

Energy Statement for Planning

Client: Level 2 Architects

Site: Moss Green Close,
Huyton,
L36

Proposals: The construction of 10 new build dwellings

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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 have been prepared in support of the construction of 10 new build dwellings at Moss Green Close, Huyton, L36.

Knowsley Council Local Plan Core Strategy (Policy CS22: Sustainable and Low Carbon Development) states:

New development will be required to meet high standards of sustainable design and construction and reduce carbon emissions. This should be achieved by Designing new buildings for flexible uses throughout their lifetime, Making the most effective and sustainable use of water, aggregates and other resources and Limiting energy use by incorporating high standards of insulation, heat retention, natural ventilation and passive solar techniques which has been applied to this project.

Government targets for carbon reduction in new development are expected to be implemented through updates to the Building Regulations.

Based on the above, there is not a specific percentage target the proposed dwellings will need to achieve. As such, this report demonstrates how the dwellings will meet current Building Regulation requirements for energy efficiency (baseline scenario) and, through an assessment of energy efficiency measures through a fabric first approach, how the dwellings could potentially achieve a greater saving in CO2 emissions. This report has been based on SAP 2012 and Part L1a 2013.

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

In order to comply with the Knowsley Council Local Plan Core Strategy (Policy CS22), an energy assessment for each planning application referable to the Core Strategy, setting out how the energy policies will be met 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 L1A Compliance; No Renewable Technologies)

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 CO ₂ /m ² /year)	Floor Area (m ²)	Total Baseline Emissions (kg CO ₂ /year)
House 1	18.73	85.2	1,596
House 2	18.73	85.2	1,596
House 3	18.73	85.2	1,596
House 4	18.73	85.2	1,596
House 5	18.54	85.2	1,580
House 6	18.47	85.2	1,574
House 7	18.02	85.2	1,535
House 8	18.01	85.2	1,535
House 9	18.02	85.2	1,535
House 10	18.01	85.2	1,535

Table 2: Baseline Area Weighted Average

	Calculation
Weighted Average Target Emission Rate (kg CO ₂ /m ² /year)	18.40
Total floor area of units	852
Total Projected Baseline Emissions (kg CO ₂ /year)	15,676

The Baseline Target emission rate for the dwellings assessed on average is shown to be 18.40 (kg CO₂/m²/year).

The total Baseline CO₂ emissions for the dwellings assessed on average is shown to be 15,676 kg/year and this is to be used as the basis for the assessment.

5 Energy Efficiency Improvement Scenario (Part L1A Compliance)

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.

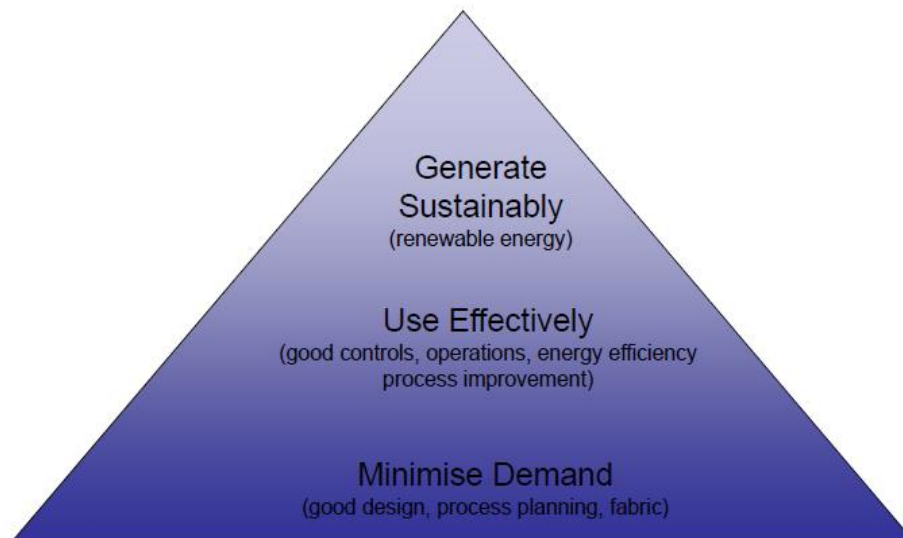


Table 3: Fabric Standards (u-values W/m²K)

	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	0.11
Windows	2.0	1.4	1.4
Air test	10	5	4
Ventilation	NA	Natural	Natural
Thermal Bridging	NA	0.05	ACD 0.05
Heating	88%	89% Gas combi	89% Gas combi
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 – Natural with extract fans only, 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% efficient 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 2 (with the DER worksheet provided in Appendix B).

Table 4: Energy Efficient SAP Calculation Results – Be Lean

	Target Emission Rate (TER) (kg CO ₂ /m ² /year)	Dwelling Emission Rate (DER) (kg CO ₂ /m ² /year)	DER/TER Variance
House 1	18.73	18.62	0.59%
House 2	18.73	18.62	0.59%
House 3	18.73	18.62	0.59%
House 4	18.73	18.62	0.59%
House 5	18.54	18.42	0.65%
House 6	18.47	18.34	0.70%
House 7	18.02	17.87	0.83%
House 8	18.01	17.87	0.78%
House 9	18.02	17.87	0.83%
House 10	18.01	17.87	0.78%

Table 5: Be Lean Energy Efficient Area Weighted Average

	Be Lean Calculation
Dwelling Emission Rate (DER) (kg CO ₂ /m ² /year)	18.27
Target Emission Rate (TER) (kg CO ₂ /m ² /year)	18.40
DER/TER Variance	0.69%
Total TER Baseline CO ₂ Emissions (kg/year)	15,676
Total DER CO ₂ Emissions (kg/year)	15,568

The average dwelling emission rate CO2 emissions for the fabric first approach is shown to be on average 18.27(kg CO2/m²/year).

The total CO2 emissions for the fabric first approach is shown to be in total 15,568 kg/year.

Based on improving the fabric elements as above, this results in a potential 0.69% reduction in CO2 emissions Kg/year over Building Regulations Part L1a 2013 using SAP 2012.

It is understood that the above fabric first approach is the desired approach, however if a further reduction in CO2 emissions is required by Knowsley Council, there is an option outlined below to include a WWHR system.

6 Renewable Technology Review

As previously detailed, in order to meet the requirements of the Knowsley Council Local Plan Core Strategy (Policy CS22: Sustainable and Low Carbon Development), the proposed dwellings will be required to meet high standards of sustainable design and construction and reduce carbon emissions. We have reviewed the potential for low or zero carbon technologies for the development.

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 mostly residential properties in close proximity. The topography of the site is relatively flat. Wind turbines would cause noise issues to the neighbouring properties within this development 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 and the trees surrounding the site, 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. Also, the inclusion of plant rooms would limit the space on site. The need for in depth design analysis to assess geology and thermal dynamics would be costly and not guarantee feasibility. Such a system would be costly and make the scheme unviable. 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. Therefore, such a system is not deemed suitable 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 potentially be enough private space for the external condensing units. However, such a system may require a re-working of scheme and layout in order to accommodate plant rooms and infrastructure. An air source heat pump does make some noise when operating, as both a fan and a compressor will be in motion. The proximity of the neighbouring dwellings mean that noise nuisance could be an issue and as other technologies which avoid this pitfall are available. Although there are more products with low noise being developed.

ASHPs are considered feasible and however more appropriate technologies would be more suitable 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 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 are no existing or proposed heat networks / energy centres within a moderate radius from the development and there are no existing networks local to the site.

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 all units. However the south west face of the dwellings would be the front of the houses and this could cause issues with the aesthetics to the development and further consultation would be required.

Based on the proposed layout of the dwellings, and that there is no significant over-shading, PV is considered a feasible solution.

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. Solar PV provides a greater reduction in CO2 emissions compared to Solar Thermal based on the current SAP 2012.

7 Heat Recovery Option (if required) Part L1A Compliance; with SWHR

As is mentioned above in section 5 of the report, a fabric first approach is the desired approach. However, if Knowsley Council require a further reduction in CO₂ emissions, the calculations have been re-run with a Shower Heat Recover System (SWHR).

SWHR transfers heat from discharged waste shower water into the incoming water supply. This heat is used to warm the incoming mains water, reducing the strain on the boiler and the energy required to heat your water up to temperature.

The SWHR has been added to the Be Lean assessment to demonstrate a further reduction in CO₂ emissions through the incorporation of on-site renewable energy. This scenario is outlined below.

Table 6: 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	0.11
Windows	2.0	1.4	1.4
Air test	10	5	4
Ventilation	NA	Natural	Natural
Thermal Bridging	NA	0.05	ACD 0.05
Heating	88%	89% Gas combi	89% Gas combi
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 4)

- 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 – Natural with extract fans only, 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% efficient Combi Boiler (Vaillant ecoTEC plus 837 VUW GB 376/5-5) with time and temperature zone control and a delayed start thermostat
- SWHR system present for all houses - Power-pipe, R4-84 for houses (63.7% efficient)
- 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 SAP calculation; the results are summarised in Table 7 (with the DER worksheet provided in Appendix C).

Table 7: Energy Efficient SAP Calculation Results – Be Lean with SWHR

	Target Emission Rate (TER) (kg CO ₂ /m ² /year)	Dwelling Emission Rate (DER) (kg CO ₂ /m ² /year)	DER/TER Variance
House 1	18.73	17.32	7.53%
House 2	18.73	17.32	7.53%
House 3	18.73	17.32	7.53%
House 4	18.73	17.32	7.53%
House 5	18.54	17.12	7.66%
House 6	18.47	17.04	7.74%
House 7	18.02	16.57	8.05%
House 8	18.01	16.57	8.00%
House 9	18.02	16.57	8.05%
House 10	18.01	16.57	8.00%

Table 8: Be Lean with SWHR Energy Efficient Area Weighted Average

	Be Lean Calculation
Dwelling Emission Rate (DER) (kg CO ₂ /m ² /year)	16.97
Target Emission Rate (TER) (kg CO ₂ /m ² /year)	18.40
DER/TER Variance	7.76%
Total TER Baseline CO ₂ Emissions (kg/year)	15,676
Total DER CO ₂ Emissions (kg/year)	14,460

Based on the Be Lean with SWHR calculations, a 7.76% reduction in CO₂ emissions can feasibly be achieved by improving the fabrics elements and installing a SWHR system for all dwellings.

8 Conclusion

There are proposals for the construction of 10 new build dwellings at Moss Green Close, Huyton, L36.

Under the Knowsley Council Local Plan Core Strategy (Policy CS22: Sustainable and Low Carbon Development), the proposed dwellings will be required to meet high standards of sustainable design and construction and reduce carbon emissions. However, there is no specific target from the council, therefore best efforts will be made to improve the energy efficiency of the dwellings where feasible.

Given the scale and nature of the site there are some site constraints to the development proposals in terms of the layout, positioning and orientation of the proposed dwelling.

We have reviewed various renewable technologies for the site, however it is at the aspiration of the client to provide a fabric first development. We have shown that a fabric first approach can meet high standards of sustainable design and construction and reduce carbon emissions and this is also the preferred option for the client.

As such, we will opt for a fabric first approach to achieve a reduction in CO2 emissions for this development and the following measures that will be implemented have been summarised below.

The following Be Lean approach has been used in the Energy Statement:

- Low fabric u-values
- High air tightness (air test of 4)
- Efficient boiler with advanced heating controls

This results in a potential 0.69% reduction in CO2 emissions Kg/year over Part L1a 2013 using SAP 2012 which is just over Building Regulations and helps contribute to Policy CS22 of the Knowsley Council Local Plan Core Strategy; *the proposed dwellings will be required to meet high standards of sustainable design and construction and reduce carbon emissions.*

However, if the fabric first approach is not approved by Knowsley Council, then there is the option to include SWHR to all dwellings. With the SWHR incorporated into the development, the overall reduction in CO2 emissions will be 7.76% over Part L1a 2013.

Appendices

Appendix A TER Worksheet - Baseline Scenario

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Property Reference	ES 8634 House 10			Issued on Date	06/08/2021
Assessment Reference	Be Lean	Prop Type Ref			
Property	House 10, Moss Green Close, , Huyton, L36				
SAP Rating	84 B	DER	17.87	TER	18.01
Environmental	86 B	% DER<TER	0.77		
CO ₂ Emissions (t/year)	1.29	DFEE	45.92	TFEE	50.39
General Requirements Compliance	Pass	% DFEE<TFEE	8.88		
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

Semi-Detached House, total floor area 85 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) 18.01 kgCO₂/m²

Dwelling Carbon Dioxide Emission Rate (DER) 17.87 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 50.4 kWh/m²/yr

Dwelling Fabric Energy Efficiency (DFEE) 45.9 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (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	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.46 (max. 2.00)	1.80 (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 837 VUW GB 376/5-5

Combi boiler

Efficiency: 89.3% 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: 4.00 m², No overhang

Windows facing South: 8.18 m², No overhang

Air change rate: 2.50 ach

Blinds/curtains: None

10 Key features

Party wall U-value 0.00 W/m²K

Roof U-value 0.11 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	42.6000 (1b)	x 2.6000 (2b)	= 110.7600 (1b) - (3b)
First floor	42.6000 (1c)	x 2.6000 (2c)	= 110.7600 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	85.2000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.5200 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 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					3 * 10 = 30.0000 (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) =				30.0000 / (5) = 0.1354 (8)
Pressure test					Yes
Measured/design AP50					4.0000
Infiltration rate					0.3354 (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) =				0.2851 (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	0.3635	0.3564	0.3493	0.3136	0.3065	0.2709	0.2709	0.2637	0.2851	0.3065	0.3208	0.3350 (22b)
Effective ac	0.5661	0.5635	0.5610	0.5492	0.5470	0.5367	0.5367	0.5348	0.5406	0.5470	0.5514	0.5561 (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
D			2.1000	1.8000	3.7800		(26)
W (Uw = 1.40)			12.1800	1.3258	16.1477		(27)
Heat Loss Floor			42.6000	0.1100	4.6860		(28a)
External Wall	96.2000	14.2800	81.9200	0.1800	14.7456		(29a)
Roof Joists	42.6000		42.6000	0.1100	4.6860		(30)
Total net area of external elements Aum(A, m ²)			181.4000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	44.0453		(33)
Party Wall			44.2000	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							13.8490 (36)
Total fabric heat loss						(33) + (36) =	57.8943 (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	41.3809	41.1933	41.0095	40.1460	39.9844	39.2323	39.2323	39.0930	39.5220	39.9844	40.3112	40.6529 (38)
Heat transfer coeff	99.2752	99.0876	98.9038	98.0403	97.8787	97.1266	97.1266	96.9874	97.4163	97.8787	98.2056	98.5473 (39)
Average = Sum(39)m / 12 =												98.0395 (39)
HLP	1.1652	1.1630	1.1608	1.1507	1.1488	1.1400	1.1400	1.1383	1.1434	1.1488	1.1526	1.1567 (40)
HLP (average)												1.1507 (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												2.5542 (42)
Average daily hot water use (litres/day)												94.8614 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	104.3475	100.5530	96.7586	92.9641	89.1697	85.3752	85.3752	89.1697	92.9641	96.7586	100.5530	104.3475 (44)
Energy content (annual)	154.7443	135.3404	139.6591	121.7582	116.8299	100.8153	93.4202	107.2011	108.4814	126.4246	138.0024	149.8616 (45)
Distribution loss (46)m = 0.15 x (45)m	23.2116	20.3011	20.9489	18.2637	17.5245	15.1223	14.0130	16.0802	16.2722	18.9637	20.7004	22.4792 (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)

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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	0.0000 (57)
Combi loss	31.9550	28.8493	31.8961	30.8145	31.8033	30.7331	31.7300	31.7775	30.7774	31.8577	30.8889	31.9403	(61)
Total heat required for water heating calculated for each month	186.6993	164.1896	171.5553	152.5727	148.6332	131.5485	125.1502	138.9786	139.2588	158.2823	168.8913	181.8019	(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	186.6993	164.1896	171.5553	152.5727	148.6332	131.5485	125.1502	138.9786	139.2588	158.2823	168.8913	181.8019	(64)
Heat gains from water heating, kWh/month	59.4412	52.2130	54.4107	48.1882	46.7968	41.2044	38.9947	43.5887	43.7644	50.0006	53.6080	57.8141	(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	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.8950	19.4469	15.8153	11.9732	8.9501	7.5561	8.1646	10.6127	14.2443	18.0864	21.1095	22.5035	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	229.9650	232.3513	226.3378	213.5359	197.3758	182.1876	172.0409	169.6546	175.6681	188.4700	204.6301	219.8183	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708	(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)	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	(71)
Water heating gains (Table 5)	79.8941	77.6979	73.1327	66.9281	62.8989	57.2283	52.4123	58.5870	60.7839	67.2051	74.4556	77.7071	(72)
Total internal gains	396.0665	393.8086	379.5983	356.7497	333.5373	311.2844	296.9302	303.1667	315.0087	338.0739	364.5076	384.3413	(73)

6. Solar gains

[Jan]												Gains
					Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		W
North					4.0000	10.6334		0.6300	0.7000	0.7700		12.9988
South					8.1800	46.7521		0.6300	0.7000	0.7700		116.8762 (74)
Solar gains	129.8750	216.2544	286.0378	343.3792	378.5042	374.1383	361.3091	334.6531	305.4573	236.0273	154.5738	111.8282 (83)
Total gains	525.9415	610.0630	665.6361	700.1289	712.0415	685.4227	658.2393	637.8199	620.4660	574.1013	519.0814	496.1696 (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	59.5986	59.7114	59.8224	60.3493	60.4490	60.9170	60.9170	61.0045	60.7359	60.4490	60.2478	60.0389	
alpha	4.9732	4.9808	4.9882	5.0233	5.0299	5.0611	5.0611	5.0670	5.0491	5.0299	5.0165	5.0026	
util living area	0.9977	0.9948	0.9882	0.9698	0.9181	0.7917	0.6216	0.6607	0.8662	0.9747	0.9951	0.9983	(86)
MIT	19.7544	19.9131	20.1460	20.4408	20.7171	20.9128	20.9799	20.9727	20.8513	20.4947	20.0651	19.7226	(87)
Th 2	19.9479	19.9497	19.9515	19.9596	19.9612	19.9683	19.9683	19.9696	19.9656	19.9612	19.9581	19.9548	(88)
util rest of house	0.9970	0.9931	0.9840	0.9576	0.8824	0.7044	0.4896	0.5313	0.7985	0.9622	0.9932	0.9977	(89)
MIT 2	18.2911	18.5236	18.8631	19.2916	19.6700	19.9059	19.9605	19.9578	19.8428	19.3736	18.7523	18.2495	(90)
Living area fraction	18.8029	19.0096	19.3118	19.6935	20.0362	20.2581	20.3170	20.3127	20.1955	19.7657	19.2115	18.7647	(92)
Temperature adjustment	18.6529	18.8596	19.1618	19.5435	19.8862	20.1081	20.1670	20.1627	20.0455	19.6157	19.0615	18.6147	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	523.6006	604.2385	651.9969	666.0106	626.0654	491.8798	339.9481	355.3927	499.2793	549.1529	514.2300	494.4926	(94)
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	1424.8846	1383.2243	1252.3009	1043.4959	801.2594	534.9785	346.4548	364.9381	579.1919	882.4451	1174.6848	1420.5330	(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	670.5553	523.4785	446.6262	271.7894	130.3444	0.0000	0.0000	0.0000	0.0000	247.9694	475.5275	688.9741	(98)
Space heating												3455.2647	(98)
Space heating per m2												40.5547	(99)

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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 %)													90.2000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3830.6704 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	670.5553	523.4785	446.6262	271.7894	130.3444	0.0000	0.0000	0.0000	0.0000	247.9694	475.5275	688.9741	(98)
Space heating efficiency (main heating system 1)	90.2000	90.2000	90.2000	90.2000	90.2000	0.0000	0.0000	0.0000	0.0000	90.2000	90.2000	90.2000	(210)
Space heating fuel (main heating system)	743.4095	580.3531	495.1510	301.3186	144.5059	0.0000	0.0000	0.0000	0.0000	274.9106	527.1923	763.8293	(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	186.6993	164.1896	171.5553	152.5727	148.6332	131.5485	125.1502	138.9786	139.2588	158.2823	168.8913	181.8019	(64)
Efficiency of water heater (217)m	89.4832	89.4148	89.2886	89.0227	88.4664	87.0000	87.0000	87.0000	87.0000	88.9256	89.3388	87.0000	(216)
Fuel for water heating, kWh/month	208.6418	183.6270	192.1357	171.3862	168.0109	151.2051	143.8508	159.7455	160.0676	177.9940	189.0458	203.1021	(219)
Water heating fuel used												2108.8127	(219)
Annual totals kWh/year													
Space heating fuel - main system												3830.6704	(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)												386.6725	(232)
Total delivered energy for all uses												6401.1556	(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	3830.6704	0.2160	827.4248 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2108.8127	0.2160	455.5035 (264)
Space and water heating			1282.9283 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	386.6725	0.5190	200.6830 (268)
Total CO2, kg/year			1522.5364 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.8700 (273)

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

DER			17.8700 ZC1
Total Floor Area	TFA		85.2000
Assumed number of occupants	N		2.5542
CO2 emission factor in Table 12 for electricity displaced from grid	EF		0.5190
CO2 emissions from appliances, equation (L14)			15.9944 ZC2
CO2 emissions from cooking, equation (L16)			2.1162 ZC3
Total CO2 emissions			35.9806 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			35.9806 ZC8

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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	42.6000 (1b)	x 2.6000 (2b)	= 110.7600 (1b) - (3b)
First floor	42.6000 (1c)	x 2.6000 (2c)	= 110.7600 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	85.2000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.5200 (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					3 * 10 = 30.0000 (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) =					30.0000 / (5) = 0.1354 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3854 (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) =	0.3276 (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	0.4177	0.4095	0.4013	0.3604	0.3522	0.3112	0.3112	0.3030	0.3276	0.3522	0.3686	0.3849 (22b)
Effective ac	0.5872	0.5839	0.5805	0.5649	0.5620	0.5484	0.5484	0.5459	0.5537	0.5620	0.5679	0.5741 (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			2.1000	1.0000	2.1000		(26)
TER Opening Type (Uw = 1.40)			12.1800	1.3258	16.1477		(27)
Heat Loss Floor			42.6000	0.1300	5.5380		(28a)
External Wall	96.2000	14.2800	81.9200	0.1800	14.7456		(29a)
Roof Joists	42.6000		42.6000	0.1300	5.5380		(30)
Total net area of external elements Aum(A, m ²)			181.4000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	44.0693		(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.4200 (36)
Total fabric heat loss (33) + (36) = 53.4893 (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	42.9282	42.6805	42.4378	41.2977	41.0843	40.0913	40.0913	39.9074	40.4738	41.0843	41.5159	41.9670 (38)
Heat transfer coeff	96.4175	96.1699	95.9271	94.7870	94.5737	93.5807	93.5807	93.3968	93.9632	94.5737	95.0052	95.4564 (39)
Average = Sum(39)m / 12 =												94.7860 (39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.1317	1.1288	1.1259	1.1125	1.1100	1.0984	1.0984	1.0962	1.1029	1.1100	1.1151	1.1204 (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												2.5542 (42)
Average daily hot water use (litres/day)												94.8614 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	104.3475	100.5530	96.7586	92.9641	89.1697	85.3752	85.3752	89.1697	92.9641	96.7586	100.5530	104.3475 (44)
Energy conte	154.7443	135.3404	139.6591	121.7582	116.8299	100.8153	93.4202	107.2011	108.4814	126.4246	138.0024	149.8616 (45)
Energy content (annual)										Total = Sum(45)m =		1492.5386 (45)
Distribution loss (46)m = 0.15 x (45)m												
Water storage loss:	23.2116	20.3011	20.9489	18.2637	17.5245	15.1223	14.0130	16.0802	16.2722	18.9637	20.7004	22.4792 (46)
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												

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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	0.0000 (57)
Total heat required for water heating calculated for each month	50.9589	46.0274	49.3071	45.8453	45.4399	42.1029	43.5063	45.4399	45.8453	49.3071	49.3151	50.9589	(61)
Solar input	205.7032	181.3678	188.9663	167.6036	162.2698	142.9182	136.9265	152.6410	154.3267	175.7317	187.3174	200.8205	(62)
Output from w/h	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)
Heat gains from water heating, kWh/month	205.7032	181.3678	188.9663	167.6036	162.2698	142.9182	136.9265	152.6410	154.3267	175.7317	187.3174	200.8205	(64)
	64.1922	56.5075	58.7634	51.9459	50.2059	44.0468	41.9388	47.0043	47.5314	54.3630	58.2145	62.5687	(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	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.8950	19.4469	15.8153	11.9732	8.9501	7.5561	8.1646	10.6127	14.2443	18.0864	21.1095	22.5035	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	229.9650	232.3513	226.3378	213.5359	197.3758	182.1876	172.0409	169.6546	175.6681	188.4700	204.6301	219.8183	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708	(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)	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	(71)
Water heating gains (Table 5)	86.2799	84.0886	78.9831	72.1471	67.4811	61.1761	56.3694	63.1779	66.0158	73.0685	80.8535	84.0977	(72)
Total internal gains	402.4523	400.1992	385.4487	361.9687	338.1195	315.2322	300.8873	307.7576	320.2406	343.9373	370.9055	390.7320	(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	4.0000				10.6334	0.6300	0.7000	0.7700	12.9988 (74)			
South	8.1800				46.7521	0.6300	0.7000	0.7700	116.8762 (78)			
Solar gains	129.8750	216.2544	286.0378	343.3792	378.5042	374.1383	361.3091	334.6531	305.4573	236.0273	154.5738	111.8282 (83)
Total gains	532.3272	616.4537	671.4866	705.3480	716.6237	689.3705	662.1964	642.4107	625.6979	579.9646	525.4793	502.5602 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (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	61.3651	61.5231	61.6788	62.4207	62.5615	63.2253	63.2253	63.3498	62.9679	62.5615	62.2773	61.9830	
alpha	5.0910	5.1015	5.1119	5.1614	5.1708	5.2150	5.2150	5.2233	5.1979	5.1708	5.1518	5.1322	
util living area	0.9976	0.9945	0.9874	0.9670	0.9105	0.7749	0.6010	0.6393	0.8532	0.9722	0.9948	0.9982	(86)
MIT	19.8065	19.9650	20.1940	20.4841	20.7479	20.9279	20.9847	20.9789	20.8727	20.5339	20.1149	19.7787	(87)
Th 2	19.9751	19.9774	19.9797	19.9906	19.9927	20.0022	20.0022	20.0039	19.9985	19.9927	19.9885	19.9842	(88)
util rest of house	0.9968	0.9926	0.9828	0.9541	0.8733	0.6879	0.4753	0.5153	0.7839	0.9587	0.9927	0.9976	(89)
MIT 2	18.3864	18.6191	18.9531	19.3757	19.7349	19.9512	19.9962	19.9948	19.8946	19.4523	18.8465	18.3523	(90)
Living area fraction	18.8831	19.0899	19.3871	19.7634	20.0892	20.2928	20.3419	20.3390	20.2367	19.8306	19.2902	18.8512	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8831	19.0899	19.3871	19.7634	20.0892	20.2928	20.3419	20.3390	20.2367	19.8306	19.2902	18.8512	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	529.9656	610.5424	657.6073	670.4300	628.7721	493.2084	344.1068	359.0681	502.1597	554.4227	520.5450	500.8720	(94)
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	1406.0656	1364.6374	1236.2237	1029.7090	793.3997	532.7362	350.1716	367.8928	576.6262	872.9734	1158.1282	1398.5507	(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	651.8184	506.7519	430.4907	258.6809	122.4829	0.0000	0.0000	0.0000	0.0000	237.0017	459.0599	667.8729	(98)
Space heating												3334.1592	(98)
Space heating per m2												39.1333	(99)

8c. Space cooling requirement

Not applicable

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

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 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 %)													93.4000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3569.7636 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	651.8184	506.7519	430.4907	258.6809	122.4829	0.0000	0.0000	0.0000	0.0000	237.0017	459.0599	667.8729	(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)	697.8783	542.5609	460.9108	276.9602	131.1380	0.0000	0.0000	0.0000	0.0000	253.7492	491.4988	715.0674	(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	205.7032	181.3678	188.9663	167.6036	162.2698	142.9182	136.9265	152.6410	154.3267	175.7317	187.3174	200.8205	(64)
Efficiency of water heater (217)m	87.7523	87.4993	87.0596	86.1401	84.3538	80.3000	80.3000	80.3000	80.3000	85.8049	87.2208	87.8457	(217)
Fuel for water heating, kWh/month	234.4134	207.2792	217.0539	194.5708	192.3681	177.9803	170.5187	190.0884	192.1877	204.8039	214.7623	228.6059	(219)
Water heating fuel used												2424.6325	(219)
Annual totals kWh/year													
Space heating fuel - main system												3569.7636	(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)												386.6725	(232)
Total delivered energy for all uses												6456.0687	(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	3569.7636	0.2160	771.0689 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2424.6325	0.2160	523.7206 (264)
Space and water heating			1294.7896 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	386.6725	0.5190	200.6830 (268)
Total CO2, kg/m2/year			1534.3976 (272)
Emissions per m2 for space and water heating			15.1971 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.3554 (272b)
Emissions per m2 for pumps and fans			0.4569 (272c)
Target Carbon Dioxide Emission Rate (TER) = (15.1971 * 1.00) + 2.3554 + 0.4569, rounded to 2 d.p.			18.0100 (273)

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

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Property Reference	ES 8634 House 10			Issued on Date	06/08/2021
Assessment Reference	Be Lean	Prop Type Ref			
Property	House 10, Moss Green Close, , Huyton, L36				
SAP Rating	84 B	DER	17.87	TER	18.01
Environmental	86 B	% DER<TER	0.77		
CO ₂ Emissions (t/year)	1.29	DFEE	45.92	TFEE	50.39
General Requirements Compliance	Pass	% DFEE<TFEE	8.88		
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

Semi-Detached House, total floor area 85 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) 18.01 kgCO₂/m²

Dwelling Carbon Dioxide Emission Rate (DER) 17.87 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 50.4 kWh/m²/yr

Dwelling Fabric Energy Efficiency (DFEE) 45.9 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (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	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.46 (max. 2.00)	1.80 (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 837 VUW GB 376/5-5

Combi boiler

Efficiency: 89.3% 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: 4.00 m², No overhang

Windows facing South: 8.18 m², No overhang

Air change rate: 2.50 ach

Blinds/curtains: None

10 Key features

Party wall U-value 0.00 W/m²K

Roof U-value 0.11 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	42.6000 (1b)	x 2.6000 (2b)	= 110.7600 (1b) - (3b)
First floor	42.6000 (1c)	x 2.6000 (2c)	= 110.7600 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	85.2000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.5200 (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					3 * 10 = 30.0000 (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) =				30.0000 / (5) = 0.1354 (8)
Pressure test					Yes
Measured/design AP50					4.0000
Infiltration rate					0.3354 (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) =				0.2851 (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	0.3635	0.3564	0.3493	0.3136	0.3065	0.2709	0.2709	0.2637	0.2851	0.3065	0.3208	0.3350 (22b)
Effective ac	0.5661	0.5635	0.5610	0.5492	0.5470	0.5367	0.5367	0.5348	0.5406	0.5470	0.5514	0.5561 (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
D			2.1000	1.8000	3.7800		(26)
W (Uw = 1.40)			12.1800	1.3258	16.1477		(27)
Heat Loss Floor			42.6000	0.1100	4.6860		(28a)
External Wall	96.2000	14.2800	81.9200	0.1800	14.7456		(29a)
Roof Joists	42.6000		42.6000	0.1100	4.6860		(30)
Total net area of external elements Aum(A, m ²)			181.4000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	44.0453		(33)
Party Wall			44.2000	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							13.8490 (36)
Total fabric heat loss						(33) + (36) =	57.8943 (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	41.3809	41.1933	41.0095	40.1460	39.9844	39.2323	39.2323	39.0930	39.5220	39.9844	40.3112	40.6529 (38)
Heat transfer coeff	99.2752	99.0876	98.9038	98.0403	97.8787	97.1266	97.1266	96.9874	97.4163	97.8787	98.2056	98.5473 (39)
Average = Sum(39)m / 12 =												98.0395 (39)
HLP	1.1652	1.1630	1.1608	1.1507	1.1488	1.1400	1.1400	1.1383	1.1434	1.1488	1.1526	1.1567 (40)
HLP (average)												1.1507 (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												2.5542 (42)
Average daily hot water use (litres/day)												94.8614 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	104.3475	100.5530	96.7586	92.9641	89.1697	85.3752	85.3752	89.1697	92.9641	96.7586	100.5530	104.3475 (44)
Energy content (annual)	154.7443	135.3404	139.6591	121.7582	116.8299	100.8153	93.4202	107.2011	108.4814	126.4246	138.0024	149.8616 (45)
Distribution loss (46)m = 0.15 x (45)m	23.2116	20.3011	20.9489	18.2637	17.5245	15.1223	14.0130	16.0802	16.2722	18.9637	20.7004	22.4792 (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)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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	31.9550	28.8493	31.8961	30.8145	31.8033	30.7331	31.7300	31.7775	30.7774	31.8577	30.8889	31.9403 (61)
Total heat required for water heating calculated for each month	186.6993	164.1896	171.5553	152.5727	148.6332	131.5485	125.1502	138.9786	139.2588	158.2823	168.8913	181.8019 (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	186.6993	164.1896	171.5553	152.5727	148.6332	131.5485	125.1502	138.9786	139.2588	158.2823	168.8913	181.8019 (64)
Heat gains from water heating, kWh/month	59.4412	52.2130	54.4107	48.1882	46.7968	41.2044	38.9947	43.5887	43.7644	50.0006	53.6080	57.8141 (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	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.8950	19.4469	15.8153	11.9732	8.9501	7.5561	8.1646	10.6127	14.2443	18.0864	21.1095	22.5035 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	229.9650	232.3513	226.3378	213.5359	197.3758	182.1876	172.0409	169.6546	175.6681	188.4700	204.6301	219.8183 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708 (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)	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665 (71)
Water heating gains (Table 5)	79.8941	77.6979	73.1327	66.9281	62.8989	57.2283	52.4123	58.5870	60.7839	67.2051	74.4556	77.7071 (72)
Total internal gains	396.0665	393.8086	379.5983	356.7497	333.5373	311.2844	296.9302	303.1667	315.0087	338.0739	364.5076	384.3413 (73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2		g	FF Specific data or Table 6b		Specific data or Table 6c		Access factor Table 6d		Gains W
North					4.0000	10.6334		0.6300			0.7000		0.7700		12.9988
South					8.1800	46.7521		0.6300			0.7000		0.7700		116.8762 (74)
Solar gains	129.8750	216.2544	286.0378	343.3792	378.5042	374.1383	361.3091	334.6531	305.4573	236.0273	154.5738	111.8282 (83)			
Total gains	525.9415	610.0630	665.6361	700.1289	712.0415	685.4227	658.2393	637.8199	620.4660	574.1013	519.0814	496.1696 (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	59.5986	59.7114	59.8224	60.3493	60.4490	60.9170	60.9170	61.0045	60.7359	60.4490	60.2478	60.0389
alpha	4.9732	4.9808	4.9882	5.0233	5.0299	5.0611	5.0611	5.0670	5.0491	5.0299	5.0165	5.0026
util living area	0.9977	0.9948	0.9882	0.9698	0.9181	0.7917	0.6216	0.6607	0.8662	0.9747	0.9951	0.9983 (86)
MIT	19.7544	19.9131	20.1460	20.4408	20.7171	20.9128	20.9799	20.9727	20.8513	20.4947	20.0651	19.7226 (87)
Th 2	19.9479	19.9497	19.9515	19.9596	19.9612	19.9683	19.9683	19.9696	19.9656	19.9612	19.9581	19.9548 (88)
util rest of house	0.9970	0.9931	0.9840	0.9576	0.8824	0.7044	0.4896	0.5313	0.7985	0.9622	0.9932	0.9977 (89)
MIT 2	18.2911	18.5236	18.8631	19.2916	19.6700	19.9059	19.9605	19.9578	19.8428	19.3736	18.7523	18.2495 (90)
Living area fraction	18.8029	19.0096	19.3118	19.6935	20.0362	20.2581	20.3170	20.3127	20.1955	19.7657	19.2115	18.7647 (92)
Temperature adjustment	18.6529	18.8596	19.1618	19.5435	19.8862	20.1081	20.1670	20.1627	20.0455	19.6157	19.0615	18.6147 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	523.6006	604.2385	651.9969	666.0106	626.0654	491.8798	339.9481	355.3927	499.2793	549.1529	514.2300	494.4926 (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	1424.8846	1383.2243	1252.3009	1043.4959	801.2594	534.9785	346.4548	364.9381	579.1919	882.4451	1174.6848	1420.5330 (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	670.5553	523.4785	446.6262	271.7894	130.3444	0.0000	0.0000	0.0000	0.0000	247.9694	475.5275	688.9741 (98)
Space heating												3455.2647 (98)
Space heating per m2										(98) / (4) =		40.5547 (99)

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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 %)												90.2000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												3830.6704 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	670.5553	523.4785	446.6262	271.7894	130.3444	0.0000	0.0000	0.0000	0.0000	247.9694	475.5275	688.9741 (98)
Space heating efficiency (main heating system 1)	90.2000	90.2000	90.2000	90.2000	90.2000	0.0000	0.0000	0.0000	0.0000	90.2000	90.2000	90.2000 (210)
Space heating fuel (main heating system)	743.4095	580.3531	495.1510	301.3186	144.5059	0.0000	0.0000	0.0000	0.0000	274.9106	527.1923	763.8293 (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	186.6993	164.1896	171.5553	152.5727	148.6332	131.5485	125.1502	138.9786	139.2588	158.2823	168.8913	181.8019 (64)
Efficiency of water heater (217)m	89.4832	89.4148	89.2886	89.0227	88.4664	87.0000	87.0000	87.0000	87.0000	88.9256	89.3388	87.0000 (216)
Fuel for water heating, kWh/month	208.6418	183.6270	192.1357	171.3862	168.0109	151.2051	143.8508	159.7455	160.0676	177.9940	189.0458	203.1021 (219)
Water heating fuel used												2108.8127 (219)
Annual totals kWh/year												
Space heating fuel - main system												3830.6704 (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)												386.6725 (232)
Total delivered energy for all uses												6401.1556 (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	3830.6704	0.2160	827.4248 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2108.8127	0.2160	455.5035 (264)
Space and water heating			1282.9283 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	386.6725	0.5190	200.6830 (268)
Total CO2, kg/year			1522.5364 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.8700 (273)

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

DER		17.8700 ZC1
Total Floor Area	TFA	85.2000
Assumed number of occupants	N	2.5542
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190
CO2 emissions from appliances, equation (L14)		15.9944 ZC2
CO2 emissions from cooking, equation (L16)		2.1162 ZC3
Total CO2 emissions		35.9806 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		35.9806 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	42.6000 (1b)	x 2.6000 (2b)	= 110.7600 (1b) - (3b)
First floor	42.6000 (1c)	x 2.6000 (2c)	= 110.7600 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	85.2000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.5200 (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) =	0.1354 (8)
Pressure test										Yes							
Measured/design AP50										5.0000							
Infiltration rate										0.3854 (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) =					0.3276 (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	0.4177	0.4095	0.4013	0.3604	0.3522	0.3112	0.3112	0.3030	0.3276	0.3522	0.3686	0.3849	(22b)				
Effective ac	0.5872	0.5839	0.5805	0.5649	0.5620	0.5484	0.5484	0.5459	0.5537	0.5620	0.5679	0.5741	(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 Opaque door			2.1000	1.0000	2.1000		(26)					
TER Opening Type (Uw = 1.40)			12.1800	1.3258	16.1477		(27)					
Heat Loss Floor			42.6000	0.1300	5.5380		(28a)					
External Wall	96.2000	14.2800	81.9200	0.1800	14.7456		(29a)					
Roof Joists	42.6000		42.6000	0.1300	5.5380		(30)					
Total net area of external elements Aum(A, m2)			181.4000				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26) ... (30) + (32) =	44.0693		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.4200 (36)					
Total fabric heat loss						(33) + (36) =	53.4893 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 42.9282	Feb 42.6805	Mar 42.4378	Apr 41.2977	May 41.0843	Jun 40.0913	Jul 40.0913	Aug 39.9074	Sep 40.4738	Oct 41.0843	Nov 41.5159	Dec 41.9670 (38)
Heat transfer coeff	96.4175	96.1699	95.9271	94.7870	94.5737	93.5807	93.5807	93.3968	93.9632	94.5737	95.0052	95.4564 (39)
Average = Sum(39)m / 12 =												94.7860 (39)
HLP	Jan 1.1317	Feb 1.1288	Mar 1.1259	Apr 1.1125	May 1.1100	Jun 1.0984	Jul 1.0984	Aug 1.0962	Sep 1.1029	Oct 1.1100	Nov 1.1151	Dec 1.1204 (40)
HLP (average)												1.1125 (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												2.5542 (42)
Average daily hot water use (litres/day)												94.8614 (43)
Daily hot water use	Jan 104.3475	Feb 100.5530	Mar 96.7586	Apr 92.9641	May 89.1697	Jun 85.3752	Jul 85.3752	Aug 89.1697	Sep 92.9641	Oct 96.7586	Nov 100.5530	Dec 104.3475 (44)
Energy conte	154.7443	135.3404	139.6591	121.7582	116.8299	100.8153	93.4202	107.2011	108.4814	126.4246	138.0024	149.8616 (45)
Energy content (annual)												Total = Sum(45)m = 1492.5386 (45)
Distribution loss (46)m = 0.15 x (45)m												
Water storage loss:	23.2116	20.3011	20.9489	18.2637	17.5245	15.1223	14.0130	16.0802	16.2722	18.9637	20.7004	22.4792 (46)
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												

FULL SAP CALCULATION PRINTOUT

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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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	0.0000 (57)
Total heat required for water heating calculated for each month	50.9589	46.0274	49.3071	45.8453	45.4399	42.1029	43.5063	45.4399	45.8453	49.3071	49.3151	50.9589	(61)
Solar input	205.7032	181.3678	188.9663	167.6036	162.2698	142.9182	136.9265	152.6410	154.3267	175.7317	187.3174	200.8205	(62)
Output from w/h	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)
Heat gains from water heating, kWh/month	205.7032	181.3678	188.9663	167.6036	162.2698	142.9182	136.9265	152.6410	154.3267	175.7317	187.3174	200.8205	(64)
	64.1922	56.5075	58.7634	51.9459	50.2059	44.0468	41.9388	47.0043	47.5314	54.3630	58.2145	62.5687	(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	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.8950	19.4469	15.8153	11.9732	8.9501	7.5561	8.1646	10.6127	14.2443	18.0864	21.1095	22.5035	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	229.9650	232.3513	226.3378	213.5359	197.3758	182.1876	172.0409	169.6546	175.6681	188.4700	204.6301	219.8183	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708	(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)	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	(71)
Water heating gains (Table 5)	86.2799	84.0886	78.9831	72.1471	67.4811	61.1761	56.3694	63.1779	66.0158	73.0685	80.8535	84.0977	(72)
Total internal gains	402.4523	400.1992	385.4487	361.9687	338.1195	315.2322	300.8873	307.7576	320.2406	343.9373	370.9055	390.7320	(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				4.0000	10.6334	0.6300	0.7000	0.7700	12.9988 (74)			
South				8.1800	46.7521	0.6300	0.7000	0.7700	116.8762 (78)			
Solar gains	129.8750	216.2544	286.0378	343.3792	378.5042	374.1383	361.3091	334.6531	305.4573	236.0273	154.5738	111.8282 (83)
Total gains	532.3272	616.4537	671.4866	705.3480	716.6237	689.3705	662.1964	642.4107	625.6979	579.9646	525.4793	502.5602 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (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	61.3651	61.5231	61.6788	62.4207	62.5615	63.2253	63.2253	63.3498	62.9679	62.5615	62.2773	61.9830	
alpha	5.0910	5.1015	5.1119	5.1614	5.1708	5.2150	5.2150	5.2233	5.1979	5.1708	5.1518	5.1322	
util living area	0.9976	0.9945	0.9874	0.9670	0.9105	0.7749	0.6010	0.6393	0.8532	0.9722	0.9948	0.9982	(86)
MIT	19.8065	19.9650	20.1940	20.4841	20.7479	20.9279	20.9847	20.9789	20.8727	20.5339	20.1149	19.7787	(87)
Th 2	19.9751	19.9774	19.9797	19.9906	19.9927	20.0022	20.0022	20.0039	19.9985	19.9927	19.9885	19.9842	(88)
util rest of house	0.9968	0.9926	0.9828	0.9541	0.8733	0.6879	0.4753	0.5153	0.7839	0.9587	0.9927	0.9976	(89)
MIT 2	18.3864	18.6191	18.9531	19.3757	19.7349	19.9512	19.9962	19.9948	19.8946	19.4523	18.8465	18.3523	(90)
Living area fraction	18.8831	19.0899	19.3871	19.7634	20.0892	20.2928	20.3419	20.3390	20.2367	19.8306	19.2902	18.8512	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8831	19.0899	19.3871	19.7634	20.0892	20.2928	20.3419	20.3390	20.2367	19.8306	19.2902	18.8512	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	529.9656	610.5424	657.6073	670.4300	628.7721	493.2084	344.1068	359.0681	502.1597	554.4227	520.5450	500.8720	(94)
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	1406.0656	1364.6374	1236.2237	1029.7090	793.3997	532.7362	350.1716	367.8928	576.6262	872.9734	1158.1282	1398.5507	(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	651.8184	506.7519	430.4907	258.6809	122.4829	0.0000	0.0000	0.0000	0.0000	237.0017	459.0599	667.8729	(98)
Space heating												3334.1592	(98)
Space heating per m2												39.1333	(99)

8c. Space cooling requirement

Not applicable

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

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 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 %)													93.4000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3569.7636 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	651.8184	506.7519	430.4907	258.6809	122.4829	0.0000	0.0000	0.0000	0.0000	237.0017	459.0599	667.8729	(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)	697.8783	542.5609	460.9108	276.9602	131.1380	0.0000	0.0000	0.0000	0.0000	253.7492	491.4988	715.0674	(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	205.7032	181.3678	188.9663	167.6036	162.2698	142.9182	136.9265	152.6410	154.3267	175.7317	187.3174	200.8205	(64)
Efficiency of water heater	87.7523	87.4993	87.0596	86.1401	84.3538	80.3000	80.3000	80.3000	80.3000	85.8049	87.2208	87.8457	(217)
Fuel for water heating, kWh/month	234.4134	207.2792	217.0539	194.5708	192.3681	177.9803	170.5187	190.0884	192.1877	204.8039	214.7623	228.6059	(219)
Water heating fuel used												2424.6325	(219)
Annual totals kWh/year													
Space heating fuel - main system												3569.7636	(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)												386.6725	(232)
Total delivered energy for all uses												6456.0687	(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	3569.7636	0.2160	771.0689 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2424.6325	0.2160	523.7206 (264)
Space and water heating			1294.7896 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	386.6725	0.5190	200.6830 (268)
Total CO2, kg/m2/year			1534.3976 (272)
Emissions per m2 for space and water heating			15.1971 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.3554 (272b)
Emissions per m2 for pumps and fans			0.4569 (272c)
Target Carbon Dioxide Emission Rate (TER) = (15.1971 * 1.00) + 2.3554 + 0.4569, rounded to 2 d.p.			18.0100 (273)

Appendix C: DER Worksheet – With SWHR

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Property Reference	ES 8634 House 10			Issued on Date	06/08/2021
Assessment Reference	Be Green	Prop Type Ref			
Property	House 10, Moss Green Close, , Huyton, L36				
SAP Rating	85 B	DER	16.57	TER	18.01
Environmental	87 B	% DER<TER	7.99		
CO ₂ Emissions (t/year)	1.18	DFEE	45.92	TFEE	50.39
General Requirements Compliance	Pass	% DFEE<TFEE	8.88		
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

Semi-Detached House, total floor area 85 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) 18.01 kgCO₂/m²

Dwelling Carbon Dioxide Emission Rate (DER) 16.57 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 50.4 kWh/m²/yr

Dwelling Fabric Energy Efficiency (DFEE) 45.9 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (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	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.46 (max. 2.00)	1.80 (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 837 VUW GB 376/5-5

Combi boiler

Efficiency: 89.3% 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: 4.00 m², No overhang

Windows facing South: 8.18 m², No overhang

Air change rate: 2.50 ach

Blinds/curtains: None

10 Key features

Party wall U-value 0.00 W/m²K

Roof U-value 0.11 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	42.6000 (1b)	x 2.6000 (2b)	= 110.7600 (1b) - (3b)
First floor	42.6000 (1c)	x 2.6000 (2c)	= 110.7600 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	85.2000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.5200 (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					3 * 10 = 30.0000 (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) =				30.0000 / (5) = 0.1354 (8)
Pressure test					Yes
Measured/design AP50					4.0000
Infiltration rate					0.3354 (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) =				0.2851 (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	0.3635	0.3564	0.3493	0.3136	0.3065	0.2709	0.2709	0.2637	0.2851	0.3065	0.3208	0.3350 (22b)
Effective ac	0.5661	0.5635	0.5610	0.5492	0.5470	0.5367	0.5367	0.5348	0.5406	0.5470	0.5514	0.5561 (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
D			2.1000	1.8000	3.7800		(26)
W (Uw = 1.40)			12.1800	1.3258	16.1477		(27)
Heat Loss Floor			42.6000	0.1100	4.6860		(28a)
External Wall	96.2000	14.2800	81.9200	0.1800	14.7456		(29a)
Roof Joists	42.6000		42.6000	0.1100	4.6860		(30)
Total net area of external elements Aum(A, m ²)			181.4000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	44.0453		(33)
Party Wall			44.2000	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							13.8490 (36)
Total fabric heat loss						(33) + (36) =	57.8943 (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	41.3809	41.1933	41.0095	40.1460	39.9844	39.2323	39.2323	39.0930	39.5220	39.9844	40.3112	40.6529 (38)
Heat transfer coeff	99.2752	99.0876	98.9038	98.0403	97.8787	97.1266	97.1266	96.9874	97.4163	97.8787	98.2056	98.5473 (39)
Average = Sum(39)m / 12 =												98.0395 (39)
HLP	1.1652	1.1630	1.1608	1.1507	1.1488	1.1400	1.1400	1.1383	1.1434	1.1488	1.1526	1.1567 (40)
HLP (average)												1.1507 (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												2.5542 (42)
Average daily hot water use (litres/day)												94.8614 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	104.3475	100.5530	96.7586	92.9641	89.1697	85.3752	85.3752	89.1697	92.9641	96.7586	100.5530	104.3475 (44)
Energy content (annual)	154.7443	135.3404	139.6591	121.7582	116.8299	100.8153	93.4202	107.2011	108.4814	126.4246	138.0024	149.8616 (45)
Distribution loss (46)m = 0.15 x (45)m	23.2116	20.3011	20.9489	18.2637	17.5245	15.1223	14.0130	16.0802	16.2722	18.9637	20.7004	22.4792 (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)

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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	31.9550	28.8493	31.8961	30.8145	31.8033	30.7331	31.7300	31.7775	30.7774	31.8577	30.8889	31.9403 (61)
Total heat required for water heating calculated for each month	186.6993	164.1896	171.5553	152.5727	148.6332	131.5485	125.1502	138.9786	139.2588	158.2823	168.8913	181.8019 (62)
WWHRS	-50.3315	-44.2843	-45.1984	-37.1944	-34.5391	-28.4954	-24.1208	-29.2033	-30.0533	-37.1472	-43.0237	-48.6462 eq. (G10)
Total of WWHRS savings												-452.2377
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	136.3678	119.9053	126.3569	115.3783	114.0941	103.0531	101.0294	109.7753	109.2055	121.1351	125.8675	133.1557 (64)
Heat gains from water heating, kWh/month	59.4412	52.2130	54.4107	48.1882	46.7968	41.2044	38.9947	43.5887	43.7644	50.0006	53.6080	57.8141 (65)
Solar input (sum of months) = Sum(63)m = 0.0000 (63)												
Total per year (kWh/year) = Sum(64)m = 1415.3241 (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
(66)m	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.8950	19.4469	15.8153	11.9732	8.9501	7.5561	8.1646	10.6127	14.2443	18.0864	21.1095	22.5035 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	229.9650	232.3513	226.3378	213.5359	197.3758	182.1876	172.0409	169.6546	175.6681	188.4700	204.6301	219.8183 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708 (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)	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665 (71)
Water heating gains (Table 5)	79.8941	77.6979	73.1327	66.9281	62.8989	57.2283	52.4123	58.5870	60.7839	67.2051	74.4556	77.7071 (72)
Total internal gains	396.0665	393.8086	379.5983	356.7497	333.5373	311.2844	296.9302	303.1667	315.0087	338.0739	364.5076	384.3413 (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			4.0000			10.6334			0.6300			0.7000			0.7700	12.9988 (74)
South			8.1800			46.7521			0.6300			0.7000			0.7700	116.8762 (78)
Solar gains	129.8750	216.2544	286.0378	343.3792	378.5042	374.1383	361.3091	334.6531	305.4573	236.0273	154.5738	111.8282 (83)				
Total gains	525.9415	610.0630	665.6361	700.1289	712.0415	685.4227	658.2393	637.8199	620.4660	574.1013	519.0814	496.1696 (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	59.5986	59.7114	59.8224	60.3493	60.4490	60.9170	60.9170	61.0045	60.7359	60.4490	60.2478	60.0389
alpha	4.9732	4.9808	4.9882	5.0233	5.0299	5.0611	5.0611	5.0670	5.0491	5.0299	5.0165	5.0026
util living area	0.9977	0.9948	0.9882	0.9698	0.9181	0.7917	0.6216	0.6607	0.8662	0.9747	0.9951	0.9983 (86)
MIT	19.7544	19.9131	20.1460	20.4408	20.7171	20.9128	20.9799	20.9727	20.8513	20.4947	20.0651	19.7226 (87)
Th 2	19.9479	19.9497	19.9515	19.9596	19.9612	19.9683	19.9683	19.9696	19.9656	19.9612	19.9581	19.9548 (88)
util rest of house	0.9970	0.9931	0.9840	0.9576	0.8824	0.7044	0.4896	0.5313	0.7985	0.9622	0.9932	0.9977 (89)
MIT 2	18.2911	18.5236	18.8631	19.2916	19.6700	19.9059	19.9605	19.9578	19.8428	19.3736	18.7523	18.2495 (90)
Living area fraction									fLA = Living area / (4) =			0.3498 (91)
MIT	18.8029	19.0096	19.3118	19.6935	20.0362	20.2581	20.3170	20.3127	20.1955	19.7657	19.2115	18.7647 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.6529	18.8596	19.1618	19.5435	19.8862	20.1081	20.1670	20.1627	20.0455	19.6157	19.0615	18.6147 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	523.6006	604.2385	651.9969	666.0106	626.0654	491.8798	339.9481	355.3927	499.2793	549.1529	514.2300	494.4926 (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	1424.8846	1383.2243	1252.3009	1043.4959	801.2594	534.9785	346.4548	364.9381	579.1919	882.4451	1174.6848	1420.5330 (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	670.5553	523.4785	446.6262	271.7894	130.3444	0.0000	0.0000	0.0000	0.0000	247.9694	475.5275	688.9741 (98)
Space heating												3455.2647 (98)
Space heating per m2										(98) / (4) =		40.5547 (99)

8c. Space cooling requirement

Not applicable

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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 %)													90.2000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3830.6704 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	670.5553	523.4785	446.6262	271.7894	130.3444	0.0000	0.0000	0.0000	0.0000	247.9694	475.5275	688.9741	(98)
Space heating efficiency (main heating system 1)	90.2000	90.2000	90.2000	90.2000	90.2000	0.0000	0.0000	0.0000	0.0000	90.2000	90.2000	90.2000	(210)
Space heating fuel (main heating system)	743.4095	580.3531	495.1510	301.3186	144.5059	0.0000	0.0000	0.0000	0.0000	274.9106	527.1923	763.8293	(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	136.3678	119.9053	126.3569	115.3783	114.0941	103.0531	101.0294	109.7753	109.2055	121.1351	125.8675	133.1557	(64)
Efficiency of water heater (217)m	89.6428	89.5859	89.4743	89.2220	88.6776	87.0000	87.0000	87.0000	87.0000	89.1242	89.5109	87.0000	(216)
Fuel for water heating, kWh/month	152.1236	133.8440	141.2215	129.3160	128.6618	118.4518	116.1258	126.1785	125.5236	135.9172	140.6170	148.5022	(219)
Water heating fuel used												1596.4827	(219)
Annual totals kWh/year													
Space heating fuel - main system												3830.6704	(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)												386.6725	(232)
Total delivered energy for all uses												5888.8257	(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	3830.6704	0.2160	827.4248 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1596.4827	0.2160	344.8403 (264)
Space and water heating			1172.2651 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	386.6725	0.5190	200.6830 (268)
Total CO2, kg/year			1411.8731 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.5700 (273)

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

DER		16.5700	ZC1
Total Floor Area	TFA	85.2000	
Assumed number of occupants	N	2.5542	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.9944	ZC2
CO2 emissions from cooking, equation (L16)		2.1162	ZC3
Total CO2 emissions		34.6806	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		34.6806	ZC8

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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	42.6000 (1b)	x 2.6000 (2b)	= 110.7600 (1b) - (3b)
First floor	42.6000 (1c)	x 2.6000 (2c)	= 110.7600 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	85.2000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.5200 (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) =	0.1354 (8)	
Pressure test										Yes							
Measured/design AP50										5.0000							
Infiltration rate										0.3854 (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) =				0.3276 (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	0.4177	0.4095	0.4013	0.3604	0.3522	0.3112	0.3112	0.3030	0.3276	0.3522	0.3686	0.3849	(22b)				
Effective ac	0.5872	0.5839	0.5805	0.5649	0.5620	0.5484	0.5484	0.5459	0.5537	0.5620	0.5679	0.5741	(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 Opaque door			2.1000	1.0000	2.1000		(26)					
TER Opening Type (Uw = 1.40)			12.1800	1.3258	16.1477		(27)					
Heat Loss Floor			42.6000	0.1300	5.5380		(28a)					
External Wall	96.2000	14.2800	81.9200	0.1800	14.7456		(29a)					
Roof Joists	42.6000		42.6000	0.1300	5.5380		(30)					
Total net area of external elements Aum(A, m2)			181.4000				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26) ... (30) + (32) =	44.0693		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.4200 (36)					
Total fabric heat loss						(33) + (36) =	53.4893 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 42.9282	Feb 42.6805	Mar 42.4378	Apr 41.2977	May 41.0843	Jun 40.0913	Jul 40.0913	Aug 39.9074	Sep 40.4738	Oct 41.0843	Nov 41.5159	Dec 41.9670 (38)
Heat transfer coeff	96.4175	96.1699	95.9271	94.7870	94.5737	93.5807	93.5807	93.3968	93.9632	94.5737	95.0052	95.4564 (39)
Average = Sum(39)m / 12 =												94.7860 (39)
HLP	Jan 1.1317	Feb 1.1288	Mar 1.1259	Apr 1.1125	May 1.1100	Jun 1.0984	Jul 1.0984	Aug 1.0962	Sep 1.1029	Oct 1.1100	Nov 1.1151	Dec 1.1204 (40)
HLP (average)												1.1125 (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												2.5542 (42)
Average daily hot water use (litres/day)												94.8614 (43)
Daily hot water use	Jan 104.3475	Feb 100.5530	Mar 96.7586	Apr 92.9641	May 89.1697	Jun 85.3752	Jul 85.3752	Aug 89.1697	Sep 92.9641	Oct 96.7586	Nov 100.5530	Dec 104.3475 (44)
Energy conte	154.7443	135.3404	139.6591	121.7582	116.8299	100.8153	93.4202	107.2011	108.4814	126.4246	138.0024	149.8616 (45)
Energy content (annual)												Total = Sum(45)m = 1492.5386 (45)
Distribution loss (46)m = 0.15 x (45)m												
Water storage loss:	23.2116	20.3011	20.9489	18.2637	17.5245	15.1223	14.0130	16.0802	16.2722	18.9637	20.7004	22.4792 (46)
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												

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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	0.0000 (57)
Total heat required for water heating calculated for each month	50.9589	46.0274	49.3071	45.8453	45.4399	42.1029	43.5063	45.4399	45.8453	49.3071	49.3151	50.9589	(61)
Solar input	205.7032	181.3678	188.9663	167.6036	162.2698	142.9182	136.9265	152.6410	154.3267	175.7317	187.3174	200.8205	(62)
Output from w/h	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)
Heat gains from water heating, kWh/month	205.7032	181.3678	188.9663	167.6036	162.2698	142.9182	136.9265	152.6410	154.3267	175.7317	187.3174	200.8205	(64)
	64.1922	56.5075	58.7634	51.9459	50.2059	44.0468	41.9388	47.0043	47.5314	54.3630	58.2145	62.5687	(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	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081	127.7081	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.8950	19.4469	15.8153	11.9732	8.9501	7.5561	8.1646	10.6127	14.2443	18.0864	21.1095	22.5035	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	229.9650	232.3513	226.3378	213.5359	197.3758	182.1876	172.0409	169.6546	175.6681	188.4700	204.6301	219.8183	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708	35.7708	(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)	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	-102.1665	(71)
Water heating gains (Table 5)	86.2799	84.0886	78.9831	72.1471	67.4811	61.1761	56.3694	63.1779	66.0158	73.0685	80.8535	84.0977	(72)
Total internal gains	402.4523	400.1992	385.4487	361.9687	338.1195	315.2322	300.8873	307.7576	320.2406	343.9373	370.9055	390.7320	(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					4.0000	10.6334	0.6300	0.7000			0.7700	12.9988
South					8.1800	46.7521	0.6300	0.7000			0.7700	116.8762 (74)
Solar gains	129.8750	216.2544	286.0378	343.3792	378.5042	374.1383	361.3091	334.6531	305.4573	236.0273	154.5738	111.8282 (83)
Total gains	532.3272	616.4537	671.4866	705.3480	716.6237	689.3705	662.1964	642.4107	625.6979	579.9646	525.4793	502.5602 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (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	61.3651	61.5231	61.6788	62.4207	62.5615	63.2253	63.2253	63.3498	62.9679	62.5615	62.2773	61.9830	
alpha	5.0910	5.1015	5.1119	5.1614	5.1708	5.2150	5.2150	5.2233	5.1979	5.1708	5.1518	5.1322	
util living area	0.9976	0.9945	0.9874	0.9670	0.9105	0.7749	0.6010	0.6393	0.8532	0.9722	0.9948	0.9982	(86)
MIT	19.8065	19.9650	20.1940	20.4841	20.7479	20.9279	20.9847	20.9789	20.8727	20.5339	20.1149	19.7787	(87)
Th 2	19.9751	19.9774	19.9797	19.9906	19.9927	20.0022	20.0022	20.0039	19.9985	19.9927	19.9885	19.9842	(88)
util rest of house	0.9968	0.9926	0.9828	0.9541	0.8733	0.6879	0.4753	0.5153	0.7839	0.9587	0.9927	0.9976	(89)
MIT 2	18.3864	18.6191	18.9531	19.3757	19.7349	19.9512	19.9962	19.9948	19.8946	19.4523	18.8465	18.3523	(90)
Living area fraction	18.8831	19.0899	19.3871	19.7634	20.0892	20.2928	20.3419	20.3390	20.2367	19.8306	19.2902	18.8512	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8831	19.0899	19.3871	19.7634	20.0892	20.2928	20.3419	20.3390	20.2367	19.8306	19.2902	18.8512	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	529.9656	610.5424	657.6073	670.4300	628.7721	493.2084	344.1068	359.0681	502.1597	554.4227	520.5450	500.8720	(94)
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	1406.0656	1364.6374	1236.2237	1029.7090	793.3997	532.7362	350.1716	367.8928	576.6262	872.9734	1158.1282	1398.5507	(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	651.8184	506.7519	430.4907	258.6809	122.4829	0.0000	0.0000	0.0000	0.0000	237.0017	459.0599	667.8729	(98)
Space heating												3334.1592	(98)
Space heating per m2												39.1333	(99)

8c. Space cooling requirement

Not applicable

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

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 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 %)													93.4000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3569.7636 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	651.8184	506.7519	430.4907	258.6809	122.4829	0.0000	0.0000	0.0000	0.0000	237.0017	459.0599	667.8729	(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)	697.8783	542.5609	460.9108	276.9602	131.1380	0.0000	0.0000	0.0000	0.0000	253.7492	491.4988	715.0674	(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	205.7032	181.3678	188.9663	167.6036	162.2698	142.9182	136.9265	152.6410	154.3267	175.7317	187.3174	200.8205	(64)
Efficiency of water heater	87.7523	87.4993	87.0596	86.1401	84.3538	80.3000	80.3000	80.3000	80.3000	85.8049	87.2208	87.8457	(217)
Fuel for water heating, kWh/month	234.4134	207.2792	217.0539	194.5708	192.3681	177.9803	170.5187	190.0884	192.1877	204.8039	214.7623	228.6059	(219)
Water heating fuel used												2424.6325	(219)
Annual totals kWh/year													
Space heating fuel - main system												3569.7636	(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)												386.6725	(232)
Total delivered energy for all uses												6456.0687	(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	3569.7636	0.2160	771.0689 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2424.6325	0.2160	523.7206 (264)
Space and water heating			1294.7896 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	386.6725	0.5190	200.6830 (268)
Total CO2, kg/m2/year			1534.3976 (272)
Emissions per m2 for space and water heating			15.1971 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.3554 (272b)
Emissions per m2 for pumps and fans			0.4569 (272c)
Target Carbon Dioxide Emission Rate (TER) = (15.1971 * 1.00) + 2.3554 + 0.4569, rounded to 2 d.p.			18.0100 (273)