Energy Statement for Planning

Client: Calm Home Developments Ltd
Suite 18, 4th Floor Amp House
Dingwall Road
Croydon
CR0 2LX

Site Details: 35 Crescent Road
Caterham
CR3 6LE

Proposals: The construction of 4 residential terrace houses

Contents:

Appendices:

Report Details:

Prepared by	Checked by	Date	Project	Revision
Nicholas Gardner	Peter Kinsella (BSc Hons)	16.03.2024	9434	2.0

1 Introduction

This Energy Statement report has been prepared in support of the planning application for the construction of 4 residential terrace houses at 35 Crescent Road, Caterham, CR3 6LE.

Tandridge District Council Core Strategy (Policy CSP 14 Sustainable Construction) states:

Policy CSP 14

Sustainable Construction

The Council will encourage all residential development (either new build or conversion) to meet Code level 3 as set out in the published Code for Sustainable Homes. Commercial* development with a floor area of 500m^2 or greater will be encouraged to meet the BREEAM "Very Good" standard.

All new residential development (either new build or conversion) and commercial* development with a floor area of 500m^2 or greater will be required to reach a minimum percentage saving in CO_2 emissions through the incorporation of on-site renewable energy (as set out in the table below). The requirement varies according to the type of development and in the case of dwellings, the size of development.

Development Type	Percentage savings in Carbon Dioxide emissions through the provision of renewable energy technologies
Dwellings (1-9 units)	10%
Dwellings (10 + units)	20%**
Commercial* (500m^2+)	10%

Development over 5000m^2 will be expected to incorporate combined heat and power or similar technology.

Small scale renewable energy projects will be permitted except where there are overriding environmental, heritage, landscape, amenity or other constraints.

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* Commercial includes all forms of non-residential development, for example social and leisure related development.

**Only where a developer can satisfy the Council why the higher target of 20% cannot be achieved will the lower target of 10% be applied.

Based on the above, the proposed dwelling will need to achieve a 10% saving in CO2 emissions through the provision of renewable technologies.

This report demonstrates how the dwellings will meet current L1A Building Regulation requirements for energy efficiency (baseline scenario) and, through an assessment of energy efficient measured and renewable technologies, demonstrates how the dwelling can achieve the required 10% saving in CO2 emissions.

2 Existing and Proposed Development

The site is located at 35 Crescent Road, Caterham, CR3 6LE. (see Figure 1).

As previously detailed, proposals are for the construction of 4 residential terrace houses at 35 Crescent Road, Caterham, CR3 6LE.

The dwellings will face in a Westerly direction.

Given the scale and nature of the site (in particular the adjacent buildings) this constrains the development proposals in terms of the layout, positioning and orientation of the proposed development.

Subsequently, these constraints will impact on the feasibility of certain renewable technologies (as discussed in Section 4 of this report).

Access and egress for the proposed development will be provided off Crescent Road which le ads from Godstone Road.

3 SAP 2012 and Building Regulations (2013)

The Standard Assessment Procedure (SAP) 2012 is the UK Government methodology for assessing and calculating the energy performance of dwellings.

The SAP calculation takes into account a range of factors that contribute to energy efficiency, including:

- Materials used for the construction of the dwelling and the thermal insulation of building fabric (u-values1)
- Ventilation of the dwelling
- Efficiency and control of heating systems
- Fuel used to provide space heating,
- Lighting
- Heat recovery systems
- Renewable technologies

Approved Document Part L of current Building Regulations (2013) addresses the conservation of fuel and power. Part L is divided into four separate documents:

- Part L1A Newly Constructed Dwellings
- Part L1B Existing Dwellings
- Part L2A Newly Constructed Non - Dwellings
- Part L2B Existing Non - Dwellings

Part L1B sets out the minimum energy efficiency requirements for ***new dwellings*** and is based on the SAP methodology.

To comply with Part L1B, the SAP calculation should demonstrate how the dwellings will either meet or achieve a percentage reduction in the Dwelling Emission Rate (DER) under the required Target Emission Rate (TER).

[1] U-values (Thermal Transmittance) - the measure of the overall rate of heat transfer by all mechanisms under standard conditions, through a particular section of a construction. Lower u-values mean better thermal insulation

4 Baseline Scenario (Part L1A Compliance)

SAP modelling has been used to calculate the Building Regulations compliance threshold for the whole building. The Target Emission Rate forms the baseline from which any CO_2 emissions reductions can be measured. Simply complying with the minimum standards for building fabric and services would not usually be sufficient to ensure a 'pass' as the limiting values are designed to allow a degree of flexibility in achieving the main CO_2 limiting criterion. A sample of units has been modelled in full with numbers of each type and orientation being approximately proportionally representative of the whole.

Table 1: Baseline Area Weighted Average CO2 Results

	Calculation
Target Emission Rate (kg CO2/m^2/year)	17.06
Total Projected Baseline Emissions (kg CO2/year)	12,212

The Baseline Target emission rate for the dwellings assessed is shown to be on average 17.06 (kg CO2/m^2/year).

The total Baseline CO2 emissions for the dwellings assessed on average is shown to be 12,212 kg/year and this is to be used as the basis for the assessment.

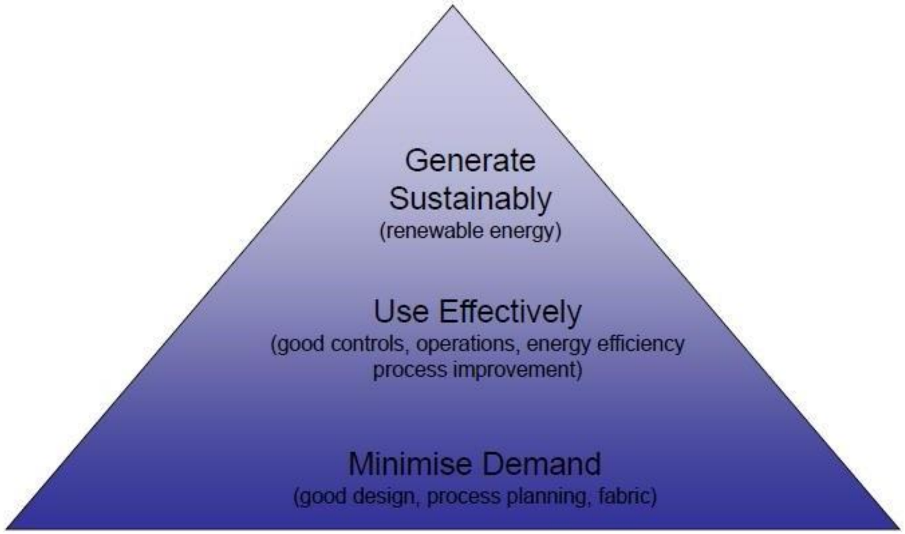
5 Be Lean Energy Efficiency Improvement Scenario

Be Lean Proposed Strategy

- Minimise demand
- Energy Efficient controls
- Generate energy

The Energy Hierarchy

Useful improvements can be made at all levels, but maximum benefits will be achieved if we focus first on minimising total energy requirements, then look at making better use of the energy we currently use, before thinking about how best to generate it.



In order to ensure that the dwellings exceed the minimum standards as set out in Part L1A, the following measures have been improved and are as proposed:

Table 2: Fabric Standards (u-values W/m²K)

	Part L1A Limiting Parameters	Notional Dwelling	Proposed Dwelling
Walls	0.30	0.18	0.2
Ground Floor	0.25	0.13	0.11
Roof	0.20	0.13	0.1 – 0.13
Windows	2.0	1.4	1.3
Air test	10	5	4
Ventilation	NA	Natural	Natural
Thermal Bridging	NA	0.05	ACD 0.05
Heating	88%	89% Gas Boiler	89.6% Gas Boiler
Heating controls	NA	Time and temp zone, weather comp	Time and temp zone, delayed start thermostat
Lights	75%	100%	100%
Thermal mass	NA	Medium	Low

- Insulation - good levels of insulation with u-values exceeding Part L1A requirements (see Table 1)
- Thermal Bridging - Accredited Construction Details provide the continuity of insulation and therefore apply a significant improvement factor on the energy performance of a dwelling
- Ventilation - design air permeability (DAP) of **4** m^3/hm^2 (@50Pa) (noting that a DAP of 10 m^3/hm^2 (@50Pa) or lower is the Part L1A minimum standard)
- Heating and Controls – 89.6% efficient ErP class Gas Combi Boiler with time and temperature zone control and a delayed start thermostat
- Lighting - the design of the dwelling allows for natural daylight which will reduce the energy use from internal lighting. All internal lighting will be low energy

The above specification has been incorporated into the baseline SAP calculation; the results are summarised in Table 3 (with the DER worksheet provided in Appendix B).

Table 3: Be Lean Energy Efficient Area Weighted Average

	Be Lean Results
Dwelling Emission Rate (DER) (kg CO_2/m^2/year)	14.78
Target Emission Rate (TER) (kg CO_2/m^2/year)	17.06
DER/TER Variance	-13.32%
Total TER Baseline CO_2 Emissions (kg/year)	12,212
Total DER Baseline CO_2 Emissions (kg/year)	10,614

The Be Lean dwelling emission rate CO_2 emissions are shown to be on average 14.78 (kg CO_2/m^2/year).

The total Be Lean CO_2 emissions for all dwellings are shown to be in total 10,614kg/year.

Based on the Be Lean calculations, a 13.32% reduction in CO_2 emissions can feasibly be achieved solely through improving the fabrics elements, air tightness.

6 Renewable Technology Review

As previously detailed, in order to meet the requirements of CSP 14 of the Core Strategy, the proposed dwellings will aim to achieve a 10% saving in CO2 emissions through the provision of on-site renewable technologies were feasible.

The baseline TER calculation indicates that the total CO2 emissions are 12,212 kg/year. Therefore, to achieve an overall 10% saving in CO2 emissions, we have conducted a renewable technology review below to assess the feasibility of certain renewable measures to achieve the council's target.

RENEWABLE TECHNOLOGIES

The Carbon Trust defines renewable energy as *'energy that occurs naturally and repeatedly in the environment. Therefore, it does not release any net greenhouse gases into the atmosphere'.*

There are a range of renewable technologies - some which generate electricity (such as photovoltaic (PV) panels, wind turbines), some which generate heat (such as ground source heat pumps, solar thermal panels for water heating), and some which generate both electricity and heat (Micro Combined Heat and Power). All can afford different benefits in reducing CO2 emissions from a dwelling. However, their feasibility depends on a number of factors including:

- Orientation
- Space (inside and outside of the dwelling)
- Surrounding topography
- Wind speed (for wind turbines)

In determining the most feasible renewable technologies for the dwelling, the following have been reviewed:

- Wind turbines
- Ground Source Heat Pumps
- Air Source Heat Pumps
- Biomass
- Micro Combined Heat and Power
- Photovoltaic Panels
- Solar water heating

WIND TURBINES

Wind turbines are used to produce electricity. They can be either pole mounted (in a suitably exposed position) or building mounted; building mounted systems need a suitable wind resource, and subsequently both a structural survey and planning permission.

The immediate surrounding area is comprised mainly by residential dwellings and the topography of the site is also significantly uneven. As previously noted, the proposed development is situated in close proximity to other existing dwellings, wind turbines will also cause noise issues to the neighbouring properties within this development and are known to be visually unsightly.

As such, wind turbines are not considered to be a suitable or feasible renewable technology for this particular development.

GROUND SOURCE HEAT PUMP (GSHP)

GSHPs use naturally occurring underground low-level heat in areas with appropriate geological features.

Heat is transferred from the ground by either extracting and discharging (re-charging) water from/to the ground directly (open loop) or circulating water through pipes buried within the ground, (closed loop). The water is passed through a heat pump in order to transfer the heat from this water into a higher temperature water circuit used for heating purposes. The loop can be fitted horizontally (laid in a shallow trench) or vertically (in a borehole).

It is important to note that GSHPs require electricity to drive the pump and is therefore not considered a completely 'renewable' technology.

For a GSHP to be installed, there needs to be suitable outdoor space for digging a trench or borehole (and the associated digging machinery) to support the ground loop.

Based on the proposed site layout plan, there would potentially be enough space for the installation of either a horizontal or vertical GSHP system. However, such a system may require a re-working of scheme and layout in order to accommodate plant rooms and infrastructure. The need for in depth design analysis to assess geology and thermal dynamics would be costly and not guarantee feasibility. Scheme success is also highly dependent on expertise and design. System efficiencies degrade over the heating season. Other technologies are available and provide more immediate, straight forward and certain benefits.

As such a GSHP is deemed feasible for consideration in this development, however other technologies would be more suitable.

AIR SOURCE HEAT PUMP (ASHP)

ASHP systems absorbs heat from outside air at a low temperature into a fluid which is then passed through a compressor where its temperature is increased. There are two main types of ASHP systems:

- Air to Water - distributes heat through the wet central heating
- Air to Air - produces warm air which is circulated by fans

Like GSHPs, ASHPs require electricity to drive the pump and therefore is not a completely 'renewable' system.

For an ASHP system to be installed, there needs to be ample outdoor space for the external condensing unit; these units can also be noisy and blow out colder air to the neighbouring environment.

The plans indicate that there is potentially enough private space for the external condensing unit to the rear of the dwellings. However this would need to be checked with an ASHP installer.

An air source heat pump both external and inside does require a significant amount of space and this would need to be design into the development with a possible reworking of the scheme design. Space would need to be made for a hot water cylinder possibly to the first floor, which is fed from the ASHP. An air source heat pump does make some noise when operating, as both a fan and a compressor will be in motion, however new technologies are being developed to overcome this noise issue.

As such ASHPs are feasible for this development, however an ASHP installer should also review the feasibility of the system.

BIOMASS

Biomass systems burn wood pellets, chips or logs to provide heat in a single room, or to power central heating and hot water boilers.

There needs to be ample space available for both the boiler and the storage of fuel. There will also be regular deliveries of fuel and therefore adequate site access is required.

The biomass boiler system would require a substantial amount of space for large boiler plant plus storage of the wood chip fuel. The transport and delivery of fuel would also have to be considered in terms of impacts to site layout and impact on surroundings. Air quality is also a concern with biomass and the proximity of boiler flues between properties would be an issue and could result in very high outlets. Even with design to mitigate immediate local impact, damaging particulates would be released and cause 'downstream impacts'. There are supply chain drawbacks in terms of security of supply, transport CO2 emissions quality and provenance.

Therefore, biomass is deemed unsuitable for this development.

COMBINED HEAT AND POWER (CHP)

CHP is effectively an on-site small power plant providing both electrical power and thermal heat energy. It is an energy efficiency and low carbon measure rather than a renewable energy technology. A CHP system operates by burning a primary fuel (normally natural gas) by use of either a reciprocating engine or turbine, which in turn drives an alternator to generate electrical power. The heat emitted by the engine and exhaust gases is recovered and used to heat the building or to provide hot water.

The viability of CHP is dependent upon the building base load requirements for both heat and power. Buildings with high heat demands and constant power demands lend themselves to CHP. It is important that the unit is not oversized as this will lead to inefficient operation. Excess generated electricity can be exported to the grid when circumstances allow. The heat generated during this process is supplied to an appropriately matched heat demand that would otherwise be met by a conventional boiler. CHP systems are highly efficient, making use of the heat which would otherwise be wasted when generating electrical or mechanical power. This allows heat requirements to be met that would otherwise require additional fuel to be burnt.

Given there will not be a significant hot water demand at the development, it would not be justified to operate the CHP all year all round at this development. The commercial viability of this type of system therefore would not be suitable for this particular development.

Be Clean - DISTRICT HEATING

District Heating systems provide multiple buildings or dwellings with heat and hot water from a central boiler house, or 'energy centre'. The system can provide heating or cooling which is transferred from the energy centre through a network of highly insulated pipes carrying the heated water to each dwelling.

SOLAR PHOTOVOLTAIC (PV)

Solar PV cells (which are mounted together in panels or tiles on the roof) convert sunlight into electricity. The cells are made from layers of semi-conducting material; when the light shines on the cell, an electric field is created across the layers. Although PV cells are most effective in bright sunlight, they can still generate electricity on a cloudy day. The power of a PV cell is measured in kilowatts peak (kWp). Each PV panel produces 0.25Watts to 0.35Watts depending on the manufacture.

In general, PV cells should be installed so that they are orientated in a southerly direction (to face between south-east and south-west), in an un-shaded area. The site plan shows that PV on a horizontal angle to the rear flat roof is feasible for all dwellings.

Based on the proposed layout of the dwellings, and that there is no significant over-shading, PV is considered a feasible solution in contributing to the saving in CO2 emissions from the dwellings.

SOLAR HOT WATER

Solar hot water systems absorb energy from the sun and transfer this energy using heat exchangers to heat water. Systems should be roof mounted and oriented to face between a south-east and south-west direction.

There are three main types of solar heating (as defined by the Carbon Trust):

- Flat Plate Collectors - a sheet of black metal that absorbs the sun's energy encases the collector system. Water is fed through the system in pipes which conduct the heat to the water

- Evacuated Tubes - a series of parallel glass heat tubes grouped together, with each tube containing an absorber tube. Sunlight passes through the outer glass tube to heat the absorber tube which in doing so, the heat is transferred to water flowing through the tube

- Solar Matting - a range of extruded hollow sections of flexible black material that can be used for solar collection. Water passes through the hollow tubes absorbing the heat from the sun

Based on the proposed layout of the dwellings, and that there is no significant over-shading, Solar Thermal would be a feasible solution in contributing to a saving in CO2 emissions from the dwellings. Solar PV provides a greater reduction in CO2 emissions compared to Solar Thermal based on the current SAP 2012.

Renewable Technology Summary

The renewable technology review indicates that the most feasible solution to achieve the 10% reduction in CO2 emissions from the dwellings (when compared with the baseline scenario) would be either the incorporation of an Air Source Heat Pump, Solar PV or solar thermal. All of these solutions would work, given the proposed layout of the dwellings and that there is no significant overshading.

For the purpose of showing a further reduction in CO2 via a renewable technology over Part L1a 2013 using SAP 2012, we have used Solar PV as the most suitable technology for this development.

The calculations to demonstrate how Solar PV can achieve the required 10% saving in CO2 emissions (when compared with the baseline scenario) are provided in Section 7 and Appendix C of this report.

7 Be Green Renewable Technology Scenario

In order to demonstrate how the dwellings can meet (or exceed) a 10% saving in CO_2 emissions through the incorporation of on-site renewable energy, the baseline TER SAP calculation (as detailed in Section 4 and Appendix A of this report) has been re-run with Solar PV as the most feasible renewable energy solution.

For the purpose of this report, an average 0.3kWp PV system per dwelling has been incorporated, which equates to an overall 3.3kWp system across the whole development (at a 30° angle, facing south), noting that a 0.25kWp system is the smallest sized system. The results are summarised inTable 4 (with the baseline DER worksheet provided in Appendix C).

Table 4: SAP Calculation Results – Be Green – Solar PV Scenario

	Be Green Results
Dwelling Emission Rate (DER) (kg CO_2/m^2/year)	12.75
Target Emission Rate (TER) (kg CO_2/m^2/year)	17.06
DER/TER Variance	-25.23%
Total TER Baseline CO2 Emissions (kg/year)	12,212
Total DER Baseline CO2 Emissions (kg/year)	9,135

A comparison of the baseline calculation results, the energy efficiency scenario results and the results of the calculation with Solar PV included is shown in Table 5 below.

Table 5: Comparison of Calculations (Baseline, Be Lean and Be Green)

	Baseline Calculation	Be Lean Calculation	Be Green Calculation
Dwelling Emission Rate (DER) (kg CO_2/m^2/year)	7.06	14.78	12.75
Target Emission Rate (TER) (kg CO_2/m^2/year)	17.06	17.06	17.06
DER/TER Variance	0.00%	-13.32%	-25.23%
Total DER Baseline CO2 Emissions (kg/year)	12,212	12,212	12,212
Total TER Baseline CO2 Emissions (kg/year)	12,212	10,614	9,135

As required by the local council a minimum 10% saving in CO_2 emissions is to be provided through energy efficient measures and through renewable technologies.

By including a 3.3kWp Solar PV System across the whole development, the total CO_2 emissions are shown to be 9,135 Kg/ year.

This results in a 25.23% reduction in CO_2 emissions Kg/year and therefore exceeds the requirement for a 10% reduction in CO_2.

Based on the above, the dwellings can therefore feasibly achieve the targets set out in the Core Strategy.

8 Conclusion

There are proposals for the construction of 4 residential terrace houses at 35 Crescent Road, Caterham, CR3 6LE.

Under the Tandridge Council Core Strategy Policy CSP 14, the proposed dwellings will aim to achieve a minimum 10% saving in CO2 emissions through the provision of renewable technologies.

Given the scale and nature of the site (in particular the adjacent buildings), this constrains the development proposals in terms of the layout, positioning and orientation of the proposed development. Subsequently, these constraints will impact on the feasibility of certain renewable technologies.

A review of renewable technologies indicates that solar PV or an ASHP would be the most feasible solutions to meet the Core Strategy requirements, Solar PV has been used for the basis of the assessment. This would be combined with a high standard of energy efficient measures below.

The following Be Green has been used in the Energy Statement

- 3.3kWp Solar PV System (facing south between 30 – 45-degree angle)

This would be combined with the following Be Lean energy efficient measures

- Low fabric u-values
- High efficient heating system and controls
- High air tightness (air test of 4)

SAP 2012 has used to calculate both a baseline scenario (to meet Building Regulation requirements), a scenario with energy efficient measures and a scenario with Solar PV.

Through the incorporation of a 3.3kWp Solar PV system, this results in a 25.23% reduction in CO2 emissions and therefore exceeds the requirement for a 10% reduction in CO2 emissions.

Appendices

Appendix A TER Worksheet - Baseline Scenario

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	EE	**Issued on Date**	01/03/2024
Assessment Reference	F1 - EE	**Prop Type Ref**	
Property	35, Crescent Road, Caterham , CR3 6LE		

SAP Rating	85 B	**DER**	15.26	**TER**	17.95
Environmental	88 B	**% DER<TER**	14.96		
CO_2 Emissions (t/year)	1.04	**DFEE**	39.39	**TFEE**	48.98
General Requirements Compliance	Pass	**% DFEE<TFEE**	19.59		

Assessor Details	Mr. Peter Kinsella, Base Energy Services Ltd, Tel: 0151 933 0328, peter@baseenergy.co.uk	**Assessor ID**	L770-0002
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

End of terrace dwelling, total floor area 117 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
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1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.95 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.26 kgCO□/m²OK
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1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)49.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)39.4 kWh/m²/yrOK
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2 Fabric U-values
Element          Average                 Highest
External wall    0.20 (max. 0.30)        0.20 (max. 0.70)          OK
Party wall       0.00 (max. 0.20)         -                        OK
Floor            0.11 (max. 0.25)        0.11 (max. 0.70)          OK
Roof             (no roof)
Openings         1.30 (max. 2.00)        1.30 (max. 3.30)          OK
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2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances  for each junction
------------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:          4.00 (design value)
Maximum                                  10.0                                                OK
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4 Heating efficiency
Main heating system:                     Boiler system with radiators or underfloor - Mains gas
Data from database
Vaillant ecoTEC exclusive 843 VUW 436/5-7 (H-GB)
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0%                                     OK

Secondary heating system:                None
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5 Cylinder insulation
Hot water storage                        No cylinder
------------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                  Time and temperature zone control                   OK


Hot water controls:                      No cylinder


Boiler interlock                         Yes                                                 OK
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7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                  75%                                                 OK
------------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Not applicable
------------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Thames Valley):        Slight                                              OK
Based on:
Overshading:                             Average
Windows facing North:                    2.86 m², No overhang
Windows facing West:                     11.55 m², No overhang
Air change rate:                         6.00 ach
Blinds/curtains:                         None
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10 Key features
Party wall U-value                       0.00 W/m²K
Exposed floor U-value                    0.11 W/m²K



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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

		Area (m2)		Storey height (m)		Volume (m3)
Ground floor		77.0000 (1b)	x	2.4000 (2b)	=	184.8000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	77.0000					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	184.8000 (5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000 (6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000 (6b)
Number of intermittent fans							0 * 10 =	0.0000 (7a)
Number of passive vents							3 * 10 =	30.0000 (7b)
Number of flueless gas fires							0 * 40 =	0.0000 (7c)

			Air changes per hour
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1623 (8)
Pressure test			Yes
Measured/design AP50			4.0000
Infiltration rate			0.3623 (18)
Number of sides sheltered			2 (19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.3080 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3927	0.3850	0.3773	0.3388	0.3311	0.2926	0.2926	0.2849	0.3080	0.3311	0.3465	0.3619	(22b)
Effective ac	0.5771	0.5741	0.5712	0.5574	0.5548	0.5428	0.5428	0.5406	0.5474	0.5548	0.5600	0.5655	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Window (Uw = 1.30)			14.4100	1.2357	17.8070			(27)
Heat Loss Floor 1			77.0000	0.1100	8.4700			(28b)
External Wall 1	50.6500	14.4100	36.2400	0.2000	7.2480			(29a)
Total net area of external elements Aum(A, m2)			127.6500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	33.5250			(33)
Party Wall 1			53.0000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		12.1215 (36)
Total fabric heat loss	(33) + (36) =	45.6465 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	35.1939	35.0113	34.8323	33.9917	33.8345	33.1023	33.1023	32.9668	33.3843	33.8345	34.1526	34.4852	(38)
Heat transfer coeff	80.8404	80.6578	80.4789	79.6383	79.4810	78.7489	78.7489	78.6133	79.0309	79.4810	79.7992	80.1318	(39)
Average = Sum(39)m / 12 =												79.6375	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0499	1.0475	1.0452	1.0343	1.0322	1.0227	1.0227	1.0210	1.0264	1.0322	1.0364	1.0407	(40)
HLP (average)												1.0343	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4035 (42)
Average daily hot water use (litres/day)	91.2825 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	100.4108	96.7595	93.1082	89.4569	85.8056	82.1543	82.1543	85.8056	89.4569	93.1082	96.7595	100.4108	(44)
Energy conte	148.9063	130.2344	134.3902	117.1646	112.4223	97.0119	89.8957	103.1567	104.3887	121.6550	132.7959	144.2078	(45)
Energy content (annual)										Total = Sum(45)m =		1436.2293	(45)
Distribution loss (46)m = 0.15 x (45)m	22.3359	19.5352	20.1585	17.5747	16.8633	14.5518	13.4844	15.4735	15.6583	18.2482	19.9194	21.6312	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Total heat required for water heating calculated for each month													
	148.9063	130.2344	134.3902	117.1646	112.4223	97.0119	89.8957	103.1567	104.3887	121.6550	132.7959	144.2078	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Output from w/h													
	148.9063	130.2344	134.3902	117.1646	112.4223	97.0119	89.8957	103.1567	104.3887	121.6550	132.7959	144.2078	(64)
								Total per year (kWh/year) = Sum(64)m =				1436.2293	(64)
Heat gains from water heating, kWh/month													
	49.5113	43.3029	44.6847	38.9572	37.3804	32.2564	29.8903	34.2996	34.7092	40.4503	44.1546	47.9491	(65)

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	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.2861	17.1297	13.9308	10.5465	7.8837	6.6557	7.1917	9.3481	12.5470	15.9313	18.5942	19.8221	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	213.0566	215.2674	209.6961	197.8355	182.8636	168.7921	159.3915	157.1806	162.7519	174.6125	189.5845	203.6559	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	(71)
Water heating gains (Table 5)													
	66.5475	64.4389	60.0601	54.1073	50.2425	44.8006	40.1752	46.1016	48.2073	54.3687	61.3259	64.4477	(72)
Total internal gains													
	360.9423	358.8882	345.7392	324.5414	303.0418	282.3005	268.8105	274.6824	285.5583	306.9646	331.5566	349.9779	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.8600	10.6334	0.6300	0.7000	0.7700	9.2941	(74)
West	11.5500	19.6403	0.6300	0.7000	0.7700	69.3268	(80)

Solar gains	78.6209	153.3795	253.5247	374.2119	464.5036	478.5617	454.3230	385.9741	296.0453	182.0649	97.9079	64.7590	(83)
Total gains	439.5632	512.2677	599.2639	698.7534	767.5454	760.8623	723.1335	660.6565	581.6036	489.0295	429.4645	414.7369	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	26.4582	26.5181	26.5770	26.8575	26.9107	27.1609	27.1609	27.2077	27.0640	26.9107	26.8034	26.6921	
alpha	2.7639	2.7679	2.7718	2.7905	2.7940	2.8107	2.8107	2.8138	2.8043	2.7940	2.7869	2.7795	
util living area													
	0.9692	0.9524	0.9165	0.8408	0.7224	0.5737	0.4456	0.4968	0.7130	0.8909	0.9552	0.9735	(86)
MIT	18.7790	19.0498	19.5128	20.0909	20.5532	20.8361	20.9410	20.9189	20.6833	20.0544	19.3117	18.7271	(87)
Th 2	20.0420	20.0439	20.0459	20.0549	20.0566	20.0644	20.0644	20.0659	20.0614	20.0566	20.0531	20.0496	(88)
util rest of house													
	0.9647	0.9455	0.9042	0.8172	0.6811	0.5097	0.3617	0.4113	0.6555	0.8693	0.9476	0.9695	(89)
MIT 2	17.0547	17.4468	18.1124	18.9314	19.5557	19.9133	20.0245	20.0075	19.7422	18.8998	17.8361	16.9839	(90)
Living area fraction									fLA = Living area / (4) =			0.3519	(91)
MIT	17.6616	18.0109	18.6053	19.3395	19.9068	20.2381	20.3471	20.3282	20.0734	19.3061	18.3555	17.5974	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5116	17.8609	18.4553	19.1895	19.7568	20.0881	20.1971	20.1782	19.9234	19.1561	18.2055	17.4474	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9476	0.9240	0.8780	0.7917	0.6667	0.5114	0.3741	0.4222	0.6460	0.8434	0.9268	0.9540	(94)
Useful gains	416.5107	473.3448	526.1675	553.2188	511.6888	389.1096	270.5394	278.9220	375.7181	412.4388	398.0466	395.6490	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1068.0301	1045.4019	962.1469	819.4379	640.3603	432.1805	283.2639	297.0200	460.2276	680.0485	886.2061	1061.5389	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	484.7305	384.4224	324.3686	191.6778	95.7316	0.0000	0.0000	0.0000	0.0000	199.1016	351.4748	495.4221	(98)
Space heating												2526.9294	(98)
Space heating per m2											(98) / (4) =	32.8173	(99)

8c. Space cooling requirement

Not applicable

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

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2792.1872	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	484.7305	384.4224	324.3686	191.6778	95.7316	0.0000	0.0000	0.0000	0.0000	199.1016	351.4748	495.4221	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	535.6138	424.7761	358.4184	211.7986	105.7808	0.0000	0.0000	0.0000	0.0000	220.0018	388.3700	547.4278	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	148.9063	130.2344	134.3902	117.1646	112.4223	97.0119	89.8957	103.1567	104.3887	121.6550	132.7959	144.2078	(64)
Efficiency of water heater												83.8000	(216)
(217)m	88.8310	88.7053	88.4289	87.8358	86.7538	83.8000	83.8000	83.8000	83.8000	87.8365	88.5584	88.8976	(217)
Fuel for water heating, kWh/month	167.6288	146.8169	151.9755	133.3905	129.5877	115.7659	107.2742	123.0987	124.5689	138.5017	149.9529	162.2179	(219)

Water heating fuel used	1650.7794	(219)
Annual totals kWh/year		
Space heating fuel - main system	2792.1872	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	75.0000	(231)
Electricity for lighting (calculated in Appendix L)	340.5986	(232)
Total delivered energy for all uses	4858.5652	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2792.1872	0.2160	603.1124	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1650.7794	0.2160	356.5683	(264)
Space and water heating			959.6808	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	340.5986	0.5190	176.7707	(268)
Total CO2, kg/year			1175.3764	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.2600	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		15.2600	ZC1
Total Floor Area	TFA	77.0000	
Assumed number of occupants	N	2.4035	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.3965	ZC2
CO2 emissions from cooking, equation (L16)		2.2946	ZC3
Total CO2 emissions		33.9511	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		33.9511	ZC8

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

		Area (m2)		Storey height (m)		Volume (m3)
Ground floor		77.0000 (1b)	x	2.4000 (2b)	=	184.8000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	77.0000					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	184.8000 (5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000 (6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000 (6b)
Number of intermittent fans							3 * 10 =	30.0000 (7a)
Number of passive vents							0 * 10 =	0.0000 (7b)
Number of flueless gas fires							0 * 40 =	0.0000 (7c)

			Air changes per hour
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1623 (8)
Pressure test			Yes
Measured/design AP50			5.0000
Infiltration rate			0.4123 (18)
Number of sides sheltered			2 (19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.3505 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4469	0.4381	0.4293	0.3855	0.3768	0.3330	0.3330	0.3242	0.3505	0.3768	0.3943	0.4118	(22b)
Effective ac	0.5998	0.5960	0.5922	0.5743	0.5710	0.5554	0.5554	0.5526	0.5614	0.5710	0.5777	0.5848	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
TER Opening Type (Uw = 1.40)			14.4100	1.3258	19.1042		(27)
Heat Loss Floor 1			77.0000	0.1300	10.0100		(28b)
External Wall 1	50.6500	14.4100	36.2400	0.1800	6.5232		(29a)
Total net area of external elements Aum(A, m2)			127.6500				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	35.6374		(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		12.1870 (36)
Total fabric heat loss	(33) + (36) =	47.8244 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	36.5811	36.3446	36.1128	35.0243	34.8206	33.8725	33.8725	33.6969	34.2377	34.8206	35.2326	35.6634	(38)
Heat transfer coeff	84.4054	84.1690	83.9372	82.8486	82.6450	81.6968	81.6968	81.5213	82.0620	82.6450	83.0570	83.4877	(39)
Average = Sum(39)m / 12 =												82.8477	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0962	1.0931	1.0901	1.0760	1.0733	1.0610	1.0610	1.0587	1.0657	1.0733	1.0787	1.0843	(40)
HLP (average)												1.0759	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4035 (42)
Average daily hot water use (litres/day)	91.2825 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	100.4108	96.7595	93.1082	89.4569	85.8056	82.1543	82.1543	85.8056	89.4569	93.1082	96.7595	100.4108	(44)
Energy conte	148.9063	130.2344	134.3902	117.1646	112.4223	97.0119	89.8957	103.1567	104.3887	121.6550	132.7959	144.2078	(45)
Energy content (annual)										Total = Sum(45)m =		1436.2293	(45)
Distribution loss (46)m = 0.15 x (45)m	22.3359	19.5352	20.1585	17.5747	16.8633	14.5518	13.4844	15.4735	15.6583	18.2482	19.9194	21.6312	(46)
Water storage loss: Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	44.5359	47.4469	44.1157	43.7256	40.5144	41.8649	43.7256	44.1157	47.4469	47.7170	50.9589	(61)

Total heat required for water heating calculated for each month

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	199.8652	174.7702	181.8371	161.2803	156.1478	137.5263	131.7607	146.8823	148.5044	169.1019	180.5129	195.1667	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h	199.8652	174.7702	181.8371	161.2803	156.1478	137.5263	131.7607	146.8823	148.5044	169.1019	180.5129	195.1667	(64)
Total per year (kWh/year) = Sum(64)m =												1983.3557	(64)
Heat gains from water heating, kWh/month	62.2511	54.4369	56.5465	49.9862	48.3118	42.3850	40.3566	45.2310	45.7382	52.3120	56.0839	60.6888	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts (66)m	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	19.2861	17.1297	13.9308	10.5465	7.8837	6.6557	7.1917	9.3481	12.5470	15.9313	18.5942	19.8221	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	213.0566	215.2674	209.6961	197.8355	182.8636	168.7921	159.3915	157.1806	162.7519	174.6125	189.5845	203.6559	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	(71)
Water heating gains (Table 5)	83.6708	81.0073	76.0033	69.4252	64.9352	58.8681	54.2427	60.7943	63.5252	70.3118	77.8943	81.5710	(72)
Total internal gains	378.0656	375.4566	361.6824	339.8594	317.7346	296.3680	282.8780	289.3752	300.8763	322.9078	348.1250	367.1012	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.8600	10.6334	0.6300	0.7000	0.7700	9.2941	(74)
West	11.5500	19.6403	0.6300	0.7000	0.7700	69.3268	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	78.6209	153.3795	253.5247	374.2119	464.5036	478.5617	454.3230	385.9741	296.0453	182.0649	97.9079	64.7590	(83)
Total gains	456.6865	528.8361	615.2071	714.0713	782.2381	774.9298	737.2010	675.3493	596.9216	504.9727	446.0329	431.8602	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	63.3516	63.5296	63.7050	64.5421	64.7011	65.4520	65.4520	65.5930	65.1607	64.7011	64.3802	64.0480	
alpha	5.2234	5.2353	5.2470	5.3028	5.3134	5.3635	5.3635	5.3729	5.3440	5.3134	5.2920	5.2699	
util living area	0.9981	0.9956	0.9860	0.9460	0.8341	0.6457	0.4822	0.5445	0.8193	0.9747	0.9960	0.9986	(86)
MIT	19.8252	19.9787	20.2472	20.5958	20.8564	20.9722	20.9951	20.9910	20.9044	20.5456	20.1223	19.8009	(87)
Th 2	20.0040	20.0065	20.0089	20.0205	20.0227	20.0328	20.0328	20.0347	20.0289	20.0227	20.0183	20.0137	(88)
util rest of house	0.9975	0.9941	0.9811	0.9271	0.7829	0.5601	0.3791	0.4358	0.7455	0.9624	0.9944	0.9981	(89)
MIT 2	18.4345	18.6602	19.0511	19.5510	19.8861	20.0150	20.0310	20.0311	19.9536	19.4923	18.8791	18.4060	(90)
Living area fraction									fLA = Living area / (4) =			0.3519	(91)
MIT	18.9239	19.1243	19.4721	19.9187	20.2276	20.3519	20.3703	20.3689	20.2882	19.8630	19.3166	18.8969	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9239	19.1243	19.4721	19.9187	20.2276	20.3519	20.3703	20.3689	20.2882	19.8630	19.3166	18.8969	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9965	0.9922	0.9776	0.9248	0.7947	0.5894	0.4156	0.4743	0.7673	0.9598	0.9927	0.9974	(94)
Useful gains	455.0859	524.7147	601.4352	660.3774	621.6209	456.7176	306.3553	320.2879	458.0055	484.6641	442.7872	430.7182	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1234.3396	1197.2420	1088.8385	912.8858	704.7628	469.9080	308.0247	323.5509	507.8192	765.5405	1014.6758	1227.0134	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	579.7648	451.9383	362.6280	181.8060	61.8576	0.0000	0.0000	0.0000	0.0000	208.9721	411.7598	592.4436	(98)
Space heating												2851.1702	(98)
Space heating per m2											(98) / (4) =	37.0282	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Efficiency of main space heating system 1 (in %)	93.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3052.6448	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	579.7648	451.9383	362.6280	181.8060	61.8576	0.0000	0.0000	0.0000	0.0000	208.9721	411.7598	592.4436	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	620.7332	483.8740	388.2527	194.6531	66.2287	0.0000	0.0000	0.0000	0.0000	223.7388	440.8563	634.3079	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	199.8652	174.7702	181.8371	161.2803	156.1478	137.5263	131.7607	146.8823	148.5044	169.1019	180.5129	195.1667	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.5762	87.3366	86.7557	85.3533	82.9290	80.3000	80.3000	80.3000	80.3000	85.5852	87.0625	87.6676	(217)
Fuel for water heating, kWh/month	228.2187	200.1111	209.5968	188.9561	188.2911	171.2656	164.0855	182.9169	184.9370	197.5830	207.3372	222.6211	(219)

Water heating fuel used	2345.9200	(219)
Annual totals kWh/year		
Space heating fuel - main system	3052.6448	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	75.0000	(231)
Electricity for lighting (calculated in Appendix L)	340.5986	(232)
Total delivered energy for all uses	5814.1634	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3052.6448	0.2160	659.3713	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2345.9200	0.2160	506.7187	(264)
Space and water heating			1166.0900	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	340.5986	0.5190	176.7707	(268)
Total CO2, kg/m2/year			1381.7857	(272)
Emissions per m2 for space and water heating			15.1440	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2957	(272b)
Emissions per m2 for pumps and fans			0.5055	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.1440 * 1.00) + 2.2957 + 0.5055, rounded to 2 d.p.			17.9500	(273)

Appendix B: DER Worksheet – Be Lean, With Energy Efficient Measures

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	EE	**Issued on Date**	01/03/2024
Assessment Reference	F1 - EE	**Prop Type Ref**	
Property	35, Crescent Road, Caterham , CR3 6LE		

SAP Rating	85 B	**DER**	15.26	**TER**	17.95
Environmental	88 B	**% DER<TER**	14.96		
CO_2 Emissions (t/year)	1.04	**DFEE**	39.39	**TFEE**	48.98
General Requirements Compliance	Pass	**% DFEE<TFEE**	19.59		

Assessor Details	Mr. Peter Kinsella, Base Energy Services Ltd, Tel: 0151 933 0328, peter@baseenergy.co.uk	**Assessor ID**	L770-0002
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

DWELLING AS DESIGNED

End of terrace dwelling, total floor area 77 m²

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:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.95 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.26 kgCO□/m²OK
------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)49.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)39.4 kWh/m²/yrOK
------------------------------------------------------------------------
2 Fabric U-values
Element         Average              Highest
External wall   0.20 (max. 0.30)     0.20 (max. 0.70)     OK
Party wall      0.00 (max. 0.20)      -                   OK
Floor           0.11 (max. 0.25)     0.11 (max. 0.70)     OK
Roof            (no roof)
Openings        1.30 (max. 2.00)     1.30 (max. 3.30)     OK
------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances  for each junction
------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:      4.00 (design value)
Maximum                              10.0                                  OK
------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                 Boiler system with radiators or underfloor - Mains gas
Data from database
Vaillant ecoTEC exclusive 843 VUW 436/5-7 (H-GB)
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0%                                 OK

Secondary heating system:            None
------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                    No cylinder
------------------------------------------------------------------------
6 Controls
Space heating controls:              Time and temperature zone control     OK


Hot water controls:                  No cylinder


Boiler interlock                     Yes                                   OK
------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                              75%                                   OK
------------------------------------------------------------------------
8 Mechanical ventilation
Not applicable
------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Thames Valley):    Slight                                OK
Based on:
Overshading:                         Average
Windows facing North:                2.86 m², No overhang
Windows facing West:                 11.55 m², No overhang
Air change rate:                     6.00 ach
Blinds/curtains:                     None
------------------------------------------------------------------------
10 Key features
Party wall U-value                   0.00 W/m²K
Exposed floor U-value                0.11 W/m²K

------------------------------------------------------------------------
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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

		Area (m2)		Storey height (m)		Volume (m3)
Ground floor		77.0000 (1b)	x	2.4000 (2b)	=	184.8000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	77.0000					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	184.8000 (5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000 (6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000 (6b)
Number of intermittent fans							0 * 10 =	0.0000 (7a)
Number of passive vents							3 * 10 =	30.0000 (7b)
Number of flueless gas fires							0 * 40 =	0.0000 (7c)

		Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1623 (8)
Pressure test		Yes
Measured/design AP50		4.0000
Infiltration rate		0.3623 (18)
Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3080 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3927	0.3850	0.3773	0.3388	0.3311	0.2926	0.2926	0.2849	0.3080	0.3311	0.3465	0.3619	(22b)
Effective ac	0.5771	0.5741	0.5712	0.5574	0.5548	0.5428	0.5428	0.5406	0.5474	0.5548	0.5600	0.5655	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Window (Uw = 1.30)			14.4100	1.2357	17.8070		(27)
Heat Loss Floor 1			77.0000	0.1100	8.4700		(28b)
External Wall 1	50.6500	14.4100	36.2400	0.2000	7.2480		(29a)
Total net area of external elements Aum(A, m2)			127.6500				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	33.5250		(33)
Party Wall 1			53.0000	0.0000	0.0000		(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		12.1215 (36)
Total fabric heat loss	(33) + (36) =	45.6465 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	35.1939	35.0113	34.8323	33.9917	33.8345	33.1023	33.1023	32.9668	33.3843	33.8345	34.1526	34.4852	(38)
Heat transfer coeff	80.8404	80.6578	80.4789	79.6383	79.4810	78.7489	78.7489	78.6133	79.0309	79.4810	79.7992	80.1318	(39)
Average = Sum(39)m / 12 =												79.6375	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0499	1.0475	1.0452	1.0343	1.0322	1.0227	1.0227	1.0210	1.0264	1.0322	1.0364	1.0407	(40)
HLP (average)												1.0343	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4035 (42)
Average daily hot water use (litres/day)	91.2825 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	100.4108	96.7595	93.1082	89.4569	85.8056	82.1543	82.1543	85.8056	89.4569	93.1082	96.7595	100.4108	(44)
Energy conte	148.9063	130.2344	134.3902	117.1646	112.4223	97.0119	89.8957	103.1567	104.3887	121.6550	132.7959	144.2078	(45)
Energy content (annual)										Total = Sum(45)m =		1436.2293	(45)
Distribution loss (46)m = 0.15 x (45)m	22.3359	19.5352	20.1585	17.5747	16.8633	14.5518	13.4844	15.4735	15.6583	18.2482	19.9194	21.6312	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total heat required for water heating calculated for each month	148.9063	130.2344	134.3902	117.1646	112.4223	97.0119	89.8957	103.1567	104.3887	121.6550	132.7959	144.2078	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Output from w/h	148.9063	130.2344	134.3902	117.1646	112.4223	97.0119	89.8957	103.1567	104.3887	121.6550	132.7959	144.2078	(64)
Total per year (kWh/year) = Sum(64)m =												1436.2293	(64)
Heat gains from water heating, kWh/month	49.5113	43.3029	44.6847	38.9572	37.3804	32.2564	29.8903	34.2996	34.7092	40.4503	44.1546	47.9491	(65)

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	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	19.2861	17.1297	13.9308	10.5465	7.8837	6.6557	7.1917	9.3481	12.5470	15.9313	18.5942	19.8221	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	213.0566	215.2674	209.6961	197.8355	182.8636	168.7921	159.3915	157.1806	162.7519	174.6125	189.5845	203.6559	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	(71)
Water heating gains (Table 5)	66.5475	64.4389	60.0601	54.1073	50.2425	44.8006	40.1752	46.1016	48.2073	54.3687	61.3259	64.4477	(72)
Total internal gains	360.9423	358.8882	345.7392	324.5414	303.0418	282.3005	268.8105	274.6824	285.5583	306.9646	331.5566	349.9779	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.8600	10.6334	0.6300	0.7000	0.7700	9.2941	(74)
West	11.5500	19.6403	0.6300	0.7000	0.7700	69.3268	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	78.6209	153.3795	253.5247	374.2119	464.5036	478.5617	454.3230	385.9741	296.0453	182.0649	97.9079	64.7590	(83)
Total gains	439.5632	512.2677	599.2639	698.7534	767.5454	760.8623	723.1335	660.6565	581.6036	489.0295	429.4645	414.7369	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	26.4582	26.5181	26.5770	26.8575	26.9107	27.1609	27.1609	27.2077	27.0640	26.9107	26.8034	26.6921	
alpha	2.7639	2.7679	2.7718	2.7905	2.7940	2.8107	2.8107	2.8138	2.8043	2.7940	2.7869	2.7795	
util living area	0.9692	0.9524	0.9165	0.8408	0.7224	0.5737	0.4456	0.4968	0.7130	0.8909	0.9552	0.9735	(86)
MIT	18.7790	19.0498	19.5128	20.0909	20.5532	20.8361	20.9410	20.9189	20.6833	20.0544	19.3117	18.7271	(87)
Th 2	20.0420	20.0439	20.0459	20.0549	20.0566	20.0644	20.0644	20.0659	20.0614	20.0566	20.0531	20.0496	(88)
util rest of house	0.9647	0.9455	0.9042	0.8172	0.6811	0.5097	0.3617	0.4113	0.6555	0.8693	0.9476	0.9695	(89)
MIT 2	17.0547	17.4468	18.1124	18.9314	19.5557	19.9133	20.0245	20.0075	19.7422	18.8998	17.8361	16.9839	(90)
Living area fraction										fLA = Living area / (4) =		0.3519	(91)
MIT	17.6616	18.0109	18.6053	19.3395	19.9068	20.2381	20.3471	20.3282	20.0734	19.3061	18.3555	17.5974	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5116	17.8609	18.4553	19.1895	19.7568	20.0881	20.1971	20.1782	19.9234	19.1561	18.2055	17.4474	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9476	0.9240	0.8780	0.7917	0.6667	0.5114	0.3741	0.4222	0.6460	0.8434	0.9268	0.9540	(94)
Useful gains	416.5107	473.3448	526.1675	553.2188	511.6888	389.1096	270.5394	278.9220	375.7181	412.4388	398.0466	395.6490	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1068.0301	1045.4019	962.1469	819.4379	640.3603	432.1805	283.2639	297.0200	460.2276	680.0485	886.2061	1061.5389	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	484.7305	384.4224	324.3686	191.6778	95.7316	0.0000	0.0000	0.0000	0.0000	199.1016	351.4748	495.4221	(98)
Space heating												2526.9294	(98)
Space heating per m2											(98) / (4) =	32.8173	(99)

8c. Space cooling requirement

Not applicable

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

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2792.1872	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	484.7305	384.4224	324.3686	191.6778	95.7316	0.0000	0.0000	0.0000	0.0000	199.1016	351.4748	495.4221	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	535.6138	424.7761	358.4184	211.7986	105.7808	0.0000	0.0000	0.0000	0.0000	220.0018	388.3700	547.4278	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	148.9063	130.2344	134.3902	117.1646	112.4223	97.0119	89.8957	103.1567	104.3887	121.6550	132.7959	144.2078	(64)
Efficiency of water heater												83.8000	(216)
(217)m	88.8310	88.7053	88.4289	87.8358	86.7538	83.8000	83.8000	83.8000	83.8000	87.8365	88.5584	88.8976	(217)
Fuel for water heating, kWh/month	167.6288	146.8169	151.9755	133.3905	129.5877	115.7659	107.2742	123.0987	124.5689	138.5017	149.9529	162.2179	(219)

Water heating fuel used	1650.7794	(219)
Annual totals kWh/year		
Space heating fuel - main system	2792.1872	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	75.0000	(231)
Electricity for lighting (calculated in Appendix L)	340.5986	(232)
Total delivered energy for all uses	4858.5652	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2792.1872	0.2160	603.1124	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1650.7794	0.2160	356.5683	(264)
Space and water heating			959.6808	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	340.5986	0.5190	176.7707	(268)
Total CO2, kg/year			1175.3764	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.2600	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		15.2600	ZC1
Total Floor Area	TFA	77.0000	
Assumed number of occupants	N	2.4035	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.3965	ZC2
CO2 emissions from cooking, equation (L16)		2.2946	ZC3
Total CO2 emissions		33.9511	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		33.9511	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

		Area (m2)			Storey height (m)		=	Volume (m3)	
Ground floor		77.0000	(1b)	x	2.4000	(2b)	=	184.8000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	77.0000								(4)
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)...(3n)		=	184.8000	(5)

2. Ventilation rate

	main heating		secondary heating		other	=	total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1623	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4123	(18)
Number of sides sheltered			2	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.3505	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4469	0.4381	0.4293	0.3855	0.3768	0.3330	0.3330	0.3242	0.3505	0.3768	0.3943	0.4118	(22b)
Effective ac	0.5998	0.5960	0.5922	0.5743	0.5710	0.5554	0.5554	0.5526	0.5614	0.5710	0.5777	0.5848	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.40)			14.4100	1.3258	19.1042			(27)
Heat Loss Floor 1			77.0000	0.1300	10.0100			(28b)
External Wall 1	50.6500	14.4100	36.2400	0.1800	6.5232			(29a)
Total net area of external elements Aum(A, m2)			127.6500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	35.6374			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		12.1870	(36)
Total fabric heat loss	(33) + (36) =	47.8244	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	36.5811	36.3446	36.1128	35.0243	34.8206	33.8725	33.8725	33.6969	34.2377	34.8206	35.2326	35.6634	(38)
Heat transfer coeff	84.4054	84.1690	83.9372	82.8486	82.6450	81.6968	81.6968	81.5213	82.0620	82.6450	83.0570	83.4877	(39)
Average = Sum(39)m / 12 =												82.8477	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0962	1.0931	1.0901	1.0760	1.0733	1.0610	1.0610	1.0587	1.0657	1.0733	1.0787	1.0843	(40)
HLP (average)												1.0759	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4035	(42)
Average daily hot water use (litres/day)	91.2825	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	100.4108	96.7595	93.1082	89.4569	85.8056	82.1543	82.1543	85.8056	89.4569	93.1082	96.7595	100.4108	(44)
Energy conte	148.9063	130.2344	134.3902	117.1646	112.4223	97.0119	89.8957	103.1567	104.3887	121.6550	132.7959	144.2078	(45)
Energy content (annual)										Total = Sum(45)m =		1436.2293	(45)
Distribution loss (46)m = 0.15 x (45)m	22.3359	19.5352	20.1585	17.5747	16.8633	14.5518	13.4844	15.4735	15.6583	18.2482	19.9194	21.6312	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	44.5359	47.4469	44.1157	43.7256	40.5144	41.8649	43.7256	44.1157	47.4469	47.7170	50.9589	(61)

Total heat required for water heating calculated for each month

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	199.8652	174.7702	181.8371	161.2803	156.1478	137.5263	131.7607	146.8823	148.5044	169.1019	180.5129	195.1667	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)

Output from w/h

	199.8652	174.7702	181.8371	161.2803	156.1478	137.5263	131.7607	146.8823	148.5044	169.1019	180.5129	195.1667	(64)

Total per year (kWh/year) = Sum(64)m = 1983.3557 (64)

Heat gains from water heating, kWh/month

	62.2511	54.4369	56.5465	49.9862	48.3118	42.3850	40.3566	45.2310	45.7382	52.3120	56.0839	60.6888	(65)

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	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.2861	17.1297	13.9308	10.5465	7.8837	6.6557	7.1917	9.3481	12.5470	15.9313	18.5942	19.8221	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	213.0566	215.2674	209.6961	197.8355	182.8636	168.7921	159.3915	157.1806	162.7519	174.6125	189.5845	203.6559	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	(71)
Water heating gains (Table 5)													
	83.6708	81.0073	76.0033	69.4252	64.9352	58.8681	54.2427	60.7943	63.5252	70.3118	77.8943	81.5710	(72)
Total internal gains													
	378.0656	375.4566	361.6824	339.8594	317.7346	296.3680	282.8780	289.3752	300.8763	322.9078	348.1250	367.1012	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.8600	10.6334	0.6300	0.7000	0.7700	9.2941	(74)
West	11.5500	19.6403	0.6300	0.7000	0.7700	69.3268	(80)

Solar gains	78.6209	153.3795	253.5247	374.2119	464.5036	478.5617	454.3230	385.9741	296.0453	182.0649	97.9079	64.7590	(83)
Total gains	456.6865	528.8361	615.2071	714.0713	782.2381	774.9298	737.2010	675.3493	596.9216	504.9727	446.0329	431.8602	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	63.3516	63.5296	63.7050	64.5421	64.7011	65.4520	65.4520	65.5930	65.1607	64.7011	64.3802	64.0480	
alpha	5.2234	5.2353	5.2470	5.3028	5.3134	5.3635	5.3635	5.3729	5.3440	5.3134	5.2920	5.2699	
util living area													
	0.9981	0.9956	0.9860	0.9460	0.8341	0.6457	0.4822	0.5445	0.8193	0.9747	0.9960	0.9986	(86)
MIT	19.8252	19.9787	20.2472	20.5958	20.8564	20.9722	20.9951	20.9910	20.9044	20.5456	20.1223	19.8009	(87)
Th 2	20.0040	20.0065	20.0089	20.0205	20.0227	20.0328	20.0328	20.0347	20.0289	20.0227	20.0183	20.0137	(88)
util rest of house													
	0.9975	0.9941	0.9811	0.9271	0.7829	0.5601	0.3791	0.4358	0.7455	0.9624	0.9944	0.9981	(89)
MIT 2	18.4345	18.6602	19.0511	19.5510	19.8861	20.0150	20.0310	20.0311	19.9536	19.4923	18.8791	18.4060	(90)
Living area fraction									fLA = Living area / (4) =			0.3519	(91)
MIT	18.9239	19.1243	19.4721	19.9187	20.2276	20.3519	20.3703	20.3689	20.2882	19.8630	19.3166	18.8969	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9239	19.1243	19.4721	19.9187	20.2276	20.3519	20.3703	20.3689	20.2882	19.8630	19.3166	18.8969	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9965	0.9922	0.9776	0.9248	0.7947	0.5894	0.4156	0.4743	0.7673	0.9598	0.9927	0.9974	(94)
Useful gains	455.0859	524.7147	601.4352	660.3774	621.6209	456.7176	306.3553	320.2879	458.0055	484.6641	442.7872	430.7182	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1234.3396	1197.2420	1088.8385	912.8858	704.7628	469.9080	308.0247	323.5509	507.8192	765.5405	1014.6758	1227.0134	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	579.7648	451.9383	362.6280	181.8060	61.8576	0.0000	0.0000	0.0000	0.0000	208.9721	411.7598	592.4436	(98)
Space heating												2851.1702	(98)
Space heating per m2											(98) / (4) =	37.0282	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)

Fraction of space heat from main system(s) 1.0000 (202)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Efficiency of main space heating system 1 (in %)	93.4000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	3052.6448 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	579.7648	451.9383	362.6280	181.8060	61.8576	0.0000	0.0000	0.0000	0.0000	208.9721	411.7598	592.4436	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	620.7332	483.8740	388.2527	194.6531	66.2287	0.0000	0.0000	0.0000	0.0000	223.7388	440.8563	634.3079	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	199.8652	174.7702	181.8371	161.2803	156.1478	137.5263	131.7607	146.8823	148.5044	169.1019	180.5129	195.1667	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.5762	87.3366	86.7557	85.3533	82.9290	80.3000	80.3000	80.3000	80.3000	85.5852	87.0625	87.6676	(217)
Fuel for water heating, kWh/month	228.2187	200.1111	209.5968	188.9561	188.2911	171.2656	164.0855	182.9169	184.9370	197.5830	207.3372	222.6211	(219)

Water heating fuel used	2345.9200 (219)
Annual totals kWh/year	
Space heating fuel - main system	3052.6448 (211)
Space heating fuel - secondary	0.0000 (215)
Electricity for pumps and fans:	
central heating pump	30.0000 (230c)
main heating flue fan	45.0000 (230e)
Total electricity for the above, kWh/year	75.0000 (231)
Electricity for lighting (calculated in Appendix L)	340.5986 (232)
Total delivered energy for all uses	5814.1634 (238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3052.6448	0.2160	659.3713	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2345.9200	0.2160	506.7187	(264)
Space and water heating			1166.0900	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	340.5986	0.5190	176.7707	(268)
Total CO2, kg/m2/year			1381.7857	(272)
Emissions per m2 for space and water heating			15.1440	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2957	(272b)
Emissions per m2 for pumps and fans			0.5055	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.1440 * 1.00) + 2.2957 + 0.5055, rounded to 2 d.p.			17.9500	(273)

Appendix C: DER Worksheet – Be Green Option with Renewable Technology

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	PV	Issued on Date	01/03/2024
Assessment Reference	F1 - PV	Prop Type Ref	
Property	35, Crescent Road, Caterham , CR3 6LE		

SAP Rating	87 B	DER	13.52	TER	17.95
Environmental	90 B	% DER<TER	24.66		
CO_2 Emissions (t/year)	0.90	DFEE	39.39	TFEE	48.98
General Requirements Compliance	Pass	% DFEE<TFEE	19.59		

Assessor Details	Mr. Peter Kinsella, Base Energy Services Ltd, Tel: 0151 933 0328, peter@baseenergy.co.uk	Assessor ID	L770-0002
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

DWELLING AS DESIGNED

End of terrace dwelling, total floor area 117 m²

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:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.95 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 13.52 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)49.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)39.4 kWh/m²/yrOK

2 Fabric U-values
Element          Average              Highest
External wall    0.20 (max. 0.30)     0.20 (max. 0.70)     OK
Party wall       0.00 (max. 0.20)      -                   OK
Floor            0.11 (max. 0.25)     0.11 (max. 0.70)     OK
Roof             (no roof)
Openings         1.30 (max. 2.00)     1.30 (max. 3.30)     OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances  for each junction

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

4 Heating efficiency
Main heating system:                  Boiler system with radiators or underfloor - Mains gas
Data from database
Vaillant ecoTEC exclusive 843 VUW 436/5-7 (H-GB)
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0%                                  OK

Secondary heating system:             None

5 Cylinder insulation
Hot water storage                     No cylinder

6 Controls
Space heating controls:               Time and temperature zone control       OK


Hot water controls:                   No cylinder


Boiler interlock                      Yes                                     OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                               75%                                     OK

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Thames Valley):     Slight                                  OK
Based on:
Overshading:                          Average
Windows facing North:                 2.86 m², No overhang
Windows facing West:                  11.55 m², No overhang
Air change rate:                      6.00 ach
Blinds/curtains:                      None

10 Key features
Party wall U-value                    0.00 W/m²K
Exposed floor U-value                 0.11 W/m²K
Photovoltaic array                    0.30 kW
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

		Area (m2)		Storey height (m)		Volume (m3)
Ground floor		77.0000 (1b)	x	2.4000 (2b)	=	184.8000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	77.0000					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	184.8000 (5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000 (6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000 (6b)
Number of intermittent fans							0 * 10 =	0.0000 (7a)
Number of passive vents							3 * 10 =	30.0000 (7b)
Number of flueless gas fires							0 * 40 =	0.0000 (7c)

			Air changes per hour
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1623 (8)
Pressure test			Yes
Measured/design AP50			4.0000
Infiltration rate			0.3623 (18)
Number of sides sheltered			2 (19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.3080 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3927	0.3850	0.3773	0.3388	0.3311	0.2926	0.2926	0.2849	0.3080	0.3311	0.3465	0.3619	(22b)
Effective ac	0.5771	0.5741	0.5712	0.5574	0.5548	0.5428	0.5428	0.5406	0.5474	0.5548	0.5600	0.5655	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Window (Uw = 1.30)			14.4100	1.2357	17.8070		(27)
Heat Loss Floor 1			77.0000	0.1100	8.4700		(28b)
External Wall 1	50.6500	14.4100	36.2400	0.2000	7.2480		(29a)
Total net area of external elements Aum(A, m2)			127.6500				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	33.5250		(33)
Party Wall 1			53.0000	0.0000	0.0000		(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		12.1215 (36)
Total fabric heat loss	(33) + (36) =	45.6465 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	35.1939	35.0113	34.8323	33.9917	33.8345	33.1023	33.1023	32.9668	33.3843	33.8345	34.1526	34.4852	(38)
Heat transfer coeff	80.8404	80.6578	80.4789	79.6383	79.4810	78.7489	78.7489	78.6133	79.0309	79.4810	79.7992	80.1318	(39)
Average = Sum(39)m / 12 =												79.6375	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0499	1.0475	1.0452	1.0343	1.0322	1.0227	1.0227	1.0210	1.0264	1.0322	1.0364	1.0407	(40)
HLP (average)												1.0343	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4035 (42)
Average daily hot water use (litres/day)	91.2825 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	100.4108	96.7595	93.1082	89.4569	85.8056	82.1543	82.1543	85.8056	89.4569	93.1082	96.7595	100.4108	(44)
Energy conte	148.9063	130.2344	134.3902	117.1646	112.4223	97.0119	89.8957	103.1567	104.3887	121.6550	132.7959	144.2078	(45)
Energy content (annual)										Total = Sum(45)m =		1436.2293	(45)
Distribution loss (46)m = 0.15 x (45)m	22.3359	19.5352	20.1585	17.5747	16.8633	14.5518	13.4844	15.4735	15.6583	18.2482	19.9194	21.6312	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total heat required for water heating calculated for each month	148.9063	130.2344	134.3902	117.1646	112.4223	97.0119	89.8957	103.1567	104.3887	121.6550	132.7959	144.2078	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Output from w/h	148.9063	130.2344	134.3902	117.1646	112.4223	97.0119	89.8957	103.1567	104.3887	121.6550	132.7959	144.2078	(64)
Total per year (kWh/year) = Sum(64)m =												1436.2293	(64)
Heat gains from water heating, kWh/month	49.5113	43.3029	44.6847	38.9572	37.3804	32.2564	29.8903	34.2996	34.7092	40.4503	44.1546	47.9491	(65)

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	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	19.2861	17.1297	13.9308	10.5465	7.8837	6.6557	7.1917	9.3481	12.5470	15.9313	18.5942	19.8221	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	213.0566	215.2674	209.6961	197.8355	182.8636	168.7921	159.3915	157.1806	162.7519	174.6125	189.5845	203.6559	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	(71)
Water heating gains (Table 5)	66.5475	64.4389	60.0601	54.1073	50.2425	44.8006	40.1752	46.1016	48.2073	54.3687	61.3259	64.4477	(72)
Total internal gains	360.9423	358.8882	345.7392	324.5414	303.0418	282.3005	268.8105	274.6824	285.5583	306.9646	331.5566	349.9779	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.8600	10.6334	0.6300	0.7000	0.7700	9.2941	(74)
West	11.5500	19.6403	0.6300	0.7000	0.7700	69.3268	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	78.6209	153.3795	253.5247	374.2119	464.5036	478.5617	454.3230	385.9741	296.0453	182.0649	97.9079	64.7590	(83)
Total gains	439.5632	512.2677	599.2639	698.7534	767.5454	760.8623	723.1335	660.6565	581.6036	489.0295	429.4645	414.7369	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	26.4582	26.5181	26.5770	26.8575	26.9107	27.1609	27.1609	27.2077	27.0640	26.9107	26.8034	26.6921	
alpha	2.7639	2.7679	2.7718	2.7905	2.7940	2.8107	2.8107	2.8138	2.8043	2.7940	2.7869	2.7795	
util living area	0.9692	0.9524	0.9165	0.8408	0.7224	0.5737	0.4456	0.4968	0.7130	0.8909	0.9552	0.9735	(86)
MIT	18.7790	19.0498	19.5128	20.0909	20.5532	20.8361	20.9410	20.9189	20.6833	20.0544	19.3117	18.7271	(87)
Th 2	20.0420	20.0439	20.0459	20.0549	20.0566	20.0644	20.0644	20.0659	20.0614	20.0566	20.0531	20.0496	(88)
util rest of house	0.9647	0.9455	0.9042	0.8172	0.6811	0.5097	0.3617	0.4113	0.6555	0.8693	0.9476	0.9695	(89)
MIT 2	17.0547	17.4468	18.1124	18.9314	19.5557	19.9133	20.0245	20.0075	19.7422	18.8998	17.8361	16.9839	(90)
Living area fraction									fLA = Living area / (4) =			0.3519	(91)
MIT	17.6616	18.0109	18.6053	19.3395	19.9068	20.2381	20.3471	20.3282	20.0734	19.3061	18.3555	17.5974	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5116	17.8609	18.4553	19.1895	19.7568	20.0881	20.1971	20.1782	19.9234	19.1561	18.2055	17.4474	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9476	0.9240	0.8780	0.7917	0.6667	0.5114	0.3741	0.4222	0.6460	0.8434	0.9268	0.9540	(94)
Useful gains	416.5107	473.3448	526.1675	553.2188	511.6888	389.1096	270.5394	278.9220	375.7181	412.4388	398.0466	395.6490	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1068.0301	1045.4019	962.1469	819.4379	640.3603	432.1805	283.2639	297.0200	460.2276	680.0485	886.2061	1061.5389	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	484.7305	384.4224	324.3686	191.6778	95.7316	0.0000	0.0000	0.0000	0.0000	199.1016	351.4748	495.4221	(98)
Space heating												2526.9294	(98)
Space heating per m2											(98) / (4) =	32.8173	(99)

8c. Space cooling requirement

Not applicable

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

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	90.5000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	2792.1872 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	484.7305	384.4224	324.3686	191.6778	95.7316	0.0000	0.0000	0.0000	0.0000	199.1016	351.4748	495.4221	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	535.6138	424.7761	358.4184	211.7986	105.7808	0.0000	0.0000	0.0000	0.0000	220.0018	388.3700	547.4278	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	148.9063	130.2344	134.3902	117.1646	112.4223	97.0119	89.8957	103.1567	104.3887	121.6550	132.7959	144.2078	(64)
Efficiency of water heater												83.8000	(216)
(217)m	88.8310	88.7053	88.4289	87.8358	86.7538	83.8000	83.8000	83.8000	83.8000	87.8365	88.5584	88.8976	(217)
Fuel for water heating, kWh/month	167.6288	146.8169	151.9755	133.3905	129.5877	115.7659	107.2742	123.0987	124.5689	138.5017	149.9529	162.2179	(219)

Water heating fuel used		1650.7794 (219)
Annual totals kWh/year		
Space heating fuel - main system		2792.1872 (211)
Space heating fuel - secondary		0.0000 (215)
Electricity for pumps and fans:		
central heating pump		30.0000 (230c)
main heating flue fan		45.0000 (230e)
Total electricity for the above, kWh/year		75.0000 (231)
Electricity for lighting (calculated in Appendix L)		340.5986 (232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 0.30 * 1080 * 1.00) =	-259.0859	-259.0859 (233)
Total delivered energy for all uses		4599.4793 (238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	2792.1872	0.2160	603.1124 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1650.7794	0.2160	356.5683 (264)
Space and water heating			959.6808 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	340.5986	0.5190	176.7707 (268)
Energy saving/generation technologies			
PV Unit	-259.0859	0.5190	-134.4656 (269)
Total CO2, kg/year			1040.9109 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			13.5200 (273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		13.5200	ZC1
Total Floor Area	TFA	77.0000	
Assumed number of occupants	N	2.4035	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.3965	ZC2
CO2 emissions from cooking, equation (L16)		2.2946	ZC3
Total CO2 emissions		32.2111	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		32.2111	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

		Area (m2)		Storey height (m)		Volume (m3)
Ground floor		77.0000 (1b)	x	2.4000 (2b)	=	184.8000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	77.0000					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	184.8000 (5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000 (6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000 (6b)
Number of intermittent fans							3 * 10 =	30.0000 (7a)
Number of passive vents							0 * 10 =	0.0000 (7b)
Number of flueless gas fires							0 * 40 =	0.0000 (7c)

			Air changes per hour
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1623 (8)
Pressure test			Yes
Measured/design AP50			5.0000
Infiltration rate			0.4123 (18)
Number of sides sheltered			2 (19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.3505 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4469	0.4381	0.4293	0.3855	0.3768	0.3330	0.3330	0.3242	0.3505	0.3768	0.3943	0.4118	(22b)
Effective ac	0.5998	0.5960	0.5922	0.5743	0.5710	0.5554	0.5554	0.5526	0.5614	0.5710	0.5777	0.5848	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
TER Opening Type (Uw = 1.40)			14.4100	1.3258	19.1042		(27)
Heat Loss Floor 1			77.0000	0.1300	10.0100		(28b)
External Wall 1	50.6500	14.4100	36.2400	0.1800	6.5232		(29a)
Total net area of external elements Aum(A, m2)			127.6500				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	35.6374		(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		12.1870 (36)
Total fabric heat loss	(33) + (36) =	47.8244 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	36.5811	36.3446	36.1128	35.0243	34.8206	33.8725	33.8725	33.6969	34.2377	34.8206	35.2326	35.6634	(38)
Heat transfer coeff	84.4054	84.1690	83.9372	82.8486	82.6450	81.6968	81.6968	81.5213	82.0620	82.6450	83.0570	83.4877	(39)
Average = Sum(39)m / 12 =												82.8477	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0962	1.0931	1.0901	1.0760	1.0733	1.0610	1.0610	1.0587	1.0657	1.0733	1.0787	1.0843	(40)
HLP (average)												1.0759	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4035 (42)
Average daily hot water use (litres/day)	91.2825 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	100.4108	96.7595	93.1082	89.4569	85.8056	82.1543	82.1543	85.8056	89.4569	93.1082	96.7595	100.4108	(44)
Energy conte	148.9063	130.2344	134.3902	117.1646	112.4223	97.0119	89.8957	103.1567	104.3887	121.6550	132.7959	144.2078	(45)
Energy content (annual)										Total = Sum(45)m =		1436.2293	(45)
Distribution loss (46)m = 0.15 x (45)m	22.3359	19.5352	20.1585	17.5747	16.8633	14.5518	13.4844	15.4735	15.6583	18.2482	19.9194	21.6312	(46)
Water storage loss: Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	44.5359	47.4469	44.1157	43.7256	40.5144	41.8649	43.7256	44.1157	47.4469	47.7170	50.9589	(61)

Total heat required for water heating calculated for each month

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	199.8652	174.7702	181.8371	161.2803	156.1478	137.5263	131.7607	146.8823	148.5044	169.1019	180.5129	195.1667	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h	199.8652	174.7702	181.8371	161.2803	156.1478	137.5263	131.7607	146.8823	148.5044	169.1019	180.5129	195.1667	(64)
Total per year (kWh/year) = Sum(64)m =												1983.3557	(64)
Heat gains from water heating, kWh/month	62.2511	54.4369	56.5465	49.9862	48.3118	42.3850	40.3566	45.2310	45.7382	52.3120	56.0839	60.6888	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts (66)m	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	120.1737	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	19.2861	17.1297	13.9308	10.5465	7.8837	6.6557	7.1917	9.3481	12.5470	15.9313	18.5942	19.8221	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	213.0566	215.2674	209.6961	197.8355	182.8636	168.7921	159.3915	157.1806	162.7519	174.6125	189.5845	203.6559	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	35.0174	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	-96.1390	(71)
Water heating gains (Table 5)	83.6708	81.0073	76.0033	69.4252	64.9352	58.8681	54.2427	60.7943	63.5252	70.3118	77.8943	81.5710	(72)
Total internal gains	378.0656	375.4566	361.6824	339.8594	317.7346	296.3680	282.8780	289.3752	300.8763	322.9078	348.1250	367.1012	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.8600	10.6334	0.6300	0.7000	0.7700	9.2941	(74)
West	11.5500	19.6403	0.6300	0.7000	0.7700	69.3268	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	78.6209	153.3795	253.5247	374.2119	464.5036	478.5617	454.3230	385.9741	296.0453	182.0649	97.9079	64.7590	(83)
Total gains	456.6865	528.8361	615.2071	714.0713	782.2381	774.9298	737.2010	675.3493	596.9216	504.9727	446.0329	431.8602	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	63.3516	63.5296	63.7050	64.5421	64.7011	65.4520	65.4520	65.5930	65.1607	64.7011	64.3802	64.0480	
alpha	5.2234	5.2353	5.2470	5.3028	5.3134	5.3635	5.3635	5.3729	5.3440	5.3134	5.2920	5.2699	
util living area	0.9981	0.9956	0.9860	0.9460	0.8341	0.6457	0.4822	0.5445	0.8193	0.9747	0.9960	0.9986	(86)
MIT	19.8252	19.9787	20.2472	20.5958	20.8564	20.9722	20.9951	20.9910	20.9044	20.5456	20.1223	19.8009	(87)
Th 2	20.0040	20.0065	20.0089	20.0205	20.0227	20.0328	20.0328	20.0347	20.0289	20.0227	20.0183	20.0137	(88)
util rest of house	0.9975	0.9941	0.9811	0.9271	0.7829	0.5601	0.3791	0.4358	0.7455	0.9624	0.9944	0.9981	(89)
MIT 2	18.4345	18.6602	19.0511	19.5510	19.8861	20.0150	20.0310	20.0311	19.9536	19.4923	18.8791	18.4060	(90)
Living area fraction									fLA = Living area / (4) =			0.3519	(91)
MIT	18.9239	19.1243	19.4721	19.9187	20.2276	20.3519	20.3703	20.3689	20.2882	19.8630	19.3166	18.8969	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9239	19.1243	19.4721	19.9187	20.2276	20.3519	20.3703	20.3689	20.2882	19.8630	19.3166	18.8969	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9965	0.9922	0.9776	0.9248	0.7947	0.5894	0.4156	0.4743	0.7673	0.9598	0.9927	0.9974	(94)
Useful gains	455.0859	524.7147	601.4352	660.3774	621.6209	456.7176	306.3553	320.2879	458.0055	484.6641	442.7872	430.7182	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1234.3396	1197.2420	1088.8385	912.8858	704.7628	469.9080	308.0247	323.5509	507.8192	765.5405	1014.6758	1227.0134	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	579.7648	451.9383	362.6280	181.8060	61.8576	0.0000	0.0000	0.0000	0.0000	208.9721	411.7598	592.4436	(98)
Space heating												2851.1702	(98)
Space heating per m2											(98) / (4) =	37.0282	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)

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Efficiency of main space heating system 1 (in %)	93.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3052.6448	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	579.7648	451.9383	362.6280	181.8060	61.8576	0.0000	0.0000	0.0000	0.0000	208.9721	411.7598	592.4436	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	620.7332	483.8740	388.2527	194.6531	66.2287	0.0000	0.0000	0.0000	0.0000	223.7388	440.8563	634.3079	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	199.8652	174.7702	181.8371	161.2803	156.1478	137.5263	131.7607	146.8823	148.5044	169.1019	180.5129	195.1667	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.5762	87.3366	86.7557	85.3533	82.9290	80.3000	80.3000	80.3000	80.3000	85.5852	87.0625	87.6676	(217)
Fuel for water heating, kWh/month	228.2187	200.1111	209.5968	188.9561	188.2911	171.2656	164.0855	182.9169	184.9370	197.5830	207.3372	222.6211	(219)

Water heating fuel used	2345.9200	(219)
Annual totals kWh/year		
Space heating fuel - main system	3052.6448	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	75.0000	(231)
Electricity for lighting (calculated in Appendix L)	340.5986	(232)
Total delivered energy for all uses	5814.1634	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3052.6448	0.2160	659.3713	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2345.9200	0.2160	506.7187	(264)
Space and water heating			1166.0900	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	340.5986	0.5190	176.7707	(268)
Total CO2, kg/m2/year			1381.7857	(272)
Emissions per m2 for space and water heating			15.1440	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2957	(272b)
Emissions per m2 for pumps and fans			0.5055	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.1440 * 1.00) + 2.2957 + 0.5055, rounded to 2 d.p.			17.9500	(273)