SYNTEGRA CONSULTING

Energy Strategy Report

16-2501

217 Kingston Road
Teddington
TW11 9JN

November 2019

Quality Standards Control

The signatories below verify that this document has been prepared in accordance with our quality control requirements. These procedures do not affect the content and views expressed by the originator.

Revision	*Rev A*	*Rev B*	*Rev C*	*Rev D*
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1. Executive Summary

This Energy Statement demonstrates the predicted energy performance and carbon dioxide emissions of the proposed development at **217 Kingston Road, Teddington, TW11 9JN,** based on the information provided by the design team. The development will comprise of **new construction of 7no. flats and a detached house in the London Borough of Richmond upon Thames.**

1.1. Policy Requirements

The Council requires new developments to incorporate sustainable design and construction measures. The table below summarises the local policy requirements for the proposed development.

Policies	Requirements	Notes
London Plan 5.2 and 5.7 & Local Policy LP22	An overall 35% reduction of carbon emissions over the Building Regulation Part L 2013, incorporating on-site renewable technologies	The proposed development achieved an overall 36.46% carbon reduction via energy efficient measures and PV panels.
London Plan 5.15 and Local Policy LP22	Water use of 110 litres/person/day or less (including an allowance of 5litres or less) is required for the new dwellings.	Water consumption of 110 litres/person/day or less achieved using energy efficient fittings. Design stage calculations are in section 6.1 of this report.
LBRUT Sustainable Construction Checklist	Complete the Checklist and meet the required score.	The Checklist has been attached under separate cover, confirming the required score has been met.

Table 1 Policy Requirements

1.2. Methodology and Strategies

The methodology used to determine the CO_2 emissions is in accordance with the London Plan's three-step Energy Hierarchy (Policy 5.2). The below table shows the Energy Hierarchy and suggested strategies for the proposed development.

Stages	Strategies
BE LEAN Energy efficient design	• U-values and air permeability better than Building Regulations Part L. • Accredited Construction Details for all junctions • Efficient individual gas boilers for heating and hot water demand. • Natural ventilation with extract fans in wet rooms • Low energy lights • Low water consumption
BE CLEAN District heat networks or communal heating systems	• Not feasible on the site. Details are in section 7.
BE GREEN On-site renewable technologies	• PV panels of 7.875kWp for the 7 flats (18 panels on South-West roof and 7 panels on South-East roof – 315 watts per panel) • PV panels of 1.89kWp for the detached house (6 panels on the flat roof - 315 watt per panel) • Details are in section 7.2.

Table 2 Energy Hierarchy and suggested strategies

1.3. Assessment Results

After the application of all strategies based on the Energy Hierarchy, the regulated carbon dioxide emissions have been reduced as follows;

Energy Hierarchy		Regulated Carbon Emissions (Tonnes CO_2/yr)
BASELINE	TER set by Building Regulations 2013 Part L	12.29
BE LEAN	After energy demand reduction	12.23
BE CLEAN	After CHP/ Communal Heating	12.23
BE GREEN	After renewable energy	8.12

Table 3 Carbon Emissions after each stage of the proposed strategy

This carbon savings from each stage can be calculated based on the results above. The chart below summarises the total cumulative savings:

Energy Hierarchy		Regulated Carbon Savings	
		Tonnes CO_2/yr	%
BE LEAN	After energy demand reduction	0.55	4.30 %
BE CLEAN	After heat network/ CHP	0	0 %
BE GREEN	After renewable energy	4.11	33.61 %
Total Cumulative Savings		**4.66**	**36.46 %**
Total Target Savings		4.47	35 %

Table 4 Carbon dioxide Emissions after each stage of the Energy Hierarchy

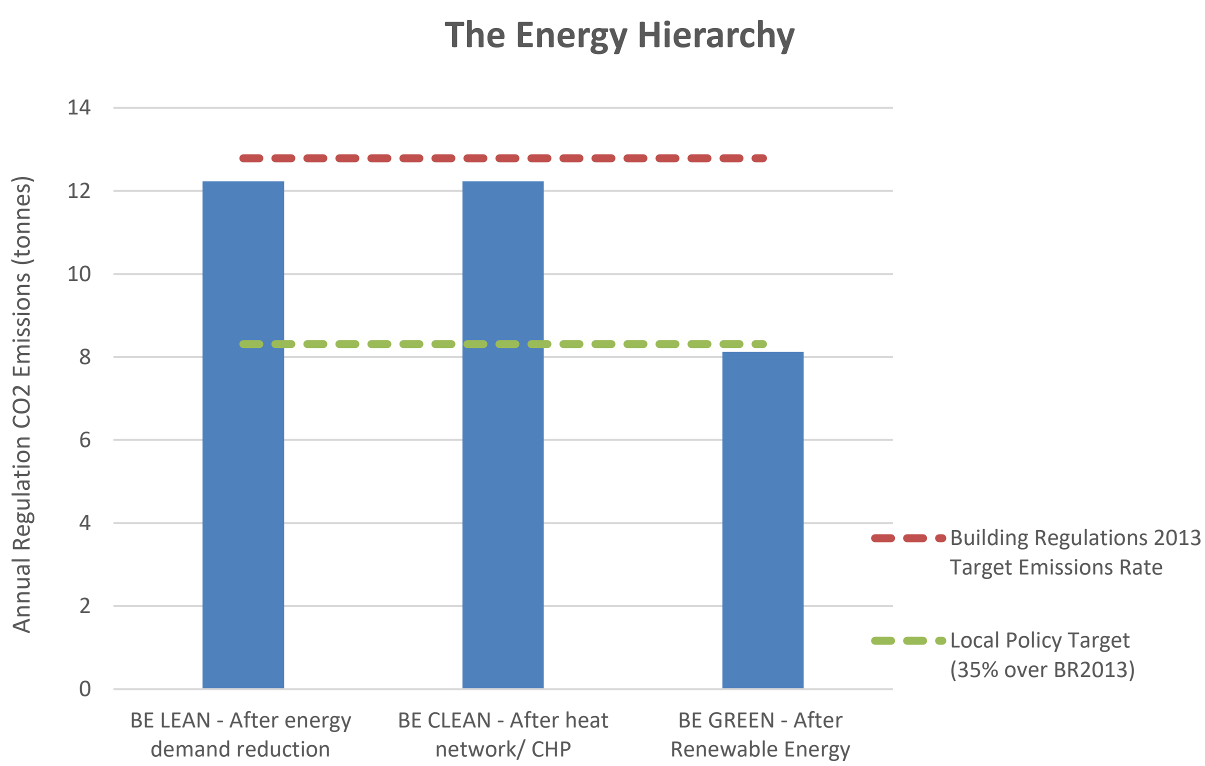


Figure 1 The Energy Hierarchy

2. Introduction

This Energy Statement will be included as part of the planning application that addresses the environmental impact of the development. This report focuses on the energy strategy for the proposed scheme and how energy consumption and carbon emissions will be minimised and to meet the targeted carbon emissions in accordance with the London Plan and Local planning policy.

The development is to be located in the **London Borough of Richmond Upon Thames** and it is in close proximity to Teddington Station (approximately 0.7 miles West) and Hampton Wick Station (approximately 0.6 miles South East). The proposal is **new construction of 7no. flats and a detached house at 217 Kingston Road, Teddington, TW11 9JN**

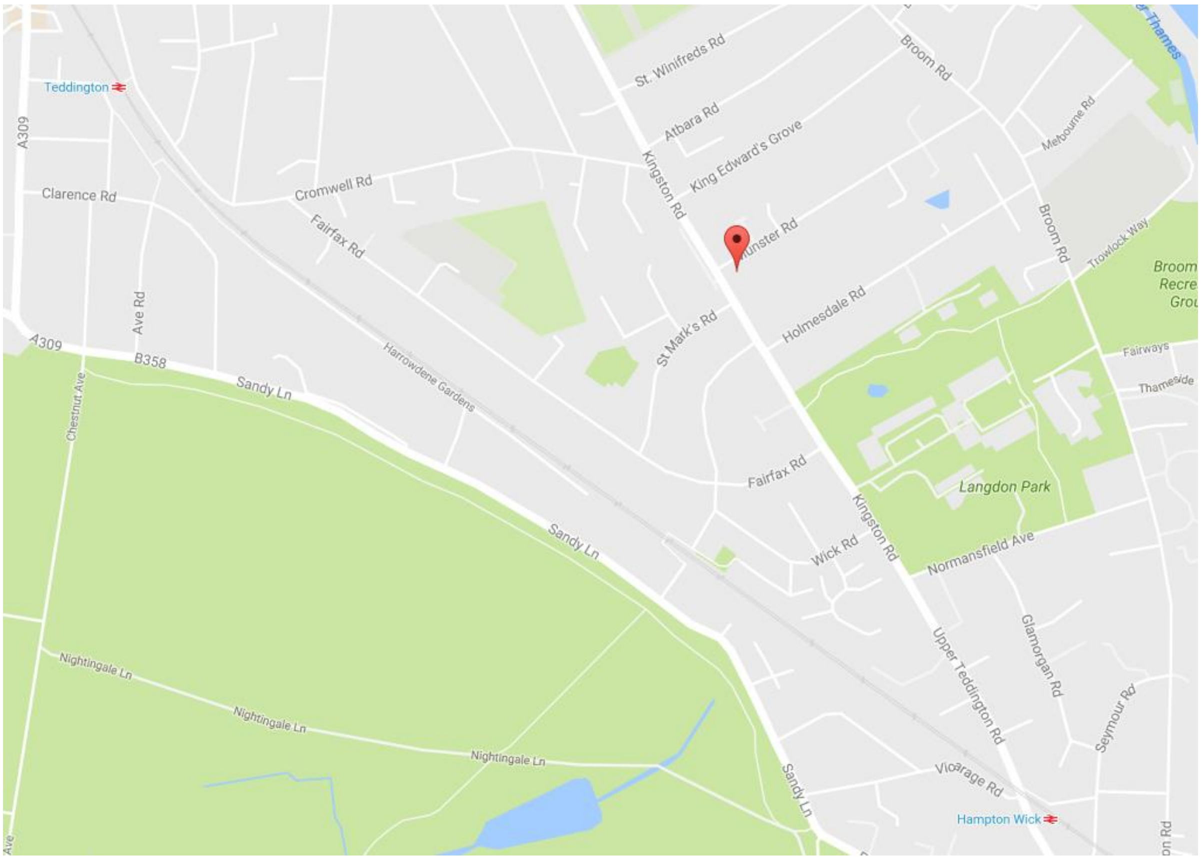


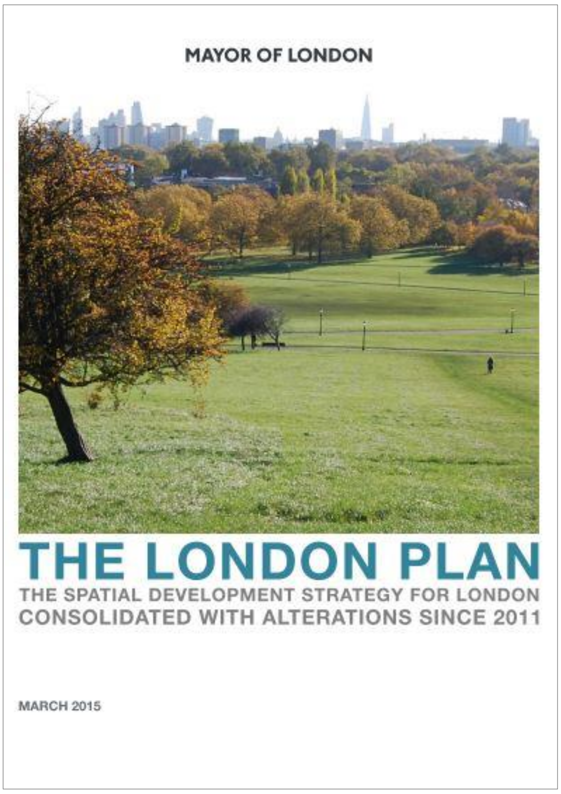
Figure 2 Site Location

3. Planning Policy

3.1. National Planning Policy Framework (March 2019)

The National Planning Policy Framework is a key part of our reforms to make the planning system less complex and more accessible, to protect the environment and to promote sustainable growth.

3.2. The London Plan (March 2016)



Policy 5.2, 5.4, 5.5, 5.6, & 5.7

According to Policy 5.2 all major new developments should show carbon emissions reduction through the Mayor's energy hierarchy (Be Lean, Be Clean and Be Green), unless it can be demonstrated that such provision is not feasible. From October 2016 Zero Carbon Standard apply to all new major residential development (10 or more units). This means that at least 35% of carbon reductions against a Building Regulations Part L 2013 must be achieved on-site, with the remaining emissions, up to 100%, to be offset through a contribution to the Council's Carbon Offset Fund. For the non-residential development must achieve a 35% reduction in CO_2 emissions against a Building Regulations Part L 2013 baseline.
For retrofitting developments, it will be a challenge to meet these target. However, available reductions in carbon emissions should be demonstrated along with water saving measures as per Policy 5.4.
Furthermore, intent must be shown for connecting to a Decentralised Energy Network and utilizing a Combined Heat & Power according to Policy 5.5 and 5.6. The Mayor and boroughs should in their DPDs adopt a presumption that developments will achieve a reduction in carbon dioxide emissions of 20% from onsite renewable energy generation according to paragraph 5.42 of Policy 5.7 Renewable Energy.

3.3. London Borough of Richmond upon Thames


LONDON BOROUGH OF RICHMOND UPON THAMES

Local Plan

As adopted by Council 3 July 2018

Publication Local Plan incorporating Inspector's Final 'Main Modifications' as published May 2018 and 'List of Council's Additional Modifications to Local Plan Publication version' as published December 2017; subject to additional minor modifications to the Plan to cover any necessary updates on adoption.

July 2018

Local Plan (Adopted in July 2018)

Policy LP22

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 floor space (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 conversion, 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 lo carbon energy generation. Proposed developments are required to meet the following minimum reductions in carbon dioxide emissions:

1. All new major residential developments (10 units or more) should achieve zero carbon standards in line with London Plan policy.
2. All other new residential buildings should achieve a 35% reduction.

3. All non-residential buildings should achieve zero carbon standards in line with London Plan policy.

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

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

1. Be lean: use less energy
2. Be clean: supply energy efficiently
3. Be green: use renewable energy

Decentralised Energy Networks

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

1. All new development will be required to connect to existing DE networks where feasible. This also applies where a DE network is planned and expected to be operational within 5 years of the development being completed.
2. Development proposals of 50 units or more, or new non-residential development of 1000sqm or more, will need to provide an assessment of the provision of on-site decentralized energy (DE) networks and combined heat and power (CHP).
3. Where feasible, new development of 50 units or more, or new non-residential development of 1000sqm or more, as well as schemes for the Proposal Sites identified in this Plan, will need to provide on-site DE and CHP; this is particularly necessary within the clusters identified for DE opportunities in the borough-wide Heat Mapping Study. Where on-site provision is not feasible, provision should be made for future connection to 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.

4. Assessment Methodology

4.1. Mayor's Energy Hierarchy

The energy hierarchy is a classification of different methods to improve energy performance in a parallel sequence. This includes primarily a focus on reducing energy use by avoiding unnecessary use, to then improving the efficiency of energy systems to minimise loss, this is followed by exploiting renewable energy sources and then low carbon energy solutions for energy needs and finally, any remaining demand can be catered for by conventional fuel sources.

The Mayor's Energy Strategy adopts a set of principles to guide design development and decisions regarding energy, balanced with the need to optimise environmental and economic benefits. These guiding principles have been reordered since the publication of the Mayor's Energy Strategy in Feb 2004 and the adopted replacement London Plan 2011 with further alterations in 2015 stating that the following hierarchy should be used to assess applications:

- **BE LEAN** – By using less energy and taking into account the further energy efficiency measure in comparison to the baseline building.

- **BE CLEAN** – By supplying energy efficiently. The clean building looks at further carbon dioxide emission savings over the lean building by taking into consideration the use of decentralise energy via CHP.

- **BE GREEN** – By integrating renewable energy into the scheme which can further reduce the carbon dioxide emission rate.

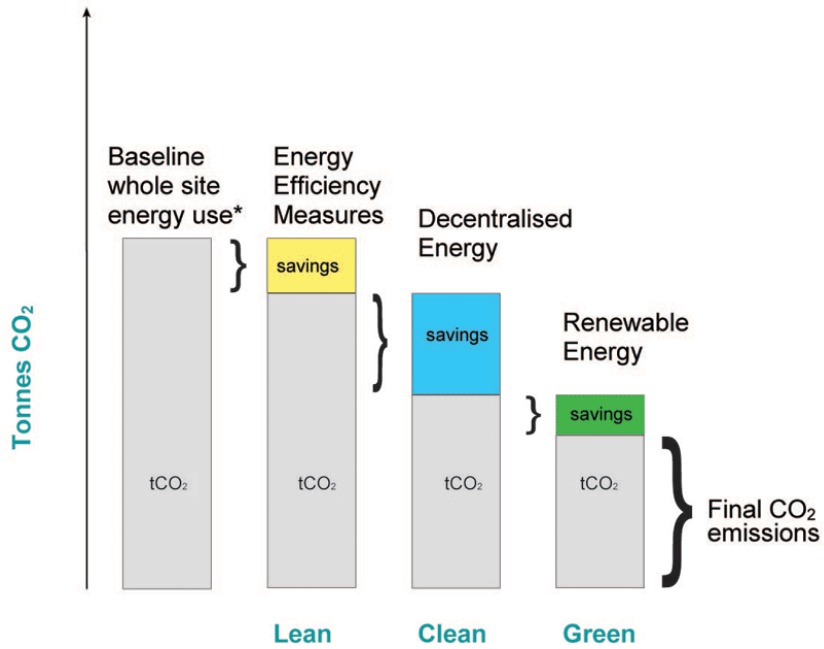


Figure 3 The Energy Hierarchy

4.2. Software and Input data

The Government approved software, i.e. **FSAP 2012**, have been utilised to carry out **Standard Assessment Procedure (SAP)** calculations for the residential units.

Syntegra received the architectural drawings and relevant documents, and they were used to undertake the energy assessments. The document references are listed in the table below.

No.	Document Name	Format	Received Date
1	240 2 PL10 P00-I	dwg	01-10-2019
2	240 PL20 E02-G	dwg	01-10-2019
3	240 PL20 P00-I	dwg	01-10-2019
4	240 PL20 P01-H	dwg	01-10-2019
5	240 PL20 P-1-I	dwg	01-10-2019
6	240 PL20 P02-I	dwg	01-10-2019
7	240 PL20 P03-E	dwg	01-10-2019
8	240 2 PL20 E01-C	dwg	23-05-2018
9	240 2 PL20 E02-C	dwg	23-05-2018
10	240 2 PL20 E03-B	dwg	23-05-2018
11	240 2 PL20 P00-D	dwg	23-05-2018
12	240 2 PL20 P01-C	dwg	23-05-2018
13	240 2 PL20 P-1-C	dwg	23-05-2018
14	240 2 PL20 S01-B	dwg	23-05-2018

Table 5 The document list

5. Baseline – Target Emission Rate

The baseline (known as Target Emission Rate), as calculated in line with the Building Regulation 2013, is the maximum amount of carbon dioxide a dwelling or non-residential unit is allowed to emit. The Target Emission Rate (TER) includes carbon dioxide emissions which are covered by Part L of the Building Regulations, known as regulated emissions (space and water heating, ventilation, lighting, pumps, fans & controls). The baseline energy uses and resulting CO_2 emissions rates of the development have been assessed using the Government approved software.

The baseline regulated CO_2 emissions for the development as a whole are presented in the tables below:

BASELINE

BASELINE: TER	Regulated CO_2 Emissions (Tonnes CO_2/yr)
Flat Unit 1	1.52
Flat Unit 1	1.54
Flat Unit 1	1.26
Flat Unit 1	1.35
Flat Unit 1	1.33
Flat Unit 1	1.39
Flat Unit 1	1.33
Detached House	3.07
TOTAL	**12.79**

Table 6 Regulated Energy Use and Carbon Emissions at Baseline

6. BE LEAN – Energy Efficient Design

This section outlines the energy efficient measures taken in order to minimise the building's energy demand and therefore reduce energy use and CO_2 emissions further than the Baseline requirements (Building Regulations 2013 Part L compliance).

6.1. Passive Design Measures

- **Enhanced Building Elements**

At the 'BE LEAN' stage of the energy hierarchy, energy efficient building elements have been incorporated into the build. The heat loss of different building element is dependent upon their U-value, air tightness, and thermal bridging y-values. Therefore, better U-values and air permeability than the minimum values set in the Part L 2013 have been suggested in this development. And, Accredited Construction Detail for Part L was also applied for all thermal bridging junctions to reduce the heat loss from the thermal bridging. Please see below more specifically:

		Part L1A 2013 min. required values	Proposed building values
U-value ($W/m^2 K$)	Wall	0.30	0.15
	Window	2.00	1.2
	Floor	0.25	0.13
	Roof	0.20	0.13
	Door	1.0 (notional)	1.2
Air Permeability ($m^3/h.m^2$ at 50 Pa)		10	4.0
Use of Accredited Construction Details		-	Yes

Table 7 Proposed Building Elements

- **Orientation & Natural Daylighting**

Passive solar gain reduces the amount of energy required for space heating during the winter months. Dwellings have enough windows and roof lights which can maximise the passive solar gains into the building throughout the day. Moreover, the internal layout of the development has been designed to improve daylighting in all habitable spaces, as a way of improving the health and wellbeing of occupants.

- **Efficient Use of Water**

In accordance with London Plan Policy 5.15 and Local Plan, the development will be based upon the specification of water efficient fittings including low volume dual flush WCs, and low flow taps/ showers/bath. These measures will result in the total water consumption rate of 110 litres/person/day or less including the external water use. Design stage calculations are below.

Installation Type	Unit of Measure	Capacity/ flow rate (1)	Use factor (2)	Fixed use (litres/head/ day) (3)	Total Consumption Litres/head/day [(1)x(2)]+(3) =(4)
WC (dual flush)	Full Flush Volume (litres)	**6**	1.46	0	**8.76**
	Part flush Volume (litres)	**4**	2.96	0	**11.85**
Taps (excluding kitchen/ utility room taps)	Flow rate (litres/minute)	**6.5**	1.58	1.58	**11.85**
Bath (where shower also present)	Capacity to overflow (litres)	**120**	0.11	0	**13.20**
Shower (where bath also present)	Flow rate (litres/minute)	**7.5**	4.37	0	**32.78**
Kitchen / utility room sink taps	Flow rate (litres/minute)	**6.5**	0.44	10.36	**13.22**
Washing machine	Litres/kg dry load	**9**	2.1	0	**18.90**
Dishwasher	Litres/place setting	**1.2**	3.6	0	**4.32**
Waste disposal unit	Litres/use	**If present = 1 If absent = 0**	3.08	0.00	**0**
Water Softener	Litres/person/day	-	1.00	0.00	-
(5)	**Total calculated use (litres/person/day) = Sum column 4**				**114.9**
(6)	**Contribution from greywater (litres/person/day)**				**0**
(7)	**Contribution from rainwater (litres/person/day)**				**0**
(8)	**Normalisation Factor**				**0.91**
(9)	**Total internal water consumption = (5) X (8)**				**104.5**
(10)	**External water use**				**5**
Total water consumption (litres/person/day) = (9) + (10)					**109.5**

Table 8 Water Use Calculations

- **Solar Shading**

The proposed design does not show risk of overheating allowing for natural ventilation through openable windows thus reducing the need for mechanical cooling systems.

- **Natural Ventilation**

A natural ventilation strategy will be adopted in all residential units with extract fans in wet rooms; toilets, kitchen, and utility rooms. Therefore, higher energy consumption and CO_2 emissions due to mechanical ventilation is avoided.

6.2. Active Design Measures

- **Heating and Hot Water System**

The space heating and hot water are provided by energy efficient systems as summarised in the table below. At the 'BE LEAN' stage **efficiency individual combi boilers have been examined for space heating and hot water demand.**

Systems	General Specification	Controls
Heating	Individual Combi Boilers (efficiency of 89.5%)	Time and temperature zone control by suitable arrangement of plumbing and electrical services
Hot water	Same as space heating	-

Table 9 Heating and Hot water systems

All suggested specifications above are provisional, and have to be reviewed with mechanical engineers and contractors at detailed design stage.

- **High Efficiency Lighting**

The proposed light fittings will be low energy efficient fittings. These can be **T5 fluorescent fittings with high frequency ballasts, or LED fittings for residential units**. The suggested specifications should be reviewed at detailed design stage with electric engineers.

The following tables demonstrate the reduction in CO_2 emissions from the energy efficiency measures mentioned above. It can be seen that the overall CO_2 reduction at Be Lean stage is ***4.3%*** for the total regulated emissions.

BE LEAN STAGE

	Regulated CO_2 Emissions (Tonnes CO_2/yr)		**Carbon Reduction** (%)
	BASELINE	**BE LEAN**	
Flat Unit 1	1.52	1.46	3.82 %
Flat Unit 1	1.54	1.50	2.75 %
Flat Unit 1	1.26	1.28	0.00 %
Flat Unit 1	1.35	1.36	0.00 %
Flat Unit 1	1.33	1.29	2.75 %
Flat Unit 1	1.39	1.37	1.35 %
Flat Unit 1	1.33	1.28	4.01 %
Detached House	3.07	2.70	12.06 %
TOTAL	**12.79**	**12.23**	**4.30 %**

Table 10 Regulated Energy Use and Carbon Emissions at Be Lean Stage

7. BE CLEAN – CHP & Decentralised Energy Networks

The Energy Hierarchy encourages the use of a CHP system and the connection to District Heating system to reduce CO_2 emissions further.

7.1. Decentralised Energy Network

The Mayor's Energy Strategy favours community heating systems because they offer:

- Potential economies of scale in respect of efficiency and therefore reduced carbon emissions; and
- Greater potential for future replacement with Low or Zero Carbon (LZC) technologies.

The feasibility of connecting into an existing heating network or providing the building with its own combined heat and power plant has been assessed alongside the **London Heat Map Study for the London Borough of Richmond Upon Thames** as part of this assessment. The study identifies that the site is not located near the existing district heating networks. This is demonstrated clearly from the London Heat Map (http://www.londonheatmap.org.uk) snapshot below.

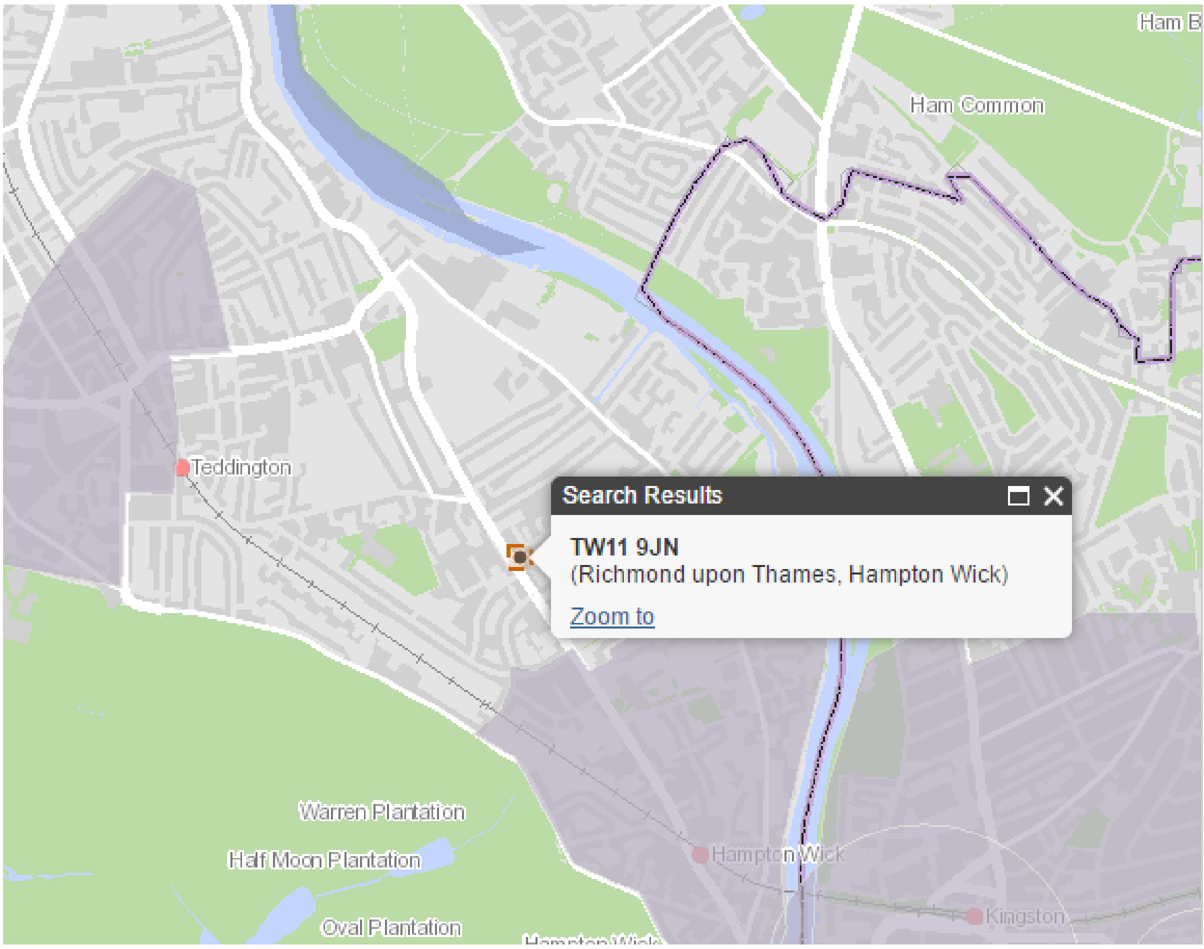


Figure 4 London Heat Map near the site

Moreover, the London heat map below identifies existing and potential DH networks in more broaden area, and it could not find any existing DH networks (in yellow) and potential networks (in red) within 1km radius from the property. The costs involved in extending the existing DH network would outweigh the advantages in this development. **Therefore, utilisation of the DH network has not been a feasible option for this development.**

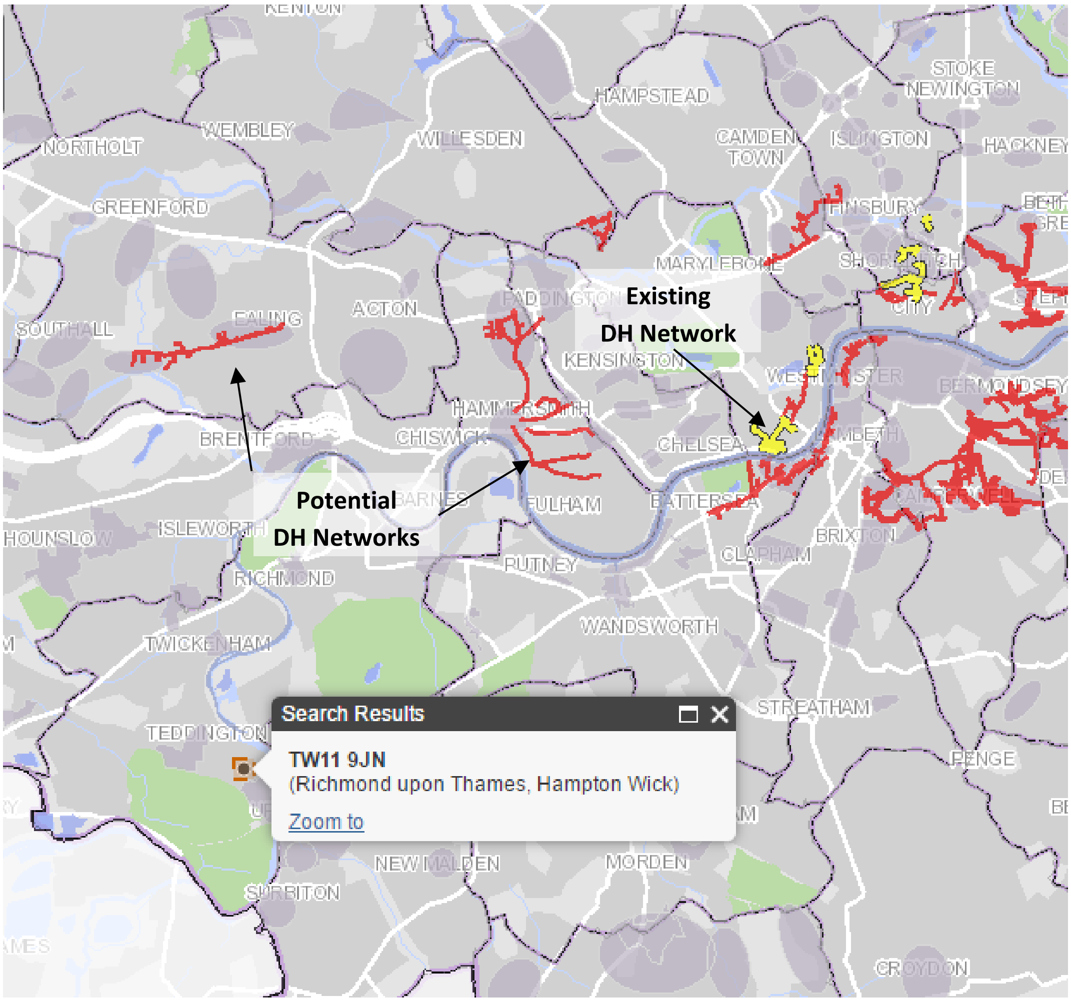


Figure 5 Existing and Potential DH Networks

7.2. CHP

The Energy Hierarchy identifies the combined heat and power (CHP) as a method of producing heat and electricity with much lower emissions than separate heat and power. Also, it encourages the creation of district heating systems supplied by CHP. The implementation of a CHP strategy should be decided according to good practice design. Key factors for the efficient implementation of the CHP system are:

- Development with high heating load for the majority of the year.
- CHP operation based on maximum heat load for minimum 10 hours per day.
- CHP operation at maximum capacity of 90% of its operating period.

To ensure that CHP is financially viable it is essential that the unit is selected to meet the base heat load and that this load is maintained over a large proportion of the day (a figure of 14 – 17 hours per day is often quoted subject to the load profiles and gas and electricity prices) to ensure that the additional costs (maintenance) associated with running a CHP unit can be recovered. This need to run the CHP plant, as far as possible continuously makes the building load profile of prime importance when reviewing the viability of such solutions and in particular the summer time heat load profile. To enable the CHP plant to run continuously when it is operating, a thermal store is often used so that excess CHP capacity can be used to generate hot water for use at a later time.

Since this development consists of only 8 dwellings that do not require high heating loads, installing the CHP system would not be beneficial given the cost. According to the Local Plan Policy LP22, developments of 50 units or more will need to provide an assessment of the provision of CHP. **Hence the CHP system has not been considered for this development at BE CLEAN stage.**

8. BE GREEN – Renewable Energy

In this section the viable renewable energy technologies that could reduce the development's CO_2 emissions are examined. In determining the appropriate renewable technology for the site, the following factors were considered;

- Renewable energy resource or fuel availability of the LZC technology on the site.
- Space limitations due to building design and urban location of the site.
- Capital, operating and maintenance cost.
- Planning Permission
- Implementation with regards the overall M&E design strategy for building type
- Available Grants

The table below summarises the various low zero carbon technologies considered for the projects, and we have identified that **Photovoltaic (PV)** would be the most appropriate option in this development.

Technology	Local Planning Requirements	Carbon Payback	Grants/ Funding	Feasibility
Air Source Heat Pumps (ASHP)	Noise Issues from External units	Medium	Renewable Heat Incentive (RHI)	**MEDIUM**
Photovoltaic (PV)	Spatial and Shadowing	High	-	**HIGH**
Solar Thermal	Spatial and Shadowing	Low	Renewable Heat Incentive (RHI)	**MEDIUM**
Ground Source Heat Pumps (GSHP)	Spatial issues for Bore Holes and noise	Medium	Renewable Heat Incentive (RHI)	**MEDIUM**
Biomass	Spatial requirement for fuel storage and biomass odour	High	Renewable Heat Incentive (RHI)	**LOW**
Wind Power	Extensive planning requirements for noise and local biodiversity	Low	-	**LOW**
Hydro Power	Extensive planning requirements for noise and water quality	None	-	**ZERO**

Table 11 Feasibility Study of LZC Technologies

8.1. Non-feasible Technology

- **Air Source Heat Pumps (ASHP)**

ASHP can meet the space heating demands on site efficiently in comparison with gas boilers. Although this low carbon technology consumes electricity to operate due to higher efficiency the heat output is much greater. However, the efficiency of heat pumps is very much dependent on the temperature difference between the heat source and the space required to be heated. As a result, ASHPs tend to have a lower COP than GSHPs. This is due to the varying levels of air temperature throughout the year when compared to the relatively stable ground temperature. Moreover, any noise associated with the external units could potentially be an issue at night due to the proximity of the neighboring residential buildings. Therefore, the use of ASHP is not a suitable option for this development.

- **Ground Source Heat Pumps (GSHP)**

Ground source heat pump would be a feasible option to meet the space heating requirements, however, it requires ground space for bore holes to extract the ground heat to be utilised for space heating requirements. In this case there is no available ground space for a borehole or trench system, the ground source loop would have to be incorporated within the foundation piles of the structure, which would result in additional cost. Hence, this option is not suitable for this development.

- **Solar Thermal**

The use of solar thermal for this development would be limited to domestic hot water only. The use of solar thermal for space heating would not be practical as it is not required when solar thermal is at its most effective during the summer months. Therefore, this system would require additional plumbing and space for hot water storage, incurring additional financial cost. Moreover, the amount of carbon offset from the system is generally lower than other technologies. Therefore, this technology is deemed to be unsuitable for this development.

- **Hydro power**

There is no river or lake within the development site boundaries. Therefore, small scale hydro-electric will not be studied any further because of the location and the spatial limitations of the development.

- **Biomass**

A biomass system designed for this development would be fueled by wood pellets which have a high energy content. However, a biomass system would not be an appropriate technology for the site for the following reasons:

i. The burning of wood pellets releases substantially more NOx emissions when compared to similar gas boilers. As the development is situated within an urban area, the installation of a biomass boiler would further impact on the air quality in this area.
ii. the lack of spaces for pellet boiler and storage on the site.
iii. Pellets would need to be transported from local pellet suppliers, which causes carbon emissions to the air.

However, if the biomass system is considered at detailed design stage, local suppliers can be found near the site as shown in the map below (http://biomass-suppliers-list.service.gov.uk .

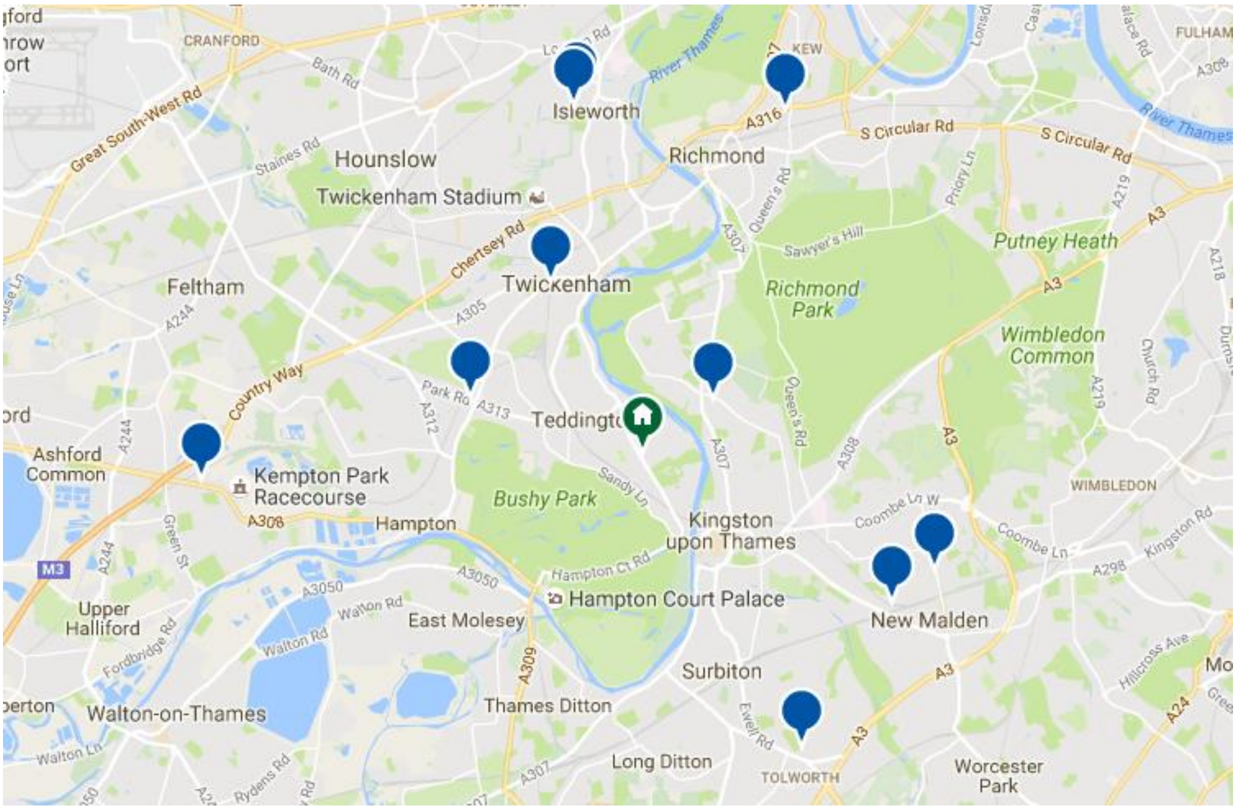


Figure 6 Map showing local suppliers to proposed development

Company Name	Contact	Fuel Supplied	Telephone
Wolseley UK Ltd	www.plumbcenter.co.uk DBD.Kingston@wolseley.co.uk	Pellets	0208 546 9287
City Plumping Suppliers (CPS) part of the Travis Perkins Group	www.cityplumbing.co.uk mark.glazier@cityplumbing.co.uk	Briquettes, Pellets	0208 941 3999
Wolseley UK Ltd	www.plumbcenter.co.uk YW.Twickenham@wolseley.co.uk	Pellets	0208 891 2381
Plumbing Trade Supplies (PTS) part of the Travis Perkins Group	www.ptsplumbing.co.uk james.newman@ptsplumbing.co.uk	Pellets	0208 329 0004
Travis Perkins Trading Co. Ltd.	www.travisperkins.co.uk tony.scott@travisperkins.co.uk	Pellets	0208 942 9498
Travis Perkins Trading Co. Ltd.	www.travisperkins.co.uk Andrew.bullen@travisperkins.co.uk	Pellets	0208 399 1307
Travis Perkins Trading Co. Ltd.	www.travisperkins.co.uk steve.burns@travisperkins.co.uk	Pellets	0208 465 2900
Wolseley UK Ltd	www.plumbcenter.co.uk EK.Isleworth@wolseley.co.uk	Pellets	0208 560 2794
Travis Perkins Trading Co. Ltd.	www.travisperkins.co.uk jack.hewitt@travisperkins.co.uk	Pellets	0208 332 9689
Travis Perkins Trading Co. Ltd.	www.travisperkins.co.uk ian.barnes@travisperkins.co.uk	Pellets	01932 782 612

Table 12 List of suppliers in the vicinity of the proposed development

- **Wind Power**

Wind turbines need extensive planning requirements and they are only feasible at consistent wind speed. Moreover, since the development is located in an urban area, the site does not have sufficient wind speed to operate wind turbine at the height of 10 meters as shown below (http://www.renew-reuse-recycle.com/noabl.pl?n=503). Hence this option has been discounted.

Estimated average windspeeds around SW11 1..

Wind speed at 10m above ground level (m/s)		
4.6	4.6	4.7
4.7	**4.8**	4.8
4.8	4.8	4.9

Wind speed at 25m above ground level (m/s)		
5.3	5.4	5.4
5.5	**5.5**	5.6
5.6	5.6	5.6

Wind speed at 45m above ground level (m/s)		
5.8	5.9	5.9
5.9	**6**	6
6	6.1	6.1

Squares surrounding the central square correspond to wind speeds for surrounding grid squares. Power generated is related to windspeed by a cubic ratio. That means if you halve the windspeed, the power goes down by a factor of 8 (which is 2 x 2 x 2). A quarter of the windspeed gives you a 64th of the power (4 x 4 x 4). As a rough guide, if your turbine is rated at producing 1KW at 12m/s then it will produce 125W at 6m/s and 15W at 3m/s.

Please note that bear in mind that the NOABL windspeed dataset used here is a model of windspeeds across the country, assuming completely flat terrain. It isn't a database of measured windspeeds. Other factors such as hills, houses, trees and other obstructions in your vicinity need to be considered as well as they can have a significant effect. If you're thinking about installing a wind turbine, you should perform your own windspeed measurements using an anemometer to determine what the actual figures are.

8.2. Proposed Technology

- **Photovoltaic (PV)**

Based on the feasibility study above, PV would be the most suitable renewable Technology for the following reasons:

i. The installation of PV is much simpler when compared to other renewable technologies
ii. There is sufficient roof space available to install enough PV modules to have a significant impact on carbon emissions of the development
iii. PV panels sited on the roof within an urban area are less visually intrusive when compared to wind turbines

The PV system capacity for the whole development depends upon the heating system selected. Therefore, the amount of PV relating to the proposed heating system option is outlined below:

- **Flats - Individual Combi Gas Boilers + 5.67 kWp PV on South West + 2.205 kWp PV on South East**
- **Detached House – Combi Boiler + 1.89 kWp PV**

The tables below illustrate the indicative PV panel's detail, should it be feasible to implement:

Orientation	• Flats - South West and South East • Detached House – South West	**Number of Panels**	• Flats – 18 panels on South-West roof and 7 panels on South-East roof • Detached house – 6 panels on the flat roof
Panel Tilt	• Flats - 30° • Detached house - 10°	**Power Output**	315 watt per panel
Overshading	None or very little	**PV Area**	1.65 m^2 per panel
Annual Ouput	• Flats - approx 6,484 kWh • Detached House – approx 1,437 kWh		

Table 13 Suggested PV details

The proposed PV panels are subject to further consideration at detailed design stage. In order to qualify both the installer and the equipment, the system must be certified under the Microgeneration Certification Scheme (MCS).

Given the proposed LZC technologies on the site (**PVs**), the overall CO_2 reduction at BE GREEN stage can be calculated as shown below. And, it can be seen that the overall CO_2 reduction via on-site renewables is ***33.61%*** for the total emissions.

BE GREEN stage

	Regulated CO_2 Emissions (Tonnes CO_2/yr)		**Carbon Reduction** (%)
	BE LEAN	**BE GREEN**	
Flat Unit 1	1.46	0.88	39.49 %
Flat Unit 1	1.50	0.94	37.13 %
Flat Unit 1	1.28	0.81	36.31 %
Flat Unit 1	1.36	0.90	33.65 %
Flat Unit 1	1.29	0.84	35.25 %
Flat Unit 1	1.37	0.91	33.45 %
Flat Unit 1	1.28	0.88	31.07 %
Detached House	2.70	1.95	27.67 %
TOTAL	**12.23**	**8.12**	**33.61 %**

Table 14 Regulated Energy Use and Carbon Reduction at Be Green Stage

9. Conclusion

This report assesses the predicted energy performance and carbon dioxide emissions of the proposed development at **217 Kingston Road, Teddington TW11 9JN,** based on the information provided by the design team.

In line with the London Plan's three step energy hierarchy the regulated CO_2 emissions for this development have been reduced by **36.46%** over Building Regulation 2013, once all measures in the table below are taken into account.

Stages	Strategies
BE LEAN Energy efficient design	• U-values and air permeability better than Building Regulations Part L. • Accredited Construction Details for all junctions • Efficient individual gas boilers for heating and hot water demand. • Natural ventilation with extract fans in wet rooms • Low energy lights • Low water consumption
BE CLEAN District heat networks or communal heating systems	• Not feasible on the site. Details are in section 7.
BE GREEN On-site renewable technologies	• PV panels of 7.875kWp for the 7 flats (18 panels on South-West roof and 7 panels on South-East roof – 315 watt per panel) • PV panels of 1.89kWp for the detached house (6 panels on the flat roof - 315 watt per panel) • Details are in section 7.2.

Table 16 Energy Hierarchy and suggested strategies

The chart below summarises the total cumulative savings. As shown in the table the proposed scheme achieves a 35% carbon reduction.

Energy Hierarchy		Regulated Carbon Savings	
		Tonnes CO_2/yr	%
BE LEAN	After energy demand reduction	0.55	4.30 %
BE CLEAN	After heat network/ CHP	0.00	0.00 %
BE GREEN	After renewable energy	4.11	33.61 %
Total Cumulative Savings		**4.66**	**36.46 %**
Total Target Savings		4.47	35 %

Table 15 Carbon dioxide Emissions after each stage of the Energy Hierarchy

10. Appendix A – SAP Reports

Block Compliance WorkSheet: 217 Kingston Road - BE LEAN

User Details

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP
Software Version: Version: 1.0.4.18

Calculation Details

Dwelling	DER	TER	DFEE	TFEE	TFA
Front - Unit 1	18.61	19.35	45.4	56.7	78.333
Front - Unit 2	19.82	20.38	49.7	61	75.469
Front - Unit 3	20.27	20.1	48.4	55.2	62.935
Front - Unit 4	21.84	21.55	54.2	62.2	62.425
Front - Unit 5	20.88	21.47	52.1	62.2	61.99
Front - Unit 6	22	22.3	54.5	66.6	62.204
Front - Unit 7	23.69	24.68	57.7	73.2	53.984
Rear House	16.12	18.33	50.9	70.6	167.515

Calculation Summary

Total Floor Area	624.86
Average TER	20.46
Average DER	19.58
Average DFEE	51.21
Average TFEE	64.30
Compliance % Improvement DER|TER % Improvement DFEE|TFEE	Pass 4.3 20.36

Block Compliance WorkSheet: 217 Kingston Road - BE GREEN

User Details

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP

Software Version: Version: 1.0.4.18

Calculation Details

Dwelling	DER	TER	DFEE	TFEE	TFA
Front - Unit 1	11.26	19.35	45.4	56.7	78.333
Front - Unit 2	12.46	20.38	49.7	61	75.469
Front - Unit 3	12.91	20.1	48.4	55.2	62.935
Front - Unit 4	14.49	21.55	54.2	62.2	62.425
Front - Unit 5	13.52	21.47	52.1	62.2	61.99
Front - Unit 6	14.64	22.3	54.5	66.6	62.204
Front - Unit 7	16.33	24.68	57.7	73.2	53.984
Rear House	11.66	18.33	50.9	70.6	167.515

Calculation Summary

Total Floor Area	624.86
Average TER	20.46
Average DER	13.00
Average DFEE	51.21
Average TFEE	64.30
Compliance	Pass
% Improvement DER|TER	36.46
% Improvement DFEE|TFEE	20.36

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.18
Printed on 05 November 2019 at 13:24:06

Project Information:

Assessed By: Su Lee (STRO031315) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 78.33m²

Site Reference : 217 Kingston Road **Plot Reference:** Front - Unit 1

Address :

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas
Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER)	19.35 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	11.26 kg/m²	**OK**

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	56.7 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	45.4 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.15 (max. 0.30)	0.15 (max. 0.70)	**OK**
Party wall	0.00 (max. 0.20)	-	**OK**
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	**OK**
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	**OK**
Openings	1.20 (max. 2.00)	1.20 (max. 3.30)	**OK**

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	4.00 (design value)	
Maximum	10.0	**OK**

4 Heating efficiency

Main Heating system:	Boiler systems with radiators or underfloor heating - mains gas Data from manufacturer Combi boiler Efficiency 89.5 % SEDBUK2009 Minimum 88.0 %	**OK**
Secondary heating system:	None	

5 Cylinder insulation

Hot water Storage:	No cylinder	
		N/A

Regulations Compliance Report

6 Controls

Space heating controls	TTZC by plumbing and electrical services	**OK**
Hot water controls:	No cylinder thermostat No cylinder	
Boiler interlock:	Yes	**OK**

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	**OK**

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Thames valley):	Slight	**OK**

Based on:

Overshading:	Average or unknown
Windows facing: South West	5.34m²
Windows facing: South East	3.5m²
Windows facing: South East	1.69m²
Windows facing: South East	0.77m²
Windows facing: North East	0.84m²
Windows facing: South West	3.79m²
Windows facing: South East	1.04m²
Windows facing: North West	1.04m²
Ventilation rate:	4.00
Blinds/curtains:	None

10 Key features

External Walls U-value	0.13 W/m²K
Party Walls U-value	0 W/m²K
Photovoltaic array	

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Su Lee	**Stroma Number:**	STRO031315
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.18

Property Address: Front - Unit 1

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	41.01	(1a)	x	2.6	(2a)	=	106.61	(3a)
Ground floor	37.33	(1b)	x	2.81	(2b)	=	104.89	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	78.33	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	211.5	(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							3	x 10 =	30	(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) =	30	÷ (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		4	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.34	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.29	(21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

DER WorkSheet: New dwelling design stage

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

0.37	0.36	0.36	0.32	0.31	0.28	0.28	0.27	0.29	0.31	0.33	0.34

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.86	x	1.2	=	2.232			(26)
Windows Type 1			5.336	x1/[1/(1.2)+ 0.04]		=	6.11			(27)
Windows Type 2			3.496	x1/[1/(1.2)+ 0.04]		=	4			(27)
Windows Type 3			1.689	x1/[1/(1.2)+ 0.04]		=	1.93			(27)
Windows Type 4			0.773	x1/[1/(1.2)+ 0.04]		=	0.89			(27)
Windows Type 5			0.84	x1/[1/(1.2)+ 0.04]		=	0.96			(27)
Windows Type 6			1.263	x1/[1/(1.2)+ 0.04]		=	1.45			(27)
Windows Type 7			1.041	x1/[1/(1.2)+ 0.04]		=	1.19			(27)
Windows Type 8			1.041	x1/[1/(1.2)+ 0.04]		=	1.19			(27)
Floor			41.005	x	0.13	=	5.33065			(28)
Walls Type1	17	0	17	x	0.15	=	2.55			(29)
Walls Type2	21.63	8.83	12.79	x	0.15	=	1.92			(29)
Walls Type3	45.44	11.03	34.4	x	0.15	=	5.16			(29)
Walls Type4	14.64	0	14.64	x	0.14	=	2.1			(29)
Walls Type5	6.89	0	6.89	x	0.13	=	0.91			(29)
Roof Type1	5.37	0	5.37	x	0.13	=	0.7			(30)
Roof Type2	2.75	0	2.75	x	0.13	=	0.36			(30)

DER WorkSheet: New dwelling design stage

Total area of elements, m²	154.72							(31)
Party wall	32.39	x	0	=	0			(32)
Party wall	13.17	x	0	=	0			(32)

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

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

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	41.87	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	0	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		16.77	(36)

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

Total fabric heat loss	(33) + (36) =	58.65	(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=	39.69	39.5	39.32	38.46	38.3	37.56	37.56	37.42	37.84	38.3	38.63	38.97	(38)

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

(39)m=	98.33	98.15	97.97	97.11	96.95	96.2	96.2	96.06	96.49	96.95	97.27	97.61	

Average = $Sum(39)_{1…12}$ /12= 97.11 (39)

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

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

Average = $Sum(40)_{1…12}$ /12= 1.24 (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 — 2.43 (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 — 91.92 (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=	101.12	97.44	93.76	90.09	86.41	82.73	82.73	86.41	90.09	93.76	97.44	101.12

Total = $Sum(44)_{1…12}$ = 1103.08 (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=	149.95	131.15	135.33	117.99	113.21	97.69	90.53	103.88	105.12	122.51	133.73	145.22

Total = $Sum(45)_{1…12}$ = 1446.32 (45)

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

(46)m=	22.49	19.67	20.3	17.7	16.98	14.65	13.58	15.58	15.77	18.38	20.06	21.78	(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)

DER WorkSheet: New dwelling design stage

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

Enter (50) or (54) in (55) 0 (55)

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

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

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

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

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

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

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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

(61)m=	50.96	44.85	47.78	44.43	44.03	40.8	42.16	44.03	44.43	47.78	48.05	50.96	(61)

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

(62)m=	200.91	176	183.11	162.41	157.24	138.49	132.69	147.91	149.55	170.29	181.78	196.18	(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=	200.91	176	183.11	162.41	157.24	138.49	132.69	147.91	149.55	170.29	181.78	196.18

Output from water heater (annual)$_{1...12}$ 1996.57 (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=	62.6	54.82	56.94	50.34	48.65	42.68	40.64	45.55	46.06	52.68	56.48	61.03	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	121.52	121.52	121.52	121.52	121.52	121.52	121.52	121.52	121.52	121.52	121.52	121.52	(66)

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

(67)m=	19.32	17.16	13.95	10.56	7.9	6.67	7.2	9.36	12.57	15.96	18.62	19.85	(67)

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

(68)m=	215.92	218.16	212.52	200.5	185.32	171.06	161.53	159.29	164.94	176.96	192.13	206.39	(68)

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

(69)m=	35.15	35.15	35.15	35.15	35.15	35.15	35.15	35.15	35.15	35.15	35.15	35.15	(69)

Pumps and fans gains (Table 5a)

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

DER WorkSheet: New dwelling design stage

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

(71)m=	-97.22	-97.22	-97.22	-97.22	-97.22	-97.22	-97.22	-97.22	-97.22	-97.22	-97.22	-97.22	(71)

Water heating gains (Table 5)

(72)m=	84.14	81.58	76.54	69.91	65.39	59.28	54.62	61.22	63.97	70.81	78.44	82.02	(72)

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

(73)m=	381.83	379.35	365.46	343.43	321.07	299.47	285.82	292.33	303.93	326.18	351.65	370.73	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	0.84	x	11.28	x	0.76	x	0.7	=	3.49	(75)
Northeast 0.9x	0.77	x	0.84	x	22.97	x	0.76	x	0.7	=	7.11	(75)
Northeast 0.9x	0.77	x	0.84	x	41.38	x	0.76	x	0.7	=	12.81	(75)
Northeast 0.9x	0.77	x	0.84	x	67.96	x	0.76	x	0.7	=	21.05	(75)
Northeast 0.9x	0.77	x	0.84	x	91.35	x	0.76	x	0.7	=	28.29	(75)
Northeast 0.9x	0.77	x	0.84	x	97.38	x	0.76	x	0.7	=	30.16	(75)
Northeast 0.9x	0.77	x	0.84	x	91.1	x	0.76	x	0.7	=	28.21	(75)
Northeast 0.9x	0.77	x	0.84	x	72.63	x	0.76	x	0.7	=	22.49	(75)
Northeast 0.9x	0.77	x	0.84	x	50.42	x	0.76	x	0.7	=	15.61	(75)
Northeast 0.9x	0.77	x	0.84	x	28.07	x	0.76	x	0.7	=	8.69	(75)
Northeast 0.9x	0.77	x	0.84	x	14.2	x	0.76	x	0.7	=	4.4	(75)
Northeast 0.9x	0.77	x	0.84	x	9.21	x	0.76	x	0.7	=	2.85	(75)
Southeast 0.9x	0.54	x	3.5	x	36.79	x	0.76	x	0.7	=	33.26	(77)
Southeast 0.9x	0.77	x	1.69	x	36.79	x	0.76	x	0.7	=	22.91	(77)
Southeast 0.9x	0.77	x	0.77	x	36.79	x	0.76	x	0.7	=	10.49	(77)
Southeast 0.9x	0.77	x	1.04	x	36.79	x	0.76	x	0.7	=	14.12	(77)
Southeast 0.9x	0.54	x	3.5	x	62.67	x	0.76	x	0.7	=	56.65	(77)
Southeast 0.9x	0.77	x	1.69	x	62.67	x	0.76	x	0.7	=	39.03	(77)
Southeast 0.9x	0.77	x	0.77	x	62.67	x	0.76	x	0.7	=	17.86	(77)
Southeast 0.9x	0.77	x	1.04	x	62.67	x	0.76	x	0.7	=	24.05	(77)
Southeast 0.9x	0.54	x	3.5	x	85.75	x	0.76	x	0.7	=	77.51	(77)
Southeast 0.9x	0.77	x	1.69	x	85.75	x	0.76	x	0.7	=	53.4	(77)
Southeast 0.9x	0.77	x	0.77	x	85.75	x	0.76	x	0.7	=	24.44	(77)
Southeast 0.9x	0.77	x	1.04	x	85.75	x	0.76	x	0.7	=	32.91	(77)
Southeast 0.9x	0.54	x	3.5	x	106.25	x	0.76	x	0.7	=	96.04	(77)
Southeast 0.9x	0.77	x	1.69	x	106.25	x	0.76	x	0.7	=	66.16	(77)
Southeast 0.9x	0.77	x	0.77	x	106.25	x	0.76	x	0.7	=	30.28	(77)
Southeast 0.9x	0.77	x	1.04	x	106.25	x	0.76	x	0.7	=	40.78	(77)
Southeast 0.9x	0.54	x	3.5	x	119.01	x	0.76	x	0.7	=	107.57	(77)
Southeast 0.9x	0.77	x	1.69	x	119.01	x	0.76	x	0.7	=	74.11	(77)

Southeast 0.9x	0.77	x	0.77	x	119.01	x	0.76	x	0.7	=	33.92	(77)
Southeast 0.9x	0.77	x	1.04	x	119.01	x	0.76	x	0.7	=	45.68	(77)
Southeast 0.9x	0.54	x	3.5	x	118.15	x	0.76	x	0.7	=	106.8	(77)
Southeast 0.9x	0.77	x	1.69	x	118.15	x	0.76	x	0.7	=	73.57	(77)
Southeast 0.9x	0.77	x	0.77	x	118.15	x	0.76	x	0.7	=	33.67	(77)
Southeast 0.9x	0.77	x	1.04	x	118.15	x	0.76	x	0.7	=	45.35	(77)
Southeast 0.9x	0.54	x	3.5	x	113.91	x	0.76	x	0.7	=	102.96	(77)
Southeast 0.9x	0.77	x	1.69	x	113.91	x	0.76	x	0.7	=	70.93	(77)
Southeast 0.9x	0.77	x	0.77	x	113.91	x	0.76	x	0.7	=	32.46	(77)
Southeast 0.9x	0.77	x	1.04	x	113.91	x	0.76	x	0.7	=	43.72	(77)
Southeast 0.9x	0.54	x	3.5	x	104.39	x	0.76	x	0.7	=	94.36	(77)
Southeast 0.9x	0.77	x	1.69	x	104.39	x	0.76	x	0.7	=	65	(77)
Southeast 0.9x	0.77	x	0.77	x	104.39	x	0.76	x	0.7	=	29.75	(77)
Southeast 0.9x	0.77	x	1.04	x	104.39	x	0.76	x	0.7	=	40.06	(77)
Southeast 0.9x	0.54	x	3.5	x	92.85	x	0.76	x	0.7	=	83.93	(77)
Southeast 0.9x	0.77	x	1.69	x	92.85	x	0.76	x	0.7	=	57.82	(77)
Southeast 0.9x	0.77	x	0.77	x	92.85	x	0.76	x	0.7	=	26.46	(77)
Southeast 0.9x	0.77	x	1.04	x	92.85	x	0.76	x	0.7	=	35.64	(77)
Southeast 0.9x	0.54	x	3.5	x	69.27	x	0.76	x	0.7	=	62.61	(77)
Southeast 0.9x	0.77	x	1.69	x	69.27	x	0.76	x	0.7	=	43.13	(77)
Southeast 0.9x	0.77	x	0.77	x	69.27	x	0.76	x	0.7	=	19.74	(77)
Southeast 0.9x	0.77	x	1.04	x	69.27	x	0.76	x	0.7	=	26.58	(77)
Southeast 0.9x	0.54	x	3.5	x	44.07	x	0.76	x	0.7	=	39.84	(77)
Southeast 0.9x	0.77	x	1.69	x	44.07	x	0.76	x	0.7	=	27.44	(77)
Southeast 0.9x	0.77	x	0.77	x	44.07	x	0.76	x	0.7	=	12.56	(77)
Southeast 0.9x	0.77	x	1.04	x	44.07	x	0.76	x	0.7	=	16.91	(77)
Southeast 0.9x	0.54	x	3.5	x	31.49	x	0.76	x	0.7	=	28.46	(77)
Southeast 0.9x	0.77	x	1.69	x	31.49	x	0.76	x	0.7	=	19.61	(77)
Southeast 0.9x	0.77	x	0.77	x	31.49	x	0.76	x	0.7	=	8.97	(77)
Southeast 0.9x	0.77	x	1.04	x	31.49	x	0.76	x	0.7	=	12.08	(77)
Southwest 0.9x	0.54	x	5.34	x	36.79		0.76	x	0.7	=	50.76	(79)
Southwest 0.9x	0.77	x	1.26	x	36.79		0.76	x	0.7	=	51.4	(79)
Southwest 0.9x	0.54	x	5.34	x	62.67		0.76	x	0.7	=	86.47	(79)
Southwest 0.9x	0.77	x	1.26	x	62.67		0.76	x	0.7	=	87.55	(79)
Southwest 0.9x	0.54	x	5.34	x	85.75		0.76	x	0.7	=	118.31	(79)
Southwest 0.9x	0.77	x	1.26	x	85.75		0.76	x	0.7	=	119.79	(79)
Southwest 0.9x	0.54	x	5.34	x	106.25		0.76	x	0.7	=	146.59	(79)
Southwest 0.9x	0.77	x	1.26	x	106.25		0.76	x	0.7	=	148.42	(79)
Southwest 0.9x	0.54	x	5.34	x	119.01		0.76	x	0.7	=	164.19	(79)
Southwest 0.9x	0.77	x	1.26	x	119.01		0.76	x	0.7	=	166.25	(79)
Southwest 0.9x	0.54	x	5.34	x	118.15		0.76	x	0.7	=	163	(79)

Southwest	0.9x	0.77	x	1.26	x	118.15		0.76	x	0.7	=	165.05	(79)
Southwest	0.9x	0.54	x	5.34	x	113.91		0.76	x	0.7	=	157.15	(79)
Southwest	0.9x	0.77	x	1.26	x	113.91		0.76	x	0.7	=	159.12	(79)
Southwest	0.9x	0.54	x	5.34	x	104.39		0.76	x	0.7	=	144.02	(79)
Southwest	0.9x	0.77	x	1.26	x	104.39		0.76	x	0.7	=	145.82	(79)
Southwest	0.9x	0.54	x	5.34	x	92.85		0.76	x	0.7	=	128.1	(79)
Southwest	0.9x	0.77	x	1.26	x	92.85		0.76	x	0.7	=	129.71	(79)
Southwest	0.9x	0.54	x	5.34	x	69.27		0.76	x	0.7	=	95.56	(79)
Southwest	0.9x	0.77	x	1.26	x	69.27		0.76	x	0.7	=	96.76	(79)
Southwest	0.9x	0.54	x	5.34	x	44.07		0.76	x	0.7	=	60.8	(79)
Southwest	0.9x	0.77	x	1.26	x	44.07		0.76	x	0.7	=	61.56	(79)
Southwest	0.9x	0.54	x	5.34	x	31.49		0.76	x	0.7	=	43.44	(79)
Southwest	0.9x	0.77	x	1.26	x	31.49		0.76	x	0.7	=	43.99	(79)
Northwest	0.9x	0.77	x	1.04	x	11.28	x	0.76	x	0.7	=	4.33	(81)
Northwest	0.9x	0.77	x	1.04	x	22.97	x	0.76	x	0.7	=	8.81	(81)
Northwest	0.9x	0.77	x	1.04	x	41.38	x	0.76	x	0.7	=	15.88	(81)
Northwest	0.9x	0.77	x	1.04	x	67.96	x	0.76	x	0.7	=	26.08	(81)
Northwest	0.9x	0.77	x	1.04	x	91.35	x	0.76	x	0.7	=	35.06	(81)
Northwest	0.9x	0.77	x	1.04	x	97.38	x	0.76	x	0.7	=	37.38	(81)
Northwest	0.9x	0.77	x	1.04	x	91.1	x	0.76	x	0.7	=	34.96	(81)
Northwest	0.9x	0.77	x	1.04	x	72.63	x	0.76	x	0.7	=	27.87	(81)
Northwest	0.9x	0.77	x	1.04	x	50.42	x	0.76	x	0.7	=	19.35	(81)
Northwest	0.9x	0.77	x	1.04	x	28.07	x	0.76	x	0.7	=	10.77	(81)
Northwest	0.9x	0.77	x	1.04	x	14.2	x	0.76	x	0.7	=	5.45	(81)
Northwest	0.9x	0.77	x	1.04	x	9.21	x	0.76	x	0.7	=	3.54	(81)

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

(83)m=	190.76	327.53	455.05	575.4	655.06	654.97	629.52	569.39	496.62	363.86	228.96	162.94	(83)

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

(84)m=	572.59	706.89	820.51	918.83	976.12	954.43	915.34	861.72	800.55	690.03	580.61	533.67	(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	
(86)m=	1	0.99	0.97	0.91	0.79	0.61	0.46	0.5	0.74	0.94	0.99	1	(86)

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

(87)m=	19.74	19.96	20.26	20.6	20.85	20.97	20.99	20.99	20.92	20.58	20.08	19.69	(87)

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

(88)m=	19.88	19.88	19.88	19.89	19.89	19.9	19.9	19.9	19.89	19.89	19.89	19.88	(88)

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

(89)m=	0.99	0.98	0.96	0.88	0.73	0.52	0.35	0.39	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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(90)m=	18.22	18.54	18.97	19.44	19.75	19.88	19.9	19.89	19.83	19.43	18.73	18.16		(90)

fLA = Living area ÷ (4) = 0.45 (91)

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

(92)m=	18.91	19.18	19.55	19.97	20.25	20.37	20.39	20.39	20.32	19.95	19.34	18.85	(92)

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

(93)m=	18.91	19.18	19.55	19.97	20.25	20.37	20.39	20.39	20.32	19.95	19.34	18.85	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.95	0.88	0.75	0.56	0.4	0.44	0.69	0.92	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	567.95	692.52	780.86	811.77	734.14	536.66	362.02	378.78	553.26	632.82	570.48	530.46	(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=	1436.16	1401.9	1278.89	1074.65	828.62	554.95	364.75	383.26	600.46	906.04	1190.59	1430.26	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	645.95	476.7	370.53	189.27	70.29	0	0	0	0	203.28	446.48	669.45	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 3071.96 (98)

Space heating requirement in kWh/m²/year 39.22 (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		90.3	(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)														
	645.95	476.7	370.53	189.27	70.29	0	0	0	0	203.28	446.48	669.45		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	715.34	527.91	410.33	209.6	77.84	0	0	0	0	225.12	494.44	741.37		
Total (kWh/year) =$Sum(211)_{1...5,10....12}$=													3401.95	(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)

200.91	176	183.11	162.41	157.24	138.49	132.69	147.91	149.55	170.29	181.78	196.18

Efficiency of water heater 81 (216)

(217)m=	87.91	87.59	87	85.75	83.66	81	81	81	81	85.81	87.4	88.01	(217)

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

(219)m=	228.55	200.94	210.48	189.4	187.95	170.98	163.81	182.61	184.63	198.45	208	222.91

	Total = Sum(219a)$_{1...12}$ =		2348.7	(219)
Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3401.95	
Water heating fuel used			2348.7	
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			341.11	(232)
Electricity generated by PVs			-1110.56	(233)

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	=	734.82	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	507.32	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1242.14	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	177.04	(268)
Energy saving/generation technologies Item 1		0.519	=	-576.38	(269)
Total CO2, kg/year		sum of (265)…(271) =		881.72	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		11.26	(273)
EI rating (section 14)				90	(274)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.18
Printed on 05 November 2019 at 13:23:54

Project Information:

Assessed By: Su Lee (STRO031315) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 75.47m²

Site Reference : 217 Kingston Road **Plot Reference:** Front - Unit 2

Address :

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas		
Fuel factor: 1.00 (mains gas)		
Target Carbon Dioxide Emission Rate (TER)	20.38 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	12.46 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	61.0 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	49.7 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.15 (max. 0.30)	0.15 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.20 (max. 2.00)	1.20 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	4.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system:	Boiler systems with radiators or underfloor heating - mains gas Data from manufacturer Combi boiler Efficiency 89.5 % SEDBUK2009 Minimum 88.0 %	OK
Secondary heating system:	None	

5 Cylinder insulation

Hot water Storage:	No cylinder	
		N/A

Regulations Compliance Report

6 Controls

Space heating controls	TTZC by plumbing and electrical services		**OK**
Hot water controls:	No cylinder thermostat		
	No cylinder		
Boiler interlock:	Yes		**OK**

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	**OK**

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Thames valley):	Slight	**OK**

Based on:

Overshading:	Average or unknown
Windows facing: South West	3.91m²
Windows facing: North West	3.5m²
Windows facing: North West	1.69m²
Windows facing: North West	0.77m²
Windows facing: North East	1.57m²
Windows facing: South West	2.89m²
Windows facing: South East	0.67m²
Windows facing: North West	0.67m²
Windows facing: West	0.87m²
Windows facing: South	0.87m²
Ventilation rate:	4.00
Blinds/curtains:	None

10 Key features

External Walls U-value	0.13 W/m²K
Party Walls U-value	0 W/m²K
Photovoltaic array	

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Su Lee	**Stroma Number:**	STRO031315
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.18

Property Address: Front - Unit 2

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	40.92	(1a)	x	2.6	(2a)	=	106.4	(3a)
Ground floor	34.54	(1b)	x	2.81	(2b)	=	97.07	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	75.47	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	203.47	(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							3	x 10 =	30	(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) =	30	÷ (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		4	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.35	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

DER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

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

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

0.38	0.37	0.36	0.32	0.32	0.28	0.28	0.27	0.3	0.32	0.33	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.86	x	1.2	=	2.232			(26)
Windows Type 1			3.908	x1/[1/(1.2)+ 0.04]		=	4.47			(27)
Windows Type 2			3.496	x1/[1/(1.2)+ 0.04]		=	4			(27)
Windows Type 3			1.689	x1/[1/(1.2)+ 0.04]		=	1.93			(27)
Windows Type 4			0.773	x1/[1/(1.2)+ 0.04]		=	0.89			(27)
Windows Type 5			1.57	x1/[1/(1.2)+ 0.04]		=	1.8			(27)
Windows Type 6			0.963	x1/[1/(1.2)+ 0.04]		=	1.1			(27)
Windows Type 7			0.665	x1/[1/(1.2)+ 0.04]		=	0.76			(27)
Windows Type 8			0.665	x1/[1/(1.2)+ 0.04]		=	0.76			(27)
Windows Type 9			0.87	x1/[1/(1.2)+ 0.04]		=	1			(27)
Windows Type 10			0.87	x1/[1/(1.2)+ 0.04]		=	1			(27)
Floor			40.925	x	0.13	=	5.32025			(28)
Walls Type1	17.03	0	17.03	x	0.15	=	2.56			(29)
Walls Type2	20.39	7.4	12.98	x	0.15	=	1.95			(29)
Walls Type3	45.54	11.85	33.69	x	0.15	=	5.05			(29)
Walls Type4	10.93	0	10.93	x	0.14	=	1.57			(29)
Walls Type5	7.45	0	7.45	x	0.13	=	0.98			(29)

DER WorkSheet: New dwelling design stage

Roof	8.07	0	8.07	x	0.13	=	1.05			(30)
Total area of elements, m²			150.34							(31)
Party wall			32.39	x	0	=	0			(32)
Party wall			9.04	x	0	=	0			(32)

** 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) =	40.63	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	0	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		17.64	(36)

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

Total fabric heat loss	(33) + (36) =	58.27	(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	
(38)m=	38.33	38.15	37.97	37.12	36.96	36.22	36.22	36.08	36.5	36.96	37.28	37.62	(38)

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

(39)m=	96.6	96.42	96.24	95.39	95.23	94.49	94.49	94.35	94.77	95.23	95.55	95.89	

Average = $Sum(39)_{1…12}$ /12= 95.38 (39)

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

(40)m=	1.28	1.28	1.28	1.26	1.26	1.25	1.25	1.25	1.26	1.26	1.27	1.27	

Average = $Sum(40)_{1…12}$ /12= 1.26 (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 2.37 (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 90.52 (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=	99.57	95.95	92.33	88.71	85.09	81.47	81.47	85.09	88.71	92.33	95.95	99.57	

Total = $Sum(44)_{1…12}$ = 1086.21 (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=	147.66	129.14	133.26	116.18	111.48	96.2	89.14	102.29	103.51	120.64	131.68	143	

Total = $Sum(45)_{1…12}$ = 1424.2 (45)

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

(46)m=	22.15	19.37	19.99	17.43	16.72	14.43	13.37	15.34	15.53	18.1	19.75	21.45	(46)

Water storage loss:

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

DER WorkSheet: New dwelling design stage

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)
Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):		0	(48)
Temperature factor from Table 2b		0	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	0	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0	(52)
Temperature factor from Table 2b		0	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0	(55)

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

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

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

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

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

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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

(61)m=	50.74	44.16	47.05	43.75	43.36	40.18	41.51	43.36	43.75	47.05	47.32	50.74	(61)

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

(62)m=	198.4	173.31	180.31	159.93	154.84	136.37	130.66	145.65	147.26	167.69	179	193.74	(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=	198.4	173.31	180.31	159.93	154.84	136.37	130.66	145.65	147.26	167.69	179	193.74	

Output from water heater (annual)$_{1...12}$ — 1967.16 (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=	61.78	53.98	56.07	49.57	47.91	42.03	40.02	44.85	45.35	51.87	55.61	60.23	(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=	118.56	118.56	118.56	118.56	118.56	118.56	118.56	118.56	118.56	118.56	118.56	118.56	(66)

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

(67)m=	18.74	16.64	13.53	10.25	7.66	6.47	6.99	9.08	12.19	15.48	18.07	19.26	(67)

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

(68)m=	209.71	211.89	206.4	194.73	179.99	166.14	156.89	154.71	160.2	171.87	186.61	200.46	(68)

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

(69)m=	34.86	34.86	34.86	34.86	34.86	34.86	34.86	34.86	34.86	34.86	34.86	34.86	(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=	-94.85	-94.85	-94.85	-94.85	-94.85	-94.85	-94.85	-94.85	-94.85	-94.85	-94.85	-94.85	(71)

Water heating gains (Table 5)

(72)m=	83.04	80.33	75.37	68.84	64.39	58.37	53.79	60.29	62.99	69.72	77.24	80.96	(72)

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

(73)m=	373.06	370.43	356.87	335.39	313.61	292.55	279.23	285.65	296.95	318.64	343.48	362.24	(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	1.57	x	11.28	x	0.76	x	0.7	=	6.53	(75)
Northeast	0.9x	0.77	x	1.57	x	22.97	x	0.76	x	0.7	=	13.29	(75)
Northeast	0.9x	0.77	x	1.57	x	41.38	x	0.76	x	0.7	=	23.95	(75)
Northeast	0.9x	0.77	x	1.57	x	67.96	x	0.76	x	0.7	=	39.33	(75)
Northeast	0.9x	0.77	x	1.57	x	91.35	x	0.76	x	0.7	=	52.87	(75)
Northeast	0.9x	0.77	x	1.57	x	97.38	x	0.76	x	0.7	=	56.37	(75)
Northeast	0.9x	0.77	x	1.57	x	91.1	x	0.76	x	0.7	=	52.73	(75)
Northeast	0.9x	0.77	x	1.57	x	72.63	x	0.76	x	0.7	=	42.04	(75)
Northeast	0.9x	0.77	x	1.57	x	50.42	x	0.76	x	0.7	=	29.18	(75)
Northeast	0.9x	0.77	x	1.57	x	28.07	x	0.76	x	0.7	=	16.25	(75)
Northeast	0.9x	0.77	x	1.57	x	14.2	x	0.76	x	0.7	=	8.22	(75)
Northeast	0.9x	0.77	x	1.57	x	9.21	x	0.76	x	0.7	=	5.33	(75)
Southeast	0.9x	0.77	x	0.67	x	36.79	x	0.76	x	0.7	=	9.02	(77)
Southeast	0.9x	0.77	x	0.67	x	62.67	x	0.76	x	0.7	=	15.37	(77)
Southeast	0.9x	0.77	x	0.67	x	85.75	x	0.76	x	0.7	=	21.02	(77)
Southeast	0.9x	0.77	x	0.67	x	106.25	x	0.76	x	0.7	=	26.05	(77)
Southeast	0.9x	0.77	x	0.67	x	119.01	x	0.76	x	0.7	=	29.18	(77)
Southeast	0.9x	0.77	x	0.67	x	118.15	x	0.76	x	0.7	=	28.97	(77)
Southeast	0.9x	0.77	x	0.67	x	113.91	x	0.76	x	0.7	=	27.93	(77)
Southeast	0.9x	0.77	x	0.67	x	104.39	x	0.76	x	0.7	=	25.59	(77)
Southeast	0.9x	0.77	x	0.67	x	92.85	x	0.76	x	0.7	=	22.76	(77)
Southeast	0.9x	0.77	x	0.67	x	69.27	x	0.76	x	0.7	=	16.98	(77)
Southeast	0.9x	0.77	x	0.67	x	44.07	x	0.76	x	0.7	=	10.8	(77)
Southeast	0.9x	0.77	x	0.67	x	31.49	x	0.76	x	0.7	=	7.72	(77)
South	0.9x	0.77	x	0.87	x	46.75	x	0.76	x	0.7	=	15	(78)
South	0.9x	0.77	x	0.87	x	76.57	x	0.76	x	0.7	=	24.56	(78)
South	0.9x	0.77	x	0.87	x	97.53	x	0.76	x	0.7	=	31.28	(78)
South	0.9x	0.77	x	0.87	x	110.23	x	0.76	x	0.7	=	35.36	(78)

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South	0.9x	0.77	x	0.87	x	114.87	x	0.76	x	0.7	=	36.84	(78)
South	0.9x	0.77	x	0.87	x	110.55	x	0.76	x	0.7	=	35.46	(78)
South	0.9x	0.77	x	0.87	x	108.01	x	0.76	x	0.7	=	34.64	(78)
South	0.9x	0.77	x	0.87	x	104.89	x	0.76	x	0.7	=	33.64	(78)
South	0.9x	0.77	x	0.87	x	101.89	x	0.76	x	0.7	=	32.68	(78)
South	0.9x	0.77	x	0.87	x	82.59	x	0.76	x	0.7	=	26.49	(78)
South	0.9x	0.77	x	0.87	x	55.42	x	0.76	x	0.7	=	17.77	(78)
South	0.9x	0.77	x	0.87	x	40.4	x	0.76	x	0.7	=	12.96	(78)
Southwest	0.9x	0.54	x	3.91	x	36.79		0.76	x	0.7	=	37.18	(79)
Southwest	0.9x	0.77	x	0.96	x	36.79		0.76	x	0.7	=	39.19	(79)
Southwest	0.9x	0.54	x	3.91	x	62.67		0.76	x	0.7	=	63.33	(79)
Southwest	0.9x	0.77	x	0.96	x	62.67		0.76	x	0.7	=	66.75	(79)
Southwest	0.9x	0.54	x	3.91	x	85.75		0.76	x	0.7	=	86.65	(79)
Southwest	0.9x	0.77	x	0.96	x	85.75		0.76	x	0.7	=	91.34	(79)
Southwest	0.9x	0.54	x	3.91	x	106.25		0.76	x	0.7	=	107.36	(79)
Southwest	0.9x	0.77	x	0.96	x	106.25		0.76	x	0.7	=	113.17	(79)
Southwest	0.9x	0.54	x	3.91	x	119.01		0.76	x	0.7	=	120.25	(79)
Southwest	0.9x	0.77	x	0.96	x	119.01		0.76	x	0.7	=	126.76	(79)
Southwest	0.9x	0.54	x	3.91	x	118.15		0.76	x	0.7	=	119.38	(79)
Southwest	0.9x	0.77	x	0.96	x	118.15		0.76	x	0.7	=	125.84	(79)
Southwest	0.9x	0.54	x	3.91	x	113.91		0.76	x	0.7	=	115.1	(79)
Southwest	0.9x	0.77	x	0.96	x	113.91		0.76	x	0.7	=	121.33	(79)
Southwest	0.9x	0.54	x	3.91	x	104.39		0.76	x	0.7	=	105.48	(79)
Southwest	0.9x	0.77	x	0.96	x	104.39		0.76	x	0.7	=	111.19	(79)
Southwest	0.9x	0.54	x	3.91	x	92.85		0.76	x	0.7	=	93.82	(79)
Southwest	0.9x	0.77	x	0.96	x	92.85		0.76	x	0.7	=	98.9	(79)
Southwest	0.9x	0.54	x	3.91	x	69.27		0.76	x	0.7	=	69.99	(79)
Southwest	0.9x	0.77	x	0.96	x	69.27		0.76	x	0.7	=	73.78	(79)
Southwest	0.9x	0.54	x	3.91	x	44.07		0.76	x	0.7	=	44.53	(79)
Southwest	0.9x	0.77	x	0.96	x	44.07		0.76	x	0.7	=	46.94	(79)
Southwest	0.9x	0.54	x	3.91	x	31.49		0.76	x	0.7	=	31.82	(79)
Southwest	0.9x	0.77	x	0.96	x	31.49		0.76	x	0.7	=	33.54	(79)
West	0.9x	0.77	x	0.87	x	19.64	x	0.76	x	0.7	=	6.3	(80)
West	0.9x	0.77	x	0.87	x	38.42	x	0.76	x	0.7	=	12.32	(80)
West	0.9x	0.77	x	0.87	x	63.27	x	0.76	x	0.7	=	20.29	(80)
West	0.9x	0.77	x	0.87	x	92.28	x	0.76	x	0.7	=	29.6	(80)
West	0.9x	0.77	x	0.87	x	113.09	x	0.76	x	0.7	=	36.27	(80)
West	0.9x	0.77	x	0.87	x	115.77	x	0.76	x	0.7	=	37.13	(80)
West	0.9x	0.77	x	0.87	x	110.22	x	0.76	x	0.7	=	35.35	(80)
West	0.9x	0.77	x	0.87	x	94.68	x	0.76	x	0.7	=	30.37	(80)
West	0.9x	0.77	x	0.87	x	73.59	x	0.76	x	0.7	=	23.6	(80)

DER WorkSheet: New dwelling design stage

West	0.9x	0.77	x	0.87	x	45.59	x	0.76	x	0.7	=	14.62	(80)
West	0.9x	0.77	x	0.87	x	24.49	x	0.76	x	0.7	=	7.85	(80)
West	0.9x	0.77	x	0.87	x	16.15	x	0.76	x	0.7	=	5.18	(80)
Northwest	0.9x	0.54	x	3.5	x	11.28	x	0.76	x	0.7	=	10.2	(81)
Northwest	0.9x	0.77	x	1.69	x	11.28	x	0.76	x	0.7	=	7.03	(81)
Northwest	0.9x	0.77	x	0.77	x	11.28	x	0.76	x	0.7	=	3.22	(81)
Northwest	0.9x	0.77	x	0.67	x	11.28	x	0.76	x	0.7	=	2.77	(81)
Northwest	0.9x	0.54	x	3.5	x	22.97	x	0.76	x	0.7	=	20.76	(81)
Northwest	0.9x	0.77	x	1.69	x	22.97	x	0.76	x	0.7	=	14.3	(81)
Northwest	0.9x	0.77	x	0.77	x	22.97	x	0.76	x	0.7	=	6.55	(81)
Northwest	0.9x	0.77	x	0.67	x	22.97	x	0.76	x	0.7	=	5.63	(81)
Northwest	0.9x	0.54	x	3.5	x	41.38	x	0.76	x	0.7	=	37.4	(81)
Northwest	0.9x	0.77	x	1.69	x	41.38	x	0.76	x	0.7	=	25.77	(81)
Northwest	0.9x	0.77	x	0.77	x	41.38	x	0.76	x	0.7	=	11.79	(81)
Northwest	0.9x	0.77	x	0.67	x	41.38	x	0.76	x	0.7	=	10.14	(81)
Northwest	0.9x	0.54	x	3.5	x	67.96	x	0.76	x	0.7	=	61.43	(81)
Northwest	0.9x	0.77	x	1.69	x	67.96	x	0.76	x	0.7	=	42.32	(81)
Northwest	0.9x	0.77	x	0.77	x	67.96	x	0.76	x	0.7	=	19.37	(81)
Northwest	0.9x	0.77	x	0.67	x	67.96	x	0.76	x	0.7	=	16.66	(81)
Northwest	0.9x	0.54	x	3.5	x	91.35	x	0.76	x	0.7	=	82.57	(81)
Northwest	0.9x	0.77	x	1.69	x	91.35	x	0.76	x	0.7	=	56.88	(81)
Northwest	0.9x	0.77	x	0.77	x	91.35	x	0.76	x	0.7	=	26.03	(81)
Northwest	0.9x	0.77	x	0.67	x	91.35	x	0.76	x	0.7	=	22.4	(81)
Northwest	0.9x	0.54	x	3.5	x	97.38	x	0.76	x	0.7	=	88.03	(81)
Northwest	0.9x	0.77	x	1.69	x	97.38	x	0.76	x	0.7	=	60.64	(81)
Northwest	0.9x	0.77	x	0.77	x	97.38	x	0.76	x	0.7	=	27.75	(81)
Northwest	0.9x	0.77	x	0.67	x	97.38	x	0.76	x	0.7	=	23.88	(81)
Northwest	0.9x	0.54	x	3.5	x	91.1	x	0.76	x	0.7	=	82.35	(81)
Northwest	0.9x	0.77	x	1.69	x	91.1	x	0.76	x	0.7	=	56.73	(81)
Northwest	0.9x	0.77	x	0.77	x	91.1	x	0.76	x	0.7	=	25.96	(81)
Northwest	0.9x	0.77	x	0.67	x	91.1	x	0.76	x	0.7	=	22.34	(81)
Northwest	0.9x	0.54	x	3.5	x	72.63	x	0.76	x	0.7	=	65.65	(81)
Northwest	0.9x	0.77	x	1.69	x	72.63	x	0.76	x	0.7	=	45.22	(81)
Northwest	0.9x	0.77	x	0.77	x	72.63	x	0.76	x	0.7	=	20.7	(81)
Northwest	0.9x	0.77	x	0.67	x	72.63	x	0.76	x	0.7	=	17.81	(81)
Northwest	0.9x	0.54	x	3.5	x	50.42	x	0.76	x	0.7	=	45.58	(81)
Northwest	0.9x	0.77	x	1.69	x	50.42	x	0.76	x	0.7	=	31.4	(81)
Northwest	0.9x	0.77	x	0.77	x	50.42	x	0.76	x	0.7	=	14.37	(81)
Northwest	0.9x	0.77	x	0.67	x	50.42	x	0.76	x	0.7	=	12.36	(81)
Northwest	0.9x	0.54	x	3.5	x	28.07	x	0.76	x	0.7	=	25.37	(81)
Northwest	0.9x	0.77	x	1.69	x	28.07	x	0.76	x	0.7	=	17.48	(81)

Northwest	0.9x	0.77	x	0.77	x	28.07	x	0.76	x	0.7	=	8	(81)
Northwest	0.9x	0.77	x	0.67	x	28.07	x	0.76	x	0.7	=	6.88	(81)
Northwest	0.9x	0.54	x	3.5	x	14.2	x	0.76	x	0.7	=	12.83	(81)
Northwest	0.9x	0.77	x	1.69	x	14.2	x	0.76	x	0.7	=	8.84	(81)
Northwest	0.9x	0.77	x	0.77	x	14.2	x	0.76	x	0.7	=	4.05	(81)
Northwest	0.9x	0.77	x	0.67	x	14.2	x	0.76	x	0.7	=	3.48	(81)
Northwest	0.9x	0.54	x	3.5	x	9.21	x	0.76	x	0.7	=	8.33	(81)
Northwest	0.9x	0.77	x	1.69	x	9.21	x	0.76	x	0.7	=	5.74	(81)
Northwest	0.9x	0.77	x	0.77	x	9.21	x	0.76	x	0.7	=	2.63	(81)
Northwest	0.9x	0.77	x	0.67	x	9.21	x	0.76	x	0.7	=	2.26	(81)

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

(83)m=	136.42	242.86	359.64	490.64	590.06	603.44	574.45	497.68	404.65	275.83	165.32	115.5	(83)

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

(84)m=	509.48	613.29	716.52	826.02	903.67	896	853.68	783.33	701.6	594.47	508.81	477.74	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.93	0.82	0.64	0.48	0.54	0.79	0.96	0.99	1	(86)

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

(87)m=	19.66	19.85	20.15	20.53	20.82	20.96	20.99	20.98	20.88	20.49	20	19.62	(87)

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

(88)m=	19.86	19.86	19.86	19.87	19.87	19.88	19.88	19.88	19.88	19.87	19.87	19.86	(88)

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

(89)m=	1	0.99	0.97	0.91	0.76	0.54	0.36	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=	18.08	18.37	18.81	19.34	19.7	19.85	19.88	19.87	19.79	19.29	18.59	18.03	(90)

fLA = Living area ÷ (4) = 0.47 (91)

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

(92)m=	18.82	19.06	19.44	19.89	20.23	20.37	20.4	20.39	20.3	19.85	19.25	18.78	(92)

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

(93)m=	18.82	19.06	19.44	19.89	20.23	20.37	20.4	20.39	20.3	19.85	19.25	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=	0.99	0.99	0.97	0.91	0.78	0.58	0.42	0.47	0.74	0.94	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	506.44	604.85	691.87	748.27	701.96	523.18	355.26	370.48	522.07	559.98	502.61	475.58	(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=	1402.65	1365.61	1245.06	1048.72	811.81	545.16	358.83	376.84	587.51	881.19	1160.74	1397.63	(97)

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

(98)m=	666.78	511.23	411.57	216.32	81.73	0	0	0	0	238.98	473.86	686	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3286.47 (98)

Space heating requirement in kWh/m²/year 43.55 (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		90.3	(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)	666.78	511.23	411.57	216.32	81.73	0	0	0	0	238.98	473.86	686	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	738.41	566.14	455.78	239.56	90.51	0	0	0	0	264.65	524.76	759.69	(211)

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 3639.51 (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)

198.4	173.31	180.31	159.93	154.84	136.37	130.66	145.65	147.26	167.69	179	193.74

Efficiency of water heater 81 (216)

(217)m=	87.98	87.75	87.25	86.1	83.99	81	81	81	81	86.22	87.54	88.07	(217)

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

(219)m=	225.49	197.5	206.67	185.75	184.36	168.36	161.3	179.82	181.8	194.49	204.47	219.98

Total = Sum(219a)$_{1...12}$ = 2310 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3639.51	
Water heating fuel used			2310	
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			330.91	(232)
Electricity generated by PVs			-1069.95	(233)

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	=	786.13	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	498.96	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1285.09	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	171.74	(268)
Energy saving/generation technologies Item 1			0.519	=	-555.3	(269)
Total CO2, kg/year			sum of (265)…(271) =		940.46	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		12.46	(273)
EI rating (section 14)					90	(274)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.18
Printed on 05 November 2019 at 13:23:43

Project Information:

Assessed By: Su Lee (STRO031315) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 62.93m²

Site Reference : 217 Kingston Road **Plot Reference:** Front - Unit 3

Address :

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas		
Fuel factor: 1.00 (mains gas)		
Target Carbon Dioxide Emission Rate (TER)	20.1 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	12.91 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	55.2 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	48.4 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.15 (max. 0.30)	0.15 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.20 (max. 2.00)	1.20 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	4.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system:	Boiler systems with radiators or underfloor heating - mains gas Data from manufacturer Combi boiler Efficiency 89.5 % SEDBUK2009 Minimum 88.0 %	OK
Secondary heating system:	None	

5 Cylinder insulation

Hot water Storage:	No cylinder	
		N/A

Regulations Compliance Report

6 Controls

Space heating controls	TTZC by plumbing and electrical services	**OK**
Hot water controls:	No cylinder thermostat	
	No cylinder	
Boiler interlock:	Yes	**OK**

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	**OK**

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Thames valley):	Medium	**OK**

Based on:

Overshading:	Average or unknown
Windows facing: North East	6.9m²
Windows facing: South East	3.41m²
Windows facing: South East	0.97m²
Windows facing: South East	2.41m²
Windows facing: North East	6.7m²
Ventilation rate:	4.00
Blinds/curtains:	None

10 Key features

Party Walls U-value	0 W/m²K
Photovoltaic array	

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Su Lee	**Stroma Number:**	STRO031315
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.18

Property Address: Front - Unit 3

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	33.25	(1a)	x	2.6	(2a)	=	86.45	(3a)
Ground floor	29.68	(1b)	x	2.81	(2b)	=	83.41	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.93	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	169.86	(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							3	x 10 =	30	(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) =	30	÷ (5) =	0.18	(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		4	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(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) =	0.32	(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

DER WorkSheet: New dwelling design stage

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

0.41	0.4	0.39	0.35	0.34	0.3	0.3	0.3	0.32	0.34	0.36	0.38

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	0.58	0.56	0.56	0.55	0.55	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	0.58	0.56	0.56	0.55	0.55	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			2.09	x	1.2	=	2.5116			(26)
Windows Type 1			6.9	x1/[1/(1.2)+ 0.04]		=	7.9			(27)
Windows Type 2			3.406	x1/[1/(1.2)+ 0.04]		=	3.9			(27)
Windows Type 3			0.967	x1/[1/(1.2)+ 0.04]		=	1.11			(27)
Windows Type 4			2.408	x1/[1/(1.2)+ 0.04]		=	2.76			(27)
Windows Type 5			6.7	x1/[1/(1.2)+ 0.04]		=	7.67			(27)
Floor			33.25	x	0.13	=	4.3225			(28)
Walls Type1	12.13	0	12.13	x	0.15	=	1.82			(29)
Walls Type2	21.13	10.31	10.83	x	0.15	=	1.62			(29)
Walls Type3	31.18	12.17	19.02	x	0.15	=	2.85			(29)
Roof Type1	1.8	0	1.8	x	0.13	=	0.23			(30)
Roof Type2	5.26	0	5.26	x	0.13	=	0.68			(30)
Total area of elements, m²			104.76							(31)
Party wall			33.28	x	0	=	0			(32)
Party wall			34.51	x	0	=	0			(32)

** 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) = 37.38 (33)

DER WorkSheet: New dwelling design stage

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 0 (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 12.72 (36)

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

Total fabric heat loss (33) + (36) = 50.1 (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=	32.7	32.52	32.34	31.5	31.35	30.62	30.62	30.49	30.9	31.35	31.66	31.99	(38)

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

(39)m=	82.8	82.62	82.44	81.61	81.45	80.72	80.72	80.59	81	81.45	81.77	82.1	

Average = Sum(39)$_{1…12}$ /12= 81.61 (39)

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

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

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 2.06 (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 83.2 (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=	91.52	88.2	84.87	81.54	78.21	74.88	74.88	78.21	81.54	84.87	88.2	91.52	

Total = Sum(44)$_{1…12}$ = 998.44 (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=	135.73	118.71	122.5	106.79	102.47	88.43	81.94	94.03	95.15	110.89	121.04	131.44	

Total = Sum(45)$_{1…12}$ = 1309.11 (45)

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

(46)m=	20.36	17.81	18.37	16.02	15.37	13.26	12.29	14.1	14.27	16.63	18.16	19.72	(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:

DER WorkSheet: New dwelling design stage

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=	46.64	40.59	43.25	40.21	39.86	36.93	38.16	39.86	40.21	43.25	43.49	46.64	(61)

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

(62)m=	182.37	159.3	165.74	147.01	142.33	125.35	120.1	133.88	135.36	154.13	164.54	178.08	(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=	182.37	159.3	165.74	147.01	142.33	125.35	120.1	133.88	135.36	154.13	164.54	178.08	

Output from water heater (annual)$_{1...12}$ — 1808.19 (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=	56.79	49.62	51.54	45.56	44.04	38.63	36.78	41.23	41.69	47.68	51.12	55.36	(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=	103.16	103.16	103.16	103.16	103.16	103.16	103.16	103.16	103.16	103.16	103.16	103.16	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	16.07	14.28	11.61	8.79	6.57	5.55	5.99	7.79	10.46	13.28	15.5	16.52	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	180.28	182.15	177.44	167.4	154.74	142.83	134.87	133	137.72	147.75	160.42	172.33	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.32	33.32	33.32	33.32	33.32	33.32	33.32	33.32	33.32	33.32	33.32	33.32	(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=	-82.53	-82.53	-82.53	-82.53	-82.53	-82.53	-82.53	-82.53	-82.53	-82.53	-82.53	-82.53	(71)
Water heating gains (Table 5)													
(72)m=	76.33	73.84	69.28	63.28	59.19	53.66	49.44	55.41	57.9	64.09	71	74.42	(72)

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

(73)m=	329.63	327.22	315.28	296.42	277.44	258.98	247.26	253.16	263.03	282.07	303.87	320.21	(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	0.54	x	6.9	x	11.28	x	0.76	x	0.7	=	20.13	(75)
Northeast 0.9x	0.77	x	6.7	x	11.28	x	0.76	x	0.7	=	27.87	(75)
Northeast 0.9x	0.54	x	6.9	x	22.97	x	0.76	x	0.7	=	40.97	(75)
Northeast 0.9x	0.77	x	6.7	x	22.97	x	0.76	x	0.7	=	56.73	(75)
Northeast 0.9x	0.54	x	6.9	x	41.38	x	0.76	x	0.7	=	73.82	(75)
Northeast 0.9x	0.77	x	6.7	x	41.38	x	0.76	x	0.7	=	102.21	(75)
Northeast 0.9x	0.54	x	6.9	x	67.96	x	0.76	x	0.7	=	121.23	(75)
Northeast 0.9x	0.77	x	6.7	x	67.96	x	0.76	x	0.7	=	167.86	(75)
Northeast 0.9x	0.54	x	6.9	x	91.35	x	0.76	x	0.7	=	162.96	(75)
Northeast 0.9x	0.77	x	6.7	x	91.35	x	0.76	x	0.7	=	225.64	(75)
Northeast 0.9x	0.54	x	6.9	x	97.38	x	0.76	x	0.7	=	173.73	(75)
Northeast 0.9x	0.77	x	6.7	x	97.38	x	0.76	x	0.7	=	240.55	(75)
Northeast 0.9x	0.54	x	6.9	x	91.1	x	0.76	x	0.7	=	162.53	(75)
Northeast 0.9x	0.77	x	6.7	x	91.1	x	0.76	x	0.7	=	225.03	(75)
Northeast 0.9x	0.54	x	6.9	x	72.63	x	0.76	x	0.7	=	129.57	(75)
Northeast 0.9x	0.77	x	6.7	x	72.63	x	0.76	x	0.7	=	179.4	(75)
Northeast 0.9x	0.54	x	6.9	x	50.42	x	0.76	x	0.7	=	89.95	(75)
Northeast 0.9x	0.77	x	6.7	x	50.42	x	0.76	x	0.7	=	124.55	(75)
Northeast 0.9x	0.54	x	6.9	x	28.07	x	0.76	x	0.7	=	50.07	(75)
Northeast 0.9x	0.77	x	6.7	x	28.07	x	0.76	x	0.7	=	69.33	(75)
Northeast 0.9x	0.54	x	6.9	x	14.2	x	0.76	x	0.7	=	25.33	(75)
Northeast 0.9x	0.77	x	6.7	x	14.2	x	0.76	x	0.7	=	35.07	(75)
Northeast 0.9x	0.54	x	6.9	x	9.21	x	0.76	x	0.7	=	16.44	(75)
Northeast 0.9x	0.77	x	6.7	x	9.21	x	0.76	x	0.7	=	22.76	(75)
Southeast 0.9x	0.54	x	3.41	x	36.79	x	0.76	x	0.7	=	32.4	(77)
Southeast 0.9x	0.77	x	0.97	x	36.79	x	0.76	x	0.7	=	13.12	(77)
Southeast 0.9x	0.77	x	2.41	x	36.79	x	0.76	x	0.7	=	32.66	(77)
Southeast 0.9x	0.54	x	3.41	x	62.67	x	0.76	x	0.7	=	55.19	(77)
Southeast 0.9x	0.77	x	0.97	x	62.67	x	0.76	x	0.7	=	22.34	(77)
Southeast 0.9x	0.77	x	2.41	x	62.67	x	0.76	x	0.7	=	55.64	(77)
Southeast 0.9x	0.54	x	3.41	x	85.75	x	0.76	x	0.7	=	75.52	(77)
Southeast 0.9x	0.77	x	0.97	x	85.75	x	0.76	x	0.7	=	30.57	(77)
Southeast 0.9x	0.77	x	2.41	x	85.75	x	0.76	x	0.7	=	76.13	(77)
Southeast 0.9x	0.54	x	3.41	x	106.25	x	0.76	x	0.7	=	93.57	(77)

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Southeast 0.9x	0.77	x	0.97	x	106.25	x	0.76	x	0.7	=	37.88	(77)
Southeast 0.9x	0.77	x	2.41	x	106.25	x	0.76	x	0.7	=	94.33	(77)
Southeast 0.9x	0.54	x	3.41	x	119.01	x	0.76	x	0.7	=	104.8	(77)
Southeast 0.9x	0.77	x	0.97	x	119.01	x	0.76	x	0.7	=	42.43	(77)
Southeast 0.9x	0.77	x	2.41	x	119.01	x	0.76	x	0.7	=	105.65	(77)
Southeast 0.9x	0.54	x	3.41	x	118.15	x	0.76	x	0.7	=	104.05	(77)
Southeast 0.9x	0.77	x	0.97	x	118.15	x	0.76	x	0.7	=	42.12	(77)
Southeast 0.9x	0.77	x	2.41	x	118.15	x	0.76	x	0.7	=	104.89	(77)
Southeast 0.9x	0.54	x	3.41	x	113.91	x	0.76	x	0.7	=	100.31	(77)
Southeast 0.9x	0.77	x	0.97	x	113.91	x	0.76	x	0.7	=	40.61	(77)
Southeast 0.9x	0.77	x	2.41	x	113.91	x	0.76	x	0.7	=	101.13	(77)
Southeast 0.9x	0.54	x	3.41	x	104.39	x	0.76	x	0.7	=	91.93	(77)
Southeast 0.9x	0.77	x	0.97	x	104.39	x	0.76	x	0.7	=	37.22	(77)
Southeast 0.9x	0.77	x	2.41	x	104.39	x	0.76	x	0.7	=	92.67	(77)
Southeast 0.9x	0.54	x	3.41	x	92.85	x	0.76	x	0.7	=	81.77	(77)
Southeast 0.9x	0.77	x	0.97	x	92.85	x	0.76	x	0.7	=	33.1	(77)
Southeast 0.9x	0.77	x	2.41	x	92.85	x	0.76	x	0.7	=	82.43	(77)
Southeast 0.9x	0.54	x	3.41	x	69.27	x	0.76	x	0.7	=	61	(77)
Southeast 0.9x	0.77	x	0.97	x	69.27	x	0.76	x	0.7	=	24.69	(77)
Southeast 0.9x	0.77	x	2.41	x	69.27	x	0.76	x	0.7	=	61.49	(77)
Southeast 0.9x	0.54	x	3.41	x	44.07	x	0.76	x	0.7	=	38.81	(77)
Southeast 0.9x	0.77	x	0.97	x	44.07	x	0.76	x	0.7	=	15.71	(77)
Southeast 0.9x	0.77	x	2.41	x	44.07	x	0.76	x	0.7	=	39.12	(77)
Southeast 0.9x	0.54	x	3.41	x	31.49	x	0.76	x	0.7	=	27.73	(77)
Southeast 0.9x	0.77	x	0.97	x	31.49	x	0.76	x	0.7	=	11.23	(77)
Southeast 0.9x	0.77	x	2.41	x	31.49	x	0.76	x	0.7	=	27.95	(77)

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

(83)m=	126.18	230.88	358.25	514.87	641.49	665.35	629.6	530.79	411.8	266.59	154.04	106.11	(83)

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

(84)m=	455.82	558.1	673.52	811.29	918.93	924.33	876.86	783.94	674.82	548.66	457.91	426.32	(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	0.89	0.73	0.54	0.4	0.46	0.74	0.95	0.99	1	(86)

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

(87)m=	19.65	19.87	20.21	20.62	20.88	20.98	21	20.99	20.91	20.52	20.01	19.61	(87)

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

(88)m=	19.83	19.83	19.83	19.84	19.85	19.85	19.85	19.86	19.85	19.85	19.84	19.84	(88)

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

(89)m=	0.99	0.98	0.95	0.86	0.67	0.45	0.3	0.35	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=	18.06	18.38	18.86	19.42	19.74	19.84	19.85	19.85	19.79	19.32	18.59	18.01	(90)

fLA = Living area ÷ (4) = 0.45 (91)

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

(92)m=	18.78	19.05	19.47	19.96	20.25	20.35	20.37	20.37	20.29	19.86	19.23	18.73	(92)

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

(93)m=	18.78	19.05	19.47	19.96	20.25	20.35	20.37	20.37	20.29	19.86	19.23	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=	0.99	0.98	0.95	0.86	0.69	0.49	0.35	0.4	0.68	0.92	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	452.23	547.66	640.31	698.77	636.36	454.5	302.66	316.59	461	506.74	450.56	423.77	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1198.95	1169.23	1069.38	902.63	696.68	464.39	304.17	319.62	501.68	754.47	991.59	1193.19	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	555.56	417.69	319.23	146.78	44.88	0	0	0	0	184.32	389.54	572.44	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2630.44 (98)

Space heating requirement in kWh/m²/year 41.8 (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		90.3	(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)													
	555.56	417.69	319.23	146.78	44.88	0	0	0	0	184.32	389.54	572.44	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	615.24	462.56	353.52	162.55	49.7	0	0	0	0	204.12	431.39	633.93	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2913 (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)

182.37	159.3	165.74	147.01	142.33	125.35	120.1	133.88	135.36	154.13	164.54	178.08

Efficiency of water heater 81 (216)

(217)m=	87.81	87.53	86.89	85.39	83.05	81	81	81	81	85.81	87.32	87.91	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	207.69	182.01	190.75	172.15	171.37	154.76	148.27	165.29	167.11	179.62	188.42	202.59	

Total = $Sum(219a)_{1...12}$ = 2130.01 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2913	
Water heating fuel used			2130.01	
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			283.84	(232)
Electricity generated by PVs			-892.25	(233)

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	=	629.21	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	460.08	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1089.29	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	147.32	(268)
Energy saving/generation technologies Item 1		0.519	=	-463.08	(269)
Total CO2, kg/year		sum of (265)…(271) =		812.45	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		12.91	(273)
EI rating (section 14)				90	(274)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.18
Printed on 05 November 2019 at 13:23:32

Project Information:

Assessed By: Su Lee (STRO031315) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 62.42m²

Site Reference : 217 Kingston Road **Plot Reference:** Front - Unit 4

Address :

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas
Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER)	21.55 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	14.49 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	62.2 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	54.2 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.15 (max. 0.30)	0.15 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.20 (max. 2.00)	1.20 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	4.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system:	Boiler systems with radiators or underfloor heating - mains gas Data from manufacturer Combi boiler Efficiency 89.5 % SEDBUK2009 Minimum 88.0 %	OK
Secondary heating system:	None	

5 Cylinder insulation

Hot water Storage:	No cylinder	N/A

Regulations Compliance Report

6 Controls

Space heating controls	TTZC by plumbing and electrical services	**OK**
Hot water controls:	No cylinder thermostat	
	No cylinder	
Boiler interlock:	Yes	**OK**

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	**OK**

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Thames valley):	Slight	**OK**

Based on:

Overshading:	Average or unknown
Windows facing: North East	6.9m²
Windows facing: North West	3.41m²
Windows facing: North West	0.97m²
Windows facing: North East	6.9m²
Ventilation rate:	4.00
Blinds/curtains:	None

10 Key features

External Walls U-value	0.13 W/m²K
Party Walls U-value	0 W/m²K
Photovoltaic array	

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Su Lee	**Stroma Number:**	STRO031315
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.18

Property Address: Front - Unit 4

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	35.14	(1a)	x	2.6	(2a)	=	91.37	(3a)
Ground floor	27.28	(1b)	x	2.81	(2b)	=	76.67	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.42	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	168.03	(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							3	x 10 =	30	(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) =	30	÷ (5) =	0.18	(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		4	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(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) =	0.32	(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

DER WorkSheet: New dwelling design stage

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

0.41	0.4	0.39	0.35	0.35	0.31	0.31	0.3	0.32	0.35	0.36	0.38

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

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

(25)m=	0.58	0.58	0.58	0.56	0.56	0.55	0.55	0.54	0.55	0.56	0.57	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			2.09	x	1.2	=	2.5116			(26)
Windows Type 1			6.9	x1/[1/(1.2)+ 0.04]		=	7.9			(27)
Windows Type 2			3.406	x1/[1/(1.2)+ 0.04]		=	3.9			(27)
Windows Type 3			0.966	x1/[1/(1.2)+ 0.04]		=	1.11			(27)
Windows Type 4			6.9	x1/[1/(1.2)+ 0.04]		=	7.9			(27)
Floor			35.141	x	0.13	=	4.56833			(28)
Walls Type1	12.14	0	12.14	x	0.15	=	1.82			(29)
Walls Type2	21.14	10.31	10.83	x	0.15	=	1.62			(29)
Walls Type3	30.22	9.96	20.26	x	0.15	=	3.04			(29)
Walls Type4	3.16	0	3.16	x	0.13	=	0.42			(29)
Roof Type1	6.5	0	6.5	x	0.13	=	0.85			(30)
Roof Type2	4.82	0	4.82	x	0.13	=	0.63			(30)
Total area of elements, m²			113.12							(31)
Party wall			33.28	x	0	=	0			(32)
Party wall			28.11	x	0	=	0			(32)

** 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) = 36.26 (33)

DER WorkSheet: New dwelling design stage

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = | 0 | (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K | 14.06 | (36)

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

Total fabric heat loss (33) + (36) = | 50.32 | (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	32.39	32.21	32.03	31.2	31.04	30.32	30.32	30.18	30.6	31.04	31.36	31.69	(38)

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

(39)m=	82.71	82.53	82.35	81.52	81.36	80.63	80.63	80.5	80.91	81.36	81.68	82.01	

Average = $Sum(39)_{1…12}$ /12= | 81.52 | (39)

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

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

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 | 2.05 | (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 | 82.87 | (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=	91.16	87.84	84.53	81.21	77.9	74.58	74.58	77.9	81.21	84.53	87.84	91.16

Total = $Sum(44)_{1…12}$ = | 994.45 | (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=	135.18	118.23	122.01	106.37	102.06	88.07	81.61	93.65	94.77	110.44	120.56	130.92

Total = $Sum(45)_{1…12}$ = | 1303.88 | (45)

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

(46)m=	20.28	17.74	18.3	15.96	15.31	13.21	12.24	14.05	14.22	16.57	18.08	19.64	(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:

DER WorkSheet: New dwelling design stage

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=	46.45	40.43	43.07	40.05	39.7	36.78	38.01	39.7	40.05	43.07	43.32	46.45	(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=	181.64	158.67	165.08	146.42	141.76	124.85	119.62	133.35	134.82	153.52	163.88	177.37	(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=	181.64	158.67	165.08	146.42	141.76	124.85	119.62	133.35	134.82	153.52	163.88	177.37	

Output from water heater (annual)$_{1...12}$ — 1800.97 (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=	56.56	49.42	51.34	45.38	43.86	38.48	36.64	41.06	41.52	47.49	50.92	55.14	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	102.47	102.47	102.47	102.47	102.47	102.47	102.47	102.47	102.47	102.47	102.47	102.47	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	15.96	14.18	11.53	8.73	6.52	5.51	5.95	7.74	10.38	13.18	15.39	16.4	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	179.02	180.88	176.2	166.23	153.65	141.83	133.93	132.07	136.75	146.72	159.3	171.12	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.25	33.25	33.25	33.25	33.25	33.25	33.25	33.25	33.25	33.25	33.25	33.25	(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=	-81.97	-81.97	-81.97	-81.97	-81.97	-81.97	-81.97	-81.97	-81.97	-81.97	-81.97	-81.97	(71)
Water heating gains (Table 5)													
(72)m=	76.02	73.54	69	63.03	58.95	53.44	49.24	55.19	57.67	63.83	70.72	74.12	(72)

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

(73)m=	327.74	325.33	313.46	294.72	275.86	257.52	245.86	251.74	261.54	280.47	302.14	318.38	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.54	x	6.9	x	11.28	x	0.76	x	0.7	=	20.13	(75)
Northeast 0.9x	0.77	x	6.9	x	11.28	x	0.76	x	0.7	=	28.7	(75)
Northeast 0.9x	0.54	x	6.9	x	22.97	x	0.76	x	0.7	=	40.97	(75)
Northeast 0.9x	0.77	x	6.9	x	22.97	x	0.76	x	0.7	=	58.42	(75)
Northeast 0.9x	0.54	x	6.9	x	41.38	x	0.76	x	0.7	=	73.82	(75)
Northeast 0.9x	0.77	x	6.9	x	41.38	x	0.76	x	0.7	=	105.26	(75)
Northeast 0.9x	0.54	x	6.9	x	67.96	x	0.76	x	0.7	=	121.23	(75)
Northeast 0.9x	0.77	x	6.9	x	67.96	x	0.76	x	0.7	=	172.87	(75)
Northeast 0.9x	0.54	x	6.9	x	91.35	x	0.76	x	0.7	=	162.96	(75)
Northeast 0.9x	0.77	x	6.9	x	91.35	x	0.76	x	0.7	=	232.37	(75)
Northeast 0.9x	0.54	x	6.9	x	97.38	x	0.76	x	0.7	=	173.73	(75)
Northeast 0.9x	0.77	x	6.9	x	97.38	x	0.76	x	0.7	=	247.73	(75)
Northeast 0.9x	0.54	x	6.9	x	91.1	x	0.76	x	0.7	=	162.53	(75)
Northeast 0.9x	0.77	x	6.9	x	91.1	x	0.76	x	0.7	=	231.75	(75)
Northeast 0.9x	0.54	x	6.9	x	72.63	x	0.76	x	0.7	=	129.57	(75)
Northeast 0.9x	0.77	x	6.9	x	72.63	x	0.76	x	0.7	=	184.75	(75)
Northeast 0.9x	0.54	x	6.9	x	50.42	x	0.76	x	0.7	=	89.95	(75)
Northeast 0.9x	0.77	x	6.9	x	50.42	x	0.76	x	0.7	=	128.26	(75)
Northeast 0.9x	0.54	x	6.9	x	28.07	x	0.76	x	0.7	=	50.07	(75)
Northeast 0.9x	0.77	x	6.9	x	28.07	x	0.76	x	0.7	=	71.4	(75)
Northeast 0.9x	0.54	x	6.9	x	14.2	x	0.76	x	0.7	=	25.33	(75)
Northeast 0.9x	0.77	x	6.9	x	14.2	x	0.76	x	0.7	=	36.11	(75)
Northeast 0.9x	0.54	x	6.9	x	9.21	x	0.76	x	0.7	=	16.44	(75)
Northeast 0.9x	0.77	x	6.9	x	9.21	x	0.76	x	0.7	=	23.44	(75)
Northwest 0.9x	0.54	x	3.41	x	11.28	x	0.76	x	0.7	=	9.94	(81)
Northwest 0.9x	0.77	x	0.97	x	11.28	x	0.76	x	0.7	=	4.02	(81)
Northwest 0.9x	0.54	x	3.41	x	22.97	x	0.76	x	0.7	=	20.23	(81)
Northwest 0.9x	0.77	x	0.97	x	22.97	x	0.76	x	0.7	=	8.18	(81)
Northwest 0.9x	0.54	x	3.41	x	41.38	x	0.76	x	0.7	=	36.44	(81)
Northwest 0.9x	0.77	x	0.97	x	41.38	x	0.76	x	0.7	=	14.74	(81)
Northwest 0.9x	0.54	x	3.41	x	67.96	x	0.76	x	0.7	=	59.84	(81)
Northwest 0.9x	0.77	x	0.97	x	67.96	x	0.76	x	0.7	=	24.2	(81)
Northwest 0.9x	0.54	x	3.41	x	91.35	x	0.76	x	0.7	=	80.44	(81)
Northwest 0.9x	0.77	x	0.97	x	91.35	x	0.76	x	0.7	=	32.53	(81)

Northwest	0.9x	0.54	x	3.41	x	97.38	x	0.76	x	0.7	=	85.76	(81)
Northwest	0.9x	0.77	x	0.97	x	97.38	x	0.76	x	0.7	=	34.68	(81)
Northwest	0.9x	0.54	x	3.41	x	91.1	x	0.76	x	0.7	=	80.23	(81)
Northwest	0.9x	0.77	x	0.97	x	91.1	x	0.76	x	0.7	=	32.44	(81)
Northwest	0.9x	0.54	x	3.41	x	72.63	x	0.76	x	0.7	=	63.96	(81)
Northwest	0.9x	0.77	x	0.97	x	72.63	x	0.76	x	0.7	=	25.87	(81)
Northwest	0.9x	0.54	x	3.41	x	50.42	x	0.76	x	0.7	=	44.4	(81)
Northwest	0.9x	0.77	x	0.97	x	50.42	x	0.76	x	0.7	=	17.96	(81)
Northwest	0.9x	0.54	x	3.41	x	28.07	x	0.76	x	0.7	=	24.72	(81)
Northwest	0.9x	0.77	x	0.97	x	28.07	x	0.76	x	0.7	=	10	(81)
Northwest	0.9x	0.54	x	3.41	x	14.2	x	0.76	x	0.7	=	12.5	(81)
Northwest	0.9x	0.77	x	0.97	x	14.2	x	0.76	x	0.7	=	5.06	(81)
Northwest	0.9x	0.54	x	3.41	x	9.21	x	0.76	x	0.7	=	8.11	(81)
Northwest	0.9x	0.77	x	0.97	x	9.21	x	0.76	x	0.7	=	3.28	(81)

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

(83)m=	62.79	127.8	230.26	378.15	508.31	541.91	506.95	404.14	280.57	156.18	79	51.27	(83)

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

(84)m=	390.53	453.14	543.72	672.87	784.17	799.43	752.81	655.88	542.12	436.66	381.14	369.65	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.94	0.8	0.61	0.46	0.55	0.83	0.98	1	1	(86)

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

(87)m=	19.55	19.72	20.04	20.48	20.82	20.96	20.99	20.98	20.84	20.39	19.89	19.53	(87)

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

(88)m=	19.82	19.82	19.83	19.84	19.84	19.85	19.85	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	0.91	0.74	0.52	0.35	0.42	0.75	0.96	0.99	1	(89)

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

(90)m=	17.91	18.15	18.62	19.24	19.67	19.82	19.84	19.84	19.72	19.13	18.42	17.88	(90)

fLA = Living area ÷ (4) = 0.48 (91)

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

(92)m=	18.71	18.91	19.31	19.84	20.23	20.37	20.4	20.4	20.27	19.74	19.13	18.68	(92)

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

(93)m=	18.71	18.91	19.31	19.84	20.23	20.37	20.4	20.4	20.27	19.74	19.13	18.68	(93)

8. Space heating requirement

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

Utilisation factor for gains, hm:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m=	1	0.99	0.97	0.91	0.77	0.56	0.4	0.48	0.78	0.96	0.99	1	(94)

DER WorkSheet: New dwelling design stage

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	388.78	449.05	530.09	614.82	600.91	448.49	303.48	315.26	425.47	419.79	377.95	368.35	(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=	1191.67	1156.46	1054.6	891.99	693.69	465.65	306.45	321.6	498.87	743.45	982.88	1187.17	(97)

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

(98)m=	597.35	475.38	390.24	199.57	69.02	0	0	0	0	240.8	435.54	609.2

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3017.1 (98)

Space heating requirement in kWh/m²/year 48.33 (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		90.3	(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)	597.35	475.38	390.24	199.57	69.02	0	0	0	0	240.8	435.54	609.2	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	661.52	526.44	432.16	221	76.44	0	0	0	0	266.67	482.33	674.64	(211)

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 3341.2 (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)

	181.64	158.67	165.08	146.42	141.76	124.85	119.62	133.35	134.82	153.52	163.88	177.37	

Efficiency of water heater 81 (216)

(217)m=	87.95	87.78	87.32	86.12	83.83	81	81	81	81	86.44	87.55	88.02	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	206.53	180.76	189.05	170.03	169.11	154.14	147.68	164.63	166.44	177.61	187.18	201.51

Total = Sum(219a)$_{1...12}$ = 2114.67 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		3341.2	
Water heating fuel used		2114.67	
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		281.85	(232)
Electricity generated by PVs		-885.02	(233)

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	=	721.7	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	456.77	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1178.47	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	146.28	(268)
Energy saving/generation technologies Item 1		0.519	=	-459.33	(269)
Total CO2, kg/year		sum of (265)…(271) =		904.35	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		14.49	(273)
EI rating (section 14)				89	(274)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.18
Printed on 05 November 2019 at 13:23:22

Project Information:

Assessed By: Su Lee (STRO031315) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 61.99m²

Site Reference : 217 Kingston Road **Plot Reference:** Front - Unit 5

Address :

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas		
Fuel factor: 1.00 (mains gas)		
Target Carbon Dioxide Emission Rate (TER)	21.47 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	13.52 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	62.2 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	52.1 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.15 (max. 0.30)	0.15 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.20 (max. 2.00)	1.20 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	4.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system:	Boiler systems with radiators or underfloor heating - mains gas Data from manufacturer Combi boiler Efficiency 89.5 % SEDBUK2009 Minimum 88.0 %	OK
Secondary heating system:	None	

5 Cylinder insulation

Hot water Storage:	No cylinder	
		N/A

Regulations Compliance Report

6 Controls

Space heating controls	TTZC by plumbing and electrical services	OK
Hot water controls:	No cylinder thermostat	
	No cylinder	
Boiler interlock:	Yes	OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	OK

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Thames valley):	High	Fail

Based on:

Overshading:	Average or unknown
Windows facing: North East	8.8m²
Windows facing: South East	4.63m²
Windows facing: South East	0.97m²
Windows facing: South East	0.77m²
Windows facing: North East	0.85m²
Windows facing: South East	1.69m²
Windows facing: South East	0.97m²
Windows facing: North West	0.97m²
Windows facing: South West	3.55m²
Windows facing: South	1.08m²
Windows facing: West	1.08m²
Ventilation rate:	3.00
Blinds/curtains:	None

10 Key features

External Walls U-value	0.13 W/m²K
Party Walls U-value	0 W/m²K
Photovoltaic array	

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Su Lee	**Stroma Number:**	STRO031315
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.18

Property Address: Front - Unit 5

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	61.99	(1a)	x	2.56	(2a)	=	158.38	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	61.99	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			158.38	(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							3	x 10 =	30	(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) =	30	÷ (5) =	0.19	(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		4	(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		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.36	(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

0.46	0.45	0.44	0.4	0.39	0.34	0.34	0.33	0.36	0.39	0.41	0.42

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=	0.61	0.6	0.6	0.58	0.57	0.56	0.56	0.56	0.56	0.57	0.58	0.59	(24d)

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

(25)m=	0.61	0.6	0.6	0.58	0.57	0.56	0.56	0.56	0.56	0.57	0.58	0.59	(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			1.86	x	1.2	=	2.232			(26)
Windows Type 1			8.8	x1/[1/(1.2)+ 0.04]		=	10.08			(27)
Windows Type 2			4.627	x1/[1/(1.2)+ 0.04]		=	5.3			(27)
Windows Type 3			0.966	x1/[1/(1.2)+ 0.04]		=	1.11			(27)
Windows Type 4			0.773	x1/[1/(1.2)+ 0.04]		=	0.89			(27)
Windows Type 5			0.85	x1/[1/(1.2)+ 0.04]		=	0.97			(27)
Windows Type 6			1.689	x1/[1/(1.2)+ 0.04]		=	1.93			(27)
Windows Type 7			0.967	x1/[1/(1.2)+ 0.04]		=	1.11			(27)
Windows Type 8			0.967	x1/[1/(1.2)+ 0.04]		=	1.11			(27)
Windows Type 9			1.182	x1/[1/(1.2)+ 0.04]		=	1.35			(27)
Windows Type 10			1.08	x1/[1/(1.2)+ 0.04]		=	1.24			(27)
Windows Type 11			1.08	x1/[1/(1.2)+ 0.04]		=	1.24			(27)
Floor Type 1			0.777	x	0.13	=	0.10101			(28)
Floor Type 2			3.701	x	0.13	=	0.48113			(28)
Walls Type1	71.85	25.35	46.51	x	0.15	=	6.98			(29)
Walls Type2	3.8	1.86	1.94	x	0.14	=	0.27			(29)
Walls Type3	9.98	0	9.98	x	0.13	=	1.32			(29)
Roof Type1	12.72	0	12.72	x	0.13	=	1.65			(30)
Roof Type2	9.99	0	9.99	x	0.13	=	1.3			(30)

DER WorkSheet: New dwelling design stage

Roof Type3	15.32	0	15.32	x	0.13	=	1.99			(30)
Total area of elements, m²			128.14							(31)
Party wall			30.05	x	0	=	0			(32)

** 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) = 45.35 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 0 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 16.97 (36)

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

Total fabric heat loss (33) + (36) = 62.32 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	31.65	31.43	31.22	30.24	30.05	29.19	29.19	29.03	29.52	30.05	30.42	30.81	(38)

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

(39)m=	93.96	93.75	93.54	92.55	92.37	91.51	91.51	91.35	91.84	92.37	92.74	93.13	

Average = Sum(39)$_{1…12}$ /12= 92.55 (39)

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

(40)m=	1.52	1.51	1.51	1.49	1.49	1.48	1.48	1.47	1.48	1.49	1.5	1.5	

Average = Sum(40)$_{1…12}$ /12= 1.49 (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 2.04 (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 82.59 (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=	90.84	87.54	84.24	80.93	77.63	74.33	74.33	77.63	80.93	84.24	87.54	90.84

Total = Sum(44)$_{1…12}$ = 991.03 (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=	134.72	117.83	121.59	106	101.71	87.77	81.33	93.33	94.44	110.06	120.14	130.47

Total = Sum(45)$_{1…12}$ = 1299.4 (45)

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

(46)m=	20.21	17.67	18.24	15.9	15.26	13.17	12.2	14	14.17	16.51	18.02	19.57	(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)

DER WorkSheet: New dwelling design stage

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=	46.29	40.29	42.93	39.91	39.56	36.65	37.88	39.56	39.91	42.93	43.17	46.29	(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=	181.01	158.12	164.51	145.92	141.27	124.42	119.21	132.89	134.36	152.99	163.32	176.76	(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=	181.01	158.12	164.51	145.92	141.27	124.42	119.21	132.89	134.36	152.99	163.32	176.76

Output from water heater (annual)$_{1...12}$ — 1794.78 (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=	56.37	49.25	51.16	45.22	43.71	38.35	36.51	40.92	41.38	47.33	50.74	54.95	(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=	101.87	101.87	101.87	101.87	101.87	101.87	101.87	101.87	101.87	101.87	101.87	101.87	(66)

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

(67)m=	15.86	14.09	11.46	8.67	6.48	5.47	5.92	7.69	10.32	13.1	15.29	16.3	(67)

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

(68)m=	177.94	179.78	175.13	165.22	152.72	140.97	133.12	131.27	135.92	145.83	158.33	170.09	(68)

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

(69)m=	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	(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=	-81.49	-81.49	-81.49	-81.49	-81.49	-81.49	-81.49	-81.49	-81.49	-81.49	-81.49	-81.49	(71)

Water heating gains (Table 5)

(72)m=	75.76	73.29	68.76	62.81	58.75	53.26	49.07	55	57.47	63.61	70.47	73.86	(72)

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

(73)m=	326.12	323.72	311.91	293.27	274.51	256.26	244.67	250.52	260.28	279.11	300.66	316.81	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.54	x	8.8	x	11.28	x	0.76	x	0.7	=	25.67	(75)
Northeast 0.9x	0.77	x	0.85	x	11.28	x	0.76	x	0.7	=	3.54	(75)
Northeast 0.9x	0.54	x	8.8	x	22.97	x	0.76	x	0.7	=	52.26	(75)
Northeast 0.9x	0.77	x	0.85	x	22.97	x	0.76	x	0.7	=	7.2	(75)
Northeast 0.9x	0.54	x	8.8	x	41.38	x	0.76	x	0.7	=	94.15	(75)
Northeast 0.9x	0.77	x	0.85	x	41.38	x	0.76	x	0.7	=	12.97	(75)
Northeast 0.9x	0.54	x	8.8	x	67.96	x	0.76	x	0.7	=	154.62	(75)
Northeast 0.9x	0.77	x	0.85	x	67.96	x	0.76	x	0.7	=	21.3	(75)
Northeast 0.9x	0.54	x	8.8	x	91.35	x	0.76	x	0.7	=	207.84	(75)
Northeast 0.9x	0.77	x	0.85	x	91.35	x	0.76	x	0.7	=	28.63	(75)
Northeast 0.9x	0.54	x	8.8	x	97.38	x	0.76	x	0.7	=	221.57	(75)
Northeast 0.9x	0.77	x	0.85	x	97.38	x	0.76	x	0.7	=	30.52	(75)
Northeast 0.9x	0.54	x	8.8	x	91.1	x	0.76	x	0.7	=	207.28	(75)
Northeast 0.9x	0.77	x	0.85	x	91.1	x	0.76	x	0.7	=	28.55	(75)
Northeast 0.9x	0.54	x	8.8	x	72.63	x	0.76	x	0.7	=	165.24	(75)
Northeast 0.9x	0.77	x	0.85	x	72.63	x	0.76	x	0.7	=	22.76	(75)
Northeast 0.9x	0.54	x	8.8	x	50.42	x	0.76	x	0.7	=	114.72	(75)
Northeast 0.9x	0.77	x	0.85	x	50.42	x	0.76	x	0.7	=	15.8	(75)
Northeast 0.9x	0.54	x	8.8	x	28.07	x	0.76	x	0.7	=	63.86	(75)
Northeast 0.9x	0.77	x	0.85	x	28.07	x	0.76	x	0.7	=	8.8	(75)
Northeast 0.9x	0.54	x	8.8	x	14.2	x	0.76	x	0.7	=	32.3	(75)
Northeast 0.9x	0.77	x	0.85	x	14.2	x	0.76	x	0.7	=	4.45	(75)
Northeast 0.9x	0.54	x	8.8	x	9.21	x	0.76	x	0.7	=	20.96	(75)
Northeast 0.9x	0.77	x	0.85	x	9.21	x	0.76	x	0.7	=	2.89	(75)
Southeast 0.9x	0.54	x	4.63	x	36.79	x	0.76	x	0.7	=	44.02	(77)
Southeast 0.9x	0.77	x	0.97	x	36.79	x	0.76	x	0.7	=	13.1	(77)
Southeast 0.9x	0.77	x	0.77	x	36.79	x	0.76	x	0.7	=	10.49	(77)
Southeast 0.9x	0.77	x	1.69	x	36.79	x	0.76	x	0.7	=	22.91	(77)
Southeast 0.9x	0.77	x	0.97	x	36.79	x	0.76	x	0.7	=	13.12	(77)
Southeast 0.9x	0.54	x	4.63	x	62.67	x	0.76	x	0.7	=	74.98	(77)

DER WorkSheet: New dwelling design stage

Southeast	0.9x	0.77	x	0.97	x	62.67	x	0.76	x	0.7	=	22.32	(77)
Southeast	0.9x	0.77	x	0.77	x	62.67	x	0.76	x	0.7	=	17.86	(77)
Southeast	0.9x	0.77	x	1.69	x	62.67	x	0.76	x	0.7	=	39.03	(77)
Southeast	0.9x	0.77	x	0.97	x	62.67	x	0.76	x	0.7	=	22.34	(77)
Southeast	0.9x	0.54	x	4.63	x	85.75	x	0.76	x	0.7	=	102.59	(77)
Southeast	0.9x	0.77	x	0.97	x	85.75	x	0.76	x	0.7	=	30.54	(77)
Southeast	0.9x	0.77	x	0.77	x	85.75	x	0.76	x	0.7	=	24.44	(77)
Southeast	0.9x	0.77	x	1.69	x	85.75	x	0.76	x	0.7	=	53.4	(77)
Southeast	0.9x	0.77	x	0.97	x	85.75	x	0.76	x	0.7	=	30.57	(77)
Southeast	0.9x	0.54	x	4.63	x	106.25	x	0.76	x	0.7	=	127.11	(77)
Southeast	0.9x	0.77	x	0.97	x	106.25	x	0.76	x	0.7	=	37.84	(77)
Southeast	0.9x	0.77	x	0.77	x	106.25	x	0.76	x	0.7	=	30.28	(77)
Southeast	0.9x	0.77	x	1.69	x	106.25	x	0.76	x	0.7	=	66.16	(77)
Southeast	0.9x	0.77	x	0.97	x	106.25	x	0.76	x	0.7	=	37.88	(77)
Southeast	0.9x	0.54	x	4.63	x	119.01	x	0.76	x	0.7	=	142.37	(77)
Southeast	0.9x	0.77	x	0.97	x	119.01	x	0.76	x	0.7	=	42.38	(77)
Southeast	0.9x	0.77	x	0.77	x	119.01	x	0.76	x	0.7	=	33.92	(77)
Southeast	0.9x	0.77	x	1.69	x	119.01	x	0.76	x	0.7	=	74.11	(77)
Southeast	0.9x	0.77	x	0.97	x	119.01	x	0.76	x	0.7	=	42.43	(77)
Southeast	0.9x	0.54	x	4.63	x	118.15	x	0.76	x	0.7	=	141.35	(77)
Southeast	0.9x	0.77	x	0.97	x	118.15	x	0.76	x	0.7	=	42.08	(77)
Southeast	0.9x	0.77	x	0.77	x	118.15	x	0.76	x	0.7	=	33.67	(77)
Southeast	0.9x	0.77	x	1.69	x	118.15	x	0.76	x	0.7	=	73.57	(77)
Southeast	0.9x	0.77	x	0.97	x	118.15	x	0.76	x	0.7	=	42.12	(77)
Southeast	0.9x	0.54	x	4.63	x	113.91	x	0.76	x	0.7	=	136.27	(77)
Southeast	0.9x	0.77	x	0.97	x	113.91	x	0.76	x	0.7	=	40.57	(77)
Southeast	0.9x	0.77	x	0.77	x	113.91	x	0.76	x	0.7	=	32.46	(77)
Southeast	0.9x	0.77	x	1.69	x	113.91	x	0.76	x	0.7	=	70.93	(77)
Southeast	0.9x	0.77	x	0.97	x	113.91	x	0.76	x	0.7	=	40.61	(77)
Southeast	0.9x	0.54	x	4.63	x	104.39	x	0.76	x	0.7	=	124.88	(77)
Southeast	0.9x	0.77	x	0.97	x	104.39	x	0.76	x	0.7	=	37.18	(77)
Southeast	0.9x	0.77	x	0.77	x	104.39	x	0.76	x	0.7	=	29.75	(77)
Southeast	0.9x	0.77	x	1.69	x	104.39	x	0.76	x	0.7	=	65	(77)
Southeast	0.9x	0.77	x	0.97	x	104.39	x	0.76	x	0.7	=	37.22	(77)
Southeast	0.9x	0.54	x	4.63	x	92.85	x	0.76	x	0.7	=	111.08	(77)
Southeast	0.9x	0.77	x	0.97	x	92.85	x	0.76	x	0.7	=	33.07	(77)
Southeast	0.9x	0.77	x	0.77	x	92.85	x	0.76	x	0.7	=	26.46	(77)
Southeast	0.9x	0.77	x	1.69	x	92.85	x	0.76	x	0.7	=	57.82	(77)
Southeast	0.9x	0.77	x	0.97	x	92.85	x	0.76	x	0.7	=	33.1	(77)
Southeast	0.9x	0.54	x	4.63	x	69.27	x	0.76	x	0.7	=	82.87	(77)
Southeast	0.9x	0.77	x	0.97	x	69.27	x	0.76	x	0.7	=	24.67	(77)

DER WorkSheet: New dwelling design stage

Southeast	0.9x	0.77	x	0.77	x	69.27	x	0.76	x	0.7	=	19.74	(77)
Southeast	0.9x	0.77	x	1.69	x	69.27	x	0.76	x	0.7	=	43.13	(77)
Southeast	0.9x	0.77	x	0.97	x	69.27	x	0.76	x	0.7	=	24.69	(77)
Southeast	0.9x	0.54	x	4.63	x	44.07	x	0.76	x	0.7	=	52.72	(77)
Southeast	0.9x	0.77	x	0.97	x	44.07	x	0.76	x	0.7	=	15.7	(77)
Southeast	0.9x	0.77	x	0.77	x	44.07	x	0.76	x	0.7	=	12.56	(77)
Southeast	0.9x	0.77	x	1.69	x	44.07	x	0.76	x	0.7	=	27.44	(77)
Southeast	0.9x	0.77	x	0.97	x	44.07	x	0.76	x	0.7	=	15.71	(77)
Southeast	0.9x	0.54	x	4.63	x	31.49	x	0.76	x	0.7	=	37.67	(77)
Southeast	0.9x	0.77	x	0.97	x	31.49	x	0.76	x	0.7	=	11.21	(77)
Southeast	0.9x	0.77	x	0.77	x	31.49	x	0.76	x	0.7	=	8.97	(77)
Southeast	0.9x	0.77	x	1.69	x	31.49	x	0.76	x	0.7	=	19.61	(77)
Southeast	0.9x	0.77	x	0.97	x	31.49	x	0.76	x	0.7	=	11.23	(77)
South	0.9x	0.77	x	1.08	x	46.75	x	0.76	x	0.7	=	18.62	(78)
South	0.9x	0.77	x	1.08	x	76.57	x	0.76	x	0.7	=	30.49	(78)
South	0.9x	0.77	x	1.08	x	97.53	x	0.76	x	0.7	=	38.84	(78)
South	0.9x	0.77	x	1.08	x	110.23	x	0.76	x	0.7	=	43.89	(78)
South	0.9x	0.77	x	1.08	x	114.87	x	0.76	x	0.7	=	45.74	(78)
South	0.9x	0.77	x	1.08	x	110.55	x	0.76	x	0.7	=	44.02	(78)
South	0.9x	0.77	x	1.08	x	108.01	x	0.76	x	0.7	=	43.01	(78)
South	0.9x	0.77	x	1.08	x	104.89	x	0.76	x	0.7	=	41.77	(78)
South	0.9x	0.77	x	1.08	x	101.89	x	0.76	x	0.7	=	40.57	(78)
South	0.9x	0.77	x	1.08	x	82.59	x	0.76	x	0.7	=	32.88	(78)
South	0.9x	0.77	x	1.08	x	55.42	x	0.76	x	0.7	=	22.07	(78)
South	0.9x	0.77	x	1.08	x	40.4	x	0.76	x	0.7	=	16.09	(78)
Southwest	0.9x	0.77	x	1.18	x	36.79		0.76	x	0.7	=	48.1	(79)
Southwest	0.9x	0.77	x	1.18	x	62.67		0.76	x	0.7	=	81.93	(79)
Southwest	0.9x	0.77	x	1.18	x	85.75		0.76	x	0.7	=	112.11	(79)
Southwest	0.9x	0.77	x	1.18	x	106.25		0.76	x	0.7	=	138.91	(79)
Southwest	0.9x	0.77	x	1.18	x	119.01		0.76	x	0.7	=	155.59	(79)
Southwest	0.9x	0.77	x	1.18	x	118.15		0.76	x	0.7	=	154.46	(79)
Southwest	0.9x	0.77	x	1.18	x	113.91		0.76	x	0.7	=	148.92	(79)
Southwest	0.9x	0.77	x	1.18	x	104.39		0.76	x	0.7	=	136.47	(79)
Southwest	0.9x	0.77	x	1.18	x	92.85		0.76	x	0.7	=	121.39	(79)
Southwest	0.9x	0.77	x	1.18	x	69.27		0.76	x	0.7	=	90.56	(79)
Southwest	0.9x	0.77	x	1.18	x	44.07		0.76	x	0.7	=	57.61	(79)
Southwest	0.9x	0.77	x	1.18	x	31.49		0.76	x	0.7	=	41.16	(79)
West	0.9x	0.77	x	1.08	x	19.64	x	0.76	x	0.7	=	7.82	(80)
West	0.9x	0.77	x	1.08	x	38.42	x	0.76	x	0.7	=	15.3	(80)
West	0.9x	0.77	x	1.08	x	63.27	x	0.76	x	0.7	=	25.19	(80)
West	0.9x	0.77	x	1.08	x	92.28	x	0.76	x	0.7	=	36.74	(80)

West	0.9x	0.77	x	1.08	x	113.09	x	0.76	x	0.7	=	45.03	(80)
West	0.9x	0.77	x	1.08	x	115.77	x	0.76	x	0.7	=	46.1	(80)
West	0.9x	0.77	x	1.08	x	110.22	x	0.76	x	0.7	=	43.89	(80)
West	0.9x	0.77	x	1.08	x	94.68	x	0.76	x	0.7	=	37.7	(80)
West	0.9x	0.77	x	1.08	x	73.59	x	0.76	x	0.7	=	29.3	(80)
West	0.9x	0.77	x	1.08	x	45.59	x	0.76	x	0.7	=	18.15	(80)
West	0.9x	0.77	x	1.08	x	24.49	x	0.76	x	0.7	=	9.75	(80)
West	0.9x	0.77	x	1.08	x	16.15	x	0.76	x	0.7	=	6.43	(80)
Northwest	0.9x	0.77	x	0.97	x	11.28	x	0.76	x	0.7	=	4.02	(81)
Northwest	0.9x	0.77	x	0.97	x	22.97	x	0.76	x	0.7	=	8.19	(81)
Northwest	0.9x	0.77	x	0.97	x	41.38	x	0.76	x	0.7	=	14.75	(81)
Northwest	0.9x	0.77	x	0.97	x	67.96	x	0.76	x	0.7	=	24.23	(81)
Northwest	0.9x	0.77	x	0.97	x	91.35	x	0.76	x	0.7	=	32.57	(81)
Northwest	0.9x	0.77	x	0.97	x	97.38	x	0.76	x	0.7	=	34.72	(81)
Northwest	0.9x	0.77	x	0.97	x	91.1	x	0.76	x	0.7	=	32.48	(81)
Northwest	0.9x	0.77	x	0.97	x	72.63	x	0.76	x	0.7	=	25.89	(81)
Northwest	0.9x	0.77	x	0.97	x	50.42	x	0.76	x	0.7	=	17.98	(81)
Northwest	0.9x	0.77	x	0.97	x	28.07	x	0.76	x	0.7	=	10.01	(81)
Northwest	0.9x	0.77	x	0.97	x	14.2	x	0.76	x	0.7	=	5.06	(81)
Northwest	0.9x	0.77	x	0.97	x	9.21	x	0.76	x	0.7	=	3.28	(81)

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

(83)m=	211.4	371.89	539.54	718.95	850.59	864.17	824.96	723.86	601.28	419.35	255.37	179.51	(83)

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

(84)m=	537.52	695.61	851.45	1012.22	1125.11	1120.43	1069.62	974.39	861.56	698.46	556.03	496.32	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.94	0.84	0.68	0.51	0.37	0.42	0.67	0.91	0.98	0.99	(86)

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

(87)m=	19.53	19.82	20.21	20.62	20.87	20.97	20.99	20.99	20.91	20.53	19.94	19.47	(87)

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

(88)m=	19.68	19.68	19.68	19.69	19.69	19.71	19.71	19.71	19.7	19.69	19.69	19.69	(88)

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

(89)m=	0.99	0.97	0.92	0.8	0.61	0.41	0.26	0.31	0.57	0.87	0.97	0.99	(89)

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

(90)m=	17.78	18.2	18.74	19.29	19.59	19.69	19.7	19.7	19.65	19.21	18.38	17.7	(90)

fLA = Living area ÷ (4) = 0.4 (91)

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

(92)m=	18.48	18.85	19.33	19.83	20.1	20.2	20.22	20.22	20.15	19.74	19.01	18.41	(92)

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

DER WorkSheet: New dwelling design stage

(93)m=	18.48	18.85	19.33	19.83	20.1	20.2	20.22	20.22	20.15	19.74	19.01	18.41	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.96	0.91	0.8	0.64	0.45	0.31	0.35	0.6	0.87	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	529.35	669.46	777.18	813.39	714.56	501.67	329.58	345.74	519.86	609.23	538.89	490.62	(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=	1332.29	1307.65	1200.14	1011.26	776.23	512.85	331.38	348.94	556.1	844.41	1104.43	1323.87	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	597.38	428.86	314.68	142.47	45.89	0	0	0	0	174.98	407.19	619.94	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2731.39 (98)

Space heating requirement in kWh/m²/year 44.06 (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		90.3	(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)														
	597.38	428.86	314.68	142.47	45.89	0	0	0	0	174.98	407.19	619.94		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	661.55	474.93	348.48	157.77	50.82	0	0	0	0	193.77	450.93	686.53		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													3024.79	(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)														
	181.01	158.12	164.51	145.92	141.27	124.42	119.21	132.89	134.36	152.99	163.32	176.76		
Efficiency of water heater													81	(216)
(217)m=	87.95	87.59	86.88	85.34	83.1	81	81	81	81	85.71	87.43	88.06		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	205.81	180.52	189.37	170.98	170.01	153.61	147.17	164.06	165.87	178.5	186.8	200.74		
Total = Sum(219a)$_{1...12}$ =													2113.43	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		3024.79

Water heating fuel used			2113.43	
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			280.15	(232)
Electricity generated by PVs			-878.85	(233)

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	=	653.35	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	456.5	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1109.86	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	145.4	(268)
Energy saving/generation technologies Item 1		0.519	=	-456.13	(269)
Total CO2, kg/year		sum of (265)…(271) =		838.05	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		13.52	(273)
EI rating (section 14)				90	(274)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.18
Printed on 05 November 2019 at 13:23:11

Project Information:

Assessed By: Su Lee (STRO031315) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 62.2m²

Site Reference : 217 Kingston Road **Plot Reference:** Front - Unit 6

Address :

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas
Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER)	22.3 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	14.64 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	66.6 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	54.5 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.15 (max. 0.30)	0.15 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.20 (max. 2.00)	1.20 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	4.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system: Boiler systems with radiators or underfloor heating - mains gas
Data from manufacturer
Combi boiler
Efficiency 89.5 % SEDBUK2009
Minimum 88.0 % **OK**

Secondary heating system: None

5 Cylinder insulation

Hot water Storage: No cylinder

N/A

Regulations Compliance Report

6 Controls

Space heating controls	TTZC by plumbing and electrical services	**OK**
Hot water controls:	No cylinder thermostat	
	No cylinder	
Boiler interlock:	Yes	**OK**

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	**OK**

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Thames valley):	Medium	**OK**

Based on:

Overshading:	Average or unknown
Windows facing: North East	4.6m²
Windows facing: North West	0.97m²
Windows facing: North West	0.77m²
Windows facing: North East	1.73m²
Windows facing: North West	1.69m²
Windows facing: South East	0.62m²
Windows facing: North West	0.62m²
Windows facing: North East	2.68m²
Windows facing: South	0.81m²
Windows facing: West	0.81m²
Ventilation rate:	3.00
Blinds/curtains:	None

10 Key features

External Walls U-value	0.13 W/m²K
Party Walls U-value	0 W/m²K
Photovoltaic array	

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Su Lee	**Stroma Number:**	STRO031315
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.18

Property Address: Front - Unit 6

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	62.2	(1a) x	2.56	(2a) =	158.93	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.2	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	158.93	(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							3	x 10 =	30	(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) =	30	÷ (5) =	0.19	(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		4	(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		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.36	(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

0.46	0.45	0.44	0.4	0.39	0.34	0.34	0.33	0.36	0.39	0.4	0.42

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=	0.61	0.6	0.6	0.58	0.57	0.56	0.56	0.56	0.56	0.57	0.58	0.59	(24d)

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

(25)m=	0.61	0.6	0.6	0.58	0.57	0.56	0.56	0.56	0.56	0.57	0.58	0.59	(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			1.86	x	1.2	=	2.232			(26)
Windows Type 1			4.6	x1/[1/(1.2)+ 0.04]		=	5.27			(27)
Windows Type 2			0.966	x1/[1/(1.2)+ 0.04]		=	1.11			(27)
Windows Type 3			0.773	x1/[1/(1.2)+ 0.04]		=	0.89			(27)
Windows Type 4			1.73	x1/[1/(1.2)+ 0.04]		=	1.98			(27)
Windows Type 5			1.689	x1/[1/(1.2)+ 0.04]		=	1.93			(27)
Windows Type 6			0.617	x1/[1/(1.2)+ 0.04]		=	0.71			(27)
Windows Type 7			0.617	x1/[1/(1.2)+ 0.04]		=	0.71			(27)
Windows Type 8			0.895	x1/[1/(1.2)+ 0.04]		=	1.02			(27)
Windows Type 9			0.81	x1/[1/(1.2)+ 0.04]		=	0.93			(27)
Windows Type 10			0.81	x1/[1/(1.2)+ 0.04]		=	0.93			(27)
Floor Type 1			1.027	x	0.13	=	0.13351			(28)
Floor Type 2			4.089	x	0.13	=	0.53157			(28)
Walls Type1	63.66	15.3	48.36	x	0.15	=	7.25			(29)
Walls Type2	10.05	1.86	8.19	x	0.14	=	1.16			(29)
Walls Type3	10.74	0	10.74	x	0.13	=	1.42			(29)
Roof Type1	8.86	0	8.86	x	0.13	=	1.15			(30)
Roof Type2	10.33	0	10.33	x	0.13	=	1.34			(30)
Roof Type3	15.4	0	15.4	x	0.13	=	2			(30)

DER WorkSheet: New dwelling design stage

Total area of elements, m²	124.16						(31)
Party wall	30.05	x	0	=	0		(32)

** 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) =	34.74	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	0	(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		18.68	(36)

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

Total fabric heat loss	(33) + (36) =	53.42	(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=	31.74	31.52	31.31	30.33	30.14	29.28	29.28	29.13	29.61	30.14	30.52	30.91	(38)

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

(39)m=	85.16	84.94	84.73	83.75	83.56	82.71	82.71	82.55	83.04	83.56	83.94	84.33	

Average = $Sum(39)_{1…12}$ /12= 83.75 (39)

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

(40)m=	1.37	1.37	1.36	1.35	1.34	1.33	1.33	1.33	1.33	1.34	1.35	1.36	

Average = $Sum(40)_{1…12}$ /12= 1.35 (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 — 2.04 (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 — 82.73 (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=	91	87.69	84.38	81.07	77.76	74.45	74.45	77.76	81.07	84.38	87.69	91	

Total = $Sum(44)_{1…12}$ = 992.72 (44)

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

(45)m=	134.95	118.03	121.79	106.18	101.88	87.92	81.47	93.49	94.6	110.25	120.35	130.69	

Total = $Sum(45)_{1…12}$ = 1301.61 (45)

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

(46)m=	20.24	17.7	18.27	15.93	15.28	13.19	12.22	14.02	14.19	16.54	18.05	19.6	(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)

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=	46.37	40.36	43	39.98	39.63	36.72	37.94	39.63	39.98	43	43.24	46.37	(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=	181.32	158.39	164.79	146.16	141.51	124.64	119.41	133.11	134.58	153.25	163.59	177.06	(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=	181.32	158.39	164.79	146.16	141.51	124.64	119.41	133.11	134.58	153.25	163.59	177.06

Output from water heater (annual)1…12 — 1797.83 (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=	56.46	49.33	51.25	45.3	43.78	38.41	36.57	40.99	41.45	47.41	50.83	55.05	(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=	102.16	102.16	102.16	102.16	102.16	102.16	102.16	102.16	102.16	102.16	102.16	102.16	(66)

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

(67)m=	15.91	14.13	11.49	8.7	6.5	5.49	5.93	7.71	10.35	13.14	15.34	16.35	(67)

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

(68)m=	178.47	180.32	175.65	165.72	153.18	141.39	133.52	131.66	136.33	146.27	158.81	170.59	(68)

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

(69)m=	33.22	33.22	33.22	33.22	33.22	33.22	33.22	33.22	33.22	33.22	33.22	33.22	(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=	-81.73	-81.73	-81.73	-81.73	-81.73	-81.73	-81.73	-81.73	-81.73	-81.73	-81.73	-81.73	(71)

Water heating gains (Table 5)

(72)m=	75.89	73.41	68.88	62.92	58.85	53.35	49.16	55.1	57.57	63.72	70.59	73.99	(72)

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

(73)m=	326.92	324.52	312.67	293.99	275.18	256.88	245.26	251.12	260.9	279.78	301.39	317.58	(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	0.54	x	4.6	x	11.28	x	0.76	x	0.7	=	13.42	(75)
Northeast 0.9x	0.77	x	1.73	x	11.28	x	0.76	x	0.7	=	7.2	(75)
Northeast 0.9x	0.77	x	0.89	x	11.28	x	0.76	x	0.7	=	11.17	(75)
Northeast 0.9x	0.54	x	4.6	x	22.97	x	0.76	x	0.7	=	27.32	(75)
Northeast 0.9x	0.77	x	1.73	x	22.97	x	0.76	x	0.7	=	14.65	(75)
Northeast 0.9x	0.77	x	0.89	x	22.97	x	0.76	x	0.7	=	22.73	(75)
Northeast 0.9x	0.54	x	4.6	x	41.38	x	0.76	x	0.7	=	49.21	(75)
Northeast 0.9x	0.77	x	1.73	x	41.38	x	0.76	x	0.7	=	26.39	(75)
Northeast 0.9x	0.77	x	0.89	x	41.38	x	0.76	x	0.7	=	40.96	(75)
Northeast 0.9x	0.54	x	4.6	x	67.96	x	0.76	x	0.7	=	80.82	(75)
Northeast 0.9x	0.77	x	1.73	x	67.96	x	0.76	x	0.7	=	43.34	(75)
Northeast 0.9x	0.77	x	0.89	x	67.96	x	0.76	x	0.7	=	67.27	(75)
Northeast 0.9x	0.54	x	4.6	x	91.35	x	0.76	x	0.7	=	108.64	(75)
Northeast 0.9x	0.77	x	1.73	x	91.35	x	0.76	x	0.7	=	58.26	(75)
Northeast 0.9x	0.77	x	0.89	x	91.35	x	0.76	x	0.7	=	90.42	(75)
Northeast 0.9x	0.54	x	4.6	x	97.38	x	0.76	x	0.7	=	115.82	(75)
Northeast 0.9x	0.77	x	1.73	x	97.38	x	0.76	x	0.7	=	62.11	(75)
Northeast 0.9x	0.77	x	0.89	x	97.38	x	0.76	x	0.7	=	96.4	(75)
Northeast 0.9x	0.54	x	4.6	x	91.1	x	0.76	x	0.7	=	108.35	(75)
Northeast 0.9x	0.77	x	1.73	x	91.1	x	0.76	x	0.7	=	58.11	(75)
Northeast 0.9x	0.77	x	0.89	x	91.1	x	0.76	x	0.7	=	90.18	(75)
Northeast 0.9x	0.54	x	4.6	x	72.63	x	0.76	x	0.7	=	86.38	(75)
Northeast 0.9x	0.77	x	1.73	x	72.63	x	0.76	x	0.7	=	46.32	(75)
Northeast 0.9x	0.77	x	0.89	x	72.63	x	0.76	x	0.7	=	71.89	(75)
Northeast 0.9x	0.54	x	4.6	x	50.42	x	0.76	x	0.7	=	59.97	(75)
Northeast 0.9x	0.77	x	1.73	x	50.42	x	0.76	x	0.7	=	32.16	(75)
Northeast 0.9x	0.77	x	0.89	x	50.42	x	0.76	x	0.7	=	49.91	(75)
Northeast 0.9x	0.54	x	4.6	x	28.07	x	0.76	x	0.7	=	33.38	(75)
Northeast 0.9x	0.77	x	1.73	x	28.07	x	0.76	x	0.7	=	17.9	(75)
Northeast 0.9x	0.77	x	0.89	x	28.07	x	0.76	x	0.7	=	27.78	(75)

DER WorkSheet: New dwelling design stage

Northeast	0.9x	0.54	x	4.6	x	14.2	x	0.76	x	0.7	=	16.88	(75)
Northeast	0.9x	0.77	x	1.73	x	14.2	x	0.76	x	0.7	=	9.05	(75)
Northeast	0.9x	0.77	x	0.89	x	14.2	x	0.76	x	0.7	=	14.05	(75)
Northeast	0.9x	0.54	x	4.6	x	9.21	x	0.76	x	0.7	=	10.96	(75)
Northeast	0.9x	0.77	x	1.73	x	9.21	x	0.76	x	0.7	=	5.88	(75)
Northeast	0.9x	0.77	x	0.89	x	9.21	x	0.76	x	0.7	=	9.12	(75)
Southeast	0.9x	0.77	x	0.62	x	36.79	x	0.76	x	0.7	=	8.37	(77)
Southeast	0.9x	0.77	x	0.62	x	62.67	x	0.76	x	0.7	=	14.26	(77)
Southeast	0.9x	0.77	x	0.62	x	85.75	x	0.76	x	0.7	=	19.51	(77)
Southeast	0.9x	0.77	x	0.62	x	106.25	x	0.76	x	0.7	=	24.17	(77)
Southeast	0.9x	0.77	x	0.62	x	119.01	x	0.76	x	0.7	=	27.07	(77)
Southeast	0.9x	0.77	x	0.62	x	118.15	x	0.76	x	0.7	=	26.88	(77)
Southeast	0.9x	0.77	x	0.62	x	113.91	x	0.76	x	0.7	=	25.91	(77)
Southeast	0.9x	0.77	x	0.62	x	104.39	x	0.76	x	0.7	=	23.75	(77)
Southeast	0.9x	0.77	x	0.62	x	92.85	x	0.76	x	0.7	=	21.12	(77)
Southeast	0.9x	0.77	x	0.62	x	69.27	x	0.76	x	0.7	=	15.76	(77)
Southeast	0.9x	0.77	x	0.62	x	44.07	x	0.76	x	0.7	=	10.02	(77)
Southeast	0.9x	0.77	x	0.62	x	31.49	x	0.76	x	0.7	=	7.16	(77)
South	0.9x	0.77	x	0.81	x	46.75	x	0.76	x	0.7	=	13.96	(78)
South	0.9x	0.77	x	0.81	x	76.57	x	0.76	x	0.7	=	22.87	(78)
South	0.9x	0.77	x	0.81	x	97.53	x	0.76	x	0.7	=	29.13	(78)
South	0.9x	0.77	x	0.81	x	110.23	x	0.76	x	0.7	=	32.92	(78)
South	0.9x	0.77	x	0.81	x	114.87	x	0.76	x	0.7	=	34.3	(78)
South	0.9x	0.77	x	0.81	x	110.55	x	0.76	x	0.7	=	33.01	(78)
South	0.9x	0.77	x	0.81	x	108.01	x	0.76	x	0.7	=	32.26	(78)
South	0.9x	0.77	x	0.81	x	104.89	x	0.76	x	0.7	=	31.32	(78)
South	0.9x	0.77	x	0.81	x	101.89	x	0.76	x	0.7	=	30.43	(78)
South	0.9x	0.77	x	0.81	x	82.59	x	0.76	x	0.7	=	24.66	(78)
South	0.9x	0.77	x	0.81	x	55.42	x	0.76	x	0.7	=	16.55	(78)
South	0.9x	0.77	x	0.81	x	40.4	x	0.76	x	0.7	=	12.06	(78)
West	0.9x	0.77	x	0.81	x	19.64	x	0.76	x	0.7	=	5.87	(80)
West	0.9x	0.77	x	0.81	x	38.42	x	0.76	x	0.7	=	11.47	(80)
West	0.9x	0.77	x	0.81	x	63.27	x	0.76	x	0.7	=	18.9	(80)
West	0.9x	0.77	x	0.81	x	92.28	x	0.76	x	0.7	=	27.56	(80)
West	0.9x	0.77	x	0.81	x	113.09	x	0.76	x	0.7	=	33.77	(80)
West	0.9x	0.77	x	0.81	x	115.77	x	0.76	x	0.7	=	34.57	(80)
West	0.9x	0.77	x	0.81	x	110.22	x	0.76	x	0.7	=	32.91	(80)
West	0.9x	0.77	x	0.81	x	94.68	x	0.76	x	0.7	=	28.27	(80)
West	0.9x	0.77	x	0.81	x	73.59	x	0.76	x	0.7	=	21.98	(80)
West	0.9x	0.77	x	0.81	x	45.59	x	0.76	x	0.7	=	13.61	(80)
West	0.9x	0.77	x	0.81	x	24.49	x	0.76	x	0.7	=	7.31	(80)

DER WorkSheet: New dwelling design stage

West	0.9x	0.77	x	0.81	x	16.15	x	0.76	x	0.7	=	4.82	(80)
Northwest	0.9x	0.77	x	0.97	x	11.28	x	0.76	x	0.7	=	4.02	(81)
Northwest	0.9x	0.77	x	0.77	x	11.28	x	0.76	x	0.7	=	3.22	(81)
Northwest	0.9x	0.77	x	1.69	x	11.28	x	0.76	x	0.7	=	7.03	(81)
Northwest	0.9x	0.77	x	0.62	x	11.28	x	0.76	x	0.7	=	2.57	(81)
Northwest	0.9x	0.77	x	0.97	x	22.97	x	0.76	x	0.7	=	8.18	(81)
Northwest	0.9x	0.77	x	0.77	x	22.97	x	0.76	x	0.7	=	6.55	(81)
Northwest	0.9x	0.77	x	1.69	x	22.97	x	0.76	x	0.7	=	14.3	(81)
Northwest	0.9x	0.77	x	0.62	x	22.97	x	0.76	x	0.7	=	5.22	(81)
Northwest	0.9x	0.77	x	0.97	x	41.38	x	0.76	x	0.7	=	14.74	(81)
Northwest	0.9x	0.77	x	0.77	x	41.38	x	0.76	x	0.7	=	11.79	(81)
Northwest	0.9x	0.77	x	1.69	x	41.38	x	0.76	x	0.7	=	25.77	(81)
Northwest	0.9x	0.77	x	0.62	x	41.38	x	0.76	x	0.7	=	9.41	(81)
Northwest	0.9x	0.77	x	0.97	x	67.96	x	0.76	x	0.7	=	24.2	(81)
Northwest	0.9x	0.77	x	0.77	x	67.96	x	0.76	x	0.7	=	19.37	(81)
Northwest	0.9x	0.77	x	1.69	x	67.96	x	0.76	x	0.7	=	42.32	(81)
Northwest	0.9x	0.77	x	0.62	x	67.96	x	0.76	x	0.7	=	15.46	(81)
Northwest	0.9x	0.77	x	0.97	x	91.35	x	0.76	x	0.7	=	32.53	(81)
Northwest	0.9x	0.77	x	0.77	x	91.35	x	0.76	x	0.7	=	26.03	(81)
Northwest	0.9x	0.77	x	1.69	x	91.35	x	0.76	x	0.7	=	56.88	(81)
Northwest	0.9x	0.77	x	0.62	x	91.35	x	0.76	x	0.7	=	20.78	(81)
Northwest	0.9x	0.77	x	0.97	x	97.38	x	0.76	x	0.7	=	34.68	(81)
Northwest	0.9x	0.77	x	0.77	x	97.38	x	0.76	x	0.7	=	27.75	(81)
Northwest	0.9x	0.77	x	1.69	x	97.38	x	0.76	x	0.7	=	60.64	(81)
Northwest	0.9x	0.77	x	0.62	x	97.38	x	0.76	x	0.7	=	22.15	(81)
Northwest	0.9x	0.77	x	0.97	x	91.1	x	0.76	x	0.7	=	32.44	(81)
Northwest	0.9x	0.77	x	0.77	x	91.1	x	0.76	x	0.7	=	25.96	(81)
Northwest	0.9x	0.77	x	1.69	x	91.1	x	0.76	x	0.7	=	56.73	(81)
Northwest	0.9x	0.77	x	0.62	x	91.1	x	0.76	x	0.7	=	20.72	(81)
Northwest	0.9x	0.77	x	0.97	x	72.63	x	0.76	x	0.7	=	25.87	(81)
Northwest	0.9x	0.77	x	0.77	x	72.63	x	0.76	x	0.7	=	20.7	(81)
Northwest	0.9x	0.77	x	1.69	x	72.63	x	0.76	x	0.7	=	45.22	(81)
Northwest	0.9x	0.77	x	0.62	x	72.63	x	0.76	x	0.7	=	16.52	(81)
Northwest	0.9x	0.77	x	0.97	x	50.42	x	0.76	x	0.7	=	17.96	(81)
Northwest	0.9x	0.77	x	0.77	x	50.42	x	0.76	x	0.7	=	14.37	(81)
Northwest	0.9x	0.77	x	1.69	x	50.42	x	0.76	x	0.7	=	31.4	(81)
Northwest	0.9x	0.77	x	0.62	x	50.42	x	0.76	x	0.7	=	11.47	(81)
Northwest	0.9x	0.77	x	0.97	x	28.07	x	0.76	x	0.7	=	10	(81)
Northwest	0.9x	0.77	x	0.77	x	28.07	x	0.76	x	0.7	=	8	(81)
Northwest	0.9x	0.77	x	1.69	x	28.07	x	0.76	x	0.7	=	17.48	(81)
Northwest	0.9x	0.77	x	0.62	x	28.07	x	0.76	x	0.7	=	6.38	(81)

Northwest	0.9x	0.77	x	0.97	x	14.2	x	0.76	x	0.7	=	5.06	(81)
Northwest	0.9x	0.77	x	0.77	x	14.2	x	0.76	x	0.7	=	4.05	(81)
Northwest	0.9x	0.77	x	1.69	x	14.2	x	0.76	x	0.7	=	8.84	(81)
Northwest	0.9x	0.77	x	0.62	x	14.2	x	0.76	x	0.7	=	3.23	(81)
Northwest	0.9x	0.77	x	0.97	x	9.21	x	0.76	x	0.7	=	3.28	(81)
Northwest	0.9x	0.77	x	0.77	x	9.21	x	0.76	x	0.7	=	2.63	(81)
Northwest	0.9x	0.77	x	1.69	x	9.21	x	0.76	x	0.7	=	5.74	(81)
Northwest	0.9x	0.77	x	0.62	x	9.21	x	0.76	x	0.7	=	2.1	(81)

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

(83)m=	76.81	147.54	245.8	377.42	488.7	514.03	483.58	396.24	290.75	174.96	95.05	63.75	(83)

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

(84)m=	403.73	472.06	558.48	671.41	763.88	770.91	728.83	647.36	551.65	454.73	396.44	381.33	(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	0.64	0.49	0.56	0.83	0.97	0.99	1	(86)

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

(87)m=	19.52	19.69	20.01	20.44	20.78	20.95	20.99	20.98	20.83	20.38	19.87	19.49	(87)

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

(88)m=	19.79	19.79	19.79	19.8	19.81	19.82	19.82	19.82	19.81	19.81	19.8	19.8	(88)

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

(89)m=	1	0.99	0.98	0.92	0.76	0.54	0.36	0.43	0.75	0.96	0.99	1	(89)

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

(90)m=	17.84	18.09	18.56	19.17	19.61	19.79	19.81	19.81	19.68	19.09	18.37	17.8	(90)

fLA = Living area ÷ (4) = 0.4 (91)

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

(92)m=	18.51	18.74	19.14	19.68	20.08	20.25	20.29	20.28	20.15	19.61	18.97	18.48	(92)

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

(93)m=	18.51	18.74	19.14	19.68	20.08	20.25	20.29	20.28	20.15	19.61	18.97	18.48	(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=	0.99	0.99	0.97	0.91	0.78	0.58	0.41	0.48	0.78	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	401.53	466.87	542.77	613.66	595.25	446.67	301.25	313.3	428.48	434.29	392.4	379.7	(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=	1210.45	1175.47	1071.13	902.89	700.29	467.59	304.85	320.32	502.1	752.94	996.58	1204.45	(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=	601.84	476.17	393.1	208.25	78.15	0	0	0	0	237.07	435.02	613.61	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3043.21 (98)

Space heating requirement in kWh/m²/year 48.92 (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		90.3	(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)	601.84	476.17	393.1	208.25	78.15	0	0	0	0	237.07	435.02	613.61		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	666.48	527.32	435.33	230.62	86.55	0	0	0	0	262.54	481.75	679.52		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													3370.11	(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)	181.32	158.39	164.79	146.16	141.51	124.64	119.41	133.11	134.58	153.25	163.59	177.06		
Efficiency of water heater													81	(216)
(217)m=	87.96	87.78	87.34	86.22	84.08	81	81	81	81	86.4	87.55	88.04		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	206.14	180.43	188.68	169.53	168.3	153.87	147.42	164.34	166.15	177.36	186.85	201.12		
Total = Sum(219a)$_{1...12}$ =													2110.21	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3370.11	
Water heating fuel used			2110.21	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			280.99	(232)
Electricity generated by PVs			-881.89	(233)

12a. CO_2 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	=	727.94	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	455.8	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1183.75	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	145.83	(268)
Energy saving/generation technologies						
Item 1			0.519	=	-457.7	(269)
Total CO2, kg/year			sum of (265)…(271) =		910.8	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		14.64	(273)
EI rating (section 14)					89	(274)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.18
Printed on 05 November 2019 at 13:23:00

Project Information:

Assessed By:	Su Lee (STRO031315)	**Building Type:**	Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE		Total Floor Area: 53.98m²	
Site Reference :	217 Kingston Road	**Plot Reference:**	Front - Unit 7
Address :			

Client Details:

Name:
Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas		
Fuel factor: 1.00 (mains gas)		
Target Carbon Dioxide Emission Rate (TER)	24.68 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	16.33 kg/m²	**OK**

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	73.2 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	57.7 kWh/m²	
		OK

2 Fabric U-values

Element	**Average**	**Highest**	
External wall	0.14 (max. 0.30)	0.15 (max. 0.70)	**OK**
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	**OK**
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	**OK**
Openings	1.20 (max. 2.00)	1.20 (max. 3.30)	**OK**

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	4.00 (design value)	
Maximum	10.0	**OK**

4 Heating efficiency

Main Heating system:	Boiler systems with radiators or underfloor heating - mains gas Data from manufacturer Combi boiler Efficiency 89.5 % SEDBUK2009 Minimum 88.0 %	**OK**
Secondary heating system:	None	

5 Cylinder insulation

Hot water Storage:	No cylinder	
		N/A

Regulations Compliance Report

6 Controls

Space heating controls	TTZC by plumbing and electrical services	**OK**
Hot water controls:	No cylinder thermostat	
	No cylinder	
Boiler interlock:	Yes	**OK**

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	**OK**

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Thames valley):	Slight	**OK**

Based on:

Overshading:	Average or unknown
Windows facing: North East	1.98m²
Windows facing: North West	1.49m²
Windows facing: North East	1.98m²
Windows facing: South East	1.49m²
Ventilation rate:	3.00
Blinds/curtains:	None

10 Key features

External Walls U-value	0.13 W/m²K
Photovoltaic array	

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Su Lee	**Stroma Number:**	STRO031315
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.18

Property Address: Front - Unit 7

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	53.98	(1a) x	2.4	(2a) =	129.56	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	53.98	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	129.56	(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) =	0.15	(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		4	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.35	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.35	(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

0.45	0.44	0.43	0.39	0.38	0.34	0.34	0.33	0.35	0.38	0.4	0.42

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=	0.6	0.6	0.59	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(24d)

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

(25)m=	0.6	0.6	0.59	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(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			1.86	x	1.2	=	2.232			(26)
Windows Type 1			1.979	x1/[1/(1.2)+ 0.04]		=	2.27			(27)
Windows Type 2			1.492	x1/[1/(1.2)+ 0.04]		=	1.71			(27)
Windows Type 3			1.979	x1/[1/(1.2)+ 0.04]		=	2.27			(27)
Windows Type 4			1.488	x1/[1/(1.2)+ 0.04]		=	1.7			(27)
Floor			1.48	x	0.13	=	0.1924			(28)
Walls Type1	62.32	6.94	55.38	x	0.15	=	8.31			(29)
Walls Type2	10.85	1.86	8.99	x	0.14	=	1.27			(29)
Walls Type3	18.12	0	18.12	x	0.13	=	2.42			(29)
Roof Type1	60.76	0	60.76	x	0.13	=	7.9			(30)
Roof Type2	4.59	0	4.59	x	0.13	=	0.6			(30)
Total area of elements, m²			158.12							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.86 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 0 (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 15.05 (36)

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

Total fabric heat loss (33) + (36) = 45.91 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.74	25.57	25.41	24.63	24.48	23.8	23.8	23.67	24.06	24.48	24.78	25.08	(38)

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

(39)m=	71.66	71.49	71.32	70.54	70.39	69.71	69.71	69.59	69.98	70.39	70.69	71	

Average = $Sum(39)_{1...12}$ /12= 70.54 (39)

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

(40)m=	1.33	1.32	1.32	1.31	1.3	1.29	1.29	1.29	1.3	1.3	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 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 77.13 (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=	84.84	81.76	78.67	75.59	72.5	69.42	69.42	72.5	75.59	78.67	81.76	84.84

Total = $Sum(44)_{1...12}$ = 925.55 (44)

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

(45)m=	125.82	110.04	113.55	99	94.99	81.97	75.96	87.16	88.2	102.79	112.21	121.85

Total = $Sum(45)_{1...12}$ = 1213.54 (45)

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

(46)m=	18.87	16.51	17.03	14.85	14.25	12.3	11.39	13.07	13.23	15.42	16.83	18.28	(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=	43.23	37.63	40.09	37.28	36.95	34.23	35.37	36.95	37.28	40.09	40.32	43.23	(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=	169.05	147.67	153.64	136.27	131.94	116.2	111.33	124.11	125.48	142.88	152.52	165.08	(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=	169.05	147.67	153.64	136.27	131.94	116.2	111.33	124.11	125.48	142.88	152.52	165.08

Output from water heater (annual)$_{1...12}$ | 1676.18 | (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=	52.64	46	47.78	42.24	40.82	35.81	34.1	38.22	38.65	44.2	47.39	51.32	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	90.38	90.38	90.38	90.38	90.38	90.38	90.38	90.38	90.38	90.38	90.38	90.38	(66)

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

(67)m=	15.55	13.81	11.23	8.5	6.36	5.37	5.8	7.54	10.12	12.85	14.99	15.98	(67)

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

(68)m=	157.56	159.2	155.08	146.31	135.23	124.83	117.88	116.24	120.36	129.13	140.2	150.61	(68)

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

(69)m=	32.04	32.04	32.04	32.04	32.04	32.04	32.04	32.04	32.04	32.04	32.04	32.04	(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=	-72.3	-72.3	-72.3	-72.3	-72.3	-72.3	-72.3	-72.3	-72.3	-72.3	-72.3	-72.3	(71)

Water heating gains (Table 5)

(72)m=	70.76	68.45	64.22	58.66	54.87	49.74	45.83	51.37	53.68	59.41	65.82	68.98	(72)

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

(73)m=	296.98	294.57	283.64	266.58	249.57	233.05	222.62	228.26	237.27	254.5	274.13	288.69	(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	0.54	x	1.98	x	11.28	x	0.76	x	0.7	=	5.77	(75)
Northeast	0.9x	0.77	x	1.98	x	11.28	x	0.76	x	0.7	=	8.23	(75)
Northeast	0.9x	0.54	x	1.98	x	22.97	x	0.76	x	0.7	=	11.75	(75)
Northeast	0.9x	0.77	x	1.98	x	22.97	x	0.76	x	0.7	=	16.76	(75)
Northeast	0.9x	0.54	x	1.98	x	41.38	x	0.76	x	0.7	=	21.17	(75)
Northeast	0.9x	0.77	x	1.98	x	41.38	x	0.76	x	0.7	=	30.19	(75)
Northeast	0.9x	0.54	x	1.98	x	67.96	x	0.76	x	0.7	=	34.77	(75)
Northeast	0.9x	0.77	x	1.98	x	67.96	x	0.76	x	0.7	=	49.58	(75)
Northeast	0.9x	0.54	x	1.98	x	91.35	x	0.76	x	0.7	=	46.74	(75)
Northeast	0.9x	0.77	x	1.98	x	91.35	x	0.76	x	0.7	=	66.65	(75)
Northeast	0.9x	0.54	x	1.98	x	97.38	x	0.76	x	0.7	=	49.83	(75)
Northeast	0.9x	0.77	x	1.98	x	97.38	x	0.76	x	0.7	=	71.05	(75)
Northeast	0.9x	0.54	x	1.98	x	91.1	x	0.76	x	0.7	=	46.61	(75)
Northeast	0.9x	0.77	x	1.98	x	91.1	x	0.76	x	0.7	=	66.47	(75)
Northeast	0.9x	0.54	x	1.98	x	72.63	x	0.76	x	0.7	=	37.16	(75)
Northeast	0.9x	0.77	x	1.98	x	72.63	x	0.76	x	0.7	=	52.99	(75)
Northeast	0.9x	0.54	x	1.98	x	50.42	x	0.76	x	0.7	=	25.8	(75)
Northeast	0.9x	0.77	x	1.98	x	50.42	x	0.76	x	0.7	=	36.79	(75)
Northeast	0.9x	0.54	x	1.98	x	28.07	x	0.76	x	0.7	=	14.36	(75)
Northeast	0.9x	0.77	x	1.98	x	28.07	x	0.76	x	0.7	=	20.48	(75)
Northeast	0.9x	0.54	x	1.98	x	14.2	x	0.76	x	0.7	=	7.26	(75)
Northeast	0.9x	0.77	x	1.98	x	14.2	x	0.76	x	0.7	=	10.36	(75)
Northeast	0.9x	0.54	x	1.98	x	9.21	x	0.76	x	0.7	=	4.71	(75)
Northeast	0.9x	0.77	x	1.98	x	9.21	x	0.76	x	0.7	=	6.72	(75)
Southeast	0.9x	0.77	x	1.49	x	36.79	x	0.76	x	0.7	=	20.18	(77)
Southeast	0.9x	0.77	x	1.49	x	62.67	x	0.76	x	0.7	=	34.38	(77)
Southeast	0.9x	0.77	x	1.49	x	85.75	x	0.76	x	0.7	=	47.04	(77)
Southeast	0.9x	0.77	x	1.49	x	106.25	x	0.76	x	0.7	=	58.29	(77)
Southeast	0.9x	0.77	x	1.49	x	119.01	x	0.76	x	0.7	=	65.29	(77)
Southeast	0.9x	0.77	x	1.49	x	118.15	x	0.76	x	0.7	=	64.82	(77)
Southeast	0.9x	0.77	x	1.49	x	113.91	x	0.76	x	0.7	=	62.49	(77)
Southeast	0.9x	0.77	x	1.49	x	104.39	x	0.76	x	0.7	=	57.27	(77)
Southeast	0.9x	0.77	x	1.49	x	92.85	x	0.76	x	0.7	=	50.94	(77)
Southeast	0.9x	0.77	x	1.49	x	69.27	x	0.76	x	0.7	=	38	(77)
Southeast	0.9x	0.77	x	1.49	x	44.07	x	0.76	x	0.7	=	24.18	(77)
Southeast	0.9x	0.77	x	1.49	x	31.49	x	0.76	x	0.7	=	17.27	(77)
Northwest	0.9x	0.77	x	1.49	x	11.28	x	0.76	x	0.7	=	6.21	(81)
Northwest	0.9x	0.77	x	1.49	x	22.97	x	0.76	x	0.7	=	12.63	(81)
Northwest	0.9x	0.77	x	1.49	x	41.38	x	0.76	x	0.7	=	22.76	(81)

Northwest	0.9x	0.77	x	1.49	x	67.96	x	0.76	x	0.7	=	37.38	(81)
Northwest	0.9x	0.77	x	1.49	x	91.35	x	0.76	x	0.7	=	50.25	(81)
Northwest	0.9x	0.77	x	1.49	x	97.38	x	0.76	x	0.7	=	53.57	(81)
Northwest	0.9x	0.77	x	1.49	x	91.1	x	0.76	x	0.7	=	50.11	(81)
Northwest	0.9x	0.77	x	1.49	x	72.63	x	0.76	x	0.7	=	39.95	(81)
Northwest	0.9x	0.77	x	1.49	x	50.42	x	0.76	x	0.7	=	27.73	(81)
Northwest	0.9x	0.77	x	1.49	x	28.07	x	0.76	x	0.7	=	15.44	(81)
Northwest	0.9x	0.77	x	1.49	x	14.2	x	0.76	x	0.7	=	7.81	(81)
Northwest	0.9x	0.77	x	1.49	x	9.21	x	0.76	x	0.7	=	5.07	(81)

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

(83)m=	40.4	75.52	121.17	180.02	228.92	239.27	225.68	187.37	141.26	88.28	49.61	33.78	(83)

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

(84)m=	337.38	370.09	404.81	446.61	478.49	472.31	448.3	415.63	378.52	342.78	323.73	322.47	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.92	0.8	0.64	0.7	0.9	0.98	1	1	(86)

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

(87)m=	19.55	19.68	19.93	20.29	20.64	20.88	20.97	20.95	20.76	20.33	19.88	19.53	(87)

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

(88)m=	19.82	19.82	19.82	19.84	19.84	19.85	19.85	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	0.99	0.96	0.89	0.7	0.49	0.56	0.84	0.97	0.99	1	(89)

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

(90)m=	17.9	18.1	18.46	18.99	19.47	19.76	19.84	19.83	19.64	19.05	18.4	17.88	(90)

fLA = Living area ÷ (4) = 0.5 (91)

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

(92)m=	18.72	18.89	19.2	19.64	20.05	20.32	20.4	20.39	20.2	19.69	19.14	18.7	(92)

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

(93)m=	18.72	18.89	19.2	19.64	20.05	20.32	20.4	20.39	20.2	19.69	19.14	18.7	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.99	0.96	0.89	0.75	0.57	0.63	0.87	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	335.88	367.41	398.78	429.04	427.26	352.06	254.61	261.37	327.79	333.18	321.22	321.3	(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=	1033.6	999.78	905.44	757.51	587.85	398.82	264.85	277.48	426.75	639.87	851.08	1029.57	(97)

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

(98)m=	519.1	424.96	376.95	236.5	119.48	0	0	0	0	228.18	381.5	526.95

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2813.62 (98)

Space heating requirement in kWh/m²/year 52.12 (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 90.3 (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)	519.1	424.96	376.95	236.5	119.48	0	0	0	0	228.18	381.5	526.95		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	574.86	470.6	417.45	261.9	132.31	0	0	0	0	252.69	422.48	583.56		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													3115.85	(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)	169.05	147.67	153.64	136.27	131.94	116.2	111.33	124.11	125.48	142.88	152.52	165.08		
Efficiency of water heater													81	(216)
(217)m=	87.82	87.7	87.39	86.66	85.17	81	81	81	81	86.48	87.43	87.89		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	192.49	168.38	175.8	157.25	154.91	143.46	137.45	153.22	154.91	165.23	174.45	187.82		
Total = Sum(219a)$_{1...12}$ =													1965.36	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3115.85	
Water heating fuel used			1965.36	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			274.62	(232)
Electricity generated by PVs			-765.35	(233)

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	=	673.02	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	424.52	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1097.54	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	142.53	(268)
Energy saving/generation technologies						
Item 1			0.519	=	-397.22	(269)
Total CO2, kg/year			sum of (265)…(271) =		881.78	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		16.33	(273)
EI rating (section 14)					88	(274)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.18
Printed on 05 November 2019 at 13:22:49

Project Information:

Assessed By: Su Lee (STRO031315) **Building Type:** Detached House

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 167.51m²

Site Reference : 217 Kingston Road **Plot Reference:** Rear House

Address :

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas
Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER)	18.33 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	11.66 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	70.6 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	50.9 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.15 (max. 0.30)	0.15 (max. 0.70)	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.20 (max. 2.00)	1.20 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	4.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system: Boiler systems with radiators or underfloor heating - mains gas
Data from manufacturer
Combi boiler
Efficiency 89.5 % SEDBUK2009
Minimum 88.0 % OK

Secondary heating system: None

5 Cylinder insulation

Hot water Storage: No cylinder

N/A

Regulations Compliance Report

6 Controls

Space heating controls	TTZC by plumbing and electrical services	**OK**
Hot water controls:	No cylinder thermostat	
	No cylinder	
Boiler interlock:	Yes	**OK**

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	**OK**

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Thames valley):	Slight	**OK**

Based on:

Overshading:	Average or unknown
Windows facing: South West	15.76m²
Windows facing: North East	7.02m²
Windows facing: South West	1.98m²
Windows facing: North East	1.99m²
Windows facing: South West	3.93m²
Roof windows facing: South West	4.04m²
Roof windows facing: North East	4.04m²
Ventilation rate:	4.00
Blinds/curtains:	None

10 Key features

Photovoltaic array

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Su Lee	**Stroma Number:**	STRO031315
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.18

Property Address: Rear House

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	101.64	(1a)	x	2.7	(2a)	=	274.43	(3a)
Ground floor	65.88	(1b)	x	2.76	(2b)	=	182.08	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	167.51	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	456.51	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							4	x 10 =	40	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40	÷ (5) =	0.09	(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		4	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.29	(18)

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

Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.29	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

DER WorkSheet: New dwelling design stage

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

0.37	0.36	0.35	0.32	0.31	0.27	0.27	0.27	0.29	0.31	0.32	0.34

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.15	x	1.2	=	2.586			(26)
Windows Type 1			15.756	x1/[1/(1.2)+ 0.04]		=	18.04			(27)
Windows Type 2			7.02	x1/[1/(1.2)+ 0.04]		=	8.04			(27)
Windows Type 3			0.991	x1/[1/(1.2)+ 0.04]		=	1.13			(27)
Windows Type 4			0.996	x1/[1/(1.2)+ 0.04]		=	1.14			(27)
Windows Type 5			3.929	x1/[1/(1.2)+ 0.04]		=	4.5			(27)
Rooflights Type 1			2.02	x1/[1/(1.2) + 0.04]		=	2.424			(27b)
Rooflights Type 2			2.02	x1/[1/(1.2) + 0.04]		=	2.424			(27b)
Floor			101.64	x	0.13	=	13.2132			(28)
Walls Type1	45.8	0	45.8	x	0.15	=	6.87			(29)
Walls Type2	74.79	24.93	49.86	x	0.15	=	7.48			(29)
Walls Type3	76.94	7.9	69.04	x	0.15	=	10.36			(29)
Roof Type1	33.77	0	33.77	x	0.13	=	4.39			(30)
Roof Type2	4.35	0	4.35	x	0.13	=	0.57			(30)
Roof Type3	15.23	0	15.23	x	0.13	=	1.98			(30)
Roof Type4	60.62	8.08	52.54	x	0.13	=	6.83			(30)
Total area of elements, m²			413.14							(31)

DER WorkSheet: New dwelling design stage

** 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) =		98.65	(33)
Heat capacity Cm = S(A x k)		((28)…(30) + (32) + (32a)…(32e) =	0	(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		33.72	(36)

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

Total fabric heat loss	(33) + (36) =	132.36	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	85.45	85.06	84.67	82.86	82.52	80.95	80.95	80.66	81.55	82.52	83.21	83.93	(38)

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

(39)m=	217.82	217.42	217.04	215.23	214.89	213.31	213.31	213.02	213.92	214.89	215.57	216.29	

Average = Sum(39)$_{1…12}$ /12= 215.23 (39)

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

(40)m=	1.3	1.3	1.3	1.28	1.28	1.27	1.27	1.27	1.28	1.28	1.29	1.29	

Average = Sum(40)$_{1…12}$ /12= 1.28 (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	2.96	(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	104.48	(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=	114.93	110.75	106.57	102.39	98.21	94.03	94.03	98.21	102.39	106.57	110.75	114.93	

Total = Sum(44)$_{1…12}$ = 1253.78 (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=	170.44	149.07	153.82	134.11	128.68	111.04	102.89	118.07	119.48	139.25	152	165.06	

Total = Sum(45)$_{1…12}$ = 1643.91 (45)

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

(46)m=	25.57	22.36	23.07	20.12	19.3	16.66	15.43	17.71	17.92	20.89	22.8	24.76	(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)

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Energy lost from water storage, kWh/year	(48) x (49) =	0	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0	(52)
Temperature factor from Table 2b		0	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0	(55)

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

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

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

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

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

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

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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

(61)m=	50.96	46.03	50.96	49.32	50.05	46.37	47.92	50.05	49.32	50.96	49.32	50.96	(61)

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

(62)m=	221.4	195.09	204.78	183.42	178.73	157.41	150.81	168.12	168.8	190.2	201.31	216.02	(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=	221.4	195.09	204.78	183.42	178.73	157.41	150.81	168.12	168.8	190.2	201.31	216.02

Output from water heater (annual)$_{1...12}$ | 2236.1 | (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=	69.41	61.07	63.89	56.92	55.3	48.51	46.19	51.77	52.06	59.04	62.87	67.62	(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=	147.96	147.96	147.96	147.96	147.96	147.96	147.96	147.96	147.96	147.96	147.96	147.96	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	30.22	26.84	21.83	16.53	12.35	10.43	11.27	14.65	19.66	24.97	29.14	31.06	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	339.01	342.52	333.66	314.79	290.96	268.57	253.62	250.1	258.96	277.84	301.66	324.05	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	37.8	37.8	37.8	37.8	37.8	37.8	37.8	37.8	37.8	37.8	37.8	37.8	(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=	-118.37	-118.37	-118.37	-118.37	-118.37	-118.37	-118.37	-118.37	-118.37	-118.37	-118.37	-118.37	(71)

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Water heating gains (Table 5)

(72)m=	93.29	90.88	85.87	79.05	74.32	67.38	62.09	69.59	72.3	79.35	87.32	90.89	(72)

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

(73)m=	532.91	530.64	511.75	480.76	448.03	416.77	397.36	404.72	421.32	452.54	488.5	516.39	(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	7.02	x	11.28	x	0.76	x	0.7	=	29.2	(75)
Northeast	0.9x	0.77	x	1	x	11.28	x	0.76	x	0.7	=	8.29	(75)
Northeast	0.9x	0.77	x	7.02	x	22.97	x	0.76	x	0.7	=	59.44	(75)
Northeast	0.9x	0.77	x	1	x	22.97	x	0.76	x	0.7	=	16.87	(75)
Northeast	0.9x	0.77	x	7.02	x	41.38	x	0.76	x	0.7	=	107.09	(75)
Northeast	0.9x	0.77	x	1	x	41.38	x	0.76	x	0.7	=	30.39	(75)
Northeast	0.9x	0.77	x	7.02	x	67.96	x	0.76	x	0.7	=	175.88	(75)
Northeast	0.9x	0.77	x	1	x	67.96	x	0.76	x	0.7	=	49.91	(75)
Northeast	0.9x	0.77	x	7.02	x	91.35	x	0.76	x	0.7	=	236.41	(75)
Northeast	0.9x	0.77	x	1	x	91.35	x	0.76	x	0.7	=	67.08	(75)
Northeast	0.9x	0.77	x	7.02	x	97.38	x	0.76	x	0.7	=	252.04	(75)
Northeast	0.9x	0.77	x	1	x	97.38	x	0.76	x	0.7	=	71.52	(75)
Northeast	0.9x	0.77	x	7.02	x	91.1	x	0.76	x	0.7	=	235.78	(75)
Northeast	0.9x	0.77	x	1	x	91.1	x	0.76	x	0.7	=	66.9	(75)
Northeast	0.9x	0.77	x	7.02	x	72.63	x	0.76	x	0.7	=	187.97	(75)
Northeast	0.9x	0.77	x	1	x	72.63	x	0.76	x	0.7	=	53.34	(75)
Northeast	0.9x	0.77	x	7.02	x	50.42	x	0.76	x	0.7	=	130.49	(75)
Northeast	0.9x	0.77	x	1	x	50.42	x	0.76	x	0.7	=	37.03	(75)
Northeast	0.9x	0.77	x	7.02	x	28.07	x	0.76	x	0.7	=	72.64	(75)
Northeast	0.9x	0.77	x	1	x	28.07	x	0.76	x	0.7	=	20.61	(75)
Northeast	0.9x	0.77	x	7.02	x	14.2	x	0.76	x	0.7	=	36.74	(75)
Northeast	0.9x	0.77	x	1	x	14.2	x	0.76	x	0.7	=	10.43	(75)
Northeast	0.9x	0.77	x	7.02	x	9.21	x	0.76	x	0.7	=	23.85	(75)
Northeast	0.9x	0.77	x	1	x	9.21	x	0.76	x	0.7	=	6.77	(75)
Southwest	0.9x	0.77	x	15.76	x	36.79		0.76	x	0.7	=	213.73	(79)
Southwest	0.9x	0.77	x	0.99	x	36.79		0.76	x	0.7	=	26.89	(79)
Southwest	0.9x	0.77	x	3.93	x	36.79		0.76	x	0.7	=	53.3	(79)
Southwest	0.9x	0.77	x	15.76	x	62.67		0.76	x	0.7	=	364.06	(79)
Southwest	0.9x	0.77	x	0.99	x	62.67		0.76	x	0.7	=	45.8	(79)
Southwest	0.9x	0.77	x	3.93	x	62.67		0.76	x	0.7	=	90.78	(79)
Southwest	0.9x	0.77	x	15.76	x	85.75		0.76	x	0.7	=	498.12	(79)
Southwest	0.9x	0.77	x	0.99	x	85.75		0.76	x	0.7	=	62.66	(79)

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Southwest	0.9x	0.77	x	3.93	x	85.75		0.76	x	0.7	=	124.22	(79)
Southwest	0.9x	0.77	x	15.76	x	106.25		0.76	x	0.7	=	617.2	(79)
Southwest	0.9x	0.77	x	0.99	x	106.25		0.76	x	0.7	=	77.64	(79)
Southwest	0.9x	0.77	x	3.93	x	106.25		0.76	x	0.7	=	153.91	(79)
Southwest	0.9x	0.77	x	15.76	x	119.01		0.76	x	0.7	=	691.32	(79)
Southwest	0.9x	0.77	x	0.99	x	119.01		0.76	x	0.7	=	86.96	(79)
Southwest	0.9x	0.77	x	3.93	x	119.01		0.76	x	0.7	=	172.39	(79)
Southwest	0.9x	0.77	x	15.76	x	118.15		0.76	x	0.7	=	686.32	(79)
Southwest	0.9x	0.77	x	0.99	x	118.15		0.76	x	0.7	=	86.33	(79)
Southwest	0.9x	0.77	x	3.93	x	118.15		0.76	x	0.7	=	171.14	(79)
Southwest	0.9x	0.77	x	15.76	x	113.91		0.76	x	0.7	=	661.68	(79)
Southwest	0.9x	0.77	x	0.99	x	113.91		0.76	x	0.7	=	83.24	(79)
Southwest	0.9x	0.77	x	3.93	x	113.91		0.76	x	0.7	=	165	(79)
Southwest	0.9x	0.77	x	15.76	x	104.39		0.76	x	0.7	=	606.39	(79)
Southwest	0.9x	0.77	x	0.99	x	104.39		0.76	x	0.7	=	76.28	(79)
Southwest	0.9x	0.77	x	3.93	x	104.39		0.76	x	0.7	=	151.21	(79)
Southwest	0.9x	0.77	x	15.76	x	92.85		0.76	x	0.7	=	539.36	(79)
Southwest	0.9x	0.77	x	0.99	x	92.85		0.76	x	0.7	=	67.85	(79)
Southwest	0.9x	0.77	x	3.93	x	92.85		0.76	x	0.7	=	134.5	(79)
Southwest	0.9x	0.77	x	15.76	x	69.27		0.76	x	0.7	=	402.37	(79)
Southwest	0.9x	0.77	x	0.99	x	69.27		0.76	x	0.7	=	50.61	(79)
Southwest	0.9x	0.77	x	3.93	x	69.27		0.76	x	0.7	=	100.34	(79)
Southwest	0.9x	0.77	x	15.76	x	44.07		0.76	x	0.7	=	256	(79)
Southwest	0.9x	0.77	x	0.99	x	44.07		0.76	x	0.7	=	32.2	(79)
Southwest	0.9x	0.77	x	3.93	x	44.07		0.76	x	0.7	=	63.84	(79)
Southwest	0.9x	0.77	x	15.76	x	31.49		0.76	x	0.7	=	182.91	(79)
Southwest	0.9x	0.77	x	0.99	x	31.49		0.76	x	0.7	=	23.01	(79)
Southwest	0.9x	0.77	x	3.93	x	31.49		0.76	x	0.7	=	45.61	(79)
Rooflights	0.9x	1	x	2.02	x	40.32	x	0.76	x	0.7	=	77.99	(82)
Rooflights	0.9x	1	x	2.02	x	16.09	x	0.76	x	0.7	=	31.13	(82)
Rooflights	0.9x	1	x	2.02	x	73.69	x	0.76	x	0.7	=	142.54	(82)
Rooflights	0.9x	1	x	2.02	x	32.97	x	0.76	x	0.7	=	63.77	(82)
Rooflights	0.9x	1	x	2.02	x	111.54	x	0.76	x	0.7	=	215.77	(82)
Rooflights	0.9x	1	x	2.02	x	60.54	x	0.76	x	0.7	=	117.1	(82)
Rooflights	0.9x	1	x	2.02	x	151.96	x	0.76	x	0.7	=	293.94	(82)
Rooflights	0.9x	1	x	2.02	x	101.95	x	0.76	x	0.7	=	197.21	(82)
Rooflights	0.9x	1	x	2.02	x	179.7	x	0.76	x	0.7	=	347.6	(82)
Rooflights	0.9x	1	x	2.02	x	139.58	x	0.76	x	0.7	=	270.01	(82)
Rooflights	0.9x	1	x	2.02	x	181.76	x	0.76	x	0.7	=	351.58	(82)
Rooflights	0.9x	1	x	2.02	x	149.95	x	0.76	x	0.7	=	290.06	(82)
Rooflights	0.9x	1	x	2.02	x	173.9	x	0.76	x	0.7	=	336.37	(82)

Rooflights	0.9x	1	x	2.02	x	139.82	x	0.76	x	0.7	=	270.46	(82)
Rooflights	0.9x	1	x	2.02	x	153.23	x	0.76	x	0.7	=	296.39	(82)
Rooflights	0.9x	1	x	2.02	x	109.87	x	0.76	x	0.7	=	212.52	(82)
Rooflights	0.9x	1	x	2.02	x	125.83	x	0.76	x	0.7	=	243.4	(82)
Rooflights	0.9x	1	x	2.02	x	74.51	x	0.76	x	0.7	=	144.13	(82)
Rooflights	0.9x	1	x	2.02	x	84.58	x	0.76	x	0.7	=	163.61	(82)
Rooflights	0.9x	1	x	2.02	x	40.53	x	0.76	x	0.7	=	78.4	(82)
Rooflights	0.9x	1	x	2.02	x	49.27	x	0.76	x	0.7	=	95.3	(82)
Rooflights	0.9x	1	x	2.02	x	20.27	x	0.76	x	0.7	=	39.21	(82)
Rooflights	0.9x	1	x	2.02	x	33.84	x	0.76	x	0.7	=	65.46	(82)
Rooflights	0.9x	1	x	2.02	x	13.14	x	0.76	x	0.7	=	25.41	(82)

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

(83)m=	440.52	783.26	1155.34	1565.69	1871.77	1909	1819.44	1584.1	1296.75	888.58	533.72	373.01	(83)

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

(84)m=	973.43	1313.9	1667.09	2046.44	2319.8	2325.77	2216.8	1988.82	1718.07	1341.13	1022.23	889.4	(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	0.9	0.76	0.57	0.42	0.48	0.75	0.96	1	1	(86)

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

(87)m=	19.55	19.8	20.17	20.59	20.87	20.97	20.99	20.99	20.9	20.48	19.92	19.5	(87)

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

(88)m=	19.84	19.84	19.84	19.85	19.85	19.86	19.86	19.86	19.86	19.85	19.85	19.85	(88)

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

(89)m=	1	0.99	0.96	0.87	0.69	0.47	0.31	0.37	0.67	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=	17.91	18.29	18.81	19.4	19.74	19.85	19.86	19.86	19.79	19.27	18.46	17.85	(90)

fLA = Living area ÷ (4) = | 0.49 | (91)

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

(92)m=	18.7	19.02	19.47	19.98	20.28	20.39	20.41	20.41	20.33	19.86	19.17	18.65	(92)

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

(93)m=	18.7	19.02	19.47	19.98	20.28	20.39	20.41	20.41	20.33	19.86	19.17	18.65	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.96	0.88	0.72	0.52	0.36	0.42	0.7	0.94	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	970.2	1298.18	1601.65	1796.81	1663.06	1203.9	807.97	844.12	1211.12	1261.43	1013.72	887.4	(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)

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Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(97)m=	3137.61	3070.33	2815.24	2383.78	1844.65	1235.68	812.91	853.83	1332.46	1989.61	2601.77	3125.53		(97)

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

(98)m=	1612.55	1190.88	902.91	422.62	135.1	0	0	0	0	541.77	1143.39	1665.17		

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 7614.4 (98)

Space heating requirement in kWh/m²/year 45.46 (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		90.3	(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)	1612.55	1190.88	902.91	422.62	135.1	0	0	0	0	541.77	1143.39	1665.17		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	1785.77	1318.81	999.9	468.02	149.62	0	0	0	0	599.96	1266.22	1844.04		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													8432.34	(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)	221.4	195.09	204.78	183.42	178.73	157.41	150.81	168.12	168.8	190.2	201.31	216.02		
Efficiency of water heater													81	(216)
(217)m=	89.07	88.86	88.42	87.27	84.76	81	81	81	81	87.68	88.77	89.12		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	248.58	219.54	231.59	210.18	210.87	194.34	186.19	207.56	208.39	216.92	226.77	242.38		
Total = Sum(219a)$_{1...12}$ =													2603.31	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			8432.34	
Water heating fuel used			2603.31	
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			533.74	(232)
Electricity generated by PVs			-1437.33	(233)

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	=	1821.38	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	562.31	(264)
Space and water heating	(261) + (262) + (263) + (264) =				2383.7	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	277.01	(268)
Energy saving/generation technologies Item 1			0.519	=	-745.97	(269)
Total CO2, kg/year			sum of (265)…(271) =		1953.66	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		11.66	(273)
EI rating (section 14)					88	(274)