ENERGY STATEMENT

FOR

NEW RESIDENTIAL BUILDING

AT

18- 20 LANCASTER GROVE, BELSIZE PARK, NW3 4PB

LONDON BOROUGH OF CAMDEN

CONSULTANT:

SLENDER WINTER PARTNERSHIP LTD
THE OLD SCHOOL
LONDON ROAD
WESTERHAM
KENT
TN16 1DN

ARCHITECT:

ADAM ARCHITECTURE
OLD HYDE HOUSE
75 HYDE STREET
WINCHESTER
HAMPSHIRE
SO23 7DW

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01 Issue to CSH Assessor

02 Minor changes following client meeting on 19th March 2014

03 Minor change following comments from Project Manager 14th March 2014

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1. EXECUTIVE SUMMARY

This document outlines the energy savings and energy efficiency measures including use of renewable technologies that are to be employed as part of the proposed new residential premises at 18-20 Lancaster Grove in order to meet Code for Sustainable Homes Level 4 which requires a betterment of 25% over current Building Regulation Part L requirements.

The proposed heating, domestic hot water, comfort cooling systems and efficient lighting in conjunction with various low and zero-carbon renewable energy systems have been considered and adopted or dismissed as detailed herein. An assessment was carried out to compare the energy consumption and subsequent $C0_2$ emissions of the new residential building against those of the existing residence. This proposed building has been specifically assessed in terms of predicted carbon emissions.

The key low carbon technology deemed as the most viable option for the proposed dwelling is the use of Ground Source Heat Pump (GSHP) system connected to a subterranean vertical closed loop to provide the heating and preheat to domestic hot water.

The SAP calculations have been prepared to determine the energy consumption and $C0_2$ emission with the new and existing building; these are provided below in Table 1.

	ENERGY CONSUMPTION (KWh/year)			
	HEATING ENERGY	**DHW ENERGY**	**LIGHTING AND ELECTRICAL ANCILLARIES**	**$C0_2$ (Kg/year)**
Proposed new Building	11,135	2,050	6,450	10,224

Table 1: Predicted Annual Energy Consumptions and $C0_2$ production

This approach has predicted to achieve **10.2 tonnes $C0_2$** per annum.

Table 2 shows that the results of the SAP calculations proposed building's Dwelling Emission Rate (DER) is considerably lower than both that of the Building Regulations minimum required Target Emissions Rate (TER) and the 25% improvement required for Code for Sustainable Homes Level 4.

ASSESSMENT	$C0_2$ (Kg/m^2/year)
New Building TER	20.46
TER +25% Improvement	15.35
New Building DER	14.93

Table 2: Predicted Annual $C0_2$ Emissions against Limits

This proposed redevelopment at 18-20 Lancaster Grove therefore is expected to reduce its carbon emissions by **27%** over current Part L Building Regulations required minimum standards.

1. INTRODUCTION

This Energy Statement describes the methodology used in assessing the proposed re-development and the assessment of the predicted energy target and renewable proposals to support the planning application for the new residential premises at 18-20 Lancaster Grove.

It is proposed that existing building located at 18-20 Lancaster Grove, Camden be demolished and reconstructed with the addition of a Basement level, resulting in a usable floor area of 712m^2.

2. BACKGROUND TO THE NEW RESIDENTIAL PREMISES

It is the intention of our client to re develop the site at 18-20 Lancaster Grove by the demolition of the existing buildings and construction of the single new building to current Building Regulations and achieve Code for Sustainable Homes Level 4, with the addition of subterranean basement level equating to a total SAP assessed area of 712m^2.

The proposed development over four floors consists of following SAP assessed areas:

Floor	Floor Area / (m^2)
Basement Floor (subterranean)	204
Ground Floor	205
First Floor	201
Second Floor	102

Table 3: the proposed Building Area

3. METHODOLOGY ADOPTED IN THE STRATEGY

The Energy consumption and carbon emissions for the proposed dwelling have been estimated using FSAP methodology (FSAP 2009 version: 1.5.0.63). The floor areas and building layout used in this analysis have been obtained from the Architect's drawing files.

ASSESSMENT TYPE	HEATED BUILDING AREA (m^2)	COOLED BUILDING AREA (m^2)
Proposed Building	712	500 [1]

Table 4: Heated and Cooled building Areas

[1] Cooling area is estimated at approximately 70% of the TFA and will be cooled by the ground source heat pump. This is not accounted for within the SAP 2009 software under the cooling section due to limitations of data entry.

4. BASE CASE ENERGY DEMAND AND CARBON EMISSIONS

The baseline energy demand for a notional building has been established within FSAP and use for the building regulation compliance checks;

The energy consumption benchmarks used in the assessment shows in the table below:

Benchmark data / (kWh per annum)

Building Type	Heating	Hot Water	Cooling	Electricity (lighting and power)
Notional Building	56,614	4,191	0	2,161

Table 5: Benchmark Data

From the Notional calculations the total estimated CO_2 level is estimated as **13,748.52 kg/year**

The Carbon emissions factors used in the assessment shows in the table below:

Fuel	Carbon Factors /(Kg/kWh)
Natural Gas	0.198
Electricity	0.517
Electricity Displaced	0.529

Table 6: Carbon Factors

5. ENERGY EFFICIENT MEASURES APPLIED TO THE PROPOSED DWELLING

The energy consumption of the building will be reduced further by incorporation of energy efficiency measures in the design of the mechanical and electrical engineering systems.

The following energy efficiency measures proposed for the new dwelling are described in more detail below:

5.1. DESIGN

The energy performance of the building is affected by the design, its construction and its use. Whilst occupant behaviour is beyond the remit of this statement, improved design and construction methods can significantly reduce the carbon emissions of a building and assist the occupant to reduce consumption. Sustainable design is not just incorporating renewable technologies but should be designed at the outset to provide suitable environmental conditions for the occupant's whilst also consuming as little energy as practically achievable.

5.2. THERMAL ELEMENTS

The proposed new building's fabric elements as advised by the Architect, shall be in compliance with the Approved Building Regulations Part L1A 2010.

Element	Design U-Values (W/m^2K)
External Walls	0.21
Roof	0.2
Floor	0.25
Windows & Doors	1.6

Table 7: Design U-Values

A design air permeability rate has been set at $3m^3/m^2/hr$ at 50Pa.

5.3. HEATING

The residential premises will utilise a ground source heat pump (GSHP) system (with a COP of up to 4.6 – 460% efficient) located in the basement plant room, serving the full space heating load utilising underfloor heating and radiator solutions. It will also serve the preheat to the domestic hot water demand.

Subject to how the space heating will be provided this will be sized to cover load, a provisional allowance for underfloor background heating in the region of 15**kW** has been allowed. The areas within the building shall be suitably zoned for space heating provision.

5.4. DOMESTIC HOT WATER SERVICES

The hot water generation shall be supplied by the same GSHP system that serves the building heating systems with boost and back-up from a gas fired condensing boiler. Provisionally 300 litres of hot water storage has been allowed for.

5.5. COMFORT COOLING

It has been requested by the Client that a system of comfort cooling may be considered to the principal occupied rooms within the house. This shall be provided via Fan Coil Units with heat rejection via the vertical thermal piles of the GSHP system.

5.6. ARTIFICIAL LIGHTING

The provision of natural daylight is considered an important factor in the design in order to minimise the use of artificial light within the building. Floors from ground level upward have access to natural light with high specification glazing being specified to maximise day lighting levels and minimise associated heat loss. High efficiency LED lamps will be considered in conjunction with the client's preferences and facilities for automatic switching and dimming systems shall also be incorporated where possible. This will however be subject to the client's and interior designer's agreement**.**

5.7. SUSTAINABLE CONSIDERATIONS

The 18-20 Lancaster Grove development incorporates a rainwater harvesting scheme to minimise mains water consumption. Rainwater shall be collected at roof level and sufficient volume stored for garden irrigations and car cleaning.

5.8. ON-SITE RENEWABLE ENERGY ASSESSMENT

A number of technologies were apprised in terms of technical, physical and financial feasibility, as potential low carbon system for use on the project.

5.8.1. Ground source heat pumps

illustrative images only

Heat pumps use refrigerant gases and an electrical compressor to take heat from a source and deliver it to an output. In this way they can be used to supply heat to a building. The ground acts as a huge solar collector and thermal store, which dampens fluctuations in ground temperature. The fluctuations reduce with depth and stabilise at the annual mean by about 12m below the surface; for the UK this is in the range 9–12°C.

Ground source heat pumps make use of this heat stored in the ground and raise it to a more useful temperature of around 40-50°C. It should be noted that at these temperatures, the heat produced is only useful for low temperature applications such as under floor heating installations; otherwise, a degree of top-up by conventional means is required when used for generating domestic hot water for example.

The viability of such a system and therefore costs rely almost entirely on the sub-structure build-up, the adjacency and restrictions on sub-structural service distributions and transport systems and the structural interface required to achieve thermal piles below the building.
From the survey it shows the site has the potential for ground source geothermal heat extraction below the garden of the proposed development.

It is proposed to install a total of 6 thermal pile/bore hole to be used in conjunction with heat pump systems to provide heating and cooling within the building.

5.8.2. Air Source Heat Pumps

Illustrative images only

Air source heat pumps operate using the same reverse refrigeration cycle as ground source heat pumps; however the initial heat energy is extracted from the external air rather than the ground. These heat pumps can be reversed to provide cooling to an area although this reduces the coefficient of performance of the pumps.

The heat pump connects multiple inside units with a single outside unit. The latter resembles an air conditioning condenser unit and care must be taken to locate the unit where any noise generation is not obtrusive and the location should ensure the unit is not visually obtrusive.

Since there is already adequate thermal load provided by the ground-source heat pump, and since air-source cannot provide as high efficiencies as ground source, there is no need to make use of air-source technology in addition to the ground-source heat pump already specified.

5.8.3. Solar Water Heating

Illustrative images only

Solar collectors, which are at the heart of most solar systems, absorb the sun's energy and provide heat for hot water, heating and other applications.

There is useable space at second floor roof level to accommodate the panels; however the building domestic hot water demand is already met with the use of the GSHP system and the space could instead be used for solar photovoltaic panels.

Solar hot water heating therefore will not be progressed further.

5.8.4. Photovoltaics

Illustrative images only

Photovoltaic panels (PV) provide clean silent electricity and generate green power during most daylight conditions although they are most efficient when exposed to direct sunlight or are orientated to face plus or minus 30 degrees of due south.

PV panels typically have an electrical warranty of 20 – 25 years and are eligible for the Government's Feed in Tariff (FITS) incentive scheme for the 25 years after the installation.

There is space to accommodate panels at roof level, however the site is shaded by mature trees both at the road side and to the sides. As a 27% CO_2 reduction is achievable with the GSHP alone PV technology is not recommended at this time.

5.8.5. Wind turbines

Illustrative images only

Wind power can be used to generate electricity either in parallel with mains supplies or as standalone solutions using battery back-up.

In order to generate worthwhile quantities of electricity, average wind speeds of between 5-6 m/s are necessary (the UK government is currently advising 5.5-6.0m/s as the threshold). However Government wind speed database predicts local wind speed at 18-20 Lancaster Grove to be 4.6 m/s at 10 m above ground level and 4.9 m/s at 25 m above ground level thus rendering the option unviable.

5.8.6. Combined Heat and Power (CHP)

Illustrative images only

Combined heat and power (CHP) also called co-generation is a de-centralised method of producing electricity from a fuel and 'capturing' the heat generated for space heating and hot water usage.

The production and transportation of electricity via the National Grid is very inefficient with over 65% of the energy produced at the power station being lost to the atmosphere and through transportation.

The system would generate electricity for use within the building with any surplus being sold back to the grid. The heat would be distributed via a communal heating and hot water infrastructure within the building. For a CHP plant to be efficient it needs operate for as much of the time as possible (usually deemed to be in excess of 14 hours per day). Therefore the size of the unit is usually based upon the hot water load of the building with additional boilers meeting the space heating demand.

In order to optimize a CHP system, whether it is fuelled by biomass or other means the proposed building needs to have a continuous heat demand throughout the year which unfortunately the proposed building does not have, therefore this option is unfeasible.

5.8.7. Biomass boilers

Illustrative images only

Energy from biomass is produced by burning organic matter. Organic matter is harvested and processed to create bio-energy which can take the form of liquid or solid fuels.

Although biomass is carbon-based (and hence generates carbon emissions), the carbon that is released during combustion is equal to that carbon that was absorbed during growth and so the fuel is classed as carbon neutral (the fuel generally requires treatment and transport, with associated carbon emissions however, but these effects will be ignored here).

This technology analysis assumes that a gas fired boiler would also be installed to allow a high optimization of the biomass boiler therefore a 13kW load would require approximately 6 tonnes/year of wood pellets and an estimated fuel store in the region of 8m^3. This would give rise to a number of deliveries of fuel a year which would be an unacceptable option and shall not be considered further.

5.8.8. Summary of Renewable Energy Feasibility

Technology	Feasible For This Site	Reason
Photovoltaics	**No**	Not Proposed due to Shading
Solar Water	**No**	Dismissed since load already supplied by GSHP.
Ground source heat pumps	**Yes**	Boreholes could be accommodated within the footprint of the site.
Air Source heat pumps	**No**	Enough space to accommodate Air source heat pump out door unit (condenser), however not necessary as GSHP can accommodate heating load more efficiently.
Wind Generators	**No**	Insufficient wind speeds at site.
CHP	**No**	There is not a consistent heat load throughout the year with which to justify the use of CHP plant.
Biomass Boilers	**No**	Regular fuel deliveries would be unacceptable and require unavailable fuel storage space.

6. ACHIEVABLE EMISSIONS REDUCTION

The figures below demonstrate the proposed energy consumption and CO_2 emissions resulting from the passive and active energy efficiency measures.

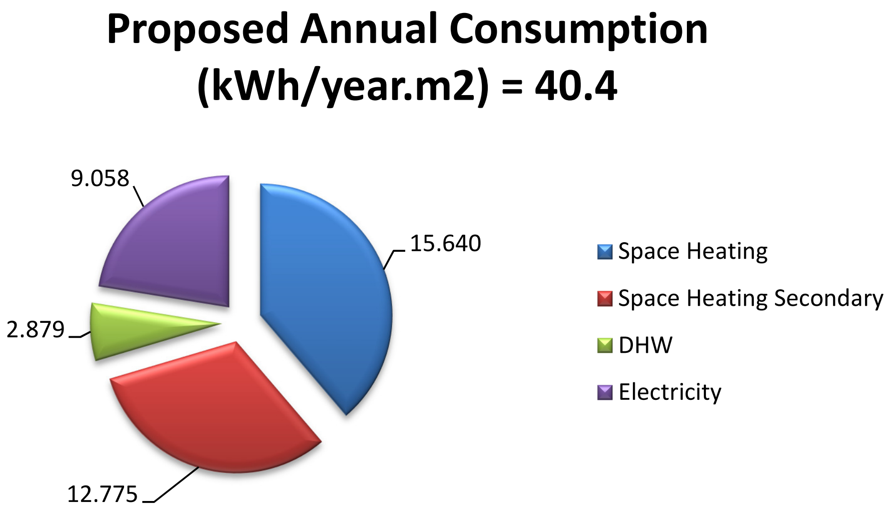

Figure 4

Figure 5 shows the estimated carbon dioxide emissions broken down by type of use.

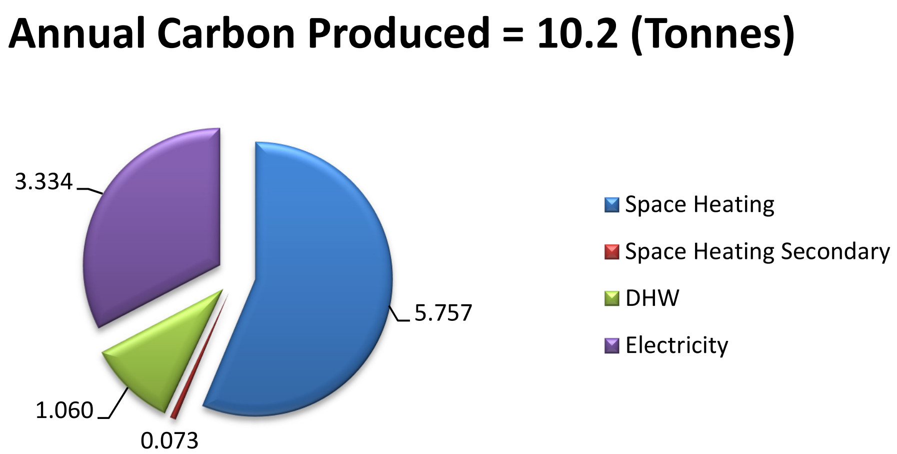

Figure 5

By utilising energy efficiency measures and supplying a majority of the development's energy requirements with low carbon technologies a total level of emissions of **10.2 tonnes** CO_2 per annum is predicted by SAP 9.9 software (FSAP 2009; Version 1.5.0.63). This equates to a saving of **3.5 tonnes** CO_2 per annum over the base case existing building.

7. CONCLUSIONS

This report demonstrates how a variety of technologies that may or may not be incorporated into the design of the proposed new building in order to reduce the Carbon emissions to **10.2 tonnes CO_2** per annum from the notional case of **13.7 tonnes CO_2**, representing an annual CO_2 saving of **27%.**

Type of Assessment	Energy Requirement (KWh p.a.)	Carbon Emission Rate ($KgCO_2$)
Notional building Value	62,966	13,749
Proposed Refurbish Building Value	28,731	10,224
Saving over base case	34,235	9,124
Approximate % Reduction over Notional Building Regulation Pass Level	**54%**	**27%**

ASSESSMENT	CO_2 (Kg/m^2/year)
New Building TER	20.46
TER +25% Improvement	15.35
New Building DER	14.93

APPENDIX A

SAP Worksheet For the Proposed New Dwelling

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2009	**Software Version:**	Version: 1.5.0.63

Property Address: 18-20 Lancaster Grove

Address : 18, Lancaster Grove, LONDON, NW3 4PB

1. Overall dwelling dimensions:

	Area(m²)		Ave Height(m)		Volume(m³)	
Basement	204	(1a) x	3.05	(2a) =	622.2	(3a)
Ground floor	205	(1b) x	2.9	(2b) =	594.5	(3b)
First floor	201	(1c) x	2.8	(2c) =	562.8	(3c)
Second floor	102	(1d) x	2.3	(2d) =	234.6	(3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	712	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		2014.1	(5)

2. Ventilation rate:

	main heating		Secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	1	+	0	=	1	x 40 =	40	(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) =	40	÷ (5) =	0.02	(8)

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

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)		0.17	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides on which sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.17	(21)

Infiltration rate modified for monthly wind speed

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

DRAFT

SAP WorkSheet: New dwelling design stage

Monthly average wind speed from Table 7

(22)m=	5.4	5.1	5.1	4.5	4.1	3.9	3.7	3.7	4.2	4.5	4.8	5.1

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27

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

	0.23	0.22	0.22	0.19	0.17	0.17	0.16	0.16	0.18	0.19	0.2	0.22

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) =	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=	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(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=	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(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	x 2	= 4			(26)
Windows Type 1			4	x1/[1/(1.6)+ 0.04]	= 6.02			(27)
Windows Type 2			2.5	x1/[1/(1.6)+ 0.04]	= 3.76			(27)
Windows Type 3			1.3	x1/[1/(1.6)+ 0.04]	= 1.95			(27)
Windows Type 4			2	x1/[1/(1.6)+ 0.04]	= 3.01			(27)
Windows Type 5			0.6	x1/[1/(1.6)+ 0.04]	= 0.9			(27)
Windows Type 6			2.2	x1/[1/(1.6)+ 0.04]	= 3.31			(27)
Windows Type 7			1.1	x1/[1/(1.6)+ 0.04]	= 1.65			(27)
Windows Type 8			3.7	x1/[1/(1.6)+ 0.04]	= 5.56			(27)
Windows Type 9			3.4	x1/[1/(1.6)+ 0.04]	= 5.11			(27)
Windows Type 10			1.4	x1/[1/(1.6)+ 0.04]	= 2.11			(27)
Windows Type 11			2.5	x1/[1/(1.6)+ 0.04]	= 3.76			(27)
Windows Type 12			2	x1/[1/(1.6)+ 0.04]	= 3.01			(27)
Windows Type 13			1	x1/[1/(1.6)+ 0.04]	= 1.5			(27)

SAP WorkSheet: New dwelling design stage

Windows Type 14			2.5	x1/[1/(1.6)+ 0.04] =	3.76				(27)
Windows Type 15			2	x1/[1/(1.6)+ 0.04] =	3.01				(27)
Floor Type 1			205	x 0.25	= 51.25				(28)
Floor Type 2			12	x 0.25	= 3				(28)
Walls Type1	302	93.4	208.6	x 0.21	= 43.81				(29)
Walls Type2	148	0	148	x 0.21	= 31.08				(29)
Roof Type1	108	0	108	x 0.2	= 21.6				(30)
Roof Type2	161	0	161	x 0.2	= 32.2				(30)
Total area of elements, m²			936						(31)

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

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	324.38	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	73860.9999	(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		140.4	(36)

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

Total fabric heat loss	(33) + (36) =	464.78	(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=	332.33	332.33	332.33	332.33	332.33	332.33	332.33	332.33	332.33	332.33	332.33	332.33		(38)

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

(39)m=	797.11	797.11	797.11	797.11	797.11	797.11	797.11	797.11	797.11	797.11	797.11	797.11		
										Average = Sum(39)$_{1…12}$ /12=			797.11	(39)

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

(40)m=	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12		
										Average = Sum(40)$_{1…12}$ /12=			1.12	(40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N	3.67	(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	121.3	(43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)														
(44)m=	133.43	128.58	123.73	118.88	114.03	109.17	109.17	114.03	118.88	123.73	128.58	133.43		
										Total = Sum(44)$_{1…12}$ =			1455.65	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)														
(45)m=	198.35	173.48	179.02	156.07	149.75	129.23	119.75	137.41	139.05	162.05	176.89	192.09		
										Total = Sum(45)$_{1…12}$ =			1913.15	(45)

SAP WorkSheet: New dwelling design stage

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

(46)m=	29.75	26.02	26.85	23.41	22.46	19.38	17.96	20.61	20.86	24.31	26.53	28.81	(46)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):		0	(47)
Temperature factor from Table 2b		0	(48)
Energy lost from water storage, kWh/year	(47) x (48) =	0	(49)
If manufacturer's declared cylinder loss factor is not known:			
Cylinder volume (litres) including any solar storage within same		300	(50)

If community heating and no tank in dwelling, enter 110 litres in box (50)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)

Hot water storage loss factor from Table 2 (kWh/litre/day)		0.01	(51)
Volume factor from Table 2a		0.74	(52)
Temperature factor from Table 2b		0.54	(53)
Energy lost from water storage, kWh/year	((50) x (51) x (52) x (53) =	1.62	(54)
Enter (49) or (54) in (55)		1.62	(55)

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

(56)m=	50.3	45.43	50.3	48.68	50.3	48.68	50.3	50.3	48.68	50.3	48.68	50.3	(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=	50.3	45.43	50.3	48.68	50.3	48.68	50.3	50.3	48.68	50.3	48.68	50.3	(57)

Primary circuit loss (annual) from Table 3 | 360 | (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=	30.58	27.62	30.58	29.59	30.58	0	0	0	0	30.58	29.59	30.58	(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=	279.23	246.53	259.89	234.34	230.63	177.9	170.05	187.71	187.73	242.93	255.16	272.97	(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=	279.23	246.53	259.89	234.34	230.63	0	0	0	0	242.93	255.16	272.97	

Output from water heater (annual)₁…₁₂ | 2021.67 | (64)

Output immersion

(64)m=	0	0	0	0	0	177.9	170.05	187.71	187.73	0	0	0	

Output from immersion (annual)₁…₁₂ | 723.3916 | (64)

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

(65)m=	130.65	116.12	124.22	114.51	114.49	81.91	80.06	85.93	85.18	118.58	121.43	128.57	(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=	220.05	220.05	220.05	220.05	220.05	220.05	220.05	220.05	220.05	220.05	220.05	220.05	(66)

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

(67)m=	198.91	176.67	143.68	108.77	81.31	68.64	74.17	96.41	129.4	164.31	191.77	204.44	(67)

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

(68)m=	1107.4	1118.89	1089.94	1028.29	950.47	877.33	828.47	816.98	845.93	907.58	985.4	1058.54	(68)

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

(69)m=	60.67	60.67	60.67	60.67	60.67	60.67	60.67	60.67	60.67	60.67	60.67	60.67	(69)

Pumps and fans gains (Table 5a)

(70)m=	10	10	10	10	10	10	10	10	10	10	10	10	(70)

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

(71)m=	-146.7	-146.7	-146.7	-146.7	-146.7	-146.7	-146.7	-146.7	-146.7	-146.7	-146.7	-146.7	(71)

Water heating gains (Table 5)

(72)m=	175.61	172.8	166.97	159.04	153.89	113.76	107.6	115.5	118.3	159.39	168.65	172.81	(72)

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

(73)m=	1625.94	1612.39	1544.6	1440.12	1329.69	1203.76	1154.27	1172.91	1237.66	1375.3	1489.85	1579.81	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	4	x	10.73	x	0.72	x	0.7	=	59.94	(74)
North	0.9x	0.77	x	2.5	x	10.73	x	0.72	x	0.7	=	37.46	(74)
North	0.9x	0.77	x	1.3	x	10.73	x	0.72	x	0.7	=	19.48	(74)
North	0.9x	0.77	x	2	x	10.73	x	0.72	x	0.7	=	7.49	(74)
North	0.9x	0.77	x	0.6	x	10.73	x	0.72	x	0.7	=	2.25	(74)
North	0.9x	0.77	x	4	x	20.36	x	0.72	x	0.7	=	113.77	(74)
North	0.9x	0.77	x	2.5	x	20.36	x	0.72	x	0.7	=	71.11	(74)
North	0.9x	0.77	x	1.3	x	20.36	x	0.72	x	0.7	=	36.98	(74)
North	0.9x	0.77	x	2	x	20.36	x	0.72	x	0.7	=	14.22	(74)
North	0.9x	0.77	x	0.6	x	20.36	x	0.72	x	0.7	=	4.27	(74)
North	0.9x	0.77	x	4	x	33.31	x	0.72	x	0.7	=	186.14	(74)
North	0.9x	0.77	x	2.5	x	33.31	x	0.72	x	0.7	=	116.34	(74)
North	0.9x	0.77	x	1.3	x	33.31	x	0.72	x	0.7	=	60.5	(74)
North	0.9x	0.77	x	2	x	33.31	x	0.72	x	0.7	=	23.27	(74)
North	0.9x	0.77	x	0.6	x	33.31	x	0.72	x	0.7	=	6.98	(74)
North	0.9x	0.77	x	4	x	54.64	x	0.72	x	0.7	=	305.35	(74)
North	0.9x	0.77	x	2.5	x	54.64	x	0.72	x	0.7	=	190.84	(74)
North	0.9x	0.77	x	1.3	x	54.64	x	0.72	x	0.7	=	99.24	(74)
North	0.9x	0.77	x	2	x	54.64	x	0.72	x	0.7	=	38.17	(74)
North	0.9x	0.77	x	0.6	x	54.64	x	0.72	x	0.7	=	11.45	(74)
North	0.9x	0.77	x	4	x	75.22	x	0.72	x	0.7	=	420.33	(74)
North	0.9x	0.77	x	2.5	x	75.22	x	0.72	x	0.7	=	262.71	(74)

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North	0.9x	0.77	x	1.3	x	75.22	x	0.72	x	0.7	=	136.61	(74)
North	0.9x	0.77	x	2	x	75.22	x	0.72	x	0.7	=	52.54	(74)
North	0.9x	0.77	x	0.6	x	75.22	x	0.72	x	0.7	=	15.76	(74)
North	0.9x	0.77	x	4	x	84.09	x	0.72	x	0.7	=	469.92	(74)
North	0.9x	0.77	x	2.5	x	84.09	x	0.72	x	0.7	=	293.7	(74)
North	0.9x	0.77	x	1.3	x	84.09	x	0.72	x	0.7	=	152.72	(74)
North	0.9x	0.77	x	2	x	84.09	x	0.72	x	0.7	=	58.74	(74)
North	0.9x	0.77	x	0.6	x	84.09	x	0.72	x	0.7	=	17.62	(74)
North	0.9x	0.77	x	4	x	79.12	x	0.72	x	0.7	=	442.15	(74)
North	0.9x	0.77	x	2.5	x	79.12	x	0.72	x	0.7	=	276.34	(74)
North	0.9x	0.77	x	1.3	x	79.12	x	0.72	x	0.7	=	143.7	(74)
North	0.9x	0.77	x	2	x	79.12	x	0.72	x	0.7	=	55.27	(74)
North	0.9x	0.77	x	0.6	x	79.12	x	0.72	x	0.7	=	16.58	(74)
North	0.9x	0.77	x	4	x	61.56	x	0.72	x	0.7	=	344.05	(74)
North	0.9x	0.77	x	2.5	x	61.56	x	0.72	x	0.7	=	215.03	(74)
North	0.9x	0.77	x	1.3	x	61.56	x	0.72	x	0.7	=	111.82	(74)
North	0.9x	0.77	x	2	x	61.56	x	0.72	x	0.7	=	43.01	(74)
North	0.9x	0.77	x	0.6	x	61.56	x	0.72	x	0.7	=	12.9	(74)
North	0.9x	0.77	x	4	x	41.09	x	0.72	x	0.7	=	229.6	(74)
North	0.9x	0.77	x	2.5	x	41.09	x	0.72	x	0.7	=	143.5	(74)
North	0.9x	0.77	x	1.3	x	41.09	x	0.72	x	0.7	=	74.62	(74)
North	0.9x	0.77	x	2	x	41.09	x	0.72	x	0.7	=	28.7	(74)
North	0.9x	0.77	x	0.6	x	41.09	x	0.72	x	0.7	=	8.61	(74)
North	0.9x	0.77	x	4	x	24.81	x	0.72	x	0.7	=	138.67	(74)
North	0.9x	0.77	x	2.5	x	24.81	x	0.72	x	0.7	=	86.67	(74)
North	0.9x	0.77	x	1.3	x	24.81	x	0.72	x	0.7	=	45.07	(74)
North	0.9x	0.77	x	2	x	24.81	x	0.72	x	0.7	=	17.33	(74)
North	0.9x	0.77	x	0.6	x	24.81	x	0.72	x	0.7	=	5.2	(74)
North	0.9x	0.77	x	4	x	13.22	x	0.72	x	0.7	=	73.87	(74)
North	0.9x	0.77	x	2.5	x	13.22	x	0.72	x	0.7	=	46.17	(74)
North	0.9x	0.77	x	1.3	x	13.22	x	0.72	x	0.7	=	24.01	(74)
North	0.9x	0.77	x	2	x	13.22	x	0.72	x	0.7	=	9.23	(74)
North	0.9x	0.77	x	0.6	x	13.22	x	0.72	x	0.7	=	2.77	(74)
North	0.9x	0.77	x	4	x	8.94	x	0.72	x	0.7	=	49.98	(74)
North	0.9x	0.77	x	2.5	x	8.94	x	0.72	x	0.7	=	31.24	(74)
North	0.9x	0.77	x	1.3	x	8.94	x	0.72	x	0.7	=	16.25	(74)
North	0.9x	0.77	x	2	x	8.94	x	0.72	x	0.7	=	6.25	(74)
North	0.9x	0.77	x	0.6	x	8.94	x	0.72	x	0.7	=	1.87	(74)
East	0.9x	1	x	2.5	x	19.87	x	0.72	x	0.7	=	17.35	(76)
East	0.9x	1	x	2	x	19.87	x	0.72	x	0.7	=	13.88	(76)
East	0.9x	1	x	2.5	x	38.52	x	0.72	x	0.7	=	33.63	(76)

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East	0.9x	1	x	2	x	38.52	x	0.72	x	0.7	=	26.91	(76)
East	0.9x	1	x	2.5	x	61.57	x	0.72	x	0.7	=	53.76	(76)
East	0.9x	1	x	2	x	61.57	x	0.72	x	0.7	=	43.01	(76)
East	0.9x	1	x	2.5	x	91.41	x	0.72	x	0.7	=	79.82	(76)
East	0.9x	1	x	2	x	91.41	x	0.72	x	0.7	=	63.85	(76)
East	0.9x	1	x	2.5	x	111.22	x	0.72	x	0.7	=	97.11	(76)
East	0.9x	1	x	2	x	111.22	x	0.72	x	0.7	=	77.69	(76)
East	0.9x	1	x	2.5	x	116.05	x	0.72	x	0.7	=	101.33	(76)
East	0.9x	1	x	2	x	116.05	x	0.72	x	0.7	=	81.07	(76)
East	0.9x	1	x	2.5	x	112.64	x	0.72	x	0.7	=	98.36	(76)
East	0.9x	1	x	2	x	112.64	x	0.72	x	0.7	=	78.69	(76)
East	0.9x	1	x	2.5	x	98.03	x	0.72	x	0.7	=	85.6	(76)
East	0.9x	1	x	2	x	98.03	x	0.72	x	0.7	=	68.48	(76)
East	0.9x	1	x	2.5	x	73.6	x	0.72	x	0.7	=	64.27	(76)
East	0.9x	1	x	2	x	73.6	x	0.72	x	0.7	=	51.42	(76)
East	0.9x	1	x	2.5	x	46.91	x	0.72	x	0.7	=	40.96	(76)
East	0.9x	1	x	2	x	46.91	x	0.72	x	0.7	=	32.77	(76)
East	0.9x	1	x	2.5	x	24.71	x	0.72	x	0.7	=	21.57	(76)
East	0.9x	1	x	2	x	24.71	x	0.72	x	0.7	=	17.26	(76)
East	0.9x	1	x	2.5	x	16.39	x	0.72	x	0.7	=	14.31	(76)
East	0.9x	1	x	2	x	16.39	x	0.72	x	0.7	=	11.45	(76)
South	0.9x	0.77	x	2.2	x	47.32	x	0.72	x	0.7	=	145.45	(78)
South	0.9x	0.77	x	1.1	x	47.32	x	0.72	x	0.7	=	36.36	(78)
South	0.9x	0.77	x	3.7	x	47.32	x	0.72	x	0.7	=	428.09	(78)
South	0.9x	0.77	x	3.4	x	47.32	x	0.72	x	0.7	=	56.2	(78)
South	0.9x	0.77	x	1.4	x	47.32	x	0.72	x	0.7	=	46.28	(78)
South	0.9x	0.77	x	2.2	x	77.18	x	0.72	x	0.7	=	237.23	(78)
South	0.9x	0.77	x	1.1	x	77.18	x	0.72	x	0.7	=	59.31	(78)
South	0.9x	0.77	x	3.7	x	77.18	x	0.72	x	0.7	=	698.21	(78)
South	0.9x	0.77	x	3.4	x	77.18	x	0.72	x	0.7	=	91.66	(78)
South	0.9x	0.77	x	1.4	x	77.18	x	0.72	x	0.7	=	75.48	(78)
South	0.9x	0.77	x	2.2	x	94.25	x	0.72	x	0.7	=	289.67	(78)
South	0.9x	0.77	x	1.1	x	94.25	x	0.72	x	0.7	=	72.42	(78)
South	0.9x	0.77	x	3.7	x	94.25	x	0.72	x	0.7	=	852.56	(78)
South	0.9x	0.77	x	3.4	x	94.25	x	0.72	x	0.7	=	111.92	(78)
South	0.9x	0.77	x	1.4	x	94.25	x	0.72	x	0.7	=	92.17	(78)
South	0.9x	0.77	x	2.2	x	105.11	x	0.72	x	0.7	=	323.08	(78)
South	0.9x	0.77	x	1.1	x	105.11	x	0.72	x	0.7	=	80.77	(78)
South	0.9x	0.77	x	3.7	x	105.11	x	0.72	x	0.7	=	950.88	(78)
South	0.9x	0.77	x	3.4	x	105.11	x	0.72	x	0.7	=	124.83	(78)
South	0.9x	0.77	x	1.4	x	105.11	x	0.72	x	0.7	=	102.8	(78)

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South	0.9x	0.77	x	2.2	x	108.55	x	0.72	x	0.7	=	333.64	(78)
South	0.9x	0.77	x	1.1	x	108.55	x	0.72	x	0.7	=	83.41	(78)
South	0.9x	0.77	x	3.7	x	108.55	x	0.72	x	0.7	=	981.96	(78)
South	0.9x	0.77	x	3.4	x	108.55	x	0.72	x	0.7	=	128.91	(78)
South	0.9x	0.77	x	1.4	x	108.55	x	0.72	x	0.7	=	106.16	(78)
South	0.9x	0.77	x	2.2	x	108.9	x	0.72	x	0.7	=	334.71	(78)
South	0.9x	0.77	x	1.1	x	108.9	x	0.72	x	0.7	=	83.68	(78)
South	0.9x	0.77	x	3.7	x	108.9	x	0.72	x	0.7	=	985.11	(78)
South	0.9x	0.77	x	3.4	x	108.9	x	0.72	x	0.7	=	129.32	(78)
South	0.9x	0.77	x	1.4	x	108.9	x	0.72	x	0.7	=	106.5	(78)
South	0.9x	0.77	x	2.2	x	107.14	x	0.72	x	0.7	=	329.3	(78)
South	0.9x	0.77	x	1.1	x	107.14	x	0.72	x	0.7	=	82.32	(78)
South	0.9x	0.77	x	3.7	x	107.14	x	0.72	x	0.7	=	969.18	(78)
South	0.9x	0.77	x	3.4	x	107.14	x	0.72	x	0.7	=	127.23	(78)
South	0.9x	0.77	x	1.4	x	107.14	x	0.72	x	0.7	=	104.78	(78)
South	0.9x	0.77	x	2.2	x	103.88	x	0.72	x	0.7	=	319.29	(78)
South	0.9x	0.77	x	1.1	x	103.88	x	0.72	x	0.7	=	79.82	(78)
South	0.9x	0.77	x	3.7	x	103.88	x	0.72	x	0.7	=	939.74	(78)
South	0.9x	0.77	x	3.4	x	103.88	x	0.72	x	0.7	=	123.36	(78)
South	0.9x	0.77	x	1.4	x	103.88	x	0.72	x	0.7	=	101.59	(78)
South	0.9x	0.77	x	2.2	x	99.99	x	0.72	x	0.7	=	307.33	(78)
South	0.9x	0.77	x	1.1	x	99.99	x	0.72	x	0.7	=	76.83	(78)
South	0.9x	0.77	x	3.7	x	99.99	x	0.72	x	0.7	=	904.53	(78)
South	0.9x	0.77	x	3.4	x	99.99	x	0.72	x	0.7	=	118.74	(78)
South	0.9x	0.77	x	1.4	x	99.99	x	0.72	x	0.7	=	97.79	(78)
South	0.9x	0.77	x	2.2	x	85.29	x	0.72	x	0.7	=	262.15	(78)
South	0.9x	0.77	x	1.1	x	85.29	x	0.72	x	0.7	=	65.54	(78)
South	0.9x	0.77	x	3.7	x	85.29	x	0.72	x	0.7	=	771.56	(78)
South	0.9x	0.77	x	3.4	x	85.29	x	0.72	x	0.7	=	101.29	(78)
South	0.9x	0.77	x	1.4	x	85.29	x	0.72	x	0.7	=	83.41	(78)
South	0.9x	0.77	x	2.2	x	56.07	x	0.72	x	0.7	=	172.33	(78)
South	0.9x	0.77	x	1.1	x	56.07	x	0.72	x	0.7	=	43.08	(78)
South	0.9x	0.77	x	3.7	x	56.07	x	0.72	x	0.7	=	507.21	(78)
South	0.9x	0.77	x	3.4	x	56.07	x	0.72	x	0.7	=	66.58	(78)
South	0.9x	0.77	x	1.4	x	56.07	x	0.72	x	0.7	=	54.83	(78)
South	0.9x	0.77	x	2.2	x	40.89	x	0.72	x	0.7	=	125.68	(78)
South	0.9x	0.77	x	1.1	x	40.89	x	0.72	x	0.7	=	31.42	(78)
South	0.9x	0.77	x	3.7	x	40.89	x	0.72	x	0.7	=	369.9	(78)
South	0.9x	0.77	x	3.4	x	40.89	x	0.72	x	0.7	=	48.56	(78)
South	0.9x	0.77	x	1.4	x	40.89	x	0.72	x	0.7	=	39.99	(78)
West	0.9x	0.77	x	2.5	x	19.87	x	0.72	x	0.7	=	34.7	(80)

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West	0.9x	0.77	x	2	x	19.87	x	0.72	x	0.7	=	27.76	(80)
West	0.9x	0.77	x	1	x	19.87	x	0.72	x	0.7	=	6.94	(80)
West	0.9x	0.77	x	2.5	x	38.52	x	0.72	x	0.7	=	67.27	(80)
West	0.9x	0.77	x	2	x	38.52	x	0.72	x	0.7	=	53.81	(80)
West	0.9x	0.77	x	1	x	38.52	x	0.72	x	0.7	=	13.45	(80)
West	0.9x	0.77	x	2.5	x	61.57	x	0.72	x	0.7	=	107.52	(80)
West	0.9x	0.77	x	2	x	61.57	x	0.72	x	0.7	=	86.01	(80)
West	0.9x	0.77	x	1	x	61.57	x	0.72	x	0.7	=	21.5	(80)
West	0.9x	0.77	x	2.5	x	91.41	x	0.72	x	0.7	=	159.63	(80)
West	0.9x	0.77	x	2	x	91.41	x	0.72	x	0.7	=	127.71	(80)
West	0.9x	0.77	x	1	x	91.41	x	0.72	x	0.7	=	31.93	(80)
West	0.9x	0.77	x	2.5	x	111.22	x	0.72	x	0.7	=	194.23	(80)
West	0.9x	0.77	x	2	x	111.22	x	0.72	x	0.7	=	155.38	(80)
West	0.9x	0.77	x	1	x	111.22	x	0.72	x	0.7	=	38.85	(80)
West	0.9x	0.77	x	2.5	x	116.05	x	0.72	x	0.7	=	202.67	(80)
West	0.9x	0.77	x	2	x	116.05	x	0.72	x	0.7	=	162.13	(80)
West	0.9x	0.77	x	1	x	116.05	x	0.72	x	0.7	=	40.53	(80)
West	0.9x	0.77	x	2.5	x	112.64	x	0.72	x	0.7	=	196.71	(80)
West	0.9x	0.77	x	2	x	112.64	x	0.72	x	0.7	=	157.37	(80)
West	0.9x	0.77	x	1	x	112.64	x	0.72	x	0.7	=	39.34	(80)
West	0.9x	0.77	x	2.5	x	98.03	x	0.72	x	0.7	=	171.2	(80)
West	0.9x	0.77	x	2	x	98.03	x	0.72	x	0.7	=	136.96	(80)
West	0.9x	0.77	x	1	x	98.03	x	0.72	x	0.7	=	34.24	(80)
West	0.9x	0.77	x	2.5	x	73.6	x	0.72	x	0.7	=	128.54	(80)
West	0.9x	0.77	x	2	x	73.6	x	0.72	x	0.7	=	102.83	(80)
West	0.9x	0.77	x	1	x	73.6	x	0.72	x	0.7	=	25.71	(80)
West	0.9x	0.77	x	2.5	x	46.91	x	0.72	x	0.7	=	81.92	(80)
West	0.9x	0.77	x	2	x	46.91	x	0.72	x	0.7	=	65.54	(80)
West	0.9x	0.77	x	1	x	46.91	x	0.72	x	0.7	=	16.38	(80)
West	0.9x	0.77	x	2.5	x	24.71	x	0.72	x	0.7	=	43.15	(80)
West	0.9x	0.77	x	2	x	24.71	x	0.72	x	0.7	=	34.52	(80)
West	0.9x	0.77	x	1	x	24.71	x	0.72	x	0.7	=	8.63	(80)
West	0.9x	0.77	x	2.5	x	16.39	x	0.72	x	0.7	=	28.63	(80)
West	0.9x	0.77	x	2	x	16.39	x	0.72	x	0.7	=	22.9	(80)
West	0.9x	0.77	x	1	x	16.39	x	0.72	x	0.7	=	5.73	(80)

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

(83)m=	939.66	1597.31	2123.76	2690.33	3085.29	3219.75	3117.31	2787.1	2363.02	1814.46	1125.22	804.16	(83)

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

(84)m=	2565.6	3209.69	3668.36	4130.45	4414.98	4423.51	4271.58	3960.01	3600.68	3189.76	2615.07	2383.98	(84)

7. Mean internal temperature (heating season)

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

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

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

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(86)m=	1	1	1	0.99	0.97	0.89	0.71	0.75	0.95	1	1	1	(86)
Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)													
(87)m=	19.6	19.73	19.98	20.24	20.59	20.85	20.97	20.96	20.75	20.34	19.87	19.61	(87)
Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)													
(88)m=	19.99	19.99	19.99	19.99	19.99	19.99	19.99	19.99	19.99	19.99	19.99	19.99	(88)
Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)													
(89)m=	1	1	1	0.99	0.95	0.82	0.56	0.6	0.92	0.99	1	1	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
(90)m=	18.09	18.29	18.66	19.03	19.52	19.86	19.97	19.97	19.75	19.18	18.48	18.11	(90)

fLA = Living area ÷ (4) = 0.05 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2													
(92)m=	18.16	18.36	18.72	19.09	19.57	19.91	20.02	20.02	19.8	19.23	18.55	18.19	(92)
Apply adjustment to the mean internal temperature from Table 4e, where appropriate													
(93)m=	18.16	18.36	18.72	19.09	19.57	19.91	20.02	20.02	19.8	19.23	18.55	18.19	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	1	0.99	0.94	0.82	0.57	0.6	0.91	0.99	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	2564.43	3204.94	3651.32	4071.52	4171.76	3617.79	2421.39	2395.34	3265.85	3152.95	2612.15	2383.1	(95)
Monthly average external temperature from Table 8													
(96)m=	4.5	5	6.8	8.7	11.7	14.6	16.9	16.9	14.3	10.8	7	4.9	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	10887.76	10647.9	9500.67	8283	6275.57	4231.21	2488.64	2485.06	4380.32	6723.32	9206.29	10589.87	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	6192.55	5001.66	4351.91	3032.27	1565.23	0	0	0	0	2656.35	4747.79	6105.83	

Total per year (kWh/year) = Sum(98)$_{1...5,8...12}$ = 33653.6 (98)

Space heating requirement in kWh/m²/year 47.27 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0.1	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	0.9	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	0.9	(204)
Efficiency of main space heating system 1		272	(206)
Efficiency of secondary/supplementary heating system, %		37	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	6192.55	5001.66	4351.91	3032.27	1565.23	0	0	0	0	2656.35	4747.79	6105.83	
(211)m = {[(98)m x (204)] + (210)m } x 100 ÷ (206)													(211)
	2049.01	1654.96	1439.97	1003.32	517.91	0	0	0	0	878.94	1570.96	2020.31	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 11135.38 (211)

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Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] + (214) m } x 100 ÷ (208)

(215)m=	1673.66	1351.8	1176.19	819.53	423.04	0	0	0	0	717.93	1283.19	1650.22	
									Total (kWh/year) =Sum(215)$_{1...5,10...12}$=			9095.57	(215)

Water heating

Output from water heater (calculated above)

	279.23	246.53	259.89	234.34	230.63	0	0	0	0	242.93	255.16	272.97	
Efficiency of water heater												152.38	(216)
(217)m=	152.38	152.38	152.38	152.38	152.38	152.38	152.38	152.38	152.38	152.38	152.38	152.38	(217)

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

(219)m=	183.24	161.78	170.55	153.78	151.35	0	0	0	0	159.42	167.45	179.14	
									Total = Sum(219a)$_{1...12}$ =			1326.72	(219)

Water heating requirement (immersion)

	0	0	0	0	0	177.9	170.05	187.71	187.73	0	0	0	
Efficiency of water heater (Immersion)												100	(216)
(217)m=	0	0	0	0	0	100	100	100	100	0	0	0	(217)

Fuel for water heating (Immersion), kWh/month
(219)m = [(64)m + (218) m] x 100 ÷ (217)m

(219)m=	0	0	0	0	0	177.9	170.05	187.71	187.73	0	0	0	
									Total = Sum(219a)$_{1...12}$ =			723.39	(219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		11135.38	
Space heating fuel used, secondary		9095.57	
Water heating fuel used		1326.72	
Water heating fuel used (Immersion)		723.39	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	4914.4		(230a)
central heating pump:	130		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	5044.4	(231)
Electricity for lighting		1405.11	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	11.46	x 0.01 =	1276.1148	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	3.42	x 0.01 =	311.0684	(242)
Water heating cost (other fuel)	(219)	11.46	x 0.01 =	152.04	(247)
Water heating cost (Immersion)	(219)	11.46	x 0.01 =	82.9	(247)
Pumps, fans and electric keep-hot	(231)	11.46	x 0.01 =	578.09	(249)

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(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a					
Energy for lighting	(232)	11.46	x 0.01 =	161.03	(250)
Additional standing charges (Table 12)				0	(251)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)...(254) =			2561.2408	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.47	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.5902	(257)
SAP rating (Section 12)		77.8167	(258)

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

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211)	x	0.517	=	5756.99	(261)
Space heating (secondary)	(215)	x	0.008	=	72.76	(263)
Water heating	(219)	x	0.517	=	685.92	(264)
Water heating (Immersion)	(219)	x	0.517	=	373.99	(264)
Space and water heating	(261) + (262) + (263) + (264) =				6889.67	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.517	=	2607.96	(267)
Electricity for lighting	(232)	x	0.517	=	726.44	(268)
Total CO2, kg/year			sum of (265)...(271) =		10224.07	(272)
CO2 emissions per m²			(272) ÷ (4) =		14.36	(273)
EI rating (section 14)					82	(274)

13a. Primary Energy

	Energy kWh/year		Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211)	x	2.92	=	32515.32	(261)
Space heating (secondary)	(215)	x	1.05	=	9550.35	(263)
Energy for water heating	(219)	x	2.92	=	3874.03	(264)
Energy for water heating (Immersion)	(219)	x	2.92	=	2112.3	(264)
Space and water heating	(261) + (262) + (263) + (264) =				48051.99	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	2.92	=	14729.66	(267)
Electricity for lighting	(232)	x	0	=	4102.93	(268)
'Total Primary Energy			sum of (265)...(271) =		66884.58	(272)
Primary energy kWh/m²/year			(272) ÷ (4) =		93.94	(273)

APPENDIX B

TER Worksheet For the Notional Dwelling

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2009	**Software Version:**	Version: 1.5.0.63

Property Address: 18-20 Lancaster Grove

Address : 18, Lancaster Grove, LONDON, NW3 4PB

1. Overall dwelling dimensions:

	Area(m²)		Ave Height(m)		Volume(m³)	
Basement	204	(1a) x	3.05	(2a) =	622.2	(3a)
Ground floor	205	(1b) x	2.9	(2b) =	594.5	(3b)
First floor	201	(1c) x	2.8	(2c) =	562.8	(3c)
Second floor	102	(1d) x	2.3	(2d) =	234.6	(3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	712	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	2014.1	(5)

2. Ventilation rate:

	main heating		Secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	1	+	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) =	0.01	(8)

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

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*		0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		10	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.51	(18)

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

Number of sides on which sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.44	(21)

Infiltration rate modified for monthly wind speed

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

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Monthly average wind speed from Table 7

(22)m=	5.4	5.1	5.1	4.5	4.1	3.9	3.7	3.7	4.2	4.5	4.8	5.1

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27

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

0.59	0.56	0.56	0.49	0.45	0.43	0.4	0.4	0.46	0.49	0.53	0.56

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=	0.67	0.66	0.66	0.62	0.6	0.59	0.58	0.58	0.61	0.62	0.64	0.66	(24d)

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

(25)m=	0.67	0.66	0.66	0.62	0.6	0.59	0.58	0.58	0.61	0.62	0.64	0.66	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.85	x	2	=	3.7			(26)
Windows			176.15	x	1/[1/(2)+ 0.04]	=	326.2			(27)
Floor Type 1			205	x	0.25	=	51.25			(28)
Floor Type 2			12	x	0.25	=	3			(28)
Walls	450	178	272	x	0.35	=	95.2			(29)
Roof Type1	108	0	108	x	0.16	=	17.28			(30)
Roof Type2	161	0	161	x	0.16	=	25.76			(30)
Total area of elements, m²			936							(31)

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 522.39 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 26291 (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.

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Thermal bridges : S (L x Y) calculated using Appendix K		102.96	(36)
if details of thermal bridging are not known (36) = 0.15 x (31)			
Total fabric heat loss	(33) + (36) =	625.35	(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=	448.34	435.81	435.81	412.89	399.21	392.84	386.79	386.79	402.51	412.89	423.99	435.81	(38)

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

(39)m=	1073.69	1061.16	1061.16	1038.24	1024.56	1018.19	1012.15	1012.15	1027.86	1038.24	1049.34	1061.16	

Average = Sum(39)$_{1...12}$ /12= 1039.83 (39)

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

(40)m=	1.51	1.49	1.49	1.46	1.44	1.43	1.42	1.42	1.44	1.46	1.47	1.49	

Average = Sum(40)$_{1...12}$ /12= 1.46 (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 3.67 (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) + 36 127.69 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	140.46	135.35	130.24	125.13	120.03	114.92	114.92	120.03	125.13	130.24	135.35	140.46	

Total = Sum(44)$_{1...12}$ = 1532.26 (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=	208.79	182.61	188.44	164.28	157.64	136.03	126.05	144.64	146.37	170.58	186.2	202.2	

Total = Sum(45)$_{1...12}$ = 2013.84 (45)

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

(46)m=	31.32	27.39	28.27	24.64	23.65	20.4	18.91	21.7	21.96	25.59	27.93	30.33	(46)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):		0	(47)
Temperature factor from Table 2b		0	(48)
Energy lost from water storage, kWh/year	(47) x (48) =	0	(49)
If manufacturer's declared cylinder loss factor is not known:			
Cylinder volume (litres) including any solar storage within same		150	(50)
If community heating and no tank in dwelling, enter 110 litres in box (50)			
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.02	(51)
Volume factor from Table 2a		0.93	(52)
Temperature factor from Table 2b		0.54	(53)
Energy lost from water storage, kWh/year	((50) x (51) x (52) x (53) =	1.44	(54)
Enter (49) or (54) in (55)		1.44	(55)

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

(56)m=	44.53	40.22	44.53	43.09	44.53	43.09	44.53	44.53	43.09	44.53	43.09	44.53	(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=	44.53	40.22	44.53	43.09	44.53	43.09	44.53	44.53	43.09	44.53	43.09	44.53	(57)

Primary circuit loss (annual) from Table 3 — 610 (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=	51.81	46.79	51.81	50.14	51.81	50.14	51.81	51.81	50.14	51.81	50.14	51.81	(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=	305.13	269.62	284.77	257.51	253.97	229.26	222.39	240.98	239.6	266.92	279.43	298.54	(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=	305.13	269.62	284.77	257.51	253.97	229.26	222.39	240.98	239.6	266.92	279.43	298.54	

Output from water heater (annual)₁…₁₂ — 3148.12 (64)

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

(65)m=	146.49	130.33	139.72	129.21	129.48	119.81	118.98	125.16	123.25	133.79	136.5	144.3	(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=	183.38	183.38	183.38	183.38	183.38	183.38	183.38	183.38	183.38	183.38	183.38	183.38	(66)

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

(67)m=	112.45	99.88	81.22	61.49	45.97	38.81	41.93	54.5	73.16	92.89	108.41	115.57	(67)

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

(68)m=	741.96	749.66	730.26	688.95	636.81	587.81	555.07	547.37	566.78	608.08	660.22	709.22	(68)

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

(69)m=	41.34	41.34	41.34	41.34	41.34	41.34	41.34	41.34	41.34	41.34	41.34	41.34	(69)

Pumps and fans gains (Table 5a)

(70)m=	10	10	10	10	10	10	10	10	10	10	10	10	(70)

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

(71)m=	-146.7	-146.7	-146.7	-146.7	-146.7	-146.7	-146.7	-146.7	-146.7	-146.7	-146.7	-146.7	(71)

Water heating gains (Table 5)

(72)m=	196.9	193.94	187.8	179.46	174.04	166.41	159.92	168.23	171.18	179.82	189.58	193.95	(72)

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

(73)m=	1139.32	1131.49	1087.3	1017.91	944.83	881.04	844.94	858.12	899.13	968.8	1046.22	1106.76	(73)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	1	x	176.15	x	19.87	x	0.72	x	0.7	=	1222.64	(76)
East	0.9x	1	x	176.15	x	38.52	x	0.72	x	0.7	=	2369.83	(76)
East	0.9x	1	x	176.15	x	61.57	x	0.72	x	0.7	=	3787.76	(76)
East	0.9x	1	x	176.15	x	91.41	x	0.72	x	0.7	=	5623.92	(76)
East	0.9x	1	x	176.15	x	111.22	x	0.72	x	0.7	=	6842.71	(76)
East	0.9x	1	x	176.15	x	116.05	x	0.72	x	0.7	=	7140.02	(76)
East	0.9x	1	x	176.15	x	112.64	x	0.72	x	0.7	=	6930.2	(76)
East	0.9x	1	x	176.15	x	98.03	x	0.72	x	0.7	=	6031.5	(76)
East	0.9x	1	x	176.15	x	73.6	x	0.72	x	0.7	=	4528.42	(76)
East	0.9x	1	x	176.15	x	46.91	x	0.72	x	0.7	=	2886.01	(76)
East	0.9x	1	x	176.15	x	24.71	x	0.72	x	0.7	=	1520.07	(76)
East	0.9x	1	x	176.15	x	16.39	x	0.72	x	0.7	=	1008.56	(76)

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

(83)m=	1222.64	2369.83	3787.76	5623.92	6842.71	7140.02	6930.2	6031.5	4528.42	2886.01	1520.07	1008.56	(83)

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

(84)m=	2361.96	3501.32	4875.05	6641.83	7787.54	8021.06	7775.14	6889.62	5427.54	3854.81	2566.29	2115.32	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.88	0.72	0.52	0.57	0.89	0.99	1	1	(86)

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

(87)m=	19.1	19.33	19.73	20.21	20.66	20.9	20.98	20.97	20.74	20.15	19.49	19.14	(87)

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

(88)m=	19.69	19.7	19.7	19.72	19.74	19.74	19.75	19.75	19.73	19.72	19.71	19.7	(88)

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

(89)m=	1	1	0.99	0.95	0.83	0.61	0.37	0.41	0.82	0.98	1	1	(89)

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

(90)m=	17.96	18.2	18.6	19.08	19.52	19.7	19.75	19.74	19.59	19.04	18.37	18.01	(90)

fLA = Living area ÷ (4) = | 0.05 | (91)

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

(92)m=	18.01	18.25	18.65	19.14	19.57	19.76	19.81	19.8	19.65	19.09	18.42	18.06	(92)

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

(93)m=	18.01	18.25	18.65	19.14	19.57	19.76	19.81	19.8	19.65	19.09	18.42	18.06	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.95	0.82	0.61	0.37	0.42	0.81	0.98	1	1	(94)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(95)m=	2360.74	3492.59	4813.64	6280.15	6402.4	4914.59	2911.8	2893.6	4412.07	3779.31	2562.88	2114.55	(95)

Monthly average external temperature from Table 8

(96)m=	4.5	5	6.8	8.7	11.7	14.6	16.9	16.9	14.3	10.8	7	4.9	(96)

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

(97)m=	14508.98	14059.62	12577.19	10837.41	8063.49	5253.08	2941.15	2938.95	5494.98	8610.07	11985.99	13969.77	(97)

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

(98)m=	9038.29	7101.04	5776.08	3281.23	1235.85	0	0	0	0	3594.08	6784.64	8820.29	

Total per year (kWh/year) = Sum(98) = 45631.5 (98)

Space heating requirement in kWh/m²/year 64.09 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system 0.1 (201)

Fraction of space heat from main system(s) (202) = 1 – (201) = 0.9 (202)

Fraction of total heating from main system 1 (204) = (202) × [1 – (203)] = 0.9 (204)

Efficiency of main space heating system 1 78.9 (206)

Efficiency of secondary/supplementary heating system, % 100 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	9038.29	7101.04	5776.08	3281.23	1235.85	0	0	0	0	3594.08	6784.64	8820.29		
(211)m = {[(98)m x (204)] + (210)m } x 100 ÷ (206)	10309.84	8100.05	6588.69	3742.85	1409.71	0	0	0	0	4099.72	7739.13	10061.16		(211)
Total (kWh/year) =Sum(211) =													52051.14	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] + (214) m } x 100 ÷ (208)														
(215)m=	903.83	710.1	577.61	328.12	123.58	0	0	0	0	359.41	678.46	882.03		
Total (kWh/year) =Sum(215) =													4563.15	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Output from water heater (calculated above)	305.13	269.62	284.77	257.51	253.97	229.26	222.39	240.98	239.6	266.92	279.43	298.54		
Efficiency of water heater													68.8	(216)
(217)m=	78.48	78.43	78.3	77.98	76.8	68.8	68.8	68.8	68.8	78.03	78.4	78.48		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	388.78	343.76	363.68	330.22	330.67	333.22	323.24	350.26	348.26	342.08	356.43	380.39		
Total = Sum(219a) =													4191	(219)

Annual totals	kWh/year	kWh/year
Space heating fuel used, main system 1		52051.14
Space heating fuel used, secondary		4563.15
Water heating fuel used		4191
Electricity for pumps, fans and electric keep-hot		

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central heating pump:		130		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =		175	(231)
Electricity for lighting			1985.88	(232)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.194	=	10097.92	(261)
Space heating (secondary)	(215) x	0.422	=	1925.65	(263)
Water heating	(219) x	0.194	=	813.05	(264)
Space and water heating	(261) + (262) + (263) + (264) =			12836.62	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.422	=	73.85	(267)
Electricity for lighting	(232) x	0.422	=	838.04	(268)
Total CO2, kg/year		sum of (265)...(271) =		13748.52	(272)

TER = 20.46 (273)

APPENDIX C

Code for Sustainable Homes Report

Code for Sustainable Homes Report

Assessor and House Details

Assessor Name: **Assessor Number:**

Property Address: 18, Lancaster Grove
LONDON
NW3 4PB

Buiding regulation assessment

	kg/m²/year
TER	20.46
DER	14.93

The following code calculations are taken from the Code for Sustainable Homes Technical Guide (Nov 10)

Ene 1 Assessment - Dwelling Emission Rate

Total Energy Type CO2 Emissions for Codes Levels 1 - 5

	%	kg/m²/year	
DER from SAP 2009 DER Worksheet		14.93	*(ZC1)*
TER		20.46	
Residual CO2 emissions offset from biofuel CHP		0	*(ZC5)*
CO2 emissions offset from additional allowable electricty generation		0	*(ZC7)*
Total CO2 emissions offset from SAP Section 16 allowances		0	
DER accounting for SAP Section 16 allowances		14.93	
% improvement DER/TER	27		

Total Energy Type CO2 Emissions for Codes Levels 6

	kg/m²/year	
DER accounting for SAP Section 16 allowances	14.93	*(ZC1)*
CO2 emissions from appliances, equation (L14)	6.15	*(ZC2)*
CO2 emissions from cooking, equation (L16)	0.29	*(ZC3)*
Net CO2 emissions	21.4	*(ZC8)*

Result:

Credits awarded for Ene 1 = 3.2

Code Level = 4

Ene 2 - Fabric energy Efficiency

Fabric energy Efficiency: 56
Credits awarded for Ene 2 = 3.8

Ene 7 - Low or Zero Carbon (LZC) Technologies

Reduction in CO2 Emissions

	%	kg/m²/year
Standard Case CO2 emissions		25.52
Standard DER		19.08
Actual Case CO2 emissions		23.87
Actual DER		17.43
Reduction in CO2 emissions	6.47	

Credits awarded for Ene 7 = 0

Technologies eligible to contribute to achieving the requirements of this issue must produce energy from renewable sources and meet all other ancillary requirements as defined by Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.

The following requirements must also be met:

- Where not provided by accredited external renewables there must be a direct supply of energy produced to the dwelling under assessment.
- Where covered by the Microgeneration Certification Scheme (MCS), technologies under 50kWe or 300kWth must be certified.
- Combined Heat and Power (CHP) schemes above 50kWe must be certified under the CHPQA standard.
- All technologies must be accounted for by SAP.

CHP schemes fuelled by mains gas are eligible to contribute to performance against this issue. Where these schemes are above 50kWe they must be certified under the CHPQA.
It is the responsibly of the Accredited OCDEA and Code Assessor to ensure all technologies use in the calculation are appropriate before awarding credits.