

Energy Statement for Planning

Client: Atlas Property London.

Site: 18 Denmark Street
London
N17 0JL

Proposals: The construction of a run of 5 new terrace houses over two storeys.

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Report Details:

Prepared by	Checked by	Date	Project	Revision
Chris Tolman	Peter Kinsella	08/02/2024	S11818	REV1

1 Introduction

This Energy Statement has been prepared in support of the planning application for the construction of a run of 5 new terrace houses over two storeys on land to the rear of 18 Denmark Street.

National Planning Policy Framework 2021

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

The London Borough of Haringey Local Plan

Policy DM 21, 2017 has recently been updated with the new Local Plan 2020 and Policy 5.3 Climate Change and Sustainable

The existing Local Plan (2017) requires all new development to be net zero carbon. The council is proposing to keep this target and supporting it with a more comprehensive and ambitious set of policies designed to promote net zero on-site. The council has an ambition to be net zero carbon by 2041.

The Local Plan requires all developments were viable to reduce their CO₂ emissions by 20% through use of on-site renewable energy.

The energy statement should follow the energy hierarchy Be Lean, Be Green of the London Plan which has recently been updated, London Plan SI 2 2021.

Based on the above, the proposed dwellings may need to achieve net zero carbon with a minimum 35% saving in CO₂ emissions over Part L 2013, of which 20% must be through the provision of renewable technologies were feasible. This report demonstrates how the development will meet Building Regulation requirements for energy efficiency (baseline scenario) and, through an assessment of energy efficiency measures and renewable technologies, demonstrates how the dwellings can achieve a higher saving in CO₂ emissions over Part L 2013.

Current Building Regulations and SAP 10

Part L of the Building Regulations has been updated and SAP 2012 is replaced by SAP 10. Under SAP 2012 electricity has a very high carbon factor however with the new SAP 10 the carbon factors for electricity have reduced and are now similar to gas. This is to reflect the increased influence of renewable energy technologies producing electricity for the national grid.

At the time of writing this report, we are still to follow the GLA Energy Assessment Guidance 2020.

Therefore, based on the current scheme using electric heating, the SAP 10 carbon factors have been used in the energy statement as per the GLA energy assessment guidance 2020 on carbon emissions.

This report is based on a Part L1a 2013 and SAP 2012 assessment, therefore the results of this report may vary where a development falls under Part L 2021 and SAP 10 for demonstration of compliance.

2 Existing and Proposed Development

The site is located on land to the rear of 18 Denmark Street, London. (See Figure 1).

As previously detailed, proposals are for the construction of 5 new terrace houses over two storeys (with a floor area of approximately 437m²) on land to the rear of 18 Denmark Street.

The proposed development will face in a westerly direction.

Given the scale and nature of the site (in particular the adjacent buildings situated in the terrace), this constrains the development proposals in terms of the layout, positioning and orientation of the proposed dwellings. Subsequently, these constraints will impact on the feasibility of certain renewable technologies (as discussed in Section 4 of this report).

Access and egress for the proposed dwelling will be provided off Denmark Street, which leads from Park Lane.



Figure 1: Site Location and Proposed Plans

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

London Energy Plan

The London Plan 2021 energy policies (specifically Policy SI 2) requires an energy assessment for each planning application referable to the Mayor, setting out how the London Plan 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 in Policy SI 2 of the London Plan are achieved. It also contributes to the implementation of strategic energy policies relating to decentralised networks and ensures opportunities for building occupants to receive efficient, secure and affordable energy.

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

4 Baseline Scenario (Part L1 Compliance)

SAP modelling has been used to calculate the Building Regulations compliance threshold for the whole building. The Target Emission Rate forms the baseline from which any CO₂ emissions reductions can be measured. Simply complying with the minimum standards for building fabric and services would not usually be sufficient to ensure a 'pass' as the limiting values are designed to allow a degree of flexibility in achieving the main CO₂ limiting criterion. A sample of units has been modelled in full with numbers of each type and orientation being approximately proportionally representative of the whole.

Table 1: Baseline SAP Calculation Results

	Target Emission Rate (TER) (kg CO ₂ /m ² /year)	Floor Area (m ²)	Total Baseline Emissions (kg CO ₂ /year)
Development	20.7	415	8,581

The Baseline Target emission rate for the development assessed is shown to be 20.7 (kg CO₂/m²/year)

The total Baseline CO₂ emissions for the development assessed is shown to be in total 8,581 kg/year.

Due to electric heating being proposed, we have used SAP 10 carbon factors as per the GLA guidance.

Table 2: Baseline Energy Efficient Area Weighted Average – SAP 10

	Baseline Calculation SAP 10
Target Emission Rate (TER) (kg CO ₂ /m ² /year)	18.7
Total TER Baseline CO ₂ Emissions (kg/year)	7,760

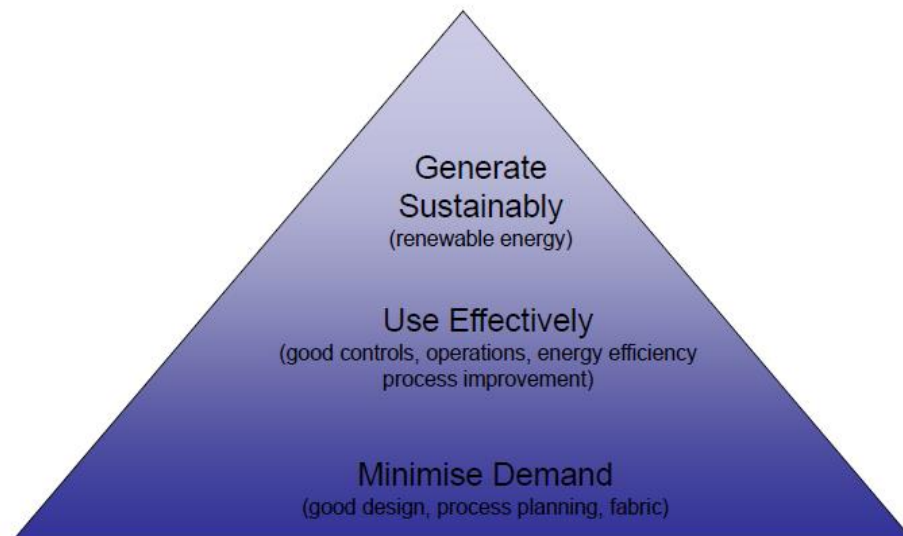
5 Be Lean Energy Efficiency Improvement Scenario

Be Lean Proposed Strategy

- Minimise demand
- Energy Efficient controls
- Generate energy

The Energy Hierarchy

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



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

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

	Part L1A Limiting Parameters	Notional Dwelling	Proposed Dwelling
Walls	0.30	0.18	0.15
Ground Floor	0.25	0.13	0.10
Roof	0.20	0.13	0.12
Windows	2.0	1.4	1.2
Air test	10	5	3
Ventilation	NA	Natural	Natural
Thermal Bridging	NA	0.05	0.05
Heating	88%	89.5% 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 3)
- Thermal Bridging - Accredited Construction Details (ACD) provide the continuity of insulation and therefore apply a significant improvement factor on the energy performance of a dwelling. Please note under the new Part L 2021, ACD will no longer be available.
- Ventilation - design air permeability (DAP) of 3 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 ErP Class Boiler with time and temperature zone control and a delayed start thermostat

- Lighting - the design of the dwellings allows for natural daylight which will reduce the energy use from internal lighting. All internal lighting will be low energy
- We have also included one energy efficient devices to help lower the overall CO2 emissions and improve the SAP rating:
 1. A Wastewater Heat Recovery System fitted to the shower, 50% efficiency and utilisation factor 0.95.
 2. MVHR with a SFP 0.80 and an 87% efficiency

The above specification has been incorporated into the baseline SAP calculation; the results are summarised in Table 4 (with the DER worksheet provided in Appendix A).

Table 4: Be Lean Energy Efficient Area Weighted Average

	Be Lean Results
Dwelling Emission Rate (DER) (kg CO₂/m²/year)	14.3
Target Emission Rate (TER) (kg CO₂/m²/year)	20.7
DER/TER Variance	-31%
Total DER Baseline CO₂ Emissions (kg/year)	5,947
Total TER Baseline CO₂ Emissions (kg/year)	8,581

The Be Lean dwelling emission rate CO2 emissions are shown to be on average 14.3(kg CO₂/m²/year).

The total Be Lean CO2 emissions for all dwellings are shown to be in total 5,947 kg/year.

Based on the Be Lean calculations, the 31% reduction in CO2 emissions can feasibly be achieved solely through improving the fabrics elements, air tightness, installing a SWHR system and MVHR.

Table 5: Be Lean Energy Efficient Area Weighted Average - SAP 10

	Baseline Calculation SAP 10
Dwelling Emission Rate (DER) (kg CO₂/m²/year)	11.6
Target Emission Rate (TER) (kg CO₂/m²/year)	18.7
DER/TER Variance	-38%
Total DER Baseline CO₂ Emissions (kg/year)	4,824
Total TER Baseline CO₂ Emissions (kg/year)	7,760

6 Renewable Technology Review

As previously detailed, in order to meet the requirements of Policy DM 21 of the Core Strategy, the proposed development will aim to achieve a minimum 35% saving in CO2 emissions through the provision of on-site renewable technologies or low-carbon technology.

The baseline TER calculation indicates that the total CO2 emissions are 8,581 kg/year. As such, a 35% saving in CO2 emissions of 3,003 kg/year is to be provided through renewable technologies.

RENEWABLE TECHNOLOGIES

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

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

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

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

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

WIND TURBINES

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

With the development being situated between runs of existing terrace houses and they are in close proximity to the proposed dwellings. 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 a vertical GSHP system. However, such a system may require a re-working of scheme and layout in order to accommodate plant rooms and infrastructure. Furthermore, space is limited for plant rooms. The need for in depth design analysis to assess geology and thermal dynamics would be costly and not guarantee feasibility. Scheme success is also highly dependent on expertise and design. System efficiencies degrade over the heating season. Other technologies are available and provide more immediate, straight forward and certain benefits and therefore such a system is deemed unsuitable for consideration in this development.

AIR SOURCE HEAT PUMP (ASHP)

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

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

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

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

Plans indicate that there would potentially be enough private space for the external condensing units on the flat roof or external walls. ASHPs are considered feasible for this development with more design consultation required. Consultation with an ASHP specialist should be gained to ensure feasibility for this development.

BIOMASS

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

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

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

COMBINED HEAT AND POWER (CHP)

CHP is effectively an on-site small power plant providing both electrical power and thermal heat energy. It is an energy efficiency and low carbon measure rather than a renewable energy technology. A CHP system operates by burning a primary fuel (normally natural gas) by use of either a

reciprocating engine or turbine, which in turn drives an alternator to generate electrical power. The heat emitted by the engine and exhaust gases is recovered and used to heat the building or to provide hot water.

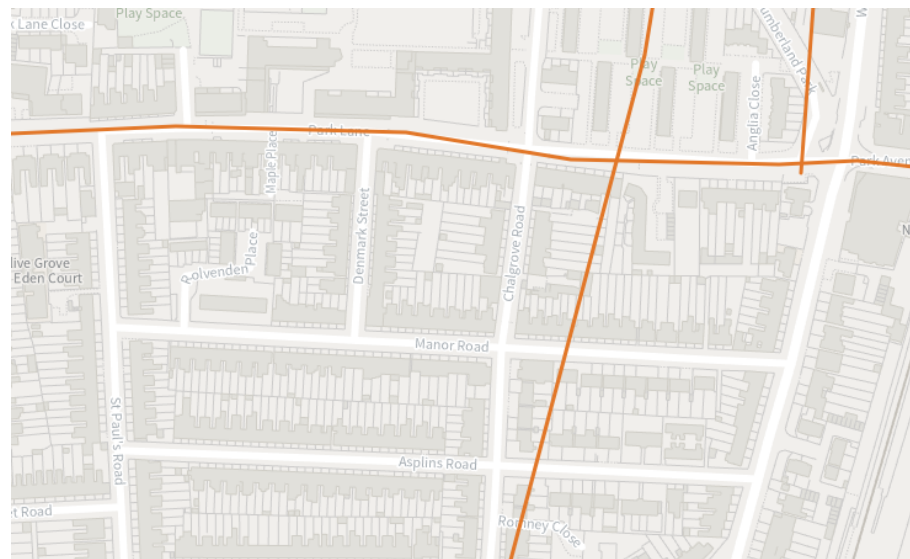
The viability of CHP is dependent upon the building base load requirements for both heat and power. Buildings with high heat demands and constant power demands lend themselves to CHP. It is important that the unit is not oversized as this will lead to inefficient operation. Excess generated electricity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

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

DISTRICT HEATING

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

With reference to the Local Heat Map, a proposed heat network system is located in close proximity so it could be potentially feasible to connect to this in the future. Further consultation with the local heat network provider should be reviewed for future connection.



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 there is a flat roof and the PV can be angled facing a southern orientation which is feasible for all units.

Based on the proposed layout of the dwellings, and that there is no significant over-shading, PV is considered a feasible solution in providing the saving in CO2 emissions from the development. Feasibility should be gained from a solar PV specialist. Due to the cost of battery storage, it has not been used at this stage, however this will be review at the design stage of the development.

SOLAR HOT WATER

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

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

- Flat Plate Collectors - a sheet of black metal that absorbs the sun's energy encases the collector system. Water is fed through the system in pipes which conduct the heat to the water
- Evacuated Tubes - a series of parallel glass heat tubes grouped together, with each tube containing an absorber tube. Sunlight passes through the outer glass tube to heat the absorber tube which in doing so, the heat is transferred to water flowing through the tube
- Solar Matting - a range of extruded hollow sections of flexible black material that can be used for solar collection. Water passes through the hollow tubes absorbing the heat from the sun

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

Renewable Technology Summary

The renewable technology review indicates that the most feasible solutions to achieve the 35% reduction in CO2 emissions which 20% must be through the provision of renewable technologies from the dwellings (when compared with the baseline scenario) would be an ASHP, PV and solar thermal. These solutions would work well, given the proposed layout of the dwellings and that there is no significant overshadowing.

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

For the purpose of showing a 35% reduction in CO2 via a renewable technology over Part L1A 2013 using SAP 2012, we have chosen solar PV alongside an ASHP as the most suitable technologies for this development.

The calculations to demonstrate how solar PV with an ASHP can achieve the required 35% saving in CO2 emissions (when compared with the baseline scenario) are provided in Section 7 and Appendix A of this report).

7 Be Green Renewable Technology Scenario

In order to demonstrate how the dwellings can meet (or exceed) a 35% saving in CO₂ emissions with 20% through the incorporation of on-site renewable energy, the be lean calculation (as detailed in Section 4 and Appendix A of this report) has been re-run with solar PV and an ASHP as the most feasible renewable energy solution.

The front of the proposed development will face in a Westerly direction (and the rear of the building in a easterly direction), with a flat roof area of 37m².

A 2.4kWp PV system per dwelling has been incorporated into the SAP calculation (at a 30° angle, facing in a south direction). Solar PV ranges from 0.25Watts to 0.45Watts per panel. With the dwelling having a flat roof area the solar PV will have to be displayed south with at least a 25-degree angle.

The baseline measures and u-values have been used as the basis for this section, only implementing solar PV with an ASHP to improve on the baseline scenario by 35% and the be lean assessment by 20%. These u-values and measures are reiterated below.

- Insulation - good levels of insulation with u-values exceeding Part L1A requirements (see Table 6)

Table 6: Fabric Standards (u-values W/m²K)

	Part L1A Limiting Parameters	Proposed Dwelling
Walls	0.30	0.15
Ground Floor	0.25	0.10
Roof	0.20	0.12
Windows	1.6	1.2
Air test	5.0	3.0
Heating	89% Gas boiler	89% Gas boiler

The results are summarised in Table 7 and 8 (with the baseline DER worksheet provided in Appendix C).

Table 7: SAP Calculation Results with PV and an ASHP – Be Green – SAP 2012 with gas baseline

	Be Green Results
Dwelling Emission Rate (DER) (kg CO₂/m²/year)	1.4
Target Emission Rate (TER) (kg CO₂/m²/year)	20.7
DER/TER Variance	-93%
Total DER Baseline CO₂ Emissions (kg/year)	594
Total TER Baseline CO₂ Emissions (kg/year)	8,581

Table 8: SAP Calculation Results with PV and an ASHP – Be Green – SAP 10 with gas baseline

	Baseline Calculation SAP 10
Dwelling Emission Rate (DER) (kg CO₂/m²/year)	0.6
Target Emission Rate (TER) (kg CO₂/m²/year)	18.7
DER/TER Variance	-97%
Total DER Baseline CO₂ Emissions (kg/year)	267
Total TER Baseline CO₂ Emissions (kg/year)	7,760

A comparison of the baseline calculation results and the results of the calculation with PV with an ASHP included is shown in Table 10 below.

Table 9: Comparison of Calculations (Baseline, Be Lean and Be Green)

	Baseline Calculation	Be Lean Calculation	Be Green Calculation	Be Green SAP 10
Dwelling Emission Rate (DER) (kg CO₂/m²/year)	20.7	14.3	1.4	0.6
Target Emission Rate (TER) (kg CO₂/m²/year)	20.7	20.7	20.7	18.8
DER/TER Variance	N/A	-31%	-93%	-97%
Total DER Baseline CO₂ Emissions (kg/year)	8,581	5,947	594	267
Total TER Baseline CO₂ Emissions (kg/year)	8,581	8,581	8,581	7,760

As required by the local council a minimum 35% saving in CO₂ emissions with at least 20% reduction from low-carbon or renewable technology, is to be provided through energy efficient measures and through renewable technologies.

By including an ASHP with a solar PV system on the residential units and applying the SAP 2012 carbon factors the total dwelling CO₂ emissions are shown to be 594 Kg/CO₂. However, by using the SAP 10 carbon factors the domestic units now show the CO₂ emissions to be 267 Kg/CO₂ which is a saving of 93% over Part L1a 2013, using SAP 10 carbon factors. The 97% CO₂ reduction is a 59% improvement from the be lean assessment and therefore exceeds the 20% reduction required from renewables.

This results in a 97% reduction in CO₂ emissions Kg/year and therefore exceeds the requirement for a 35% reduction in CO₂.

Please see below table 1 and 2 below for CO₂ savings based in tonnes per year. *(The CO₂ calculations in line with the Tables 1 and 2 of the GLA's planning guidance, March 2020).*

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

Table 2: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for domestic buildings

	Regulated domestic carbon dioxide savings	
	(Tonnes CO ₂ per annum)	(%)
Savings from energy demand reduction	3	38%
Savings from heat network / CHP	0	0%
Savings from renewable energy	5	59%
Cumulative on site savings	7	97%
Annual savings from off-set payment	0	-
	(Tonnes CO₂)	
Cumulative savings for off-set payment	8	-
Cash in-lieu contribution (£)	480	

	Total regulated emissions (Tonnes CO ₂ / year)	CO ₂ savings (Tonnes CO ₂ / year)	Percentage savings (%)
Part L 2013 baseline	8		
Be lean	5	3	38%
Be clean	5	0	0%
Be green	0	5	59%
	-	CO ₂ savings off-set (Tonnes CO ₂)	-
Off-set	-	8	-

9 Conclusion

There are proposals for the construction of 5 new terrace houses over two storeys (with a floor area of approximately 437m²) on land to the rear of 18 Denmark Street.

Under the Haringey District Council Core Strategy, the proposed development will aim to achieve a 35% saving in CO₂ emissions through the provision of renewable technologies with 20% reduction from low carbon or renewable technology.

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

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

The following Be Green has been used in the Energy Statement

- Solar PV 2.4kWp system per dwelling
- Facing in a southern direction at 30 degrees
- No shading
- ASHP

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

- Low fabric u-values
- High air tightness (air test of 3)
- Shower wastewater heat recovery.
- MVHR

SAP 2012 and SAP 10 carbon factors have been used to calculate both a baseline scenario (to meet Building Regulation requirements) and a scenario with Solar PV (2.4kWp system per dwelling, in a southerly direction) with an ASHP.

Through the incorporation of an ASHP with Solar PV and a fabric first approach, this results in a 97% reduction in CO₂ emissions with 58% from renewable technology and therefore exceeds the requirement for a 35% reduction in CO₂ emissions with 20% from renewables.

Appendices

Appendix A TER Worksheet - Baseline Scenario/DER Worksheet – Be Lean, With Energy Efficient Measures

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Property Reference	S11818 01			Issued on Date	21/02/2024
Assessment Reference	Be lean	Prop Type Ref			
Property	Denmark Street, N17 0JL				
SAP Rating	85 B	DER	14.87	TER	20.61
Environmental	88 B	% DER<TER	27.86		
CO ₂ Emissions (t/year)	1.03	DFEE	43.29	TFEE	67.71
General Requirements Compliance	Pass	% DFEE<TFEE	36.07		
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 87 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) 20.61 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 14.87 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 67.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE) 43.3 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.15 (max. 0.30)	0.15 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.10 (max. 0.25)	0.10 (max. 0.70)	OK
Roof	0.12 (max. 0.20)	0.12 (max. 0.35)	OK
Openings	1.20 (max. 2.00)	1.20 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated using user-specified ψ -value of 0.050

3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)
Maximum 10.0 OK

4 Heating efficiency

Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Potterton Assure 30 Combi
Combi boiler
Efficiency: 89.0% 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

Continuous supply and extract system
Specific fan power: 0.80
Maximum 1.5 OK
MVHR efficiency: 87%
Minimum: 70% OK

9 Summertime temperature

Overheating risk (Thames Valley): Slight OK

Based on:

Overshading: Average
Windows facing North: 1.08 m², No overhang
Windows facing South: 9.89 m², No overhang
Windows facing West: 7.80 m², No overhang
Air change rate: 5.00 ach
Blinds/curtains: None

10 Key features

Party wall U-value 0.00 W/m²K
Roof U-value 0.12 W/m²K
Roof U-value 0.12 W/m²K
Floor U-value 0.10 W/m²K
Exposed floor U-value 0.10 W/m²K
Door U-value 1.00 W/m²K
Air permeability 3.0 m³/m²h

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	51.5600 (1b)	x 2.6000 (2b)	= 134.0560 (1b) - (3b)
First floor	34.9800 (1c)	x 2.9000 (2c)	= 101.4420 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	86.5400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 235.4980 (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					0 * 10 = 0.0000 (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) =					0.0000 / (5) = 0.0000 (8)
Pressure test					Yes
Measured/design AP50					3.0000
Infiltration rate					0.1500 (18)
Number of sides sheltered					1 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.9250 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.1388 (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	0.1769	0.1734	0.1700	0.1526	0.1492	0.1318	0.1318	0.1283	0.1388	0.1492	0.1561	0.1630 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation:												0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												60.9000 (23c)
Effective ac	0.3724	0.3689	0.3655	0.3481	0.3447	0.3273	0.3273	0.3238	0.3343	0.3447	0.3516	0.3585 (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
Windows (Uw = 1.20)			18.7700	1.1450	21.4924		(27)
Roof light (Uw = 1.20)			2.2800	1.1450	2.6107		(27a)
Ground floor			51.1300	0.1000	5.1130		(28a)
Exposed floor			0.4300	0.1000	0.0430		(28b)
External wall	140.5300	18.7700	121.7600	0.1500	18.2640		(29a)
Flat roof	34.9800	2.2800	32.7000	0.1200	3.9240		(30)
Balcony roof	17.0000		17.0000	0.1200	2.0400		(30)
Total net area of external elements Aum(A, m ²)			244.0700				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		53.4871		(33)
Party Wall 1			13.2300	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (User defined value 0.050 * total exposed area)							12.2035 (36)
Total fabric heat loss						(33) + (36) =	65.6906 (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	28.9413	28.6717	28.4022	27.0543	26.7847	25.4369	25.4369	25.1673	25.9760	26.7847	27.3239	27.8630 (38)
Heat transfer coeff	94.6319	94.3623	94.0927	92.7449	92.4753	91.1274	91.1274	90.8579	91.6666	92.4753	93.0144	93.5536 (39)
Average = Sum(39)m / 12 =												92.6775 (39)
HLP	1.0935	1.0904	1.0873	1.0717	1.0686	1.0530	1.0530	1.0499	1.0592	1.0686	1.0748	1.0810 (40)
HLP (average)												1.0709 (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												2.5753 (42)
Average daily hot water use (litres/day)												95.3643 (43)
Daily hot water use	104.9007	101.0862	97.2716	93.4570	89.6424	85.8279	85.8279	89.6424	93.4570	97.2716	101.0862	104.9007 (44)
Energy conte	155.5647	136.0579	140.3996	122.4038	117.4493	101.3498	93.9155	107.7694	109.0565	127.0949	138.7340	150.6561 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum (45)m = 1500.4517 (45)
Distribution loss (46)m = 0.15 x (45)m												
23.3347	20.4087	21.0599	18.3606	17.6174	15.2025	14.0873	16.1654	16.3585	19.0642	20.8101	22.5984	(46)
Water storage loss:												
Total storage loss												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	16.9398	15.2965	16.9227	16.3609	16.8946	16.3362	16.8724	16.8868	16.3496	16.9111	16.3828	16.9354 (61)
Total heat required for water heating calculated for each month												
172.5046	151.3544	157.3223	138.7646	134.3439	117.6860	110.7879	124.6562	125.4062	144.0060	155.1168	167.5916	(62)
WWHRS	-40.1211	-35.3008	-36.0294	-29.6481	-27.5310	-22.7133	-19.2258	-23.2770	-23.9548	-29.6099	-34.2949	-38.7779 eq. (G10)
Total of WWHRS savings												-360.4839
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum (63)m =												0.0000 (63)
Output from w/h												
132.3835	116.0536	121.2930	109.1165	106.8129	94.9727	91.5621	101.3792	101.4513	114.3961	120.8218	128.8137	(64)
Heat gains from water heating, kWh/month												
55.9602	49.0634	50.9135	44.7895	43.2755	37.7829	35.4450	40.0550	40.3487	46.4868	50.2247	54.3270	(65)

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

Metabolic gains (Table 5), Watts												
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
128.7669	128.7669	128.7669	128.7669	128.7669	128.7669	128.7669	128.7669	128.7669	128.7669	128.7669	128.7669	128.7669 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
20.7335	18.4153	14.9763	11.3380	8.4753	7.1552	7.7315	10.0496	13.4886	17.1269	19.9896	21.3097	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
232.5663	234.9796	228.8982	215.9514	199.6085	184.2485	173.9871	171.5738	177.6552	190.6019	206.9449	222.3049	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
35.8767	35.8767	35.8767	35.8767	35.8767	35.8767	35.8767	35.8767	35.8767	35.8767	35.8767	35.8767	(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	(70)
Losses e.g. evaporation (negative values) (Table 5)												
-103.0135	-103.0135	-103.0135	-103.0135	-103.0135	-103.0135	-103.0135	-103.0135	-103.0135	-103.0135	-103.0135	-103.0135	(71)
Water heating gains (Table 5)												
75.2154	73.0110	68.4322	62.2076	58.1661	52.4762	47.6411	53.8374	56.0399	62.4823	69.7566	73.0202	(72)
Total internal gains	393.1452	391.0360	376.9367	354.1271	330.8800	308.5100	293.9897	300.0909	311.8138	334.8412	361.3211	381.2649 (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				1.0800	10.6334	0.6300	0.7000			0.7700			3.5097 (74)
South				9.8900	46.7521	0.6300	0.7000			0.7700			141.3087 (78)
West				7.8000	19.6403	0.6300	0.7000			0.7700			46.8181 (80)
Horizontal				2.2800	26.0000	0.6300	0.7000			1.0000			23.5282 (82)
Solar gains	215.1647	378.5869	543.8972	707.2070	815.1953	817.4902	784.8836	704.3608	601.1415	426.0002	260.0681	182.5341 (83)	
Total gains	608.3099	769.6228	920.8339	1061.3341	1146.0753	1126.0002	1078.8734	1004.4517	912.9553	760.8414	621.3892	563.7989 (84)	

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	63.5063	63.6878	63.8702	64.7984	64.9873	65.9486	65.9486	66.1442	65.5607	64.9873	64.6106	64.2383
alpha	5.2338	5.2459	5.2580	5.3199	5.3325	5.3966	5.3966	5.4096	5.3707	5.3325	5.3074	5.2826
util living area	0.9958	0.9859	0.9550	0.8643	0.7020	0.5107	0.3705	0.4140	0.6600	0.9226	0.9893	0.9971 (86)
MIT	19.9314	20.1656	20.4677	20.7744	20.9390	20.9909	20.9987	20.9976	20.9669	20.7138	20.2538	19.8905 (87)
Th 2	20.0061	20.0087	20.0112	20.0240	20.0266	20.0394	20.0394	20.0420	20.0343	20.0266	20.0215	20.0163 (88)
util rest of house	0.9945	0.9815	0.9417	0.8296	0.6431	0.4373	0.2902	0.3289	0.5803	0.8934	0.9852	0.9962 (89)
MIT 2	18.5907	18.9315	19.3614	19.7802	19.9734	20.0340	20.0389	20.0411	20.0114	19.7168	19.0711	18.5386 (90)
Living area fraction												
fLA = Living area / (4) =												0.1511 (91)
MIT	18.7933	19.1181	19.5286	19.9305	20.1193	20.1786	20.1840	20.1857	20.1558	19.8675	19.2499	18.7429 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.6433	18.9681	19.3786	19.7805	19.9693	20.0286	20.0340	20.0357	20.0058	19.7175	19.0999	18.5929 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9917	0.9751	0.9309	0.8198	0.6394	0.4364	0.2898	0.3283	0.5779	0.8820	0.9797	0.9941 (94)
Useful gains	603.2450	750.4597	857.2351	870.0665	732.8315	491.4046	312.6517	329.7867	527.5616	671.0257	608.7717	560.4869 (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	1357.3348	1327.4940	1211.7811	1009.1074	764.7087	494.6980	312.9310	330.3279	541.3659	843.1408	1116.1632	1346.5115 (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	561.0428	387.7671	263.7822	100.1095	23.7166	0.0000	0.0000	0.0000	0.0000	128.0536	365.3219	584.8023 (98)
Space heating												2414.5960 (98)
Space heating per m2												(98) / (4) = 27.9015 (99)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													89.9000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													2685.8687 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	561.0428	387.7671	263.7822	100.1095	23.7166	0.0000	0.0000	0.0000	0.0000	128.0536	365.3219	584.8023	(98)
Space heating efficiency (main heating system 1)	89.9000	89.9000	89.9000	89.9000	89.9000	0.0000	0.0000	0.0000	0.0000	89.9000	89.9000	89.9000	(210)
Space heating fuel (main heating system)	624.0743	431.3316	293.4174	111.3565	26.3811	0.0000	0.0000	0.0000	0.0000	142.4401	406.3647	650.5031	(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	132.3835	116.0536	121.2930	109.1165	106.8129	94.9727	91.5621	101.3792	101.4513	114.3961	120.8218	128.8137	(64)
Efficiency of water heater (217)m	89.2710	89.1421	88.8669	88.2022	87.2644	86.7000	86.7000	86.7000	86.7000	88.3612	89.0828	86.7000	(216)
Fuel for water heating, kWh/month	148.2940	130.1894	136.4884	123.7118	122.4015	109.5418	105.6080	116.9310	117.0142	129.4642	135.6286	144.2401	(219)
Water heating fuel used												1519.5131	(219)
Annual totals kWh/year													
Space heating fuel - main system												2685.8687	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 1.0000)													
mechanical ventilation fans (SFP = 1.0000)													287.3076 (230a)
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
Total electricity for the above, kWh/year													362.3076 (231)
Electricity for lighting (calculated in Appendix L)													366.1593 (232)
Total delivered energy for all uses													4933.8487 (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	2685.8687	0.2160	580.1476 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1519.5131	0.2160	328.2148 (264)
Space and water heating			908.3625 (265)
Pumps and fans	362.3076	0.5190	188.0376 (267)
Energy for lighting	366.1593	0.5190	190.0367 (268)
Total CO2, kg/year			1286.4368 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			14.8700 (273)

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

DER			14.8700 ZC1
Total Floor Area		TFA	86.5400
Assumed number of occupants		N	2.5753
CO2 emission factor in Table 12 for electricity displaced from grid		EF	0.5190
CO2 emissions from appliances, equation (L14)			15.9249 ZC2
CO2 emissions from cooking, equation (L16)			2.0893 ZC3
Total CO2 emissions			32.8842 ZC4
Residual CO2 emissions offset from biofuel CHP			0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year			0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation			0.0000 ZC7
Net CO2 emissions			32.8842 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	51.5600 (1b)	x 2.6000 (2b)	= 134.0560 (1b) - (3b)
First floor	34.9800 (1c)	x 2.9000 (2c)	= 101.4420 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	86.5400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 235.4980 (5)

2. Ventilation rate

										main	secondary	other	total	m3 per hour				
										heating	heating							
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) =	0.1274 (8)	
Pressure test																Yes		
Measured/design AP50																	5.0000	
Infiltration rate																	0.3774 (18)	
Number of sides sheltered																	1 (19)	
Shelter factor															(20) = 1 - [0.075 x (19)] =		0.9250 (20)	
Infiltration rate adjusted to include shelter factor															(21) = (18) x (20) =		0.3491 (21)	
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec						
	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	0.4451	0.4364	0.4276	0.3840	0.3753	0.3316	0.3316	0.3229	0.3491	0.3753	0.3927	0.4102	(22b)					
Effective ac	0.5990	0.5952	0.5914	0.5737	0.5704	0.5550	0.5550	0.5521	0.5609	0.5704	0.5771	0.5841	(25)					

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
TER Opening Type (Uw = 1.40)			18.7700	1.3258	24.8845		(27)					
TER Room Window (Uw = 1.70)			2.2800	1.5918	3.6292		(27a)					
Ground floor			51.1300	0.1300	6.6469		(28a)					
Exposed floor			0.4300	0.1300	0.0559		(28b)					
External wall	140.5300	18.7700	121.7600	0.1800	21.9168		(29a)					
Flat roof	34.9800	2.2800	32.7000	0.1300	4.2510		(30)					
Balcony roof	17.0000		17.0000	0.1300	2.2100		(30)					
Total net area of external elements Aum(A, m2)			244.0700				(31)					
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		63.5943		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							25.4630 (36)					
Total fabric heat loss						(33) + (36) =	89.0573 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 46.5548	Feb 46.2559	Mar 45.9629	Apr 44.5867	May 44.3292	Jun 43.1307	Jul 43.1307	Aug 42.9087	Sep 43.5923	Oct 44.3292	Nov 44.8501	Dec 45.3946 (38)
Heat transfer coeff	135.6120	135.3131	135.0202	133.6440	133.3865	132.1879	132.1879	131.9660	132.6496	133.3865	133.9074	134.4519 (39)
Average = Sum(39)m / 12 =												133.6428 (39)
HLP	Jan 1.5670	Feb 1.5636	Mar 1.5602	Apr 1.5443	May 1.5413	Jun 1.5275	Jul 1.5275	Aug 1.5249	Sep 1.5328	Oct 1.5413	Nov 1.5473	Dec 1.5536 (40)
HLP (average)												1.5443 (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												2.5753 (42)
Average daily hot water use (litres/day)												95.3643 (43)
Daily hot water use	Jan 104.9007	Feb 101.0862	Mar 97.2716	Apr 93.4570	May 89.6424	Jun 85.8279	Jul 85.8279	Aug 89.6424	Sep 93.4570	Oct 97.2716	Nov 101.0862	Dec 104.9007 (44)
Energy conte	155.5647	136.0579	140.3996	122.4038	117.4493	101.3498	93.9155	107.7694	109.0565	127.0949	138.7340	150.6561 (45)
Energy content (annual)												1500.4517 (45)
Distribution loss (46)m = 0.15 x (45)m												
23.3347	20.4087	21.0599	18.3606	17.6174	15.2025	14.0873	16.1654	16.3585	19.0642	20.8101	22.5984 (46)	
Water storage loss:												
Total storage loss												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	50.9589	46.0274	49.5685	46.0884	45.6808	42.3261	43.7369	45.6808	46.0884	49.5685	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month	206.5236	182.0853	189.9681	168.4921	163.1301	143.6759	137.6525	153.4502	155.1449	176.6634	188.0491	201.6150 (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	206.5236	182.0853	189.9681	168.4921	163.1301	143.6759	137.6525	153.4502	155.1449	176.6634	188.0491	201.6150 (64)
Heat gains from water heating, kWh/month	64.4650	56.7461	59.0750	52.2213	50.4721	44.2803	42.1611	47.2535	47.7834	54.6512	58.4578	62.8329 (65)
Total per year (kWh/year) = Sum(63)m = 2066.4504 (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)
(66)m	128.7669	128.7669	128.7669	128.7669	128.7669	128.7669	128.7669	128.7669	128.7669	128.7669	128.7669	128.7669	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.7335	18.4153	14.9763	11.3380	8.4753	7.1552	7.7315	10.0496	13.4886	17.1269	19.9896	21.3097	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	232.5663	234.9796	228.8982	215.9514	199.6085	184.2485	173.9871	171.5738	177.6552	190.6019	206.9449	222.3049	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.8767	35.8767	35.8767	35.8767	35.8767	35.8767	35.8767	35.8767	35.8767	35.8767	35.8767	35.8767	(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)	-103.0135	-103.0135	-103.0135	-103.0135	-103.0135	-103.0135	-103.0135	-103.0135	-103.0135	-103.0135	-103.0135	-103.0135	(71)
Water heating gains (Table 5)	86.6465	84.4436	79.4019	72.5296	67.8388	61.5005	56.6682	63.5128	66.3658	73.4559	81.1914	84.4528	(72)
Total internal gains	404.5764	402.4686	387.9064	364.4492	340.5528	317.5343	303.0168	309.7663	322.1397	345.8148	372.7560	392.6975	(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			1.0800		10.6334	0.6300		0.7000		0.7700		3.5097 (74)
South			9.8900		46.7521	0.6300		0.7000		0.7700		141.3087 (78)
West			7.8000		19.6403	0.6300		0.7000		0.7700		46.8181 (80)
Horizontal			2.2800		26.0000	0.6300		0.7000		1.0000		23.5282 (82)
Solar gains	215.1647	378.5869	543.8972	707.2070	815.1953	817.4902	784.8836	704.3608	601.1415	426.0002	260.0681	182.5341 (83)
Total gains	619.7411	781.0555	931.8036	1071.6562	1155.7481	1135.0245	1087.9004	1014.1271	923.2812	771.8150	632.8240	575.2315 (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	44.3155	44.4134	44.5098	44.9681	45.0549	45.4635	45.4635	45.5399	45.3052	45.0549	44.8797	44.6979	
alpha	3.9544	3.9609	3.9673	3.9979	4.0037	4.0309	4.0309	4.0360	4.0203	4.0037	3.9920	3.9799	
util living area	0.9957	0.9889	0.9717	0.9253	0.8274	0.6702	0.5138	0.5658	0.7973	0.9552	0.9911	0.9968	(86)
MIT	19.3381	19.5809	19.9374	20.3667	20.7121	20.9133	20.9770	20.9663	20.8183	20.3415	19.7511	19.2962	(87)
Th 2	19.6376	19.6401	19.6426	19.6544	19.6566	19.6670	19.6670	19.6689	19.6630	19.6566	19.6522	19.6475	(88)
util rest of house	0.9941	0.9850	0.9616	0.8977	0.7647	0.5591	0.3683	0.4175	0.7027	0.9328	0.9873	0.9956	(89)
MIT 2	17.4751	17.8292	18.3433	18.9497	19.3932	19.6146	19.6598	19.6570	19.5306	18.9324	18.0869	17.4203	(90)
Living area fraction	17.7567	18.0939	18.5842	19.1639	19.5926	19.8109	19.8589	19.8549	19.7252	19.1454	18.3384	17.7038	(92)
Temperature adjustment	17.7567	18.0939	18.5842	19.1639	19.5926	19.8109	19.8589	19.8549	19.7252	19.1454	18.3384	17.7038	(93)
adjusted MIT	17.7567	18.0939	18.5842	19.1639	19.5926	19.8109	19.8589	19.8549	19.7252	19.1454	18.3384	17.7038	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9907	0.9784	0.9505	0.8850	0.7612	0.5722	0.3902	0.4396	0.7079	0.9210	0.9815	0.9929	(94)
Useful gains	613.9949	764.1521	885.6505	948.3826	879.7324	649.4548	424.5122	445.7851	653.6012	710.8354	621.1228	571.1660	(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	1824.8873	1785.3115	1631.6162	1371.7099	1052.7620	688.8123	430.7886	455.9272	746.1818	1139.8444	1504.9060	1815.6164	(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	900.9040	686.2191	554.9986	304.7956	128.7340	0.0000	0.0000	0.0000	0.0000	319.1827	636.3239	925.8711	(98)
Space heating												4457.0290	(98)
Space heating per m2												51.5025	(99)
										(98) / (4) =			

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 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 %)													93.4000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													4771.9796 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	900.9040	686.2191	554.9986	304.7956	128.7340	0.0000	0.0000	0.0000	0.0000	319.1827	636.3239	925.8711	(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)	964.5653	734.7099	594.2169	326.3337	137.8308	0.0000	0.0000	0.0000	0.0000	341.7373	681.2890	991.2967	(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	206.5236	182.0853	189.9681	168.4921	163.1301	143.6759	137.6525	153.4502	155.1449	176.6634	188.0491	201.6150	(64)
Efficiency of water heater (217)m	88.3281	88.0769	87.5906	86.5256	84.4622	80.3000	80.3000	80.3000	80.3000	86.5226	87.8786	88.4115	(216)
Fuel for water heating, kWh/month	233.8141	206.7345	216.8817	194.7310	193.1397	178.9239	171.4227	191.0962	193.2066	204.1817	213.9873	228.0417	(219)
Water heating fuel used												2426.1611	(219)
Annual totals kWh/year													
Space heating fuel - main system												4771.9796	(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)												366.1593	(232)
Total delivered energy for all uses												7639.3000	(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	4771.9796	0.2160	1030.7476 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2426.1611	0.2160	524.0508 (264)
Space and water heating			1554.7984 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	366.1593	0.5190	190.0367 (268)
Total CO2, kg/m2/year			1783.7601 (272)
Emissions per m2 for space and water heating			17.9662 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.1959 (272b)
Emissions per m2 for pumps and fans			0.4498 (272c)
Target Carbon Dioxide Emission Rate (TER) = (17.9662 * 1.00) + 2.1959 + 0.4498, rounded to 2 d.p.			20.6100 (273)

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

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Property Reference	S11818 01			Issued on Date	21/02/2024
Assessment Reference	Be Green ASHP	Prop Type Ref			
Property	Denmark Street, N17 0JL				
SAP Rating	100 A	DER	2.08	TER	30.09
Environmental	100 A	% DER<TER	93.09		
CO ₂ Emissions (t/year)	-0.14	DFEE	43.29	TFEE	67.71
General Requirements Compliance	Pass	% DFEE<TFEE	36.07		
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 87 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:Electricity

Fuel factor:1.55 (electricity)

Target Carbon Dioxide Emission Rate (TER) 30.09 kgCO₂/m²

Dwelling Carbon Dioxide Emission Rate (DER) 2.08 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)67.7 kWh/m²/yr

Dwelling Fabric Energy Efficiency (DFEE)43.3 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.15 (max. 0.30)	0.15 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.10 (max. 0.25)	0.10 (max. 0.70)	OK
Roof	0.12 (max. 0.20)	0.12 (max. 0.35)	OK
Openings	1.20 (max. 2.00)	1.20 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated using user-specified y-value of 0.050

3 Air permeability

Air permeability at 50 pascals:	3.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main heating system: Heat pump with radiators or underfloor - Electric
Mitsubishi Electric Ecodan 8.5 kW PUZ-WM85VAA

Secondary heating system: None

5 Cylinder insulation

Hot water storage	Nominal cylinder loss: 1.74 kWh/day	
Permitted by DBSCG 2.24	OK	
Primary pipework insulated:	Yes	OK

6 Controls

Space heating controls:	Time and temperature zone control	OK
Hot water controls:	Cylinderstat	OK
	Independent timer for DHW	OK

7 Low energy lights

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

8 Mechanical ventilation

Continuous supply and extract system		
Specific fan power:	0.80	
Maximum	1.5	OK
MVHR efficiency:	87%	
Minimum:	70%	OK

9 Summertime temperature

Overheating risk (Thames Valley):	Slight	OK
Based on:		
Overshading:	Average	
Windows facing North:	1.08 m ² , No overhang	
Windows facing South:	9.89 m ² , No overhang	
Windows facing West:	7.80 m ² , No overhang	
Air change rate:	5.00 ach	
Blinds/curtains:	None	

10 Key features

Party wall U-value	0.00 W/m ² K
Roof U-value	0.12 W/m ² K
Roof U-value	0.12 W/m ² K
Floor U-value	0.10 W/m ² K
Exposed floor U-value	0.10 W/m ² K
Door U-value	1.00 W/m ² K
Air permeability	3.0 m ³ /m ² h
Photovoltaic array	2.40 kW

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	51.5600 (1b)	x 2.6000 (2b)	= 134.0560 (1b) - (3b)
First floor	34.9800 (1c)	x 2.9000 (2c)	= 101.4420 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	86.5400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 235.4980 (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					0 * 10 = 0.0000 (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) =					0.0000 / (5) = 0.0000 (8)
Pressure test					Yes
Measured/design AP50					3.0000
Infiltration rate					0.1500 (18)
Number of sides sheltered					1 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.9250 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.1388 (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	0.1769	0.1734	0.1700	0.1526	0.1492	0.1318	0.1318	0.1283	0.1388	0.1492	0.1561	0.1630 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation:												0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												60.9000 (23c)
Effective ac	0.3724	0.3689	0.3655	0.3481	0.3447	0.3273	0.3273	0.3238	0.3343	0.3447	0.3516	0.3585 (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
Windows (Uw = 1.20)			18.7700	1.1450	21.4924		(27)
Roof light (Uw = 1.20)			2.2800	1.1450	2.6107		(27a)
Ground floor			51.1300	0.1000	5.1130		(28a)
Exposed floor			0.4300	0.1000	0.0430		(28b)
External wall	140.5300	18.7700	121.7600	0.1500	18.2640		(29a)
Flat roof	34.9800	2.2800	32.7000	0.1200	3.9240		(30)
Balcony roof	17.0000		17.0000	0.1200	2.0400		(30)
Total net area of external elements Aum(A, m ²)			244.0700				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		53.4871		(33)
Party Wall 1			13.2300	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (User defined value 0.050 * total exposed area)							12.2035 (36)
Total fabric heat loss						(33) + (36) =	65.6906 (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	28.9413	28.6717	28.4022	27.0543	26.7847	25.4369	25.4369	25.1673	25.9760	26.7847	27.3239	27.8630 (38)
Heat transfer coeff	94.6319	94.3623	94.0927	92.7449	92.4753	91.1274	91.1274	90.8579	91.6666	92.4753	93.0144	93.5536 (39)
Average = Sum(39)m / 12 =												92.6775 (39)
HLP	1.0935	1.0904	1.0873	1.0717	1.0686	1.0530	1.0530	1.0499	1.0592	1.0686	1.0748	1.0810 (40)
HLP (average)												1.0709 (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												2.5753 (42)
Average daily hot water use (litres/day)												95.3643 (43)
Daily hot water use	104.9007	101.0862	97.2716	93.4570	89.6424	85.8279	85.8279	89.6424	93.4570	97.2716	101.0862	104.9007 (44)
Energy conte	155.5647	136.0579	140.3996	122.4038	117.4493	101.3498	93.9155	107.7694	109.0565	127.0949	138.7340	150.6561 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum (45)m =	1500.4517 (45)
Distribution loss (46)m = 0.15 x (45)m													
23.3347	20.4087	21.0599	18.3606	17.6174	15.2025	14.0873	16.1654	16.3585	19.0642	20.8101	22.5984	(46)	
Water storage loss:													
Store volume												200.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0103	(51)
Volume factor from Table 2a												0.8434	(52)
Temperature factor from Table 2b												0.5400	(53)
Enter (49) or (54) in (55)												0.9372	(55)
Total storage loss													
29.0527	26.2411	29.0527	28.1155	29.0527	28.1155	29.0527	29.0527	28.1155	29.0527	28.1155	29.0527	(56)	
If cylinder contains dedicated solar storage													
29.0527	26.2411	29.0527	28.1155	29.0527	28.1155	29.0527	29.0527	28.1155	29.0527	28.1155	29.0527	(57)	
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	(59)	
Total heat required for water heating calculated for each month													
207.8798	183.3103	192.7147	173.0313	169.7644	151.9773	146.2306	160.0845	159.6840	179.4100	189.3615	202.9712	(62)	
WWHRS	-40.1211	-35.3008	-36.0294	-29.6481	-27.5310	-22.7133	-19.2258	-23.2770	-23.9548	-29.6099	-34.2949	-38.7779	eq. (G10)
Total of WWHRS savings												-360.4839	
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)	
Output from w/h	167.7588	148.0095	156.6853	143.3832	142.2334	129.2641	127.0048	136.8075	135.7292	149.8001	155.0666	164.1933	(64)
Heat gains from water heating, kWh/month	93.5773	83.0411	88.5349	81.2013	80.9040	74.2008	73.0790	77.6854	76.7633	84.1111	86.6311	91.9452	(65)
93.5773	83.0411	88.5349	81.2013	80.9040	74.2008	73.0790	77.6854	76.7633	84.1111	86.6311	91.9452	(65)	

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

Metabolic gains (Table 5), Watts													
(66)m	128.7669	128.7669	128.7669	128.7669	128.7669	128.7669	128.7669	128.7669	128.7669	128.7669	128.7669	(66)	
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.7335	18.4153	14.9763	11.3380	8.4753	7.1552	7.7315	10.0496	13.4886	17.1269	19.9896	21.3097	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	232.5663	234.9796	228.8982	215.9514	199.6085	184.2485	173.9871	171.5738	177.6552	190.6019	206.9449	222.3049	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.8767	35.8767	35.8767	35.8767	35.8767	35.8767	35.8767	35.8767	35.8767	35.8767	35.8767	35.8767	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-103.0135	-103.0135	-103.0135	-103.0135	-103.0135	-103.0135	-103.0135	-103.0135	-103.0135	-103.0135	-103.0135	-103.0135	(71)
Water heating gains (Table 5)	125.7760	123.5731	118.9986	112.7795	108.7419	103.0567	98.2244	104.4159	106.6157	113.0526	120.3209	123.5823	(72)
Total internal gains	440.7059	438.5981	424.5031	401.6991	378.4558	356.0905	341.5730	347.6693	359.3896	382.4115	408.8855	428.8270	(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					1.0800	10.6334	0.6300	0.7000			0.7700			3.5097 (74)
South					9.8900	46.7521	0.6300	0.7000			0.7700			141.3087 (78)
West					7.8000	19.6403	0.6300	0.7000			0.7700			46.8181 (80)
Horizontal					2.2800	26.0000	0.6300	0.7000			1.0000			23.5282 (82)

Solar gains	215.1647	378.5869	543.8972	707.2070	815.1953	817.4902	784.8836	704.3608	601.1415	426.0002	260.0681	182.5341 (83)		
Total gains	655.8706	817.1850	968.4003	1108.9060	1193.6512	1173.5807	1126.4567	1052.0302	960.5311	808.4117	668.9535	611.3610 (84)		

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
tau	63.5063	63.6878	63.8702	64.7984	64.9873	65.9486	65.9486	66.1442	65.5607	64.9873	64.6106	64.2383	
alpha	5.2338	5.2459	5.2580	5.3199	5.3325	5.3966	5.3966	5.4096	5.3707	5.3325	5.3074	5.2826	
util living area	0.9941	0.9818	0.9458	0.8467	0.6804	0.4911	0.3551	0.3956	0.6329	0.9053	0.9852	0.9958	(86)
Tweekday	18.6643	18.9997	19.4158	19.8086	19.9812	20.0350	20.0390	20.0413	20.0158	19.7575	19.1407	18.6132	
Tweekend	20.3419	20.4915	20.6818	20.8696	20.9659	20.9951	20.9993	20.9988	20.9824	20.8363	20.5491	20.3159	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	19.9844	20.2134	20.5088	20.7964	20.9474	20.9925	20.9989	20.9981	20.9726	20.7474	20.2960	19.9442	(87)
Th 2	20.0061	20.0087	20.0112	20.0240	20.0266	20.0394	20.0394	20.0420	20.0343	20.0266	20.0215	20.0163	(88)
util rest of house	0.9922	0.9762	0.9304	0.8099	0.6215	0.4200	0.2780	0.3141	0.5544	0.8720	0.9797	0.9945	(89)
Tweekday	18.6643	18.9997	19.4158	19.8086	19.9812	20.0350	20.0390	20.0413	20.0158	19.7575	19.1407	18.6132	
Tweekend	18.6643	18.9997	19.4158	19.8086	19.9812	20.0350	20.0390	20.0413	20.0158	19.7575	19.1407	18.6132	
MIT 2	18.6643	18.9997	19.4158	19.8086	19.9812	20.0350	20.0390	20.0413	20.0158	19.7575	19.1407	18.6132	(90)
Living area fraction												0.1511	(91)
MIT	18.8638	19.1831	19.5810	19.9579	20.1272	20.1797	20.1841	20.1859	20.1604	19.9071	19.3153	18.8144	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8638	19.1831	19.5810	19.9579	20.1272	20.1797	20.1841	20.1859	20.1604	19.9071	19.3153	18.8144	(93)

8. Space heating requirement

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9891	0.9702	0.9222	0.8071	0.6279	0.4306	0.2897	0.3264	0.5651	0.8672	0.9744	0.9921	(94)
Useful gains	648.7478	792.8040	893.0892	895.0350	749.4548	505.2897	326.3195	343.4293	542.7716	701.0771	651.8091	606.5171	(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	1378.1999	1347.7866	1230.8249	1025.5616	779.3088	508.4621	326.6105	343.9770	555.5352	860.6790	1136.2038	1367.2247	(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	542.7124	372.9483	251.2753	93.9791	22.2113	0.0000	0.0000	0.0000	0.0000	118.7439	348.7642	565.9665	(98)
Space heating												2316.6010	(98)
Space heating per m2											(98) / (4) =	26.7691	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000	(201)
Fraction of space heat from main system(s)													1.0000	(202)
Efficiency of main space heating system 1 (in %)													202.1626	(206)
Efficiency of secondary/supplementary heating system, %													100.0000	(208)
Space heating requirement													1145.9096	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	542.7124	372.9483	251.2753	93.9791	22.2113	0.0000	0.0000	0.0000	0.0000	118.7439	348.7642	565.9665	(98)	
Space heating efficiency (main heating system 1)	202.1626	202.1626	202.1626	202.1626	202.1626	0.0000	0.0000	0.0000	0.0000	202.1626	202.1626	202.1626	(210)	
Space heating fuel (main heating system)	268.4534	184.4794	124.2937	46.4869	10.9869	0.0000	0.0000	0.0000	0.0000	58.7368	172.5166	279.9560	(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														
Water heating requirement	167.7588	148.0095	156.6853	143.3832	142.2334	129.2641	127.0048	136.8075	135.7292	149.8001	155.0666	164.1933	(64)	
Efficiency of water heater	282.8150	282.8150	282.8150	282.8150	282.8150	282.8150	282.8150	282.8150	282.8150	282.8150	282.8150	282.8150	(216)	
(217)m	282.8150	282.8150	282.8150	282.8150	282.8150	282.8150	282.8150	282.8150	282.8150	282.8150	282.8150	282.8150	(217)	
Fuel for water heating, kWh/month	59.3175	52.3344	55.4020	50.6986	50.2920	45.7062	44.9074	48.3735	47.9922	52.9675	54.8297	58.0568	(219)	
Water heating fuel used												620.8778	(219)	
Annual totals kWh/year														
Space heating fuel - main system												1145.9096	(211)	
Space heating fuel - secondary												0.0000	(215)	
Electricity for pumps and fans:														
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 1.0000)														
mechanical ventilation fans (SFP = 1.0000)													287.3076	(230a)
Total electricity for the above, kWh/year													287.3076	(231)
Electricity for lighting (calculated in Appendix L)													366.1593	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV Unit 0 (0.80 * 2.40 * 1080 * 1.00) =										-2072.6873		-2072.6873	(233)	
Total delivered energy for all uses												347.5671	(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	1145.9096	0.5190	594.7271 (261)
Space heating - secondary	0.0000	0.5190	0.0000 (263)
Water heating (other fuel)	620.8778	0.5190	322.2356 (264)
Space and water heating			916.9627 (265)
Pumps and fans	287.3076	0.5190	149.1126 (267)
Energy for lighting	366.1593	0.5190	190.0367 (268)
Energy saving/generation technologies			
PV Unit	-2072.6873	0.5190	-1075.7247 (269)
Total CO2, kg/year			180.3873 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			2.0800 (273)

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

DER		2.0800	ZC1
Total Floor Area		86.5400	
Assumed number of occupants		2.5753	
CO2 emission factor in Table 12 for electricity displaced from grid		0.5190	
CO2 emissions from appliances, equation (L14)		15.9249	ZC2
CO2 emissions from cooking, equation (L16)		2.0893	ZC3
Total CO2 emissions		20.0942	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		20.0942	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	51.5600 (1b)	x 2.6000 (2b)	= 134.0560 (1b) - (3b)
First floor	34.9800 (1c)	x 2.9000 (2c)	= 101.4420 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	86.5400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 235.4980 (5)

2. Ventilation rate

										main	secondary	other	total	m3 per hour
										heating	heating			
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) =	0.1274 (8)	
Pressure test												Yes		
Measured/design AP50												5.0000		
Infiltration rate												0.3774 (18)		
Number of sides sheltered												1 (19)		
Shelter factor											(20) = 1 - [0.075 x (19)] =	0.9250 (20)		
Infiltration rate adjusted to include shelter factor											(21) = (18) x (20) =	0.3491 (21)		
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
	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	0.4451	0.4364	0.4276	0.3840	0.3753	0.3316	0.3316	0.3229	0.3491	0.3753	0.3927	0.4102 (22b)		
Effective ac	0.5990	0.5952	0.5914	0.5737	0.5704	0.5550	0.5550	0.5521	0.5609	0.5704	0.5771	0.5841 (25)		

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
TER Opening Type (Uw = 1.40)			18.7700	1.3258	24.8845		(27)					
TER Room Window (Uw = 1.70)			2.2800	1.5918	3.6292		(27a)					
Ground floor			51.1300	0.1300	6.6469		(28a)					
Exposed floor			0.4300	0.1300	0.0559		(28b)					
External wall	140.5300	18.7700	121.7600	0.1800	21.9168		(29a)					
Flat roof	34.9800	2.2800	32.7000	0.1300	4.2510		(30)					
Balcony roof	17.0000		17.0000	0.1300	2.2100		(30)					
Total net area of external elements Aum(A, m2)			244.0700				(31)					
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		63.5943		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							25.4630 (36)					
Total fabric heat loss						(33) + (36) =	89.0573 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 46.5548	Feb 46.2559	Mar 45.9629	Apr 44.5867	May 44.3292	Jun 43.1307	Jul 43.1307	Aug 42.9087	Sep 43.5923	Oct 44.3292	Nov 44.8501	Dec 45.3946 (38)
Heat transfer coeff	135.6120	135.3131	135.0202	133.6440	133.3865	132.1879	132.1879	131.9660	132.6496	133.3865	133.9074	134.4519 (39)
Average = Sum(39)m / 12 =												133.6428 (39)
HLP	Jan 1.5670	Feb 1.5636	Mar 1.5602	Apr 1.5443	May 1.5413	Jun 1.5275	Jul 1.5275	Aug 1.5249	Sep 1.5328	Oct 1.5413	Nov 1.5473	Dec 1.5536 (40)
HLP (average)												1.5443 (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												2.5753 (42)
Average daily hot water use (litres/day)												95.3643 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	104.9007	101.0862	97.2716	93.4570	89.6424	85.8279	85.8279	89.6424	93.4570	97.2716	101.0862	104.9007 (44)
Energy conte	155.5647	136.0579	140.3996	122.4038	117.4493	101.3498	93.9155	107.7694	109.0565	127.0949	138.7340	150.6561 (45)
Energy content (annual)	Total = Sum(45)m =											1500.4517 (45)
Distribution loss	(46)m = 0.15 x (45)m											
	23.3347	20.4087	21.0599	18.3606	17.6174	15.2025	14.0873	16.1654	16.3585	19.0642	20.8101	22.5984 (46)
Water storage loss:												
Store volume												200.0000 (47)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

a) If manufacturer declared loss factor is known (kWh/day):	1.6525 (48)
Temperature factor from Table 2b	0.5400 (49)
Enter (49) or (54) in (55)	0.8924 (55)
Total storage loss	
27.6637 24.9865 27.6637 26.7713 27.6637 26.7713 27.6637 26.7713 27.6637 26.7713 27.6637 26.7713	27.6637 (56)
If cylinder contains dedicated solar storage	
27.6637 24.9865 27.6637 26.7713 27.6637 26.7713 27.6637 26.7713 27.6637 26.7713 27.6637 26.7713	27.6637 (57)
Primary loss	23.2624 (59)
Total heat required for water heating calculated for each month	
206.4908 182.0557 191.3257 171.6871 168.3754 150.6331 144.8416 158.6955 158.3398 178.0210 188.0173 201.5822	(62)
Solar input	0.0000 (63)
Solar input (sum of months) = Sum(63)m =	0.0000 (63)
Output from w/h	
206.4908 182.0557 191.3257 171.6871 168.3754 150.6331 144.8416 158.6955 158.3398 178.0210 188.0173 201.5822	(64)
Heat gains from water heating, kWh/month	2100.0651 (64)
92.4661 82.0375 87.4237 80.1259 79.7928 73.1255 71.9678 76.5742 75.6879 82.9999 85.5557 90.8340	(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 128.7669 128.7669 128.7669 128.7669 128.7669 128.7669 128.7669 128.7669 128.7669 128.7669 128.7669 128.7669	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	
20.7335 18.4153 14.9763 11.3380 8.4753 7.1552 7.7315 10.0496 13.4886 17.1269 19.9896 21.3097	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	
232.5663 234.9796 228.8982 215.9514 199.6085 184.2485 173.9871 171.5738 177.6552 190.6019 206.9449 222.3049	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	
35.8767 35.8767 35.8767 35.8767 35.8767 35.8767 35.8767 35.8767 35.8767 35.8767 35.8767 35.8767	(69)
Pumps, fans	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	
-103.0135 -103.0135 -103.0135 -103.0135 -103.0135 -103.0135 -103.0135 -103.0135 -103.0135 -103.0135 -103.0135 -103.0135	(71)
Water heating gains (Table 5)	
124.2824 122.0795 117.5050 111.2860 107.2483 101.5631 96.7309 102.9223 105.1221 111.5590 118.8274 122.0887	(72)
Total internal gains	
442.2123 440.1045 426.0096 403.2055 379.9623 357.5969 343.0795 349.1758 360.8960 383.9179 410.3919 430.3334	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data g or Table 6b	Specific data or Table 6c	Access factor Table 6d	Gains W
North	1.0800	10.6334	0.6300	0.7000	0.7700	3.5097 (74)
South	9.8900	46.7521	0.6300	0.7000	0.7700	141.3087 (78)
West	7.8000	19.6403	0.6300	0.7000	0.7700	46.8181 (80)
Horizontal	2.2800	26.0000	0.6300	0.7000	1.0000	23.5282 (82)

Solar gains	215.1647 378.5869 543.8972 707.2070 815.1953 817.4902 784.8836 704.3608 601.1415 426.0002 260.0681 182.5341	(83)
Total gains	657.3770 818.6914 969.9067 1110.4125 1195.1576 1175.0871 1127.9631 1053.5366 962.0375 809.9181 670.4600 612.8675	(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 44.3155 44.4134 44.5098 44.9681 45.0549 45.4635 45.4635 45.5399 45.3052 45.0549 44.8797 44.6979	
alpha 3.9544 3.9609 3.9673 3.9979 4.0037 4.0309 4.0309 4.0360 4.0203 4.0037 3.9920 3.9799	
util living area	
0.9947 0.9870 0.9679 0.9177 0.8148 0.6536 0.4977 0.5481 0.7804 0.9482 0.9891 0.9959	(86)
MIT 19.3753 19.6169 19.9710 20.3945 20.7298 20.9209 20.9795 20.9699 20.8331 20.3727 19.7875 19.3336	(87)
Th 2 19.6376 19.6401 19.6426 19.6544 19.6566 19.6670 19.6670 19.6689 19.6630 19.6566 19.6522 19.6475	(88)
util rest of house	
0.9928 0.9825 0.9566 0.8881 0.7500 0.5430 0.3557 0.4028 0.6834 0.9231 0.9845 0.9945	(89)
MIT 2 17.5290 17.8809 18.3903 18.9855 19.4120 19.6197 19.6607 19.6584 19.5435 18.9736 18.1392 17.4748	(90)
Living area fraction	
MIT 17.8081 18.1433 18.6292 19.1984 19.6112 19.8164 19.8600 19.8567 19.7384 19.1850 18.3883 17.7557	(91)
Temperature adjustment	0.0000
adjusted MIT 17.8081 18.1433 18.6292 19.1984 19.6112 19.8164 19.8600 19.8567 19.7384 19.1850 18.3883 17.7557	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9888	0.9751	0.9449	0.8755	0.7475	0.5564	0.3771	0.4245	0.6898	0.9111	0.9779	0.9913	(94)
Useful gains	650.0067	798.2984	916.4498	972.2082	893.3988	653.8718	425.3817	447.2075	663.6027	737.9441	655.6703	607.5278	(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													
	1831.8595	1791.9859	1637.6924	1376.3253	1055.2449	689.5434	430.9325	456.1604	747.9305	1145.1270	1511.5906	1822.5930	(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													
	879.2985	667.7580	536.6045	290.9643	120.4135	0.0000	0.0000	0.0000	0.0000	302.9441	616.2626	904.0085	(98)
Space heating												4318.2541	(99)
Space heating per m2													(98) / (4) = 49.8989 (99)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

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

0.0000 (201)

Fraction of space heat from main system(s)

1.0000 (202)

Efficiency of main space heating system 1 (in %)

93.5000 (206)

Efficiency of secondary/supplementary heating system, %

0.0000 (208)

Space heating requirement

4618.4536 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	879.2985	667.7580	536.6045	290.9643	120.4135	0.0000	0.0000	0.0000	0.0000	302.9441	616.2626	904.0085	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)	940.4262	714.1797	573.9086	311.1918	128.7845	0.0000	0.0000	0.0000	0.0000	324.0044	659.1044	966.8540	(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	206.4908	182.0557	191.3257	171.6871	168.3754	150.6331	144.8416	158.6955	158.3398	178.0210	188.0173	201.5822	(64)
Efficiency of water heater (217)m	88.2497	87.9730	87.4191	86.2103	83.9380	79.8000	79.8000	79.8000	79.8000	86.2209	87.7495	88.3403	(216)
Fuel for water heating, kWh/month	233.9848	206.9450	218.8601	199.1491	200.5950	188.7633	181.5058	198.8665	198.4208	206.4707	214.2660	228.1883	(219)
Water heating fuel used												2476.0156	(219)
Annual totals kWh/year													
Space heating fuel - main system												4618.4536	(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)												366.1593	(232)
Total delivered energy for all uses												7535.6285	(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	4618.4536	0.2160	997.5860 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2476.0156	0.2160	534.8194 (264)
Space and water heating			1532.4053 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	366.1593	0.5190	190.0367 (268)
Total CO2, kg/m2/year			1761.3670 (272)
Emissions per m2 for space and water heating			17.7075 (272a)
Fuel factor (electricity)			1.5500
Emissions per m2 for lighting			2.1959 (272b)
Emissions per m2 for pumps and fans			0.4498 (272c)
Target Carbon Dioxide Emission Rate (TER) = (17.7075 * 1.55) + 2.1959 + 0.4498, rounded to 2 d.p.			30.0900 (273)