

Energy Statement for Planning

Client: N A Design

Site: 409 Wilbraham Road
Manchester
Chorlton

Proposals: The demolition of an existing building and the construction of a new three storey detached dwelling.

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Report Details:

Prepared by	Checked by	Date	Job	Revision
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1 Introduction

This report and accompanying Energy Statement has been prepared in support of the planning application for the demolition on an existing building and the construction of a new three storey detached dwelling.

National Planning Policy Framework 2021

The NPPF has been updated and meeting the challenge of climate change has taken a main focus of the new policy update. New developments should be planned and designed in ways to mitigate against climate change. With focus on locations of new developments, reduce emissions through use of location, orientation and design. Helping to increase the supply of renewable and low carbon energy sources.

Local Planning

Manchester District Council have asked for the principle of the Code for Sustainable Homes to be followed, as such a 19% CO2 reduction will need to be achieved.

Based on the above, the proposed dwelling will need to achieve a 19% saving in CO2 emissions through the provision of renewable technologies or low-carbon technology

This report demonstrates how the dwelling will meet current Building Regulation requirements for energy efficiency (baseline scenario) and, through an assessment of renewable technologies or lo-carbon technology, demonstrates how the dwelling can achieve the required 19% saving in CO2 emissions.

2 Existing and Proposed Development

The site is located on land to 409 Wilbraham Road in Chorlton. (See Figure 1).

As previously detailed, proposals are for the demolition of an existing building and the construction of a new three storey detached dwelling. (with a ground floor area of approximately 165m²) on the land at 409 Wilbraham Road.

The proposed dwelling will face in a northerly direction.

Given the scale and nature of the site (in particular the adjacent buildings situated in the surrounding area, the main road to the front and the football pitch to the rear), this constrains the development proposals in terms of the layout, positioning and orientation of the proposed dwelling. 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 dwelling will be provided off Wilbraham Road.

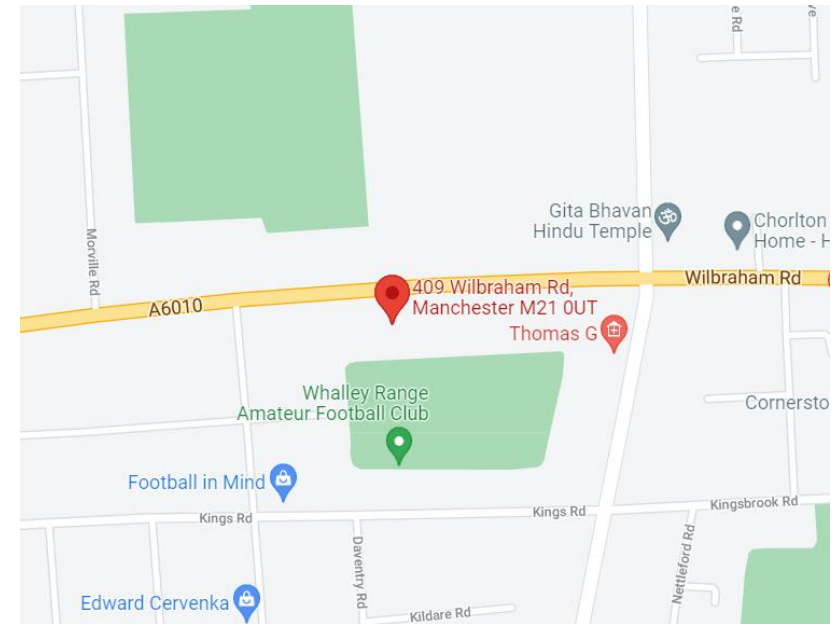


Figure 1: Site Location

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 L1A sets out the minimum energy efficiency requirements for **new dwellings** and is based on the SAP methodology.

To comply with Part L1A, the SAP calculation should demonstrate how the dwelling 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

Energy Plan

The council's energy policy requires an energy assessment for each planning application referable to the Council Core Strategy, setting out how the energy policies can feasibly be achieved within the development. Specifically, applicants are required to set out how the proposals apply the following energy hierarchy:

- Be lean: use less energy
- Be clean: supply energy efficiently
- Be green: use renewable energy

The hierarchy provides the mechanism through which the carbon dioxide (CO₂) emission reduction targets are achieved. It also contributes to the implementation of strategic energy policies relating to decentralised networks and ensures opportunities for building occupants to receive efficient, secure and affordable energy.

The following will report will follow the steps in line with this energy hierarchy, with minimising energy demand via fabric improvements, then use energy more efficiently and use heat recovery systems, then the final step is to use renewable technology.

4 Baseline Scenario (Part L1 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 CO₂ 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 CO₂ 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 SAP Calculation Results

	Target Emission Rate (TER) (kg CO₂/m²/year)	Floor Area (m²)	Total Baseline Emissions (kg CO₂/year)
01	12.3	389	4,781

The Baseline Target emission rate for dwelling assessed is shown to be 12.3 (kg CO₂/m²/year)

The total Baseline CO₂ emissions for the dwelling assessed is shown to be in total 4,781 kg/year.

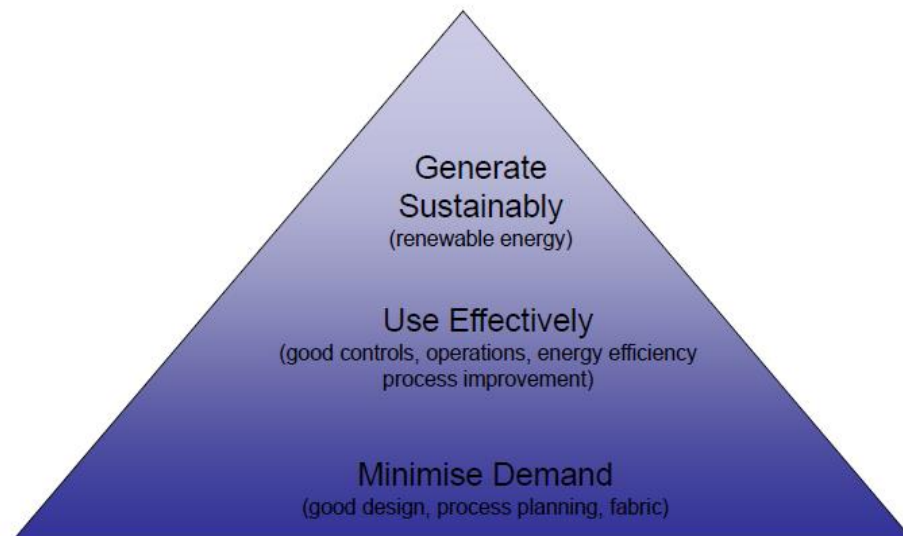
5 Be Lean Energy Efficiency Improvement Scenario

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 dwelling exceeds 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	0.18
Ground Floor	0.25	0.13	0.11
Roof	0.20	0.13	0.16
Windows	2.0	1.4	1.3
Air test	10	5	4
Ventilation	NA	Natural	Natural
Thermal Bridging	NA	0.05	0.05
Heating	88%	89% Gas combi	89.8% Gas system
Heating controls	NA	Time and temp zone, weather comp	Time and temp zone, delayed start thermostat
Lights	75%	100%	100%
Thermal mass	NA	Medium	Medium

- 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 m³/hm² (@50Pa) (noting that a DAP of 10 m³/hm² (@50Pa) or lower is the Part L1A minimum standard)
- Heating and Controls – 89.8% efficient ErP Class 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 2 (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 CO₂/m²/year)	12.2
Target Emission Rate (TER) (kg CO₂/m²/year)	12.3
DER/TER Variance	-1%
Total DER Baseline CO₂ Emissions (kg/year)	4,755
Total TER Baseline CO₂ Emissions (kg/year)	4,781

The Be Lean dwelling emission rate CO₂ emissions are shown to be on average 12.2 (kg CO₂/m²/year).

The total Be Lean CO₂ emissions for the dwelling is shown to be in total 4,755 kg/year.

Based on the Be Lean calculations, a 1% reduction in CO₂ emissions can feasibly be achieved solely through improving the fabrics elements and air tightness.

6 Renewable Technology Review

As previously detailed, in order to meet the requirements of code for sustainable homes, the proposed dwelling will need to achieve a 19% saving in CO2 emissions through the provision of on-site renewable technologies or low-carbon technology.

The baseline TER calculation indicates that the total CO2 emissions are 4,781 kg/year. As such, a 19% saving in CO2 emissions of 908 kg/year is to be provided through renewable technologies.

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 of existing properties with a main road to the front and a football pitch to the rear. The topography of the site is relatively flat. Wind turbine would cause noise issues to the neighbouring properties and are known to be visually unsightly.

Due to viability concerns for this type of site and location and close proximity of the existing properties, 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 and therefore such a system is deemed unsuitable for consideration in this development.

AIR SOURCE HEAT PUMP (ASHP)

ASHP systems absorb 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.

Plans indicate that there would be enough private space for the external condensing units. ASHPs are considered feasible for this development.

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 constant 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.

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.

There is no district heating in the current area, to allow for future connection to local heat networks that may arise in the area, provision should be made to enable the distribution system within the residential building to be linked directly into a heat main. This will need to be researched further on the feasibility of installing such a system.

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 southern orientation is feasible for the dwelling.

Based on the proposed layout of the dwelling, and that there is no significant over-shading, PV is considered a feasible solution in providing the 19% saving in CO2 emissions from the dwelling.

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 providing the 19% saving in CO2 emissions from the dwelling. 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 solutions to achieve the 19% reduction in CO2 emissions from the dwelling (when compared with the baseline scenario) would be ASHP, PV and solar thermal. All these solutions would work well, given the proposed layout of the dwelling and that there is no significant overshading.

The proposed dwelling will have a pitched roof with ample space for PV or solar thermal panels. The panels would need to be appropriately angled and situated in a south-westerly to south-easterly direction.

For the purpose of showing a 19% reduction in CO2 via a renewable technology over Part L1a 2013 using SAP 2012, we have chosen solar PV as the most suitable technology for this development. Solar thermal and an ASHP could also provide the 19% reduction; however, we have used PV as this currently reduces the CO2 emissions more than the Solar Thermal.

The calculations to demonstrate how solar PV can achieve the required 19% 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 dwelling can meet (or exceed) a 19% saving in CO₂ 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.

The front of the proposed dwelling will face in a northerly direction (and the rear of the building in a southerly direction), with a pitched roof area of roughly 20.0m².

A 2.1kWp PV system has been incorporated into the SAP calculation (at a 45° angle, facing in a southerly direction). Solar PV ranges from 0.25Watts to 0.35Watts per panel.

The baseline measures and u-values have been used as the basis for this section, only implementing solar PV to improve on the baseline scenario by 19%. These u-values and measures are reiterated below.

- Insulation - good levels of insulation with u-values exceeding Part L1A requirements (see Table 3)

Table 3: Fabric Standards (u-values W/m²K)

	Part L1A Limiting Parameters	Proposed Dwelling
Walls	0.30	0.18
Ground Floor	0.25	0.11
Roof	0.20	0.16
Windows	1.6	1.3
Air test	5.0	4.0
Heating	89% Gas boiler	89.8% Gas boiler

The results are summarised in Table 4 (with the baseline DER worksheet provided in Appendix C).

Table 4: SAP Calculation Results with PV – Be Green – SAP 2012 with gas baseline

	Be Green Results
Dwelling Emission Rate (DER) (kg CO ₂ /m ² /year)	9.8
Target Emission Rate (TER) (kg CO ₂ /m ² /year)	12.3
DER/TER Variance	-20%
Total DER Baseline CO ₂ Emissions (kg/year)	3,824
Total TER Baseline CO ₂ Emissions (kg/year)	4,781

A comparison of the baseline calculation results and the results of the calculation with 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)	12.3	12.2	9.8
Target Emission Rate (TER) (kg CO ₂ /m ² /year)	12.3	12.3	12.3
DER/TER Variance	N/A	-1%	-20%
Total DER Baseline CO ₂ Emissions (kg/year)	4,781	4,755	3,824
Total TER Baseline CO ₂ Emissions (kg/year)	4,781	4,781	4,781

As required by the local council a minimum 19% saving in CO₂ emissions is to be provided through energy efficient measures and through renewable technologies.

By including a PV system on the residential unit and applying the SAP 2012 carbon factors the total dwelling CO₂ emissions are shown to be 3,824 Kg/year.

This results in a 20% reduction in CO₂ emissions Kg/year and therefore exceeds the requirement for a 19% reduction in CO₂.

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

Table 6: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for domestic buildings

	Carbon dioxide emissions (Tonnes CO ₂ per annum)		
	Regulated	Un-Regulated	Total
Baseline: Building Regulations 2013 Part L Compliant Development	4.8	0	4.8
After energy efficiency measures reduction	4.8	0	4.8
After renewable energy system	3.8	0	3.8

Please note that savings are to be expressed in tonnes of CO₂ per annum, not kgCO₂/m² per annum.

Table 7 Regulated carbon dioxide savings from each stage of the Energy Hierarchy for domestic buildings

	Carbon dioxide savings (Tonnes CO2 per annum)		Carbon dioxide savings (%)	
	Regulated	Total	Regulated	Total
Savings from energy efficiency measures reduction	0	0	0%	1%
Savings from heat network/ CHP	-	-	0.00%	0
Savings from renewable energy system	0.9	0	0%	19%
Total Cumulative onsite Savings	1.0	0	0%	20%

8 Conclusion

There are proposals for the demolition of an existing building and the construction of a detached, three storey residential dwelling (with a ground floor area of approximately 165m²) on the land at 409 Wilbraham Road

Under the principle of the Code for Sustainable Homes the proposed dwelling will need to achieve a 19% saving in CO₂ emissions through the provision of renewable technologies.

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

A review of renewable technologies indicates that solar PV would be the most feasible solutions to meet the Core Strategy requirements, and this 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

- Solar PV 2.1kWp system
- 45° angle
- Facing in a southern direction
- No shading

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

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

SAP 2012 factors have been used to calculate both a baseline scenario (to meet Building Regulation requirements) and a scenario with PV (2.1kWp system per dwelling, 30° to 45° angle, facing in a southerly direction).

Through the incorporation of PV and a fabric first approach, this results in a 20% reduction in CO₂ emissions and therefore exceeds the requirement for a 19% reduction in CO₂ emissions.

Appendices

Appendix A DER Worksheet – Be Lean, With Energy Efficient Measures

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Property Reference	S9174 01				Issued on Date	11/01/2022
Assessment Reference	Be lean	Prop Type Ref				
Property	Wilbraham Road, M14					
SAP Rating	88 B	DER	12.23	TER	12.30	
Environmental	86 B	% DER<TER	0.54			
CO ₂ Emissions (t/year)	4.07	DFEE	43.83	TFEE	51.68	
General Requirements Compliance	Pass	% DFEE<TFEE	15.19			
Assessor Details	Mr. Peter Kinsella, Base Energy Services Ltd, Tel: 0151 933 0328, peter@baseenergy.co.uk				Assessor ID	L770-0002
Client						

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

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

DWELLING AS DESIGNED

Detached House, total floor area 389 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) 12.30 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 12.23 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)51.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)43.8 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.17 (max. 0.30)	0.18 (max. 0.70)	OK
Floor	0.11 (max. 0.25)	0.11 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.31 (max. 2.00)	1.40 (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 plus 415 VU 156/6-5 OVZ (H-GB)

Efficiency: 89.8% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation

Hot water storage Measured cylinder loss: 1.61 kWh/day
Permitted by DBSCG 2.56 OK
Primary pipework insulated: Yes OK

6 Controls

Space heating controls: Time and temperature zone control OK

Hot water controls:

Cylinderstat OK
Independent timer for DHW OK

Boiler interlock

Yes OK

7 Low energy lights

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

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (West Pennines (England)):Not significant OK

Based on:

Overshading: Average
Windows facing North: 20.74 m², No overhang
Windows facing East: 3.63 m², No overhang
Windows facing South: 21.82 m², No overhang
Windows facing West: 3.64 m², No overhang
Air change rate: 2.50 ach
Blinds/curtains: None

10 Key features

External wall U-value 0.12 W/m²K
Floor U-value 0.11 W/m²K

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	165.7200 (1b)	x 2.6200 (2b)	= 434.1864 (1b) - (3b)
First floor	130.6700 (1c)	x 2.6400 (2c)	= 344.9688 (1c) - (3c)
Second floor	92.4400 (1d)	x 2.0800 (2d)	= 192.2752 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	388.8300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 971.4304 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					7 * 10 = 70.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				70.0000 / (5) = 0.0721 (8)
Pressure test					Yes
Measured/design AP50					4.0000
Infiltration rate					0.2721 (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) =				0.2312 (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	0.2948	0.2891	0.2833	0.2544	0.2486	0.2197	0.2197	0.2139	0.2312	0.2486	0.2602	0.2717 (22b)
Effective ac	0.5435	0.5418	0.5401	0.5324	0.5309	0.5241	0.5241	0.5229	0.5267	0.5309	0.5338	0.5369 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Front door			9.4300	1.4000	13.2020		(26)
Window (Uw = 1.30)			49.8300	1.2357	61.5770		(27)
Roof light (Uw = 1.30)			12.2900	1.2357	15.1873		(27a)
Heat Loss Floor 1			165.7200	0.1100	18.2292		(28a)
Cavity wall	251.4800	49.2200	202.2600	0.1800	36.4068		(29a)
Front wall area	15.1200	10.0400	5.0800	0.1800	0.9144		(29a)
Stud wall	43.2700		43.2700	0.1200	5.1924		(29a)
Flat ceiling	55.7100	4.4600	51.2500	0.1600	8.2000		(30)
Pitched roof	155.5400	7.8300	147.7100	0.1600	23.6336		(30)
Total net area of external elements Aum(A, m ²)			686.8400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	182.5427		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							33.4844 (36)
Total fabric heat loss						(33) + (36) =	216.0271 (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	174.2201	173.6790	173.1487	170.6576	170.1915	168.0218	168.0218	167.6200	168.8576	170.1915	171.1344	172.1201 (38)
Heat transfer coeff	390.2472	389.7061	389.1757	386.6846	386.2186	384.0489	384.0489	383.6471	384.8846	386.2186	387.1614	388.1472 (39)
Average = Sum(39)m / 12 =												386.6824 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.0036	1.0023	1.0009	0.9945	0.9933	0.9877	0.9877	0.9867	0.9899	0.9933	0.9957	0.9982 (40)
HLP (average)												0.9945 (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												3.2474 (42)
Average daily hot water use (litres/day)												111.3260 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	122.4586	118.0055	113.5525	109.0994	104.6464	100.1934	100.1934	104.6464	109.0994	113.5525	118.0055	122.4586 (44)
Energy conte	181.6025	158.8307	163.8991	142.8912	137.1075	118.3133	109.6347	125.8074	127.3100	148.3675	161.9547	175.8723 (45)
Energy content (annual)										Total = Sum(45)m =		1751.5909 (45)
Distribution loss (46)m = 0.15 x (45)m												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

27.2404	23.8246	24.5849	21.4337	20.5661	17.7470	16.4452	18.8711	19.0965	22.2551	24.2932	26.3808 (46)
Water storage loss:											250.0000 (47)
Store volume											1.6100 (48)
a) If manufacturer declared loss factor is known (kWh/day):											0.5400 (49)
Temperature factor from Table 2b											0.8694 (55)
Enter (49) or (54) in (55)											
Total storage loss											
26.9514	24.3432	26.9514	26.0820	26.9514	26.0820	26.9514	26.9514	26.0820	26.9514	26.0820	26.9514 (56)
If cylinder contains dedicated solar storage											
26.9514	24.3432	26.9514	26.0820	26.9514	26.0820	26.9514	26.9514	26.0820	26.9514	26.0820	26.9514 (57)
23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month											
231.8163	204.1851	214.1129	191.4852	187.3213	166.9073	159.8485	176.0212	175.9040	198.5813	210.5487	226.0861 (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 (63)
Solar input (sum of months) = Sum(63)m =											0.0000 (63)
Output from w/h											
231.8163	204.1851	214.1129	191.4852	187.3213	166.9073	159.8485	176.0212	175.9040	198.5813	210.5487	226.0861 (64)
Heat gains from water heating, kWh/month											
100.5539	89.0947	94.6675	86.3865	85.7593	78.2144	76.6246	82.0020	81.2058	89.5032	92.7251	98.6486 (65)
Total per year (kWh/year) = Sum(64)m =											2342.8179 (64)

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
162.3705	162.3705	162.3705	162.3705	162.3705	162.3705	162.3705	162.3705	162.3705	162.3705	162.3705	162.3705 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5											
48.6357	43.1978	35.1308	26.5963	19.8810	16.7844	18.1362	23.5741	31.6411	40.1756	46.8908	49.9875 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5											
526.7769	532.2432	518.4684	489.1432	452.1256	417.3342	394.0914	388.6251	402.4000	431.7251	468.7427	503.5342 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5											
39.2370	39.2370	39.2370	39.2370	39.2370	39.2370	39.2370	39.2370	39.2370	39.2370	39.2370	39.2370 (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)											
-129.8964	-129.8964	-129.8964	-129.8964	-129.8964	-129.8964	-129.8964	-129.8964	-129.8964	-129.8964	-129.8964	-129.8964 (71)
Water heating gains (Table 5)											
135.1531	132.5814	127.2412	119.9813	115.2678	108.6311	102.9900	110.2178	112.7858	120.3000	128.7849	132.5922 (72)
Total internal gains											
785.2769	782.7337	755.5516	710.4320	661.9856	617.4608	589.9287	597.1280	621.5379	666.9118	719.1297	760.8250 (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					20.7400	10.6334		0.6300	0.7000		0.7700	67.3988 (74)	
East					3.6300	19.6403		0.6300	0.7000		0.7700	21.7884 (76)	
South					21.8200	46.7521		0.6300	0.7000		0.7700	311.7650 (78)	
West					3.6400	19.6403		0.6300	0.7000		0.7700	21.8484 (80)	
North					0.8200	15.2954		0.6300	0.7000		1.0000	4.9780 (82)	
East					2.4300	25.9287		0.6300	0.7000		1.0000	25.0074 (82)	
South					1.3400	34.8864		0.6300	0.7000		1.0000	21.0568 (82)	
West					3.2400	25.9287		0.6300	0.7000		1.0000	33.3432 (82)	
Horizontal					4.4600	26.0000		0.6300	0.7000		1.0000	46.0245 (82)	
Solar gains	553.2107	985.6405	1456.2985	1972.9291	2354.9480	2399.4209	2287.8744	1995.0054	1634.7807	1119.0928	670.6859	468.1166	(83)
Total gains	1338.4876	1768.3741	2211.8500	2683.3611	3016.9336	3016.8817	2877.8031	2592.1334	2256.3187	1786.0046	1389.8155	1228.9415	(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	69.1923	69.2883	69.3828	69.8297	69.9140	70.3090	70.3090	70.3826	70.1563	69.9140	69.7437	69.5666
alpha	5.6128	5.6192	5.6255	5.6553	5.6609	5.6873	5.6873	5.6922	5.6771	5.6609	5.6496	5.6378
util living area												
	0.9999	0.9994	0.9969	0.9812	0.9132	0.7516	0.5751	0.6544	0.9101	0.9943	0.9996	0.9999 (86)
MIT												
Th 2	19.9877	20.1126	20.3115	20.5705	20.7960	20.9167	20.9457	20.9395	20.8397	20.5341	20.2078	19.9659 (87)
util rest of house												
	20.0803	20.0815	20.0826	20.0879	20.0889	20.0936	20.0936	20.0945	20.0918	20.0889	20.0869	20.0848 (88)
0.9999												
MIT 2	0.9992	0.9957	0.9734	0.8784	0.6691	0.4630	0.5387	0.8594	0.9912	0.9995	0.9999 (89)	
Living area fraction	18.6955	18.8793	19.1708	19.5495	19.8575	19.9986	20.0210	20.0188	19.9213	19.5012	19.0230	18.6671 (90)
MIT	18.8015	18.9804	19.2644	19.6332	19.9345	20.0739	20.0969	20.0943	19.9967	19.5859	19.1202	18.7736 (92)
fLA = Living area / (4) =												
Temperature adjustment	18.8015	18.9804	19.2644	19.6332	19.9345	20.0739	20.0969	20.0943	19.9967	19.5859	19.1202	18.7736 (92)
adjusted MIT	18.6515	18.8304	19.1144	19.4832	19.7845	19.9239	19.9469	19.9443	19.8467	19.4359	18.9702	-0.1500
	18.6515	18.8304	19.1144	19.4832	19.7845	19.9239	19.9469	19.9443	19.8467	19.4359	18.9702	18.6236 (93)

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.9998	0.9988	0.9938	0.9663	0.8641	0.6519	0.4441	0.5181	0.8416	0.9876	0.9992	0.9998 (94)
Useful gains	1338.1572	1766.1895	2198.0770	2592.9912	2606.8492	1966.7512	1278.0599	1343.0994	1763.9209	1388.6874	1228.7557 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W											
5600.6333	5428.7680	4909.1999	4092.3615	3122.3826	2044.6429	1285.3589	1359.7504	2211.7991	3412.5831	4595.6881	5598.4904 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating kWh
3171.2822 2461.2528 2017.0755 1079.5466 383.5568 0.0000 0.0000 0.0000 0.0000 1226.6047 2309.0404 3251.0826 (98)
Space heating 15899.4418 (98)
Space heating per m2 (98) / (4) = 40.8905 (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)
Efficiency of main space heating system 1 (in %) 93.2000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 17059.4869 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	3171.2822	2461.2528	2017.0755	1079.5466	383.5568	0.0000	0.0000	0.0000	0.0000	1226.6047	2309.0404	3251.0826	(98)
Space heating efficiency (main heating system 1)	93.2000	93.2000	93.2000	93.2000	93.2000	0.0000	0.0000	0.0000	0.0000	93.2000	93.2000	93.2000	(210)
Space heating fuel (main heating system)	3402.6633	2640.8292	2164.2441	1158.3118	411.5417	0.0000	0.0000	0.0000	0.0000	1316.0995	2477.5112	3488.2861	(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 requirement	231.8163	204.1851	214.1129	191.4852	187.3213	166.9073	159.8485	176.0212	175.9040	198.5813	210.5487	226.0861	(64)
Efficiency of water heater (217)m	89.9812	89.8802	89.6508	89.0087	86.9871	80.1000	80.1000	80.1000	80.1000	89.1408	89.7976	90.0181	(216)
Fuel for water heating, kWh/month	257.6275	227.1746	238.8300	215.1308	215.3436	208.3737	199.5612	219.7518	219.6054	222.7726	234.4703	251.1562	(219)
Water heating fuel used													(219)
Annual totals kWh/year													
Space heating fuel - main system													17059.4869 (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)													858.9224 (232)
Total delivered energy for all uses													20703.2069 (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	17059.4869	0.2160	3684.8492	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2709.7977	0.2160	585.3163	(264)
Space and water heating			4270.1655	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	858.9224	0.5190	445.7807	(268)
Total CO2, kg/year			4754.8712	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			12.2300	(273)

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

	DER			
Total Floor Area		TFA	12.2300	ZC1
Assumed number of occupants		N	388.8300	
CO2 emission factor in Table 12 for electricity displaced from grid		EF	3.2474	
CO2 emissions from appliances, equation (L14)			0.5190	
CO2 emissions from cooking, equation (L16)			8.0281	ZC2
Total CO2 emissions			0.5065	ZC3
Residual CO2 emissions offset from biofuel CHP			20.7646	ZC4
Additional allowable electricity generation, kWh/m²/year			0.0000	ZC5
Resulting CO2 emissions offset from additional allowable electricity generation			0.0000	ZC6
Net CO2 emissions			0.0000	ZC7
			20.7646	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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	165.7200 (1b)	x 2.6200 (2b)	= 434.1864 (1b) - (3b)
First floor	130.6700 (1c)	x 2.6400 (2c)	= 344.9688 (1c) - (3c)
Second floor	92.4400 (1d)	x 2.0800 (2d)	= 192.2752 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	388.8300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 971.4304 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					Air changes per hour 40.0000 / (5) = 0.0412 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.2912 (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) =		0.2475 (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	0.3156	0.3094	0.3032	0.2722	0.2661	0.2351	0.2351	0.2289	0.2475	0.2661	0.2784	0.2908 (22b)
Effective ac	0.5498	0.5479	0.5460	0.5371	0.5354	0.5276	0.5276	0.5262	0.5306	0.5354	0.5388	0.5423 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Opaque door			9.4300	1.0000	9.4300		(26)
TER Opening Type (Uw = 1.40)			49.8300	1.3258	66.0625		(27)
TER Room Window (Uw = 1.70)			12.2900	1.5918	19.5627		(27a)
Heat Loss Floor 1			165.7200	0.1300	21.5436		(28a)
Cavity wall	251.4800	49.2200	202.2600	0.1800	36.4068		(29a)
Front wall area	15.1200	10.0400	5.0800	0.1800	0.9144		(29a)
Stud wall	43.2700		43.2700	0.1800	7.7886		(29a)
Flat ceiling	55.7100	4.4600	51.2500	0.1300	6.6625		(30)
Pitched roof	155.5400	7.8300	147.7100	0.1300	19.2023		(30)
Total net area of external elements Aum(A, m ²)			686.8400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	187.5734		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							31.6812 (36)
Total fabric heat loss						(33) + (36) =	219.2546 (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	176.2472	175.6274	175.0199	172.1664	171.6325	169.1472	169.1472	168.6870	170.1045	171.6325	172.7126	173.8417 (38)
Heat transfer coeff	395.5019	394.8821	394.2746	391.4211	390.8872	388.4019	388.4019	387.9416	389.3592	390.8872	391.9672	393.0963 (39)
Average = Sum(39)m / 12 =												391.4185 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.0172	1.0156	1.0140	1.0067	1.0053	0.9989	0.9989	0.9977	1.0014	1.0053	1.0081	1.0110 (40)
HLP (average)												1.0067 (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												3.2474 (42)
Average daily hot water use (litres/day)												111.3260 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	122.4586	118.0055	113.5525	109.0994	104.6464	100.1934	100.1934	104.6464	109.0994	113.5525	118.0055	122.4586 (44)
Energy conte	181.6025	158.8307	163.8991	142.8912	137.1075	118.3133	109.6347	125.8074	127.3100	148.3675	161.9547	175.8723 (45)
Energy content (annual)										Total = Sum(45)m =		1751.5909 (45)
Distribution loss (46)m = 0.15 x (45)m												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	27.2404	23.8246	24.5849	21.4337	20.5661	17.7470	16.4452	18.8711	19.0965	22.2551	24.2932	26.3808 (46)
Water storage loss:												
Store volume												250.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.8903 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.0208 (55)
Total storage loss												
	31.6444	28.5820	31.6444	30.6236	31.6444	30.6236	31.6444	31.6444	30.6236	31.6444	30.6236	31.6444 (56)
If cylinder contains dedicated solar storage												
	31.6444	28.5820	31.6444	30.6236	31.6444	30.6236	31.6444	31.6444	30.6236	31.6444	30.6236	31.6444 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month												
	236.5093	208.4239	218.8059	196.0268	192.0143	171.4489	164.5415	180.7142	180.4456	203.2743	215.0903	230.7791 (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)
Output from w/h								Solar input (sum of months) =	Sum (63)m =			0.0000 (63)
	236.5093	208.4239	218.8059	196.0268	192.0143	171.4489	164.5415	180.7142	180.4456	203.2743	215.0903	230.7791 (64)
Heat gains from water heating, kWh/month								Total per year (kWh/year) =	Sum (64)m =			2398.0741 (64)
	104.3083	92.4858	98.4219	90.0198	89.5137	81.8477	80.3790	85.7564	84.8390	93.2576	96.3584	102.4030 (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	162.3705	162.3705	162.3705	162.3705	162.3705	162.3705	162.3705	162.3705	162.3705	162.3705	162.3705	162.3705 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	48.6357	43.1978	35.1308	26.5963	19.8810	16.7844	18.1362	23.5741	31.6411	40.1756	46.8908	49.9875 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	526.7769	532.2432	518.4684	489.1432	452.1256	417.3342	394.0914	388.6251	402.4000	431.7251	468.7427	503.5342 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	39.2370	39.2370	39.2370	39.2370	39.2370	39.2370	39.2370	39.2370	39.2370	39.2370	39.2370	39.2370 (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)												
	-129.8964	-129.8964	-129.8964	-129.8964	-129.8964	-129.8964	-129.8964	-129.8964	-129.8964	-129.8964	-129.8964	-129.8964 (71)
Water heating gains (Table 5)												
	140.1993	137.6277	132.2875	125.0275	120.3141	113.6773	108.0362	115.2640	117.8320	125.3463	133.8311	137.6384 (72)
Total internal gains												
	790.3231	787.7799	760.5978	715.4782	667.0318	622.5070	594.9749	602.1742	626.5842	671.9581	724.1759	765.8712 (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					20.7400	10.6334		0.6300	0.7000	0.7700		67.3988 (74)
East					3.6300	19.6403		0.6300	0.7000	0.7700		21.7884 (76)
South					21.8200	46.7521		0.6300	0.7000	0.7700		311.7650 (78)
West					3.6400	19.6403		0.6300	0.7000	0.7700		21.8484 (80)
North					0.8200	15.2954		0.6300	0.7000	1.0000		4.9780 (82)
East					2.4300	25.9287		0.6300	0.7000	1.0000		25.0074 (82)
South					1.3400	34.8864		0.6300	0.7000	1.0000		21.0568 (82)
West					3.2400	25.9287		0.6300	0.7000	1.0000		33.3432 (82)
Horizontal					4.4600	26.0000		0.6300	0.7000	1.0000		46.0245 (82)

Solar gains	553.2107	985.6405	1456.2985	1972.9291	2354.9480	2399.4209	2287.8744	1995.0054	1634.7807	1119.0928	670.6859	468.1166 (83)
Total gains	1343.5338	1773.4204	2216.8963	2688.4073	3021.9798	3021.9279	2882.8493	2597.1796	2261.3649	1791.0508	1394.8618	1233.9878 (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	
68.2730	68.3801	68.4855	68.9847	69.0790	69.5210	69.5210	69.6035	69.3501	69.0790	68.8886	68.6908	
alpha	5.5515	5.5587	5.5657	5.5990	5.6053	5.6347	5.6402	5.6233	5.6053	5.5926	5.5794	
util living area	0.9999	0.9994	0.9969	0.9814	0.9150	0.7557	0.5797	0.6589	0.9117	0.9943	0.9996	0.9999 (86)
MIT	19.6977	19.8647	20.1314	20.4797	20.7842	20.9498	20.9906	20.9818	20.8449	20.4333	19.9948	19.6692 (87)
Th 2	20.0691	20.0704	20.0717	20.0778	20.0789	20.0843	20.0843	20.0852	20.0822	20.0789	20.0766	20.0742 (88)
util rest of house	0.9998	0.9992	0.9956	0.9737	0.8806	0.6727	0.4659	0.5418	0.8613	0.9911	0.9995	0.9999 (89)
MIT 2	18.2950	18.5406	18.9313	19.4394	19.8558	20.0489	20.0805	20.0770	19.9435	19.3777	18.7358	18.2572 (90)
Living area fraction									fLA = Living area / (4) =			0.0820 (91)
MIT	18.4101	18.6492	19.0297	19.5247	19.9319	20.1228	20.1552	20.1512	20.0174	19.4643	18.8390	18.3730 (92)
Temperature adjustment												0.0000
adjusted MIT	18.4101	18.6492	19.0297	19.5247	19.9319	20.1228	20.1552	20.1512	20.0174	19.4643	18.8390	18.3730 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9997	0.9987	0.9936	0.9674	0.8739	0.6765	0.4750	0.5507	0.8568	0.9879	0.9991	0.9998 (94)
Useful gains	1343.1576	1771.0424	2202.6887	2600.8589	2640.9438	2044.4739	1369.3849	1430.3334	1937.6072	1769.3569	1393.6345	1233.7739 (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												
	5580.5619	5429.2979	4940.1516	4158.7360	3217.7462	2145.0646	1380.8398	1455.2551	2303.9913	3464.9253	4601.3125	5571.3474 (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)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Space heating kWh
 3152.6288 2458.3477 2036.6724 1121.6715 429.1410 0.0000 0.0000 0.0000 0.0000 1261.5029 2309.5281 3227.1547 (98)
 Space heating 15996.6471 (98)
 Space heating per m2 (98) / (4) = 41.1405 (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)
 Efficiency of main space heating system 1 (in %) 93.5000 (206)
 Efficiency of secondary/supplementary heating system, % 0.0000 (208)
 Space heating requirement 17108.7135 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	3152.6288	2458.3477	2036.6724	1121.6715	429.1410	0.0000	0.0000	0.0000	0.0000	1261.5029	2309.5281	3227.1547	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)	3371.7955	2629.2489	2178.2592	1199.6487	458.9744	0.0000	0.0000	0.0000	0.0000	1349.2009	2470.0836	3451.5023	(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 requirement	236.5093	208.4239	218.8059	196.0268	192.0143	171.4489	164.5415	180.7142	180.4456	203.2743	215.0903	230.7791	(64)
Efficiency of water heater (217)m	89.6610	89.5614	89.3379	88.7301	86.8982	79.8000	79.8000	79.8000	79.8000	88.8468	89.4778	89.6973	(216)
Fuel for water heating, kWh/month	263.7816	232.7162	244.9194	220.9248	220.9647	214.8483	206.1923	226.4589	226.1223	228.7920	240.3839	257.2865	(219)
Water heating fuel used												2783.3909	(219)
Annual totals kWh/year													
Space heating fuel - main system												17108.7135	(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)												858.9224	(232)
Total delivered energy for all uses												20826.0268	(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	17108.7135	0.2160	3695.4821	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2783.3909	0.2160	601.2124	(264)
Space and water heating			4296.6945	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	858.9224	0.5190	445.7807	(268)
Total CO2, kg/m2/year			4781.4003	(272)
Emissions per m2 for space and water heating			11.0503	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			1.1465	(272b)
Emissions per m2 for pumps and fans			0.1001	(272c)
Target Carbon Dioxide Emission Rate (TER) = (11.0503 * 1.00) + 1.1465 + 0.1001, rounded to 2 d.p.			12.3000	(273)

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

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Property Reference	S9174 01				Issued on Date	11/01/2022
Assessment Reference	Be green	Prop Type Ref				
Property	Wilbraham Road, M14					
SAP Rating	91 B	DER	9.83	TER	12.30	
Environmental	89 B	% DER<TER	20.06			
CO ₂ Emissions (t/year)	3.20	DFEE	43.83	TFEE	51.68	
General Requirements Compliance	Pass	% DFEE<TFEE	15.19			
Assessor Details	Mr. Peter Kinsella, Base Energy Services Ltd, Tel: 0151 933 0328, peter@baseenergy.co.uk				Assessor ID	L770-0002
Client						

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

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

DWELLING AS DESIGNED

Detached House, total floor area 389 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) 12.30 kgCO₂/m²

Dwelling Carbon Dioxide Emission Rate (DER) 9.83 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)51.7 kWh/m²/yr

Dwelling Fabric Energy Efficiency (DFEE)43.8 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.17 (max. 0.30)	0.18 (max. 0.70)	OK
Floor	0.11 (max. 0.25)	0.11 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.31 (max. 2.00)	1.40 (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 plus 415 VU 156/6-5 OVZ (H-GB)

Efficiency: 89.8% SEDBUK2009

Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation

Hot water storage Measured cylinder loss: 1.61 kWh/day

Permitted by DBSCG 2.56 OK

Primary pipework insulated: Yes OK

6 Controls

Space heating controls: Time and temperature zone control OK

Hot water controls:

Cylinderstat OK

Independent timer for DHW OK

Boiler interlock

Yes OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings:100%

Minimum 75% OK

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (West Pennines (England)):Not significant OK

Based on:

Overshading: Average

Windows facing North: 20.74 m², No overhang

Windows facing East: 3.63 m², No overhang

Windows facing South: 21.82 m², No overhang

Windows facing West: 3.64 m², No overhang

Air change rate: 2.50 ach

Blinds/curtains: None

10 Key features

External wall U-value 0.12 W/m²K

Floor U-value 0.11 W/m²K

Photovoltaic array 2.10 kW

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	165.7200 (1b)	x 2.6200 (2b)	= 434.1864 (1b) - (3b)
First floor	130.6700 (1c)	x 2.6400 (2c)	= 344.9688 (1c) - (3c)
Second floor	92.4400 (1d)	x 2.0800 (2d)	= 192.2752 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	388.8300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 971.4304 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					7 * 10 = 70.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				70.0000 / (5) = 0.0721 (8)
Pressure test					Yes
Measured/design AP50					4.0000
Infiltration rate					0.2721 (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) =				0.2312 (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	0.2948	0.2891	0.2833	0.2544	0.2486	0.2197	0.2197	0.2139	0.2312	0.2486	0.2602	0.2717 (22b)
Effective ac	0.5435	0.5418	0.5401	0.5324	0.5309	0.5241	0.5241	0.5229	0.5267	0.5309	0.5338	0.5369 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Front door			9.4300	1.4000	13.2020		(26)
Window (Uw = 1.30)			49.8300	1.2357	61.5770		(27)
Roof light (Uw = 1.30)			12.2900	1.2357	15.1873		(27a)
Heat Loss Floor 1			165.7200	0.1100	18.2292		(28a)
Cavity wall	251.4800	49.2200	202.2600	0.1800	36.4068		(29a)
Front wall area	15.1200	10.0400	5.0800	0.1800	0.9144		(29a)
Stud wall	43.2700		43.2700	0.1200	5.1924		(29a)
Flat ceiling	55.7100	4.4600	51.2500	0.1600	8.2000		(30)
Pitched roof	155.5400	7.8300	147.7100	0.1600	23.6336		(30)
Total net area of external elements Aum(A, m ²)				686.8400			(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	182.5427		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							33.4844 (36)
Total fabric heat loss							(33) + (36) = 216.0271 (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	174.2201	173.6790	173.1487	170.6576	170.1915	168.0218	168.0218	167.6200	168.8576	170.1915	171.1344	172.1201 (38)
Heat transfer coeff	390.2472	389.7061	389.1757	386.6846	386.2186	384.0489	384.0489	383.6471	384.8846	386.2186	387.1614	388.1472 (39)
Average = Sum(39)m / 12 =												386.6824 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.0036	1.0023	1.0009	0.9945	0.9933	0.9877	0.9877	0.9867	0.9899	0.9933	0.9957	0.9982 (40)
HLP (average)												0.9945 (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												3.2474 (42)
Average daily hot water use (litres/day)												111.3260 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	122.4586	118.0055	113.5525	109.0994	104.6464	100.1934	100.1934	104.6464	109.0994	113.5525	118.0055	122.4586 (44)
Energy conte	181.6025	158.8307	163.8991	142.8912	137.1075	118.3133	109.6347	125.8074	127.3100	148.3675	161.9547	175.8723 (45)
Energy content (annual)												Total = Sum(45)m = 1751.5909 (45)
Distribution loss (46)m = 0.15 x (45)m												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

27.2404	23.8246	24.5849	21.4337	20.5661	17.7470	16.4452	18.8711	19.0965	22.2551	24.2932	26.3808 (46)
Water storage loss:											250.0000 (47)
Store volume											1.6100 (48)
a) If manufacturer declared loss factor is known (kWh/day):											0.5400 (49)
Temperature factor from Table 2b											0.8694 (55)
Enter (49) or (54) in (55)											
Total storage loss											
26.9514	24.3432	26.9514	26.0820	26.9514	26.0820	26.9514	26.9514	26.0820	26.9514	26.0820	26.9514 (56)
If cylinder contains dedicated solar storage											
26.9514	24.3432	26.9514	26.0820	26.9514	26.0820	26.9514	26.9514	26.0820	26.9514	26.0820	26.9514 (57)
23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month											
231.8163	204.1851	214.1129	191.4852	187.3213	166.9073	159.8485	176.0212	175.9040	198.5813	210.5487	226.0861 (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 (63)
Solar input (sum of months) = Sum(63)m =											0.0000 (63)
Output from w/h											
231.8163	204.1851	214.1129	191.4852	187.3213	166.9073	159.8485	176.0212	175.9040	198.5813	210.5487	226.0861 (64)
Heat gains from water heating, kWh/month											
100.5539	89.0947	94.6675	86.3865	85.7593	78.2144	76.6246	82.0020	81.2058	89.5032	92.7251	98.6486 (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
162.3705	162.3705	162.3705	162.3705	162.3705	162.3705	162.3705	162.3705	162.3705	162.3705	162.3705	162.3705 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5											
48.6357	43.1978	35.1308	26.5963	19.8810	16.7844	18.1362	23.5741	31.6411	40.1756	46.8908	49.9875 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5											
526.7769	532.2432	518.4684	489.1432	452.1256	417.3342	394.0914	388.6251	402.4000	431.7251	468.7427	503.5342 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5											
39.2370	39.2370	39.2370	39.2370	39.2370	39.2370	39.2370	39.2370	39.2370	39.2370	39.2370	39.2370 (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)											
-129.8964	-129.8964	-129.8964	-129.8964	-129.8964	-129.8964	-129.8964	-129.8964	-129.8964	-129.8964	-129.8964	-129.8964 (71)
Water heating gains (Table 5)											
135.1531	132.5814	127.2412	119.9813	115.2678	108.6311	102.9900	110.2178	112.7858	120.3000	128.7849	132.5922 (72)
Total internal gains											
785.2769	782.7337	755.5516	710.4320	661.9856	617.4608	589.9287	597.1280	621.5379	666.9118	719.1297	760.8250 (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					20.7400	10.6334		0.6300	0.7000		0.7700	67.3988 (74)	
East					3.6300	19.6403		0.6300	0.7000		0.7700	21.7884 (76)	
South					21.8200	46.7521		0.6300	0.7000		0.7700	311.7650 (78)	
West					3.6400	19.6403		0.6300	0.7000		0.7700	21.8484 (80)	
North					0.8200	15.2954		0.6300	0.7000		1.0000	4.9780 (82)	
East					2.4300	25.9287		0.6300	0.7000		1.0000	25.0074 (82)	
South					1.3400	34.8864		0.6300	0.7000		1.0000	21.0568 (82)	
West					3.2400	25.9287		0.6300	0.7000		1.0000	33.3432 (82)	
Horizontal					4.4600	26.0000		0.6300	0.7000		1.0000	46.0245 (82)	
Solar gains	553.2107	985.6405	1456.2985	1972.9291	2354.9480	2399.4209	2287.8744	1995.0054	1634.7807	1119.0928	670.6859	468.1166	(83)
Total gains	1338.4876	1768.3741	2211.8500	2683.3611	3016.9336	3016.8817	2877.8031	2592.1334	2256.3187	1786.0046	1389.8155	1228.9415	(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	69.1923	69.2883	69.3828	69.8297	69.9140	70.3090	70.3090	70.3826	70.1563	69.9140	69.7437	69.5666	
alpha	5.6128	5.6192	5.6255	5.6553	5.6609	5.6873	5.6873	5.6922	5.6771	5.6609	5.6496	5.6378	
util living area													
	0.9999	0.9994	0.9969	0.9812	0.9132	0.7516	0.5751	0.6544	0.9101	0.9943	0.9996	0.9999 (86)	
MIT													
Th 2	19.9877	20.1126	20.3115	20.5705	20.7960	20.9167	20.9457	20.9395	20.8397	20.5341	20.2078	19.9659 (87)	
util rest of house													
	20.0803	20.0815	20.0826	20.0879	20.0889	20.0936	20.0936	20.0945	20.0918	20.0889	20.0869	20.0848 (88)	
0.9999													
MIT 2	0.9992	0.9957	0.9734	0.8784	0.6691	0.4630	0.5387	0.8594	0.9912	0.9995	0.9999 (89)		
Living area fraction	18.6955	18.8793	19.1708	19.5495	19.8575	19.9986	20.0210	20.0188	19.9213	19.5012	19.0230	18.6671 (90)	
MIT	18.8015	18.9804	19.2644	19.6332	19.9345	20.0739	20.0969	20.0943	fLA = Living area / (4) =	19.9967	19.5859	19.1202	0.0820 (91)
Temperature adjustment	18.8015	18.9804	19.2644	19.6332	19.9345	20.0739	20.0969	20.0943	19.9967	19.5859	19.1202	18.7736 (92)	
adjusted MIT	18.6515	18.8304	19.1144	19.4832	19.7845	19.9239	19.9469	19.9443	19.8467	19.4359	18.9702	-0.1500	
	18.6515	18.8304	19.1144	19.4832	19.7845	19.9239	19.9469	19.9443	19.8467	19.4359	18.9702	18.6236 (93)	

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.9998	0.9988	0.9938	0.9663	0.8641	0.6519	0.4441	0.5181	0.8416	0.9876	0.9992	0.9998 (94)
Useful gains	1338.1572	1766.1895	2198.0770	2592.9912	2606.8492	1966.7512	1278.0599	1343.0994	1763.9209	1388.6874	1228.7557 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W											
5600.6333	5428.7680	4909.1999	4092.3615	3122.3826	2044.6429	1285.3589	1359.7504	2211.7991	3412.5831	4595.6881	5598.4904 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating kWh
3171.2822 2461.2528 2017.0755 1079.5466 383.5568 0.0000 0.0000 0.0000 0.0000 1226.6047 2309.0404 3251.0826 (98)
Space heating
15899.4418 (98)
Space heating per m2 (98) / (4) = 40.8905 (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)
Efficiency of main space heating system 1 (in %) 93.2000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 17059.4869 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	3171.2822	2461.2528	2017.0755	1079.5466	383.5568	0.0000	0.0000	0.0000	0.0000	1226.6047	2309.0404	3251.0826	(98)
Space heating efficiency (main heating system 1)	93.2000	93.2000	93.2000	93.2000	93.2000	0.0000	0.0000	0.0000	0.0000	93.2000	93.2000	93.2000	(210)
Space heating fuel (main heating system)	3402.6633	2640.8292	2164.2441	1158.3118	411.5417	0.0000	0.0000	0.0000	0.0000	1316.0995	2477.5112	3488.2861	(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 requirement	231.8163	204.1851	214.1129	191.4852	187.3213	166.9073	159.8485	176.0212	175.9040	198.5813	210.5487	226.0861	(64)
Efficiency of water heater (217)m	89.9812	89.8802	89.6508	89.0087	86.9871	80.1000	80.1000	80.1000	80.1000	89.1408	89.7976	90.0181	(216)
Fuel for water heating, kWh/month	257.6275	227.1746	238.8300	215.1308	215.3436	208.3737	199.5612	219.7518	219.6054	222.7726	234.4703	251.1562	(219)
Water heating fuel used													(219)
Annual totals kWh/year													
Space heating fuel - main system													17059.4869 (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)													858.9224 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.10 * 1068 * 1.00) =										-1794.3584			-1794.3584 (233)
Total delivered energy for all uses													18908.8485 (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	17059.4869	0.2160	3684.8492	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2709.7977	0.2160	585.3163	(264)
Space and water heating			4270.1655	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	858.9224	0.5190	445.7807	(268)
Energy saving/generation technologies				
PV Unit	-1794.3584	0.5190	-931.2720	(269)
Total CO2, kg/year			3823.5992	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			9.8300	(273)

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

	TFA	N	EF	
DER				9.8300 ZC1
Total Floor Area	388.8300			
Assumed number of occupants	3.2474			
CO2 emission factor in Table 12 for electricity displaced from grid	0.5190			
CO2 emissions from appliances, equation (L14)	8.0281			ZC2
CO2 emissions from cooking, equation (L16)	0.5065			ZC3
Total CO2 emissions	18.3646			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	18.3646			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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	165.7200 (1b)	x 2.6200 (2b)	= 434.1864 (1b) - (3b)
First floor	130.6700 (1c)	x 2.6400 (2c)	= 344.9688 (1c) - (3c)
Second floor	92.4400 (1d)	x 2.0800 (2d)	= 192.2752 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	388.8300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 971.4304 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					Air changes per hour 40.0000 / (5) = 0.0412 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.2912 (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) =		0.2475 (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	0.3156	0.3094	0.3032	0.2722	0.2661	0.2351	0.2351	0.2289	0.2475	0.2661	0.2784	0.2908 (22b)
Effective ac	0.5498	0.5479	0.5460	0.5371	0.5354	0.5276	0.5276	0.5262	0.5306	0.5354	0.5388	0.5423 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Opaque door			9.4300	1.0000	9.4300		(26)
TER Opening Type (Uw = 1.40)			49.8300	1.3258	66.0625		(27)
TER Room Window (Uw = 1.70)			12.2900	1.5918	19.5627		(27a)
Heat Loss Floor 1			165.7200	0.1300	21.5436		(28a)
Cavity wall	251.4800	49.2200	202.2600	0.1800	36.4068		(29a)
Front wall area	15.1200	10.0400	5.0800	0.1800	0.9144		(29a)
Stud wall	43.2700		43.2700	0.1800	7.7886		(29a)
Flat ceiling	55.7100	4.4600	51.2500	0.1300	6.6625		(30)
Pitched roof	155.5400	7.8300	147.7100	0.1300	19.2023		(30)
Total net area of external elements Aum(A, m ²)			686.8400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	187.5734		(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K		250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		31.6812 (36)
Total fabric heat loss	(33) + (36) =	219.2546 (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	176.2472	175.6274	175.0199	172.1664	171.6325	169.1472	169.1472	168.6870	170.1045	171.6325	172.7126	173.8417 (38)
Heat transfer coeff	395.5019	394.8821	394.2746	391.4211	390.8872	388.4019	388.4019	387.9416	389.3592	390.8872	391.9672	393.0963 (39)
Average = Sum(39)m / 12 =												391.4185 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.0172	1.0156	1.0140	1.0067	1.0053	0.9989	0.9989	0.9977	1.0014	1.0053	1.0081	1.0110 (40)
HLP (average)												1.0067 (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		3.2474 (42)
Average daily hot water use (litres/day)		111.3260 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	122.4586	118.0055	113.5525	109.0994	104.6464	100.1934	100.1934	104.6464	109.0994	113.5525	118.0055	122.4586 (44)
Energy conte	181.6025	158.8307	163.8991	142.8912	137.1075	118.3133	109.6347	125.8074	127.3100	148.3675	161.9547	175.8723 (45)
Energy content (annual)										Total = Sum(45)m =		1751.5909 (45)
Distribution loss (46)m = 0.15 x (45)m												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	27.2404	23.8246	24.5849	21.4337	20.5661	17.7470	16.4452	18.8711	19.0965	22.2551	24.2932	26.3808 (46)
Water storage loss:												
Store volume												250.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.8903 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.0208 (55)
Total storage loss												
	31.6444	28.5820	31.6444	30.6236	31.6444	30.6236	31.6444	31.6444	30.6236	31.6444	30.6236	31.6444 (56)
If cylinder contains dedicated solar storage												
	31.6444	28.5820	31.6444	30.6236	31.6444	30.6236	31.6444	31.6444	30.6236	31.6444	30.6236	31.6444 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month												
	236.5093	208.4239	218.8059	196.0268	192.0143	171.4489	164.5415	180.7142	180.4456	203.2743	215.0903	230.7791 (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)
Output from w/h								Solar input (sum of months) =	Sum (63)m =			0.0000 (63)
	236.5093	208.4239	218.8059	196.0268	192.0143	171.4489	164.5415	180.7142	180.4456	203.2743	215.0903	230.7791 (64)
								Total per year (kWh/year) =	Sum (64)m =			2398.0741 (64)
Heat gains from water heating, kWh/month												
	104.3083	92.4858	98.4219	90.0198	89.5137	81.8477	80.3790	85.7564	84.8390	93.2576	96.3584	102.4030 (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	162.3705	162.3705	162.3705	162.3705	162.3705	162.3705	162.3705	162.3705	162.3705	162.3705	162.3705	162.3705 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	48.6357	43.1978	35.1308	26.5963	19.8810	16.7844	18.1362	23.5741	31.6411	40.1756	46.8908	49.9875 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	526.7769	532.2432	518.4684	489.1432	452.1256	417.3342	394.0914	388.6251	402.4000	431.7251	468.7427	503.5342 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	39.2370	39.2370	39.2370	39.2370	39.2370	39.2370	39.2370	39.2370	39.2370	39.2370	39.2370	39.2370 (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)												
	-129.8964	-129.8964	-129.8964	-129.8964	-129.8964	-129.8964	-129.8964	-129.8964	-129.8964	-129.8964	-129.8964	-129.8964 (71)
Water heating gains (Table 5)												
	140.1993	137.6277	132.2875	125.0275	120.3141	113.6773	108.0362	115.2640	117.8320	125.3463	133.8311	137.6384 (72)
Total internal gains												
	790.3231	787.7799	760.5978	715.4782	667.0318	622.5070	594.9749	602.1742	626.5842	671.9581	724.1759	765.8712 (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					20.7400	10.6334		0.6300	0.7000	0.7700		67.3988 (74)
East					3.6300	19.6403		0.6300	0.7000	0.7700		21.7884 (76)
South					21.8200	46.7521		0.6300	0.7000	0.7700		311.7650 (78)
West					3.6400	19.6403		0.6300	0.7000	0.7700		21.8484 (80)
North					0.8200	15.2954		0.6300	0.7000	1.0000		4.9780 (82)
East					2.4300	25.9287		0.6300	0.7000	1.0000		25.0074 (82)
South					1.3400	34.8864		0.6300	0.7000	1.0000		21.0568 (82)
West					3.2400	25.9287		0.6300	0.7000	1.0000		33.3432 (82)
Horizontal					4.4600	26.0000		0.6300	0.7000	1.0000		46.0245 (82)

Solar gains	553.2107	985.6405	1456.2985	1972.9291	2354.9480	2399.4209	2287.8744	1995.0054	1634.7807	1119.0928	670.6859	468.1166 (83)
Total gains	1343.5338	1773.4204	2216.8963	2688.4073	3021.9798	3021.9279	2882.8493	2597.1796	2261.3649	1791.0508	1394.8618	1233.9878 (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	
68.2730	68.3801	68.4855	68.9847	69.0790	69.5210	69.5210	69.6035	69.3501	69.0790	68.8886	68.6908	
alpha	5.5515	5.5587	5.5657	5.5990	5.6053	5.6347	5.6402	5.6233	5.6053	5.5926	5.5794	
util living area	0.9999	0.9994	0.9969	0.9814	0.9150	0.7557	0.5797	0.6589	0.9117	0.9943	0.9996	0.9999 (86)
MIT	19.6977	19.8647	20.1314	20.4797	20.7842	20.9498	20.9906	20.9818	20.8449	20.4333	19.9948	19.6692 (87)
Th 2	20.0691	20.0704	20.0717	20.0778	20.0789	20.0843	20.0843	20.0852	20.0822	20.0789	20.0766	20.0742 (88)
util rest of house	0.9998	0.9992	0.9956	0.9737	0.8806	0.6727	0.4659	0.5418	0.8613	0.9911	0.9995	0.9999 (89)
MIT 2	18.2950	18.5406	18.9313	19.4394	19.8558	20.0489	20.0805	20.0770	19.9435	19.3777	18.7358	18.2572 (90)
Living area fraction									fLA = Living area / (4) =			0.0820 (91)
MIT	18.4101	18.6492	19.0297	19.5247	19.9319	20.1228	20.1552	20.1512	20.0174	19.4643	18.8390	18.3730 (92)
Temperature adjustment												0.0000
adjusted MIT	18.4101	18.6492	19.0297	19.5247	19.9319	20.1228	20.1552	20.1512	20.0174	19.4643	18.8390	18.3730 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9997	0.9987	0.9936	0.9674	0.8739	0.6765	0.4750	0.5507	0.8568	0.9879	0.9991	0.9998 (94)
Useful gains	1343.1576	1771.0424	2202.6887	2600.8589	2640.9438	2044.4739	1369.3849	1430.3334	1937.6072	1769.3569	1393.6345	1233.7739 (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												
	5580.5619	5429.2979	4940.1516	4158.7360	3217.7462	2145.0646	1380.8398	1455.2551	2303.9913	3464.9253	4601.3125	5571.3474 (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)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Space heating kWh
 3152.6288 2458.3477 2036.6724 1121.6715 429.1410 0.0000 0.0000 0.0000 0.0000 1261.5029 2309.5281 3227.1547 (98)
 Space heating 15996.6471 (98)
 Space heating per m2 (98) / (4) = 41.1405 (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)
 Efficiency of main space heating system 1 (in %) 93.5000 (206)
 Efficiency of secondary/supplementary heating system, % 0.0000 (208)
 Space heating requirement 17108.7135 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	3152.6288	2458.3477	2036.6724	1121.6715	429.1410	0.0000	0.0000	0.0000	0.0000	1261.5029	2309.5281	3227.1547 (98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000 (210)
Space heating fuel (main heating system)	3371.7955	2629.2489	2178.2592	1199.6487	458.9744	0.0000	0.0000	0.0000	0.0000	1349.2009	2470.0836	3451.5023 (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 requirement	236.5093	208.4239	218.8059	196.0268	192.0143	171.4489	164.5415	180.7142	180.4456	203.2743	215.0903	230.7791 (64)
Efficiency of water heater (217)m	89.6610	89.5614	89.3379	88.7301	86.8982	79.8000	79.8000	79.8000	79.8000	88.8468	89.4778	79.8000 (216)
Fuel for water heating, kWh/month	263.7816	232.7162	244.9194	220.9248	220.9647	214.8483	206.1923	226.4589	226.1223	228.7920	240.3839	257.2865 (219)
Water heating fuel used												2783.3909 (219)
Annual totals kWh/year												
Space heating fuel - main system												17108.7135 (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)												858.9224 (232)
Total delivered energy for all uses												20826.0268 (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	17108.7135	0.2160	3695.4821 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2783.3909	0.2160	601.2124 (264)
Space and water heating			4296.6945 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	858.9224	0.5190	445.7807 (268)
Total CO2, kg/m2/year			4781.4003 (272)
Emissions per m2 for space and water heating			11.0503 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			1.1465 (272b)
Emissions per m2 for pumps and fans			0.1001 (272c)
Target Carbon Dioxide Emission Rate (TER) = (11.0503 * 1.00) + 1.1465 + 0.1001, rounded to 2 d.p.			12.3000 (273)