Three Fold Architects on behalf of Charles Morin and Emilie Bellet

Energy & Sustainability Assessment

Proposed demolition of existing house and development of 1no new mid-terrace house @ 59 Camden Mews, London, NW1 9BY

13 October 2017

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Issue Status

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First Issue Date	Revision Issue Date	Issue Revision	Issued By
October 13, 2017			*DW*

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Section

Appendices

1. Executive Summary

This document is in response to the London Borough of Camden Council's Local Plan 2016, and specifically deals with the following policies that cover climate change and sustainability:

- CC1 – Climate Change Mitigation
- CC2 – Adapting to Climate Change

The report details how the development will incorporate Sustainable Design and resource efficiency measures in accordance with the Energy Hierarchy, so to meet the policy requirements and reduce its overall environmental impact.

In relation to Policy CC1 – Renewable and Low-Carbon Sources of Energy, the development is required to achieve a 19% Carbon Reduction over Part L Compliancy of the Building Regulations, in addition to any requirements for renewable energy.

In order to demonstrate this 19% reduction in carbon emissions, four separate scenarios have been tested, each utilising a mix of resource efficiency measures, the application of Low / Zero Carbon technologies or both.

The figures used within this report have been based on the most recent issue of drawings (October 2017) and modelled using SAP 2012 to accurately predict Energy Usage and CO_2 reductions.

In the proposed scenario the new dwellings utilise highly efficient regular condensing gas boilers to satisfy both the space heating and well insulated hot water cylinders for the hot water requirement in addition to U Values and design targets specified to well exceed Part L 2014 compliance.

Following the LZC feasibility assessment, it is proposed that the development will not utilise any renewable technologies as the energy efficiency measures incorporated achieved the required percentage reduction.

As a result of the above, the predicted site wide reduction in CO_2 over Part L 2014 of the Building Regulations is **19.3%**.

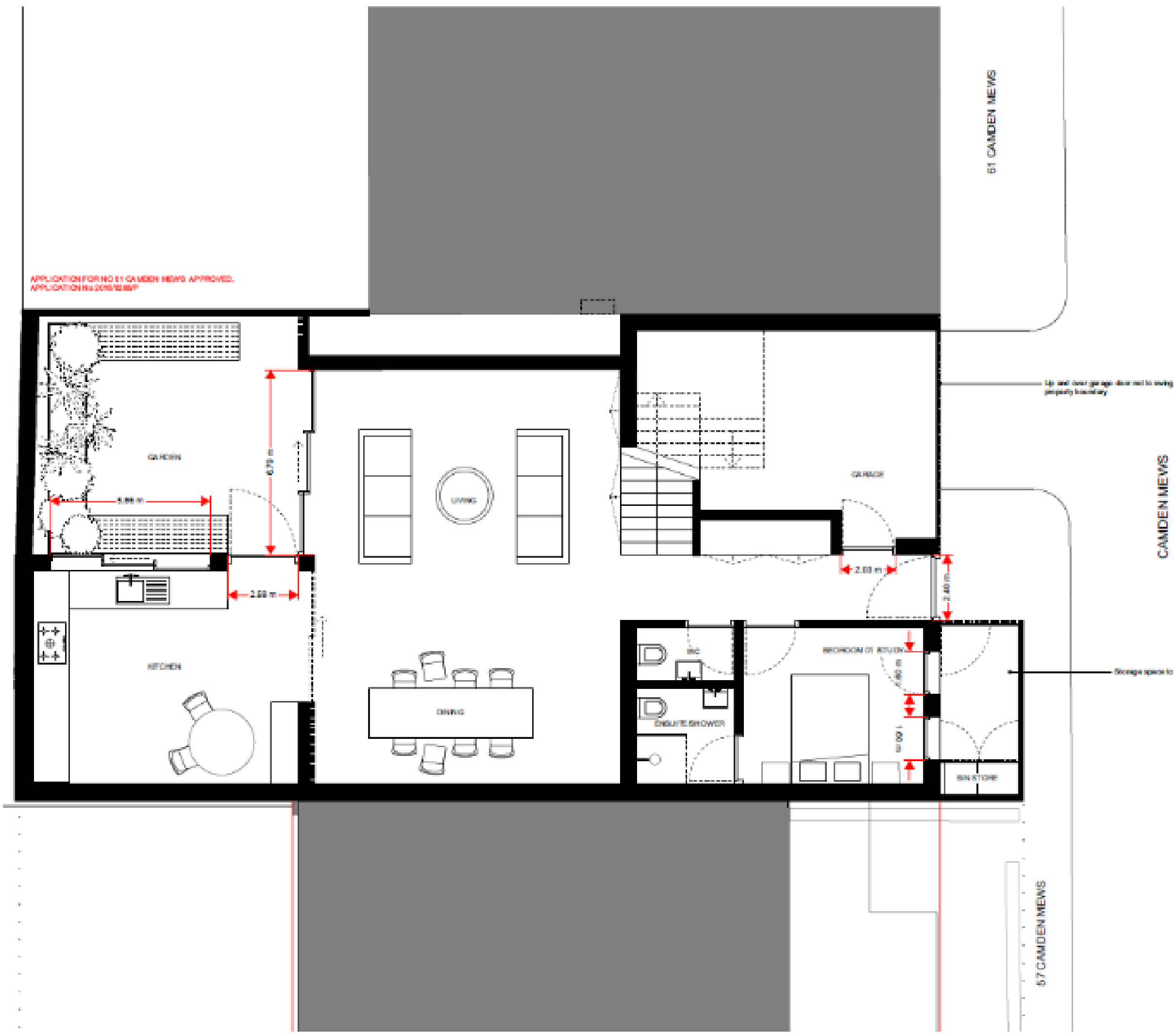
Therefore, the development complies with the CO_2 reduction target requirement as outlined within Policy CC1.

2. Planning Statement

The following report relates to the proposed new dwelling on the land at 59 Camden Mews, London, NW1 9BY.

2.1 The Development

The development includes the demolition of the existing mid-terrace dwelling and the subsequent construction of 1No. two-storey, mid-terrace dwelling with accompanying garage.



Proposed Ground Floor Plan (not to scale)

2.2 Relevant Policies

This report is a resultant production in response to the London Borough of Camden Council's Local Plan 2016, and specifically deals with planning policies CC1 and CC2, covering Climate Change and Sustainability.

CC1 – Mitigating and Adapting to Climate Change

Policy CC1 Climate change mitigation

The Council will require all development to minimise the effects of climate change and encourage all developments to meet the highest feasible environmental standards that are financially viable during construction and occupation.

We will:

a. promote zero carbon development and require all development to reduce carbon dioxide emissions through following the steps in the energy hierarchy;
b. require all major development to demonstrate how London Plan targets for carbon dioxide emissions have been met;
c. ensure that the location of development and mix of land uses minimise the need to travel by car and help to support decentralised energy networks;
d. support and encourage sensitive energy efficiency improvements to existing buildings;
e. require all proposals that involve substantial demolition to demonstrate that it is not possible to retain and improve the existing building; and
f. expect all developments to optimise resource efficiency.

For decentralised energy networks, we will promote decentralised energy by:

g. working with local organisations and developers to implement decentralised energy networks in the parts of Camden most likely to support them;
h. protecting existing decentralised energy networks (e.g. at Gower Street Bloomsbury, King's Cross, Gospel Oak and Somers Town) and safeguarding potential network routes; and
i. requiring all major developments to assess the feasibility of connecting to an existing decentralised energy network, or where this is not possible establishing a new network.

To ensure that the Council can monitor the effectiveness of renewable and low carbon technologies, major developments will be required to install appropriate monitoring equipment.

The energy hierarchy

The Council's Sustainability Plan 'Green Action for Change' commits the Council to seek low and where possible zero carbon buildings. New developments in Camden will be expected to be designed to minimise energy use and CO2 emissions in operation through the application of the "energy hierarchy". The energy hierarchy is a sequence of steps that minimise the energy consumption of a building. Buildings designed in line with the energy hierarchy prioritise lower cost passive design measures, such as improved fabric performance over higher cost active systems such as renewable energy technologies.

The following diagram shows a simplified schematic of the energy hierarchy, which is explained further in supplementary planning document Camden Planning Guidance 3: Sustainability.

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

All developments involving five or more dwellings and/or more than 500 sqm of (gross internal) any floorspace will be required to submit an energy statement demonstrating how the energy hierarchy has been applied to make the fullest contribution to CO2 reduction. All new residential development will also be required to demonstrate a 19% CO2 reduction below Part L 2013 Building Regulations (in addition to any requirements for renewable energy). This can be demonstrated through an energy statement or sustainability statement.

Be lean

Proposals should demonstrate how passive design measures including the development orientation, form, mass, and window sizes and positions have been taken into consideration to reduce energy demand, demonstrating that the minimum energy efficiency requirements required under building regulations will be met and where possible exceeded. This is in line with stage one of the energy hierarchy 'Be lean'.

Be clean

The second stage of the energy hierarchy 'Be clean' should demonstrate how the development will supply energy efficiently through decentralised energy. Please refer to the section below on decentralised energy generation.

Be green

The Council will expect developments of five or more dwellings and/or more than 500 sqm of any gross internal floorspace to achieve a 20% reduction in carbon dioxide emissions from on-site renewable energy generation (which can include sources of site related decentralised renewable energy) unless it can be demonstrated that such provision is not feasible. This is in line with stage three of the energy hierarchy 'Be green'. The 20% reduction should be calculated from the regulated CO2 emissions of the development after all proposed energy efficiency measures and any CO2 reduction from non-renewable decentralised energy (e.g. CHP) have been incorporated.

All major developments will also be expected to demonstrate how relevant London Plan targets for CO2 reduction, including targets for renewable energy, have been met. Where it is demonstrated that the required London Plan reductions in carbon dioxide emissions cannot be met on site, the Council will require a financial contribution to an agreed borough wide programme to provide for local low carbon projects. The borough wide programme will be connected to key projects identified in the Council's Green Action for Change.

CC2 – Adapting to Climate Change

Policy CC2 Adapting to climate change

The Council will require development to be resilient to climate change.

All development should adopt appropriate climate change adaptation measures such as::

a. the protection of existing green spaces and promoting new appropriate green infrastructure;
b. not increasing, and wherever possible reducing, surface water run-off through increasing permeable surfaces and use of Sustainable Drainage Systems;
c. incorporating bio-diverse roofs, combination green and blue roofs and green walls where appropriate; and
d. measures to reduce the impact of urban and dwelling overheating, including application of the cooling hierarchy.

Any development involving 5 or more residential units or 500 sqm or more of any additional floorspace is required to demonstrate the above in a Sustainability Statement.

Sustainable design and construction measures

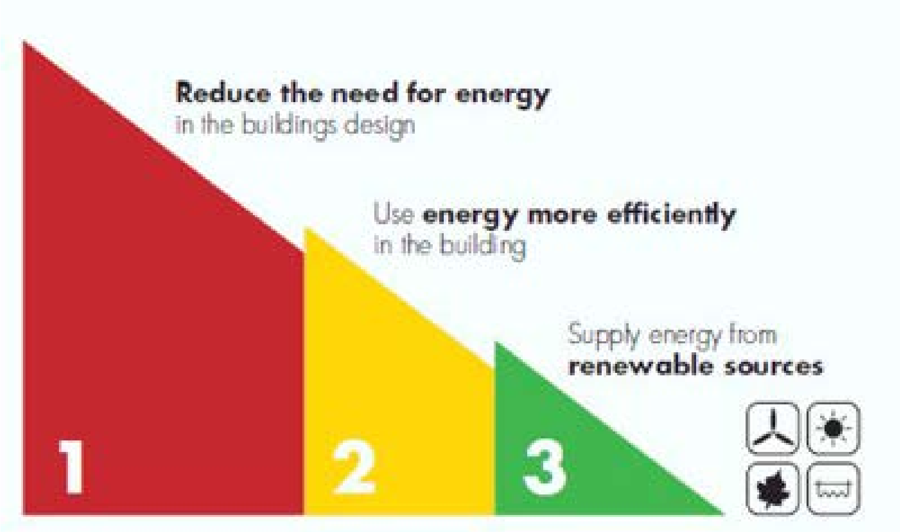
The Council will promote and measure sustainable design and construction by:

e. ensuring development schemes demonstrate how adaptation measures and sustainable development principles have been incorporated into the design and proposed implementation;
f. encourage new build residential development to use the Home Quality Mark and Passivhaus design standards;
g. expecting developments (conversions/extensions) of 500 sqm of residential floorspace or above or five or more dwellings to achieve "excellent" in BREEAM domestic refurbishment; and
h. expecting non-domestic developments of 500 sqm of floorspace or above to achieve "excellent" in BREEAM assessments and encouraging zero carbon in new development from 2019.

2.3 Sustainable Design Strategy

To achieve the most accurate calculations and estimates, the proposed dwelling has been modelled using *SAP 2012* the governments Standard Assessment Procedure for residential dwellings.

A Part L compliant baseline has been established and then further improvements have been made to the building fabric and specification prior to the addition of LZC technologies. This is in compliance with the Energy Hierarchy:



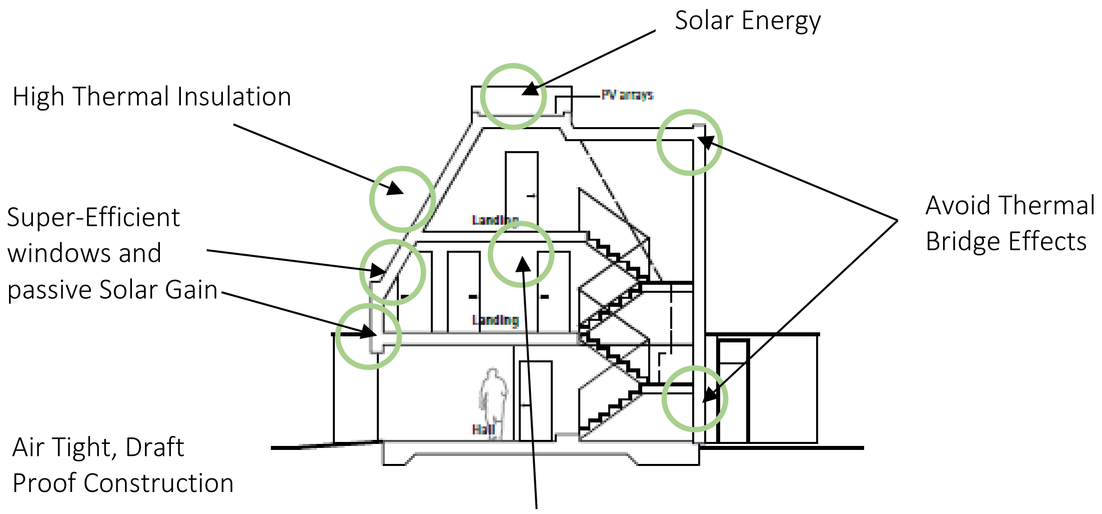
In accordance with the above methodology, the development will be designed with a fabric first approach, meaning all fabric U Values, air permeability and ventilation targets are above and beyond Building Regulations Compliancy.

Further efficiency measures to both the building fabric and building services will be incorporated to reduce the energy demand further and associated carbon emissions. This approach demonstrates a holistic low energy design concept, involving very low limiting values and thus leads to high energy performance targets.

2.4 Energy Efficient Design and Specification

In line with the above Sustainable Design Strategy, the following Energy Efficient design measures are specified.

- High levels of insulation throughout with minimal thermal bridges.
- Passive solar gains and internal heat sources.
- Excellent level of airtightness.
- Good indoor air quality by openable windows



The Proposed specifications and key energy efficient design measures are as follows:

- Ground Floor U-value of 0.12 W/m²K
- External Wall U-value of 0.2 W/m²K
- Roof U-value of 0.1 W/m²K
- Use of Accredited Construction Details to minimize Thermal Bridging and y Value. Specifically installing Hi-Therm lintels with a thermal conductivity of 0.05 W/m²K.
- Low Double-Glazed Window and Rooflight U-values of 1.2 W/m²K
- Low Door U-values of 1 W/m²K
- 100% low energy lighting throughout
- Vaillant ecoTEC plus 415 Regular Condensing gas boiler- 89.3% efficiency
- Design Air Permeability Rate of 4m³/hm².
- Fully insulated, 100mm thickness, 300 Litre Hot Water Cylinder

Operational usage will be improved further by ensuring better occupant management through the following:

- Energy Display devices showing electricity and primary fuel consumption.
- Efficient White Goods where supplied (A+ or A rated).
- Low Water Use fittings on Sanitary Ware
- A Home User Guide to explain how to use the dwelling, fittings and appliances efficiently.

2.5 Sustainable Development

In addition to the primary building design and fabric, many other issues will influence creating a Sustainable Development. Sustainability should be shown early consideration and then continually promoted throughout construction. Features which enable more efficient usage should also be specified to encourage the building users to maintain efficient use throughout occupation.

Materials

- Where possible, responsibly sourced (such as FSC timber), recycled or reclaimed materials will be used.

Water Use

- Indoor water use will be restricted by use of fittings with lower flow rates, baths with smaller capacity, dual-flush toilets, and (where applicable) washing machines and dishwashers with low water usage.

Waste

- The contractor will be obligated to produce a Site Waste Management Plan (SWMP) to set targets and monitor to reduce waste and divert from landfill.
- The development will incorporate dedicated internal and external general waste and recyclable storage in accordance with the LA collection.

Health, Wellbeing & pollution

- Key rooms have good levels of day lighting and so the need for artificial lighting is reduced.
- Boilers with very Low NOx emissions will be specified.
- Improved acoustic performance between rooms.

Demolition

The existing building, constructed in the 1970's, requires significant refurbishment and upgrading of the building fabric to meet the energy standards required under current building regulations. Significant works are also required to the fabric of the building to provide more space for its current owner occupiers. Early design proposals looked to reuse the existing building to improve its energy use, reduce C02 emissions and provide a higher quality family dwelling. Having reviewed the structural implications and outlined a sustainable design strategy to achieve this it was concluded that a better long term sustainable solution would to be to demolish and rebuild.

2.6 Choice and Impact of Renewable Technology

All reasonable technologies were investigated for their suitability to the site and development; please refer to section 3 for details, however no renewable technologies have been specified. This is due to highly efficient measures being incorporated into the design which enable to 19% reduction in carbon emissions being achieved.

2.7 Energy & CO_2 Reduction Summary

A summary of all stages of the energy demand assessment from baseline figures to final carbon reduction are shown in Figures 1 and 2 below:

Summary of CO2 Emission Reductions	Total CO2 emissions (kgCO2/year)
Baseline emissions	2876.7
Improved emissions (after application of energy efficiency measures)	2321.9
Improved emissions (after incorporation of efficient energy supply)	2321.9
Improved emissions (after incorporation of renewable energy technology) % CO2 displaced in total	2321.9
% CO2 displaced in total	**19.3%**
% CO2 displaced by energy efficiency measures	19.3%
% CO2 displaced by efficient supply of energy	0.0%
% CO2 displaced by LZC Technologies	**0.0%**

Fig 1. Summary of CO2 Reductions

	Energy demand (kWh pa)	Energy saving achieved (%)	Regulated CO_2 emissions (kg pa)	Saving achieved on residual CO_2 emissions (%)
Building Regulations Part L compliance ("Baseline" energy demand & emissions)	12458.6		2876.7	
Proposed scheme after energy efficiency measures and CHP ("Residual" energy demand & emissions)	9890.0	20.6%	2321.9	19.3%
Proposed scheme after on-site renewables	9890.0	20.6%	2321.9	0.0%
Proposed scheme offset for financial contribution or other "allowable solution"			0	0
Total savings on residual emissions				**0.0%**

Fig 2. Savings on residual emissions

For a full Breakdown of the figures and calculations, please see Appendix A – Energy Demand Assessment Spreadsheet.

Baseline energy demand

'Standard Assessment Procedure - SAP 2012' produce example SAP reports to generate the figures used within the calculations.

Baseline energy demand (kWh pa)	12458.6
Regulated emissions (kg pa)	2876.7

Heating

The heating and cooling hierarchy has been applied to the design process of the development. It has resulted in large focus on energy efficiency measures and as can be seen in Figure 1.

Energy savings from the use of CHP systems (kWh pa)	-
Emission savings from the use of CHP systems (kg pa)	-
Total regulated emissions after CHP savings (kg pa)	2321.9

Energy efficiency

The following table demonstrates how the development achieves the reduction in carbon dioxide emissions from energy efficiency measures.

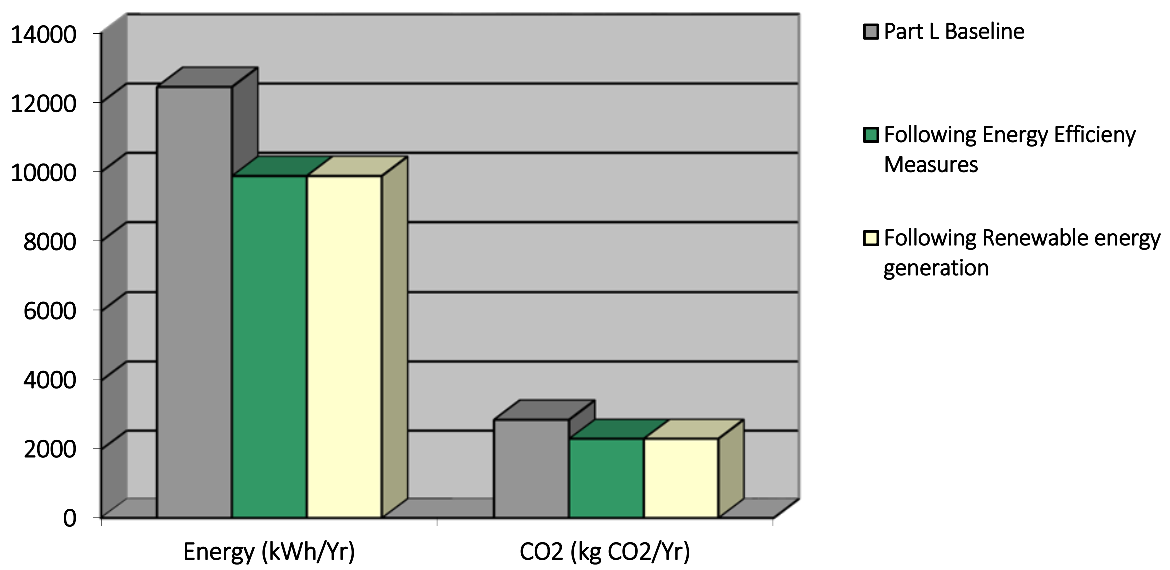
Energy savings from energy efficiency measures (kWh pa)	2568.6
Emission savings from energy efficiency measures (kg pa)	554.8
Total regulated emissions after CHP savings and energy effi ciency measures (kg pa) ("residual emissions")	2321.9

On-site renewables

The following table demonstrates how the development achieves the reduction in carbon dioxide emissions from LZC technologies.

Energy saving from the use of renewables (kWh)	0.0
Saving on residual emissions from the use of renewables (kg)	0.0
Saving on residual emissions from the use of renewables (%)	0.0%

The chart below illustrates the improvements over the Part L Compliant Baseline for Scenario 1:



3. Feasibility assessment of renewable energy technologies

Solar Hot Water (Thermal)

Solar water heating systems are one of the more familiar renewable technologies used at present. They use the energy from the sun to heat water, most commonly for hot water needs. Solar heating systems use a heat collector that is usually mounted on a roof in which the sun heats a fluid. This fluid is used to heat water that is stored in either a separate hot water cylinder or in a twin-coil hot water cylinder (the second coil is used to provide additional heating from a boiler or other heat source).

Solar hot water panels could be used however; PV will provide slightly better savings and avoid the need for water storage cylinders when compared.

Renewable Technology Not Chosen.

Wind

Wind turbines convert the kinetic energy in wind into mechanical energy and then again into electricity. Turbines are available in a range of sizes and designs and can be freestanding, mounted on a building or integrated into a building structure.

The wind speed in the area is under the advised minimum, the small size of the site and limited available space, in addition to the large initial costs means that a wind turbine would not be feasible.

Renewable Technology Not Viable

Photovoltaic Panels (PV)

Photovoltaic modules convert sunlight directly to DC electricity. The solar cells consist of a thin piece of semiconductor material, in most cases of silicon. Through a process called doping, very small amounts of impurities are added to the semiconductor, which creates two different layers called n-type and p-type layers.

Certain wavelengths of light are able to ionize the silicon atoms, which separates some of the positive charges (holes) from the negative charges (electrons). The holes move into the positive or p-layer and the electrons into the negative or n-layer. These opposite charges are attracted to each other, but most of them can only re-combine by the electrons passing through an external circuit, due to an internal potential energy barrier. This flow of electrons produces a DC current.

A PV array can be mounted on the suitable roof space and has been tested in scenario 3. However no PV has been specified for this development due to scenario 1 being proposed as PV has financial and aesthetic implications. Furthermore the percentage improvement requirements have been met through the use of highly efficient and thermally efficient specifications.

Renewable technology tested but not chosen

Biomass Heating

Biomass is any plant-derived organic material that renews itself over a short period.

Biomass energy systems are based on either the direct or indirect combustion of fuels derived from those plant sources. The most common form of biomass is the direct combustion of wood in treated or untreated forms. The use of biomass is becoming increasingly common in some European countries (some countries such as Austria are heavily dependent on biomass).

The environmental benefits relate to the significantly lower amounts of energy used in biomass production and processing compared to the energy released when they are burnt. This can range from a four-fold return for biodiesel to an approximate 20-fold energy return for woody biomass. Biomass-fuels can be used to produce energy on a continuous basis (unlike renewables such as wind or solar energy) and it can be an economic alternative to fossil fuels as it is a potential source of both heat and electricity.

However, Biomass systems have particular design management and maintenance requirements associated with sourcing, transportation and storage and are therefore more commonly used in commercial developments rather than domestic installations. It can be less convenient to operate than mains-supplied fuels such as natural gas and are more management intensive and require expertise in facilities management. Sources of biomass can also fluctuate, so boilers should be specified to operate on a variety of fuels without risk of overheating or tripping out.

A communal biomass system would not be feasible for this development due to use, space and maintenance issues. The system would be extremely large and there is very little space around the properties to locate the boilers, hoppers and fuel stores that is suitable for deliveries, but also appropriate for feeding the boiler.

Renewable Technology Not Viable

Ground Source Heat pumps

A heat pump is a device that takes up heat at a certain temperature and releases it at a higher temperature. The essential components of a heat pump are heat exchangers (through which energy is extracted and emitted) and a means of pumping heat between the exchangers. The effectiveness of the heat pump is measured by the ratio of the heating capacity to the effective power input, usually known as the coefficient of performance (COP). Ground-source heat pumps (GSHP) extract heat from the ground. They are classified as either water-to-air or water-to-water units depending on whether the heat distribution system in the building uses air or water. Ground source heat pumps either use long shallow trenches or deep vertical boreholes to take low grade heat from the ground and then compress it to create higher temperatures.

Ground source heat pumps would not be suitable due to the lack of land space around the properties and the associates costs.

Renewable Technology Not Viable

Air Source Heat pumps

Air source heat pumps absorb heat from the outside air. This is usually used to heat radiators, underfloor heating systems, or warm air convectors and hot water in your home. An air source heat pump extracts heat from the outside air in the same way that a fridge extracts heat from its inside.

The system performs down to air temperatures of -20°c which means that they are more than suitable for installations within the UK. Hot water and Heating can be provided 365 days a year. The hot water is produced without the aid of electrical immersions and at 55°c is more than hot enough for baths and showers.

There are two main types of air source heat pump system:

- An air-to-water system distributes heat via your wet central heating system. Heat pumps work much more efficiently at a lower temperature than a standard boiler system would. So they are more suitable for under-floor heating systems or larger radiators, which give out heat at lower temperatures over longer periods of time.
- An air-to-air system produces warm air which is circulated by fans to heat your home. They are unlikely to provide you with hot water as well.

Air Source heat pumps are a good option to provide heating and cooling however the aesthetic and spatial implications associated with this development mean that this technology has not been opted for. It has been tested and information provided as part of this report for comparison purposes.

Renewable technology tested but not chosen

House Type	House 1	TOTAL (kWh/yr)		TOTAL (kgCO2/yr)
BASELINE Dwelling Emission Rate (DER)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)
Main Heating Fuel Requirement (DER)	9111.81	9111.8	0.216	1968.2
Secondary Main Heating Fuel Requirement (DER)	0	0.0	0.216	0.0
Secondary Heating Fuel Requirement (DER)	0	0.0	0.519	0.0
Water Fuel Requirement (DER)	2734.07	2734.1	0.216	590.6
Electricity Pumps Fans Requirement (DER)	75	75.0	0.519	38.9
Electricity Lighting Requirement (DER)	537.75	537.8	0.519	279.1
TOTAL PER DEVELOPMENT		12458.6		2876.7
AFTER ENERGY SAVING MEASURES Dwelling Emission Rate (DER)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)
Main Heating Fuel Requirement (DER)	6464.89	6464.9	0.216	1396.4
Secondary Main Heating Fuel Requirement (DER)	0	0.0	0.216	0.0
Secondary Heating Fuel Requirement (DER)	0	0.0	0.519	0.0
Water Fuel Requirement (DER)	2812.39	2812.4	0.216	607.5
Electricity Pumps Fans Requirement (DER)	75	75.0	0.519	38.9
Electricity Lighting Requirement (DER)	537.75	537.8	0.519	279.1
TOTAL PER DEVELOPMENT		9890.0		2321.9
FINAL Dwelling Emission Rate (DER)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)
Main Heating Fuel Requirement (DER)	6464.89	6464.9	0.216	1396.4
Secondary Main Heating Fuel Requirement (DER)	0	0.0	0.216	0.0
Secondary Heating Fuel Requirement (DER)	0	0.0	0.519	0.0
Water Fuel Requirement (DER)	2812.39	2812.4	0.216	607.5
Electricity Pumps Fans Requirement (DER)	75	75.0	0.519	38.9
Electricity Lighting Requirement (DER)	537.75	537.8	0.519	279.1
PV Energy Produced (DER)		0.0	0.519	0.0
TOTAL PER DEVELOPMENT		9890.0		2321.9

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.10
Printed on 13 October 2017 at 14:59:02

Project Information:

Assessed By:	Daniel Watt (STRO026464)	**Building Type:**	Mid-terrace House

Dwelling Details:

NEW DWELLING DESIGN STAGE		Total Floor Area: 170m²	
Site Reference :	14107 Camden	**Plot Reference:**	59 Camden Mews - Option 1
Address :	59 Camden Mews, London, tba		

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)	16.92 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	13.66 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	66.4 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	47.7 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.20 (max. 0.30)	0.20 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.10 (max. 0.20)	0.10 (max. 0.35)	OK
Openings	1.19 (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:	Database: (rev 418, product index 017821): Boiler systems with radiators or underfloor heating - mains gas Brand name: Vaillant Model: ecoTEC plus 415 Model qualifier: VU 156/6-5 (Regular) Efficiency 89.3 % SEDBUK2009 Minimum 88.0 %	OK
Secondary heating system:	None	

Regulations Compliance Report

5 Cylinder insulation

Hot water Storage:	Measured cylinder loss: 2.27 kWh/day	
	Permitted by DBSCG: 2.86 kWh/day	**OK**
Primary pipework insulated:	Yes	**OK**

6 Controls

Space heating controls	TTZC by plumbing and electrical services	**OK**
Hot water controls:	Cylinderstat	**OK**
	Independent timer for DHW	**OK**
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 East	2.72m²
Windows facing: South East	3.12m²
Windows facing: North West	8.84m²
Windows facing: North East	3.12m²
Windows facing: North East	4.87m²
Windows facing: South East	3.2m²
Windows facing: South East	4.3m²
Windows facing: North West	2.28m²
Windows facing: North West	2.28m²
Roof windows facing: Horizontal	37.85m²
Ventilation rate:	8.00
Blinds/curtains:	Dark-coloured curtain or roller blind Closed 100% of daylight hours

10 Key features

Doors U-value	1 W/m²K
Roofs U-value	0.1 W/m²K
Party Walls U-value	0 W/m²K
Floors U-value	0.12 W/m²K

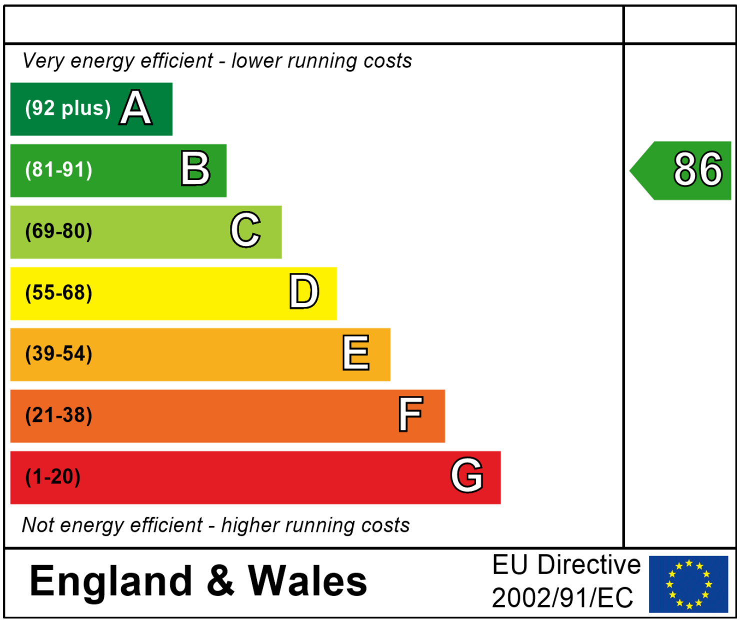
Predicted Energy Assessment

59 Camden Mews	Dwelling type:	Mid-terrace House
London	Date of assessment:	13 October 2017
tba	Produced by:	Daniel Watt
	Total floor area:	170 m²

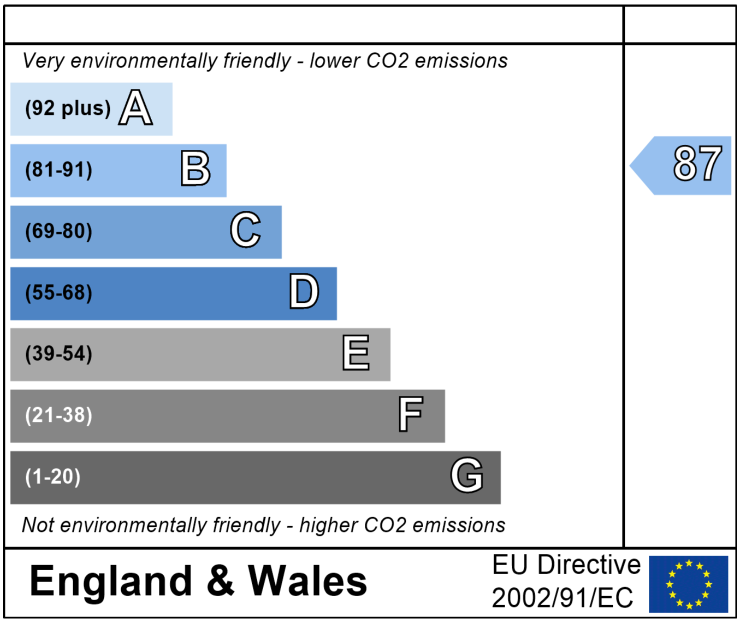
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home’s impact on the environment in terms of carbonn dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

SAP Input

Property Details: 59 Camden Mews - Option 1

Address:	59 Camden Mews, London, tba
Located in:	England
Region:	Thames valley
UPRN:	
Date of assessment:	13 October 2017
Date of certificate:	13 October 2017
Assessment type:	New dwelling design stage
Transaction type:	New dwelling
Tenure type:	Owner-occupied
Related party disclosure:	Employed by the professional dealing with the property transaction
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	418

Property description:

Dwelling type:	House
Detachment:	Mid-terrace
Year Completed:	2017

Floor Location:	Floor area:	Storey height:
Floor 0	90 m²	3 m
Floor 1	80 m²	2.6 m

Living area:	40 m² (fraction 0.235)
Front of dwelling faces:	South East

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
Door to garage	Manufacturer	Solid			
Bedroom 1/study	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	Wood
Entrance door	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	Wood
Living	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	Wood
Kitchen Door	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	Wood
Kitchen window	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	Wood
Bedroom 2	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	Wood
Bedroom 3	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	Wood
En suite	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	Wood
Master Bedroom	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	Wood
Rooflights	Manufacturer	Roof Windows	low-E, En = 0.05, soft coat	Yes	Wood

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
Door to garage	mm	0.7	0	1	2.6	1
Bedroom 1/study	16mm or more	0.7	0.72	1.2	1.36	2
Entrance door	16mm or more	0.8	0.72	1.2	3.12	1
Living	16mm or more	0.7	0.72	1.2	8.84	1
Kitchen Door	16mm or more	0.7	0.72	1.2	3.12	1
Kitchen window	16mm or more	0.7	0.72	1.2	4.87	1
Bedroom 2	16mm or more	0.7	0.72	1.2	1.6	2
Bedroom 3	16mm or more	0.7	0.72	1.2	4.3	1
En suite	16mm or more	0.7	0.72	1.2	2.28	1
Master Bedroom	16mm or more	0.7	0.72	1.2	2.28	1
Rooflights	16mm or more	0.7	0.73	1.2	37.85	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
Door to garage		Walls to Garage	North East	1	2.6
Bedroom 1/study		Exposed Walls	South East	0.8	1.7
Entrance door		Exposed Walls	South East	1.2	2.6

SAP Input

Living	Exposed Walls	North West	3.4	2.6
Kitchen Door	Exposed Walls	North East	1.2	2.6
Kitchen window	Exposed Walls	North East	2.95	1.65
Bedroom 2	Exposed Walls	South East	0.8	2
Bedroom 3	Exposed Walls	South East	2.15	2
En suite	Exposed Walls	North West	1.3	1.75
Master Bedroom	Exposed Walls	North West	1.3	1.75
Rooflights	Flat Roof	Horizontal	0.001	0

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
Exposed Walls	129	34.73	94.27	0.2	0	False	N/A
Walls to Garage	25	2.6	22.4	0.2	0.68	False	N/A
Flat Roof	108	37.85	70.15	0.1	0		N/A
Ground	90			0.12			N/A
Floor to Garage Below	18			0.12			N/A
Internal Elements							
Party Elements							
Sheltered Walls	58						N/A

Thermal bridges:

Thermal bridges: User-defined (individual PSI-values) Y-Value = 0.0451

	Length	Psi-value		
	19	0.05	E2	Other lintels (including other steel lintels)
[Approved]	2.2	0.04	E3	Sill
[Approved]	49.9	0.05	E4	Jamb
[Approved]	21	0.16	E5	Ground floor (normal)
[Approved]	25	0.07	E6	Intermediate floor within a dwelling
	45	0	E15	Flat roof with parapet
[Approved]	17	0.09	E16	Corner (normal)
[Approved]	8	-0.09	E17	Corner (inverted internal area greater than external area)
[Approved]	8	0.06	E18	Party wall between dwellings
	25	0	E25	Staggered party wall between dwellings
	8	0.16	P1	Ground floor
	0	0	P3	Intermediate floor between dwellings (in blocks of flats)
	14.24	0.08	R1	Head
	14.24	0.06	R2	Sill
	43.46	0.08	R3	Jamb

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Natural ventilation (extract fans)
Number of chimneys:	0
Number of open flues:	0
Number of fans:	7
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	4

Main heating system:

Main heating system: Boiler systems with radiators or underfloor heating
Gas boilers and oil boilers
Fuel: mains gas
Info Source: Boiler Database

SAP Input

	Database: (rev 418, product index 017821) Efficiency: Winter 79.6 % Summer: 90.3 Brand name: Vaillant Model: ecoTEC plus 415 Model qualifier: VU 156/6-5 (Regular boiler) Underfloor heating, pipes in screed above insulation Central heating pump : 2013 or later Design flow temperature: Design flow temperature<=35°C Room-sealed Boiler interlock: Yes Delayed start
Main heating Control:	
Main heating Control:	Time and temperature zone control by suitable arrangement of plumbing and electrical services Control code: 2110
Secondary heating system:	
Secondary heating system:	None
Water heating:	
Water heating:	From main heating system Water code: 901 Fuel :mains gas Hot water cylinder Cylinder volume: 300 litres Cylinder insulation: Factory 100 mm Primary pipework insulation: True Cylinderstat: True Cylinder in heated space: True Solar panel: False
Others:	
Electricity tariff:	Standard Tariff
In Smoke Control Area:	Unknown
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

SAP WorkSheet: New dwelling design stage

User Details:			
Assessor Name:	Daniel Watt	**Stroma Number:**	STRO026464
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: 59 Camden Mews - Option 1

Address : 59 Camden Mews, London, tba

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	90	(1a)	x	3	(2a)	=	270	(3a)
First floor	80	(1b)	x	2.6	(2b)	=	208	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	170	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	478	(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							7	x 10 =	70	(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) =	70	÷ (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) =	0.29	(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

SAP 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	0.29	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	0.55	0.56	(24d)

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

(25)m=	0.57	0.57	0.57	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			2.6	x	1	=	2.6			(26)
Windows Type 1			1.36	x1/[1/(1.2)+ 0.04]		=	1.56			(27)
Windows Type 2			3.12	x1/[1/(1.2)+ 0.04]		=	3.57			(27)
Windows Type 3			8.84	x1/[1/(1.2)+ 0.04]		=	10.12			(27)
Windows Type 4			3.12	x1/[1/(1.2)+ 0.04]		=	3.57			(27)
Windows Type 5			4.87	x1/[1/(1.2)+ 0.04]		=	5.58			(27)
Windows Type 6			1.6	x1/[1/(1.2)+ 0.04]		=	1.83			(27)
Windows Type 7			4.3	x1/[1/(1.2)+ 0.04]		=	4.92			(27)
Windows Type 8			2.28	x1/[1/(1.2)+ 0.04]		=	2.61			(27)
Windows Type 9			2.28	x1/[1/(1.2)+ 0.04]		=	2.61			(27)
Rooflights			37.85	x1/[1/(1.2) + 0.04]		=	45.42			(27b)
Floor Type 1			90	x	0.12	=	10.8			(28)
Floor Type 2			18	x	0.12	=	2.16			(28)
Walls Type1	129	34.73	94.27	x	0.2	=	18.85			(29)
Walls Type2	25	2.6	22.4	x	0.18	=	3.94			(29)
Roof	108	37.85	70.15	x	0.1	=	7.02			(30)
Total area of elements, m²			370							(31)

SAP WorkSheet: New dwelling design stage

Party wall	58	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) =	128.48	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	14091.38	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		16.68	(36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss	(33) + (36) =	145.16	(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=	89.99	89.56	89.13	87.15	86.77	85.04	85.04	84.72	85.71	86.77	87.53	88.31	(38)

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

(39)m=	235.15	234.72	234.3	232.31	231.94	230.21	230.21	229.88	230.87	231.94	232.69	233.48	

Average = Sum(39)$_{1…12}$ /12= 232.31 (39)

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

(40)m=	1.38	1.38	1.38	1.37	1.36	1.35	1.35	1.35	1.36	1.36	1.37	1.37	

Average = Sum(40)$_{1…12}$ /12= 1.37 (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) + 36 104.56 (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=	115.02	110.83	106.65	102.47	98.29	94.11	94.11	98.29	102.47	106.65	110.83	115.02	

Total = Sum(44)$_{1…12}$ = 1254.73 (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=	170.57	149.18	153.94	134.21	128.78	111.12	102.97	118.16	119.57	139.35	152.11	165.19	

Total = Sum(45)$_{1…12}$ = 1645.15 (45)

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

(46)m=	25.59	22.38	23.09	20.13	19.32	16.67	15.45	17.72	17.94	20.9	22.82	24.78	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 300 (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) =	300	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.01	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0.74	(52)
Temperature factor from Table 2b		0.54	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	1.23	(54)
Enter (50) or (54) in (55)		1.23	(55)

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

(56)m=	38.07	34.39	38.07	36.84	38.07	36.84	38.07	38.07	36.84	38.07	36.84	38.07	(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=	38.07	34.39	38.07	36.84	38.07	36.84	38.07	38.07	36.84	38.07	36.84	38.07	(57)

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

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

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

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

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

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

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

(62)m=	231.9	204.58	215.27	193.56	190.11	170.48	164.3	179.49	178.93	200.68	211.47	226.52	(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=	231.9	204.58	215.27	193.56	190.11	170.48	164.3	179.49	178.93	200.68	211.47	226.52

Output from water heater (annual)$_{1...12}$ — 2367.29 (64)

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

(65)m=	105.78	93.92	100.25	92.11	91.88	84.43	83.3	88.35	87.24	95.4	98.06	103.99	(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=	177.75	177.75	177.75	177.75	177.75	177.75	177.75	177.75	177.75	177.75	177.75	177.75	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	76.12	67.61	54.99	41.63	31.12	26.27	28.39	36.9	49.52	62.88	73.39	78.24	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	509.78	515.07	501.74	473.36	437.53	403.87	381.37	376.08	389.41	417.79	453.61	487.28	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	55.74	55.74	55.74	55.74	55.74	55.74	55.74	55.74	55.74	55.74	55.74	55.74	(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=	-118.5	-118.5	-118.5	-118.5	-118.5	-118.5	-118.5	-118.5	-118.5	-118.5	-118.5	-118.5	(71)

Water heating gains (Table 5)

(72)m=	142.18	139.76	134.75	127.93	123.5	117.27	111.97	118.76	121.17	128.23	136.2	139.77	(72)

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

(73)m=	846.07	840.43	809.46	760.9	710.14	665.39	639.72	649.73	678.09	726.89	781.19	823.28	(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	3.12	x	11.28	x	0.72	x	0.7	=	8.62	(75)
Northeast	0.9x	0.54	x	4.87	x	11.28	x	0.72	x	0.7	=	13.46	(75)
Northeast	0.9x	0.54	x	3.12	x	22.97	x	0.72	x	0.7	=	17.55	(75)
Northeast	0.9x	0.54	x	4.87	x	22.97	x	0.72	x	0.7	=	27.4	(75)
Northeast	0.9x	0.54	x	3.12	x	41.38	x	0.72	x	0.7	=	31.62	(75)
Northeast	0.9x	0.54	x	4.87	x	41.38	x	0.72	x	0.7	=	49.36	(75)
Northeast	0.9x	0.54	x	3.12	x	67.96	x	0.72	x	0.7	=	51.93	(75)
Northeast	0.9x	0.54	x	4.87	x	67.96	x	0.72	x	0.7	=	81.06	(75)
Northeast	0.9x	0.54	x	3.12	x	91.35	x	0.72	x	0.7	=	69.81	(75)
Northeast	0.9x	0.54	x	4.87	x	91.35	x	0.72	x	0.7	=	108.96	(75)
Northeast	0.9x	0.54	x	3.12	x	97.38	x	0.72	x	0.7	=	74.42	(75)
Northeast	0.9x	0.54	x	4.87	x	97.38	x	0.72	x	0.7	=	116.17	(75)
Northeast	0.9x	0.54	x	3.12	x	91.1	x	0.72	x	0.7	=	69.62	(75)
Northeast	0.9x	0.54	x	4.87	x	91.1	x	0.72	x	0.7	=	108.67	(75)
Northeast	0.9x	0.54	x	3.12	x	72.63	x	0.72	x	0.7	=	55.5	(75)
Northeast	0.9x	0.54	x	4.87	x	72.63	x	0.72	x	0.7	=	86.63	(75)
Northeast	0.9x	0.54	x	3.12	x	50.42	x	0.72	x	0.7	=	38.53	(75)
Northeast	0.9x	0.54	x	4.87	x	50.42	x	0.72	x	0.7	=	60.15	(75)
Northeast	0.9x	0.54	x	3.12	x	28.07	x	0.72	x	0.7	=	21.45	(75)
Northeast	0.9x	0.54	x	4.87	x	28.07	x	0.72	x	0.7	=	33.48	(75)
Northeast	0.9x	0.54	x	3.12	x	14.2	x	0.72	x	0.7	=	10.85	(75)
Northeast	0.9x	0.54	x	4.87	x	14.2	x	0.72	x	0.7	=	16.94	(75)
Northeast	0.9x	0.54	x	3.12	x	9.21	x	0.72	x	0.7	=	7.04	(75)
Northeast	0.9x	0.54	x	4.87	x	9.21	x	0.72	x	0.7	=	10.99	(75)
Southeast	0.9x	0.54	x	1.36	x	36.79	x	0.72	x	0.7	=	24.51	(77)
Southeast	0.9x	0.77	x	3.12	x	36.79	x	0.72	x	0.8	=	45.82	(77)
Southeast	0.9x	0.77	x	1.6	x	36.79	x	0.72	x	0.7	=	41.12	(77)
Southeast	0.9x	0.77	x	4.3	x	36.79	x	0.72	x	0.7	=	55.26	(77)
Southeast	0.9x	0.54	x	1.36	x	62.67	x	0.72	x	0.7	=	41.76	(77)
Southeast	0.9x	0.77	x	3.12	x	62.67	x	0.72	x	0.8	=	78.05	(77)
Southeast	0.9x	0.77	x	1.6	x	62.67	x	0.72	x	0.7	=	70.05	(77)
Southeast	0.9x	0.77	x	4.3	x	62.67	x	0.72	x	0.7	=	94.13	(77)

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Southeast	0.9x	0.54	x	1.36	x	85.75	x	0.72	x	0.7	=	57.13	(77)
Southeast	0.9x	0.77	x	3.12	x	85.75	x	0.72	x	0.8	=	106.8	(77)
Southeast	0.9x	0.77	x	1.6	x	85.75	x	0.72	x	0.7	=	95.84	(77)
Southeast	0.9x	0.77	x	4.3	x	85.75	x	0.72	x	0.7	=	128.79	(77)
Southeast	0.9x	0.54	x	1.36	x	106.25	x	0.72	x	0.7	=	70.79	(77)
Southeast	0.9x	0.77	x	3.12	x	106.25	x	0.72	x	0.8	=	132.33	(77)
Southeast	0.9x	0.77	x	1.6	x	106.25	x	0.72	x	0.7	=	118.75	(77)
Southeast	0.9x	0.77	x	4.3	x	106.25	x	0.72	x	0.7	=	159.58	(77)
Southeast	0.9x	0.54	x	1.36	x	119.01	x	0.72	x	0.7	=	79.29	(77)
Southeast	0.9x	0.77	x	3.12	x	119.01	x	0.72	x	0.8	=	148.22	(77)
Southeast	0.9x	0.77	x	1.6	x	119.01	x	0.72	x	0.7	=	133.01	(77)
Southeast	0.9x	0.77	x	4.3	x	119.01	x	0.72	x	0.7	=	178.74	(77)
Southeast	0.9x	0.54	x	1.36	x	118.15	x	0.72	x	0.7	=	78.72	(77)
Southeast	0.9x	0.77	x	3.12	x	118.15	x	0.72	x	0.8	=	147.14	(77)
Southeast	0.9x	0.77	x	1.6	x	118.15	x	0.72	x	0.7	=	132.05	(77)
Southeast	0.9x	0.77	x	4.3	x	118.15	x	0.72	x	0.7	=	177.45	(77)
Southeast	0.9x	0.54	x	1.36	x	113.91	x	0.72	x	0.7	=	75.89	(77)
Southeast	0.9x	0.77	x	3.12	x	113.91	x	0.72	x	0.8	=	141.86	(77)
Southeast	0.9x	0.77	x	1.6	x	113.91	x	0.72	x	0.7	=	127.31	(77)
Southeast	0.9x	0.77	x	4.3	x	113.91	x	0.72	x	0.7	=	171.08	(77)
Southeast	0.9x	0.54	x	1.36	x	104.39	x	0.72	x	0.7	=	69.55	(77)
Southeast	0.9x	0.77	x	3.12	x	104.39	x	0.72	x	0.8	=	130.01	(77)
Southeast	0.9x	0.77	x	1.6	x	104.39	x	0.72	x	0.7	=	116.67	(77)
Southeast	0.9x	0.77	x	4.3	x	104.39	x	0.72	x	0.7	=	156.78	(77)
Southeast	0.9x	0.54	x	1.36	x	92.85	x	0.72	x	0.7	=	61.86	(77)
Southeast	0.9x	0.77	x	3.12	x	92.85	x	0.72	x	0.8	=	115.64	(77)
Southeast	0.9x	0.77	x	1.6	x	92.85	x	0.72	x	0.7	=	103.78	(77)
Southeast	0.9x	0.77	x	4.3	x	92.85	x	0.72	x	0.7	=	139.45	(77)
Southeast	0.9x	0.54	x	1.36	x	69.27	x	0.72	x	0.7	=	46.15	(77)
Southeast	0.9x	0.77	x	3.12	x	69.27	x	0.72	x	0.8	=	86.27	(77)
Southeast	0.9x	0.77	x	1.6	x	69.27	x	0.72	x	0.7	=	77.42	(77)
Southeast	0.9x	0.77	x	4.3	x	69.27	x	0.72	x	0.7	=	104.03	(77)
Southeast	0.9x	0.54	x	1.36	x	44.07	x	0.72	x	0.7	=	29.36	(77)
Southeast	0.9x	0.77	x	3.12	x	44.07	x	0.72	x	0.8	=	54.89	(77)
Southeast	0.9x	0.77	x	1.6	x	44.07	x	0.72	x	0.7	=	49.26	(77)
Southeast	0.9x	0.77	x	4.3	x	44.07	x	0.72	x	0.7	=	66.19	(77)
Southeast	0.9x	0.54	x	1.36	x	31.49	x	0.72	x	0.7	=	20.98	(77)
Southeast	0.9x	0.77	x	3.12	x	31.49	x	0.72	x	0.8	=	39.22	(77)
Southeast	0.9x	0.77	x	1.6	x	31.49	x	0.72	x	0.7	=	35.19	(77)
Southeast	0.9x	0.77	x	4.3	x	31.49	x	0.72	x	0.7	=	47.29	(77)
Northwest	0.9x	0.54	x	8.84	x	11.28	x	0.72	x	0.7	=	24.43	(81)

Northwest	0.9x	0.77	x	2.28	x	11.28	x	0.72	x	0.7	=	8.99	(81)
Northwest	0.9x	0.77	x	2.28	x	11.28	x	0.72	x	0.7	=	8.99	(81)
Northwest	0.9x	0.54	x	8.84	x	22.97	x	0.72	x	0.7	=	49.73	(81)
Northwest	0.9x	0.77	x	2.28	x	22.97	x	0.72	x	0.7	=	18.29	(81)
Northwest	0.9x	0.77	x	2.28	x	22.97	x	0.72	x	0.7	=	18.29	(81)
Northwest	0.9x	0.54	x	8.84	x	41.38	x	0.72	x	0.7	=	89.6	(81)
Northwest	0.9x	0.77	x	2.28	x	41.38	x	0.72	x	0.7	=	32.95	(81)
Northwest	0.9x	0.77	x	2.28	x	41.38	x	0.72	x	0.7	=	32.95	(81)
Northwest	0.9x	0.54	x	8.84	x	67.96	x	0.72	x	0.7	=	147.15	(81)
Northwest	0.9x	0.77	x	2.28	x	67.96	x	0.72	x	0.7	=	54.12	(81)
Northwest	0.9x	0.77	x	2.28	x	67.96	x	0.72	x	0.7	=	54.12	(81)
Northwest	0.9x	0.54	x	8.84	x	91.35	x	0.72	x	0.7	=	197.79	(81)
Northwest	0.9x	0.77	x	2.28	x	91.35	x	0.72	x	0.7	=	72.74	(81)
Northwest	0.9x	0.77	x	2.28	x	91.35	x	0.72	x	0.7	=	72.74	(81)
Northwest	0.9x	0.54	x	8.84	x	97.38	x	0.72	x	0.7	=	210.87	(81)
Northwest	0.9x	0.77	x	2.28	x	97.38	x	0.72	x	0.7	=	77.55	(81)
Northwest	0.9x	0.77	x	2.28	x	97.38	x	0.72	x	0.7	=	77.55	(81)
Northwest	0.9x	0.54	x	8.84	x	91.1	x	0.72	x	0.7	=	197.26	(81)
Northwest	0.9x	0.77	x	2.28	x	91.1	x	0.72	x	0.7	=	72.55	(81)
Northwest	0.9x	0.77	x	2.28	x	91.1	x	0.72	x	0.7	=	72.55	(81)
Northwest	0.9x	0.54	x	8.84	x	72.63	x	0.72	x	0.7	=	157.26	(81)
Northwest	0.9x	0.77	x	2.28	x	72.63	x	0.72	x	0.7	=	57.84	(81)
Northwest	0.9x	0.77	x	2.28	x	72.63	x	0.72	x	0.7	=	57.84	(81)
Northwest	0.9x	0.54	x	8.84	x	50.42	x	0.72	x	0.7	=	109.18	(81)
Northwest	0.9x	0.77	x	2.28	x	50.42	x	0.72	x	0.7	=	40.15	(81)
Northwest	0.9x	0.77	x	2.28	x	50.42	x	0.72	x	0.7	=	40.15	(81)
Northwest	0.9x	0.54	x	8.84	x	28.07	x	0.72	x	0.7	=	60.77	(81)
Northwest	0.9x	0.77	x	2.28	x	28.07	x	0.72	x	0.7	=	22.35	(81)
Northwest	0.9x	0.77	x	2.28	x	28.07	x	0.72	x	0.7	=	22.35	(81)
Northwest	0.9x	0.54	x	8.84	x	14.2	x	0.72	x	0.7	=	30.74	(81)
Northwest	0.9x	0.77	x	2.28	x	14.2	x	0.72	x	0.7	=	11.31	(81)
Northwest	0.9x	0.77	x	2.28	x	14.2	x	0.72	x	0.7	=	11.31	(81)
Northwest	0.9x	0.54	x	8.84	x	9.21	x	0.72	x	0.7	=	19.95	(81)
Northwest	0.9x	0.77	x	2.28	x	9.21	x	0.72	x	0.7	=	7.34	(81)
Northwest	0.9x	0.77	x	2.28	x	9.21	x	0.72	x	0.7	=	7.34	(81)
Rooflights	0.9x	1	x	37.85	x	26	x	0.73	x	0.7	=	452.59	(82)
Rooflights	0.9x	1	x	37.85	x	54	x	0.73	x	0.7	=	939.99	(82)
Rooflights	0.9x	1	x	37.85	x	96	x	0.73	x	0.7	=	1671.09	(82)
Rooflights	0.9x	1	x	37.85	x	150	x	0.73	x	0.7	=	2611.08	(82)
Rooflights	0.9x	1	x	37.85	x	192	x	0.73	x	0.7	=	3342.19	(82)
Rooflights	0.9x	1	x	37.85	x	200	x	0.73	x	0.7	=	3481.44	(82)

Rooflights 0.9x	1	x	37.85	x	189	x	0.73	x	0.7	=	3289.96	(82)
Rooflights 0.9x	1	x	37.85	x	157	x	0.73	x	0.7	=	2732.93	(82)
Rooflights 0.9x	1	x	37.85	x	115	x	0.73	x	0.7	=	2001.83	(82)
Rooflights 0.9x	1	x	37.85	x	66	x	0.73	x	0.7	=	1148.88	(82)
Rooflights 0.9x	1	x	37.85	x	33	x	0.73	x	0.7	=	574.44	(82)
Rooflights 0.9x	1	x	37.85	x	21	x	0.73	x	0.7	=	365.55	(82)

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

(83)m=	683.79	1355.23	2296.14	3480.9	4403.5	4573.36	4326.76	3621.01	2710.72	1623.15	855.27	560.89	(83)

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

(84)m=	1529.86	2195.66	3105.59	4241.8	5113.64	5238.76	4966.48	4270.74	3388.81	2350.04	1636.46	1384.17	(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	0.96	0.85	0.62	0.42	0.28	0.2	0.25	0.46	0.83	0.97	0.99	(86)

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

(87)m=	19.98	20.27	20.63	20.87	20.93	20.94	20.94	20.94	20.93	20.75	20.28	19.92	(87)

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

(88)m=	19.78	19.78	19.78	19.79	19.79	19.8	19.8	19.8	19.8	19.79	19.79	19.78	(88)

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

(89)m=	0.99	0.95	0.81	0.57	0.36	0.23	0.15	0.18	0.38	0.77	0.96	0.99	(89)

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

(90)m=	18.44	18.86	19.35	19.63	19.69	19.71	19.71	19.71	19.7	19.52	18.9	18.37	(90)

fLA = Living area ÷ (4) = | 0.24 | (91)

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

(92)m=	18.81	19.19	19.65	19.92	19.98	20	20	20	19.99	19.81	19.22	18.74	(92)

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

(93)m=	18.66	19.04	19.5	19.77	19.83	19.85	19.85	19.85	19.84	19.66	19.07	18.59	(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	0.94	0.81	0.57	0.37	0.23	0.15	0.19	0.39	0.77	0.96	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	1502.65	2057.66	2501.47	2414.09	1871.28	1206.53	747.58	792.53	1311.67	1800.6	1566.89	1367.14	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	3375.8	3320.03	3046.24	2526.04	1886.24	1207.95	747.73	792.9	1324.58	2100.52	2785.84	3358.88	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1393.62	848.32	405.31	80.61	11.13	0	0	0	0	223.14	877.64	1481.86	

	Total per year (kWh/year) = Sum(98)1...5,9...12 =	5321.62	(98)
Space heating requirement in kWh/m²/year		31.3	(99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.3	(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)	1393.62	848.32	405.31	80.61	11.13	0	0	0	0	223.14	877.64	1481.86		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	1493.7	909.23	434.42	86.4	11.93	0	0	0	0	239.16	940.67	1588.28		(211)
Total (kWh/year) =Sum(211)1...5,10...12=													5703.78	(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)	231.9	204.58	215.27	193.56	190.11	170.48	164.3	179.49	178.93	200.68	211.47	226.52		
Efficiency of water heater													79.6	(216)
(217)m=	88.6	88	86.28	82.47	80.13	79.6	79.6	79.6	79.6	84.9	88	88.72		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	261.73	232.47	249.51	234.7	237.26	214.17	206.41	225.5	224.78	236.39	240.3	255.32		
Total = Sum(219a)1...12 =													2818.54	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			5703.78	
Water heating fuel used			2818.54	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			537.75	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	198.49	(240)

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Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	98.09	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	70.93	(250)
Additional standing charges (Table 12)				120	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	497.4	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	0.97	(257)
SAP rating (Section 12)		86.45	(258)

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	=	1232.02	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	608.8	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1840.82	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	279.09	(268)
Total CO2, kg/year		sum of (265)…(271) =		2158.84	(272)
CO2 emissions per m²		(272) ÷ (4) =		12.7	(273)
EI rating (section 14)				87	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	6958.61	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	3438.62	(264)
Space and water heating	(261) + (262) + (263) + (264) =			10397.23	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	230.25	(267)
Electricity for lighting	(232) x	0	=	1650.88	(268)
'Total Primary Energy		sum of (265)…(271) =		12278.36	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		72.23	(273)

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User Details:			
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Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: 59 Camden Mews - Option 1

Address : 59 Camden Mews, London, tba

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	90	(1a)	x	3	(2a)	=	270	(3a)
First floor	80	(1b)	x	2.6	(2b)	=	208	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	170	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	478	(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) =	0.08	(8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.33	(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) =	0.28	(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

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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

0.36	0.35	0.35	0.31	0.3	0.27	0.27	0.26	0.28	0.3	0.32	0.33

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	0.53	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	0.53	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			2.6	x	1	=	2.6			(26)
Windows Type 1			0.75	x1/[1/(1.4)+ 0.04]		=	0.99			(27)
Windows Type 2			1.72	x1/[1/(1.4)+ 0.04]		=	2.28			(27)
Windows Type 3			4.86	x1/[1/(1.4)+ 0.04]		=	6.44			(27)
Windows Type 4			1.72	x1/[1/(1.4)+ 0.04]		=	2.28			(27)
Windows Type 5			2.68	x1/[1/(1.4)+ 0.04]		=	3.55			(27)
Windows Type 6			0.88	x1/[1/(1.4)+ 0.04]		=	1.17			(27)
Windows Type 7			2.36	x1/[1/(1.4)+ 0.04]		=	3.13			(27)
Windows Type 8			1.25	x1/[1/(1.4)+ 0.04]		=	1.66			(27)
Windows Type 9			1.25	x1/[1/(1.4)+ 0.04]		=	1.66			(27)
Rooflights			20.80759	x1/[1/(1.7) + 0.04]		=	35.37291			(27b)
Floor Type 1			90	x	0.13	=	11.7			(28)
Floor Type 2			18	x	0.13	=	2.34			(28)
Walls Type1	129	19.1	109.9	x	0.18	=	19.78			(29)
Walls Type2	25	2.6	22.4	x	0.18	=	4.03			(29)
Roof	108	20.81	87.19	x	0.13	=	11.34			(30)
Total area of elements, m²			370							(31)

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Party wall	58	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) =	110.23	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	14385.43	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		41.02	(36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss	(33) + (36) =	151.25	(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=	89.18	88.78	88.39	86.55	86.2	84.6	84.6	84.3	85.21	86.2	86.9	87.63	(38)

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

(39)m=	240.43	240.03	239.64	237.79	237.45	235.84	235.84	235.55	236.46	237.45	238.15	238.88	

Average = Sum(39)$_{1…12}$ /12= 237.79 (39)

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

(40)m=	1.41	1.41	1.41	1.4	1.4	1.39	1.39	1.39	1.39	1.4	1.4	1.41	

Average = Sum(40)$_{1…12}$ /12= 1.4 (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	104.56	(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=	115.02	110.83	106.65	102.47	98.29	94.11	94.11	98.29	102.47	106.65	110.83	115.02	

Total = Sum(44)$_{1…12}$ = 1254.73 (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=	170.57	149.18	153.94	134.21	128.78	111.12	102.97	118.16	119.57	139.35	152.11	165.19	

Total = Sum(45)$_{1…12}$ = 1645.15 (45)

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

(46)m=	25.59	22.38	23.09	20.13	19.32	16.67	15.45	17.72	17.94	20.9	22.82	24.78	(46)

Water storage loss:

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

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

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

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day):	2.11	(48)
Temperature factor from Table 2b	0.54	(49)

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Energy lost from water storage, kWh/year	(48) x (49) =		1.14	(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)			1.14	(55)

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

(56)m=	35.37	31.94	35.37	34.23	35.37	34.23	35.37	35.37	34.23	35.37	34.23	35.37	(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=	35.37	31.94	35.37	34.23	35.37	34.23	35.37	35.37	34.23	35.37	34.23	35.37	(57)

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

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

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

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

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

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

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

(62)m=	229.2	202.13	212.57	190.95	187.4	167.86	161.6	176.79	176.31	197.98	208.85	223.81	(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=	229.2	202.13	212.57	190.95	187.4	167.86	161.6	176.79	176.31	197.98	208.85	223.81

Output from water heater (annual)1…12 — 2335.46 (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=	103.62	91.97	98.09	90.01	89.72	82.34	81.14	86.19	85.15	93.24	95.97	101.83	(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=	148.13	148.13	148.13	148.13	148.13	148.13	148.13	148.13	148.13	148.13	148.13	148.13	(66)

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

(67)m=	30.45	27.04	21.99	16.65	12.45	10.51	11.35	14.76	19.81	25.15	29.36	31.3	(67)

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

(68)m=	341.55	345.09	336.16	317.15	293.15	270.59	255.52	251.98	260.91	279.92	303.92	326.48	(68)

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

(69)m=	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81	(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=	-118.5	-118.5	-118.5	-118.5	-118.5	-118.5	-118.5	-118.5	-118.5	-118.5	-118.5	-118.5	(71)

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Water heating gains (Table 5)

(72)m=	139.27	136.85	131.84	125.02	120.59	114.36	109.06	115.85	118.26	125.32	133.29	136.86	(72)

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

(73)m=	581.71	579.43	560.43	529.26	496.63	465.9	446.37	453.02	469.42	500.83	537.01	565.08	(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	1.72	x	11.28	x	0.63	x	0.7	=	4.16	(75)
Northeast	0.9x	0.54	x	2.68	x	11.28	x	0.63	x	0.7	=	6.48	(75)
Northeast	0.9x	0.54	x	1.72	x	22.97	x	0.63	x	0.7	=	8.47	(75)
Northeast	0.9x	0.54	x	2.68	x	22.97	x	0.63	x	0.7	=	13.19	(75)
Northeast	0.9x	0.54	x	1.72	x	41.38	x	0.63	x	0.7	=	15.25	(75)
Northeast	0.9x	0.54	x	2.68	x	41.38	x	0.63	x	0.7	=	23.77	(75)
Northeast	0.9x	0.54	x	1.72	x	67.96	x	0.63	x	0.7	=	25.05	(75)
Northeast	0.9x	0.54	x	2.68	x	67.96	x	0.63	x	0.7	=	39.03	(75)
Northeast	0.9x	0.54	x	1.72	x	91.35	x	0.63	x	0.7	=	33.67	(75)
Northeast	0.9x	0.54	x	2.68	x	91.35	x	0.63	x	0.7	=	52.47	(75)
Northeast	0.9x	0.54	x	1.72	x	97.38	x	0.63	x	0.7	=	35.9	(75)
Northeast	0.9x	0.54	x	2.68	x	97.38	x	0.63	x	0.7	=	55.94	(75)
Northeast	0.9x	0.54	x	1.72	x	91.1	x	0.63	x	0.7	=	33.58	(75)
Northeast	0.9x	0.54	x	2.68	x	91.1	x	0.63	x	0.7	=	52.33	(75)
Northeast	0.9x	0.54	x	1.72	x	72.63	x	0.63	x	0.7	=	26.77	(75)
Northeast	0.9x	0.54	x	2.68	x	72.63	x	0.63	x	0.7	=	41.72	(75)
Northeast	0.9x	0.54	x	1.72	x	50.42	x	0.63	x	0.7	=	18.59	(75)
Northeast	0.9x	0.54	x	2.68	x	50.42	x	0.63	x	0.7	=	28.96	(75)
Northeast	0.9x	0.54	x	1.72	x	28.07	x	0.63	x	0.7	=	10.35	(75)
Northeast	0.9x	0.54	x	2.68	x	28.07	x	0.63	x	0.7	=	16.12	(75)
Northeast	0.9x	0.54	x	1.72	x	14.2	x	0.63	x	0.7	=	5.23	(75)
Northeast	0.9x	0.54	x	2.68	x	14.2	x	0.63	x	0.7	=	8.15	(75)
Northeast	0.9x	0.54	x	1.72	x	9.21	x	0.63	x	0.7	=	3.4	(75)
Northeast	0.9x	0.54	x	2.68	x	9.21	x	0.63	x	0.7	=	5.29	(75)
Southeast	0.9x	0.54	x	0.75	x	36.79	x	0.63	x	0.7	=	11.83	(77)
Southeast	0.9x	0.77	x	1.72	x	36.79	x	0.63	x	0.7	=	19.34	(77)
Southeast	0.9x	0.77	x	0.88	x	36.79	x	0.63	x	0.7	=	19.79	(77)
Southeast	0.9x	0.77	x	2.36	x	36.79	x	0.63	x	0.7	=	26.54	(77)
Southeast	0.9x	0.54	x	0.75	x	62.67	x	0.63	x	0.7	=	20.15	(77)
Southeast	0.9x	0.77	x	1.72	x	62.67	x	0.63	x	0.7	=	32.94	(77)
Southeast	0.9x	0.77	x	0.88	x	62.67	x	0.63	x	0.7	=	33.71	(77)
Southeast	0.9x	0.77	x	2.36	x	62.67	x	0.63	x	0.7	=	45.2	(77)

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Southeast	0.9x	0.54	x	0.75	x	85.75	x	0.63	x	0.7	=	27.57	(77)
Southeast	0.9x	0.77	x	1.72	x	85.75	x	0.63	x	0.7	=	45.08	(77)
Southeast	0.9x	0.77	x	0.88	x	85.75	x	0.63	x	0.7	=	46.12	(77)
Southeast	0.9x	0.77	x	2.36	x	85.75	x	0.63	x	0.7	=	61.85	(77)
Southeast	0.9x	0.54	x	0.75	x	106.25	x	0.63	x	0.7	=	34.16	(77)
Southeast	0.9x	0.77	x	1.72	x	106.25	x	0.63	x	0.7	=	55.85	(77)
Southeast	0.9x	0.77	x	0.88	x	106.25	x	0.63	x	0.7	=	57.15	(77)
Southeast	0.9x	0.77	x	2.36	x	106.25	x	0.63	x	0.7	=	76.63	(77)
Southeast	0.9x	0.54	x	0.75	x	119.01	x	0.63	x	0.7	=	38.26	(77)
Southeast	0.9x	0.77	x	1.72	x	119.01	x	0.63	x	0.7	=	62.56	(77)
Southeast	0.9x	0.77	x	0.88	x	119.01	x	0.63	x	0.7	=	64.01	(77)
Southeast	0.9x	0.77	x	2.36	x	119.01	x	0.63	x	0.7	=	85.84	(77)
Southeast	0.9x	0.54	x	0.75	x	118.15	x	0.63	x	0.7	=	37.98	(77)
Southeast	0.9x	0.77	x	1.72	x	118.15	x	0.63	x	0.7	=	62.11	(77)
Southeast	0.9x	0.77	x	0.88	x	118.15	x	0.63	x	0.7	=	63.55	(77)
Southeast	0.9x	0.77	x	2.36	x	118.15	x	0.63	x	0.7	=	85.22	(77)
Southeast	0.9x	0.54	x	0.75	x	113.91	x	0.63	x	0.7	=	36.62	(77)
Southeast	0.9x	0.77	x	1.72	x	113.91	x	0.63	x	0.7	=	59.88	(77)
Southeast	0.9x	0.77	x	0.88	x	113.91	x	0.63	x	0.7	=	61.27	(77)
Southeast	0.9x	0.77	x	2.36	x	113.91	x	0.63	x	0.7	=	82.16	(77)
Southeast	0.9x	0.54	x	0.75	x	104.39	x	0.63	x	0.7	=	33.56	(77)
Southeast	0.9x	0.77	x	1.72	x	104.39	x	0.63	x	0.7	=	54.87	(77)
Southeast	0.9x	0.77	x	0.88	x	104.39	x	0.63	x	0.7	=	56.15	(77)
Southeast	0.9x	0.77	x	2.36	x	104.39	x	0.63	x	0.7	=	75.29	(77)
Southeast	0.9x	0.54	x	0.75	x	92.85	x	0.63	x	0.7	=	29.85	(77)
Southeast	0.9x	0.77	x	1.72	x	92.85	x	0.63	x	0.7	=	48.81	(77)
Southeast	0.9x	0.77	x	0.88	x	92.85	x	0.63	x	0.7	=	49.94	(77)
Southeast	0.9x	0.77	x	2.36	x	92.85	x	0.63	x	0.7	=	66.97	(77)
Southeast	0.9x	0.54	x	0.75	x	69.27	x	0.63	x	0.7	=	22.27	(77)
Southeast	0.9x	0.77	x	1.72	x	69.27	x	0.63	x	0.7	=	36.41	(77)
Southeast	0.9x	0.77	x	0.88	x	69.27	x	0.63	x	0.7	=	37.26	(77)
Southeast	0.9x	0.77	x	2.36	x	69.27	x	0.63	x	0.7	=	49.96	(77)
Southeast	0.9x	0.54	x	0.75	x	44.07	x	0.63	x	0.7	=	14.17	(77)
Southeast	0.9x	0.77	x	1.72	x	44.07	x	0.63	x	0.7	=	23.17	(77)
Southeast	0.9x	0.77	x	0.88	x	44.07	x	0.63	x	0.7	=	23.7	(77)
Southeast	0.9x	0.77	x	2.36	x	44.07	x	0.63	x	0.7	=	31.79	(77)
Southeast	0.9x	0.54	x	0.75	x	31.49	x	0.63	x	0.7	=	10.12	(77)
Southeast	0.9x	0.77	x	1.72	x	31.49	x	0.63	x	0.7	=	16.55	(77)
Southeast	0.9x	0.77	x	0.88	x	31.49	x	0.63	x	0.7	=	16.94	(77)
Southeast	0.9x	0.77	x	2.36	x	31.49	x	0.63	x	0.7	=	22.71	(77)
Northeast	0.9x	0.54	x	4.86	x	11.28	x	0.63	x	0.7	=	11.75	(81)

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Northwest	0.9x	0.77	x	1.25	x	11.28	x	0.63	x	0.7	=	4.31	(81)
Northwest	0.9x	0.77	x	1.25	x	11.28	x	0.63	x	0.7	=	4.31	(81)
Northwest	0.9x	0.54	x	4.86	x	22.97	x	0.63	x	0.7	=	23.92	(81)
Northwest	0.9x	0.77	x	1.25	x	22.97	x	0.63	x	0.7	=	8.77	(81)
Northwest	0.9x	0.77	x	1.25	x	22.97	x	0.63	x	0.7	=	8.77	(81)
Northwest	0.9x	0.54	x	4.86	x	41.38	x	0.63	x	0.7	=	43.1	(81)
Northwest	0.9x	0.77	x	1.25	x	41.38	x	0.63	x	0.7	=	15.81	(81)
Northwest	0.9x	0.77	x	1.25	x	41.38	x	0.63	x	0.7	=	15.81	(81)
Northwest	0.9x	0.54	x	4.86	x	67.96	x	0.63	x	0.7	=	70.78	(81)
Northwest	0.9x	0.77	x	1.25	x	67.96	x	0.63	x	0.7	=	25.96	(81)
Northwest	0.9x	0.77	x	1.25	x	67.96	x	0.63	x	0.7	=	25.96	(81)
Northwest	0.9x	0.54	x	4.86	x	91.35	x	0.63	x	0.7	=	95.15	(81)
Northwest	0.9x	0.77	x	1.25	x	91.35	x	0.63	x	0.7	=	34.9	(81)
Northwest	0.9x	0.77	x	1.25	x	91.35	x	0.63	x	0.7	=	34.9	(81)
Northwest	0.9x	0.54	x	4.86	x	97.38	x	0.63	x	0.7	=	101.44	(81)
Northwest	0.9x	0.77	x	1.25	x	97.38	x	0.63	x	0.7	=	37.2	(81)
Northwest	0.9x	0.77	x	1.25	x	97.38	x	0.63	x	0.7	=	37.2	(81)
Northwest	0.9x	0.54	x	4.86	x	91.1	x	0.63	x	0.7	=	94.89	(81)
Northwest	0.9x	0.77	x	1.25	x	91.1	x	0.63	x	0.7	=	34.8	(81)
Northwest	0.9x	0.77	x	1.25	x	91.1	x	0.63	x	0.7	=	34.8	(81)
Northwest	0.9x	0.54	x	4.86	x	72.63	x	0.63	x	0.7	=	75.65	(81)
Northwest	0.9x	0.77	x	1.25	x	72.63	x	0.63	x	0.7	=	27.74	(81)
Northwest	0.9x	0.77	x	1.25	x	72.63	x	0.63	x	0.7	=	27.74	(81)
Northwest	0.9x	0.54	x	4.86	x	50.42	x	0.63	x	0.7	=	52.52	(81)
Northwest	0.9x	0.77	x	1.25	x	50.42	x	0.63	x	0.7	=	19.26	(81)
Northwest	0.9x	0.77	x	1.25	x	50.42	x	0.63	x	0.7	=	19.26	(81)
Northwest	0.9x	0.54	x	4.86	x	28.07	x	0.63	x	0.7	=	29.24	(81)
Northwest	0.9x	0.77	x	1.25	x	28.07	x	0.63	x	0.7	=	10.72	(81)
Northwest	0.9x	0.77	x	1.25	x	28.07	x	0.63	x	0.7	=	10.72	(81)
Northwest	0.9x	0.54	x	4.86	x	14.2	x	0.63	x	0.7	=	14.79	(81)
Northwest	0.9x	0.77	x	1.25	x	14.2	x	0.63	x	0.7	=	5.42	(81)
Northwest	0.9x	0.77	x	1.25	x	14.2	x	0.63	x	0.7	=	5.42	(81)
Northwest	0.9x	0.54	x	4.86	x	9.21	x	0.63	x	0.7	=	9.6	(81)
Northwest	0.9x	0.77	x	1.25	x	9.21	x	0.63	x	0.7	=	3.52	(81)
Northwest	0.9x	0.77	x	1.25	x	9.21	x	0.63	x	0.7	=	3.52	(81)
Rooflights	0.9x	1	x	20.81	x	26	x	0.63	x	0.7	=	214.72	(82)
Rooflights	0.9x	1	x	20.81	x	54	x	0.63	x	0.7	=	445.96	(82)
Rooflights	0.9x	1	x	20.81	x	96	x	0.63	x	0.7	=	792.82	(82)
Rooflights	0.9x	1	x	20.81	x	150	x	0.63	x	0.7	=	1238.78	(82)
Rooflights	0.9x	1	x	20.81	x	192	x	0.63	x	0.7	=	1585.64	(82)
Rooflights	0.9x	1	x	20.81	x	200	x	0.63	x	0.7	=	1651.71	(82)

Rooflights 0.9x	1	x	20.81	x	189	x	0.63	x	0.7	=	1560.86	(82)
Rooflights 0.9x	1	x	20.81	x	157	x	0.63	x	0.7	=	1296.59	(82)
Rooflights 0.9x	1	x	20.81	x	115	x	0.63	x	0.7	=	949.73	(82)
Rooflights 0.9x	1	x	20.81	x	66	x	0.63	x	0.7	=	545.06	(82)
Rooflights 0.9x	1	x	20.81	x	33	x	0.63	x	0.7	=	272.53	(82)
Rooflights 0.9x	1	x	20.81	x	21	x	0.63	x	0.7	=	173.43	(82)

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

(83)m=	323.23	641.1	1087.17	1649.36	2087.39	2168.24	2051.2	1716.09	1283.89	768.11	404.38	265.08	(83)

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

(84)m=	904.94	1220.53	1647.61	2178.62	2584.01	2634.14	2497.57	2169.12	1753.31	1268.94	941.38	830.16	(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	0.98	0.91	0.74	0.55	0.41	0.49	0.78	0.97	1	1	(86)

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

(87)m=	19.36	19.6	20.02	20.52	20.85	20.97	20.99	20.99	20.86	20.35	19.75	19.32	(87)

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

(88)m=	19.75	19.75	19.76	19.76	19.77	19.77	19.77	19.77	19.77	19.77	19.76	19.76	(88)

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

(89)m=	1	0.99	0.97	0.87	0.68	0.45	0.3	0.36	0.69	0.96	1	1	(89)

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

(90)m=	17.58	17.94	18.54	19.24	19.63	19.75	19.77	19.77	19.67	19.02	18.15	17.53	(90)

fLA = Living area ÷ (4) = 0.24 (91)

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

(92)m=	18	18.33	18.88	19.54	19.92	20.04	20.06	20.06	19.95	19.33	18.53	17.95	(92)

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

(93)m=	18	18.33	18.88	19.54	19.92	20.04	20.06	20.06	19.95	19.33	18.53	17.95	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.96	0.87	0.68	0.48	0.32	0.39	0.71	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	902.31	1208.57	1585.97	1888.77	1768.05	1253.33	811.34	851.57	1237.43	1205.07	934.99	828.47	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	3293.93	3223.33	2967.92	2530.13	1951.64	1283.03	815.64	861.05	1383.35	2073.56	2721.8	3284.18	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1779.36	1353.92	1028.17	461.78	136.59	0	0	0	0	646.16	1286.51	1827.05	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ =	8519.54	(98)
Space heating requirement in kWh/m²/year	50.11	(99)

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

Space heating:

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	1779.36	1353.92	1028.17	461.78	136.59	0	0	0	0	646.16	1286.51	1827.05		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	1903.06	1448.05	1099.65	493.88	146.09	0	0	0	0	691.08	1375.94	1954.07		(211)
Total (kWh/year) =$Sum(211)_{1...5,10...12}$=													9111.81	(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)	229.2	202.13	212.57	190.95	187.4	167.86	161.6	176.79	176.31	197.98	208.85	223.81		
Efficiency of water heater													79.8	(216)
(217)m=	89.14	88.95	88.47	87.08	83.99	79.8	79.8	79.8	79.8	87.74	88.84	89.19		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	257.13	227.24	240.28	219.27	223.14	210.35	202.51	221.54	220.94	225.64	235.1	250.93		
Total = $Sum(219a)_{1...12}$ =													2734.07	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			9111.81	
Water heating fuel used			2734.07	
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			537.75	(232)

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	=	1968.15	(261)

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Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	590.56	(264)
Space and water heating	(261) + (262) + (263) + (264) =			2558.71	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	279.09	(268)
Total CO2, kg/year		sum of (265)…(271) =		2876.72	(272)

TER =	16.92	(273)