ENERGY STATEMENT ADDENDUM

NEW HOUSE, 68-70 BOVILL ROAD , LONDON, SE23 1EJ

CONSULT JA LTD
8 Grove Close
Ickenham, Uxbridge UB10 8QN

ASSESSMENT INFORMATION

Prepared by:
Ondrej Gajdos

Date:
26 March 2024

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This report is prepared for the use of 68-70 Bovill Road, a duty of care is not owed to other parties.

CONTENT

INTRODUCTION

NEW HOUSE, 68-70 BOVILL ROAD , LONDON, SE23 1EJ

This report is an addendum to previously submitted energy statement, following changes in the proposed heating strategy for newly constructed house from heat pump to gas boiler.
The London Plan approach of “Be lean” – “Be clean” – “Be green” is fully adopted by implementing:

- Passive measures (low U-values, air permeability, avoidance of thermal bridging by accredited details)
- High efficiency services, i.e., high efficiency ventilation with heat recovery, high efficiency lighting
- Renewable sources: solar PV

Excluded renewable sources are:

- Solar hot water
- Biomass
- Wind turbines
- Heat pumps

The proposed development will achieve:

- 41% domestic regulated CO2 reduction against 2013 Part L compliant baseline

- 23% domestic regulated CO2 reduction by renewable sources

- 18% domestic regulated CO2 reduction by efficiency measures (“Be Lean” stage of the energy hierarchy)

ABOUT THE ENERGY STATEMENT

Consult JA Ltd have been appointed to provide an Energy Statement for the proposed development.

This statement covers possible active and passive measures including renewable energy sources to make this development sustainable and environmentally friendly.

Specific requirements of London Plan on Energy Efficiency and Renewable Energy will be met through a combination of passive design features, energy efficient building services and renewable energy sources. This is to comply fully with the London Plan Policies and ensure they are following the "Energy Hierarchy". This document has been prepared in line with the GLA Energy Team Guidance on Planning Energy Assessments.

Baseline and all estimated energy consumptions have been calculated using a SAP 2012 assessment, with 10.2 carbon factors applied to calculate the CO2 reductions.

The table below shows a summary of energy requirements for baseline scheme and reduction proposed to be achieved by passive measures, efficient services and on-site renewable energy sources.

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

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO_2 per annum)	
	Regulated	**Unregulated**
Baseline: Part L 2013 of the Building Regulations Compliant Development	1.6	0.4
After energy demand reduction (be lean)	1.3	0.4
After renewable energy (be green)	1.0	0.4

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

	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	**(%)**
Be lean: Savings from energy demand reduction	0.3	18%
Be green: Savings from renewable energy	0.4	23%
Cumulative on site savings	**0.7**	**41%**

SAP results summary of the proposed development

DOMESTIC ENERGY CONSUMPTION AND CO2 ANALYSIS

Unit identifier (e.g. plot number, dwelling type etc.)	Model total floor area (m^2)	REGULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - 'BE GREEN' SAP DER WORKSHEET				SAP 10.2 REGULATED CO_2 EMISSIONS PER UNIT			
		Space Heating (Heat Source 1)	Domestic Hot Water (Heat Source 1)	Lighting	Auxiliary	Space Heating	Domestic Hot Water	SAP 10.2 CO_2 emissions ($kgCO_2$ p.a.)	Calculated DER SAP 10.0 ($kgCO_2$ / m^2)
House	98.9	3307	2635	401	331	694	553	972	9.8

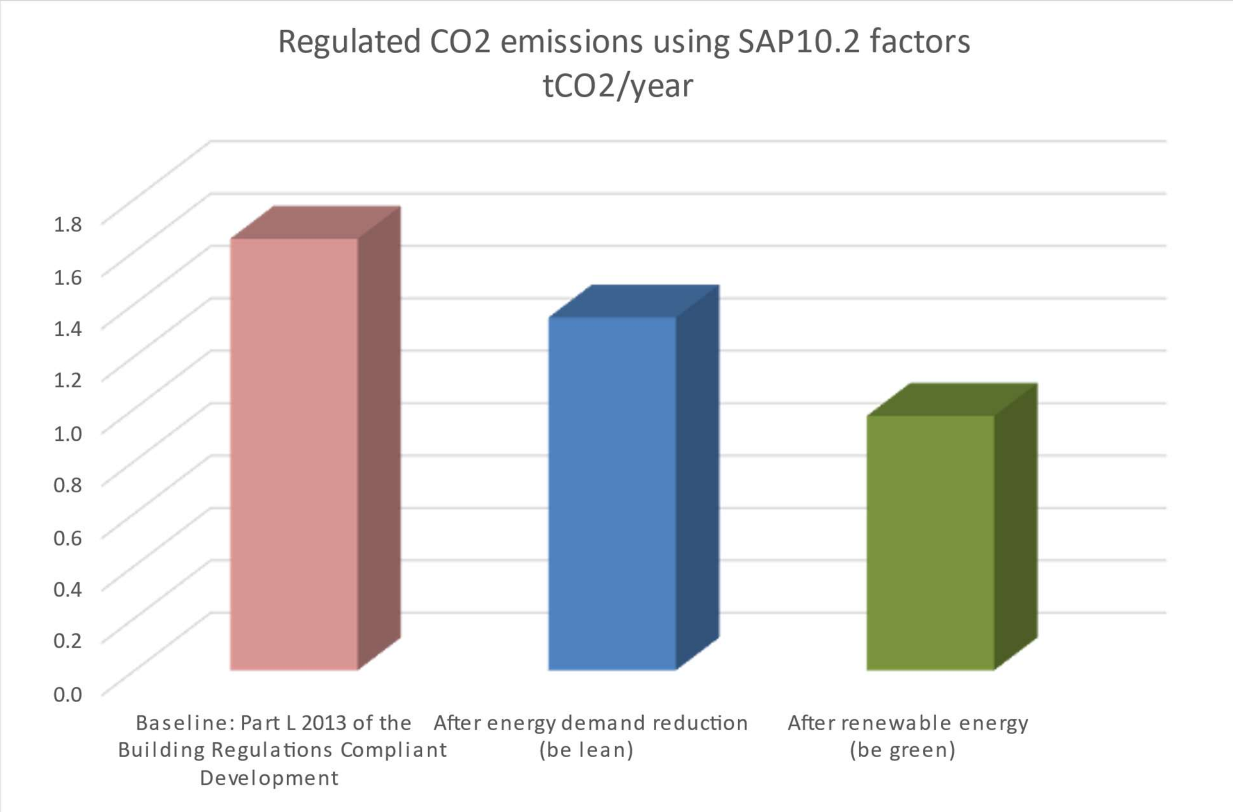


Table 3: SAP calculation specification for each stage of the energy hierarchy

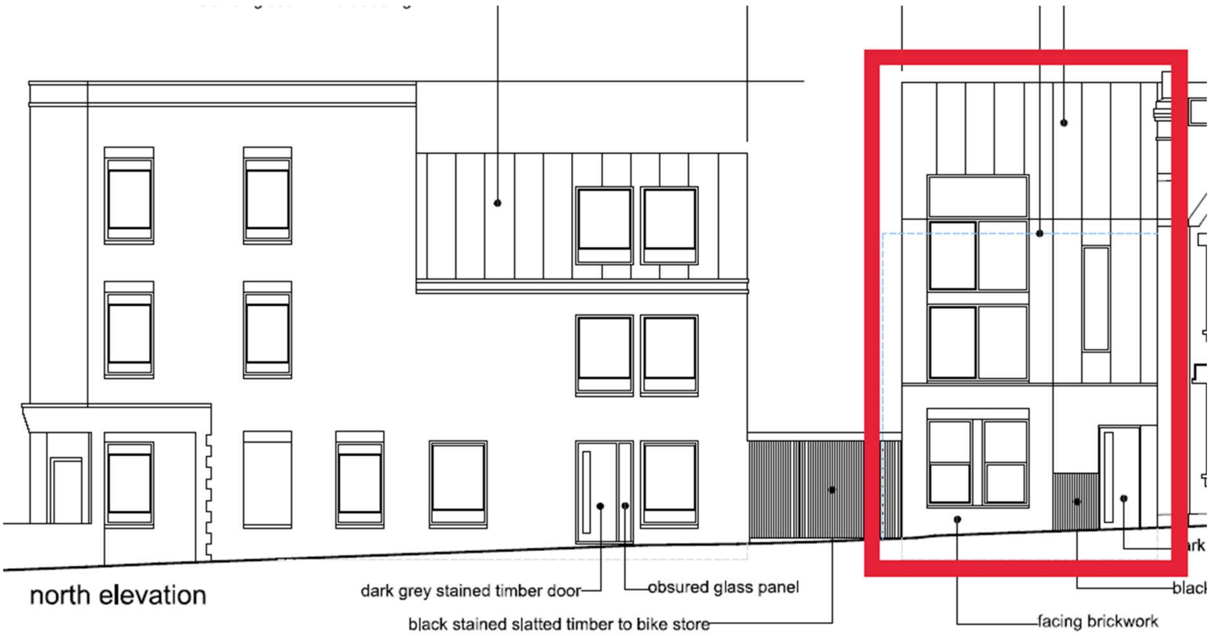
Specification	Notional Baseline	Efficient Baseline (Be Lean)	Proposed Development (Be Green)
Ground floor U-value	0.13	0.13	
External Wall U-value	0.18	0.18	
Flat Roof U-value	0.13	0.11	
Pitched roof with insulation at rafter level U-value	0.13	0.11	
Windows and glazed doors U-value	1.4	1.2	
Air Permeability (m3/h.m2)	5	5	
Thermal bridging	Accredited construction details	Generally in line with Recognised Construction Details	
Ventilation System	Natural ventilation with intermittent mechanical extracts	MVHR Nuaire MRXBOXAB-Eco3 or equivalent approved by SAP assessor; Supply and extract duct to and from exterior has to be insulated with 25mm insulation if less than 2m long or 50mm thickness for ducts over 2m long	
Space Heating System and hot water	Gas boiler, SEDBUK efficiency 89.5%, ratdiators, time and temperature zone control, weather compensator	Gas boiler Vaillant EcoTec Plus 418 or equivalent approved by SAP assessor, radiators, time and temperature zone control, delayed start thermostat; Indirect cylinder	Gas boiler Vaillant EcoTec Plus 418 or equivalent approved by SAP assessor, radiators, time and temperature zone control, delayed start thermostat; Indirect cylinder
Renewable	-	-	Solar PV system with total peak output of 3.2 kWp (e.g. 8 panels @ 0.4 kWp each), installed on the south facing pitched roof
Low energy lights	100%	100%	100%
% Improvement in CO2 over Building regulations compliant baseline	**0.0%**	**18.2%**	**41%**

BACKGROUND

Consult JA Ltd have been appointed to provide an Energy Statement for the proposed development.
This statement covers possible active and passive measures including renewable energy sources to make this development sustainable and environmentally friendly.

DESCRIPTION OF THE SITE

The proposed development includes conversion of existing Edwardian property into 5 flats and new construction of 3-bedroom, 3-storey house to the rear of the site. This energy statement covers only the newly constructed house.



NATIONAL POLICY

DCLG sets out basis for local policies in section 14 of National Planning Policy Framework. It requires new development to be planned in ways that can help to reduce greenhouse gas emissions, such as through its location, orientation and design. To help increase the use and supply of renewable and low carbon energy and heat, plans are encouraged to:
a) provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts);
b) consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and
c) identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for co-locating potential heat customers and suppliers.

THE NEW LONDON PLAN

The London Plan is the name given to the Mayor's spatial development strategy. The current version of London Plan was adopted in March 2021. The aim is to develop London as an exemplary sustainable world city, based on three interwoven themes.

- Strong, diverse long term economic growth
- Social inclusivity to give all Londoners the opportunity to share in London's future success
- Fundamental improvements in London's environment and use of resources.

Specific requirements on development sustainability are set out in the following policies:

POLICY SI 2 MINIMISING CO2 EMISSIONS

A. Major development should be net zero-carbon.151 This means reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand in accordance with the following energy hierarchy:
1) be lean: use less energy and manage demand during operation

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

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

C. A minimum on-site reduction of at least 35 per cent beyond Building Regulations 152 is required for major development. Residential development should achieve 10 per cent, and non-residential development should achieve 15 per cent through energy efficiency measures. Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided, in agreement with the borough, either:

1) through a cash in lieu contribution to the borough's carbon offset fund, or

2) off-site provided that an alternative proposal is identified and delivery is certain.

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

POLICY SI 3 D – ENERGY INFRASTRUCTURE

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

1) the heat source for the communal heating system should be selected in accordance with the following heating hierarchy:
   a) connect to local existing or planned heat networks
   b) use zero-emission or local secondary heat sources (in conjunction with heat pump, if required)
   c) use low-emission combined heat and power (CHP) (only where there is a case for CHP to enable the delivery of an area-wide heat network, meet the development's electricity demand and provide demand response to the local electricity network)

d) use ultra-low NOx gas boilers

2) CHP and ultra-low NOx gas boiler communal or district heating systems should be designed to ensure that they meet the requirements in Part B of Policy SI 1 Improving air quality

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

POLICY SI 4 – MANAGING HEAT RISK

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

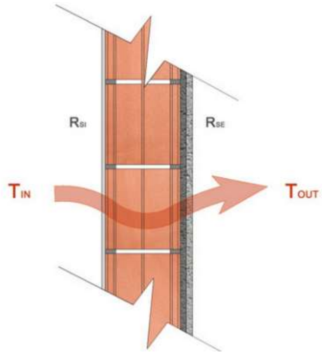
B. Major development proposals should demonstrate through an energy strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems in accordance with the following cooling hierarchy:

1) reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure
2) minimise internal heat generation through energy efficient design
3) manage the heat within the building through exposed internal thermal mass and high ceilings
4) provide passive ventilation
5) provide mechanical ventilation
6) provide active cooling systems.

Be lean: Passive design measures and efficient services

Number of passive design measures and measures improving energy efficiency of building services have been included in the design to underline the "Passive first" approach in the scheme design. Implemented measures are summarised in Table 3 of this report and include:

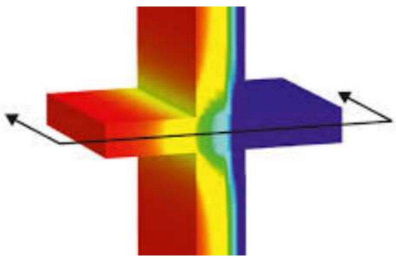
Low U-values of building fabric



Thermal performance of fabric is the most important aspect of passive measures mosaic. Low U-values ensure, that the amount of heat transmitted through building external elements is minimised. This is achieved by using highly insulated building materials with low thermal conductivity.

Notional dwelling U-values as set out in 2021 Part L1 are generally followed with small variations in the proposed scheme. The current notional building U-values are already challenging in real world and making significant improvements over them is usually not practical from payback and technical point of view.

Avoidance of Thermal Bridging



Thermal bridges occur at all junctions between building thermal elements, typically at junctions between wall/floor, wall/roof etc. Recent changes in the building regulations have emphasized the significance of thermal bridging in building design.

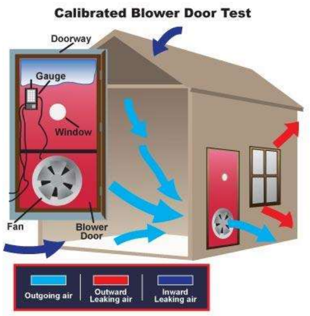
Continuity of insulation has to be maximised in order to minimise thermal bridging. Calculations presented in this energy statement and current proposal are based on thermal bridging Psi-values from Recognised Construction Details. Psi-values of all applicable junctions will be assessed by a suitably qualified assessor at the detailed design stage by either:

- Custom Psi-value calculation by 2D thermal modelling
- Psi value from database of approved details

BE LEAN: PASSIVE DESIGN MEASURES AND EFFICIENT SERVICES

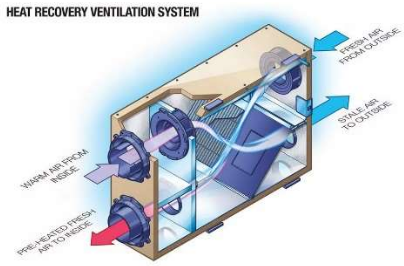
NEW HOUSE, 68-70 BOVILL ROAD , LONDON, SE23 1EJ

AIR TIGHTNESS



Air tight buildings minimise their heat loss through infiltration of cold air through gaps and cracks in building envelope. Air tightness of buildings is expressed as air permeability rate. Air permeability rate of 5.0 m3/h.m2 is set out as a reference value for the current building regulations notional dwelling. This value has to be confirmed by post-construction air tightness testing.

MECHANICAL VENTILATION WITH HEAT RECOVERY



Building regulations Part F recommends mechanical ventilation for dwellings with design air permeability of 5 or less. The most efficient form of mechanical ventilation is the heat recovery ventilation, where warm air extracted from bathrooms and kitchen passes the heat on to the supply air in heat exchanger. Supply air is then distributed to habitable rooms (bedrooms, living rooms).

To meet a good practice for MVHR efficiency, the installed units have to have hight heat recovery efficiency and low specific fan power. Such performance can be verified by choosing units from SAP Product Characteristics Database. Ductwork between the unit and exterior (supply and extract) has to be insulated to “Level 1” standard, i.e. 25mm insulation if less than 2m long or 50mm thickness for ducts over 2m long.

HIGH EFFICIENCY LIGHTING

While previous versions of Part L1 recognised low energy lighting to certain degree, the impact of low energy lighting is more accurate and more significant in the new 2021 Part L. All installed light fittings need to be included in detail in the assessment. To meet the efficiency level of notional reference dwelling, the installed power density shouldn’t exceed 2.3 W/m2 and all light fittings should achieve a luminaire efficacy of at least 80 lm/W

WATER EFFICIENCY

Reducing general water consumption in dwellings also reduces amount of energy needed to provide hot water. New Part L1 notional building therefore allows for overall water consumption of 125 l/person.day and more specifically, showers with flow rate of 8 l/min.

COMBINED HEAT AND POWER

Although gas CHP's used to help to reduce CO2 emissions by delivering heat and electricity locally and reducing the losses that normally occur by conventional power plants. This is no longer true, after significant grid electricity de-carbonisation in recent years. Any local electricity generation using fossil fuels (e.g. mains gas) will deliver electricity with higher carbon footprint than grid electricity. Combined heat and power is therefore no longer considered a low carbon technology.

DISTRICT HEATING CONNECTION

District heating connection is not feasible due to the size and nature of this development (single house).

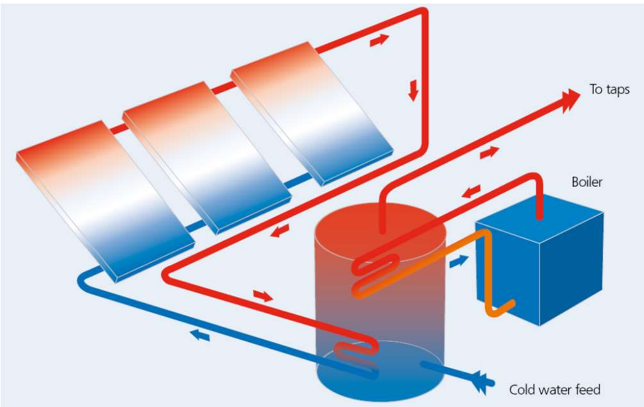
BE GREEN: ON-SITE RENEWABLE ENERGY SOURCES – SOLAR HOT WATER

GENERAL INFORMATION

Solar hot water systems for dwellings use collector which provides a separate heating circuit for hot water cylinder. This is usually backed up by electric immersion heater or other source of heat.

Two types of collectors are available:

- Flat Plate – less expensive, less efficient
- Evacuated Tube – more expensive and more efficient



RECOMMENDATIONS SPECIFIC TO THIS DEVELOPMENT

Solar hot water system has been ruled out as a less suitable system compared to the proposed solar PV. Solar photovoltaic is preferred due to longer life span and higher CO2 savings.

BE GREEN: ON-SITE RENEWABLE ENERGY SOURCE - AIR SOURCE HEAT PUMPS

GENERAL INFORMATION

An air source heat pump extracts heat from the outside air in the same way that a fridge extracts heat from its inside. It can extract heat from the air even when the outside temperature is as low as minus 15° C.

On 17 December 2008, the European Parliament adopted the EU Directive on promoting the use of energy from renewable sources. For the first time however, in addition to geothermal energy, aerothermal and hydrothermal energy are also recognised as renewable energy sources.

There are two main types of ASHP:

AIR-TO-WATER SYSTEM

Air-to-water system uses the heat to warm water. Heat pumps heat water to a lower temperature than a standard boiler system would, so they are more suitable for underfloor heating systems than radiator systems. Although some ASHP systems are capable of heating the water to the higher temperature, the efficiency is higher when using low temperature underfloor heating or low temperature fan convectors.

AIR-TO-AIR SYSTEM

Air-to-air system uses the heat to warm the indoor air. The air is heated through individual fan-coils or centrally and then distributed to rooms via ductwork.

RECOMMENDATIONS SPECIFIC TO THIS DEVELOPMENT

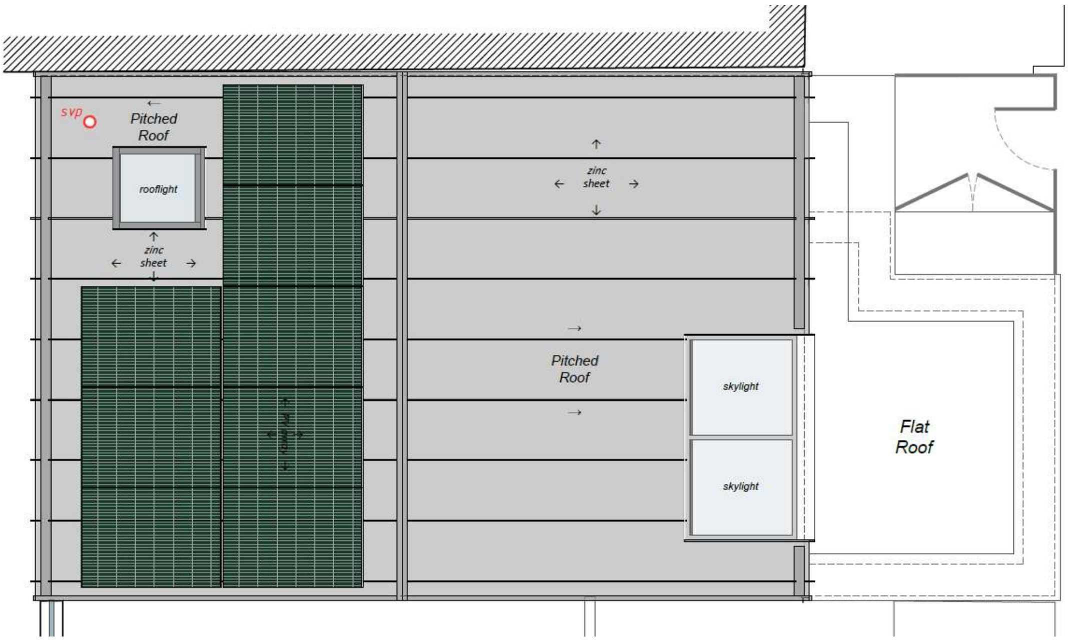
Air source heat pump has been ruled out due to the negative impact upon the usability of amenity space especially once the plant is enclosed to prevent disturbance to residents/neighbours.

BE GREEN: ON-SITE RENEWABLE ENERGY SOURCE - SOLAR PHOTOVOLTAICS

GENERAL INFORMATION

This system uses semi-conductor cells to convert solar energy into electricity. Two main types of PV panels are available:
- Monocrystalline – More expensive and more efficient
- Polycrystalline – Less expensive and less efficient
Depending on type, the output of 1 kWp (kilowatt peak) can be achieved by panels with area between 6 and 20 m2.

The use of PV panels generally requires relatively large unshaded roof area where they can be mounted facing south, ideally having between 30° and 40° inclination.



RECOMMENDATIONS SPECIFIC TO THIS DEVELOPMENT

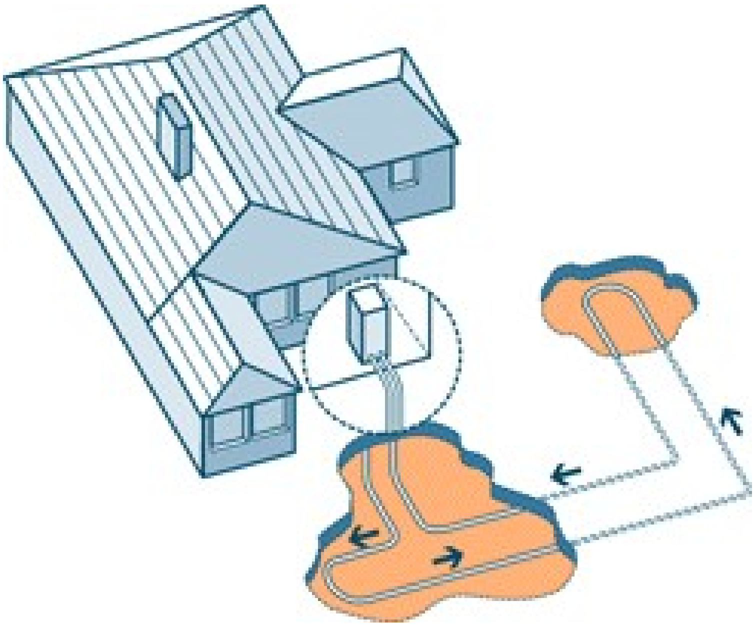
It is proposed to install a PV system on the south facing pitched roof, as indicated on architect roof plan, with total peak output of 3.2 kWp (e.g. 8 panels @ 0.4 kWp each). This is considered as a maximum PV system that can fit on the roof.

BE GREEN: ON-SITE RENEWABLE ENERGY SOURCE - GROUND SOURCE HEAT PUMP

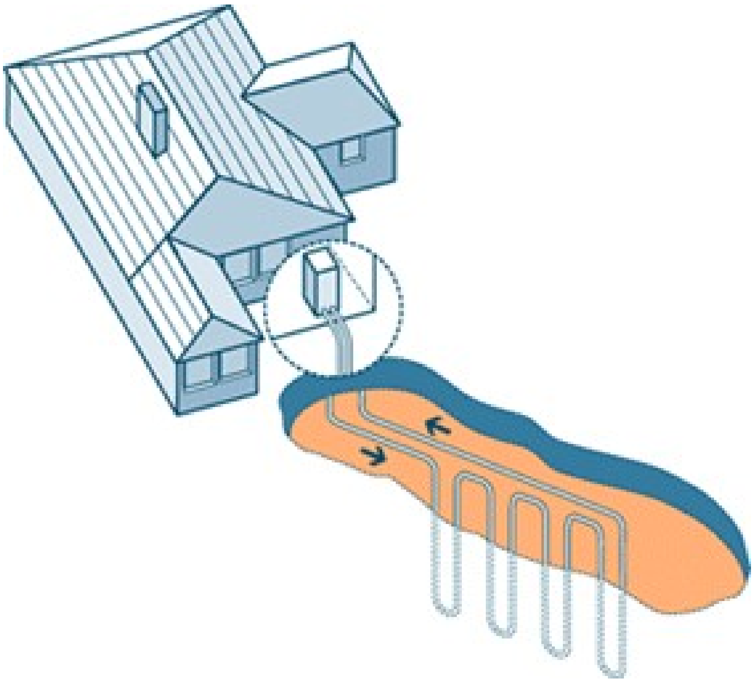
GENERAL INFORMATION

Ground source heat pumps use a buried ground loop which transfers heat from the ground into the building through heating distribution system. GSHP technology can be used both for heating and cooling. Two main types of GSHP are available:

- Horizontal loop is suitable for applications where sufficient area is available to accommodate horizontally buried pipes



- Vertical loop system can be used where ground space is limited, but will require boreholes typically 15-150m deep, and is consequently more expensive to install than horizontal systems.



RECOMMENDATIONS SPECIFIC TO THIS DEVELOPMENT

Ground source heat pumps have been ruled out due to higher installation cost maintenance and running cost compared to the proposed heating solution.

BE GREEN: ON-SITE RENEWABLE ENERGY SOURCES

BE GREEN: ON-SITE RENEWABLE ENERGY SOURCE - BIOMASS / BIOFUELS

GENERAL INFORMATION

Producing energy from biomass has both environmental and economic advantages. It is a carbon neutral process as the CO2 released when energy is generated from biomass is balanced by that absorbed during the fuel's production.
There are two main ways of using biomass to heat a domestic property:

- Standalone stoves providing space heating for a room. These can be fuelled by logs or pellets but only pellets are suitable for automatic feed. Generally they are 6-12 kW in output, and some models can be fitted with a back boiler to provide water heating.

- Boilers connected to central heating and hot water systems. These are suitable for pellets, logs or chips, and are generally larger than 15 kW.

RECOMMENDATIONS SPECIFIC TO THIS DEVELOPMENT

Biofuels are ruled out due to negative impact on air quality and environmental issues surrounding liquid biofuels as currently there are no established standards relating to the sustainability of biofuels.

BE GREEN: ON-SITE RENEWABLE ENERGY SOURCE - WIND ENERGY

GENERAL INFORMATION

Wind power is a clean, renewable source of energy which produces no carbon dioxide emissions or waste products. The turbines can have horizontal or vertical axis (Darrieus type). Wind turbines use the wind's lift forces to rotate aerodynamic blades that turn a rotor which creates electricity. Most small wind turbines generate direct current (DC) electricity and are not connected to the national grid. A special inverter and controller is required to convert DC electricity to AC at a quality and standard acceptable to the grid if the turbine is to be connected to national grid.

RECOMMENDATIONS SPECIFIC TO THIS DEVELOPMENT

Wind energy systems will not be considered due to negative visual effects, interference, flicker and noise risk. Exposure to wind would be limited by surrounding buildings.

CONCLUSION

The London Plan approach of “Be lean” – “Be clean” – “Be green” is fully adopted by implementing:

- Passive measures (low U-values, air permeability, avoidance of thermal bridging by accredited details)
- High efficiency services, i.e., high efficiency ventilation with heat recovery, high efficiency lighting
- Renewable sources: solar PV

Excluded renewable sources are:

- Solar hot water
- Biomass
- Wind turbines
- Heat pumps

The proposed development will achieve:

- 41% domestic regulated CO2 reduction against 2013 Part L compliant baseline

- 23% domestic regulated CO2 reduction by renewable sources

- 18% domestic regulated CO2 reduction by efficiency measures (“Be Lean” stage of the energy hierarchy)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Ondrej Gajdos	**Stroma Number:**	STRO006629
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.60

Property Address: Be Lean

Address : Be Lean, 68-70 Bovill Road, LONDON, SE23 1EJ

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	37.5	(1a) x	2.4	(2a) =	90	(3a)
First floor	30.7	(1b) x	2.65	(2b) =	81.36	(3b)
Second floor	30.7	(1c) x	2.3	(2c) =	70.61	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	98.9	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	241.97	(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) =	0.12	(8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.37	(18)

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

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.29	(21)

Infiltration rate modified for monthly wind speed

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

TER 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			2.07	x	1.2	=	2.484			(26)
Windows Type 1			1.34	x1/[1/(1.4)+ 0.04]		=	1.78			(27)
Windows Type 2			1.34	x1/[1/(1.4)+ 0.04]		=	1.78			(27)
Windows Type 3			7.24	x1/[1/(1.4)+ 0.04]		=	9.6			(27)
Windows Type 4			2.34	x1/[1/(1.4)+ 0.04]		=	3.1			(27)
Windows Type 5			2.34	x1/[1/(1.4)+ 0.04]		=	3.1			(27)
Windows Type 6			2.57	x1/[1/(1.4)+ 0.04]		=	3.41			(27)
Windows Type 7			1.88	x1/[1/(1.4)+ 0.04]		=	2.49			(27)
Windows Type 8			1.13	x1/[1/(1.4)+ 0.04]		=	1.5			(27)
Rooflights Type 1			1.884348	x1/[1/(1.7) + 0.04]		=	3.203391			(27b)
Rooflights Type 2			0.5824347	x1/[1/(1.7) + 0.04]		=	0.9901391			(27b)
Floor			37.5	x	0.13	=	4.875			(28)
Walls	161.58	22.25	139.33	x	0.18	=	25.08			(29)
Roof Type1	5.5	0	5.5	x	0.13	=	0.71			(30)
Roof Type2	37.5	2.47	35.03	x	0.13	=	4.55			(30)
Total area of elements, m²			242.08							(31)
Internal wall **			163.69							(32c)

TER WorkSheet: New dwelling design stage

Internal floor	61.4				(32d)
Internal ceiling	61.4				(32e)

** 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) =	68.39	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	15980.61	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		16.3	(36)

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

Total fabric heat loss	(33) + (36) =	84.68	(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=	45.38	45.16	44.96	43.98	43.8	42.95	42.95	42.79	43.28	43.8	44.17	44.55	(38)

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

(39)m=	130.06	129.85	129.64	128.67	128.48	127.64	127.64	127.48	127.96	128.48	128.85	129.24	

Average = $Sum(39)_{1…12}$ /12= 128.67 (39)

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

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

Average = $Sum(40)_{1…12}$ /12= 1.3 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.73 (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 99.02 (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=	108.92	104.96	101	97.04	93.08	89.11	89.11	93.08	97.04	101	104.96	108.92	

Total = $Sum(44)_{1…12}$ = 1188.2 (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=	161.52	141.27	145.78	127.09	121.95	105.23	97.51	111.9	113.23	131.96	144.05	156.43	

Total = $Sum(45)_{1…12}$ = 1557.91 (45)

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

(46)m=	24.23	21.19	21.87	19.06	18.29	15.78	14.63	16.78	16.98	19.79	21.61	23.46	(46)

Water storage loss:

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

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

a) If manufacturer's declared loss factor is known (kWh/day):		1.7	(48)
Temperature factor from Table 2b		0.54	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	0.92	(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)		0.92	(55)

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

(56)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(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=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(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=	213.27	188.01	197.52	177.17	173.69	155.31	149.26	163.64	163.31	183.71	194.12	208.17	(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=	213.27	188.01	197.52	177.17	173.69	155.31	149.26	163.64	163.31	183.71	194.12	208.17

Output from water heater (annual)$_{1…12}$ — 2167.19 — (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=	95.1	84.36	89.87	82.32	81.94	75.05	73.82	78.6	77.71	85.27	87.96	93.41	(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=	136.46	136.46	136.46	136.46	136.46	136.46	136.46	136.46	136.46	136.46	136.46	136.46	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	22.69	20.15	16.39	12.41	9.28	7.83	8.46	11	14.76	18.74	21.88	23.32	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	254.54	257.18	250.52	236.35	218.47	201.65	190.42	187.78	194.44	208.61	226.5	243.31	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	36.65	36.65	36.65	36.65	36.65	36.65	36.65	36.65	36.65	36.65	36.65	36.65	(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=	-109.16	-109.16	-109.16	-109.16	-109.16	-109.16	-109.16	-109.16	-109.16	-109.16	-109.16	-109.16	(71)

Water heating gains (Table 5)

(72)m=	127.83	125.54	120.79	114.33	110.14	104.24	99.22	105.65	107.93	114.62	122.16	125.55	(72)

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

(73)m=	471.99	469.81	454.64	430.03	404.82	380.66	365.04	371.37	384.07	408.91	437.47	459.12	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	1.34	x	10.63	x	0.63	x	0.7	=	4.35	(74)
North	0.9x	0.77	x	1.34	x	10.63	x	0.63	x	0.7	=	4.35	(74)
North	0.9x	0.77	x	2.57	x	10.63	x	0.63	x	0.7	=	8.35	(74)
North	0.9x	0.77	x	1.88	x	10.63	x	0.63	x	0.7	=	6.11	(74)
North	0.9x	0.77	x	1.13	x	10.63	x	0.63	x	0.7	=	3.67	(74)
North	0.9x	0.77	x	1.34	x	20.32	x	0.63	x	0.7	=	8.32	(74)
North	0.9x	0.77	x	1.34	x	20.32	x	0.63	x	0.7	=	8.32	(74)
North	0.9x	0.77	x	2.57	x	20.32	x	0.63	x	0.7	=	15.96	(74)
North	0.9x	0.77	x	1.88	x	20.32	x	0.63	x	0.7	=	11.68	(74)
North	0.9x	0.77	x	1.13	x	20.32	x	0.63	x	0.7	=	7.02	(74)
North	0.9x	0.77	x	1.34	x	34.53	x	0.63	x	0.7	=	14.14	(74)
North	0.9x	0.77	x	1.34	x	34.53	x	0.63	x	0.7	=	14.14	(74)
North	0.9x	0.77	x	2.57	x	34.53	x	0.63	x	0.7	=	27.12	(74)
North	0.9x	0.77	x	1.88	x	34.53	x	0.63	x	0.7	=	19.84	(74)
North	0.9x	0.77	x	1.13	x	34.53	x	0.63	x	0.7	=	11.92	(74)
North	0.9x	0.77	x	1.34	x	55.46	x	0.63	x	0.7	=	22.71	(74)
North	0.9x	0.77	x	1.34	x	55.46	x	0.63	x	0.7	=	22.71	(74)
North	0.9x	0.77	x	2.57	x	55.46	x	0.63	x	0.7	=	43.56	(74)
North	0.9x	0.77	x	1.88	x	55.46	x	0.63	x	0.7	=	31.87	(74)
North	0.9x	0.77	x	1.13	x	55.46	x	0.63	x	0.7	=	19.15	(74)
North	0.9x	0.77	x	1.34	x	74.72	x	0.63	x	0.7	=	30.6	(74)
North	0.9x	0.77	x	1.34	x	74.72	x	0.63	x	0.7	=	30.6	(74)
North	0.9x	0.77	x	2.57	x	74.72	x	0.63	x	0.7	=	58.68	(74)
North	0.9x	0.77	x	1.88	x	74.72	x	0.63	x	0.7	=	42.93	(74)
North	0.9x	0.77	x	1.13	x	74.72	x	0.63	x	0.7	=	25.8	(74)
North	0.9x	0.77	x	1.34	x	79.99	x	0.63	x	0.7	=	32.76	(74)
North	0.9x	0.77	x	1.34	x	79.99	x	0.63	x	0.7	=	32.76	(74)
North	0.9x	0.77	x	2.57	x	79.99	x	0.63	x	0.7	=	62.82	(74)
North	0.9x	0.77	x	1.88	x	79.99	x	0.63	x	0.7	=	45.96	(74)
North	0.9x	0.77	x	1.13	x	79.99	x	0.63	x	0.7	=	27.62	(74)

North	0.9x	0.77	x	1.34	x	74.68	x	0.63	x	0.7	=	30.58	(74)
North	0.9x	0.77	x	1.34	x	74.68	x	0.63	x	0.7	=	30.58	(74)
North	0.9x	0.77	x	2.57	x	74.68	x	0.63	x	0.7	=	58.65	(74)
North	0.9x	0.77	x	1.88	x	74.68	x	0.63	x	0.7	=	42.91	(74)
North	0.9x	0.77	x	1.13	x	74.68	x	0.63	x	0.7	=	25.79	(74)
North	0.9x	0.77	x	1.34	x	59.25	x	0.63	x	0.7	=	24.26	(74)
North	0.9x	0.77	x	1.34	x	59.25	x	0.63	x	0.7	=	24.26	(74)
North	0.9x	0.77	x	2.57	x	59.25	x	0.63	x	0.7	=	46.53	(74)
North	0.9x	0.77	x	1.88	x	59.25	x	0.63	x	0.7	=	34.04	(74)
North	0.9x	0.77	x	1.13	x	59.25	x	0.63	x	0.7	=	20.46	(74)
North	0.9x	0.77	x	1.34	x	41.52	x	0.63	x	0.7	=	17	(74)
North	0.9x	0.77	x	1.34	x	41.52	x	0.63	x	0.7	=	17	(74)
North	0.9x	0.77	x	2.57	x	41.52	x	0.63	x	0.7	=	32.61	(74)
North	0.9x	0.77	x	1.88	x	41.52	x	0.63	x	0.7	=	23.85	(74)
North	0.9x	0.77	x	1.13	x	41.52	x	0.63	x	0.7	=	14.34	(74)
North	0.9x	0.77	x	1.34	x	24.19	x	0.63	x	0.7	=	9.91	(74)
North	0.9x	0.77	x	1.34	x	24.19	x	0.63	x	0.7	=	9.91	(74)
North	0.9x	0.77	x	2.57	x	24.19	x	0.63	x	0.7	=	19	(74)
North	0.9x	0.77	x	1.88	x	24.19	x	0.63	x	0.7	=	13.9	(74)
North	0.9x	0.77	x	1.13	x	24.19	x	0.63	x	0.7	=	8.35	(74)
North	0.9x	0.77	x	1.34	x	13.12	x	0.63	x	0.7	=	5.37	(74)
North	0.9x	0.77	x	1.34	x	13.12	x	0.63	x	0.7	=	5.37	(74)
North	0.9x	0.77	x	2.57	x	13.12	x	0.63	x	0.7	=	10.3	(74)
North	0.9x	0.77	x	1.88	x	13.12	x	0.63	x	0.7	=	7.54	(74)
North	0.9x	0.77	x	1.13	x	13.12	x	0.63	x	0.7	=	4.53	(74)
North	0.9x	0.77	x	1.34	x	8.86	x	0.63	x	0.7	=	3.63	(74)
North	0.9x	0.77	x	1.34	x	8.86	x	0.63	x	0.7	=	3.63	(74)
North	0.9x	0.77	x	2.57	x	8.86	x	0.63	x	0.7	=	6.96	(74)
North	0.9x	0.77	x	1.88	x	8.86	x	0.63	x	0.7	=	5.09	(74)
North	0.9x	0.77	x	1.13	x	8.86	x	0.63	x	0.7	=	3.06	(74)
East	0.9x	0.77	x	7.24	x	19.64	x	0.63	x	0.7	=	43.46	(76)
East	0.9x	0.77	x	2.34	x	19.64	x	0.63	x	0.7	=	14.05	(76)
East	0.9x	0.77	x	2.34	x	19.64	x	0.63	x	0.7	=	14.05	(76)
East	0.9x	0.77	x	7.24	x	38.42	x	0.63	x	0.7	=	85.01	(76)
East	0.9x	0.77	x	2.34	x	38.42	x	0.63	x	0.7	=	27.48	(76)
East	0.9x	0.77	x	2.34	x	38.42	x	0.63	x	0.7	=	27.48	(76)
East	0.9x	0.77	x	7.24	x	63.27	x	0.63	x	0.7	=	140	(76)
East	0.9x	0.77	x	2.34	x	63.27	x	0.63	x	0.7	=	45.25	(76)
East	0.9x	0.77	x	2.34	x	63.27	x	0.63	x	0.7	=	45.25	(76)
East	0.9x	0.77	x	7.24	x	92.28	x	0.63	x	0.7	=	204.18	(76)
East	0.9x	0.77	x	2.34	x	92.28	x	0.63	x	0.7	=	65.99	(76)

TER WorkSheet: New dwelling design stage

East	0.9x	0.77	x	2.34	x	92.28	x	0.63	x	0.7	=	65.99	(76)
East	0.9x	0.77	x	7.24	x	113.09	x	0.63	x	0.7	=	250.23	(76)
East	0.9x	0.77	x	2.34	x	113.09	x	0.63	x	0.7	=	80.88	(76)
East	0.9x	0.77	x	2.34	x	113.09	x	0.63	x	0.7	=	80.88	(76)
East	0.9x	0.77	x	7.24	x	115.77	x	0.63	x	0.7	=	256.16	(76)
East	0.9x	0.77	x	2.34	x	115.77	x	0.63	x	0.7	=	82.79	(76)
East	0.9x	0.77	x	2.34	x	115.77	x	0.63	x	0.7	=	82.79	(76)
East	0.9x	0.77	x	7.24	x	110.22	x	0.63	x	0.7	=	243.87	(76)
East	0.9x	0.77	x	2.34	x	110.22	x	0.63	x	0.7	=	78.82	(76)
East	0.9x	0.77	x	2.34	x	110.22	x	0.63	x	0.7	=	78.82	(76)
East	0.9x	0.77	x	7.24	x	94.68	x	0.63	x	0.7	=	209.48	(76)
East	0.9x	0.77	x	2.34	x	94.68	x	0.63	x	0.7	=	67.71	(76)
East	0.9x	0.77	x	2.34	x	94.68	x	0.63	x	0.7	=	67.71	(76)
East	0.9x	0.77	x	7.24	x	73.59	x	0.63	x	0.7	=	162.83	(76)
East	0.9x	0.77	x	2.34	x	73.59	x	0.63	x	0.7	=	52.63	(76)
East	0.9x	0.77	x	2.34	x	73.59	x	0.63	x	0.7	=	52.63	(76)
East	0.9x	0.77	x	7.24	x	45.59	x	0.63	x	0.7	=	100.87	(76)
East	0.9x	0.77	x	2.34	x	45.59	x	0.63	x	0.7	=	32.6	(76)
East	0.9x	0.77	x	2.34	x	45.59	x	0.63	x	0.7	=	32.6	(76)
East	0.9x	0.77	x	7.24	x	24.49	x	0.63	x	0.7	=	54.19	(76)
East	0.9x	0.77	x	2.34	x	24.49	x	0.63	x	0.7	=	17.51	(76)
East	0.9x	0.77	x	2.34	x	24.49	x	0.63	x	0.7	=	17.51	(76)
East	0.9x	0.77	x	7.24	x	16.15	x	0.63	x	0.7	=	35.74	(76)
East	0.9x	0.77	x	2.34	x	16.15	x	0.63	x	0.7	=	11.55	(76)
East	0.9x	0.77	x	2.34	x	16.15	x	0.63	x	0.7	=	11.55	(76)
Rooflights	0.9x	1	x	1.88	x	16.18	x	0.63	x	0.7	=	12.1	(82)
Rooflights	0.9x	1	x	0.58	x	43.99	x	0.63	x	0.7	=	10.17	(82)
Rooflights	0.9x	1	x	1.88	x	30.63	x	0.63	x	0.7	=	22.91	(82)
Rooflights	0.9x	1	x	0.58	x	80.27	x	0.63	x	0.7	=	18.56	(82)
Rooflights	0.9x	1	x	1.88	x	55.7	x	0.63	x	0.7	=	41.66	(82)
Rooflights	0.9x	1	x	0.58	x	121.32	x	0.63	x	0.7	=	28.04	(82)
Rooflights	0.9x	1	x	1.88	x	101.28	x	0.63	x	0.7	=	75.75	(82)
Rooflights	0.9x	1	x	0.58	x	165.18	x	0.63	x	0.7	=	38.18	(82)
Rooflights	0.9x	1	x	1.88	x	149.52	x	0.63	x	0.7	=	111.83	(82)
Rooflights	0.9x	1	x	0.58	x	195.41	x	0.63	x	0.7	=	45.17	(82)
Rooflights	0.9x	1	x	1.88	x	166.08	x	0.63	x	0.7	=	124.21	(82)
Rooflights	0.9x	1	x	0.58	x	197.72	x	0.63	x	0.7	=	45.71	(82)
Rooflights	0.9x	1	x	1.88	x	152.65	x	0.63	x	0.7	=	114.16	(82)
Rooflights	0.9x	1	x	0.58	x	189.14	x	0.63	x	0.7	=	43.72	(82)
Rooflights	0.9x	1	x	1.88	x	112.79	x	0.63	x	0.7	=	84.36	(82)
Rooflights	0.9x	1	x	0.58	x	166.58	x	0.63	x	0.7	=	38.51	(82)

Rooflights 0.9x	1	x	1.88	x	70.26	x	0.63	x	0.7	=	52.55	(82)
Rooflights 0.9x	1	x	0.58	x	136.8	x	0.63	x	0.7	=	31.62	(82)
Rooflights 0.9x	1	x	1.88	x	37.03	x	0.63	x	0.7	=	27.7	(82)
Rooflights 0.9x	1	x	0.58	x	92.07	x	0.63	x	0.7	=	21.28	(82)
Rooflights 0.9x	1	x	1.88	x	19.8	x	0.63	x	0.7	=	14.81	(82)
Rooflights 0.9x	1	x	0.58	x	53.73	x	0.63	x	0.7	=	12.42	(82)
Rooflights 0.9x	1	x	1.88	x	13.64	x	0.63	x	0.7	=	10.2	(82)
Rooflights 0.9x	1	x	0.58	x	36.94	x	0.63	x	0.7	=	8.54	(82)

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

(83)m=	120.66	232.73	387.37	590.12	757.59	793.57	747.91	617.32	457.05	276.12	149.55	99.96	(83)

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

(84)m=	592.65	702.54	842.01	1020.15	1162.41	1174.23	1112.95	988.69	841.13	685.03	587.03	559.07	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.94	0.83	0.65	0.49	0.57	0.84	0.98	1	1	(86)

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

(87)m=	19.54	19.72	20.03	20.45	20.79	20.95	20.99	20.98	20.84	20.38	19.89	19.51	(87)

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

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

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

(89)m=	1	0.99	0.98	0.92	0.77	0.55	0.37	0.44	0.76	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=	17.9	18.15	18.61	19.21	19.64	19.82	19.84	19.84	19.72	19.13	18.41	17.86	(90)

fLA = Living area ÷ (4) = | 0.3 | (91)

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

(92)m=	18.39	18.62	19.04	19.58	19.99	20.16	20.19	20.18	20.05	19.5	18.85	18.35	(92)

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

(93)m=	18.39	18.62	19.04	19.58	19.99	20.16	20.19	20.18	20.05	19.5	18.85	18.35	(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	0.97	0.92	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=	590.21	696.2	820.84	936.62	909.51	679.49	453.06	472.67	654.13	656.93	582.19	557.29	(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=	1832.55	1781.62	1625.07	1374.24	1064.56	709.02	457.66	481.95	761.53	1143.8	1513.77	1828.81	(97)

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=	924.31	729.4	598.35	315.09	115.36	0	0	0	0	362.23	670.74	946.01

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4661.49 (98)

Space heating requirement in kWh/m²/year 47.13 (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)	924.31	729.4	598.35	315.09	115.36	0	0	0	0	362.23	670.74	946.01	
(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)	988.56	780.11	639.94	336.99	123.38	0	0	0	0	387.41	717.37	1011.78	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 4985.55 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

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

Water heating

Output from water heater (calculated above)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	213.27	188.01	197.52	177.17	173.69	155.31	149.26	163.64	163.31	183.71	194.12	208.17

Efficiency of water heater 79.8 (216)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(217)m=	88.28	88.08	87.59	86.33	83.75	79.8	79.8	79.8	79.8	86.59	87.86	88.36	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(219)m=	241.58	213.45	225.52	205.21	207.39	194.62	187.04	205.07	204.65	212.15	220.96	235.59

Total = Sum(219a)$_{1...12}$ = 2553.23 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			4985.55	
Water heating fuel used			2553.23	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			400.75	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			8014.53	(338)

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

TER 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	=	1076.88	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	551.5	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1628.38	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	207.99	(268)
Total CO2, kg/year			sum of (265)…(271) =		1875.29	(272)

TER =	18.96	(273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Ondrej Gajdos	**Stroma Number:**	STRO006629
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.60

Property Address: Be Lean

Address : Be Lean, 68-70 Bovill Road, LONDON, SE23 1EJ

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	37.5	(1a)	x	2.4	(2a)	=	90	(3a)
First floor	30.7	(1b)	x	2.65	(2b)	=	81.36	(3b)
Second floor	30.7	(1c)	x	2.3	(2c)	=	70.61	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	98.9	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	241.97	(5)

2. Ventilation rate:

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

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

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

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

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

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

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

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.19	(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

0.25	0.24	0.24	0.21	0.21	0.18	0.18	0.18	0.19	0.21	0.22	0.23

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

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

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 75.65 (23c)

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

(24a)m=	0.37	0.36	0.36	0.33	0.33	0.31	0.31	0.3	0.32	0.33	0.34	0.35	(24a)

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

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

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

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

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

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

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

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

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

(25)m=	0.37	0.36	0.36	0.33	0.33	0.31	0.31	0.3	0.32	0.33	0.34	0.35	(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			2.07	x	1	=	2.07			(26)
Windows Type 1			1.57	x1/[1/(1.2)+ 0.04]		=	1.8			(27)
Windows Type 2			1.57	x1/[1/(1.2)+ 0.04]		=	1.8			(27)
Windows Type 3			8.45	x1/[1/(1.2)+ 0.04]		=	9.68			(27)
Windows Type 4			2.73	x1/[1/(1.2)+ 0.04]		=	3.13			(27)
Windows Type 5			2.73	x1/[1/(1.2)+ 0.04]		=	3.13			(27)
Windows Type 6			3	x1/[1/(1.2)+ 0.04]		=	3.44			(27)
Windows Type 7			2.2	x1/[1/(1.2)+ 0.04]		=	2.52			(27)
Windows Type 8			1.32	x1/[1/(1.2)+ 0.04]		=	1.51			(27)
Rooflights Type 1			2.2	x1/[1/(1.2) + 0.04]		=	2.64			(27b)
Rooflights Type 2			0.68	x1/[1/(1.2) + 0.04]		=	0.816			(27b)
Floor			37.5	x	0.13	=	4.875	110	4125	(28)
Walls	161.58	25.64	135.94	x	0.18	=	24.47	60	8156.4	(29)
Roof Type1	5.5	0	5.5	x	0.11	=	0.6	9	49.5	(30)
Roof Type2	37.5	2.88	34.62	x	0.11	=	3.81	9	311.58	(30)
Total area of elements, m²			242.08							(31)
Internal wall **			163.69					9	1473.21	(32c)

DER WorkSheet: New dwelling design stage

Internal floor	61.4	18	1105.2	(32d)
Internal ceiling	61.4	9	552.6	(32e)

** 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) =	66.11	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	15773.49	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	= (34) ÷ (4) =	159.49	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		8.18	(36)

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

Total fabric heat loss	(33) + (36) =	74.29	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	29.45	29.06	28.67	26.74	26.35	24.42	24.42	24.03	25.19	26.35	27.13	27.9	(38)

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

(39)m=	103.74	103.35	102.97	101.03	100.65	98.71	98.71	98.33	99.49	100.65	101.42	102.19	

Average = Sum(39)$_{1…12}$ /12= 100.94 (39)

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

(40)m=	1.05	1.05	1.04	1.02	1.02	1	1	0.99	1.01	1.02	1.03	1.03	

Average = Sum(40)$_{1…12}$ /12= 1.02 (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 2.73 (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 99.02 (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=	108.92	104.96	101	97.04	93.08	89.11	89.11	93.08	97.04	101	104.96	108.92	

Total = Sum(44)$_{1…12}$ = 1188.2 (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=	161.52	141.27	145.78	127.09	121.95	105.23	97.51	111.9	113.23	131.96	144.05	156.43	

Total = Sum(45)$_{1…12}$ = 1557.91 (45)

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

(46)m=	24.23	21.19	21.87	19.06	18.29	15.78	14.63	16.78	16.98	19.79	21.61	23.46	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (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:

DER WorkSheet: New dwelling design stage

a) If manufacturer's declared loss factor is known (kWh/day):		1.97	(48)
Temperature factor from Table 2b		0.54	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	1.06	(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)		1.06	(55)

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

(56)m=	32.98	29.79	32.98	31.91	32.98	31.91	32.98	32.98	31.91	32.98	31.91	32.98	(56)

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

(57)m=	32.98	29.79	32.98	31.91	32.98	31.91	32.98	32.98	31.91	32.98	31.91	32.98	(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=	217.76	192.07	202.02	181.52	178.19	159.66	153.75	168.14	167.66	188.2	198.47	212.67	(62)

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

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	217.76	192.07	202.02	181.52	178.19	159.66	153.75	168.14	167.66	188.2	198.47	212.67

Output from water heater (annual)$_{1…12}$ — 2220.09 (64)

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

(65)m=	98.7	87.61	93.46	85.8	85.54	78.53	77.41	82.2	81.19	88.87	91.44	97	(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=	136.46	136.46	136.46	136.46	136.46	136.46	136.46	136.46	136.46	136.46	136.46	136.46	(66)

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

(67)m=	22.69	20.15	16.39	12.41	9.28	7.83	8.46	11	14.76	18.74	21.88	23.32	(67)

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

(68)m=	254.54	257.18	250.52	236.35	218.47	201.65	190.42	187.78	194.44	208.61	226.5	243.31	(68)

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

(69)m=	36.65	36.65	36.65	36.65	36.65	36.65	36.65	36.65	36.65	36.65	36.65	36.65	(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=	-109.16	-109.16	-109.16	-109.16	-109.16	-109.16	-109.16	-109.16	-109.16	-109.16	-109.16	-109.16	(71)

Water heating gains (Table 5)

(72)m=	132.66	130.37	125.62	119.16	114.97	109.07	104.05	110.48	112.76	119.45	126.99	130.38	(72)

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

(73)m=	476.82	474.64	459.47	434.86	409.65	385.49	369.87	376.2	388.9	413.74	442.3	463.95	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	1.57	x	10.63	x	0.63	x	0.7	=	5.1	(74)
North	0.9x	0.77	x	1.57	x	10.63	x	0.63	x	0.7	=	5.1	(74)
North	0.9x	0.77	x	3	x	10.63	x	0.63	x	0.7	=	9.75	(74)
North	0.9x	0.77	x	2.2	x	10.63	x	0.63	x	0.7	=	7.15	(74)
North	0.9x	0.77	x	1.32	x	10.63	x	0.63	x	0.7	=	4.29	(74)
North	0.9x	0.77	x	1.57	x	20.32	x	0.63	x	0.7	=	9.75	(74)
North	0.9x	0.77	x	1.57	x	20.32	x	0.63	x	0.7	=	9.75	(74)
North	0.9x	0.77	x	3	x	20.32	x	0.63	x	0.7	=	18.63	(74)
North	0.9x	0.77	x	2.2	x	20.32	x	0.63	x	0.7	=	13.66	(74)
North	0.9x	0.77	x	1.32	x	20.32	x	0.63	x	0.7	=	8.2	(74)
North	0.9x	0.77	x	1.57	x	34.53	x	0.63	x	0.7	=	16.57	(74)
North	0.9x	0.77	x	1.57	x	34.53	x	0.63	x	0.7	=	16.57	(74)
North	0.9x	0.77	x	3	x	34.53	x	0.63	x	0.7	=	31.66	(74)
North	0.9x	0.77	x	2.2	x	34.53	x	0.63	x	0.7	=	23.22	(74)
North	0.9x	0.77	x	1.32	x	34.53	x	0.63	x	0.7	=	13.93	(74)
North	0.9x	0.77	x	1.57	x	55.46	x	0.63	x	0.7	=	26.61	(74)
North	0.9x	0.77	x	1.57	x	55.46	x	0.63	x	0.7	=	26.61	(74)
North	0.9x	0.77	x	3	x	55.46	x	0.63	x	0.7	=	50.85	(74)
North	0.9x	0.77	x	2.2	x	55.46	x	0.63	x	0.7	=	37.29	(74)
North	0.9x	0.77	x	1.32	x	55.46	x	0.63	x	0.7	=	22.37	(74)
North	0.9x	0.77	x	1.57	x	74.72	x	0.63	x	0.7	=	35.85	(74)
North	0.9x	0.77	x	1.57	x	74.72	x	0.63	x	0.7	=	35.85	(74)
North	0.9x	0.77	x	3	x	74.72	x	0.63	x	0.7	=	68.5	(74)
North	0.9x	0.77	x	2.2	x	74.72	x	0.63	x	0.7	=	50.23	(74)
North	0.9x	0.77	x	1.32	x	74.72	x	0.63	x	0.7	=	30.14	(74)
North	0.9x	0.77	x	1.57	x	79.99	x	0.63	x	0.7	=	38.38	(74)
North	0.9x	0.77	x	1.57	x	79.99	x	0.63	x	0.7	=	38.38	(74)
North	0.9x	0.77	x	3	x	79.99	x	0.63	x	0.7	=	73.33	(74)
North	0.9x	0.77	x	2.2	x	79.99	x	0.63	x	0.7	=	53.78	(74)
North	0.9x	0.77	x	1.32	x	79.99	x	0.63	x	0.7	=	32.27	(74)

DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	1.57	x	74.68	x	0.63	x	0.7	=	35.83	(74)
North	0.9x	0.77	x	1.57	x	74.68	x	0.63	x	0.7	=	35.83	(74)
North	0.9x	0.77	x	3	x	74.68	x	0.63	x	0.7	=	68.47	(74)
North	0.9x	0.77	x	2.2	x	74.68	x	0.63	x	0.7	=	50.21	(74)
North	0.9x	0.77	x	1.32	x	74.68	x	0.63	x	0.7	=	30.13	(74)
North	0.9x	0.77	x	1.57	x	59.25	x	0.63	x	0.7	=	28.43	(74)
North	0.9x	0.77	x	1.57	x	59.25	x	0.63	x	0.7	=	28.43	(74)
North	0.9x	0.77	x	3	x	59.25	x	0.63	x	0.7	=	54.32	(74)
North	0.9x	0.77	x	2.2	x	59.25	x	0.63	x	0.7	=	39.83	(74)
North	0.9x	0.77	x	1.32	x	59.25	x	0.63	x	0.7	=	23.9	(74)
North	0.9x	0.77	x	1.57	x	41.52	x	0.63	x	0.7	=	19.92	(74)
North	0.9x	0.77	x	1.57	x	41.52	x	0.63	x	0.7	=	19.92	(74)
North	0.9x	0.77	x	3	x	41.52	x	0.63	x	0.7	=	38.06	(74)
North	0.9x	0.77	x	2.2	x	41.52	x	0.63	x	0.7	=	27.91	(74)
North	0.9x	0.77	x	1.32	x	41.52	x	0.63	x	0.7	=	16.75	(74)
North	0.9x	0.77	x	1.57	x	24.19	x	0.63	x	0.7	=	11.61	(74)
North	0.9x	0.77	x	1.57	x	24.19	x	0.63	x	0.7	=	11.61	(74)
North	0.9x	0.77	x	3	x	24.19	x	0.63	x	0.7	=	22.18	(74)
North	0.9x	0.77	x	2.2	x	24.19	x	0.63	x	0.7	=	16.26	(74)
North	0.9x	0.77	x	1.32	x	24.19	x	0.63	x	0.7	=	9.76	(74)
North	0.9x	0.77	x	1.57	x	13.12	x	0.63	x	0.7	=	6.29	(74)
North	0.9x	0.77	x	1.57	x	13.12	x	0.63	x	0.7	=	6.29	(74)
North	0.9x	0.77	x	3	x	13.12	x	0.63	x	0.7	=	12.03	(74)
North	0.9x	0.77	x	2.2	x	13.12	x	0.63	x	0.7	=	8.82	(74)
North	0.9x	0.77	x	1.32	x	13.12	x	0.63	x	0.7	=	5.29	(74)
North	0.9x	0.77	x	1.57	x	8.86	x	0.63	x	0.7	=	4.25	(74)
North	0.9x	0.77	x	1.57	x	8.86	x	0.63	x	0.7	=	4.25	(74)
North	0.9x	0.77	x	3	x	8.86	x	0.63	x	0.7	=	8.13	(74)
North	0.9x	0.77	x	2.2	x	8.86	x	0.63	x	0.7	=	5.96	(74)
North	0.9x	0.77	x	1.32	x	8.86	x	0.63	x	0.7	=	3.58	(74)
East	0.9x	0.77	x	8.45	x	19.64	x	0.63	x	0.7	=	50.72	(76)
East	0.9x	0.77	x	2.73	x	19.64	x	0.63	x	0.7	=	16.39	(76)
East	0.9x	0.77	x	2.73	x	19.64	x	0.63	x	0.7	=	16.39	(76)
East	0.9x	0.77	x	8.45	x	38.42	x	0.63	x	0.7	=	99.22	(76)
East	0.9x	0.77	x	2.73	x	38.42	x	0.63	x	0.7	=	32.06	(76)
East	0.9x	0.77	x	2.73	x	38.42	x	0.63	x	0.7	=	32.06	(76)
East	0.9x	0.77	x	8.45	x	63.27	x	0.63	x	0.7	=	163.4	(76)
East	0.9x	0.77	x	2.73	x	63.27	x	0.63	x	0.7	=	52.79	(76)
East	0.9x	0.77	x	2.73	x	63.27	x	0.63	x	0.7	=	52.79	(76)
East	0.9x	0.77	x	8.45	x	92.28	x	0.63	x	0.7	=	238.31	(76)
East	0.9x	0.77	x	2.73	x	92.28	x	0.63	x	0.7	=	76.99	(76)

DER WorkSheet: New dwelling design stage

East	0.9x	0.77	x	2.73	x	92.28	x	0.63	x	0.7	=	76.99	(76)
East	0.9x	0.77	x	8.45	x	113.09	x	0.63	x	0.7	=	292.05	(76)
East	0.9x	0.77	x	2.73	x	113.09	x	0.63	x	0.7	=	94.36	(76)
East	0.9x	0.77	x	2.73	x	113.09	x	0.63	x	0.7	=	94.36	(76)
East	0.9x	0.77	x	8.45	x	115.77	x	0.63	x	0.7	=	298.97	(76)
East	0.9x	0.77	x	2.73	x	115.77	x	0.63	x	0.7	=	96.59	(76)
East	0.9x	0.77	x	2.73	x	115.77	x	0.63	x	0.7	=	96.59	(76)
East	0.9x	0.77	x	8.45	x	110.22	x	0.63	x	0.7	=	284.63	(76)
East	0.9x	0.77	x	2.73	x	110.22	x	0.63	x	0.7	=	91.96	(76)
East	0.9x	0.77	x	2.73	x	110.22	x	0.63	x	0.7	=	91.96	(76)
East	0.9x	0.77	x	8.45	x	94.68	x	0.63	x	0.7	=	244.49	(76)
East	0.9x	0.77	x	2.73	x	94.68	x	0.63	x	0.7	=	78.99	(76)
East	0.9x	0.77	x	2.73	x	94.68	x	0.63	x	0.7	=	78.99	(76)
East	0.9x	0.77	x	8.45	x	73.59	x	0.63	x	0.7	=	190.04	(76)
East	0.9x	0.77	x	2.73	x	73.59	x	0.63	x	0.7	=	61.4	(76)
East	0.9x	0.77	x	2.73	x	73.59	x	0.63	x	0.7	=	61.4	(76)
East	0.9x	0.77	x	8.45	x	45.59	x	0.63	x	0.7	=	117.73	(76)
East	0.9x	0.77	x	2.73	x	45.59	x	0.63	x	0.7	=	38.04	(76)
East	0.9x	0.77	x	2.73	x	45.59	x	0.63	x	0.7	=	38.04	(76)
East	0.9x	0.77	x	8.45	x	24.49	x	0.63	x	0.7	=	63.24	(76)
East	0.9x	0.77	x	2.73	x	24.49	x	0.63	x	0.7	=	20.43	(76)
East	0.9x	0.77	x	2.73	x	24.49	x	0.63	x	0.7	=	20.43	(76)
East	0.9x	0.77	x	8.45	x	16.15	x	0.63	x	0.7	=	41.71	(76)
East	0.9x	0.77	x	2.73	x	16.15	x	0.63	x	0.7	=	13.48	(76)
East	0.9x	0.77	x	2.73	x	16.15	x	0.63	x	0.7	=	13.48	(76)
Rooflights	0.9x	1	x	2.2	x	16.18	x	0.63	x	0.7	=	14.12	(82)
Rooflights	0.9x	1	x	0.68	x	43.99	x	0.63	x	0.7	=	11.87	(82)
Rooflights	0.9x	1	x	2.2	x	30.63	x	0.63	x	0.7	=	26.75	(82)
Rooflights	0.9x	1	x	0.68	x	80.27	x	0.63	x	0.7	=	21.66	(82)
Rooflights	0.9x	1	x	2.2	x	55.7	x	0.63	x	0.7	=	48.64	(82)
Rooflights	0.9x	1	x	0.68	x	121.32	x	0.63	x	0.7	=	32.74	(82)
Rooflights	0.9x	1	x	2.2	x	101.28	x	0.63	x	0.7	=	88.44	(82)
Rooflights	0.9x	1	x	0.68	x	165.18	x	0.63	x	0.7	=	44.58	(82)
Rooflights	0.9x	1	x	2.2	x	149.52	x	0.63	x	0.7	=	130.56	(82)
Rooflights	0.9x	1	x	0.68	x	195.41	x	0.63	x	0.7	=	52.74	(82)
Rooflights	0.9x	1	x	2.2	x	166.08	x	0.63	x	0.7	=	145.01	(82)
Rooflights	0.9x	1	x	0.68	x	197.72	x	0.63	x	0.7	=	53.36	(82)
Rooflights	0.9x	1	x	2.2	x	152.65	x	0.63	x	0.7	=	133.29	(82)
Rooflights	0.9x	1	x	0.68	x	189.14	x	0.63	x	0.7	=	51.05	(82)
Rooflights	0.9x	1	x	2.2	x	112.79	x	0.63	x	0.7	=	98.49	(82)
Rooflights	0.9x	1	x	0.68	x	166.58	x	0.63	x	0.7	=	44.96	(82)

Rooflights 0.9x	1	x	2.2	x	70.26	x	0.63	x	0.7	=	61.35	(82)
Rooflights 0.9x	1	x	0.68	x	136.8	x	0.63	x	0.7	=	36.92	(82)
Rooflights 0.9x	1	x	2.2	x	37.03	x	0.63	x	0.7	=	32.34	(82)
Rooflights 0.9x	1	x	0.68	x	92.07	x	0.63	x	0.7	=	24.85	(82)
Rooflights 0.9x	1	x	2.2	x	19.8	x	0.63	x	0.7	=	17.29	(82)
Rooflights 0.9x	1	x	0.68	x	53.73	x	0.63	x	0.7	=	14.5	(82)
Rooflights 0.9x	1	x	2.2	x	13.64	x	0.63	x	0.7	=	11.91	(82)
Rooflights 0.9x	1	x	0.68	x	36.94	x	0.63	x	0.7	=	9.97	(82)

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

(83)m=	140.88	271.73	452.3	689.05	884.64	926.66	873.34	720.83	533.67	322.4	174.62	116.71	(83)

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

(84)m=	617.71	746.38	911.77	1123.92	1294.29	1312.15	1243.22	1097.03	922.58	736.14	616.93	580.66	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.97	0.94	0.83	0.65	0.47	0.35	0.41	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=	19.47	19.72	20.12	20.6	20.87	20.97	20.99	20.99	20.9	20.48	19.89	19.43	(87)

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

(88)m=	20.04	20.05	20.05	20.07	20.07	20.08	20.08	20.09	20.08	20.07	20.06	20.06	(88)

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

(89)m=	0.98	0.97	0.92	0.8	0.6	0.41	0.28	0.33	0.6	0.88	0.97	0.99	(89)

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

(90)m=	17.99	18.36	18.94	19.6	19.94	20.07	20.08	20.08	19.99	19.46	18.62	17.95	(90)

fLA = Living area ÷ (4) = | 0.3 | (91)

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

(92)m=	18.43	18.76	19.29	19.9	20.22	20.34	20.35	20.35	20.26	19.76	19	18.39	(92)

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

(93)m=	18.43	18.76	19.29	19.9	20.22	20.34	20.35	20.35	20.26	19.76	19	18.39	(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	0.79	0.61	0.42	0.3	0.35	0.61	0.87	0.96	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	604.29	715.57	829.46	888.91	790.57	554.52	368.39	384.54	565.68	643.98	593.74	570.36	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1466.11	1432.95	1317.17	1110.94	857.51	566.25	370.55	388.64	613.2	922.31	1206.96	1450.63	(97)

DER WorkSheet: New dwelling design stage

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

(98)m=	641.2	482.08	362.85	159.86	49.81	0	0	0	0	207.08	441.52	654.92

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2999.31 (98)

Space heating requirement in kWh/m²/year 30.33 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.7	(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)														
	641.2	482.08	362.85	159.86	49.81	0	0	0	0	207.08	441.52	654.92		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	706.94	531.51	400.06	176.25	54.91	0	0	0	0	228.31	486.79	722.07		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													3306.85	(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)														
	217.76	192.07	202.02	181.52	178.19	159.66	153.75	168.14	167.66	188.2	198.47	212.67		
Efficiency of water heater													80	(216)
(217)m=	87.73	87.37	86.56	84.68	82.12	80	80	80	80	85.27	87.09	87.82		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	248.23	219.83	233.38	214.36	216.99	199.57	192.19	210.17	209.57	220.71	227.9	242.16		
Total = Sum(219a)$_{1...12}$ =													2635.08	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3306.85	
Water heating fuel used			2635.08	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		256.23		(230a)
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		331.23	(231)
Electricity for lighting			400.75	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			6673.91	(338)

DER WorkSheet: New dwelling design stage

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	714.28	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	569.18	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1283.46	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	171.91	(267)
Electricity for lighting	(232) x	0.519	=	207.99	(268)
Total CO2, kg/year		sum of (265)…(271) =		1663.35	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		16.82	(273)
EI rating (section 14)				85	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Ondrej Gajdos	**Stroma Number:**	STRO006629
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.60

Property Address: Be Green

Address : Be Green, 68-70 Bovill Road, LONDON, SE23 1EJ

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	37.5	(1a)	x	2.4	(2a)	=	90	(3a)
First floor	30.7	(1b)	x	2.65	(2b)	=	81.36	(3b)
Second floor	30.7	(1c)	x	2.3	(2c)	=	70.61	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	98.9	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	241.97	(5)

2. Ventilation rate:

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

Air changes per hour

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

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

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

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

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

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

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.19	(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

0.25	0.24	0.24	0.21	0.21	0.18	0.18	0.18	0.19	0.21	0.22	0.23

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

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

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 75.65 (23c)

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

(24a)m=	0.37	0.36	0.36	0.33	0.33	0.31	0.31	0.3	0.32	0.33	0.34	0.35	(24a)

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

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

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

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

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

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

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

(25)m=	0.37	0.36	0.36	0.33	0.33	0.31	0.31	0.3	0.32	0.33	0.34	0.35	(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			2.07	x	1	=	2.07			(26)
Windows Type 1			1.57	x1/[1/(1.2)+ 0.04]		=	1.8			(27)
Windows Type 2			1.57	x1/[1/(1.2)+ 0.04]		=	1.8			(27)
Windows Type 3			8.45	x1/[1/(1.2)+ 0.04]		=	9.68			(27)
Windows Type 4			2.73	x1/[1/(1.2)+ 0.04]		=	3.13			(27)
Windows Type 5			2.73	x1/[1/(1.2)+ 0.04]		=	3.13			(27)
Windows Type 6			3	x1/[1/(1.2)+ 0.04]		=	3.44			(27)
Windows Type 7			2.2	x1/[1/(1.2)+ 0.04]		=	2.52			(27)
Windows Type 8			1.32	x1/[1/(1.2)+ 0.04]		=	1.51			(27)
Rooflights Type 1			2.2	x1/[1/(1.2) + 0.04]		=	2.64			(27b)
Rooflights Type 2			0.68	x1/[1/(1.2) + 0.04]		=	0.816			(27b)
Floor			37.5	x	0.13	=	4.875	110	4125	(28)
Walls	161.58	25.64	135.94	x	0.18	=	24.47	60	8156.4	(29)
Roof Type1	5.5	0	5.5	x	0.11	=	0.6	9	49.5	(30)
Roof Type2	37.5	2.88	34.62	x	0.11	=	3.81	9	311.58	(30)
Total area of elements, m²			242.08							(31)
Internal wall **			163.69					9	1473.21	(32c)

DER WorkSheet: New dwelling design stage

Internal floor	61.4	18	1105.2	(32d)
Internal ceiling	61.4	9	552.6	(32e)

** 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) =	66.11	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	15773.49	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	= (34) ÷ (4) =	159.49	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K — 8.18 (36)

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

Total fabric heat loss (33) + (36) = 74.29 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	29.45	29.06	28.67	26.74	26.35	24.42	24.42	24.03	25.19	26.35	27.13	27.9	(38)

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

(39)m=	103.74	103.35	102.97	101.03	100.65	98.71	98.71	98.33	99.49	100.65	101.42	102.19	

Average = Sum(39)$_{1…12}$ /12= 100.94 (39)

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

(40)m=	1.05	1.05	1.04	1.02	1.02	1	1	0.99	1.01	1.02	1.03	1.03	

Average = Sum(40)$_{1…12}$ /12= 1.02 (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 — 2.73 (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 — 99.02 (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=	108.92	104.96	101	97.04	93.08	89.11	89.11	93.08	97.04	101	104.96	108.92	

Total = Sum(44)$_{1…12}$ = 1188.2 (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=	161.52	141.27	145.78	127.09	121.95	105.23	97.51	111.9	113.23	131.96	144.05	156.43	

Total = Sum(45)$_{1…12}$ = 1557.91 (45)

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

(46)m=	24.23	21.19	21.87	19.06	18.29	15.78	14.63	16.78	16.98	19.79	21.61	23.46	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 210 (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:

DER WorkSheet: New dwelling design stage

a) If manufacturer's declared loss factor is known (kWh/day):		1.97	(48)
Temperature factor from Table 2b		0.54	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	1.06	(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)		1.06	(55)

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

(56)m=	32.98	29.79	32.98	31.91	32.98	31.91	32.98	32.98	31.91	32.98	31.91	32.98	(56)

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

(57)m=	32.98	29.79	32.98	31.91	32.98	31.91	32.98	32.98	31.91	32.98	31.91	32.98	(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=	217.76	192.07	202.02	181.52	178.19	159.66	153.75	168.14	167.66	188.2	198.47	212.67	(62)

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

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	217.76	192.07	202.02	181.52	178.19	159.66	153.75	168.14	167.66	188.2	198.47	212.67	

Output from water heater (annual)1…12 — 2220.09 (64)

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

(65)m=	98.7	87.61	93.46	85.8	85.54	78.53	77.41	82.2	81.19	88.87	91.44	97	(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=	136.46	136.46	136.46	136.46	136.46	136.46	136.46	136.46	136.46	136.46	136.46	136.46	(66)

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

(67)m=	22.69	20.15	16.39	12.41	9.28	7.83	8.46	11	14.76	18.74	21.88	23.32	(67)

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

(68)m=	254.54	257.18	250.52	236.35	218.47	201.65	190.42	187.78	194.44	208.61	226.5	243.31	(68)

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

(69)m=	36.65	36.65	36.65	36.65	36.65	36.65	36.65	36.65	36.65	36.65	36.65	36.65	(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=	-109.16	-109.16	-109.16	-109.16	-109.16	-109.16	-109.16	-109.16	-109.16	-109.16	-109.16	-109.16	(71)

Water heating gains (Table 5)

(72)m=	132.66	130.37	125.62	119.16	114.97	109.07	104.05	110.48	112.76	119.45	126.99	130.38	(72)

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

(73)m=	476.82	474.64	459.47	434.86	409.65	385.49	369.87	376.2	388.9	413.74	442.3	463.95	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	1.57	x	10.63	x	0.63	x	0.7	=	5.1	(74)
North	0.9x	0.77	x	1.57	x	10.63	x	0.63	x	0.7	=	5.1	(74)
North	0.9x	0.77	x	3	x	10.63	x	0.63	x	0.7	=	9.75	(74)
North	0.9x	0.77	x	2.2	x	10.63	x	0.63	x	0.7	=	7.15	(74)
North	0.9x	0.77	x	1.32	x	10.63	x	0.63	x	0.7	=	4.29	(74)
North	0.9x	0.77	x	1.57	x	20.32	x	0.63	x	0.7	=	9.75	(74)
North	0.9x	0.77	x	1.57	x	20.32	x	0.63	x	0.7	=	9.75	(74)
North	0.9x	0.77	x	3	x	20.32	x	0.63	x	0.7	=	18.63	(74)
North	0.9x	0.77	x	2.2	x	20.32	x	0.63	x	0.7	=	13.66	(74)
North	0.9x	0.77	x	1.32	x	20.32	x	0.63	x	0.7	=	8.2	(74)
North	0.9x	0.77	x	1.57	x	34.53	x	0.63	x	0.7	=	16.57	(74)
North	0.9x	0.77	x	1.57	x	34.53	x	0.63	x	0.7	=	16.57	(74)
North	0.9x	0.77	x	3	x	34.53	x	0.63	x	0.7	=	31.66	(74)
North	0.9x	0.77	x	2.2	x	34.53	x	0.63	x	0.7	=	23.22	(74)
North	0.9x	0.77	x	1.32	x	34.53	x	0.63	x	0.7	=	13.93	(74)
North	0.9x	0.77	x	1.57	x	55.46	x	0.63	x	0.7	=	26.61	(74)
North	0.9x	0.77	x	1.57	x	55.46	x	0.63	x	0.7	=	26.61	(74)
North	0.9x	0.77	x	3	x	55.46	x	0.63	x	0.7	=	50.85	(74)
North	0.9x	0.77	x	2.2	x	55.46	x	0.63	x	0.7	=	37.29	(74)
North	0.9x	0.77	x	1.32	x	55.46	x	0.63	x	0.7	=	22.37	(74)
North	0.9x	0.77	x	1.57	x	74.72	x	0.63	x	0.7	=	35.85	(74)
North	0.9x	0.77	x	1.57	x	74.72	x	0.63	x	0.7	=	35.85	(74)
North	0.9x	0.77	x	3	x	74.72	x	0.63	x	0.7	=	68.5	(74)
North	0.9x	0.77	x	2.2	x	74.72	x	0.63	x	0.7	=	50.23	(74)
North	0.9x	0.77	x	1.32	x	74.72	x	0.63	x	0.7	=	30.14	(74)
North	0.9x	0.77	x	1.57	x	79.99	x	0.63	x	0.7	=	38.38	(74)
North	0.9x	0.77	x	1.57	x	79.99	x	0.63	x	0.7	=	38.38	(74)
North	0.9x	0.77	x	3	x	79.99	x	0.63	x	0.7	=	73.33	(74)
North	0.9x	0.77	x	2.2	x	79.99	x	0.63	x	0.7	=	53.78	(74)
North	0.9x	0.77	x	1.32	x	79.99	x	0.63	x	0.7	=	32.27	(74)

DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	1.57	x	74.68	x	0.63	x	0.7	=	35.83	(74)
North	0.9x	0.77	x	1.57	x	74.68	x	0.63	x	0.7	=	35.83	(74)
North	0.9x	0.77	x	3	x	74.68	x	0.63	x	0.7	=	68.47	(74)
North	0.9x	0.77	x	2.2	x	74.68	x	0.63	x	0.7	=	50.21	(74)
North	0.9x	0.77	x	1.32	x	74.68	x	0.63	x	0.7	=	30.13	(74)
North	0.9x	0.77	x	1.57	x	59.25	x	0.63	x	0.7	=	28.43	(74)
North	0.9x	0.77	x	1.57	x	59.25	x	0.63	x	0.7	=	28.43	(74)
North	0.9x	0.77	x	3	x	59.25	x	0.63	x	0.7	=	54.32	(74)
North	0.9x	0.77	x	2.2	x	59.25	x	0.63	x	0.7	=	39.83	(74)
North	0.9x	0.77	x	1.32	x	59.25	x	0.63	x	0.7	=	23.9	(74)
North	0.9x	0.77	x	1.57	x	41.52	x	0.63	x	0.7	=	19.92	(74)
North	0.9x	0.77	x	1.57	x	41.52	x	0.63	x	0.7	=	19.92	(74)
North	0.9x	0.77	x	3	x	41.52	x	0.63	x	0.7	=	38.06	(74)
North	0.9x	0.77	x	2.2	x	41.52	x	0.63	x	0.7	=	27.91	(74)
North	0.9x	0.77	x	1.32	x	41.52	x	0.63	x	0.7	=	16.75	(74)
North	0.9x	0.77	x	1.57	x	24.19	x	0.63	x	0.7	=	11.61	(74)
North	0.9x	0.77	x	1.57	x	24.19	x	0.63	x	0.7	=	11.61	(74)
North	0.9x	0.77	x	3	x	24.19	x	0.63	x	0.7	=	22.18	(74)
North	0.9x	0.77	x	2.2	x	24.19	x	0.63	x	0.7	=	16.26	(74)
North	0.9x	0.77	x	1.32	x	24.19	x	0.63	x	0.7	=	9.76	(74)
North	0.9x	0.77	x	1.57	x	13.12	x	0.63	x	0.7	=	6.29	(74)
North	0.9x	0.77	x	1.57	x	13.12	x	0.63	x	0.7	=	6.29	(74)
North	0.9x	0.77	x	3	x	13.12	x	0.63	x	0.7	=	12.03	(74)
North	0.9x	0.77	x	2.2	x	13.12	x	0.63	x	0.7	=	8.82	(74)
North	0.9x	0.77	x	1.32	x	13.12	x	0.63	x	0.7	=	5.29	(74)
North	0.9x	0.77	x	1.57	x	8.86	x	0.63	x	0.7	=	4.25	(74)
North	0.9x	0.77	x	1.57	x	8.86	x	0.63	x	0.7	=	4.25	(74)
North	0.9x	0.77	x	3	x	8.86	x	0.63	x	0.7	=	8.13	(74)
North	0.9x	0.77	x	2.2	x	8.86	x	0.63	x	0.7	=	5.96	(74)
North	0.9x	0.77	x	1.32	x	8.86	x	0.63	x	0.7	=	3.58	(74)
East	0.9x	0.77	x	8.45	x	19.64	x	0.63	x	0.7	=	50.72	(76)
East	0.9x	0.77	x	2.73	x	19.64	x	0.63	x	0.7	=	16.39	(76)
East	0.9x	0.77	x	2.73	x	19.64	x	0.63	x	0.7	=	16.39	(76)
East	0.9x	0.77	x	8.45	x	38.42	x	0.63	x	0.7	=	99.22	(76)
East	0.9x	0.77	x	2.73	x	38.42	x	0.63	x	0.7	=	32.06	(76)
East	0.9x	0.77	x	2.73	x	38.42	x	0.63	x	0.7	=	32.06	(76)
East	0.9x	0.77	x	8.45	x	63.27	x	0.63	x	0.7	=	163.4	(76)
East	0.9x	0.77	x	2.73	x	63.27	x	0.63	x	0.7	=	52.79	(76)
East	0.9x	0.77	x	2.73	x	63.27	x	0.63	x	0.7	=	52.79	(76)
East	0.9x	0.77	x	8.45	x	92.28	x	0.63	x	0.7	=	238.31	(76)
East	0.9x	0.77	x	2.73	x	92.28	x	0.63	x	0.7	=	76.99	(76)

DER WorkSheet: New dwelling design stage

East	0.9x	0.77	x	2.73	x	92.28	x	0.63	x	0.7	=	76.99	(76)
East	0.9x	0.77	x	8.45	x	113.09	x	0.63	x	0.7	=	292.05	(76)
East	0.9x	0.77	x	2.73	x	113.09	x	0.63	x	0.7	=	94.36	(76)
East	0.9x	0.77	x	2.73	x	113.09	x	0.63	x	0.7	=	94.36	(76)
East	0.9x	0.77	x	8.45	x	115.77	x	0.63	x	0.7	=	298.97	(76)
East	0.9x	0.77	x	2.73	x	115.77	x	0.63	x	0.7	=	96.59	(76)
East	0.9x	0.77	x	2.73	x	115.77	x	0.63	x	0.7	=	96.59	(76)
East	0.9x	0.77	x	8.45	x	110.22	x	0.63	x	0.7	=	284.63	(76)
East	0.9x	0.77	x	2.73	x	110.22	x	0.63	x	0.7	=	91.96	(76)
East	0.9x	0.77	x	2.73	x	110.22	x	0.63	x	0.7	=	91.96	(76)
East	0.9x	0.77	x	8.45	x	94.68	x	0.63	x	0.7	=	244.49	(76)
East	0.9x	0.77	x	2.73	x	94.68	x	0.63	x	0.7	=	78.99	(76)
East	0.9x	0.77	x	2.73	x	94.68	x	0.63	x	0.7	=	78.99	(76)
East	0.9x	0.77	x	8.45	x	73.59	x	0.63	x	0.7	=	190.04	(76)
East	0.9x	0.77	x	2.73	x	73.59	x	0.63	x	0.7	=	61.4	(76)
East	0.9x	0.77	x	2.73	x	73.59	x	0.63	x	0.7	=	61.4	(76)
East	0.9x	0.77	x	8.45	x	45.59	x	0.63	x	0.7	=	117.73	(76)
East	0.9x	0.77	x	2.73	x	45.59	x	0.63	x	0.7	=	38.04	(76)
East	0.9x	0.77	x	2.73	x	45.59	x	0.63	x	0.7	=	38.04	(76)
East	0.9x	0.77	x	8.45	x	24.49	x	0.63	x	0.7	=	63.24	(76)
East	0.9x	0.77	x	2.73	x	24.49	x	0.63	x	0.7	=	20.43	(76)
East	0.9x	0.77	x	2.73	x	24.49	x	0.63	x	0.7	=	20.43	(76)
East	0.9x	0.77	x	8.45	x	16.15	x	0.63	x	0.7	=	41.71	(76)
East	0.9x	0.77	x	2.73	x	16.15	x	0.63	x	0.7	=	13.48	(76)
East	0.9x	0.77	x	2.73	x	16.15	x	0.63	x	0.7	=	13.48	(76)
Rooflights	0.9x	1	x	2.2	x	16.18	x	0.63	x	0.7	=	14.12	(82)
Rooflights	0.9x	1	x	0.68	x	43.99	x	0.63	x	0.7	=	11.87	(82)
Rooflights	0.9x	1	x	2.2	x	30.63	x	0.63	x	0.7	=	26.75	(82)
Rooflights	0.9x	1	x	0.68	x	80.27	x	0.63	x	0.7	=	21.66	(82)
Rooflights	0.9x	1	x	2.2	x	55.7	x	0.63	x	0.7	=	48.64	(82)
Rooflights	0.9x	1	x	0.68	x	121.32	x	0.63	x	0.7	=	32.74	(82)
Rooflights	0.9x	1	x	2.2	x	101.28	x	0.63	x	0.7	=	88.44	(82)
Rooflights	0.9x	1	x	0.68	x	165.18	x	0.63	x	0.7	=	44.58	(82)
Rooflights	0.9x	1	x	2.2	x	149.52	x	0.63	x	0.7	=	130.56	(82)
Rooflights	0.9x	1	x	0.68	x	195.41	x	0.63	x	0.7	=	52.74	(82)
Rooflights	0.9x	1	x	2.2	x	166.08	x	0.63	x	0.7	=	145.01	(82)
Rooflights	0.9x	1	x	0.68	x	197.72	x	0.63	x	0.7	=	53.36	(82)
Rooflights	0.9x	1	x	2.2	x	152.65	x	0.63	x	0.7	=	133.29	(82)
Rooflights	0.9x	1	x	0.68	x	189.14	x	0.63	x	0.7	=	51.05	(82)
Rooflights	0.9x	1	x	2.2	x	112.79	x	0.63	x	0.7	=	98.49	(82)
Rooflights	0.9x	1	x	0.68	x	166.58	x	0.63	x	0.7	=	44.96	(82)

DER WorkSheet: New dwelling design stage

Rooflights 0.9x	1	x	2.2	x	70.26	x	0.63	x	0.7	=	61.35	(82)
Rooflights 0.9x	1	x	0.68	x	136.8	x	0.63	x	0.7	=	36.92	(82)
Rooflights 0.9x	1	x	2.2	x	37.03	x	0.63	x	0.7	=	32.34	(82)
Rooflights 0.9x	1	x	0.68	x	92.07	x	0.63	x	0.7	=	24.85	(82)
Rooflights 0.9x	1	x	2.2	x	19.8	x	0.63	x	0.7	=	17.29	(82)
Rooflights 0.9x	1	x	0.68	x	53.73	x	0.63	x	0.7	=	14.5	(82)
Rooflights 0.9x	1	x	2.2	x	13.64	x	0.63	x	0.7	=	11.91	(82)
Rooflights 0.9x	1	x	0.68	x	36.94	x	0.63	x	0.7	=	9.97	(82)

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

(83)m=	140.88	271.73	452.3	689.05	884.64	926.66	873.34	720.83	533.67	322.4	174.62	116.71	(83)

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

(84)m=	617.71	746.38	911.77	1123.92	1294.29	1312.15	1243.22	1097.03	922.58	736.14	616.93	580.66	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.97	0.94	0.83	0.65	0.47	0.35	0.41	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=	19.47	19.72	20.12	20.6	20.87	20.97	20.99	20.99	20.9	20.48	19.89	19.43	(87)

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

(88)m=	20.04	20.05	20.05	20.07	20.07	20.08	20.08	20.09	20.08	20.07	20.06	20.06	(88)

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

(89)m=	0.98	0.97	0.92	0.8	0.6	0.41	0.28	0.33	0.6	0.88	0.97	0.99	(89)

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

(90)m=	17.99	18.36	18.94	19.6	19.94	20.07	20.08	20.08	19.99	19.46	18.62	17.95	(90)

fLA = Living area ÷ (4) = 0.3 (91)

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

(92)m=	18.43	18.76	19.29	19.9	20.22	20.34	20.35	20.35	20.26	19.76	19	18.39	(92)

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

(93)m=	18.43	18.76	19.29	19.9	20.22	20.34	20.35	20.35	20.26	19.76	19	18.39	(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	0.79	0.61	0.42	0.3	0.35	0.61	0.87	0.96	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	604.29	715.57	829.46	888.91	790.57	554.52	368.39	384.54	565.68	643.98	593.74	570.36	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1466.11	1432.95	1317.17	1110.94	857.51	566.25	370.55	388.64	613.2	922.31	1206.96	1450.63	(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=	641.2	482.08	362.85	159.86	49.81	0	0	0	0	207.08	441.52	654.92

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2999.31 (98)

Space heating requirement in kWh/m²/year 30.33 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system 0 (201)

Fraction of space heat from main system(s) (202) = 1 – (201) = 1 (202)

Fraction of total heating from main system 1 (204) = (202) × [1 – (203)] = 1 (204)

Efficiency of main space heating system 1 90.7 (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)	641.2	482.08	362.85	159.86	49.81	0	0	0	0	207.08	441.52	654.92		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	706.94	531.51	400.06	176.25	54.91	0	0	0	0	228.31	486.79	722.07		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													3306.85	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	217.76	192.07	202.02	181.52	178.19	159.66	153.75	168.14	167.66	188.2	198.47	212.67		
Efficiency of water heater													80	(216)
(217)m=	87.73	87.37	86.56	84.68	82.12	80	80	80	80	85.27	87.09	87.82		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	248.23	219.83	233.38	214.36	216.99	199.57	192.19	210.17	209.57	220.71	227.9	242.16		
Total = Sum(219a)$_{1...12}$ =													2635.08	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3306.85	
Water heating fuel used			2635.08	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		256.23		(230a)
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		331.23	(231)
Electricity for lighting			400.75	(232)
Electricity generated by PVs			-2763.58	(233)

DER WorkSheet: New dwelling design stage

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =				3910.32	(338)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	714.28	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	569.18	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1283.46	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	171.91	(267)
Electricity for lighting	(232) x	0.519	=	207.99	(268)
Energy saving/generation technologies Item 1		0.519	=	-1434.3	(269)
Total CO2, kg/year		sum of (265)…(271) =		229.05	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		2.32	(273)
EI rating (section 14)				98	(274)