Maison Henry Bertrand (England) Ltd

52 Holmes Road, Camden

Revised Energy Statement

712445R(02)

12TH AUGUST 2016

RSK GENERAL NOTES

Project No.: 712445R(02)

Title: 52 Holmes Road, Camden – Revised Energy Statement

Client: Maison Henry Bertrand (England) Ltd

Date: 12th August 2016

Author	James Blake	**Reviewer**	David Lloyd
Date:	12th August 2016	Date:	12th August 2016

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APPENDICES

1 INTRODUCTION

RSK Environment Ltd ("RSK") has been appointed by GML Architects, on behalf of Maison Henry Bertrand (England) Ltd (the applicant), to prepare this Revised Energy Statement in support of the planning application to the London Borough of Camden for the proposed development of 9 new residential apartments and 377 sqm light industrial space at 52 Holmes Road.

Chapter 2 of this Statement sets out requests for further information as received from the London Borough of Camden following submission of the original Energy Statement [RSK Ref. 712140R(02), 5th April 2016], together with responses to each request.

Chapter 3 sets out Camden's planning policies in relation to required energy and carbon dioxide (CO_2) standards. **Chapter 4** describes the approach taken to the energy assessment work, whilst **Chapter 5** reports the findings of energy modelling which establishes how the targeted energy / CO_2 standards can be achieved. SAP reports for selected apartments are presented at **Appendix 1,** whilst SBEM reports for the ground floor non-domestic space are presented at **Appendix 2**.

2 REQUEST FOR FURTHER INFORMATION

2.1 Introduction

The London Borough of Camden's Sustainability Officer has raised the following requests for further information based on the original Energy Statement [RSK Ref. 712140R(02), 5th April 2016]. Responses are provided below each item.

2.2 Further Information Requests & Responses

2.2.1 Applicant to seek further reductions with the aim of meeting/exceeding the London Plan 35% CO_2 reduction (beyond Part L 2013) target.

Further SAP and SBEM modelling has been undertaken to demonstrate how the development can achieve a 35% reduction in regulated CO_2 emissions below 2013 Building Regulations standards, as reported in **Chapter 5**. This performance is achieved through a range of energy efficiency measures including good u values, facade air tightness, 100% low energy lighting, high efficiency gas condensing boilers with 'gas saver' units (apartments) and ASHP (commercial) for space and water heating. A 9.9 kWp solar PV array is proposed to achieve the remaining CO_2 reduction necessary to achieve the 35% target in full on site.

2.2.2 Applicant to submit details of sampled apartments used in the energy assessment.

Two apartments (top floor unit and 2nd floor unit 'B') have been selected for SAP modelling, as stated in **Chapter 5**, on the basis of having energy / CO_2 performance that is likely to be representative of the development as a whole given their relatives sizes and locations within the block, as determined by professional experience and judgement. The modelled units are presented in **Figures 1 & 2** below.

Figure 1. SAP Modelled 2nd Floor Unit 'B'

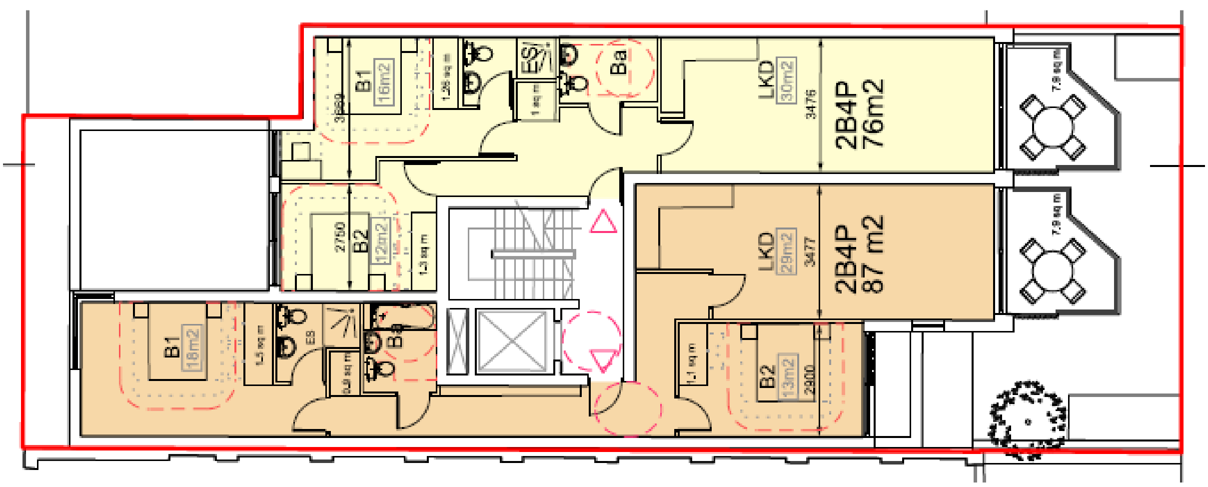
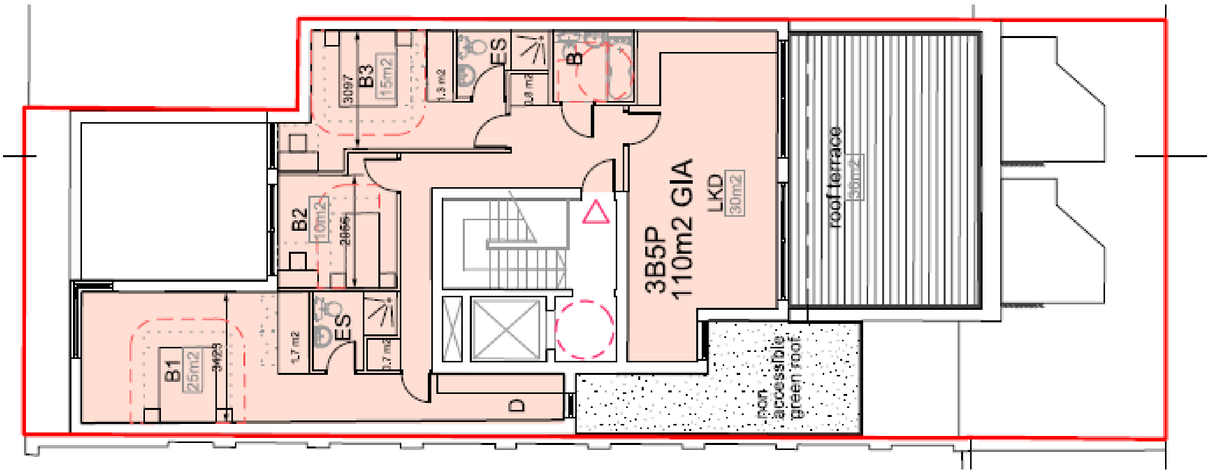


Figure 2. SAP Modelled Top Floor Unit



2.2.3 Applicant to confirm measures undertaken to reduce overheating

All living rooms have balconies above them, or projecting eaves / louvers on the top floor which are south facing. Only the south-facing bedrooms are unprotected, however these have smaller windows in order to minimise overheating risks. Indeed SAP reports only a ‘slight’ risk of overheating between June and August in the modelled apartments, with natural ventilation (dual aspect units), dark roller blinds and windows open half the time assumed.

2.2.4 Applicant to reconsider implementing a communal heating system and consider the feasibility of connecting to a future decentralized energy network

Paragraph 11.13 of the GLA’s Energy Planning Guidance (March 2016) states that applicants must work on the assumption that a site heat network will be required unless it can be clearly demonstrated that it is not applicable due to local circumstances. Therefore, where multiple high density buildings are proposed and the development is located in an area that could be served by a district heating network in the future, a communal heating system must ordinarily be adopted with all apartments and non-domestic buildings/uses within the development connected into a single site wide heat network.

However the proposals do not comprise multiple high density buildings and nor is the site located within 1km of an existing or emerging local heat network according to Figure 4 of London Borough of Camden’s Planning Guidance – Sustainability CGP3 (July 2015).

Additionally, paragraph 11.14 of the GLA guidance recognises that, where a development contains small commercial/retail units, i.e. total area less than 500 sqm, as is the case for the proposed development, it is not necessary to connect these to the site heat network. These units are often categorised as shell and core at the planning stage and, when built out, have very small heating demands which are usually met by air source heat pumps. Therefore, on balance, in these circumstances the small benefit in terms of carbon reduction and contribution to strategic heat network policy is not considered to outweigh the practical constraints involved in connecting to the site heat network.

Finally, specifying individual high efficiency gas condensing boilers for the 9 apartments allows the integration of 'gas saver' units which deliver CO_2 emission savings at the first stage of the energy hierarchy. We have modelled a communal gas boiler and can confirm this increases CO_2 emissions by around 4% relative to the proposed individual gas boiler plus gas saver scenario given its effect on both DER and TER values.

2.2.5 Applicant to seek to improve efficiency of ASHP further

A coefficient of performance (COP) of 3.0 has been assumed for the air source heat pump (ASHP) unit in the commercial space as part of the updated SBEM modelling reported in this Revised Energy Statement. This compares to a COP of 2.5 assumed in the original energy statement.

The Heat Pump Field Trial report published by the Energy Saving Trust (2010) concluded that heat pump performance is highly sensitive to installation and commissioning practices but that the highest measured system efficiencies for air source heat pumps was in excess of 3.0 therefore this increased COP assumption appears reasonable.

2.2.6 Applicant to submit details of the solar PV array and seek to expand further (considering combining with green roof spaces where feasible)

A 9.9 kWp solar PV array is proposed, with 8.2 kWp serving the apartments and 1.2 kWp serving the commercial use. A total PV array area of circa 74 sqm is estimated, which will be integrated in the roof of the development whilst allowing space between the arrays to avoid overshadowing, as well as space for the ASHP unit, lift and roof access for maintenance etc.

2.2.7 Should the proposals not meet the 35% CO_2 reduction target on-site, Camden may accept a financial contribution (charged at £90/tonne CO_2/yr over a 30 year period), which will be used to secure CO_2 reduction measures elsewhere in the Borough

The development can achieve the 35% CO_2 reduction target in full on-site and therefore offset payment is not required.

3 PLANNING POLICY CONTEXT

3.1 London Borough of Camden

3.1.1 Planning Guidance – Sustainability CGP3 (July 2015)

Developments providing 500 sqm or more of non-residential floorspace need to be designed in line with BREEAM. It should be noted that the proposed ground floor commercial uses fall below this threshold and therefore BREEAM certification is not required.

This guidance mirrors the requirements of London Plan Policy 5.2 'Minimising CO_2 Emissions' and the GLA's Energy Planning Guidance (March 2016) in requiring new developments to achieve a 35% reduction in CO_2 emissions below 2013 Building Regulations standards through application of the energy hierarchy, and including a 20% CO_2 reduction through on-site renewable energy. **Chapter 4** explains the approach taken to this assessment.

4 APPROACH TO MODELLING

In order to demonstrate how the development can achieve the targeted 35% reduction in CO_2 emissions below 2013 Building Regulation standards (including a 20% CO_2 reduction through on-site renewable energy), SAP 2012 modelling has been undertaken on 2 No. apartments (top floor unit and 2nd floor unit B), selected on the basis of having energy / CO_2 performance that is likely to be representative of the development as a whole given their relatives sizes and locations within the block, as determined by professional experience and judgement.

The SAP models were run initially to achieve a “baseline” performance (i.e. compliance with the 2013 Building Regulations only). Additional model iterations were then run to establish the CO_2 reduction effect of energy efficiency measures (e.g. enhanced U values, thermal bridging, air tightness, low energy lighting etc), followed by on-site renewable energy (solar PV) in accordance with the energy hierarchy.

SAP results from the modelled apartments are then extrapolated to all units on an area-weighted basis in order to estimate energy / CO_2 performance of the development as a whole. A similar approach to the above has been undertaken for the SBEM modelling of the commercial space. The results of the energy modelling work are presented in **Chapter 5**.

5 ENERGY & CO_2 STRATEGY

5.1 Energy Efficiency ("Be Lean")

The first stage of the energy hierarchy is to ensure energy demand and associated CO_2 emissions are minimised from the outset through good design and energy efficiency measures. A range of energy efficiency measures beyond the standard 'back stop' values permitted by 2013 Building Regulations are proposed, as presented in Table 1.

Table 1: 'Standard' & 'Enhanced' Energy Efficiency Specifications

Parameter	Standard Value	Enhanced Value
U values (W/m^{2}K)		
External wall	0.30	0.20
Party wall	0.20	0.00
Basement floor	0.25	0.25
Ground floor	0.25	0.10
Roof	0.20	0.15
Glazing	2.00	1.10
Door	2.00	1.00
Air permeability (m^3/m^2/hr)	10	5
Thermal bridging (y value, W/m^{2}k)	0.05	0.1
Low energy lighting	100%	
Lighting (commercial)	5W/m^2	
Heating (residential)	Independent gas boilers	Independent gas boilers + Zenex Gas Savers
Heating (commercial)	Independent gas boiler	Air Source Heat Pump (COP = 3.0)
Ventilation	Natural Ventilation	

Communal heating arrangements (e.g. gas boilers within a central plant room), as sought by London Plan Policy 5.6 as part of the energy hierarchy, are unlikely to be merited at the limited scale of development proposed here.

5.2 Supply Energy Efficiently ("Be Clean")

The second stage of the energy hierarchy is to ensure that energy demands following the implementation of energy efficiency measures are met as efficiently as possible. This can be achieved in appropriate developments by connecting them to local energy networks, or by providing on-site combined heat & power (CHP) which can generate both heat and power in a highly efficient manner on suitable applications.

5.2.1 Energy Networks

The London Plan seeks that new developments connect to an existing or approved decentralised energy network, safeguard potential network routes, and make provision to allow future connection to a network, where possible. However the limited scale of development that is proposed is considered unlikely to justify communal heating arrangements (with individual gas boilers for each apartment more likely to be preferred), and a result is unlikely to be either technically or commercially viable for the development to connect to a local heat network in the event that one is available.

5.2.2 Combined Heat & Power (CHP)

The GLA recognises that, for small to medium scale residential developments comprising less than 500 apartments, it is generally not economic to install on-site CHP as the lead heat source. This is particularly relevant to the development proposals given the limited amount of commercial floorspace that is proposed which otherwise may help to increase CHP feasibility by providing complementary heat demand e.g. daytime during week days when apartments are unoccupied. For these reasons on-site CHP is not proposed.

5.3 Renewable Energy ("Be Green")

The third and final stage of the energy hierarchy is to incorporate on-site renewable energy technology to address any residual energy demand or CO_2 emissions reduction that may be required to achieve planning policy targets following the two previous stages of the energy hierarchy. Preferred renewable energy technology options are discussed below.

5.3.1.1 Solar photovoltaics (PV)

Solar photovoltaic (PV) arrays generate zero carbon electricity from sunlight. They have a range of benefits over other renewable energy technologies which make them attractive to new developments, including:

- ease of building integration;
- a proven technology widely accepted by home owners;
- minimal maintenance requirements;
- minimal environmental or planning implications; and
- commercial benefits through the Feed In Tariff despite recent cuts.

5.3.1.2 Air Source Heat Pump

Air Source Heat Pump (COP = 3) is proposed to provide space and water heating demand in the commercial unit.

5.4 Modelling Results

Table 2 presents the SAP results for the apartments. It first presents CO_2 emissions estimated for all 9 apartments in the "baseline" (i.e. 2013 Building Regulations Part L compliant) scenario. It then shows the CO_2 reduction effect of the energy efficiency measures set out in Table 1 ("Be Lean"), which includes the provision of "gas savers" for the apartment boilers. CO_2 emissions are then presented following the "Be Clean" stage of the energy hierarchy, for which no measures are proposed given the limited scale of development. Finally, a solar PV array of 8.2 kWp (kilowatt peak) is proposed as the final "Be Green" scenario for the apartments.

Table 2. Apartments CO_2 Emissions at each stage of Energy Hierarchy

Scenario	CO_2 emissions (tonnes/year)	
	Regulated	Unregulated
"Baseline" - 2013 Building Regulations compliance	13.6	15.0
"Be Lean" - Energy efficiency measures (Table 1)	12.5	
"Be Clean" – CHP (not proposed)	12.5	
"Be Green" – 8.2 kWp solar PV	8.8	

Table 3 presents regulated CO_2 emission savings at each stage of the energy hierarchy for the apartments from which it can be seen that the energy efficiency measures set out in Table 1 are together predicted to achieve a circa 7.9% CO_2 emissions reduction below 2013 Building Regulations standards ("Be Lean"). "Be Clean" measures (e.g. on-site CHP) are not proposed. An 8.2 kWp solar PV array is estimated to deliver the remaining CO_2 emissions reduction to achieve the 35% CO_2 reduction target. The SAP reports for the final "Be Green" scenario for the modelled apartments are presented at **Appendix 1**.

Table 3. Apartments Regulated CO_2 Emissions Savings

Scenario	CO_2 emission saving (tonnes / year)	% Saving
"Baseline" - 2013 Building Regulations compliance	--	--
"Be Lean" - Energy efficiency measures (Table 1)	1.1	7.9%
"Be Clean" – CHP (not proposed)	--	--
"Be Green" – 8.2 kWp solar PV	3.7	27.1%
Total CO_2 Savings	**4.7**	**35.0%**

Tables 4 and 5 presents the SBEM modelling results for the ground floor commercial space. It can be that the energy efficiency measures in Table 1 (which include Air Source Heat Pump) are predicted to achieve a 21.8% reduction in CO_2 emissions below 2013 Building Regulations standards. The SBEM reports are presented at **Appendix 2**.

Table 4. Commercial CO_2 Emissions at each stage of Energy Hierarchy

Scenario	CO_2 emissions (tonnes/year)	
	Regulated	Unregulated
"Baseline" - 2013 Building Regulations compliance	7.7	9.7
"Be Lean" - Energy efficiency measures (Table 1)	5.7	
"Be Clean" – CHP (not proposed)	5.7	
"Be Green" – 1.7 kWp solar PV	5.0	

Table 5. Commercial Space Regulated CO_2 Emissions Savings

Scenario	CO_2 emission saving (tonnes / year)	% Saving
"Baseline" - 2013 Building Regulations compliance	--	--
"Be Lean" - Energy efficiency measures (Table 1)	2.0	26.0%
"Be Clean" – CHP (not proposed)	--	--
"Be Green" – 1.7 kWp solar PV	0.7	9.0%
Total CO_2 Savings	**2.7**	**35.0%**

The SAP and SBEM results are combined on an area-weighted basis to provide the modelling results for the development as a whole in Tables 6 and 7. It can be seen that a 35.0% reduction in CO_2 emissions below 2013 Building Regulations standards is predicted for the development as whole (including a 20.5% CO_2 through on-site renewable energy) in accordance with Camden planning policy.

Table 6. Development CO_2 Emissions at each stage of Energy Hierarchy

Scenario	CO_2 emissions (tonnes/year)	
	Regulated	Unregulated
"Baseline" - 2013 Building Regulations compliance	21.3	24.7
"Be Lean" - Energy efficiency measures (Table 1)	18.2	
"Be Clean" – CHP (not proposed)	18.2	
"Be Green" – 9.9 kWp solar PV	13.8	

Because the 35% CO_2 reduction target is achieved in full on site, no cash payment to Camden for offsetting residual CO_2 emissions is required.

Table 7. Development Regulated CO_2 Emissions Savings

Scenario	CO_2 emission saving (tonnes / year)	% Saving
"Baseline" - 2013 Building Regulations compliance	--	--
"Be Lean" - Energy efficiency measures (Table 1)	3.1	14.5%
"Be Clean" – CHP (not proposed)	--	--
"Be Green" – 9.9 kWp solar PV	4.4	20.5%
Total CO_2 Savings	**7.5**	**35.0%**

5.5 Estimated Area of Solar PV Array

Each kWp of solar PV in the UK, assuming a suitable orientation (i.e. from south-east to south-west facing) and pitch (between 30 and 40 degrees) requires an area of approximately 7.5 sqm. On this basis, the 9.9 kWp PV array estimated for the development will require a total area of approximately 74 sqm relative to the development's useable roof area of circa 120 sqm.

5.6 Further Work

Further work will be required as part of detailed architectural and M&E design and to progress the energy / CO_2 strategy work reported here, including:

- SAP models and "as designed" and "as built" EPCs for all dwellings;
- SBEM model, "as designed" and "as built" EPC for the commercial unit; and
- Engagement with a solar PV and Air Source Heat Pump installation company.

Appendix 1
SAP 2012 Reports (Top Floor Unit & 2nd Floor Unit B)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.3.10
Printed on 09 August 2016 at 13:36:46

Project Information:

Assessed By: David Lloyd (STRO006228) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 83.85m²

Site Reference : 52 Holmes Rd **Plot Reference:** 2nd Floor B GS PV

Address : 2nd Floor B GS PV

Client Details:

Name:

Address :

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

1a TER and DER

Fuel for main heating system: Mains gas		
Fuel factor: 1.00 (mains gas)		
Target Carbon Dioxide Emission Rate (TER)	16.35 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	10.62 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	41.4 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	37.1 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.20 (max. 0.30)	0.20 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	(no roof)		
Openings	1.09 (max. 2.00)	1.10 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system:	Database: (rev 396, product index 017556): Boiler systems with radiators or underfloor heating - mains gas Brand name: Worcester Model: Greenstar Model qualifier: 29CDi Classic ErP (Combi) Efficiency 89.1 % SEDBUK2009 Minimum 88.0 %	OK
Secondary heating system:	None	

Regulations Compliance Report

5 Cylinder insulation

Hot water Storage:	No cylinder

6 Controls

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

7 Low energy lights

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

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Thames valley):	Slight	OK

Based on:

Overshading:	Average or unknown
Windows facing: South	3.99m²
Windows facing: North	6.26m²
Windows facing: North	2.16m²
Ventilation rate:	3.00
Blinds/curtains:	Dark-coloured curtain or roller blind Closed 100% of daylight hours

10 Key features

Windows U-value	1.1 W/m²K
Doors U-value	1 W/m²K
Party Walls U-value	0 W/m²K
Photovoltaic array	

Predicted Energy Assessment

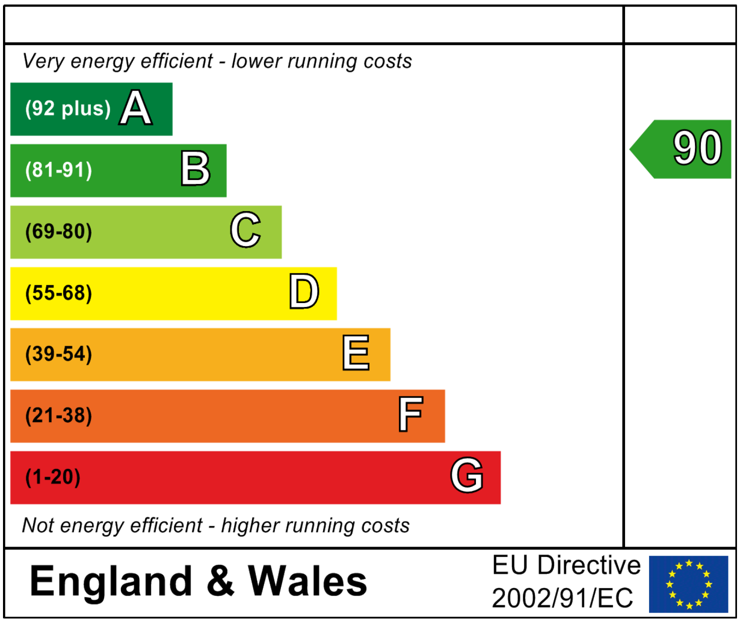
2nd Floor B GS PV

Dwelling type: Mid floor Flat
Date of assessment: 09 August 2016
Produced by: David Lloyd
Total floor area: 83.85 m²

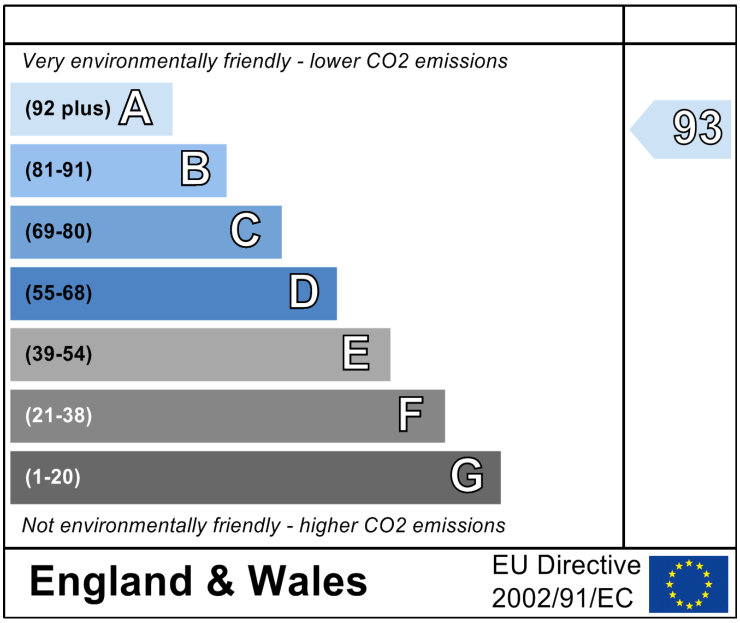
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about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

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

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



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

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

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	David Lloyd	**Stroma Number:**	STRO006228
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.3.10

Property Address: 2nd Floor B GS PV

Address : 2nd Floor B GS PV

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	83.85	(1a)	x	2.5	(2a)	=	209.62	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	83.85	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			209.62	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.14	(8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

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

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.91	x	1	=	1.91			(26)
Windows Type 1			3.99	x1/[1/(1.1)+ 0.04]		=	4.2			(27)
Windows Type 2			6.26	x1/[1/(1.1)+ 0.04]		=	6.6			(27)
Windows Type 3			2.16	x1/[1/(1.1)+ 0.04]		=	2.28			(27)
Walls Type1	73.1	12.41	60.69	x	0.2	=	12.14			(29)
Walls Type2	20.04	1.91	18.13	x	0.19	=	3.41			(29)
Total area of elements, m²			93.14							(31)
Party wall			32.61	x	0	=	0			(32)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.54 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 17709.11 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 9.65 (36)

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

Total fabric heat loss (33) + (36) = 40.19 (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=	40.87	40.62	40.38	39.26	39.05	38.07	38.07	37.89	38.45	39.05	39.48	39.92	(38)

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

(39)m=	81.06	80.82	80.58	79.45	79.24	78.27	78.27	78.09	78.64	79.24	79.67	80.11	

Average = Sum(39)$_{1…12}$ /12= 79.45 (39)

DER WorkSheet: New dwelling design stage

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(40)m=	0.97	0.96	0.96	0.95	0.95	0.93	0.93	0.93	0.94	0.95	0.95	0.96

Average = Sum(40)$_{1…12}$ /12= 0.95 (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 2.53 (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 94.33 (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=	103.76	99.99	96.22	92.45	88.67	84.9	84.9	88.67	92.45	96.22	99.99	103.76

Total = Sum(44)$_{1…12}$ = 1131.98 (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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(45)m=	153.88	134.58	138.88	121.08	116.18	100.25	92.9	106.6	107.88	125.72	137.23	149.02

Total = Sum(45)$_{1…12}$ = 1484.21 (45)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	23.08	20.19	20.83	18.16	17.43	15.04	13.93	15.99	16.18	18.86	20.58	22.35	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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

(61)m=	38.44	34.72	38.44	37.2	38.44	37.2	38.44	38.44	37.2	38.44	37.2	38.44	(61)

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

(62)m=	192.32	169.3	177.32	158.27	154.61	137.45	131.33	145.04	145.07	164.15	174.43	187.46	(62)

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

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	42.12	34.93	32.24	23.51	15.77	10.22	9.51	10.81	10.93	24.11	33.46	42.15	(63) (G2)

Output from water heater

(64)m=	150.2	134.37	145.07	134.76	138.84	127.23	121.83	134.23	134.14	140.04	140.97	145.31	

Output from water heater (annual)$_{1...12}$ 1647 (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=	60.77	53.43	55.79	49.56	48.24	42.63	40.5	45.05	45.17	51.41	54.93	59.16	(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=	126.59	126.59	126.59	126.59	126.59	126.59	126.59	126.59	126.59	126.59	126.59	126.59	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	21.48	19.08	15.52	11.75	8.78	7.41	8.01	10.41	13.98	17.74	20.71	22.08	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	227.3	229.66	223.71	211.06	195.09	180.08	170.05	167.69	173.63	186.28	202.26	217.27	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	35.66	35.66	35.66	35.66	35.66	35.66	35.66	35.66	35.66	35.66	35.66	35.66	(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=	-101.27	-101.27	-101.27	-101.27	-101.27	-101.27	-101.27	-101.27	-101.27	-101.27	-101.27	-101.27	(71)
Water heating gains (Table 5)													
(72)m=	81.69	79.51	74.98	68.83	64.84	59.21	54.43	60.56	62.73	69.1	76.29	79.52	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	394.44	392.22	378.19	355.62	332.68	310.68	296.47	302.63	314.32	337.11	363.24	382.84	(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	6.26	x	10.63	x	0.72	x	0.7	=	23.25	(74)
North	0.9x	0.77	x	2.16	x	10.63	x	0.72	x	0.7	=	8.02	(74)
North	0.9x	0.77	x	6.26	x	20.32	x	0.72	x	0.7	=	44.43	(74)
North	0.9x	0.77	x	2.16	x	20.32	x	0.72	x	0.7	=	15.33	(74)

North	0.9x	0.77	x	6.26	x	34.53	x	0.72	x	0.7	=	75.5	(74)
North	0.9x	0.77	x	2.16	x	34.53	x	0.72	x	0.7	=	26.05	(74)
North	0.9x	0.77	x	6.26	x	55.46	x	0.72	x	0.7	=	121.27	(74)
North	0.9x	0.77	x	2.16	x	55.46	x	0.72	x	0.7	=	41.84	(74)
North	0.9x	0.77	x	6.26	x	74.72	x	0.72	x	0.7	=	163.36	(74)
North	0.9x	0.77	x	2.16	x	74.72	x	0.72	x	0.7	=	56.37	(74)
North	0.9x	0.77	x	6.26	x	79.99	x	0.72	x	0.7	=	174.88	(74)
North	0.9x	0.77	x	2.16	x	79.99	x	0.72	x	0.7	=	60.34	(74)
North	0.9x	0.77	x	6.26	x	74.68	x	0.72	x	0.7	=	163.28	(74)
North	0.9x	0.77	x	2.16	x	74.68	x	0.72	x	0.7	=	56.34	(74)
North	0.9x	0.77	x	6.26	x	59.25	x	0.72	x	0.7	=	129.54	(74)
North	0.9x	0.77	x	2.16	x	59.25	x	0.72	x	0.7	=	44.7	(74)
North	0.9x	0.77	x	6.26	x	41.52	x	0.72	x	0.7	=	90.77	(74)
North	0.9x	0.77	x	2.16	x	41.52	x	0.72	x	0.7	=	31.32	(74)
North	0.9x	0.77	x	6.26	x	24.19	x	0.72	x	0.7	=	52.89	(74)
North	0.9x	0.77	x	2.16	x	24.19	x	0.72	x	0.7	=	18.25	(74)
North	0.9x	0.77	x	6.26	x	13.12	x	0.72	x	0.7	=	28.68	(74)
North	0.9x	0.77	x	2.16	x	13.12	x	0.72	x	0.7	=	9.9	(74)
North	0.9x	0.77	x	6.26	x	8.86	x	0.72	x	0.7	=	19.38	(74)
North	0.9x	0.77	x	2.16	x	8.86	x	0.72	x	0.7	=	6.69	(74)
South	0.9x	0.77	x	3.99	x	46.75	x	0.72	x	0.7	=	65.15	(78)
South	0.9x	0.77	x	3.99	x	76.57	x	0.72	x	0.7	=	106.7	(78)
South	0.9x	0.77	x	3.99	x	97.53	x	0.72	x	0.7	=	135.92	(78)
South	0.9x	0.77	x	3.99	x	110.23	x	0.72	x	0.7	=	153.62	(78)
South	0.9x	0.77	x	3.99	x	114.87	x	0.72	x	0.7	=	160.08	(78)
South	0.9x	0.77	x	3.99	x	110.55	x	0.72	x	0.7	=	154.06	(78)
South	0.9x	0.77	x	3.99	x	108.01	x	0.72	x	0.7	=	150.52	(78)
South	0.9x	0.77	x	3.99	x	104.89	x	0.72	x	0.7	=	146.18	(78)
South	0.9x	0.77	x	3.99	x	101.89	x	0.72	x	0.7	=	141.99	(78)
South	0.9x	0.77	x	3.99	x	82.59	x	0.72	x	0.7	=	115.09	(78)
South	0.9x	0.77	x	3.99	x	55.42	x	0.72	x	0.7	=	77.23	(78)
South	0.9x	0.77	x	3.99	x	40.4	x	0.72	x	0.7	=	56.3	(78)

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

(83)m=	96.42	166.47	237.47	316.74	379.81	389.29	370.14	320.42	264.08	186.23	115.81	82.37	(83)

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

(84)m=	490.87	558.69	615.66	672.35	712.5	699.96	666.61	623.05	578.4	523.34	479.04	465.21	(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	0.96	0.87	0.68	0.51	0.57	0.83	0.97	1	1	(86)

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

(87)m=	20	20.14	20.35	20.63	20.86	20.97	21	20.99	20.93	20.63	20.27	19.98	(87)

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

(88)m=	20.11	20.11	20.12	20.13	20.13	20.14	20.14	20.14	20.14	20.13	20.13	20.12	(88)

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

(89)m=	1	0.99	0.98	0.95	0.83	0.61	0.41	0.47	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=	18.77	18.97	19.28	19.69	19.99	20.12	20.14	20.14	20.08	19.7	19.17	18.74	(90)

fLA = Living area ÷ (4) = 0.39 (91)

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

(92)m=	19.25	19.43	19.7	20.06	20.34	20.46	20.48	20.47	20.41	20.07	19.6	19.23	(92)

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

(93)m=	19.25	19.43	19.7	20.06	20.34	20.46	20.48	20.47	20.41	20.07	19.6	19.23	(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	0.98	0.94	0.84	0.64	0.45	0.51	0.78	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	489.31	554.73	604.63	634.91	596.55	445.07	301.81	315.33	452.85	502.71	475.64	464.11	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1212	1174.13	1063.8	886.82	684.35	458.48	303.33	318.17	496.21	750.26	995.97	1203.89	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	537.68	416.24	341.62	181.37	65.33	0	0	0	0	184.18	374.64	550.4	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2651.46 (98)

Space heating requirement in kWh/m²/year 31.62 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90	(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)	537.68	416.24	341.62	181.37	65.33	0	0	0	0	184.18	374.64	550.4	
(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)	597.43	462.49	379.58	201.52	72.59	0	0	0	0	204.64	416.27	611.56	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2946.07 (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)

150.2	134.37	145.07	134.76	138.84	127.23	121.83	134.23	134.14	140.04	140.97	145.31

Efficiency of water heater 86.7 (216)

(217)m=	89.26	89.17	88.99	88.56	87.73	86.7	86.7	86.7	86.7	88.54	89.07	89.29	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	168.27	150.69	163.02	152.16	158.26	146.75	140.52	154.82	154.72	158.16	158.26	162.74

Total = Sum(219a)$_{1...12}$ = 1868.38 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2946.07	
Water heating fuel used			1868.38	
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			379.37	(232)
Electricity generated by PVs			-742.71	(233)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	636.35	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	403.57	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1039.92	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	196.89	(268)
Energy saving/generation technologies Item 1		0.519	=	-385.47	(269)
Total CO2, kg/year		sum of (265)…(271) =		890.27	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		10.62	(273)
EI rating (section 14)				91	(274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	David Lloyd	**Stroma Number:**	STRO006228
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.3.10

Property Address: 2nd Floor B GS PV

Address : 2nd Floor B GS PV

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	83.85	(1a)	x	2.5	(2a)	=	209.62	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	83.85	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			209.62	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.14	(8)

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

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

TER WorkSheet: New dwelling design stage

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

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

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.91	x	1	=	1.91			(26)
Windows Type 1			3.99	x1/[1/(1.4)+ 0.04]		=	5.29			(27)
Windows Type 2			6.26	x1/[1/(1.4)+ 0.04]		=	8.3			(27)
Windows Type 3			2.16	x1/[1/(1.4)+ 0.04]		=	2.86			(27)
Walls Type1	73.1	12.41	60.69	x	0.18	=	10.92			(29)
Walls Type2	20.04	1.91	18.13	x	0.18	=	3.26			(29)
Total area of elements, m²			93.14							(31)
Party wall			32.61	x	0	=	0			(32)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 32.55 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 17709.11 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 6.14 (36)

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

Total fabric heat loss (33) + (36) = 38.69 (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=	40.87	40.62	40.38	39.26	39.05	38.07	38.07	37.89	38.45	39.05	39.48	39.92	(38)

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

(39)m=	79.55	79.31	79.07	77.95	77.74	76.76	76.76	76.58	77.14	77.74	78.16	78.61	

Average = Sum(39)$_{1…12}$ /12= 77.95 (39)

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

(40)m=	0.95	0.95	0.94	0.93	0.93	0.92	0.92	0.91	0.92	0.93	0.93	0.94	

Average = Sum(40)$_{1…12}$ /12= 0.93 (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 — 2.53 (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 — 94.33 (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=	103.76	99.99	96.22	92.45	88.67	84.9	84.9	88.67	92.45	96.22	99.99	103.76	
										Total = Sum(44)$_{1…12}$ =		1131.98	(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=	153.88	134.58	138.88	121.08	116.18	100.25	92.9	106.6	107.88	125.72	137.23	149.02	
										Total = Sum(45)$_{1…12}$ =		1484.21	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	23.08	20.19	20.83	18.16	17.43	15.04	13.93	15.99	16.18	18.86	20.58	22.35	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b — 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

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

Enter (50) or (54) in (55) — 0 (55)

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

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

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

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

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

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

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

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

(61)m=	50.96	46.02	49.03	45.59	45.19	41.87	43.26	45.19	45.59	49.03	49.31	50.96	(61)

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

(62)m=	204.84	180.61	187.91	166.67	161.36	142.12	136.16	151.79	153.47	174.75	186.54	199.98	(62)

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

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	204.84	180.61	187.91	166.67	161.36	142.12	136.16	151.79	153.47	174.75	186.54	199.98	

Output from water heater (annual)$_{1...12}$ 2046.2 (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=	63.9	56.26	58.44	51.66	49.93	43.8	41.7	46.74	47.27	54.06	57.96	62.29	(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=	126.59	126.59	126.59	126.59	126.59	126.59	126.59	126.59	126.59	126.59	126.59	126.59	(66)

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

(67)m=	21.48	19.08	15.52	11.75	8.78	7.41	8.01	10.41	13.98	17.74	20.71	22.08	(67)

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

(68)m=	227.3	229.66	223.71	211.06	195.09	180.08	170.05	167.69	173.63	186.28	202.26	217.27	(68)

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

(69)m=	35.66	35.66	35.66	35.66	35.66	35.66	35.66	35.66	35.66	35.66	35.66	35.66	(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=	-101.27	-101.27	-101.27	-101.27	-101.27	-101.27	-101.27	-101.27	-101.27	-101.27	-101.27	-101.27	(71)

Water heating gains (Table 5)

(72)m=	85.89	83.71	78.54	71.74	67.1	60.83	56.05	62.83	65.65	72.66	80.5	83.72	(72)

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

(73)m=	398.65	396.43	381.75	358.53	334.95	312.3	298.09	304.9	317.23	340.67	367.44	387.05	(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	6.26	x	10.63	x	0.63	x	0.7	=	20.34	(74)
North	0.9x	0.77	x	2.16	x	10.63	x	0.63	x	0.7	=	7.02	(74)
North	0.9x	0.77	x	6.26	x	20.32	x	0.63	x	0.7	=	38.88	(74)
North	0.9x	0.77	x	2.16	x	20.32	x	0.63	x	0.7	=	13.41	(74)

TER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	6.26	x	34.53	x	0.63	x	0.7	=	66.06	(74)
North	0.9x	0.77	x	2.16	x	34.53	x	0.63	x	0.7	=	22.79	(74)
North	0.9x	0.77	x	6.26	x	55.46	x	0.63	x	0.7	=	106.11	(74)
North	0.9x	0.77	x	2.16	x	55.46	x	0.63	x	0.7	=	36.61	(74)
North	0.9x	0.77	x	6.26	x	74.72	x	0.63	x	0.7	=	142.94	(74)
North	0.9x	0.77	x	2.16	x	74.72	x	0.63	x	0.7	=	49.32	(74)
North	0.9x	0.77	x	6.26	x	79.99	x	0.63	x	0.7	=	153.02	(74)
North	0.9x	0.77	x	2.16	x	79.99	x	0.63	x	0.7	=	52.8	(74)
North	0.9x	0.77	x	6.26	x	74.68	x	0.63	x	0.7	=	142.87	(74)
North	0.9x	0.77	x	2.16	x	74.68	x	0.63	x	0.7	=	49.3	(74)
North	0.9x	0.77	x	6.26	x	59.25	x	0.63	x	0.7	=	113.35	(74)
North	0.9x	0.77	x	2.16	x	59.25	x	0.63	x	0.7	=	39.11	(74)
North	0.9x	0.77	x	6.26	x	41.52	x	0.63	x	0.7	=	79.43	(74)
North	0.9x	0.77	x	2.16	x	41.52	x	0.63	x	0.7	=	27.41	(74)
North	0.9x	0.77	x	6.26	x	24.19	x	0.63	x	0.7	=	46.28	(74)
North	0.9x	0.77	x	2.16	x	24.19	x	0.63	x	0.7	=	15.97	(74)
North	0.9x	0.77	x	6.26	x	13.12	x	0.63	x	0.7	=	25.1	(74)
North	0.9x	0.77	x	2.16	x	13.12	x	0.63	x	0.7	=	8.66	(74)
North	0.9x	0.77	x	6.26	x	8.86	x	0.63	x	0.7	=	16.96	(74)
North	0.9x	0.77	x	2.16	x	8.86	x	0.63	x	0.7	=	5.85	(74)
South	0.9x	0.77	x	3.99	x	46.75	x	0.63	x	0.7	=	57.01	(78)
South	0.9x	0.77	x	3.99	x	76.57	x	0.63	x	0.7	=	93.37	(78)
South	0.9x	0.77	x	3.99	x	97.53	x	0.63	x	0.7	=	118.93	(78)
South	0.9x	0.77	x	3.99	x	110.23	x	0.63	x	0.7	=	134.42	(78)
South	0.9x	0.77	x	3.99	x	114.87	x	0.63	x	0.7	=	140.07	(78)
South	0.9x	0.77	x	3.99	x	110.55	x	0.63	x	0.7	=	134.8	(78)
South	0.9x	0.77	x	3.99	x	108.01	x	0.63	x	0.7	=	131.71	(78)
South	0.9x	0.77	x	3.99	x	104.89	x	0.63	x	0.7	=	127.91	(78)
South	0.9x	0.77	x	3.99	x	101.89	x	0.63	x	0.7	=	124.24	(78)
South	0.9x	0.77	x	3.99	x	82.59	x	0.63	x	0.7	=	100.7	(78)
South	0.9x	0.77	x	3.99	x	55.42	x	0.63	x	0.7	=	67.58	(78)
South	0.9x	0.77	x	3.99	x	40.4	x	0.63	x	0.7	=	49.26	(78)

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

(83)m=	84.37	145.66	207.79	277.14	332.34	340.62	323.87	280.36	231.07	162.95	101.33	72.07	(83)

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

(84)m=	483.02	542.09	589.54	635.67	667.29	652.93	621.96	585.27	548.3	503.62	468.77	459.12	(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	0.89	0.71	0.54	0.59	0.84	0.98	1	1	(86)

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

(87)m=	20.02	20.14	20.35	20.62	20.85	20.97	21	20.99	20.92	20.63	20.28	20	(87)

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

(88)m=	20.13	20.13	20.13	20.14	20.14	20.15	20.15	20.16	20.15	20.14	20.14	20.14	(88)

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

(89)m=	1	1	0.99	0.95	0.85	0.63	0.44	0.49	0.78	0.97	0.99	1	(89)

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

(90)m=	18.8	18.99	19.29	19.68	19.99	20.13	20.15	20.15	20.08	19.71	19.2	18.78	(90)

fLA = Living area ÷ (4) = 0.39 (91)

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

(92)m=	19.28	19.44	19.7	20.05	20.33	20.46	20.48	20.48	20.41	20.07	19.62	19.26	(92)

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

(93)m=	19.28	19.44	19.7	20.05	20.33	20.46	20.48	20.48	20.41	20.07	19.62	19.26	(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	0.98	0.95	0.86	0.67	0.48	0.53	0.8	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	481.6	538.72	580.6	606.03	573.37	434.24	296.34	309.4	439.89	486.04	465.73	458.11	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1191.73	1153.44	1043.93	869.11	670.79	450.07	298.16	312.69	486.95	736.25	978.7	1183.7	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	528.33	413.1	344.71	189.42	72.49	0	0	0	0	186.16	369.34	539.84	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2643.38 (98)

Space heating requirement in kWh/m²/year 31.53 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	528.33	413.1	344.71	189.42	72.49	0	0	0	0	186.16	369.34	539.84	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	565.67	442.29	369.07	202.8	77.61	0	0	0	0	199.31	395.44	577.99	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2830.17 (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)

204.84	180.61	187.91	166.67	161.36	142.12	136.16	151.79	153.47	174.75	186.54	199.98

Efficiency of water heater 80.3 (216)

(217)m=	87.33	87.07	86.56	85.37	83.18	80.3	80.3	80.3	80.3	85.21	86.74	87.43	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	234.55	207.43	217.09	195.22	193.99	176.99	169.57	189.03	191.11	205.08	215.06	228.74

Total = Sum(219a)$_{1...12}$ = 2423.87 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2830.17	
Water heating fuel used		2423.87	
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		379.37	(232)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	611.32	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	523.56	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1134.87	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	196.89	(268)
Total CO2, kg/year		sum of (265)…(271) =		1370.69	(272)

TER = 16.35 (273)

SAP 2012 Overheating Assessment

Calculated by Stroma FSAP 2012 program, produced and printed on 09 August 2016

Property Details: 2nd Floor B GS PV

Dwelling type:	Flat
Located in:	England
Region:	Thames valley
Cross ventilation possible:	Yes
Number of storeys:	1
Front of dwelling faces:	West
Overshading:	Average or unknown
Overhangs:	as detailed below
Thermal mass parameter:	Indicative Value Medium
Night ventilation:	False
Blinds, curtains, shutters:	Dark-coloured curtain or roller blind
Ventilation rate during hot weather (ach):	3 (Windows open half the time)

Overheating Details:

Summer ventilation heat loss coefficient:	207.53	**(P1)**
Transmission heat loss coefficient:	40.2	
Summer heat loss coefficient:	247.72	**(P2)**

Overhangs:

Orientation:	Ratio:	Z_overhangs:
South (South)	1.19	0.48
North (North 1)	0.71	0.87
North (North 2)	0.71	0.87

Solar shading:

Orientation:	Z blinds:	Solar access:	Overhangs:	Z summer:	
South (South)	0.85	1	0.48	0.41	**(P8)**
North (North 1)	0.85	1	0.87	0.74	**(P8)**
North (North 2)	0.85	1	0.87	0.74	**(P8)**

Solar gains:

Orientation		Area	Flux	g_	FF	Shading	Gains	
South (South)	1 x	3.99	112.21	0.72	0.7	0.41	82.94	
North (North 1)	1 x	6.26	81.19	0.72	0.7	0.74	170.2	
North (North 2)	1 x	2.16	81.19	0.72	0.7	0.74	58.73	
						Total	311.86	**(P3/P4)**

Internal gains:

	June	July	August	
Internal gains	449.23	430.92	439.31	
Total summer gains	782.86	742.78	707.28	**(P5)**
Summer gain/loss ratio	3.16	3	2.86	**(P6)**
Mean summer external temperature (Thames valley)	16	17.9	17.8	
Thermal mass temperature increment	0.25	0.25	0.25	
Threshold temperature	19.41	21.15	20.91	**(P7)**
Likelihood of high internal temperature	**Not significant**	**Slight**	**Slight**	

Assessment of likelihood of high internal temperature: <u>Slight</u>

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.3.10
Printed on 09 August 2016 at 13:36:38

Project Information:

Assessed By: David Lloyd (STRO006228) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 116.37m²

Site Reference : 52 Holmes Rd **Plot Reference:** Top Floor GS PV

Address : Top Floor GS PV

Client Details:

Name:

Address :

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

1a TER and DER

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

Target Carbon Dioxide Emission Rate (TER)	17.69 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	11.47 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	58.7 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	48.2 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.20 (max. 0.30)	0.20 (max. 0.70)	OK
Floor	(no floor)		
Roof	0.15 (max. 0.20)	0.15 (max. 0.35)	OK
Openings	1.09 (max. 2.00)	1.10 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system: Database: (rev 396, product index 017556):
Boiler systems with radiators or underfloor heating - mains gas
Brand name: Worcester
Model: Greenstar
Model qualifier: 29CDi Classic ErP
(Combi)
Efficiency 89.1 % SEDBUK2009
Minimum 88.0 % OK

Secondary heating system: None

Regulations Compliance Report

5 Cylinder insulation

Hot water Storage:	No cylinder

6 Controls

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

7 Low energy lights

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

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Thames valley):	Not significant	OK

Based on:

Overshading:	Average or unknown
Windows facing: South	5.8m²
Windows facing: North	6.26m²
Windows facing: North	2.16m²
Windows facing: North	6.2m²
Windows facing: South	6.22m²
Windows facing: South	1.58m²
Ventilation rate:	6.00
Blinds/curtains:	Dark-coloured curtain or roller blind Closed 100% of daylight hours

10 Key features

Windows U-value	1.1 W/m²K
Doors U-value	1 W/m²K
Photovoltaic array	

Predicted Energy Assessment

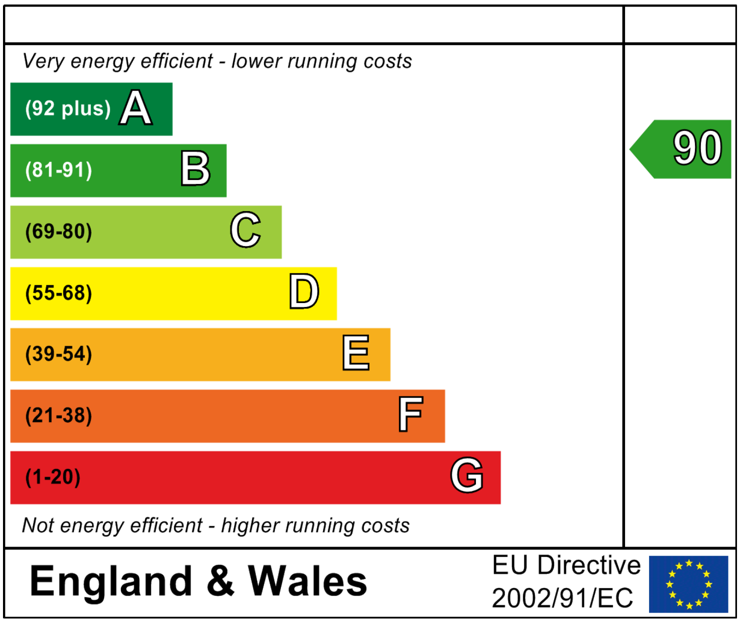
Top Floor GS PV

Dwelling type:	Top floor Flat
Date of assessment:	09 August 2016
Produced by:	David Lloyd
Total floor area:	116.37 m²

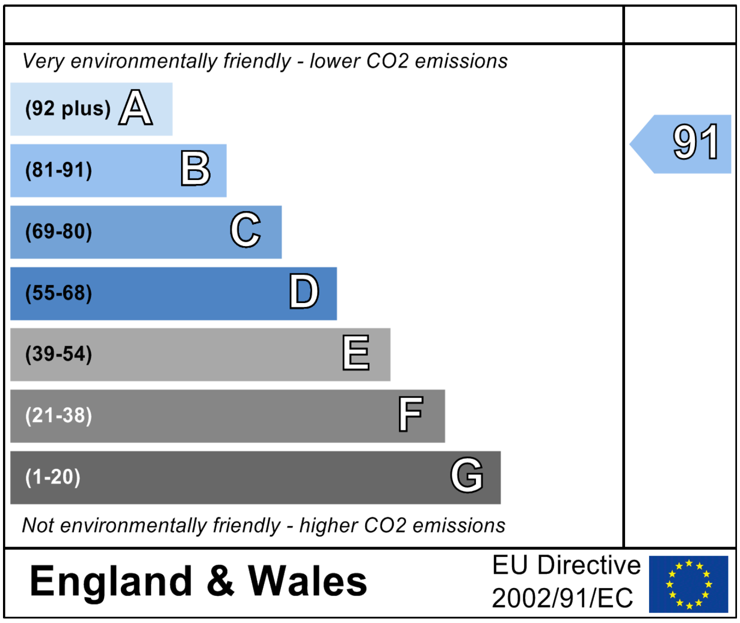
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about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

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

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



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

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

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	David Lloyd	**Stroma Number:**	STRO006228
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.3.10

Property Address: Top Floor GS PV

Address : Top Floor GS PV

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	116.37	(1a)	x	2.5	(2a)	=	290.93	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	116.37	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			290.93	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40	÷ (5) =	0.14	(8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

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

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.3	0.33	0.35	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

(25)m=	0.59	0.58	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.91	x	1	=	1.91			(26)
Windows Type 1			5.8	x1/[1/(1.1)+ 0.04]		=	6.11			(27)
Windows Type 2			6.26	x1/[1/(1.1)+ 0.04]		=	6.6			(27)
Windows Type 3			2.16	x1/[1/(1.1)+ 0.04]		=	2.28			(27)
Windows Type 4			6.2	x1/[1/(1.1)+ 0.04]		=	6.53			(27)
Windows Type 5			6.22	x1/[1/(1.1)+ 0.04]		=	6.55			(27)
Windows Type 6			1.58	x1/[1/(1.1)+ 0.04]		=	1.66			(27)
Walls Type1	133.89	28.22	105.67	x	0.2	=	21.13			(29)
Walls Type2	43.17	1.91	41.26	x	0.19	=	7.77			(29)
Roof	116.37	0	116.37	x	0.15	=	17.46			(30)
Total area of elements, m²			293.43							(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) = 78 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 21826.05 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 14.04 (36)

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

Total fabric heat loss (33) + (36) = 92.05 (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=	56.47	56.14	55.82	54.3	54.02	52.7	52.7	52.46	53.21	54.02	54.59	55.19	(38)

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

(39)m=	148.51	148.19	147.86	146.35	146.07	144.75	144.75	144.5	145.26	146.07	146.64	147.24	

Average = Sum(39)$_{1…12}$ /12= 146.35 (39)

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

(40)m=	1.28	1.27	1.27	1.26	1.26	1.24	1.24	1.24	1.25	1.26	1.26	1.27	

Average = Sum(40)$_{1…12}$ /12= 1.26 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.85 (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) + 36 101.84 (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=	112.03	107.95	103.88	99.81	95.73	91.66	91.66	95.73	99.81	103.88	107.95	112.03

Total = Sum(44)$_{1…12}$ = 1222.12 (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=	166.13	145.3	149.94	130.72	125.43	108.24	100.3	115.09	116.47	135.73	148.16	160.89

Total = Sum(45)$_{1…12}$ = 1602.39 (45)

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

(46)m=	24.92	21.8	22.49	19.61	18.81	16.24	15.04	17.26	17.47	20.36	22.22	24.13	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

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

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

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

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

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

(61)m=	38.44	34.72	38.44	37.2	38.44	37.2	38.44	38.44	37.2	38.44	37.2	38.44	(61)

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

(62)m=	204.57	180.02	188.37	167.92	163.86	145.43	138.73	153.53	153.66	174.17	185.36	199.33	(62)

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

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	64.23	51	45.11	31.01	20.66	10.96	10.22	11.58	11.7	32.18	49.15	64.3	(63) (G2)

Output from water heater

(64)m=	140.34	129.02	143.26	136.91	143.2	134.47	128.51	141.95	141.96	141.98	136.2	135.02	

Output from water heater (annual)$_{1...12}$ | 1652.83 | (64)

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

(65)m=	64.85	56.99	59.46	52.76	51.31	45.29	42.96	47.88	48.02	54.74	58.56	63.11	(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=	142.41	142.41	142.41	142.41	142.41	142.41	142.41	142.41	142.41	142.41	142.41	142.41	(66)

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

(67)m=	25	22.2	18.06	13.67	10.22	8.63	9.32	12.12	16.26	20.65	24.1	25.69	(67)

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

(68)m=	280.41	283.32	275.99	260.38	240.67	222.15	209.78	206.87	214.2	229.81	249.52	268.04	(68)

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

(69)m=	37.24	37.24	37.24	37.24	37.24	37.24	37.24	37.24	37.24	37.24	37.24	37.24	(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=	-113.93	-113.93	-113.93	-113.93	-113.93	-113.93	-113.93	-113.93	-113.93	-113.93	-113.93	-113.93	(71)

Water heating gains (Table 5)

(72)m=	87.16	84.81	79.92	73.28	68.97	62.9	57.74	64.35	66.7	73.57	81.34	84.82	(72)

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

(73)m=	461.29	459.05	442.69	416.05	388.58	362.4	345.56	352.06	365.89	392.76	423.68	447.27	(73)

6. Solar gains:

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

DER WorkSheet: New dwelling design stage

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.26	x	10.63	x	0.72	x	0.7	=	23.25	(74)
North	0.9x	0.77	x	2.16	x	10.63	x	0.72	x	0.7	=	8.02	(74)
North	0.9x	0.77	x	6.2	x	10.63	x	0.72	x	0.7	=	23.03	(74)
North	0.9x	0.77	x	6.26	x	20.32	x	0.72	x	0.7	=	44.43	(74)
North	0.9x	0.77	x	2.16	x	20.32	x	0.72	x	0.7	=	15.33	(74)
North	0.9x	0.77	x	6.2	x	20.32	x	0.72	x	0.7	=	44	(74)
North	0.9x	0.77	x	6.26	x	34.53	x	0.72	x	0.7	=	75.5	(74)
North	0.9x	0.77	x	2.16	x	34.53	x	0.72	x	0.7	=	26.05	(74)
North	0.9x	0.77	x	6.2	x	34.53	x	0.72	x	0.7	=	74.77	(74)
North	0.9x	0.77	x	6.26	x	55.46	x	0.72	x	0.7	=	121.27	(74)
North	0.9x	0.77	x	2.16	x	55.46	x	0.72	x	0.7	=	41.84	(74)
North	0.9x	0.77	x	6.2	x	55.46	x	0.72	x	0.7	=	120.11	(74)
North	0.9x	0.77	x	6.26	x	74.72	x	0.72	x	0.7	=	163.36	(74)
North	0.9x	0.77	x	2.16	x	74.72	x	0.72	x	0.7	=	56.37	(74)
North	0.9x	0.77	x	6.2	x	74.72	x	0.72	x	0.7	=	161.8	(74)
North	0.9x	0.77	x	6.26	x	79.99	x	0.72	x	0.7	=	174.88	(74)
North	0.9x	0.77	x	2.16	x	79.99	x	0.72	x	0.7	=	60.34	(74)
North	0.9x	0.77	x	6.2	x	79.99	x	0.72	x	0.7	=	173.21	(74)
North	0.9x	0.77	x	6.26	x	74.68	x	0.72	x	0.7	=	163.28	(74)
North	0.9x	0.77	x	2.16	x	74.68	x	0.72	x	0.7	=	56.34	(74)
North	0.9x	0.77	x	6.2	x	74.68	x	0.72	x	0.7	=	161.71	(74)
North	0.9x	0.77	x	6.26	x	59.25	x	0.72	x	0.7	=	129.54	(74)
North	0.9x	0.77	x	2.16	x	59.25	x	0.72	x	0.7	=	44.7	(74)
North	0.9x	0.77	x	6.2	x	59.25	x	0.72	x	0.7	=	128.3	(74)
North	0.9x	0.77	x	6.26	x	41.52	x	0.72	x	0.7	=	90.77	(74)
North	0.9x	0.77	x	2.16	x	41.52	x	0.72	x	0.7	=	31.32	(74)
North	0.9x	0.77	x	6.2	x	41.52	x	0.72	x	0.7	=	89.9	(74)
North	0.9x	0.77	x	6.26	x	24.19	x	0.72	x	0.7	=	52.89	(74)
North	0.9x	0.77	x	2.16	x	24.19	x	0.72	x	0.7	=	18.25	(74)
North	0.9x	0.77	x	6.2	x	24.19	x	0.72	x	0.7	=	52.38	(74)
North	0.9x	0.77	x	6.26	x	13.12	x	0.72	x	0.7	=	28.68	(74)
North	0.9x	0.77	x	2.16	x	13.12	x	0.72	x	0.7	=	9.9	(74)
North	0.9x	0.77	x	6.2	x	13.12	x	0.72	x	0.7	=	28.41	(74)
North	0.9x	0.77	x	6.26	x	8.86	x	0.72	x	0.7	=	19.38	(74)
North	0.9x	0.77	x	2.16	x	8.86	x	0.72	x	0.7	=	6.69	(74)
North	0.9x	0.77	x	6.2	x	8.86	x	0.72	x	0.7	=	19.2	(74)
South	0.9x	0.77	x	5.8	x	46.75	x	0.72	x	0.7	=	94.71	(78)
South	0.9x	0.77	x	6.22	x	46.75	x	0.72	x	0.7	=	101.57	(78)
South	0.9x	0.77	x	1.58	x	46.75	x	0.72	x	0.7	=	25.8	(78)

South	0.9x	0.77	x	5.8	x	76.57	x	0.72	x	0.7	=	155.11	(78)
South	0.9x	0.77	x	6.22	x	76.57	x	0.72	x	0.7	=	166.34	(78)
South	0.9x	0.77	x	1.58	x	76.57	x	0.72	x	0.7	=	42.25	(78)
South	0.9x	0.77	x	5.8	x	97.53	x	0.72	x	0.7	=	197.58	(78)
South	0.9x	0.77	x	6.22	x	97.53	x	0.72	x	0.7	=	211.89	(78)
South	0.9x	0.77	x	1.58	x	97.53	x	0.72	x	0.7	=	53.82	(78)
South	0.9x	0.77	x	5.8	x	110.23	x	0.72	x	0.7	=	223.31	(78)
South	0.9x	0.77	x	6.22	x	110.23	x	0.72	x	0.7	=	239.48	(78)
South	0.9x	0.77	x	1.58	x	110.23	x	0.72	x	0.7	=	60.83	(78)
South	0.9x	0.77	x	5.8	x	114.87	x	0.72	x	0.7	=	232.7	(78)
South	0.9x	0.77	x	6.22	x	114.87	x	0.72	x	0.7	=	249.55	(78)
South	0.9x	0.77	x	1.58	x	114.87	x	0.72	x	0.7	=	63.39	(78)
South	0.9x	0.77	x	5.8	x	110.55	x	0.72	x	0.7	=	223.95	(78)
South	0.9x	0.77	x	6.22	x	110.55	x	0.72	x	0.7	=	240.16	(78)
South	0.9x	0.77	x	1.58	x	110.55	x	0.72	x	0.7	=	61.01	(78)
South	0.9x	0.77	x	5.8	x	108.01	x	0.72	x	0.7	=	218.81	(78)
South	0.9x	0.77	x	6.22	x	108.01	x	0.72	x	0.7	=	234.65	(78)
South	0.9x	0.77	x	1.58	x	108.01	x	0.72	x	0.7	=	59.61	(78)
South	0.9x	0.77	x	5.8	x	104.89	x	0.72	x	0.7	=	212.49	(78)
South	0.9x	0.77	x	6.22	x	104.89	x	0.72	x	0.7	=	227.88	(78)
South	0.9x	0.77	x	1.58	x	104.89	x	0.72	x	0.7	=	57.89	(78)
South	0.9x	0.77	x	5.8	x	101.89	x	0.72	x	0.7	=	206.4	(78)
South	0.9x	0.77	x	6.22	x	101.89	x	0.72	x	0.7	=	221.34	(78)
South	0.9x	0.77	x	1.58	x	101.89	x	0.72	x	0.7	=	56.23	(78)
South	0.9x	0.77	x	5.8	x	82.59	x	0.72	x	0.7	=	167.3	(78)
South	0.9x	0.77	x	6.22	x	82.59	x	0.72	x	0.7	=	179.41	(78)
South	0.9x	0.77	x	1.58	x	82.59	x	0.72	x	0.7	=	45.57	(78)
South	0.9x	0.77	x	5.8	x	55.42	x	0.72	x	0.7	=	112.26	(78)
South	0.9x	0.77	x	6.22	x	55.42	x	0.72	x	0.7	=	120.39	(78)
South	0.9x	0.77	x	1.58	x	55.42	x	0.72	x	0.7	=	30.58	(78)
South	0.9x	0.77	x	5.8	x	40.4	x	0.72	x	0.7	=	81.84	(78)
South	0.9x	0.77	x	6.22	x	40.4	x	0.72	x	0.7	=	87.76	(78)
South	0.9x	0.77	x	1.58	x	40.4	x	0.72	x	0.7	=	22.29	(78)

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

(83)m=	276.37	467.47	639.62	806.85	927.17	933.55	894.39	800.79	695.97	515.81	330.22	237.16	(83)

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

(84)m=	737.67	926.52	1082.31	1222.9	1315.76	1295.95	1239.95	1152.85	1061.85	908.57	753.9	684.43	(84)

7. Mean internal temperature (heating season)

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

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

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

(86)m=	1	0.99	0.98	0.94	0.84	0.67	0.5	0.56	0.8	0.96	0.99	1	(86)

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

(87)m=	19.62	19.84	20.14	20.51	20.8	20.95	20.99	20.98	20.88	20.49	19.98	19.58	(87)

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

(88)m=	19.86	19.86	19.86	19.87	19.88	19.89	19.89	19.89	19.88	19.88	19.87	19.87	(88)

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

(89)m=	1	0.99	0.97	0.92	0.78	0.57	0.38	0.43	0.72	0.94	0.99	1	(89)

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

(90)m=	18.04	18.36	18.79	19.31	19.68	19.85	19.88	19.88	19.79	19.3	18.57	17.99	(90)

fLA = Living area ÷ (4) = 0.28 (91)

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

(92)m=	18.49	18.78	19.18	19.65	20	20.16	20.2	20.19	20.1	19.64	18.97	18.44	(92)

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

(93)m=	18.49	18.78	19.18	19.65	20	20.16	20.2	20.19	20.1	19.64	18.97	18.44	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.97	0.91	0.79	0.59	0.42	0.47	0.73	0.94	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	733.93	913.75	1044.92	1112.83	1037.95	770.88	515.4	539.4	780.3	852.74	745.26	681.92	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	2107.16	2056.74	1874.46	1573.14	1212.32	805.41	520.45	548.07	871.37	1319.92	1740.39	2096.76	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1021.68	768.09	617.17	331.42	129.73	0	0	0	0	347.59	716.49	1052.64	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4984.82 (98)

Space heating requirement in kWh/m²/year 42.84 (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	(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)													
	1021.68	768.09	617.17	331.42	129.73	0	0	0	0	347.59	716.49	1052.64	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	1135.2	853.43	685.75	368.25	144.15	0	0	0	0	386.21	796.1	1169.6	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 5538.69 (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)

140.34	129.02	143.26	136.91	143.2	134.47	128.51	141.95	141.96	141.98	136.2	135.02

Efficiency of water heater 86.7 (216)

(217)m=	89.59	89.51	89.36	89.01	88.24	86.7	86.7	86.7	86.7	89.02	89.46	89.61	(217)

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

(219)m=	156.64	144.14	160.32	153.81	162.29	155.1	148.23	163.72	163.74	159.5	152.26	150.68

Total = Sum(219a)$_{1...12}$ = 1870.43 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			5538.69	
Water heating fuel used			1870.43	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			441.48	(232)
Electricity generated by PVs			-1027.71	(233)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	1196.36	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	404.01	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1600.37	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	229.13	(268)
Energy saving/generation technologies Item 1		0.519	=	-533.38	(269)
Total CO2, kg/year		sum of (265)…(271) =		1335.05	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		11.47	(273)
EI rating (section 14)				89	(274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	David Lloyd	**Stroma Number:**	STRO006228
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.3.10

Property Address: Top Floor GS PV

Address : Top Floor GS PV

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	116.37	(1a)	x	2.5	(2a)	=	290.93	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	116.37	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			290.93	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40	÷ (5) =	0.14	(8)

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

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.3	0.33	0.35	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

(25)m=	0.59	0.58	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.91	x	1	=	1.91			(26)
Windows Type 1			5.59	x1/[1/(1.4)+ 0.04]		=	7.41			(27)
Windows Type 2			6.03	x1/[1/(1.4)+ 0.04]		=	7.99			(27)
Windows Type 3			2.08	x1/[1/(1.4)+ 0.04]		=	2.76			(27)
Windows Type 4			5.97	x1/[1/(1.4)+ 0.04]		=	7.91			(27)
Windows Type 5			5.99	x1/[1/(1.4)+ 0.04]		=	7.94			(27)
Windows Type 6			1.52	x1/[1/(1.4)+ 0.04]		=	2.02			(27)
Walls Type1	133.89	27.18	106.71	x	0.18	=	19.21			(29)
Walls Type2	43.17	1.91	41.26	x	0.18	=	7.43			(29)
Roof	116.37	0	116.37	x	0.13	=	15.13			(30)
Total area of elements, m²			293.43							(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) = 79.71 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 22023.65 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 13.66 (36)

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

Total fabric heat loss (33) + (36) = 93.37 (37)

TER WorkSheet: New dwelling design stage

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	56.47	56.14	55.82	54.3	54.02	52.7	52.7	52.46	53.21	54.02	54.59	55.19	(38)

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

(39)m=	149.84	149.51	149.19	147.67	147.39	146.07	146.07	145.83	146.58	147.39	147.96	148.56	

Average = Sum(39)$_{1…12}$ /12= 147.67 (39)

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

(40)m=	1.29	1.28	1.28	1.27	1.27	1.26	1.26	1.25	1.26	1.27	1.27	1.28	

Average = Sum(40)$_{1…12}$ /12= 1.27 (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 2.85 (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) + 36 101.84 (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=	112.03	107.95	103.88	99.81	95.73	91.66	91.66	95.73	99.81	103.88	107.95	112.03	

Total = Sum(44)$_{1…12}$ = 1222.12 (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=	166.13	145.3	149.94	130.72	125.43	108.24	100.3	115.09	116.47	135.73	148.16	160.89	

Total = Sum(45)$_{1…12}$ = 1602.39 (45)

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

(46)m=	24.92	21.8	22.49	19.61	18.81	16.24	15.04	17.26	17.47	20.36	22.22	24.13	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

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

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

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

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

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

(61)m=	50.96	46.03	50.96	49.22	48.78	45.2	46.71	48.78	49.22	50.96	49.32	50.96	(61)

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

(62)m=	217.09	191.33	200.9	179.94	174.21	153.44	147	163.88	165.68	186.69	197.47	211.85	(62)

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

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	217.09	191.33	200.9	179.94	174.21	153.44	147	163.88	165.68	186.69	197.47	211.85	

Output from water heater (annual)1…12 | 2189.48 | (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=	67.98	59.82	62.59	55.77	53.9	47.29	45.03	50.46	51.03	57.87	61.59	66.24	(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=	142.41	142.41	142.41	142.41	142.41	142.41	142.41	142.41	142.41	142.41	142.41	142.41	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	25	22.2	18.06	13.67	10.22	8.63	9.32	12.12	16.26	20.65	24.1	25.69	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	280.41	283.32	275.99	260.38	240.67	222.15	209.78	206.87	214.2	229.81	249.52	268.04	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	37.24	37.24	37.24	37.24	37.24	37.24	37.24	37.24	37.24	37.24	37.24	37.24	(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=	-113.93	-113.93	-113.93	-113.93	-113.93	-113.93	-113.93	-113.93	-113.93	-113.93	-113.93	-113.93	(71)
Water heating gains (Table 5)													
(72)m=	91.37	89.02	84.13	77.46	72.45	65.68	60.52	67.83	70.87	77.78	85.54	89.03	(72)
Total internal gains =					(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m								
(73)m=	465.5	463.26	446.9	420.23	392.06	365.18	348.34	355.54	370.06	396.97	427.88	451.48	(73)

6. Solar gains:

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

TER WorkSheet: New dwelling design stage

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.03	x	10.63	x	0.63	x	0.7	=	19.6	(74)
North	0.9x	0.77	x	2.08	x	10.63	x	0.63	x	0.7	=	6.76	(74)
North	0.9x	0.77	x	5.97	x	10.63	x	0.63	x	0.7	=	19.4	(74)
North	0.9x	0.77	x	6.03	x	20.32	x	0.63	x	0.7	=	37.45	(74)
North	0.9x	0.77	x	2.08	x	20.32	x	0.63	x	0.7	=	12.92	(74)
North	0.9x	0.77	x	5.97	x	20.32	x	0.63	x	0.7	=	37.08	(74)
North	0.9x	0.77	x	6.03	x	34.53	x	0.63	x	0.7	=	63.63	(74)
North	0.9x	0.77	x	2.08	x	34.53	x	0.63	x	0.7	=	21.95	(74)
North	0.9x	0.77	x	5.97	x	34.53	x	0.63	x	0.7	=	63	(74)
North	0.9x	0.77	x	6.03	x	55.46	x	0.63	x	0.7	=	102.21	(74)
North	0.9x	0.77	x	2.08	x	55.46	x	0.63	x	0.7	=	35.26	(74)
North	0.9x	0.77	x	5.97	x	55.46	x	0.63	x	0.7	=	101.2	(74)
North	0.9x	0.77	x	6.03	x	74.72	x	0.63	x	0.7	=	137.69	(74)
North	0.9x	0.77	x	2.08	x	74.72	x	0.63	x	0.7	=	47.49	(74)
North	0.9x	0.77	x	5.97	x	74.72	x	0.63	x	0.7	=	136.32	(74)
North	0.9x	0.77	x	6.03	x	79.99	x	0.63	x	0.7	=	147.4	(74)
North	0.9x	0.77	x	2.08	x	79.99	x	0.63	x	0.7	=	50.84	(74)
North	0.9x	0.77	x	5.97	x	79.99	x	0.63	x	0.7	=	145.93	(74)
North	0.9x	0.77	x	6.03	x	74.68	x	0.63	x	0.7	=	137.62	(74)
North	0.9x	0.77	x	2.08	x	74.68	x	0.63	x	0.7	=	47.47	(74)
North	0.9x	0.77	x	5.97	x	74.68	x	0.63	x	0.7	=	136.25	(74)
North	0.9x	0.77	x	6.03	x	59.25	x	0.63	x	0.7	=	109.18	(74)
North	0.9x	0.77	x	2.08	x	59.25	x	0.63	x	0.7	=	37.66	(74)
North	0.9x	0.77	x	5.97	x	59.25	x	0.63	x	0.7	=	108.1	(74)
North	0.9x	0.77	x	6.03	x	41.52	x	0.63	x	0.7	=	76.51	(74)
North	0.9x	0.77	x	2.08	x	41.52	x	0.63	x	0.7	=	26.39	(74)
North	0.9x	0.77	x	5.97	x	41.52	x	0.63	x	0.7	=	75.75	(74)
North	0.9x	0.77	x	6.03	x	24.19	x	0.63	x	0.7	=	44.58	(74)
North	0.9x	0.77	x	2.08	x	24.19	x	0.63	x	0.7	=	15.38	(74)
North	0.9x	0.77	x	5.97	x	24.19	x	0.63	x	0.7	=	44.13	(74)
North	0.9x	0.77	x	6.03	x	13.12	x	0.63	x	0.7	=	24.17	(74)
North	0.9x	0.77	x	2.08	x	13.12	x	0.63	x	0.7	=	8.34	(74)
North	0.9x	0.77	x	5.97	x	13.12	x	0.63	x	0.7	=	23.93	(74)
North	0.9x	0.77	x	6.03	x	8.86	x	0.63	x	0.7	=	16.34	(74)
North	0.9x	0.77	x	2.08	x	8.86	x	0.63	x	0.7	=	5.63	(74)
North	0.9x	0.77	x	5.97	x	8.86	x	0.63	x	0.7	=	16.17	(74)
South	0.9x	0.77	x	5.59	x	46.75	x	0.63	x	0.7	=	79.87	(78)
South	0.9x	0.77	x	5.99	x	46.75	x	0.63	x	0.7	=	85.59	(78)
South	0.9x	0.77	x	1.52	x	46.75	x	0.63	x	0.7	=	21.72	(78)

TER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	5.59	x	76.57	x	0.63	x	0.7	=	130.81	(78)
South	0.9x	0.77	x	5.99	x	76.57	x	0.63	x	0.7	=	140.17	(78)
South	0.9x	0.77	x	1.52	x	76.57	x	0.63	x	0.7	=	35.57	(78)
South	0.9x	0.77	x	5.59	x	97.53	x	0.63	x	0.7	=	166.62	(78)
South	0.9x	0.77	x	5.99	x	97.53	x	0.63	x	0.7	=	178.55	(78)
South	0.9x	0.77	x	1.52	x	97.53	x	0.63	x	0.7	=	45.31	(78)
South	0.9x	0.77	x	5.59	x	110.23	x	0.63	x	0.7	=	188.32	(78)
South	0.9x	0.77	x	5.99	x	110.23	x	0.63	x	0.7	=	201.8	(78)
South	0.9x	0.77	x	1.52	x	110.23	x	0.63	x	0.7	=	51.21	(78)
South	0.9x	0.77	x	5.59	x	114.87	x	0.63	x	0.7	=	196.24	(78)
South	0.9x	0.77	x	5.99	x	114.87	x	0.63	x	0.7	=	210.29	(78)
South	0.9x	0.77	x	1.52	x	114.87	x	0.63	x	0.7	=	53.36	(78)
South	0.9x	0.77	x	5.59	x	110.55	x	0.63	x	0.7	=	188.86	(78)
South	0.9x	0.77	x	5.99	x	110.55	x	0.63	x	0.7	=	202.37	(78)
South	0.9x	0.77	x	1.52	x	110.55	x	0.63	x	0.7	=	51.35	(78)
South	0.9x	0.77	x	5.59	x	108.01	x	0.63	x	0.7	=	184.53	(78)
South	0.9x	0.77	x	5.99	x	108.01	x	0.63	x	0.7	=	197.73	(78)
South	0.9x	0.77	x	1.52	x	108.01	x	0.63	x	0.7	=	50.17	(78)
South	0.9x	0.77	x	5.59	x	104.89	x	0.63	x	0.7	=	179.2	(78)
South	0.9x	0.77	x	5.99	x	104.89	x	0.63	x	0.7	=	192.02	(78)
South	0.9x	0.77	x	1.52	x	104.89	x	0.63	x	0.7	=	48.73	(78)
South	0.9x	0.77	x	5.59	x	101.89	x	0.63	x	0.7	=	174.06	(78)
South	0.9x	0.77	x	5.99	x	101.89	x	0.63	x	0.7	=	186.51	(78)
South	0.9x	0.77	x	1.52	x	101.89	x	0.63	x	0.7	=	47.33	(78)
South	0.9x	0.77	x	5.59	x	82.59	x	0.63	x	0.7	=	141.09	(78)
South	0.9x	0.77	x	5.99	x	82.59	x	0.63	x	0.7	=	151.18	(78)
South	0.9x	0.77	x	1.52	x	82.59	x	0.63	x	0.7	=	38.36	(78)
South	0.9x	0.77	x	5.59	x	55.42	x	0.63	x	0.7	=	94.67	(78)
South	0.9x	0.77	x	5.99	x	55.42	x	0.63	x	0.7	=	101.45	(78)
South	0.9x	0.77	x	1.52	x	55.42	x	0.63	x	0.7	=	25.74	(78)
South	0.9x	0.77	x	5.59	x	40.4	x	0.63	x	0.7	=	69.02	(78)
South	0.9x	0.77	x	5.99	x	40.4	x	0.63	x	0.7	=	73.95	(78)
South	0.9x	0.77	x	1.52	x	40.4	x	0.63	x	0.7	=	18.77	(78)

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

(83)m=	232.93	393.98	539.06	679.99	781.39	786.76	753.76	674.89	586.55	434.72	278.31	199.88	(83)

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

(84)m=	698.43	857.24	985.96	1100.22	1173.45	1151.94	1102.11	1030.42	956.61	831.69	706.19	651.36	(84)

7. Mean internal temperature (heating season)

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

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

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

(86)m=	1	0.99	0.99	0.96	0.88	0.73	0.56	0.62	0.85	0.97	1	1	(86)

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

(87)m=	19.58	19.78	20.06	20.42	20.73	20.92	20.98	20.97	20.84	20.43	19.93	19.54	(87)

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

(88)m=	19.85	19.85	19.85	19.87	19.87	19.88	19.88	19.88	19.87	19.87	19.86	19.86	(88)

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

(89)m=	1	0.99	0.98	0.94	0.83	0.63	0.43	0.48	0.77	0.96	0.99	1	(89)

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

(90)m=	17.97	18.26	18.67	19.19	19.61	19.83	19.87	19.87	19.75	19.21	18.49	17.92	(90)

fLA = Living area ÷ (4) = 0.28 (91)

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

(92)m=	18.42	18.69	19.06	19.54	19.93	20.14	20.19	20.18	20.06	19.55	18.9	18.38	(92)

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

(93)m=	18.42	18.69	19.06	19.54	19.93	20.14	20.19	20.18	20.06	19.55	18.9	18.38	(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	0.93	0.84	0.66	0.47	0.52	0.78	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	695.55	848.36	961.13	1027.53	981.4	755.88	515.18	537.3	750.14	793.01	699.85	649.39	(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=	2116.31	2061.19	1874.5	1570.92	1212.39	808.89	523.7	551.3	873.01	1319.84	1745.85	2106.97	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1057.05	815.02	679.55	391.24	171.86	0	0	0	0	391.96	753.12	1084.44	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 5344.23 (98)

Space heating requirement in kWh/m²/year 45.92 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	1057.05	815.02	679.55	391.24	171.86	0	0	0	0	391.96	753.12	1084.44	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	1131.74	872.62	727.57	418.89	184	0	0	0	0	419.66	806.33	1161.07	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 5721.87 (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)

217.09	191.33	200.9	179.94	174.21	153.44	147	163.88	165.68	186.69	197.47	211.85

Efficiency of water heater 80.3 (216)

(217)m=	88.5	88.29	87.88	86.95	85.02	80.3	80.3	80.3	80.3	86.87	88.1	88.58	(217)

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

(219)m=	245.29	216.71	228.61	206.93	204.92	191.08	183.07	204.08	206.33	214.89	224.15	239.16

Total = Sum(219a)$_{1...12}$ = 2565.23 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			5721.87	
Water heating fuel used			2565.23	
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			441.48	(232)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	1235.92	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	554.09	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1790.01	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	229.13	(268)
Total CO2, kg/year		sum of (265)…(271) =		2058.07	(272)

TER = 17.69 (273)

SAP 2012 Overheating Assessment

Calculated by Stroma FSAP 2012 program, produced and printed on 09 August 2016

Property Details: Top Floor GS PV

Dwelling type:	Flat
Located in:	England
Region:	Thames valley
Cross ventilation possible:	Yes
Number of storeys:	1
Front of dwelling faces:	West
Overshading:	Average or unknown
Overhangs:	None
Thermal mass parameter:	Indicative Value Medium
Night ventilation:	False
Blinds, curtains, shutters:	Dark-coloured curtain or roller blind
Ventilation rate during hot weather (ach):	6 (Windows fully open)

Overheating Details:

Summer ventilation heat loss coefficient:	576.03	**(P1)**
Transmission heat loss coefficient:	92	
Summer heat loss coefficient:	668.08	**(P2)**

Overhangs:

Orientation:	**Ratio:**	**Z_overhangs:**
South (South 1)	0	1
North (North 1)	0	1
North (North 2)	0	1
North (North 3)	0	1
South (South 2)	0	1
South (South 3)	0	1

Solar shading:

Orientation:	**Z blinds:**	**Solar access:**	**Overhangs:**	**Z summer:**	
South (South 1)	0.85	1	1	0.85	**(P8)**
North (North 1)	0.85	1	1	0.85	**(P8)**
North (North 2)	0.85	1	1	0.85	**(P8)**
North (North 3)	0.85	1	1	0.85	**(P8)**
South (South 2)	0.85	1	1	0.85	**(P8)**
South (South 3)	0.85	1	1	0.85	**(P8)**

Solar gains:

Orientation		**Area**	**Flux**	**g_**	**FF**	**Shading**	**Gains**	
South (South 1)	1 x	5.8	112.21	0.72	0.7	0.85	250.92	
North (North 1)	1 x	6.26	81.19	0.72	0.7	0.85	195.95	
North (North 2)	1 x	2.16	81.19	0.72	0.7	0.85	67.61	
North (North 3)	1 x	6.2	81.19	0.72	0.7	0.85	194.07	
South (South 2)	1 x	6.22	112.21	0.72	0.7	0.85	269.09	
South (South 3)	1 x	1.58	112.21	0.72	0.7	0.85	68.35	
						Total	1046	**(P3/P4)**

Internal gains:

	June	**July**	**August**	
Internal gains	527.94	506.05	515.3	
Total summer gains	1632.92	1552.04	1467.9	**(P5)**

SAP 2012 Overheating Assessment

Summer gain/loss ratio	2.44	2.32	2.2	**(P6)**
Mean summer external temperature (Thames valley)	16	17.9	17.8	
Thermal mass temperature increment	0.25	0.25	0.25	
Threshold temperature	18.69	20.47	20.25	**(P7)**
Likelihood of high internal temperature	**Not significant**	**Not significant**	**Not significant**	

Assessment of likelihood of high internal temperature: Not significant

Appendix 2
SBEM Report (Commercial Space)

SBEM Main Calculation Output Document

Tue Aug 09 10:24:07 2016 v5.2.g.3

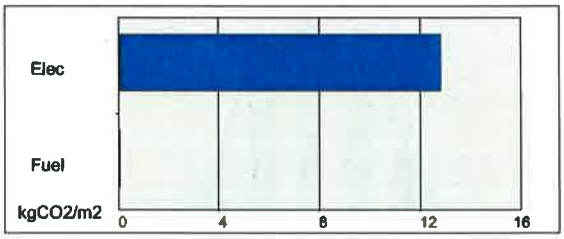
Building name

52 Holmes Rd PV

Building type: B1 Offices and Workshop businesses

SBEM is an energy calculation tool for the purpose of assessing and demonstrating compliance with Building Regulations (Part L for England and Wales, Section 6 for Scotland, Part F for Northern Ireland, Part L for Republic of Ireland and Building Bye-laws Jersey Part 11) and to produce Energy Performance Certificates and Building Energy Ratings. Although the data produced by the tool may be of use in the design process, **SBEM is not intended as a building design tool.**

Building Energy Performance and CO2 emissions

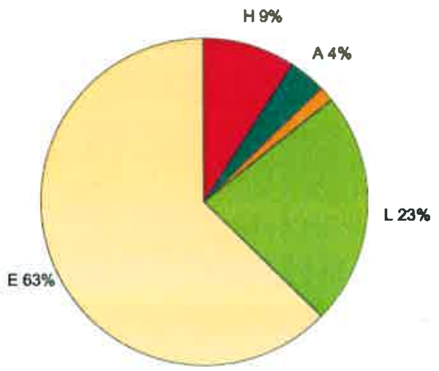


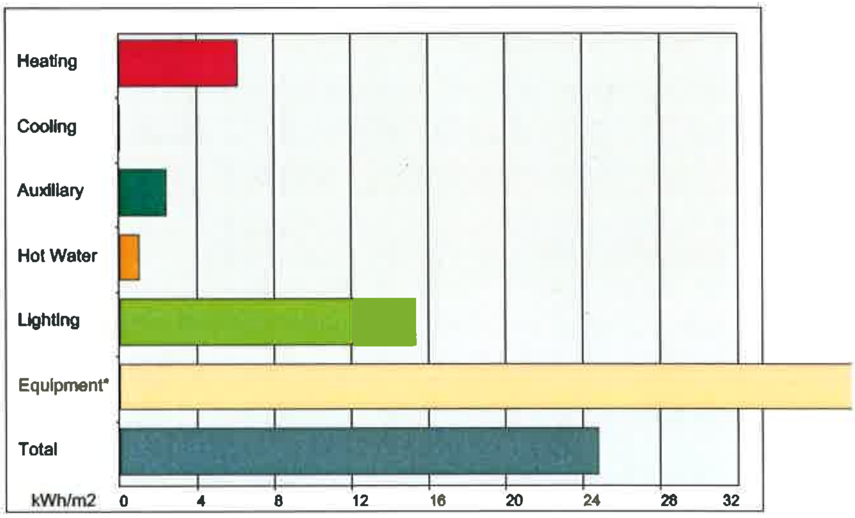
2 kgCO2/m2 displaced by the use of renewable sources.

Building area is 447.06 m2

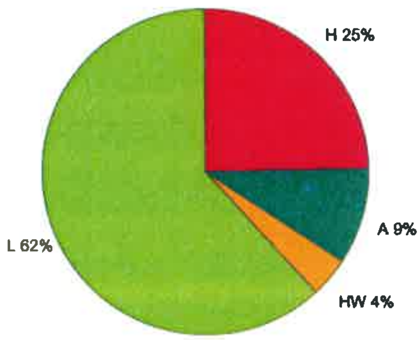
Annual Energy Consumption

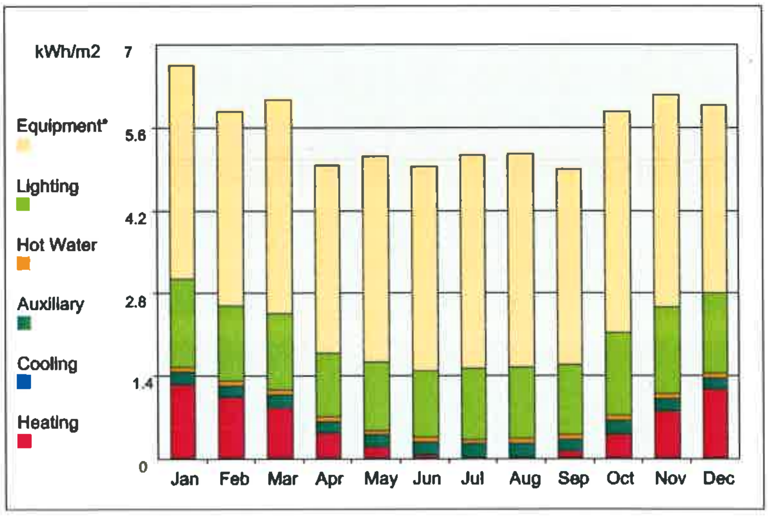
(Pie chart including Equipment end-use)





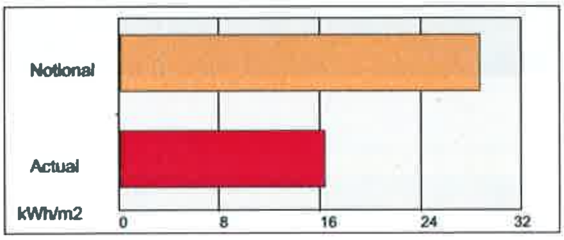
(Pie chart excluding Equipment end-use)

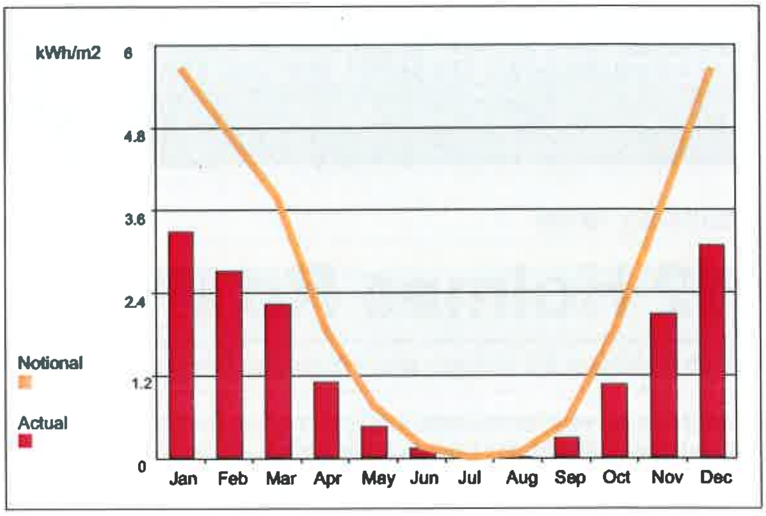




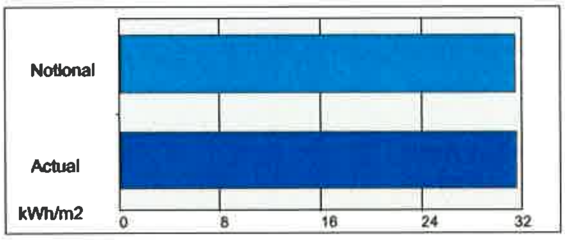
(*) Although energy consumption by equipment is shown in the graphs, the CO2 emissions associated with this end-use have not been taken into account when producing the rating.

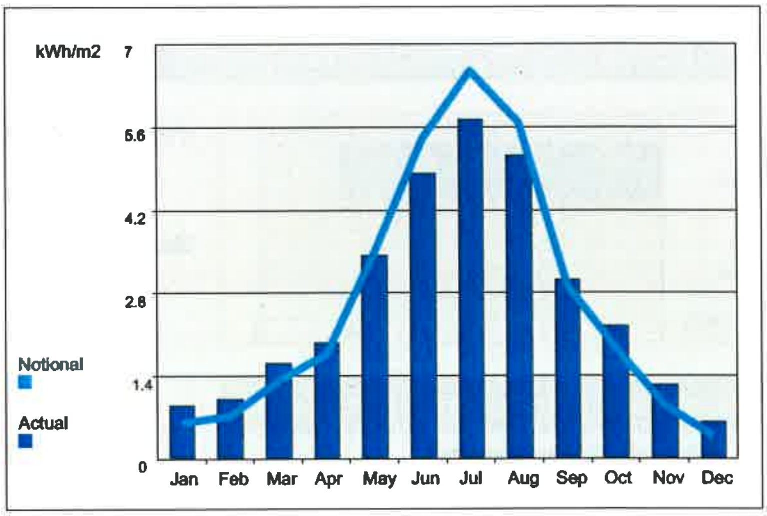
Annual Heating Demand





Annual Cooling Demand





BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name **Shell and Core**

52 Holmes Rd PV

As designed

Date: Tue Aug 09 10:24:07 2016

Administrative information

Building Details

Address: 52 Holmes Rd, Camden, London, NW5

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.2.g.3

Interface to calculation engine: iSBEM

Interface to calculation engine version: v5.2.g

BRUKL compliance check version: v5.2.g.3

Owner Details

Name: Information not provided by the user

Telephone number: Information not provided by the user

Address: Information not provided by the user, Information not provided by the user, Information not provided by the user

Certifier details

Name: D Lloyd

Telephone number: 02476 505600

Address: Abbey Park, Humber Road, Coventry, CV3 4AQ

Criterion 1: The calculated CO_2 emission rate for the building should not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	17.3
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	17.3
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	11.3
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and the building services should achieve reasonable overall standards of energy efficiency

Values not achieving standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	Surface where the maximum value occurs*
Wall**	0.35	0.2	0.2	LG a/su
Floor	0.25	0.15	0.2	LG a/ci
Roof	0.25	0.2	0.2	LG a/c
Windows***, roof windows, and rooflights	2.2	1.1	1.1	LG a/e/g
Personnel doors	2.2	-	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]

U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]

U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.

** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

*** Display windows and similar glazing are excluded from the U-value check.

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	5

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	<0.9

1- Heating

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3	-	-	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.

1- Hot Water

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	Hot water provided by HVAC system	-
Standard value	N/A	N/A

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	**SFP [W/(l/s)]**									**HR efficiency**	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
LG a	-	-	-	-	-	-	-	-	-	-	N/A
LG b	-	-	-	-	-	-	-	-	-	-	N/A
LG c	-	-	-	-	-	-	-	-	-	-	N/A
LG d	-	-	-	-	-	-	-	-	-	-	N/A
UG a	-	-	-	-	-	-	-	-	-	-	N/A
UG b	-	-	-	-	-	-	-	-	-	-	N/A
UG c	1.5	-	-	-	-	-	-	-	-	-	N/A
UG d	-	-	-	-	-	-	-	-	-	-	N/A

Shell and core configuration

Zone	Assumed shell?
LG a	YES
LG b	YES
LG c	YES
LG d	YES
UG a	YES
UG b	YES

Shell and core configuration

Zone	Assumed shell?
UG c	NO
UG d	NO

General lighting and display lighting

	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
LG a	79	-	-	300
LG b	83	-	-	70
LG c	83	-	-	40
LG d	80	-	-	880
UG a	80	-	-	740
UG b	83	-	-	40
UG c	-	52	-	90
UG d	73	-	-	126

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
LG a	NO (-59.8%)	NO
LG b	YES (+17.9%)	NO
LG c	N/A	N/A
LG d	NO (-5%)	NO
UG a	NO (-72.9%)	NO
UG b	NO (-7.4%)	NO
UG d	NO (-38.7%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	447.1	447.1
External area [m²]	977.1	977.1
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	5	3
Average conductance [W/K]	240.56	447.83
Average U-value [W/m²K]	0.25	0.46
Alpha value* [%]	26.65	16.73

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
100	**B1 Offices and Workshop businesses**
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Inst.: Hospitals and Care Homes
	C2 Residential Inst.: Residential schools
	C2 Residential Inst.: Universities and colleges
	C2A Secure Residential Inst.
	Residential spaces
	D1 Non-residential Inst.: Community/Day Centre
	D1 Non-residential Inst.: Libraries, Museums, and Galleries
	D1 Non-residential Inst.: Education
	D1 Non-residential Inst.: Primary Health Care Building
	D1 Non-residential Inst.: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others - Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	6.1	11.8
Cooling	0	0
Auxiliary	2.35	1.07
Lighting	15.25	20.28
Hot water	0.99	1.1
Equipment*	41.63	41.63
TOTAL**	**24.69**	**34.24**

* Energy used by equipment does not count towards the total for calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	3	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	172.25	216.06
Primary energy* [kWh/m²]	75.8	102.5
Total emissions [kg/m²]	11.3	17.3

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	58.8	113.5	6.1	0	2.3	2.68	0	3	0
	Notional	103.2	112.9	11.8	0	1.1	2.43	0	---	---

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Key Features

The BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.2	LG a/su
Floor	0.2	0.13	LG d/f
Roof	0.15	0.2	LG a/c
Windows, roof windows, and rooflights	1.5	1.1	LG a/e/g
Personnel doors	1.5	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	5