwest	0.9x	0.77	x	7.35	x	11.28	x	0.3	x	0.7	=	12.07	(81)
Northwest	0.9x	0.77	x	7.35	x	22.97	x	0.3	x	0.7	=	24.57	(81)
Northwest	0.9x	0.77	x	7.35	x	41.38	x	0.3	x	0.7	=	44.26	(81)
Northwest	0.9x	0.77	x	7.35	x	67.96	x	0.3	x	0.7	=	72.69	(81)
Northwest	0.9x	0.77	x	7.35	x	91.35	x	0.3	x	0.7	=	97.71	(81)
Northwest	0.9x	0.77	x	7.35	x	97.38	x	0.3	x	0.7	=	104.17	(81)
Northwest	0.9x	0.77	x	7.35	x	91.1	x	0.3	x	0.7	=	97.45	(81)
Northwest	0.9x	0.77	x	7.35	x	72.63	x	0.3	x	0.7	=	77.69	(81)
Northwest	0.9x	0.77	x	7.35	x	50.42	x	0.3	x	0.7	=	53.93	(81)
Northwest	0.9x	0.77	x	7.35	x	28.07	x	0.3	x	0.7	=	30.02	(81)
Northwest	0.9x	0.77	x	7.35	x	14.2	x	0.3	x	0.7	=	15.19	(81)
Northwest	0.9x	0.77	x	7.35	x	9.21	x	0.3	x	0.7	=	9.86	(81)

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

(83)m=	44.25	79.38	119.26	165.62	201.8	207.51	197.07	168.99	135.14	90.61	53.73	37.4	(83)

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

(84)m=	329.54	362.93	392.39	422.03	441.46	430.82	409.65	386.59	361.21	333.57	316.1	314.11	(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

DER WorkSheet: New dwelling design stage

(86)m=	0.98	0.97	0.96	0.91	0.83	0.69	0.54	0.58	0.79	0.93	0.97	0.99	(86)

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

(87)m=	19.35	19.53	19.84	20.25	20.62	20.87	20.96	20.94	20.76	20.3	19.76	19.31	(87)

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

(88)m=	20.51	20.51	20.51	20.52	20.52	20.52	20.52	20.52	20.52	20.52	20.52	20.51	(88)

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

(89)m=	0.98	0.97	0.95	0.91	0.81	0.65	0.49	0.53	0.76	0.92	0.97	0.98	(89)

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

(90)m=	17.89	18.15	18.59	19.18	19.68	20	20.09	20.08	19.88	19.26	18.48	17.83	(90)

fLA = Living area ÷ (4) = 0.6 (91)

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

(92)m=	18.77	18.98	19.34	19.82	20.25	20.52	20.62	20.6	20.41	19.88	19.25	18.73	(92)

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

(93)m=	18.77	18.98	19.34	19.82	20.25	20.52	20.62	20.6	20.41	19.88	19.25	18.73	(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=	0.97	0.96	0.94	0.89	0.8	0.65	0.5	0.54	0.76	0.91	0.96	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	320.78	349.16	368.7	375.92	352.59	280.33	204.34	210.05	273.41	302.83	303.68	306.91	(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=	792.97	770.21	701.25	591.06	461.67	317.02	214.88	224.49	339.14	501.43	658.46	790.22	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	351.31	282.95	247.42	154.9	81.16	0	0	0	0	147.76	255.44	359.58	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1880.51 (98)

Space heating requirement in kWh/m²/year 33.62 (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		100	(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)													
	351.31	282.95	247.42	154.9	81.16	0	0	0	0	147.76	255.44	359.58	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	351.31	282.95	247.42	154.9	81.16	0	0	0	0	147.76	255.44	359.58	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 1880.51 (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)

154.99	136.33	142.51	126.83	123.62	109.5	104.25	115.65	115.84	131.56	140.27	150.95

Efficiency of water heater 349.41 (216)

(217)m=	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	44.36	39.02	40.79	36.3	35.38	31.34	29.84	33.1	33.15	37.65	40.14	43.2

Total = Sum(219a)$_{1...12}$ = 444.26 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		1880.51	
Water heating fuel used		444.26	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	153.56		(230a)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		153.56	(231)
Electricity for lighting		256.01	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		2734.33	(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	0.519	=	975.98	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	230.57	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1206.55	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	79.7	(267)
Electricity for lighting	(232) x	0.519	=	132.87	(268)
Total CO2, kg/year		sum of (265)…(271) =		1419.12	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		25.37	(273)
EI rating (section 14)				81	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.41

Property Address: 1 Bed End - TF

Address : 1 Bed End - TF, London, TBC

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	55.94	(1a) x	2.5	(2a) =	139.85	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.94	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	139.85	(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		2	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.1	(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) =	0.08	(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

0.11	0.11	0.1	0.09	0.09	0.08	0.08	0.08	0.08	0.09	0.1	0.1

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) =	75.65	(23c)

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

(24a)m=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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			3.57	x	1	=	3.57			(26)
Windows Type 1			7.35	x	1/[1/(1)+ 0.04]	=	7.07			(27)
Windows Type 2			3.8	x	1/[1/(1)+ 0.04]	=	3.65			(27)
Windows Type 3			2.21	x	1/[1/(1)+ 0.04]	=	2.13			(27)
Walls	64.93	16.93	48	x	0.18	=	8.64	14	672	(29)
Roof	55.94	0	55.94	x	0.11	=	6.15	9	503.46	(30)
Total area of elements, m²			120.87							(31)
Party wall			19.92	x	0	=	0	20	398.4	(32)
Party floor			55.94					40	2237.6	(32a)
Internal wall **			63.63					9	572.67	(32c)

** 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) =	31.21	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	4384.13	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	= (34) ÷ (4) =	78.37	(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		15.6	(36)

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

Total fabric heat loss	(33) + (36) =	46.8	(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=	10.62	10.52	10.42	9.93	9.84	9.35	9.35	9.25	9.54	9.84	10.03	10.23	(38)

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

(39)m=	57.43	57.33	57.23	56.74	56.64	56.15	56.15	56.05	56.35	56.64	56.84	57.03	

Average = $Sum(39)_{1...12}$ /12= 56.71 (39)

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

(40)m=	1.03	1.02	1.02	1.01	1.01	1	1	1	1.01	1.01	1.02	1.02	

Average = $Sum(40)_{1...12}$ /12= 1.01 (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 1.86 (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 78.49 (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=	86.34	83.2	80.06	76.92	73.78	70.64	70.64	73.78	76.92	80.06	83.2	86.34	

Total = $Sum(44)_{1...12}$ = 941.88 (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=	128.04	111.98	115.56	100.75	96.67	83.42	77.3	88.7	89.76	104.61	114.19	124	

Total = $Sum(45)_{1...12}$ = 1234.95 (45)

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

(46)m=	19.21	16.8	17.33	15.11	14.5	12.51	11.59	13.31	13.46	15.69	17.13	18.6	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 201 (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): 0.54 (48)

Temperature factor from Table 2b 0.8694 (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) 0.87 (55)

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

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95	(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=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95	(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=	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=	154.99	136.33	142.51	126.83	123.62	109.5	104.25	115.65	115.84	131.56	140.27	150.95	(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=	154.99	136.33	142.51	126.83	123.62	109.5	104.25	115.65	115.84	131.56	140.27	150.95	

Output from water heater (annual)$_{1...12}$ | 1552.29 | (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=	42.57	37.23	38.42	33.5	32.14	27.74	25.7	29.49	29.85	34.78	37.97	41.23	(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=	93.24	93.24	93.24	93.24	93.24	93.24	93.24	93.24	93.24	93.24	93.24	93.24	(66)

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

(67)m=	14.5	12.88	10.47	7.93	5.93	5	5.41	7.03	9.43	11.97	13.98	14.9	(67)

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

(68)m=	162.6	164.29	160.04	150.99	139.56	128.82	121.65	119.96	124.21	133.26	144.69	155.43	(68)

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

(69)m=	32.32	32.32	32.32	32.32	32.32	32.32	32.32	32.32	32.32	32.32	32.32	32.32	(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=	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	-74.59	(71)

Water heating gains (Table 5)

(72)m=	57.22	55.41	51.64	46.52	43.2	38.52	34.54	39.64	41.45	46.75	52.73	55.42	(72)

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

(73)m=	285.29	283.55	273.13	256.41	239.66	223.32	212.57	217.6	226.07	242.96	262.37	276.72	(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)	
Southeast	0.9x	0.77	x	3.8	x	36.79	x	0.3	x	0.7	=	20.35	(77)

Southeast	0.9x	0.77	x	3.8	x	62.67	x	0.3	x	0.7	=	34.66	(77)
Southeast	0.9x	0.77	x	3.8	x	85.75	x	0.3	x	0.7	=	47.42	(77)
Southeast	0.9x	0.77	x	3.8	x	106.25	x	0.3	x	0.7	=	58.76	(77)
Southeast	0.9x	0.77	x	3.8	x	119.01	x	0.3	x	0.7	=	65.81	(77)
Southeast	0.9x	0.77	x	3.8	x	118.15	x	0.3	x	0.7	=	65.34	(77)
Southeast	0.9x	0.77	x	3.8	x	113.91	x	0.3	x	0.7	=	62.99	(77)
Southeast	0.9x	0.77	x	3.8	x	104.39	x	0.3	x	0.7	=	57.73	(77)
Southeast	0.9x	0.77	x	3.8	x	92.85	x	0.3	x	0.7	=	51.35	(77)
Southeast	0.9x	0.77	x	3.8	x	69.27	x	0.3	x	0.7	=	38.31	(77)
Southeast	0.9x	0.77	x	3.8	x	44.07	x	0.3	x	0.7	=	24.37	(77)
Southeast	0.9x	0.77	x	3.8	x	31.49	x	0.3	x	0.7	=	17.41	(77)
Southwest	0.9x	0.77	x	2.21	x	36.79		0.3	x	0.7	=	11.83	(79)
Southwest	0.9x	0.77	x	2.21	x	62.67		0.3	x	0.7	=	20.16	(79)
Southwest	0.9x	0.77	x	2.21	x	85.75		0.3	x	0.7	=	27.58	(79)
Southwest	0.9x	0.77	x	2.21	x	106.25		0.3	x	0.7	=	34.17	(79)
Southwest	0.9x	0.77	x	2.21	x	119.01		0.3	x	0.7	=	38.28	(79)
Southwest	0.9x	0.77	x	2.21	x	118.15		0.3	x	0.7	=	38	(79)
Southwest	0.9x	0.77	x	2.21	x	113.91		0.3	x	0.7	=	36.64	(79)
Southwest	0.9x	0.77	x	2.21	x	104.39		0.3	x	0.7	=	33.57	(79)
Southwest	0.9x	0.77	x	2.21	x	92.85		0.3	x	0.7	=	29.86	(79)
Southwest	0.9x	0.77	x	2.21	x	69.27		0.3	x	0.7	=	22.28	(79)
Southwest	0.9x	0.77	x	2.21	x	44.07		0.3	x	0.7	=	14.17	(79)
Southwest	0.9x	0.77	x	2.21	x	31.49		0.3	x	0.7	=	10.13	(79)
Northwest	0.9x	0.77	x	7.35	x	11.28	x	0.3	x	0.7	=	12.07	(81)
Northwest	0.9x	0.77	x	7.35	x	22.97	x	0.3	x	0.7	=	24.57	(81)
Northwest	0.9x	0.77	x	7.35	x	41.38	x	0.3	x	0.7	=	44.26	(81)
Northwest	0.9x	0.77	x	7.35	x	67.96	x	0.3	x	0.7	=	72.69	(81)
Northwest	0.9x	0.77	x	7.35	x	91.35	x	0.3	x	0.7	=	97.71	(81)
Northwest	0.9x	0.77	x	7.35	x	97.38	x	0.3	x	0.7	=	104.17	(81)
Northwest	0.9x	0.77	x	7.35	x	91.1	x	0.3	x	0.7	=	97.45	(81)
Northwest	0.9x	0.77	x	7.35	x	72.63	x	0.3	x	0.7	=	77.69	(81)
Northwest	0.9x	0.77	x	7.35	x	50.42	x	0.3	x	0.7	=	53.93	(81)
Northwest	0.9x	0.77	x	7.35	x	28.07	x	0.3	x	0.7	=	30.02	(81)
Northwest	0.9x	0.77	x	7.35	x	14.2	x	0.3	x	0.7	=	15.19	(81)
Northwest	0.9x	0.77	x	7.35	x	9.21	x	0.3	x	0.7	=	9.86	(81)

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

(83)m=	44.25	79.38	119.26	165.62	201.8	207.51	197.07	168.99	135.14	90.61	53.73	37.4	(83)

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

(84)m=	329.54	362.93	392.39	422.03	441.46	430.82	409.65	386.59	361.21	333.57	316.1	314.11	(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=	0.95	0.93	0.91	0.85	0.77	0.64	0.52	0.56	0.73	0.87	0.93	0.95	(86)

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

(87)m=	18.5	18.74	19.17	19.74	20.27	20.68	20.87	20.83	20.52	19.84	19.08	18.45	(87)

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

(88)m=	20.49	20.49	20.49	20.49	20.49	20.5	20.5	20.5	20.5	20.49	20.49	20.49	(88)

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

(89)m=	0.95	0.93	0.9	0.84	0.75	0.61	0.47	0.51	0.71	0.86	0.93	0.95	(89)

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

(90)m=	16.7	17.04	17.66	18.47	19.22	19.76	19.98	19.95	19.57	18.64	17.54	16.62	(90)

fLA = Living area ÷ (4) = 0.6 (91)

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

(92)m=	17.79	18.07	18.57	19.23	19.85	20.31	20.51	20.48	20.14	19.37	18.47	17.73	(92)

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

(93)m=	17.79	18.07	18.57	19.23	19.85	20.31	20.51	20.48	20.14	19.37	18.47	17.73	(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=	0.92	0.9	0.87	0.81	0.72	0.6	0.47	0.51	0.69	0.83	0.9	0.93	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	304.11	327.96	341.91	343.41	319.85	258.4	194.58	197.92	248.54	277.72	284.97	291.99	(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=	774.58	754.95	690.62	586.32	461.81	320.85	219.71	228.87	340.42	496.46	646.13	771.4	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	350.03	286.94	259.44	174.89	105.62	0	0	0	0	162.74	260.03	356.68	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 1956.38 (98)

Space heating requirement in kWh/m²/year 34.97 (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		100	(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)													
	350.03	286.94	259.44	174.89	105.62	0	0	0	0	162.74	260.03	356.68	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	350.03	286.94	259.44	174.89	105.62	0	0	0	0	162.74	260.03	356.68	

Total (kWh/year) = $Sum(211)_{1...5,10....12}$ = 1956.38 (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)

	154.99	136.33	142.51	126.83	123.62	109.5	104.25	115.65	115.84	131.56	140.27	150.95		
Efficiency of water heater													349.41	(216)
(217)m=	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41		(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	44.36	39.02	40.79	36.3	35.38	31.34	29.84	33.1	33.15	37.65	40.14	43.2		
								Total = Sum(219a)$_{1...12}$ =					444.26	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1956.38	
Water heating fuel used			444.26	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		153.56		(230a)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		153.56	(231)
Electricity for lighting			256.01	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			2810.21	(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	0.519	=	1015.36	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	230.57	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1245.93	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	79.7	(267)
Electricity for lighting	(232) x	0.519	=	132.87	(268)
Total CO2, kg/year		sum of (265)…(271) =		1458.5	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		26.07	(273)
EI rating (section 14)				81	(274)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: 1 Bed Mid - EF

Address : 1 Bed Mid - EF, London, TBC

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	55.83	(1a)	x	2.5	(2a)	=	139.58	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.83	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			139.58	(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		2	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.1	(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) =	0.08	(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

0.11	0.11	0.1	0.09	0.09	0.08	0.08	0.08	0.08	0.09	0.1	0.1

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) = 75.65 (23c)

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

(24a)m=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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			3.57	x	1	=	3.57			(26)
Windows Type 1			7.35	x	1/[1/(1)+ 0.04]	=	7.07			(27)
Windows Type 2			3.8	x	1/[1/(1)+ 0.04]	=	3.65			(27)
Windows Type 3			2.21	x	1/[1/(1)+ 0.04]	=	2.13			(27)
Floor			13.85	x	0.13	=	1.8005	75	1038.75	(28)
Walls	44.98	16.93	28.05	x	0.18	=	5.05	14	392.7	(29)
Total area of elements, m²			58.83							(31)
Party wall			39.86	x	0	=	0	20	797.2	(32)
Party floor			41.98					40	1679.2	(32a)
Party ceiling			55.83					30	1674.9	(32b)
Internal wall **			63.71					9	573.39	(32c)

** 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) = 23.27 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6156.14 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 110.27 (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 11.09 (36)

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

Total fabric heat loss (33) + (36) = 34.36 (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=	10.6	10.5	10.4	9.91	9.82	9.33	9.33	9.23	9.52	9.82	10.01	10.21	(38)

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

(39)m=	44.96	44.86	44.76	44.27	44.17	43.68	43.68	43.59	43.88	44.17	44.37	44.57	

Average = Sum(39)$_{1...12}$ /12= 44.25 (39)

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

(40)m=	0.81	0.8	0.8	0.79	0.79	0.78	0.78	0.78	0.79	0.79	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 1.86 (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 78.41 (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=	86.26	83.12	79.98	76.85	73.71	70.57	70.57	73.71	76.85	79.98	83.12	86.26	

Total = Sum(44)$_{1...12}$ = 940.97 (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=	127.91	111.87	115.44	100.65	96.57	83.34	77.22	88.61	89.67	104.5	114.07	123.88	

Total = Sum(45)$_{1...12}$ = 1233.75 (45)

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

(46)m=	19.19	16.78	17.32	15.1	14.49	12.5	11.58	13.29	13.45	15.68	17.11	18.58	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 201 (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): 0.54 (48)

Temperature factor from Table 2b 0.8694 (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) 0.87 (55)

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

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95	(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=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95	(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=	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=	154.87	136.22	142.4	126.73	123.52	109.42	104.17	115.57	115.75	131.46	140.16	150.83	(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	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	154.87	136.22	142.4	126.73	123.52	109.42	104.17	115.57	115.75	131.46	140.16	150.83	

Output from water heater (annual)$_{1...12}$ — 1551.09 (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=	42.53	37.2	38.39	33.47	32.11	27.71	25.68	29.46	29.82	34.75	37.93	41.19	(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=	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	(66)

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

(67)m=	14.47	12.85	10.45	7.91	5.92	4.99	5.4	7.01	9.41	11.95	13.95	14.87	(67)

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

(68)m=	162.32	164.01	159.76	150.73	139.32	128.6	121.44	119.75	124	133.03	144.44	155.16	(68)

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

(69)m=	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	(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=	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	(71)

Water heating gains (Table 5)

(72)m=	57.17	55.35	51.59	46.48	43.16	38.48	34.51	39.6	41.41	46.7	52.68	55.36	(72)

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

(73)m=	284.88	283.14	272.73	256.04	239.32	223	212.27	217.29	225.75	242.61	262	276.32	(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)	
Southeast 0.9x	0.77	x	3.8	x	36.79	x	0.3	x	0.7	=	20.35	(77)
Southeast 0.9x	0.77	x	3.8	x	62.67	x	0.3	x	0.7	=	34.66	(77)
Southeast 0.9x	0.77	x	3.8	x	85.75	x	0.3	x	0.7	=	47.42	(77)
Southeast 0.9x	0.77	x	3.8	x	106.25	x	0.3	x	0.7	=	58.76	(77)
Southeast 0.9x	0.77	x	3.8	x	119.01	x	0.3	x	0.7	=	65.81	(77)
Southeast 0.9x	0.77	x	3.8	x	118.15	x	0.3	x	0.7	=	65.34	(77)
Southeast 0.9x	0.77	x	3.8	x	113.91	x	0.3	x	0.7	=	62.99	(77)
Southeast 0.9x	0.77	x	3.8	x	104.39	x	0.3	x	0.7	=	57.73	(77)
Southeast 0.9x	0.77	x	3.8	x	92.85	x	0.3	x	0.7	=	51.35	(77)
Southeast 0.9x	0.77	x	3.8	x	69.27	x	0.3	x	0.7	=	38.31	(77)
Southeast 0.9x	0.77	x	3.8	x	44.07	x	0.3	x	0.7	=	24.37	(77)
Southeast 0.9x	0.77	x	3.8	x	31.49	x	0.3	x	0.7	=	17.41	(77)
Southwest 0.9x	0.77	x	2.21	x	36.79		0.3	x	0.7	=	11.83	(79)
Southwest 0.9x	0.77	x	2.21	x	62.67		0.3	x	0.7	=	20.16	(79)
Southwest 0.9x	0.77	x	2.21	x	85.75		0.3	x	0.7	=	27.58	(79)
Southwest 0.9x	0.77	x	2.21	x	106.25		0.3	x	0.7	=	34.17	(79)
Southwest 0.9x	0.77	x	2.21	x	119.01		0.3	x	0.7	=	38.28	(79)
Southwest 0.9x	0.77	x	2.21	x	118.15		0.3	x	0.7	=	38	(79)
Southwest 0.9x	0.77	x	2.21	x	113.91		0.3	x	0.7	=	36.64	(79)
Southwest 0.9x	0.77	x	2.21	x	104.39		0.3	x	0.7	=	33.57	(79)
Southwest 0.9x	0.77	x	2.21	x	92.85		0.3	x	0.7	=	29.86	(79)
Southwest 0.9x	0.77	x	2.21	x	69.27		0.3	x	0.7	=	22.28	(79)
Southwest 0.9x	0.77	x	2.21	x	44.07		0.3	x	0.7	=	14.17	(79)
Southwest 0.9x	0.77	x	2.21	x	31.49		0.3	x	0.7	=	10.13	(79)
Northwest 0.9x	0.77	x	7.35	x	11.28	x	0.3	x	0.7	=	12.07	(81)
Northwest 0.9x	0.77	x	7.35	x	22.97	x	0.3	x	0.7	=	24.57	(81)
Northwest 0.9x	0.77	x	7.35	x	41.38	x	0.3	x	0.7	=	44.26	(81)
Northwest 0.9x	0.77	x	7.35	x	67.96	x	0.3	x	0.7	=	72.69	(81)
Northwest 0.9x	0.77	x	7.35	x	91.35	x	0.3	x	0.7	=	97.71	(81)
Northwest 0.9x	0.77	x	7.35	x	97.38	x	0.3	x	0.7	=	104.17	(81)
Northwest 0.9x	0.77	x	7.35	x	91.1	x	0.3	x	0.7	=	97.45	(81)
Northwest 0.9x	0.77	x	7.35	x	72.63	x	0.3	x	0.7	=	77.69	(81)
Northwest 0.9x	0.77	x	7.35	x	50.42	x	0.3	x	0.7	=	53.93	(81)
Northwest 0.9x	0.77	x	7.35	x	28.07	x	0.3	x	0.7	=	30.02	(81)
Northwest 0.9x	0.77	x	7.35	x	14.2	x	0.3	x	0.7	=	15.19	(81)
Northwest 0.9x	0.77	x	7.35	x	9.21	x	0.3	x	0.7	=	9.86	(81)

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

(83)m=	44.25	79.38	119.26	165.62	201.8	207.51	197.07	168.99	135.14	90.61	53.73	37.4	(83)

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

(84)m=	329.13	362.52	391.99	421.66	441.12	430.51	409.34	386.28	360.89	333.22	315.73	313.72	(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=	0.97	0.95	0.93	0.86	0.75	0.59	0.45	0.49	0.71	0.89	0.95	0.97	(86)

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

(87)m=	19.53	19.72	20.03	20.42	20.73	20.92	20.98	20.97	20.84	20.44	19.92	19.49	(87)

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

(88)m=	20.6	20.6	20.6	20.6	20.6	20.61	20.61	20.61	20.61	20.6	20.6	20.6	(88)

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

(89)m=	0.97	0.95	0.92	0.85	0.73	0.57	0.42	0.46	0.68	0.88	0.95	0.97	(89)

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

(90)m=	18.26	18.53	18.97	19.53	19.95	20.19	20.25	20.25	20.1	19.57	18.83	18.2	(90)

fLA = Living area ÷ (4) = | 0.6 | (91)

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

(92)m=	19.03	19.25	19.61	20.06	20.42	20.63	20.69	20.68	20.55	20.1	19.49	18.98	(92)

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

(93)m=	19.03	19.25	19.61	20.06	20.42	20.63	20.69	20.68	20.55	20.1	19.49	18.98	(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=	0.96	0.94	0.91	0.84	0.73	0.57	0.42	0.46	0.68	0.86	0.94	0.96	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	314.54	340.15	354.97	353.69	320.29	244.04	173.47	179.41	245.11	287.11	295.57	301.57	(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=	662.17	643.76	586.82	494.19	385.33	263.4	178.63	186.61	282.9	419.47	549.79	658.68	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	258.63	204.03	172.49	101.16	48.39	0	0	0	0	98.48	183.04	265.69	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 1331.91 | (98)

Space heating requirement in kWh/m²/year | 23.86 | (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		100	(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)	258.63	204.03	172.49	101.16	48.39	0	0	0	0	98.48	183.04	265.69		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	258.63	204.03	172.49	101.16	48.39	0	0	0	0	98.48	183.04	265.69		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													1331.91	(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)	154.87	136.22	142.4	126.73	123.52	109.42	104.17	115.57	115.75	131.46	140.16	150.83		
Efficiency of water heater													349.41	(216)
(217)m=	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	44.32	38.99	40.75	36.27	35.35	31.31	29.81	33.07	33.13	37.62	40.11	43.17		
Total = Sum(219a)$_{1...12}$ =													443.92	(219)

Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			1331.91	
Water heating fuel used			443.92	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		153.25		(230a)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		153.25	(231)
Electricity for lighting			255.56	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			2184.65	(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	0.519	=	691.26	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.519	=	230.39	(264)
Space and water heating	(261) + (262) + (263) + (264) =				921.66	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	79.54	(267)
Electricity for lighting	(232)	x	0.519	=	132.64	(268)
Total CO2, kg/year			sum of (265)…(271) =		1133.83	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		20.31	(273)
EI rating (section 14)					85	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: 1 Bed Mid - GF

Address : 1 Bed Mid - GF, London, TBC

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	55.83	(1a) x	2.5	(2a) =	139.58	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.83	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	139.58	(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		2	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.1	(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) =	0.08	(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

0.11	0.11	0.1	0.09	0.09	0.08	0.08	0.08	0.08	0.09	0.1	0.1

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) =	75.65	(23c)

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

(24a)m=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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			3.57	x	1	=	3.57			(26)
Windows Type 1			7.35	x	1/[1/(1)+ 0.04]	=	7.07			(27)
Windows Type 2			3.8	x	1/[1/(1)+ 0.04]	=	3.65			(27)
Windows Type 3			2.21	x	1/[1/(1)+ 0.04]	=	2.13			(27)
Floor			55.83	x	0.13	=	7.2579	75	4187.25	(28)
Walls	44.98	16.93	28.05	x	0.18	=	5.05	14	392.7	(29)
Total area of elements, m²			100.81							(31)
Party wall			39.86	x	0	=	0	20	797.2	(32)
Party ceiling			55.83					30	1674.9	(32b)
Internal wall **			63.71					9	573.39	(32c)

** 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) =	28.72	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	7625.44	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	= (34) ÷ (4) =	136.58	(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		11.28	(36)

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

Total fabric heat loss	(33) + (36) =	40	(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=	10.6	10.5	10.4	9.91	9.82	9.33	9.33	9.23	9.52	9.82	10.01	10.21	(38)

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

(39)m=	50.6	50.51	50.41	49.92	49.82	49.33	49.33	49.23	49.53	49.82	50.02	50.21	

Average = $Sum(39)_{1...12}$ /12= 49.89 (39)

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

(40)m=	0.91	0.9	0.9	0.89	0.89	0.88	0.88	0.88	0.89	0.89	0.9	0.9

Average = $Sum(40)_{1...12}$ /12= 0.89 (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 1.86 (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 78.41 (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=	86.26	83.12	79.98	76.85	73.71	70.57	70.57	73.71	76.85	79.98	83.12	86.26

Total = $Sum(44)_{1...12}$ = 940.97 (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=	127.91	111.87	115.44	100.65	96.57	83.34	77.22	88.61	89.67	104.5	114.07	123.88

Total = $Sum(45)_{1...12}$ = 1233.75 (45)

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

(46)m=	19.19	16.78	17.32	15.1	14.49	12.5	11.58	13.29	13.45	15.68	17.11	18.58	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 201 (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): 0.54 (48)

Temperature factor from Table 2b 0.8694 (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) 0.87 (55)

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

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95	(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=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95	(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=	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=	154.87	136.22	142.4	126.73	123.52	109.42	104.17	115.57	115.75	131.46	140.16	150.83	(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	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	154.87	136.22	142.4	126.73	123.52	109.42	104.17	115.57	115.75	131.46	140.16	150.83	

Output from water heater (annual)1…12 | 1551.09 | (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=	42.53	37.2	38.39	33.47	32.11	27.71	25.68	29.46	29.82	34.75	37.93	41.19	(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=	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	(66)

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

(67)m=	14.47	12.85	10.45	7.91	5.92	4.99	5.4	7.01	9.41	11.95	13.95	14.87	(67)

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

(68)m=	162.32	164.01	159.76	150.73	139.32	128.6	121.44	119.75	124	133.03	144.44	155.16	(68)

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

(69)m=	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	(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=	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	(71)

Water heating gains (Table 5)

(72)m=	57.17	55.35	51.59	46.48	43.16	38.48	34.51	39.6	41.41	46.7	52.68	55.36	(72)

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

(73)m=	284.88	283.14	272.73	256.04	239.32	223	212.27	217.29	225.75	242.61	262	276.32	(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)	
Southeast	0.9x	0.77	x	3.8	x	36.79	x	0.3	x	0.7	=	20.35	(77)

Southeast	0.9x	0.77	x	3.8	x	62.67	x	0.3	x	0.7	=	34.66	(77)
Southeast	0.9x	0.77	x	3.8	x	85.75	x	0.3	x	0.7	=	47.42	(77)
Southeast	0.9x	0.77	x	3.8	x	106.25	x	0.3	x	0.7	=	58.76	(77)
Southeast	0.9x	0.77	x	3.8	x	119.01	x	0.3	x	0.7	=	65.81	(77)
Southeast	0.9x	0.77	x	3.8	x	118.15	x	0.3	x	0.7	=	65.34	(77)
Southeast	0.9x	0.77	x	3.8	x	113.91	x	0.3	x	0.7	=	62.99	(77)
Southeast	0.9x	0.77	x	3.8	x	104.39	x	0.3	x	0.7	=	57.73	(77)
Southeast	0.9x	0.77	x	3.8	x	92.85	x	0.3	x	0.7	=	51.35	(77)
Southeast	0.9x	0.77	x	3.8	x	69.27	x	0.3	x	0.7	=	38.31	(77)
Southeast	0.9x	0.77	x	3.8	x	44.07	x	0.3	x	0.7	=	24.37	(77)
Southeast	0.9x	0.77	x	3.8	x	31.49	x	0.3	x	0.7	=	17.41	(77)
Southwest	0.9x	0.77	x	2.21	x	36.79		0.3	x	0.7	=	11.83	(79)
Southwest	0.9x	0.77	x	2.21	x	62.67		0.3	x	0.7	=	20.16	(79)
Southwest	0.9x	0.77	x	2.21	x	85.75		0.3	x	0.7	=	27.58	(79)
Southwest	0.9x	0.77	x	2.21	x	106.25		0.3	x	0.7	=	34.17	(79)
Southwest	0.9x	0.77	x	2.21	x	119.01		0.3	x	0.7	=	38.28	(79)
Southwest	0.9x	0.77	x	2.21	x	118.15		0.3	x	0.7	=	38	(79)
Southwest	0.9x	0.77	x	2.21	x	113.91		0.3	x	0.7	=	36.64	(79)
Southwest	0.9x	0.77	x	2.21	x	104.39		0.3	x	0.7	=	33.57	(79)
Southwest	0.9x	0.77	x	2.21	x	92.85		0.3	x	0.7	=	29.86	(79)
Southwest	0.9x	0.77	x	2.21	x	69.27		0.3	x	0.7	=	22.28	(79)
Southwest	0.9x	0.77	x	2.21	x	44.07		0.3	x	0.7	=	14.17	(79)
Southwest	0.9x	0.77	x	2.21	x	31.49		0.3	x	0.7	=	10.13	(79)
Northwest	0.9x	0.77	x	7.35	x	11.28	x	0.3	x	0.7	=	12.07	(81)
Northwest	0.9x	0.77	x	7.35	x	22.97	x	0.3	x	0.7	=	24.57	(81)
Northwest	0.9x	0.77	x	7.35	x	41.38	x	0.3	x	0.7	=	44.26	(81)
Northwest	0.9x	0.77	x	7.35	x	67.96	x	0.3	x	0.7	=	72.69	(81)
Northwest	0.9x	0.77	x	7.35	x	91.35	x	0.3	x	0.7	=	97.71	(81)
Northwest	0.9x	0.77	x	7.35	x	97.38	x	0.3	x	0.7	=	104.17	(81)
Northwest	0.9x	0.77	x	7.35	x	91.1	x	0.3	x	0.7	=	97.45	(81)
Northwest	0.9x	0.77	x	7.35	x	72.63	x	0.3	x	0.7	=	77.69	(81)
Northwest	0.9x	0.77	x	7.35	x	50.42	x	0.3	x	0.7	=	53.93	(81)
Northwest	0.9x	0.77	x	7.35	x	28.07	x	0.3	x	0.7	=	30.02	(81)
Northwest	0.9x	0.77	x	7.35	x	14.2	x	0.3	x	0.7	=	15.19	(81)
Northwest	0.9x	0.77	x	7.35	x	9.21	x	0.3	x	0.7	=	9.86	(81)

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

(83)m=	44.25	79.38	119.26	165.62	201.8	207.51	197.07	168.99	135.14	90.61	53.73	37.4	(83)

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

(84)m=	329.13	362.52	391.99	421.66	441.12	430.51	409.34	386.28	360.89	333.22	315.73	313.72	(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

DER WorkSheet: New dwelling design stage

(86)m=	0.98	0.97	0.95	0.91	0.81	0.66	0.51	0.55	0.77	0.93	0.97	0.99	(86)

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

(87)m=	19.53	19.7	19.99	20.37	20.7	20.91	20.97	20.96	20.82	20.41	19.9	19.49	(87)

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

(88)m=	20.55	20.55	20.55	20.55	20.55	20.56	20.56	20.56	20.56	20.55	20.55	20.55	(88)

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

(89)m=	0.98	0.97	0.95	0.9	0.79	0.62	0.46	0.51	0.74	0.92	0.97	0.98	(89)

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

(90)m=	18.18	18.43	18.85	19.4	19.84	20.1	20.16	20.16	20	19.45	18.73	18.13	(90)

fLA = Living area ÷ (4) = 0.6 (91)

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

(92)m=	18.99	19.2	19.54	19.99	20.36	20.59	20.65	20.64	20.5	20.03	19.44	18.95	(92)

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

(93)m=	18.99	19.2	19.54	19.99	20.36	20.59	20.65	20.64	20.5	20.03	19.44	18.95	(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=	0.97	0.96	0.94	0.88	0.78	0.63	0.47	0.52	0.74	0.9	0.96	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	320.61	348.82	367.8	373.17	345.98	269.58	193.31	199.58	266.78	301.16	303.34	306.76	(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=	743.61	722.14	657.34	553.39	431.51	295.33	199.94	208.96	316.78	469.67	617.06	740.63	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	314.71	250.87	215.42	129.76	63.63	0	0	0	0	125.38	225.87	322.8	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1648.44 (98)

Space heating requirement in kWh/m²/year 29.53 (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		100	(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)													
	314.71	250.87	215.42	129.76	63.63	0	0	0	0	125.38	225.87	322.8	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	314.71	250.87	215.42	129.76	63.63	0	0	0	0	125.38	225.87	322.8	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1648.44 (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)

154.87	136.22	142.4	126.73	123.52	109.42	104.17	115.57	115.75	131.46	140.16	150.83

Efficiency of water heater 349.41 (216)

(217)m=	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	44.32	38.99	40.75	36.27	35.35	31.31	29.81	33.07	33.13	37.62	40.11	43.17

Total = Sum(219a)$_{1...12}$ = 443.92 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		1648.44	
Water heating fuel used		443.92	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	153.25		(230a)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		153.25	(231)
Electricity for lighting		255.56	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		2501.17	(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	0.519	=	855.54	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	230.39	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1085.93	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	79.54	(267)
Electricity for lighting	(232) x	0.519	=	132.64	(268)
Total CO2, kg/year		sum of (265)…(271) =		1298.11	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		23.25	(273)
EI rating (section 14)				83	(274)

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User Details:

Assessor Name: | **Stroma Number:**

Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.41

Property Address: 1 Bed Mid - MF

Address : 1 Bed Mid - MF, London, TBC

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	55.83	(1a) x	2.5	(2a) =	139.58	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.83	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	139.58	(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		2	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.1	(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) =	0.08	(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

0.11	0.11	0.1	0.09	0.09	0.08	0.08	0.08	0.08	0.09	0.1	0.1

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) =	75.65	(23c)

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

(24a)m=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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			3.57	x	1	=	3.57			(26)
Windows Type 1			7.35	x	1/[1/(1)+ 0.04]	=	7.07			(27)
Windows Type 2			3.8	x	1/[1/(1)+ 0.04]	=	3.65			(27)
Windows Type 3			2.21	x	1/[1/(1)+ 0.04]	=	2.13			(27)
Walls	44.98	16.93	28.05	x	0.18	=	5.05	14	392.7	(29)
Total area of elements, m²			44.98							(31)
Party wall			39.86	x	0	=	0	20	797.2	(32)
Party floor			55.83					40	2233.2	(32a)
Party ceiling			55.83					30	1674.9	(32b)
Internal wall **			63.71					9	573.39	(32c)

** 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) =	21.47	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	5671.39	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	= (34) ÷ (4) =	101.58	(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		7.11	(36)

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

Total fabric heat loss	(33) + (36) =	28.58	(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=	10.6	10.5	10.4	9.91	9.82	9.33	9.33	9.23	9.52	9.82	10.01	10.21	(38)

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

(39)m=	39.18	39.08	38.98	38.49	38.39	37.9	37.9	37.81	38.1	38.39	38.59	38.78	

Average = $Sum(39)_{1...12}$ /12= 38.47 (39)

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

(40)m=	0.7	0.7	0.7	0.69	0.69	0.68	0.68	0.68	0.68	0.69	0.69	0.69	

Average = $Sum(40)_{1...12}$ /12= 0.69 (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 1.86 (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 78.41 (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=	86.26	83.12	79.98	76.85	73.71	70.57	70.57	73.71	76.85	79.98	83.12	86.26	

Total = $Sum(44)_{1...12}$ = 940.97 (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=	127.91	111.87	115.44	100.65	96.57	83.34	77.22	88.61	89.67	104.5	114.07	123.88	

Total = $Sum(45)_{1...12}$ = 1233.75 (45)

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

(46)m=	19.19	16.78	17.32	15.1	14.49	12.5	11.58	13.29	13.45	15.68	17.11	18.58	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 201 (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): 0.54 (48)

Temperature factor from Table 2b 0.8694 (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) 0.87 (55)

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

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95	(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=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95	(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=	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=	154.87	136.22	142.4	126.73	123.52	109.42	104.17	115.57	115.75	131.46	140.16	150.83	(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	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	154.87	136.22	142.4	126.73	123.52	109.42	104.17	115.57	115.75	131.46	140.16	150.83	

Output from water heater (annual)1…12 | 1551.09 | (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=	42.53	37.2	38.39	33.47	32.11	27.71	25.68	29.46	29.82	34.75	37.93	41.19	(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=	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	(66)

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

(67)m=	14.47	12.85	10.45	7.91	5.92	4.99	5.4	7.01	9.41	11.95	13.95	14.87	(67)

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

(68)m=	162.32	164.01	159.76	150.73	139.32	128.6	121.44	119.75	124	133.03	144.44	155.16	(68)

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

(69)m=	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	(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=	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	(71)

Water heating gains (Table 5)

(72)m=	57.17	55.35	51.59	46.48	43.16	38.48	34.51	39.6	41.41	46.7	52.68	55.36	(72)

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

(73)m=	284.88	283.14	272.73	256.04	239.32	223	212.27	217.29	225.75	242.61	262	276.32	(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)	
Southeast	0.9x	0.77	x	3.8	x	36.79	x	0.3	x	0.7	=	20.35	(77)

Southeast	0.9x	0.77	x	3.8	x	62.67	x	0.3	x	0.7	=	34.66	(77)
Southeast	0.9x	0.77	x	3.8	x	85.75	x	0.3	x	0.7	=	47.42	(77)
Southeast	0.9x	0.77	x	3.8	x	106.25	x	0.3	x	0.7	=	58.76	(77)
Southeast	0.9x	0.77	x	3.8	x	119.01	x	0.3	x	0.7	=	65.81	(77)
Southeast	0.9x	0.77	x	3.8	x	118.15	x	0.3	x	0.7	=	65.34	(77)
Southeast	0.9x	0.77	x	3.8	x	113.91	x	0.3	x	0.7	=	62.99	(77)
Southeast	0.9x	0.77	x	3.8	x	104.39	x	0.3	x	0.7	=	57.73	(77)
Southeast	0.9x	0.77	x	3.8	x	92.85	x	0.3	x	0.7	=	51.35	(77)
Southeast	0.9x	0.77	x	3.8	x	69.27	x	0.3	x	0.7	=	38.31	(77)
Southeast	0.9x	0.77	x	3.8	x	44.07	x	0.3	x	0.7	=	24.37	(77)
Southeast	0.9x	0.77	x	3.8	x	31.49	x	0.3	x	0.7	=	17.41	(77)
Southwest	0.9x	0.77	x	2.21	x	36.79		0.3	x	0.7	=	11.83	(79)
Southwest	0.9x	0.77	x	2.21	x	62.67		0.3	x	0.7	=	20.16	(79)
Southwest	0.9x	0.77	x	2.21	x	85.75		0.3	x	0.7	=	27.58	(79)
Southwest	0.9x	0.77	x	2.21	x	106.25		0.3	x	0.7	=	34.17	(79)
Southwest	0.9x	0.77	x	2.21	x	119.01		0.3	x	0.7	=	38.28	(79)
Southwest	0.9x	0.77	x	2.21	x	118.15		0.3	x	0.7	=	38	(79)
Southwest	0.9x	0.77	x	2.21	x	113.91		0.3	x	0.7	=	36.64	(79)
Southwest	0.9x	0.77	x	2.21	x	104.39		0.3	x	0.7	=	33.57	(79)
Southwest	0.9x	0.77	x	2.21	x	92.85		0.3	x	0.7	=	29.86	(79)
Southwest	0.9x	0.77	x	2.21	x	69.27		0.3	x	0.7	=	22.28	(79)
Southwest	0.9x	0.77	x	2.21	x	44.07		0.3	x	0.7	=	14.17	(79)
Southwest	0.9x	0.77	x	2.21	x	31.49		0.3	x	0.7	=	10.13	(79)
Northwest	0.9x	0.77	x	7.35	x	11.28	x	0.3	x	0.7	=	12.07	(81)
Northwest	0.9x	0.77	x	7.35	x	22.97	x	0.3	x	0.7	=	24.57	(81)
Northwest	0.9x	0.77	x	7.35	x	41.38	x	0.3	x	0.7	=	44.26	(81)
Northwest	0.9x	0.77	x	7.35	x	67.96	x	0.3	x	0.7	=	72.69	(81)
Northwest	0.9x	0.77	x	7.35	x	91.35	x	0.3	x	0.7	=	97.71	(81)
Northwest	0.9x	0.77	x	7.35	x	97.38	x	0.3	x	0.7	=	104.17	(81)
Northwest	0.9x	0.77	x	7.35	x	91.1	x	0.3	x	0.7	=	97.45	(81)
Northwest	0.9x	0.77	x	7.35	x	72.63	x	0.3	x	0.7	=	77.69	(81)
Northwest	0.9x	0.77	x	7.35	x	50.42	x	0.3	x	0.7	=	53.93	(81)
Northwest	0.9x	0.77	x	7.35	x	28.07	x	0.3	x	0.7	=	30.02	(81)
Northwest	0.9x	0.77	x	7.35	x	14.2	x	0.3	x	0.7	=	15.19	(81)
Northwest	0.9x	0.77	x	7.35	x	9.21	x	0.3	x	0.7	=	9.86	(81)

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

(83)m=	44.25	79.38	119.26	165.62	201.8	207.51	197.07	168.99	135.14	90.61	53.73	37.4	(83)

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

(84)m=	329.13	362.52	391.99	421.66	441.12	430.51	409.34	386.28	360.89	333.22	315.73	313.72	(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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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.96	0.94	0.9	0.83	0.7	0.53	0.4	0.44	0.65	0.85	0.94	0.96	(86)

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

(87)m=	19.73	19.92	20.21	20.56	20.82	20.95	20.99	20.98	20.89	20.57	20.1	19.69	(87)

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

(88)m=	20.65	20.65	20.65	20.66	20.66	20.66	20.66	20.66	20.66	20.66	20.65	20.65	(88)

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

(89)m=	0.96	0.94	0.9	0.82	0.68	0.51	0.37	0.41	0.63	0.84	0.93	0.96	(89)

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

(90)m=	18.61	18.88	19.3	19.79	20.14	20.31	20.35	20.35	20.25	19.82	19.15	18.56	(90)

fLA = Living area ÷ (4) = 0.6 (91)

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

(92)m=	19.29	19.51	19.85	20.25	20.55	20.7	20.73	20.73	20.64	20.27	19.72	19.24	(92)

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

(93)m=	19.29	19.51	19.85	20.25	20.55	20.7	20.73	20.73	20.64	20.27	19.72	19.24	(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=	0.94	0.92	0.88	0.8	0.68	0.51	0.38	0.41	0.63	0.83	0.92	0.95	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	310.73	334.38	345.81	338.35	298.23	220.3	154.09	159.96	225.96	276.31	290.31	298.35	(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=	587.18	570.88	520.29	437.04	339.69	231.11	156.71	163.7	249.09	371.24	486.99	583.32	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	205.68	158.93	129.81	71.06	30.85	0	0	0	0	70.63	141.61	212.02	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1020.58 (98)

Space heating requirement in kWh/m²/year 18.28 (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		100	(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)													
	205.68	158.93	129.81	71.06	30.85	0	0	0	0	70.63	141.61	212.02	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	205.68	158.93	129.81	71.06	30.85	0	0	0	0	70.63	141.61	212.02	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 1020.58 (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)

154.87	136.22	142.4	126.73	123.52	109.42	104.17	115.57	115.75	131.46	140.16	150.83

Efficiency of water heater 349.41 (216)

(217)m=	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	44.32	38.99	40.75	36.27	35.35	31.31	29.81	33.07	33.13	37.62	40.11	43.17

Total = Sum(219a)$_{1...12}$ = 443.92 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		1020.58	
Water heating fuel used		443.92	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	153.25		(230a)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	153.25	(231)
Electricity for lighting		255.56	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		1873.32	(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	0.519	=	529.68	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.519	=	230.39	(264)
Space and water heating	(261) + (262) + (263) + (264) =				760.07	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	79.54	(267)
Electricity for lighting	(232)	x	0.519	=	132.64	(268)
Total CO2, kg/year			sum of (265)…(271) =		972.25	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		17.41	(273)
EI rating (section 14)					87	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.5.41

Property Address: 1 Bed Mid - TF

Address : 1 Bed Mid - TF, London, TBC

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	55.83	(1a) x	2.5	(2a) =	139.58	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.83	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	139.58	(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		2	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.1	(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) =	0.08	(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

0.11	0.11	0.1	0.09	0.09	0.08	0.08	0.08	0.08	0.09	0.1	0.1

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) = 75.65 (23c)

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

(24a)m=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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			3.57	x	1	=	3.57			(26)
Windows Type 1			7.35	x	1/[1/(1)+ 0.04]	=	7.07			(27)
Windows Type 2			3.8	x	1/[1/(1)+ 0.04]	=	3.65			(27)
Windows Type 3			2.21	x	1/[1/(1)+ 0.04]	=	2.13			(27)
Walls	44.98	16.93	28.05	x	0.18	=	5.05	14	392.7	(29)
Roof	55.83	0	55.83	x	0.11	=	6.14	9	502.47	(30)
Total area of elements, m²			100.81							(31)
Party wall			39.86	x	0	=	0	20	797.2	(32)
Party floor			55.83					40	2233.2	(32a)
Internal wall **			63.71					9	573.39	(32c)

** 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) = 27.61 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 4498.96 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 80.58 (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 14.72 (36)

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

Total fabric heat loss (33) + (36) = 42.32 (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

DER WorkSheet: New dwelling design stage

(38)m=	10.6	10.5	10.4	9.91	9.82	9.33	9.33	9.23	9.52	9.82	10.01	10.21	(38)

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

(39)m=	52.92	52.82	52.73	52.24	52.14	51.65	51.65	51.55	51.84	52.14	52.33	52.53	

Average = $Sum(39)_{1...12}$ /12= 52.21 (39)

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

(40)m=	0.95	0.95	0.94	0.94	0.93	0.93	0.93	0.92	0.93	0.93	0.94	0.94	

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 1.86 (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 78.41 (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=	86.26	83.12	79.98	76.85	73.71	70.57	70.57	73.71	76.85	79.98	83.12	86.26	

Total = $Sum(44)_{1...12}$ = 940.97 (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=	127.91	111.87	115.44	100.65	96.57	83.34	77.22	88.61	89.67	104.5	114.07	123.88	

Total = $Sum(45)_{1...12}$ = 1233.75 (45)

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

(46)m=	19.19	16.78	17.32	15.1	14.49	12.5	11.58	13.29	13.45	15.68	17.11	18.58	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 201 (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): 0.54 (48)

Temperature factor from Table 2b 0.8694 (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) 0.87 (55)

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

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95	(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=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95	(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=	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=	154.87	136.22	142.4	126.73	123.52	109.42	104.17	115.57	115.75	131.46	140.16	150.83	(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	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	154.87	136.22	142.4	126.73	123.52	109.42	104.17	115.57	115.75	131.46	140.16	150.83	

Output from water heater (annual)$_{1...12}$ | 1551.09 | (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=	42.53	37.2	38.39	33.47	32.11	27.71	25.68	29.46	29.82	34.75	37.93	41.19	(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=	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	93.08	(66)

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

(67)m=	14.47	12.85	10.45	7.91	5.92	4.99	5.4	7.01	9.41	11.95	13.95	14.87	(67)

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

(68)m=	162.32	164.01	159.76	150.73	139.32	128.6	121.44	119.75	124	133.03	144.44	155.16	(68)

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

(69)m=	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	32.31	(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=	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	-74.47	(71)

Water heating gains (Table 5)

(72)m=	57.17	55.35	51.59	46.48	43.16	38.48	34.51	39.6	41.41	46.7	52.68	55.36	(72)

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

(73)m=	284.88	283.14	272.73	256.04	239.32	223	212.27	217.29	225.75	242.61	262	276.32	(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)	
Southeast	0.9x	0.77	x	3.8	x	36.79	x	0.3	x	0.7	=	20.35	(77)

Southeast	0.9x	0.77	x	3.8	x	62.67	x	0.3	x	0.7	=	34.66	(77)
Southeast	0.9x	0.77	x	3.8	x	85.75	x	0.3	x	0.7	=	47.42	(77)
Southeast	0.9x	0.77	x	3.8	x	106.25	x	0.3	x	0.7	=	58.76	(77)
Southeast	0.9x	0.77	x	3.8	x	119.01	x	0.3	x	0.7	=	65.81	(77)
Southeast	0.9x	0.77	x	3.8	x	118.15	x	0.3	x	0.7	=	65.34	(77)
Southeast	0.9x	0.77	x	3.8	x	113.91	x	0.3	x	0.7	=	62.99	(77)
Southeast	0.9x	0.77	x	3.8	x	104.39	x	0.3	x	0.7	=	57.73	(77)
Southeast	0.9x	0.77	x	3.8	x	92.85	x	0.3	x	0.7	=	51.35	(77)
Southeast	0.9x	0.77	x	3.8	x	69.27	x	0.3	x	0.7	=	38.31	(77)
Southeast	0.9x	0.77	x	3.8	x	44.07	x	0.3	x	0.7	=	24.37	(77)
Southeast	0.9x	0.77	x	3.8	x	31.49	x	0.3	x	0.7	=	17.41	(77)
Southwest	0.9x	0.77	x	2.21	x	36.79		0.3	x	0.7	=	11.83	(79)
Southwest	0.9x	0.77	x	2.21	x	62.67		0.3	x	0.7	=	20.16	(79)
Southwest	0.9x	0.77	x	2.21	x	85.75		0.3	x	0.7	=	27.58	(79)
Southwest	0.9x	0.77	x	2.21	x	106.25		0.3	x	0.7	=	34.17	(79)
Southwest	0.9x	0.77	x	2.21	x	119.01		0.3	x	0.7	=	38.28	(79)
Southwest	0.9x	0.77	x	2.21	x	118.15		0.3	x	0.7	=	38	(79)
Southwest	0.9x	0.77	x	2.21	x	113.91		0.3	x	0.7	=	36.64	(79)
Southwest	0.9x	0.77	x	2.21	x	104.39		0.3	x	0.7	=	33.57	(79)
Southwest	0.9x	0.77	x	2.21	x	92.85		0.3	x	0.7	=	29.86	(79)
Southwest	0.9x	0.77	x	2.21	x	69.27		0.3	x	0.7	=	22.28	(79)
Southwest	0.9x	0.77	x	2.21	x	44.07		0.3	x	0.7	=	14.17	(79)
Southwest	0.9x	0.77	x	2.21	x	31.49		0.3	x	0.7	=	10.13	(79)
Northwest	0.9x	0.77	x	7.35	x	11.28	x	0.3	x	0.7	=	12.07	(81)
Northwest	0.9x	0.77	x	7.35	x	22.97	x	0.3	x	0.7	=	24.57	(81)
Northwest	0.9x	0.77	x	7.35	x	41.38	x	0.3	x	0.7	=	44.26	(81)
Northwest	0.9x	0.77	x	7.35	x	67.96	x	0.3	x	0.7	=	72.69	(81)
Northwest	0.9x	0.77	x	7.35	x	91.35	x	0.3	x	0.7	=	97.71	(81)
Northwest	0.9x	0.77	x	7.35	x	97.38	x	0.3	x	0.7	=	104.17	(81)
Northwest	0.9x	0.77	x	7.35	x	91.1	x	0.3	x	0.7	=	97.45	(81)
Northwest	0.9x	0.77	x	7.35	x	72.63	x	0.3	x	0.7	=	77.69	(81)
Northwest	0.9x	0.77	x	7.35	x	50.42	x	0.3	x	0.7	=	53.93	(81)
Northwest	0.9x	0.77	x	7.35	x	28.07	x	0.3	x	0.7	=	30.02	(81)
Northwest	0.9x	0.77	x	7.35	x	14.2	x	0.3	x	0.7	=	15.19	(81)
Northwest	0.9x	0.77	x	7.35	x	9.21	x	0.3	x	0.7	=	9.86	(81)

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

(83)m=	44.25	79.38	119.26	165.62	201.8	207.51	197.07	168.99	135.14	90.61	53.73	37.4	(83)

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

(84)m=	329.13	362.52	391.99	421.66	441.12	430.51	409.34	386.28	360.89	333.22	315.73	313.72	(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=	0.95	0.93	0.9	0.85	0.76	0.62	0.49	0.53	0.72	0.87	0.93	0.95	(86)

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

(87)m=	18.75	18.98	19.38	19.91	20.4	20.75	20.9	20.88	20.61	20	19.29	18.7	(87)

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

(88)m=	20.53	20.53	20.53	20.53	20.53	20.54	20.54	20.54	20.54	20.53	20.53	20.53	(88)

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

(89)m=	0.95	0.93	0.9	0.84	0.74	0.59	0.45	0.49	0.69	0.86	0.93	0.95	(89)

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

(90)m=	17.09	17.42	18	18.76	19.43	19.9	20.07	20.05	19.73	18.89	17.87	17.02	(90)

fLA = Living area ÷ (4) = 0.6 (91)

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

(92)m=	18.09	18.36	18.84	19.46	20.02	20.41	20.57	20.55	20.26	19.56	18.73	18.03	(92)

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

(93)m=	18.09	18.36	18.84	19.46	20.02	20.41	20.57	20.55	20.26	19.56	18.73	18.03	(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=	0.92	0.91	0.87	0.81	0.72	0.58	0.46	0.49	0.68	0.83	0.9	0.93	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	304.44	328.14	341.6	341.74	315.75	251.56	186.81	190.81	244.44	276.76	285.08	292.35	(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=	729.89	711.23	650.4	551.43	433.57	300.2	205.15	213.85	319.4	467.15	608.42	726.55	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	316.53	257.44	229.75	150.98	87.66	0	0	0	0	141.65	232.8	323.05	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1739.86 (98)

Space heating requirement in kWh/m²/year 31.16 (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		100	(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)													
	316.53	257.44	229.75	150.98	87.66	0	0	0	0	141.65	232.8	323.05	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	316.53	257.44	229.75	150.98	87.66	0	0	0	0	141.65	232.8	323.05	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1739.86 (211)

DER 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)

154.87	136.22	142.4	126.73	123.52	109.42	104.17	115.57	115.75	131.46	140.16	150.83

Efficiency of water heater 349.41 (216)

(217)m=	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	44.32	38.99	40.75	36.27	35.35	31.31	29.81	33.07	33.13	37.62	40.11	43.17

Total = Sum(219a)$_{1...12}$ = 443.92 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		1739.86	
Water heating fuel used		443.92	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	153.25		(230a)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		153.25	(231)
Electricity for lighting		255.56	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		2592.59	(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	0.519	=	902.99	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.519	=	230.39	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1133.38	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	79.54	(267)
Electricity for lighting	(232)	x	0.519	=	132.64	(268)
Total CO2, kg/year			sum of (265)…(271) =		1345.56	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		24.1	(273)
EI rating (section 14)					82	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.41

Property Address: 1 Bed Var - EF

Address : 1 Bed Var - EF, London, TBC

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	54.08	(1a) x	2.5	(2a) =	135.2	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	54.08	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		135.2	(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		2	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.1	(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) =	0.08	(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

0.11	0.11	0.1	0.09	0.09	0.08	0.08	0.08	0.08	0.09	0.1	0.1

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) = 75.65 (23c)

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

(24a)m=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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			3.57	x	1	=	3.57			(26)
Windows Type 1			1.81	x	1/[1/(1)+ 0.04]	=	1.74			(27)
Windows Type 2			6.09	x	1/[1/(1)+ 0.04]	=	5.86			(27)
Windows Type 3			1.05	x	1/[1/(1)+ 0.04]	=	1.01			(27)
Windows Type 4			5.57	x	1/[1/(1)+ 0.04]	=	5.36			(27)
Floor			13.85	x	0.13	=	1.8005	75	1038.75	(28)
Walls	62.5	18.09	44.41	x	0.18	=	7.99	14	621.74	(29)
Total area of elements, m²			76.35							(31)
Party wall			19.77	x	0	=	0	20	395.4	(32)
Party floor			40.23					40	1609.2	(32a)
Party ceiling			54.08					30	1622.4	(32b)
Internal wall **			63.3					9	569.7	(32c)

** 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) = 27.33 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5857.19 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 108.31 (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 (36)

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

DER WorkSheet: New dwelling design stage

Total fabric heat loss (33) + (36) = 40.33 (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=	10.27	10.17	10.08	9.6	9.51	9.03	9.03	8.94	9.22	9.51	9.7	9.89	(38)

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

(39)m=	50.59	50.5	50.41	49.93	49.84	49.36	49.36	49.27	49.55	49.84	50.03	50.22	

Average = Sum(39)$_{1...12}$ /12= 49.91 (39)

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

(40)m=	0.94	0.93	0.93	0.92	0.92	0.91	0.91	0.91	0.92	0.92	0.93	0.93	

Average = Sum(40)$_{1...12}$ /12= 0.92 (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 1.81 (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 77.2 (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=	84.92	81.83	78.74	75.65	72.56	69.48	69.48	72.56	75.65	78.74	81.83	84.92	

Total = Sum(44)$_{1...12}$ = 926.35 (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=	125.93	110.14	113.65	99.08	95.07	82.04	76.02	87.24	88.28	102.88	112.3	121.95	

Total = Sum(45)$_{1...12}$ = 1214.59 (45)

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

(46)m=	18.89	16.52	17.05	14.86	14.26	12.31	11.4	13.09	13.24	15.43	16.85	18.29	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 201 (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): 0.54 (48)

Temperature factor from Table 2b 0.8694 (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) 0.87 (55)

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

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95	(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=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95	(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=	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=	152.88	134.48	140.6	125.17	122.02	108.12	102.97	114.19	114.36	129.83	138.39	148.91	(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=	152.88	134.48	140.6	125.17	122.02	108.12	102.97	114.19	114.36	129.83	138.39	148.91	

Output from water heater (annual)$_{1...12}$ | 1531.92 | (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=	41.87	36.62	37.79	32.95	31.61	27.28	25.28	29.01	29.35	34.21	37.34	40.55	(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=	90.52	90.52	90.52	90.52	90.52	90.52	90.52	90.52	90.52	90.52	90.52	90.52	(66)

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

(67)m=	14.07	12.5	10.16	7.69	5.75	4.86	5.25	6.82	9.15	11.62	13.56	14.46	(67)

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

(68)m=	157.81	159.45	155.32	146.54	135.45	125.02	118.06	116.42	120.55	129.34	140.43	150.85	(68)

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

(69)m=	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	(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=	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	(71)

Water heating gains (Table 5)

(72)m=	56.28	54.49	50.79	45.76	42.49	37.89	33.98	38.99	40.77	45.98	51.86	54.5	(72)

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

(73)m=	278.31	276.6	266.43	250.14	233.84	217.92	207.44	212.39	220.63	237.09	256.01	269.97	(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)	
Northeast 0.9x	0.77	x	1.81	x	11.28	x	0.3	x	0.7	=	2.97	(75)
Northeast 0.9x	0.77	x	1.81	x	22.97	x	0.3	x	0.7	=	6.05	(75)
Northeast 0.9x	0.77	x	1.81	x	41.38	x	0.3	x	0.7	=	10.9	(75)
Northeast 0.9x	0.77	x	1.81	x	67.96	x	0.3	x	0.7	=	17.9	(75)
Northeast 0.9x	0.77	x	1.81	x	91.35	x	0.3	x	0.7	=	24.06	(75)
Northeast 0.9x	0.77	x	1.81	x	97.38	x	0.3	x	0.7	=	25.65	(75)
Northeast 0.9x	0.77	x	1.81	x	91.1	x	0.3	x	0.7	=	24	(75)
Northeast 0.9x	0.77	x	1.81	x	72.63	x	0.3	x	0.7	=	19.13	(75)
Northeast 0.9x	0.77	x	1.81	x	50.42	x	0.3	x	0.7	=	13.28	(75)
Northeast 0.9x	0.77	x	1.81	x	28.07	x	0.3	x	0.7	=	7.39	(75)
Northeast 0.9x	0.77	x	1.81	x	14.2	x	0.3	x	0.7	=	3.74	(75)
Northeast 0.9x	0.77	x	1.81	x	9.21	x	0.3	x	0.7	=	2.43	(75)
Southeast 0.9x	0.77	x	1.05	x	36.79	x	0.3	x	0.7	=	5.62	(77)
Southeast 0.9x	0.77	x	1.05	x	62.67	x	0.3	x	0.7	=	9.58	(77)
Southeast 0.9x	0.77	x	1.05	x	85.75	x	0.3	x	0.7	=	13.1	(77)
Southeast 0.9x	0.77	x	1.05	x	106.25	x	0.3	x	0.7	=	16.24	(77)
Southeast 0.9x	0.77	x	1.05	x	119.01	x	0.3	x	0.7	=	18.19	(77)
Southeast 0.9x	0.77	x	1.05	x	118.15	x	0.3	x	0.7	=	18.05	(77)
Southeast 0.9x	0.77	x	1.05	x	113.91	x	0.3	x	0.7	=	17.41	(77)
Southeast 0.9x	0.77	x	1.05	x	104.39	x	0.3	x	0.7	=	15.95	(77)
Southeast 0.9x	0.77	x	1.05	x	92.85	x	0.3	x	0.7	=	14.19	(77)
Southeast 0.9x	0.77	x	1.05	x	69.27	x	0.3	x	0.7	=	10.58	(77)
Southeast 0.9x	0.77	x	1.05	x	44.07	x	0.3	x	0.7	=	6.73	(77)
Southeast 0.9x	0.77	x	1.05	x	31.49	x	0.3	x	0.7	=	4.81	(77)
Southwest 0.9x	0.77	x	5.57	x	36.79		0.3	x	0.7	=	29.83	(79)
Southwest 0.9x	0.77	x	5.57	x	62.67		0.3	x	0.7	=	50.8	(79)
Southwest 0.9x	0.77	x	5.57	x	85.75		0.3	x	0.7	=	69.51	(79)
Southwest 0.9x	0.77	x	5.57	x	106.25		0.3	x	0.7	=	86.13	(79)
Southwest 0.9x	0.77	x	5.57	x	119.01		0.3	x	0.7	=	96.47	(79)
Southwest 0.9x	0.77	x	5.57	x	118.15		0.3	x	0.7	=	95.77	(79)
Southwest 0.9x	0.77	x	5.57	x	113.91		0.3	x	0.7	=	92.34	(79)
Southwest 0.9x	0.77	x	5.57	x	104.39		0.3	x	0.7	=	84.62	(79)
Southwest 0.9x	0.77	x	5.57	x	92.85		0.3	x	0.7	=	75.27	(79)
Southwest 0.9x	0.77	x	5.57	x	69.27		0.3	x	0.7	=	56.15	(79)
Southwest 0.9x	0.77	x	5.57	x	44.07		0.3	x	0.7	=	35.72	(79)
Southwest 0.9x	0.77	x	5.57	x	31.49		0.3	x	0.7	=	25.52	(79)
Northwest 0.9x	0.77	x	6.09	x	11.28	x	0.3	x	0.7	=	10	(81)
Northwest 0.9x	0.77	x	6.09	x	22.97	x	0.3	x	0.7	=	20.35	(81)
Northwest 0.9x	0.77	x	6.09	x	41.38	x	0.3	x	0.7	=	36.67	(81)

Northwest	0.9x	0.77	x	6.09	x	67.96	x	0.3	x	0.7	=	60.23	(81)
Northwest	0.9x	0.77	x	6.09	x	91.35	x	0.3	x	0.7	=	80.96	(81)
Northwest	0.9x	0.77	x	6.09	x	97.38	x	0.3	x	0.7	=	86.31	(81)
Northwest	0.9x	0.77	x	6.09	x	91.1	x	0.3	x	0.7	=	80.74	(81)
Northwest	0.9x	0.77	x	6.09	x	72.63	x	0.3	x	0.7	=	64.37	(81)
Northwest	0.9x	0.77	x	6.09	x	50.42	x	0.3	x	0.7	=	44.69	(81)
Northwest	0.9x	0.77	x	6.09	x	28.07	x	0.3	x	0.7	=	24.88	(81)
Northwest	0.9x	0.77	x	6.09	x	14.2	x	0.3	x	0.7	=	12.58	(81)
Northwest	0.9x	0.77	x	6.09	x	9.21	x	0.3	x	0.7	=	8.17	(81)

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

(83)m=	48.42	86.78	130.19	180.49	219.68	225.79	214.48	184.07	147.42	99	58.78	40.93	(83)

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

(84)m=	326.73	363.38	396.62	430.64	453.52	443.71	421.92	396.45	368.05	336.09	314.79	310.9	(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=	0.97	0.95	0.93	0.87	0.77	0.62	0.48	0.53	0.73	0.89	0.95	0.97	(86)

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

(87)m=	19.21	19.42	19.77	20.22	20.61	20.86	20.95	20.94	20.75	20.26	19.66	19.16	(87)

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

(88)m=	20.53	20.53	20.53	20.54	20.54	20.54	20.54	20.54	20.54	20.54	20.54	20.54	(88)

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

(89)m=	0.97	0.95	0.92	0.86	0.75	0.59	0.44	0.48	0.7	0.88	0.95	0.97	(89)

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

(90)m=	17.73	18.03	18.53	19.17	19.7	20.03	20.12	20.11	19.9	19.24	18.38	17.66	(90)

fLA = Living area ÷ (4) = 0.6 (91)

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

(92)m=	18.61	18.86	19.27	19.8	20.24	20.52	20.62	20.61	20.41	19.85	19.14	18.56	(92)

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

(93)m=	18.61	18.86	19.27	19.8	20.24	20.52	20.62	20.61	20.41	19.85	19.14	18.56	(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=	0.95	0.94	0.9	0.84	0.74	0.59	0.45	0.49	0.7	0.86	0.93	0.96	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	311.48	340.02	358.41	362.01	333.81	260.64	188.57	193.94	256.16	290.52	294.18	298.11	(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=	724.05	704.92	643.66	544.12	425.79	292.46	198.4	207.19	312.67	460.84	602.38	720.89	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	306.95	245.21	212.23	131.12	68.43	0	0	0	0	126.72	221.9	314.55

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1627.12 (98)

Space heating requirement in kWh/m²/year 30.09 (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		100	(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)	306.95	245.21	212.23	131.12	68.43	0	0	0	0	126.72	221.9	314.55		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	306.95	245.21	212.23	131.12	68.43	0	0	0	0	126.72	221.9	314.55		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													1627.12	(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)	152.88	134.48	140.6	125.17	122.02	108.12	102.97	114.19	114.36	129.83	138.39	148.91		
Efficiency of water heater													349.41	(216)
(217)m=	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	43.75	38.49	40.24	35.82	34.92	30.94	29.47	32.68	32.73	37.16	39.61	42.62		
Total = Sum(219a)$_{1...12}$ =													438.43	(219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		1627.12	
Water heating fuel used		438.43	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	148.45		(230a)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		148.45	(231)
Electricity for lighting		248.46	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		2462.46	(338)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh	**Emissions** kg CO2/year

DER WorkSheet: New dwelling design stage

Space heating (main system 1)	(211) x	0.519	=	844.47	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	227.55	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1072.02	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	77.05	(267)
Electricity for lighting	(232) x	0.519	=	128.95	(268)
Total CO2, kg/year		sum of (265)…(271) =		1278.02	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		23.63	(273)
EI rating (section 14)				83	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: 1 Bed Var - MF

Address : 1 Bed Var - MF, London, TBC

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	54.08	(1a)	x	2.5	(2a)	=	135.2	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	54.08	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	135.2	(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		2	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.1	(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) =	0.08	(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

0.11	0.11	0.1	0.09	0.09	0.08	0.08	0.08	0.08	0.09	0.1	0.1

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) =	75.65	(23c)

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

(24a)m=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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			3.57	x	1	=	3.57			(26)
Windows Type 1			1.81	x	1/[1/(1)+ 0.04]	=	1.74			(27)
Windows Type 2			6.09	x	1/[1/(1)+ 0.04]	=	5.86			(27)
Windows Type 3			1.05	x	1/[1/(1)+ 0.04]	=	1.01			(27)
Windows Type 4			5.57	x	1/[1/(1)+ 0.04]	=	5.36			(27)
Walls	62.5	18.09	44.41	x	0.18	=	7.99	14	621.74	(29)
Total area of elements, m²			62.5							(31)
Party wall			19.77	x	0	=	0	20	395.4	(32)
Party floor			54.08					40	2163.2	(32a)
Party ceiling			54.08					30	1622.4	(32b)
Internal wall **			63.3					9	569.7	(32c)

** 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) =	25.53	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	5372.44	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	= (34) ÷ (4) =	99.34	(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		9.02	(36)

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

Total fabric heat loss	(33) + (36) =	34.55	(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=	10.27	10.17	10.08	9.6	9.51	9.03	9.03	8.94	9.22	9.51	9.7	9.89	(38)

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

(39)m=	44.81	44.72	44.63	44.15	44.06	43.58	43.58	43.49	43.77	44.06	44.25	44.44	

Average = Sum(39)$_{1…12}$ /12= 44.13 (39)

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

(40)m=	0.83	0.83	0.83	0.82	0.81	0.81	0.81	0.8	0.81	0.81	0.82	0.82	

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 1.81 (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 77.2 (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=	84.92	81.83	78.74	75.65	72.56	69.48	69.48	72.56	75.65	78.74	81.83	84.92	

Total = Sum(44)$_{1…12}$ = 926.35 (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=	125.93	110.14	113.65	99.08	95.07	82.04	76.02	87.24	88.28	102.88	112.3	121.95	

Total = Sum(45)$_{1…12}$ = 1214.59 (45)

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

(46)m=	18.89	16.52	17.05	14.86	14.26	12.31	11.4	13.09	13.24	15.43	16.85	18.29	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 201 (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): 0.54 (48)

Temperature factor from Table 2b 0.8694 (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) 0.87 (55)

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

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95	(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=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95	(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=	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=	152.88	134.48	140.6	125.17	122.02	108.12	102.97	114.19	114.36	129.83	138.39	148.91	(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=	152.88	134.48	140.6	125.17	122.02	108.12	102.97	114.19	114.36	129.83	138.39	148.91	

Output from water heater (annual)$_{1\ldots12}$ | 1531.92 | (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=	41.87	36.62	37.79	32.95	31.61	27.28	25.28	29.01	29.35	34.21	37.34	40.55	(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=	90.52	90.52	90.52	90.52	90.52	90.52	90.52	90.52	90.52	90.52	90.52	90.52	(66)

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

(67)m=	14.07	12.5	10.16	7.69	5.75	4.86	5.25	6.82	9.15	11.62	13.56	14.46	(67)

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

(68)m=	157.81	159.45	155.32	146.54	135.45	125.02	118.06	116.42	120.55	129.34	140.43	150.85	(68)

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

(69)m=	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	(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=	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	-72.41	(71)

Water heating gains (Table 5)

(72)m=	56.28	54.49	50.79	45.76	42.49	37.89	33.98	38.99	40.77	45.98	51.86	54.5	(72)

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

(73)m=	278.31	276.6	266.43	250.14	233.84	217.92	207.44	212.39	220.63	237.09	256.01	269.97	(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)	
Northeast	0.9x	0.77	x	1.81	x	11.28	x	0.3	x	0.7	=	2.97	(75)
Northeast	0.9x	0.77	x	1.81	x	22.97	x	0.3	x	0.7	=	6.05	(75)
Northeast	0.9x	0.77	x	1.81	x	41.38	x	0.3	x	0.7	=	10.9	(75)
Northeast	0.9x	0.77	x	1.81	x	67.96	x	0.3	x	0.7	=	17.9	(75)
Northeast	0.9x	0.77	x	1.81	x	91.35	x	0.3	x	0.7	=	24.06	(75)
Northeast	0.9x	0.77	x	1.81	x	97.38	x	0.3	x	0.7	=	25.65	(75)
Northeast	0.9x	0.77	x	1.81	x	91.1	x	0.3	x	0.7	=	24	(75)
Northeast	0.9x	0.77	x	1.81	x	72.63	x	0.3	x	0.7	=	19.13	(75)
Northeast	0.9x	0.77	x	1.81	x	50.42	x	0.3	x	0.7	=	13.28	(75)
Northeast	0.9x	0.77	x	1.81	x	28.07	x	0.3	x	0.7	=	7.39	(75)
Northeast	0.9x	0.77	x	1.81	x	14.2	x	0.3	x	0.7	=	3.74	(75)
Northeast	0.9x	0.77	x	1.81	x	9.21	x	0.3	x	0.7	=	2.43	(75)
Southeast	0.9x	0.77	x	1.05	x	36.79	x	0.3	x	0.7	=	5.62	(77)
Southeast	0.9x	0.77	x	1.05	x	62.67	x	0.3	x	0.7	=	9.58	(77)
Southeast	0.9x	0.77	x	1.05	x	85.75	x	0.3	x	0.7	=	13.1	(77)
Southeast	0.9x	0.77	x	1.05	x	106.25	x	0.3	x	0.7	=	16.24	(77)
Southeast	0.9x	0.77	x	1.05	x	119.01	x	0.3	x	0.7	=	18.19	(77)
Southeast	0.9x	0.77	x	1.05	x	118.15	x	0.3	x	0.7	=	18.05	(77)
Southeast	0.9x	0.77	x	1.05	x	113.91	x	0.3	x	0.7	=	17.41	(77)
Southeast	0.9x	0.77	x	1.05	x	104.39	x	0.3	x	0.7	=	15.95	(77)
Southeast	0.9x	0.77	x	1.05	x	92.85	x	0.3	x	0.7	=	14.19	(77)
Southeast	0.9x	0.77	x	1.05	x	69.27	x	0.3	x	0.7	=	10.58	(77)
Southeast	0.9x	0.77	x	1.05	x	44.07	x	0.3	x	0.7	=	6.73	(77)
Southeast	0.9x	0.77	x	1.05	x	31.49	x	0.3	x	0.7	=	4.81	(77)
Southwest	0.9x	0.77	x	5.57	x	36.79		0.3	x	0.7	=	29.83	(79)
Southwest	0.9x	0.77	x	5.57	x	62.67		0.3	x	0.7	=	50.8	(79)
Southwest	0.9x	0.77	x	5.57	x	85.75		0.3	x	0.7	=	69.51	(79)
Southwest	0.9x	0.77	x	5.57	x	106.25		0.3	x	0.7	=	86.13	(79)
Southwest	0.9x	0.77	x	5.57	x	119.01		0.3	x	0.7	=	96.47	(79)
Southwest	0.9x	0.77	x	5.57	x	118.15		0.3	x	0.7	=	95.77	(79)
Southwest	0.9x	0.77	x	5.57	x	113.91		0.3	x	0.7	=	92.34	(79)
Southwest	0.9x	0.77	x	5.57	x	104.39		0.3	x	0.7	=	84.62	(79)
Southwest	0.9x	0.77	x	5.57	x	92.85		0.3	x	0.7	=	75.27	(79)
Southwest	0.9x	0.77	x	5.57	x	69.27		0.3	x	0.7	=	56.15	(79)
Southwest	0.9x	0.77	x	5.57	x	44.07		0.3	x	0.7	=	35.72	(79)
Southwest	0.9x	0.77	x	5.57	x	31.49		0.3	x	0.7	=	25.52	(79)
Northwest	0.9x	0.77	x	6.09	x	11.28	x	0.3	x	0.7	=	10	(81)
Northwest	0.9x	0.77	x	6.09	x	22.97	x	0.3	x	0.7	=	20.35	(81)
Northwest	0.9x	0.77	x	6.09	x	41.38	x	0.3	x	0.7	=	36.67	(81)

Northwest 0.9x	0.77	x	6.09	x	67.96	x	0.3	x	0.7	=	60.23	(81)
Northwest 0.9x	0.77	x	6.09	x	91.35	x	0.3	x	0.7	=	80.96	(81)
Northwest 0.9x	0.77	x	6.09	x	97.38	x	0.3	x	0.7	=	86.31	(81)
Northwest 0.9x	0.77	x	6.09	x	91.1	x	0.3	x	0.7	=	80.74	(81)
Northwest 0.9x	0.77	x	6.09	x	72.63	x	0.3	x	0.7	=	64.37	(81)
Northwest 0.9x	0.77	x	6.09	x	50.42	x	0.3	x	0.7	=	44.69	(81)
Northwest 0.9x	0.77	x	6.09	x	28.07	x	0.3	x	0.7	=	24.88	(81)
Northwest 0.9x	0.77	x	6.09	x	14.2	x	0.3	x	0.7	=	12.58	(81)
Northwest 0.9x	0.77	x	6.09	x	9.21	x	0.3	x	0.7	=	8.17	(81)

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

(83)m=	48.42	86.78	130.19	180.49	219.68	225.79	214.48	184.07	147.42	99	58.78	40.93	(83)

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

(84)m=	326.73	363.38	396.62	430.64	453.52	443.71	421.92	396.45	368.05	336.09	314.79	310.9	(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=	0.96	0.94	0.91	0.84	0.72	0.57	0.44	0.48	0.69	0.87	0.94	0.96	(86)

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

(87)m=	19.38	19.59	19.93	20.35	20.7	20.9	20.97	20.96	20.81	20.37	19.8	19.33	(87)

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

(88)m=	20.59	20.59	20.59	20.59	20.59	20.6	20.6	20.6	20.6	20.59	20.59	20.59	(88)

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

(89)m=	0.96	0.94	0.9	0.83	0.71	0.54	0.4	0.44	0.66	0.86	0.94	0.96	(89)

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

(90)m=	18.03	18.34	18.82	19.43	19.89	20.15	20.23	20.22	20.05	19.47	18.66	17.96	(90)

fLA = Living area ÷ (4) = 0.6 (91)

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

(92)m=	18.83	19.08	19.48	19.98	20.37	20.6	20.67	20.66	20.51	20.01	19.34	18.78	(92)

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

(93)m=	18.83	19.08	19.48	19.98	20.37	20.6	20.67	20.66	20.51	20.01	19.34	18.78	(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=	0.94	0.92	0.88	0.81	0.7	0.54	0.41	0.45	0.65	0.84	0.92	0.95	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	308.05	334.93	350.55	349.28	315.58	240.35	171.21	176.82	240.49	281.73	289.67	295.2	(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=	651.28	634.29	579.35	489.12	382.01	261.46	177.34	185.22	280.38	414.5	541.64	647.76	(97)

DER WorkSheet: New dwelling design stage

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(98)m=	255.36	201.17	170.23	100.69	49.42	0	0	0	0	98.78	181.42	262.31

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1319.38 (98)

Space heating requirement in kWh/m²/year 24.4 (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		100	(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)	255.36	201.17	170.23	100.69	49.42	0	0	0	0	98.78	181.42	262.31		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	255.36	201.17	170.23	100.69	49.42	0	0	0	0	98.78	181.42	262.31		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													1319.38	(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)	152.88	134.48	140.6	125.17	122.02	108.12	102.97	114.19	114.36	129.83	138.39	148.91		
Efficiency of water heater													349.41	(216)
(217)m=	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	43.75	38.49	40.24	35.82	34.92	30.94	29.47	32.68	32.73	37.16	39.61	42.62		
Total = Sum(219a)$_{1...12}$ =													438.43	(219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		1319.38	
Water heating fuel used		438.43	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	148.45		(230a)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		148.45	(231)
Electricity for lighting		248.46	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		2154.72	(338)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh	**Emissions** kg CO2/year

DER WorkSheet: New dwelling design stage

Space heating (main system 1)	(211) x		0.519	=	684.76	(261)
Space heating (secondary)	(215) x		0.519	=	0	(263)
Water heating	(219) x		0.519	=	227.55	(264)
Space and water heating	(261) + (262) + (263) + (264) =				912.3	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	77.05	(267)
Electricity for lighting	(232) x		0.519	=	128.95	(268)
Total CO2, kg/year		sum of (265)…(271) =			1118.3	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =			20.68	(273)
EI rating (section 14)					85	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.41

Property Address: 2 Bed - EF

Address : 2 Bed - EF, London, TBC

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67.05	(1a) x	2.5	(2a) =	167.63	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67.05	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	167.63	(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		2	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.1	(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) =	0.08	(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

0.11	0.11	0.1	0.09	0.09	0.08	0.08	0.08	0.08	0.09	0.1	0.1

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) = 75.65 (23c)

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

(24a)m=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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			3.57	x	1	=	3.57			(26)
Windows Type 1			1.81	x	1/[1/(1)+ 0.04]	=	1.74			(27)
Windows Type 2			2.1	x	1/[1/(1)+ 0.04]	=	2.02			(27)
Windows Type 3			1.05	x	1/[1/(1)+ 0.04]	=	1.01			(27)
Windows Type 4			7.35	x	1/[1/(1)+ 0.04]	=	7.07			(27)
Floor			24.59	x	0.13	=	3.1967	75	1844.25	(28)
Walls	58.81	15.88	42.93	x	0.18	=	7.73	14	601.02	(29)
Total area of elements, m²			83.4							(31)
Party wall			50.53	x	0	=	0	20	1010.6	(32)
Party floor			42.46					40	1698.4	(32a)
Party ceiling			67.05					30	2011.5	(32b)
Internal wall **			87.34					9	786.0599	(32c)

** 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) = 26.33 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7951.83 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 118.6 (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 15.91 (36)

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

DER WorkSheet: New dwelling design stage

Total fabric heat loss	(33) + (36) =	42.24	(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=	12.73	12.61	12.49	11.91	11.79	11.2	11.2	11.08	11.44	11.79	12.02	12.26	(38)

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

(39)m=	54.97	54.85	54.73	54.15	54.03	53.44	53.44	53.32	53.68	54.03	54.26	54.5	

Average = $Sum(39)_{1...12}$ /12= 54.12 (39)

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

(40)m=	0.82	0.82	0.82	0.81	0.81	0.8	0.8	0.8	0.8	0.81	0.81	0.81

Average = $Sum(40)_{1...12}$ /12= 0.81 (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 85.8 (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=	94.37	90.94	87.51	84.08	80.65	77.22	77.22	80.65	84.08	87.51	90.94	94.37	

Total = $Sum(44)_{1...12}$ = 1029.54 (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=	139.96	122.41	126.31	110.12	105.66	91.18	84.49	96.96	98.11	114.34	124.81	135.54

Total = $Sum(45)_{1...12}$ = 1349.89 (45)

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

(46)m=	20.99	18.36	18.95	16.52	15.85	13.68	12.67	14.54	14.72	17.15	18.72	20.33	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel		201	(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):		0.54	(48)
Temperature factor from Table 2b		0.8694	(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)		0.87	(55)

DER WorkSheet: New dwelling design stage

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

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95	(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=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95	(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=	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=	166.91	146.75	153.26	136.2	132.62	117.26	111.44	123.91	124.2	141.29	150.9	162.49	(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=	166.91	146.75	153.26	136.2	132.62	117.26	111.44	123.91	124.2	141.29	150.9	162.49	

Output from water heater (annual)$_{1...12}$ — 1667.22 (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=	46.54	40.7	42	36.62	35.13	30.32	28.09	32.24	32.62	38.02	41.5	45.07	(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=	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	(66)

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

(67)m=	16.97	15.07	12.26	9.28	6.94	5.86	6.33	8.22	11.04	14.02	16.36	17.44	(67)

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

(68)m=	190.32	192.29	187.31	176.72	163.35	150.78	142.38	140.4	145.38	155.98	169.35	181.92	(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=	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	(71)

Water heating gains (Table 5)

(72)m=	62.55	60.57	56.45	50.85	47.22	42.11	37.76	43.33	45.31	51.1	57.64	60.57	(72)

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

(73)m=	325.42	323.51	311.61	292.44	273.09	254.33	242.05	247.55	257.31	276.68	298.93	315.52	(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)	
Northeast	0.9x	0.77	x	1.81	x	11.28	x	0.3	x	0.7	=	2.97	(75)
Northeast	0.9x	0.77	x	1.81	x	22.97	x	0.3	x	0.7	=	6.05	(75)
Northeast	0.9x	0.77	x	1.81	x	41.38	x	0.3	x	0.7	=	10.9	(75)
Northeast	0.9x	0.77	x	1.81	x	67.96	x	0.3	x	0.7	=	17.9	(75)
Northeast	0.9x	0.77	x	1.81	x	91.35	x	0.3	x	0.7	=	24.06	(75)
Northeast	0.9x	0.77	x	1.81	x	97.38	x	0.3	x	0.7	=	25.65	(75)
Northeast	0.9x	0.77	x	1.81	x	91.1	x	0.3	x	0.7	=	24	(75)
Northeast	0.9x	0.77	x	1.81	x	72.63	x	0.3	x	0.7	=	19.13	(75)
Northeast	0.9x	0.77	x	1.81	x	50.42	x	0.3	x	0.7	=	13.28	(75)
Northeast	0.9x	0.77	x	1.81	x	28.07	x	0.3	x	0.7	=	7.39	(75)
Northeast	0.9x	0.77	x	1.81	x	14.2	x	0.3	x	0.7	=	3.74	(75)
Northeast	0.9x	0.77	x	1.81	x	9.21	x	0.3	x	0.7	=	2.43	(75)
Southeast	0.9x	0.77	x	1.05	x	36.79	x	0.3	x	0.7	=	5.62	(77)
Southeast	0.9x	0.77	x	1.05	x	62.67	x	0.3	x	0.7	=	9.58	(77)
Southeast	0.9x	0.77	x	1.05	x	85.75	x	0.3	x	0.7	=	13.1	(77)
Southeast	0.9x	0.77	x	1.05	x	106.25	x	0.3	x	0.7	=	16.24	(77)
Southeast	0.9x	0.77	x	1.05	x	119.01	x	0.3	x	0.7	=	18.19	(77)
Southeast	0.9x	0.77	x	1.05	x	118.15	x	0.3	x	0.7	=	18.05	(77)
Southeast	0.9x	0.77	x	1.05	x	113.91	x	0.3	x	0.7	=	17.41	(77)
Southeast	0.9x	0.77	x	1.05	x	104.39	x	0.3	x	0.7	=	15.95	(77)
Southeast	0.9x	0.77	x	1.05	x	92.85	x	0.3	x	0.7	=	14.19	(77)
Southeast	0.9x	0.77	x	1.05	x	69.27	x	0.3	x	0.7	=	10.58	(77)
Southeast	0.9x	0.77	x	1.05	x	44.07	x	0.3	x	0.7	=	6.73	(77)
Southeast	0.9x	0.77	x	1.05	x	31.49	x	0.3	x	0.7	=	4.81	(77)
Southwest	0.9x	0.77	x	7.35	x	36.79		0.3	x	0.7	=	39.36	(79)
Southwest	0.9x	0.77	x	7.35	x	62.67		0.3	x	0.7	=	67.04	(79)
Southwest	0.9x	0.77	x	7.35	x	85.75		0.3	x	0.7	=	91.72	(79)
Southwest	0.9x	0.77	x	7.35	x	106.25		0.3	x	0.7	=	113.65	(79)
Southwest	0.9x	0.77	x	7.35	x	119.01		0.3	x	0.7	=	127.3	(79)
Southwest	0.9x	0.77	x	7.35	x	118.15		0.3	x	0.7	=	126.38	(79)
Southwest	0.9x	0.77	x	7.35	x	113.91		0.3	x	0.7	=	121.84	(79)
Southwest	0.9x	0.77	x	7.35	x	104.39		0.3	x	0.7	=	111.66	(79)
Southwest	0.9x	0.77	x	7.35	x	92.85		0.3	x	0.7	=	99.32	(79)
Southwest	0.9x	0.77	x	7.35	x	69.27		0.3	x	0.7	=	74.09	(79)
Southwest	0.9x	0.77	x	7.35	x	44.07		0.3	x	0.7	=	47.14	(79)
Southwest	0.9x	0.77	x	7.35	x	31.49		0.3	x	0.7	=	33.68	(79)
Northwest	0.9x	0.77	x	2.1	x	11.28	x	0.3	x	0.7	=	3.45	(81)
Northwest	0.9x	0.77	x	2.1	x	22.97	x	0.3	x	0.7	=	7.02	(81)
Northwest	0.9x	0.77	x	2.1	x	41.38	x	0.3	x	0.7	=	12.65	(81)

DER WorkSheet: New dwelling design stage

Northwest	0.9x	0.77	x	2.1	x	67.96	x	0.3	x	0.7	=	20.77	(81)
Northwest	0.9x	0.77	x	2.1	x	91.35	x	0.3	x	0.7	=	27.92	(81)
Northwest	0.9x	0.77	x	2.1	x	97.38	x	0.3	x	0.7	=	29.76	(81)
Northwest	0.9x	0.77	x	2.1	x	91.1	x	0.3	x	0.7	=	27.84	(81)
Northwest	0.9x	0.77	x	2.1	x	72.63	x	0.3	x	0.7	=	22.2	(81)
Northwest	0.9x	0.77	x	2.1	x	50.42	x	0.3	x	0.7	=	15.41	(81)
Northwest	0.9x	0.77	x	2.1	x	28.07	x	0.3	x	0.7	=	8.58	(81)
Northwest	0.9x	0.77	x	2.1	x	14.2	x	0.3	x	0.7	=	4.34	(81)
Northwest	0.9x	0.77	x	2.1	x	9.21	x	0.3	x	0.7	=	2.82	(81)

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

(83)m=	51.4	89.68	128.37	168.56	197.46	199.85	191.09	168.94	142.2	100.65	61.95	43.74	(83)

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

(84)m=	376.82	413.2	439.98	461	470.55	454.17	433.14	416.48	399.51	377.33	360.89	359.25	(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=	0.98	0.97	0.95	0.9	0.81	0.67	0.52	0.55	0.76	0.91	0.97	0.98	(86)

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

(87)m=	19.53	19.71	19.99	20.36	20.68	20.89	20.97	20.96	20.82	20.42	19.91	19.49	(87)

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

(88)m=	20.59	20.59	20.59	20.6	20.6	20.6	20.6	20.6	20.6	20.6	20.6	20.59	(88)

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

(89)m=	0.98	0.96	0.94	0.89	0.8	0.64	0.48	0.51	0.73	0.9	0.96	0.98	(89)

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

(90)m=	18.24	18.5	18.91	19.43	19.88	20.15	20.23	20.23	20.07	19.53	18.8	18.19	(90)

fLA = Living area ÷ (4) = | 0.54 | (91)

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

(92)m=	18.93	19.15	19.49	19.93	20.31	20.55	20.63	20.62	20.47	20	19.4	18.89	(92)

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

(93)m=	18.93	19.15	19.49	19.93	20.31	20.55	20.63	20.62	20.47	20	19.4	18.89	(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=	0.97	0.95	0.93	0.88	0.78	0.63	0.48	0.51	0.72	0.89	0.95	0.97	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	364.15	393.6	408.08	404.07	368.76	287.38	207.11	214.22	289.19	334.84	342.99	348.81	(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=	804.39	781.41	710.89	597.13	464.98	318.01	215.24	225	341.88	507.97	667.26	800.44	(97)

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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(98)m=	327.54	260.61	225.29	139.01	71.59	0	0	0	0	128.8	233.47	336.01		
Total per year (kWh/year) = Sum(98)1...5,9...12 =													1722.33	(98)

Space heating requirement in kWh/m²/year | 25.69 | (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		100	(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)	327.54	260.61	225.29	139.01	71.59	0	0	0	0	128.8	233.47	336.01		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	327.54	260.61	225.29	139.01	71.59	0	0	0	0	128.8	233.47	336.01		(211)
Total (kWh/year) =Sum(211)1...5,10....12=													1722.33	(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)	166.91	146.75	153.26	136.2	132.62	117.26	111.44	123.91	124.2	141.29	150.9	162.49		
Efficiency of water heater													349.41	(216)
(217)m=	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	47.77	42	43.86	38.98	37.95	33.56	31.89	35.46	35.54	40.44	43.19	46.5		
Total = Sum(219a)1...12 =													477.15	(219)

Annual totals

		kWh/year	kWh/year	
Space heating fuel used, main system 1			1722.33	
Water heating fuel used			477.15	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		184.05		(230a)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		184.05	(231)
Electricity for lighting			299.64	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			2683.18	(338)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh	**Emissions** kg CO2/year

DER WorkSheet: New dwelling design stage

Space heating (main system 1)	(211) x	0.519	=	893.89	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	247.64	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1141.53	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	95.52	(267)
Electricity for lighting	(232) x	0.519	=	155.51	(268)
Total CO2, kg/year		sum of (265)…(271) =		1392.57	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		20.77	(273)
EI rating (section 14)				83	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.5.41

Property Address: 2 Bed - MF

Address : 2 Bed - MF, London, TBC

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67.05	(1a) x	2.5	(2a) =	167.63	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67.05	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	167.63	(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			2	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.1	(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) =	0.08	(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

0.11	0.11	0.1	0.09	0.09	0.08	0.08	0.08	0.08	0.09	0.1	0.1

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) = 75.65 (23c)

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

(24a)m=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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			3.57	x	1	=	3.57			(26)
Windows Type 1			1.81	x	1/[1/(1)+ 0.04]	=	1.74			(27)
Windows Type 2			2.1	x	1/[1/(1)+ 0.04]	=	2.02			(27)
Windows Type 3			1.05	x	1/[1/(1)+ 0.04]	=	1.01			(27)
Windows Type 4			7.35	x	1/[1/(1)+ 0.04]	=	7.07			(27)
Walls	58.81	15.88	42.93	x	0.18	=	7.73	14	601.02	(29)
Total area of elements, m²			58.81							(31)
Party wall			50.53	x	0	=	0	20	1010.6	(32)
Party floor			67.05					40	2682	(32a)
Party ceiling			67.05					30	2011.5	(32b)
Internal wall **			87.34					9	786.0599	(32c)

** 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) = 23.13 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7091.18 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 105.76 (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 8.29 (36)

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

Total fabric heat loss (33) + (36) = 31.42 (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=	12.73	12.61	12.49	11.91	11.79	11.2	11.2	11.08	11.44	11.79	12.02	12.26	(38)

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

(39)m=	44.15	44.04	43.92	43.33	43.21	42.63	42.63	42.51	42.86	43.21	43.45	43.68	

Average = Sum(39)$_{1...12}$ /12= 43.3 (39)

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

(40)m=	0.66	0.66	0.66	0.65	0.64	0.64	0.64	0.63	0.64	0.64	0.65	0.65	

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 85.8 (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=	94.37	90.94	87.51	84.08	80.65	77.22	77.22	80.65	84.08	87.51	90.94	94.37	

Total = Sum(44)$_{1...12}$ = 1029.54 (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=	139.96	122.41	126.31	110.12	105.66	91.18	84.49	96.96	98.11	114.34	124.81	135.54	

Total = Sum(45)$_{1...12}$ = 1349.89 (45)

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

(46)m=	20.99	18.36	18.95	16.52	15.85	13.68	12.67	14.54	14.72	17.15	18.72	20.33	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 201 (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): 0.54 (48)

Temperature factor from Table 2b 0.8694 (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) 0.87 (55)

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

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95	(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=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95	(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=	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=	166.91	146.75	153.26	136.2	132.62	117.26	111.44	123.91	124.2	141.29	150.9	162.49	(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=	166.91	146.75	153.26	136.2	132.62	117.26	111.44	123.91	124.2	141.29	150.9	162.49	

Output from water heater (annual)$_{1...12}$ | 1667.22 | (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=	46.54	40.7	42	36.62	35.13	30.32	28.09	32.24	32.62	38.02	41.5	45.07	(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=	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	(66)

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

(67)m=	16.97	15.07	12.26	9.28	6.94	5.86	6.33	8.22	11.04	14.02	16.36	17.44	(67)

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

(68)m=	190.32	192.29	187.31	176.72	163.35	150.78	142.38	140.4	145.38	155.98	169.35	181.92	(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=	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	(71)

Water heating gains (Table 5)

(72)m=	62.55	60.57	56.45	50.85	47.22	42.11	37.76	43.33	45.31	51.1	57.64	60.57	(72)

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

(73)m=	325.42	323.51	311.61	292.44	273.09	254.33	242.05	247.55	257.31	276.68	298.93	315.52	(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)	
Northeast	0.9x	0.77	x	1.81	x	11.28	x	0.3	x	0.7	=	2.97	(75)
Northeast	0.9x	0.77	x	1.81	x	22.97	x	0.3	x	0.7	=	6.05	(75)
Northeast	0.9x	0.77	x	1.81	x	41.38	x	0.3	x	0.7	=	10.9	(75)
Northeast	0.9x	0.77	x	1.81	x	67.96	x	0.3	x	0.7	=	17.9	(75)
Northeast	0.9x	0.77	x	1.81	x	91.35	x	0.3	x	0.7	=	24.06	(75)
Northeast	0.9x	0.77	x	1.81	x	97.38	x	0.3	x	0.7	=	25.65	(75)
Northeast	0.9x	0.77	x	1.81	x	91.1	x	0.3	x	0.7	=	24	(75)
Northeast	0.9x	0.77	x	1.81	x	72.63	x	0.3	x	0.7	=	19.13	(75)
Northeast	0.9x	0.77	x	1.81	x	50.42	x	0.3	x	0.7	=	13.28	(75)
Northeast	0.9x	0.77	x	1.81	x	28.07	x	0.3	x	0.7	=	7.39	(75)
Northeast	0.9x	0.77	x	1.81	x	14.2	x	0.3	x	0.7	=	3.74	(75)
Northeast	0.9x	0.77	x	1.81	x	9.21	x	0.3	x	0.7	=	2.43	(75)
Southeast	0.9x	0.77	x	1.05	x	36.79	x	0.3	x	0.7	=	5.62	(77)
Southeast	0.9x	0.77	x	1.05	x	62.67	x	0.3	x	0.7	=	9.58	(77)
Southeast	0.9x	0.77	x	1.05	x	85.75	x	0.3	x	0.7	=	13.1	(77)
Southeast	0.9x	0.77	x	1.05	x	106.25	x	0.3	x	0.7	=	16.24	(77)
Southeast	0.9x	0.77	x	1.05	x	119.01	x	0.3	x	0.7	=	18.19	(77)
Southeast	0.9x	0.77	x	1.05	x	118.15	x	0.3	x	0.7	=	18.05	(77)
Southeast	0.9x	0.77	x	1.05	x	113.91	x	0.3	x	0.7	=	17.41	(77)
Southeast	0.9x	0.77	x	1.05	x	104.39	x	0.3	x	0.7	=	15.95	(77)
Southeast	0.9x	0.77	x	1.05	x	92.85	x	0.3	x	0.7	=	14.19	(77)
Southeast	0.9x	0.77	x	1.05	x	69.27	x	0.3	x	0.7	=	10.58	(77)
Southeast	0.9x	0.77	x	1.05	x	44.07	x	0.3	x	0.7	=	6.73	(77)
Southeast	0.9x	0.77	x	1.05	x	31.49	x	0.3	x	0.7	=	4.81	(77)
Southwest	0.9x	0.77	x	7.35	x	36.79		0.3	x	0.7	=	39.36	(79)
Southwest	0.9x	0.77	x	7.35	x	62.67		0.3	x	0.7	=	67.04	(79)
Southwest	0.9x	0.77	x	7.35	x	85.75		0.3	x	0.7	=	91.72	(79)
Southwest	0.9x	0.77	x	7.35	x	106.25		0.3	x	0.7	=	113.65	(79)
Southwest	0.9x	0.77	x	7.35	x	119.01		0.3	x	0.7	=	127.3	(79)
Southwest	0.9x	0.77	x	7.35	x	118.15		0.3	x	0.7	=	126.38	(79)
Southwest	0.9x	0.77	x	7.35	x	113.91		0.3	x	0.7	=	121.84	(79)
Southwest	0.9x	0.77	x	7.35	x	104.39		0.3	x	0.7	=	111.66	(79)
Southwest	0.9x	0.77	x	7.35	x	92.85		0.3	x	0.7	=	99.32	(79)
Southwest	0.9x	0.77	x	7.35	x	69.27		0.3	x	0.7	=	74.09	(79)
Southwest	0.9x	0.77	x	7.35	x	44.07		0.3	x	0.7	=	47.14	(79)
Southwest	0.9x	0.77	x	7.35	x	31.49		0.3	x	0.7	=	33.68	(79)
Northwest	0.9x	0.77	x	2.1	x	11.28	x	0.3	x	0.7	=	3.45	(81)
Northwest	0.9x	0.77	x	2.1	x	22.97	x	0.3	x	0.7	=	7.02	(81)
Northwest	0.9x	0.77	x	2.1	x	41.38	x	0.3	x	0.7	=	12.65	(81)

Northwest	0.9x	0.77	x	2.1	x	67.96	x	0.3	x	0.7	=	20.77	(81)
Northwest	0.9x	0.77	x	2.1	x	91.35	x	0.3	x	0.7	=	27.92	(81)
Northwest	0.9x	0.77	x	2.1	x	97.38	x	0.3	x	0.7	=	29.76	(81)
Northwest	0.9x	0.77	x	2.1	x	91.1	x	0.3	x	0.7	=	27.84	(81)
Northwest	0.9x	0.77	x	2.1	x	72.63	x	0.3	x	0.7	=	22.2	(81)
Northwest	0.9x	0.77	x	2.1	x	50.42	x	0.3	x	0.7	=	15.41	(81)
Northwest	0.9x	0.77	x	2.1	x	28.07	x	0.3	x	0.7	=	8.58	(81)
Northwest	0.9x	0.77	x	2.1	x	14.2	x	0.3	x	0.7	=	4.34	(81)
Northwest	0.9x	0.77	x	2.1	x	9.21	x	0.3	x	0.7	=	2.82	(81)

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

(83)m=	51.4	89.68	128.37	168.56	197.46	199.85	191.09	168.94	142.2	100.65	61.95	43.74	(83)

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

(84)m=	376.82	413.2	439.98	461	470.55	454.17	433.14	416.48	399.51	377.33	360.89	359.25	(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=	0.96	0.95	0.92	0.85	0.73	0.57	0.42	0.46	0.67	0.86	0.95	0.97	(86)

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

(87)m=	19.85	20.02	20.28	20.59	20.82	20.95	20.99	20.99	20.91	20.62	20.19	19.81	(87)

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

(88)m=	20.67	20.67	20.67	20.68	20.68	20.68	20.68	20.68	20.68	20.68	20.68	20.67	(88)

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

(89)m=	0.96	0.94	0.91	0.84	0.72	0.54	0.4	0.43	0.65	0.85	0.94	0.97	(89)

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

(90)m=	18.81	19.06	19.43	19.87	20.19	20.35	20.39	20.39	20.3	19.92	19.3	18.75	(90)

fLA = Living area ÷ (4) = 0.54 (91)

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

(92)m=	19.36	19.57	19.88	20.25	20.53	20.67	20.71	20.71	20.63	20.29	19.78	19.32	(92)

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

(93)m=	19.36	19.57	19.88	20.25	20.53	20.67	20.71	20.71	20.63	20.29	19.78	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=	0.95	0.93	0.9	0.83	0.71	0.54	0.4	0.43	0.64	0.84	0.93	0.96	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	358.67	385.05	394.39	380.95	334.08	247.02	172.59	179.49	256.17	317.34	335.08	344.25	(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=	665.13	646.15	587.74	491.96	381.49	258.95	175.21	183.1	279.76	418.83	550.76	660.45	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	228.01	175.46	143.85	79.92	35.27	0	0	0	0	75.51	155.29	235.25

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1128.57 (98)

Space heating requirement in kWh/m²/year 16.83 (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		100	(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)	228.01	175.46	143.85	79.92	35.27	0	0	0	0	75.51	155.29	235.25		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	228.01	175.46	143.85	79.92	35.27	0	0	0	0	75.51	155.29	235.25		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													1128.57	(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)	166.91	146.75	153.26	136.2	132.62	117.26	111.44	123.91	124.2	141.29	150.9	162.49		
Efficiency of water heater													349.41	(216)
(217)m=	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	47.77	42	43.86	38.98	37.95	33.56	31.89	35.46	35.54	40.44	43.19	46.5		
Total = Sum(219a)$_{1...12}$ =													477.15	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1128.57	
Water heating fuel used			477.15	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		184.05		(230a)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		184.05	(231)
Electricity for lighting			299.64	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			2089.41	(338)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh	**Emissions** kg CO2/year

DER WorkSheet: New dwelling design stage

Space heating (main system 1)	(211)	x	0.519	=	585.73	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.519	=	247.64	(264)
Space and water heating	(261) + (262) + (263) + (264) =				833.37	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	95.52	(267)
Electricity for lighting	(232)	x	0.519	=	155.51	(268)
Total CO2, kg/year			sum of (265)…(271) =		1084.41	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		16.17	(273)
EI rating (section 14)					87	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.41

Property Address: 2 Bed - TF

Address : 2 Bed - TF, London, TBC

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	67.05	(1a) x	2.5	(2a) =	167.63	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67.05	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	167.63	(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		2	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.1	(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) =	0.08	(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

0.11	0.11	0.1	0.09	0.09	0.08	0.08	0.08	0.08	0.09	0.1	0.1

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) =	75.65	(23c)

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

(24a)m=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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=	0.23	0.23	0.23	0.22	0.21	0.2	0.2	0.2	0.21	0.21	0.22	0.22	(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			3.57	x	1	=	3.57			(26)
Windows Type 1			1.81	x	1/[1/(1)+ 0.04]	=	1.74			(27)
Windows Type 2			2.1	x	1/[1/(1)+ 0.04]	=	2.02			(27)
Windows Type 3			1.05	x	1/[1/(1)+ 0.04]	=	1.01			(27)
Windows Type 4			7.35	x	1/[1/(1)+ 0.04]	=	7.07			(27)
Walls	58.81	15.88	42.93	x	0.18	=	7.73	14	601.02	(29)
Roof	67.05	0	67.05	x	0.11	=	7.38	9	603.45	(30)
Total area of elements, m²			125.86							(31)
Party wall			50.53	x	0	=	0	20	1010.6	(32)
Party floor			67.05					40	2682	(32a)
Internal wall **			87.34					9	786.0599	(32c)

** 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) =	30.51	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	5683.13	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	= (34) ÷ (4) =	84.76	(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		18.08	(36)

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

Total fabric heat loss	(33) + (36) =	48.59	(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=	12.73	12.61	12.49	11.91	11.79	11.2	11.2	11.08	11.44	11.79	12.02	12.26	(38)

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

(39)m=	61.32	61.2	61.08	60.5	60.38	59.79	59.79	59.67	60.03	60.38	60.61	60.85	

Average = Sum(39)$_{1\ldots12}$ /12= 60.47 (39)

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

(40)m=	0.91	0.91	0.91	0.9	0.9	0.89	0.89	0.89	0.9	0.9	0.9	0.91	

Average = Sum(40)$_{1\ldots12}$ /12= 0.9 (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 85.8 (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=	94.37	90.94	87.51	84.08	80.65	77.22	77.22	80.65	84.08	87.51	90.94	94.37	

Total = Sum(44)$_{1\ldots12}$ = 1029.54 (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=	139.96	122.41	126.31	110.12	105.66	91.18	84.49	96.96	98.11	114.34	124.81	135.54	

Total = Sum(45)$_{1\ldots12}$ = 1349.89 (45)

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

(46)m=	20.99	18.36	18.95	16.52	15.85	13.68	12.67	14.54	14.72	17.15	18.72	20.33	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 201 (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): 0.54 (48)

Temperature factor from Table 2b 0.8694 (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) 0.87 (55)

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

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95	(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=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95	(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=	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=	166.91	146.75	153.26	136.2	132.62	117.26	111.44	123.91	124.2	141.29	150.9	162.49	(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=	166.91	146.75	153.26	136.2	132.62	117.26	111.44	123.91	124.2	141.29	150.9	162.49	

Output from water heater (annual)1…12 | 1667.22 | (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=	46.54	40.7	42	36.62	35.13	30.32	28.09	32.24	32.62	38.02	41.5	45.07	(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=	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	108.62	(66)

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

(67)m=	16.97	15.07	12.26	9.28	6.94	5.86	6.33	8.22	11.04	14.02	16.36	17.44	(67)

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

(68)m=	190.32	192.29	187.31	176.72	163.35	150.78	142.38	140.4	145.38	155.98	169.35	181.92	(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=	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	-86.9	(71)

Water heating gains (Table 5)

(72)m=	62.55	60.57	56.45	50.85	47.22	42.11	37.76	43.33	45.31	51.1	57.64	60.57	(72)

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

(73)m=	325.42	323.51	311.61	292.44	273.09	254.33	242.05	247.55	257.31	276.68	298.93	315.52	(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)	
Northeast 0.9x	0.77	1.81	11.28	0.3	0.7	2.97	(75)
Northeast 0.9x	0.77	1.81	22.97	0.3	0.7	6.05	(75)
Northeast 0.9x	0.77	1.81	41.38	0.3	0.7	10.9	(75)
Northeast 0.9x	0.77	1.81	67.96	0.3	0.7	17.9	(75)
Northeast 0.9x	0.77	1.81	91.35	0.3	0.7	24.06	(75)
Northeast 0.9x	0.77	1.81	97.38	0.3	0.7	25.65	(75)
Northeast 0.9x	0.77	1.81	91.1	0.3	0.7	24	(75)
Northeast 0.9x	0.77	1.81	72.63	0.3	0.7	19.13	(75)
Northeast 0.9x	0.77	1.81	50.42	0.3	0.7	13.28	(75)
Northeast 0.9x	0.77	1.81	28.07	0.3	0.7	7.39	(75)
Northeast 0.9x	0.77	1.81	14.2	0.3	0.7	3.74	(75)
Northeast 0.9x	0.77	1.81	9.21	0.3	0.7	2.43	(75)
Southeast 0.9x	0.77	1.05	36.79	0.3	0.7	5.62	(77)
Southeast 0.9x	0.77	1.05	62.67	0.3	0.7	9.58	(77)
Southeast 0.9x	0.77	1.05	85.75	0.3	0.7	13.1	(77)
Southeast 0.9x	0.77	1.05	106.25	0.3	0.7	16.24	(77)
Southeast 0.9x	0.77	1.05	119.01	0.3	0.7	18.19	(77)
Southeast 0.9x	0.77	1.05	118.15	0.3	0.7	18.05	(77)
Southeast 0.9x	0.77	1.05	113.91	0.3	0.7	17.41	(77)
Southeast 0.9x	0.77	1.05	104.39	0.3	0.7	15.95	(77)
Southeast 0.9x	0.77	1.05	92.85	0.3	0.7	14.19	(77)
Southeast 0.9x	0.77	1.05	69.27	0.3	0.7	10.58	(77)
Southeast 0.9x	0.77	1.05	44.07	0.3	0.7	6.73	(77)
Southeast 0.9x	0.77	1.05	31.49	0.3	0.7	4.81	(77)
Southwest 0.9x	0.77	7.35	36.79	0.3	0.7	39.36	(79)
Southwest 0.9x	0.77	7.35	62.67	0.3	0.7	67.04	(79)
Southwest 0.9x	0.77	7.35	85.75	0.3	0.7	91.72	(79)
Southwest 0.9x	0.77	7.35	106.25	0.3	0.7	113.65	(79)
Southwest 0.9x	0.77	7.35	119.01	0.3	0.7	127.3	(79)
Southwest 0.9x	0.77	7.35	118.15	0.3	0.7	126.38	(79)
Southwest 0.9x	0.77	7.35	113.91	0.3	0.7	121.84	(79)
Southwest 0.9x	0.77	7.35	104.39	0.3	0.7	111.66	(79)
Southwest 0.9x	0.77	7.35	92.85	0.3	0.7	99.32	(79)
Southwest 0.9x	0.77	7.35	69.27	0.3	0.7	74.09	(79)
Southwest 0.9x	0.77	7.35	44.07	0.3	0.7	47.14	(79)
Southwest 0.9x	0.77	7.35	31.49	0.3	0.7	33.68	(79)
Northwest 0.9x	0.77	2.1	11.28	0.3	0.7	3.45	(81)
Northwest 0.9x	0.77	2.1	22.97	0.3	0.7	7.02	(81)
Northwest 0.9x	0.77	2.1	41.38	0.3	0.7	12.65	(81)

Northwest	0.9x	0.77	x	2.1	x	67.96	x	0.3	x	0.7	=	20.77	(81)
Northwest	0.9x	0.77	x	2.1	x	91.35	x	0.3	x	0.7	=	27.92	(81)
Northwest	0.9x	0.77	x	2.1	x	97.38	x	0.3	x	0.7	=	29.76	(81)
Northwest	0.9x	0.77	x	2.1	x	91.1	x	0.3	x	0.7	=	27.84	(81)
Northwest	0.9x	0.77	x	2.1	x	72.63	x	0.3	x	0.7	=	22.2	(81)
Northwest	0.9x	0.77	x	2.1	x	50.42	x	0.3	x	0.7	=	15.41	(81)
Northwest	0.9x	0.77	x	2.1	x	28.07	x	0.3	x	0.7	=	8.58	(81)
Northwest	0.9x	0.77	x	2.1	x	14.2	x	0.3	x	0.7	=	4.34	(81)
Northwest	0.9x	0.77	x	2.1	x	9.21	x	0.3	x	0.7	=	2.82	(81)

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

(83)m=	51.4	89.68	128.37	168.56	197.46	199.85	191.09	168.94	142.2	100.65	61.95	43.74	(83)

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

(84)m=	376.82	413.2	439.98	461	470.55	454.17	433.14	416.48	399.51	377.33	360.89	359.25	(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=	0.96	0.94	0.92	0.87	0.79	0.67	0.54	0.57	0.75	0.88	0.94	0.96	(86)

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

(87)m=	18.86	19.08	19.45	19.93	20.39	20.74	20.9	20.88	20.62	20.05	19.37	18.81	(87)

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

(88)m=	20.54	20.54	20.54	20.55	20.55	20.55	20.55	20.56	20.55	20.55	20.55	20.55	(88)

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

(89)m=	0.95	0.94	0.91	0.86	0.78	0.64	0.49	0.53	0.72	0.87	0.94	0.96	(89)

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

(90)m=	17.26	17.57	18.1	18.8	19.44	19.91	20.1	20.08	19.77	18.97	18.01	17.19	(90)

fLA = Living area ÷ (4) = 0.54 (91)

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

(92)m=	18.12	18.38	18.82	19.41	19.95	20.36	20.53	20.51	20.23	19.55	18.74	18.06	(92)

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

(93)m=	18.12	18.38	18.82	19.41	19.95	20.36	20.53	20.51	20.23	19.55	18.74	18.06	(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=	0.94	0.92	0.89	0.84	0.75	0.63	0.49	0.52	0.7	0.85	0.92	0.94	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	352.45	379.14	390.98	385.88	354.5	284.33	212.72	218.06	280.62	319.8	330.21	338.3	(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=	847.26	824.95	752.73	635.7	498.15	344.23	234.75	244.99	367.67	540.24	705.4	843.32	(97)

DER WorkSheet: New dwelling design stage

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	368.14	299.59	269.14	179.87	106.88	0	0	0	0	164.01	270.13	375.73

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2033.49 (98)

Space heating requirement in kWh/m²/year 30.33 (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 1 100 (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)	368.14	299.59	269.14	179.87	106.88	0	0	0	0	164.01	270.13	375.73	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	368.14	299.59	269.14	179.87	106.88	0	0	0	0	164.01	270.13	375.73	(211)

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2033.49 (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)

	166.91	146.75	153.26	136.2	132.62	117.26	111.44	123.91	124.2	141.29	150.9	162.49

Efficiency of water heater 349.41 (216)

(217)m=	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	47.77	42	43.86	38.98	37.95	33.56	31.89	35.46	35.54	40.44	43.19	46.5

Total = Sum(219a)$_{1...12}$ = 477.15 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2033.49	
Water heating fuel used		477.15	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	184.05		(230a)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		184.05	(231)
Electricity for lighting		299.64	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		2994.33	(338)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh	**Emissions** kg CO2/year

DER WorkSheet: New dwelling design stage

Space heating (main system 1)	(211) x	0.519	=	1055.38	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	247.64	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1303.02	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	95.52	(267)
Electricity for lighting	(232) x	0.519	=	155.51	(268)
Total CO2, kg/year		sum of (265)…(271) =		1554.06	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		23.18	(273)
EI rating (section 14)				81	(274)

Be Green

APPENDIX E – BRUKL REPORTS

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name **Shell and Core**

Howson Terrace

As designed

Date: Tue Aug 24 16:59:34 2021

Administrative information

Building Details

Address: Howson Terrace, Richmond HIll, Richmond, ,

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.6.b.0

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v6.1.8

BRUKL compliance check version: v5.6.b.0

Certifier details

Name: Matt Fitzpatrick

Telephone number:

Address: 2 Dronken House 43a High Street, Kings Langley, WD4 8FG

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	10.3
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	10.3
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	9.1
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	0.18	0.18	"Ground Floor - Ground Floor_W_10"
Floor	0.25	0.13	0.13	"Ground Floor - Ground Floor_S_3"
Roof	0.25	0.11	0.11	"Ground Floor - Ground Floor_R_5"
Windows***, roof windows, and rooflights	2.2	1	1	"Ground Floor - Ground Floor_G_12"
Personnel doors	2.2	1	1	"Ground Floor - Ground Floor_D_62"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

* 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	2

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- Project HVAC

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.35	-	-	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
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- Project DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	Hot water provided by HVAC system	-
Standard value	N/A	N/A

"No zones in project where local mechanical ventilation, exhaust, or terminal unit is applicable"

Shell and core configuration

Zone	Assumed shell?
Ground Floor - Ground Floor	NO
Ground Floor - Lift Core	NO
Ground Floor - WC	NO
Ground Floor - Bin Store	NO
Ground Floor - Lobby	NO
Ground Floor - Stair Core	NO
First Floor - Stair Core	NO
First Floor - Lift Core	NO
Second Floor - Stair Core	NO
Second Floor - Lift Core	NO
Third Floor - Stair Core	NO
Third Floor - Lift Core	NO

General lighting and display lighting

	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Ground Floor - Ground Floor	-	417	-	502
Ground Floor - Lift Core	-	341	-	16
Ground Floor - WC	-	303	-	26
Ground Floor - Bin Store	-	115	-	64
Ground Floor - Lobby	-	269	-	33
Ground Floor - Stair Core	-	254	-	41
First Floor - Stair Core	-	440	-	145
First Floor - Lift Core	-	336	-	17
Second Floor - Stair Core	-	440	-	145
Second Floor - Lift Core	-	336	-	17

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Third Floor - Stair Core	-	440	-	145
Third Floor - Lift Core	-	336	-	17

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

There are no zones in the building where the solar gain check is applicable.

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?	NO
Is evidence of such assessment available as a separate submission?	NO
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]	388.8	388.8
External area [m^2]	790.9	790.9
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	2	3
Average conductance [W/K]	238.47	474.07
Average U-value [W/m^2K]	0.3	0.6
Alpha value* [%]	32.36	21.1

* 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
	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
100	**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	2.83	12.28
Cooling	0	0
Auxiliary	3.07	1.46
Lighting	11.62	6.58
Hot water	0	0
Equipment*	13.13	13.13
TOTAL**	**17.52**	**20.31**

* 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]	124.24	195.74
Primary energy* [kWh/m^2]	53.78	60.8
Total emissions [kg/m^2]	9.1	10.3

* 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] Central heating using water: floor heating, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Natural Gas										
	Actual	39.5	84.7	2.8	0	3.1	3.88	0	4.35	0
	Notional	107.4	88.3	12.3	0	1.5	2.43	0	----	----

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	0.18	"Ground Floor - Ground Floor_W_10"
Floor	0.2	0.13	"Ground Floor - Ground Floor_S_3"
Roof	0.15	0.11	"Ground Floor - Ground Floor_R_5"
Windows, roof windows, and rooflights	1.5	1	"Ground Floor - Ground Floor_G_12"
Personnel doors	1.5	1	"Ground Floor - Ground Floor_D_62"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"

$U_{i\text{-}Typ}$ = 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	2