

Energy Statement for Planning

Client: Atlas Property London.

Site: 18 Denmark Street
London
N17 0JL

Proposals: The construction of 6 new dwellings consisting of a run of 4 terrace houses with 2 apartments.

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Report Details:

Prepared by	Checked by	Date	Project	Revision
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1 Introduction

This Energy Statement has been prepared in support of the planning application for the construction of a of 6 new dwellings consisting of a run of 4 terrace houses and 2 apartments 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 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 6 new dwellings consisting of a run of 4 terrace houses and 2 apartments (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 dwelling. Subsequently, these constraints will impact on the feasibility of certain renewable technologies (as discussed in Section 4 of this report).

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

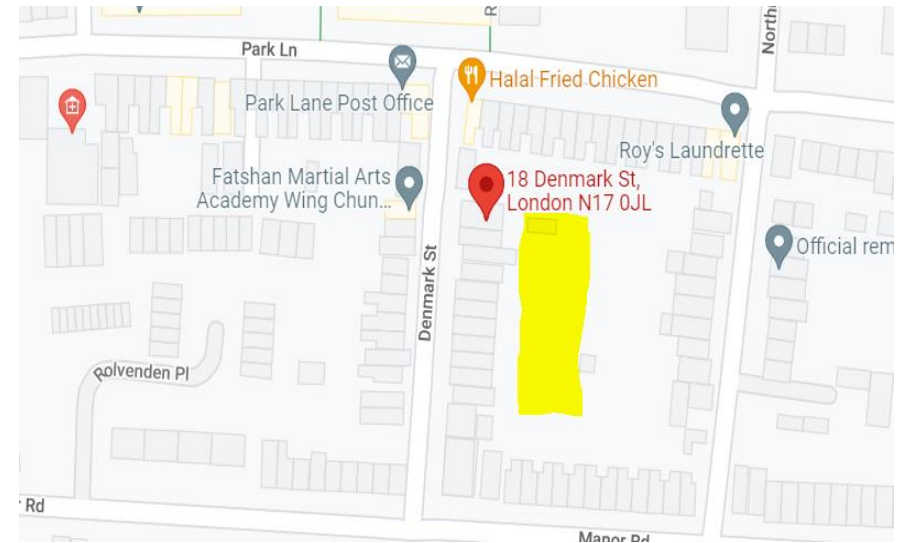


Figure 1: Site Location

3 SAP 2012 and Building Regulations (2013)

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

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

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

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

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

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

To comply with Part L1A, the SAP calculation should demonstrate how the dwelling will either meet or achieve a percentage reduction in the Dwelling Emission Rate (DER) under the required Target Emission Rate (TER).

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

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	20.9	437	9,106

The Baseline Target emission rate for the development assessed is shown to be 20.9 (kg CO₂/m²/year)

The total Baseline CO₂ emissions for the development assessed is shown to be in total 9,106 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)	18.8
Total TER Baseline CO ₂ Emissions (kg/year)	8,218

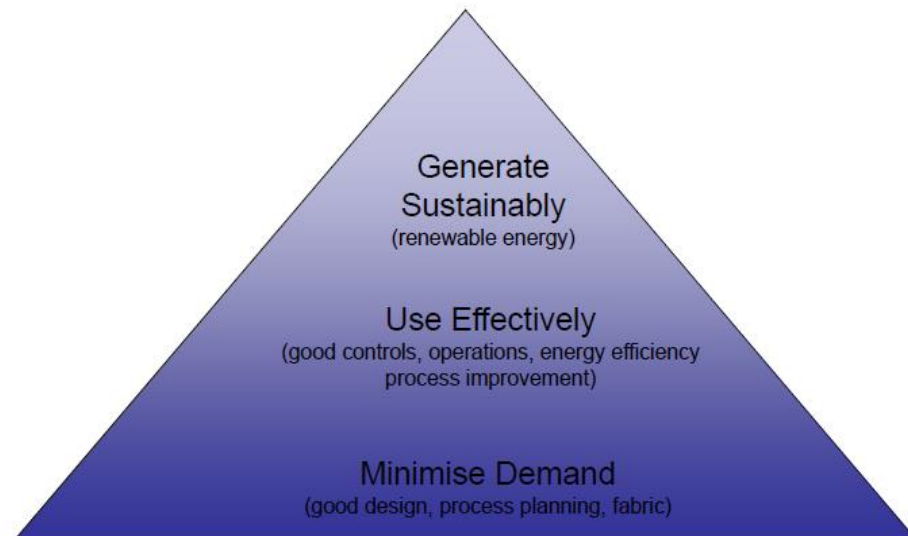
5 Be Lean Energy Efficiency Improvement Scenario

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	0.18
Ground Floor	0.25	0.13	0.13
Roof	0.20	0.13	0.13
Windows	2.0	1.4	1.4
Air test	10	5	4
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 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 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

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)	19.5
Target Emission Rate (TER) (kg CO₂/m²/year)	20.9
DER/TER Variance	-6%
Total DER Baseline CO₂ Emissions (kg/year)	8,534
Total TER Baseline CO₂ Emissions (kg/year)	9,106

The Be Lean dwelling emission rate CO₂ emissions are shown to be on average 19.5 (kg CO₂/m²/year).

The total Be Lean CO₂ emissions for all dwellings are shown to be in total 8,534 kg/year.

Based on the Be Lean calculations, the 6% reduction in CO₂ emissions can feasibly be achieved solely through improving the fabrics elements, air tightness, and installing a SWHR system.

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

	Baseline Calculation SAP 10
Target Emission Rate (TER) (kg CO₂/m²/year)	18.8
Dwelling Emission Rate (DER) (kg CO₂/m²/year)	17.6
Total TER Baseline CO₂ Emissions (kg/year)	8,216
Total DER Baseline CO₂ Emissions (kg/year)	7,662

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 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 9,106 kg/year. As such, a 35% saving in CO₂ emissions of 3,187 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 HEATPUMP (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 wall. 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.

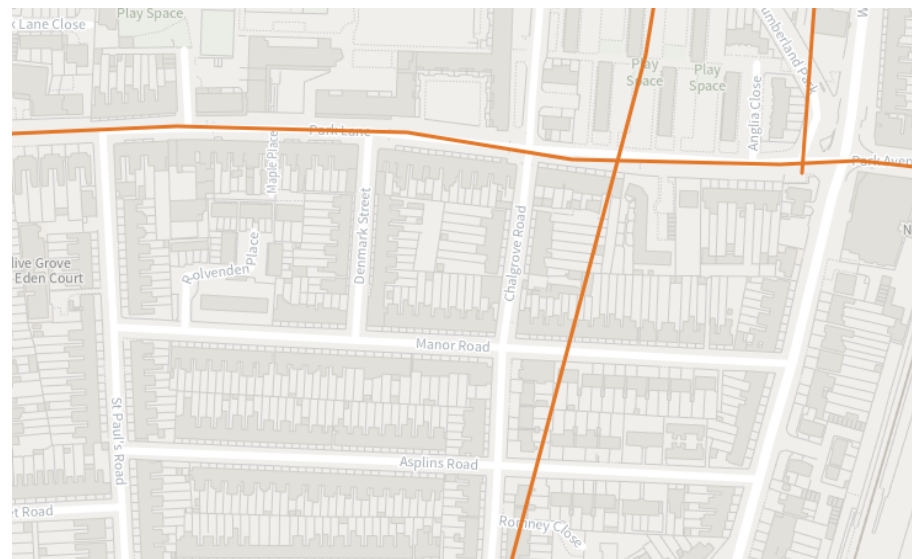
The viability of CHP is dependent upon the building base load requirements for both heat and power. Buildings with high heat demands and constant power demands lend themselves to CHP. It is important that the unit is not oversized as this will lead to inefficient operation. Excess generated electricity 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 with the PV can be angled facing a southern orientation 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 gaining from a solar PV specialist.

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 as the most suitable technology for this development. An ASHP and Solar thermal could also provide the 35% reduction; however, we have used PV as this currently reduces the CO₂ emissions more than the Solar Thermal.

The calculations to demonstrate how solar PV can achieve the required 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 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 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 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	0.18
Ground Floor	0.25	0.13
Roof	0.20	0.13
Windows	1.6	1.4
Air test	5.0	4.0
Heating	89% Gas boiler	89% Gas boiler

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

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

	Be Green Results
Dwelling Emission Rate (DER) (kg CO ₂ /m ² /year)	4.0
Target Emission Rate (TER) (kg CO ₂ /m ² /year)	20.9
DER/TER Variance	-81%
Total DER Baseline CO ₂ Emissions (kg/year)	1,726
Total TER Baseline CO ₂ Emissions (kg/year)	9,106

A comparison of the baseline calculation results and the results of the calculation with PV included is shown in Table 8 below.

Table 8: 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)	20.9	19.5	7.5	11.5
Target Emission Rate (TER) (kg CO₂/m²/year)	20.9	20.9	20.9	18.8
DER/TER Variance	N/A	-6%	-81%	-46%
Total DER Baseline CO₂ Emissions (kg/year)	9,106	8,534	1,726	4,420
Total TER Baseline CO₂ Emissions (kg/year)	9,106	9,106	9,106	8,218

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 PV system on the residential units and applying the SAP 2012 carbon factors the total dwelling CO₂ emissions are shown to be 1,726 Kg/CO₂. However, by using the SAP 10 carbon factors the domestic units now show the CO₂ emissions to be 4,420 Kg/CO₂ which is a saving of 46% over Part L1a 2013, using SAP 10. The 46% CO₂ reduction is a 39% improvement from the be lean assessment and therefore exceeds the 20% reduction required from renewables.

This results in a 46% 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 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for domestic buildings

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO ₂ per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	8	
After energy demand reduction	8	
After heat network / CHP	8	
After renewable energy	4	

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	1	7%
Savings from heat network / CHP	0	0%
Savings from renewable energy	3	39%
Cumulative on site savings	4	46%

8 Conclusion

There are proposals for the construction of a of 6 new dwellings consisting of a run of 5 terrace houses and 2 apartments (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 renewable technologies indicates that solar PV 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
- Laid on the horizontal roof as close to 30 degrees as possible.
- Facing in a southern direction
- No shading

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

- Low fabric u-values
- High air tightness (air test of 4)
- Waste water heat recovery.

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 PV (1.0kWp system per dwelling, 30° to 45° angle, facing in a southerly direction).

Through the incorporation of PV and a fabric first approach, this results in a 46% reduction in CO₂ emissions with 39% 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	S10385 01			Issued on Date	09/12/2022
Assessment Reference	Be lean	Prop Type Ref			
Property	Denmark Street, N17 0JL				
SAP Rating	83 B	DER	18.38	TER	20.58
Environmental	85 B	% DER<TER	10.71		
CO ₂ Emissions (t/year)	1.26	DFEE	58.67	TFEE	67.49
General Requirements Compliance	Pass	% DFEE<TFEE	13.07		
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) 20.58 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 18.38 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 67.5 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE) 58.7 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	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

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

4 Heating efficiency

Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
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

Not applicable

9 Summertime temperature

Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North: 0.96 m², No overhang
Windows facing South: 14.29 m², No overhang
Windows facing West: 10.77 m², No overhang
Air change rate: 5.00 ach
Blinds/curtains: None

10 Key features

Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Exposed floor U-value 0.12 W/m²K
Door U-value 1.00 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	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	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) = 0.1274 (8)
Pressure test					Yes
Measured/design AP50					4.0000
Infiltration rate					0.3274 (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) =				0.3028 (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	0.3861	0.3785	0.3710	0.3331	0.3255	0.2877	0.2877	0.2801	0.3028	0.3255	0.3407	0.3558 (22b)
Effective ac	0.5745	0.5716	0.5688	0.5555	0.5530	0.5414	0.5414	0.5392	0.5459	0.5530	0.5580	0.5633 (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 = 1.40)			26.0200	1.3258	34.4962		(27)
Roof light (Uw = 1.40)			1.4400	1.3258	1.9091		(27a)
Ground floor			51.1300	0.1200	6.1356		(28a)
Exposed floor			0.4300	0.1200	0.0516		(28b)
External wall	140.5300	26.0200	114.5100	0.1800	20.6118		(29a)
Flat roof	34.9800	1.4400	33.5400	0.1300	4.3602		(30)
Balcony roof	17.0000		17.0000	0.1300	2.2100		(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) =		69.7745		(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 (Sum(L x Psi) calculated using Appendix K)							27.6802 (36)
Total fabric heat loss						(33) + (36) =	97.4547 (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	44.6502	44.4252	44.2047	43.1691	42.9753	42.0733	42.0733	41.9062	42.4207	42.9753	43.3673	43.7771 (38)
Heat transfer coeff	142.1049	141.8799	141.6594	140.6238	140.4300	139.5280	139.5280	139.3609	139.8754	140.4300	140.8220	141.2318 (39)
Average = Sum(39)m / 12 =												140.6229 (39)
HLP	1.6421	1.6395	1.6369	1.6250	1.6227	1.6123	1.6123	1.6104	1.6163	1.6227	1.6272	1.6320 (40)
HLP (average)												1.6249 (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	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	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:												

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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	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)
Total per year (kWh/year) = Sum(63)m = 0.0000 (63)												

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	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				0.9600	10.6334	0.6300	0.7000	0.7700	3.1197 (74)			
South				14.2900	46.7521	0.6300	0.7000	0.7700	204.1761 (78)			
West				10.7700	19.6403	0.6300	0.7000	0.7700	64.6450 (80)			
Horizontal				1.4400	26.0000	0.6300	0.7000	1.0000	14.8599 (82)			
Solar gains	286.8007	497.6720	699.2094	887.1553	1005.5610	1001.6124	964.4183	876.8308	765.0785	555.5415	345.3322	244.1908 (83)
Total gains	679.9459	888.7079	1076.1462	1241.2825	1336.4409	1310.1224	1258.4080	1176.9216	1076.8923	890.3827	706.6534	625.4557 (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	42.2907	42.3578	42.4237	42.7362	42.7951	43.0718	43.0718	43.1234	42.9648	42.7951	42.6760	42.5522
alpha	3.8194	3.8239	3.8282	3.8491	3.8530	3.8715	3.8715	3.8749	3.8643	3.8530	3.8451	3.8368
util living area	0.9940	0.9833	0.9581	0.8974	0.7847	0.6234	0.4719	0.5199	0.7488	0.9362	0.9872	0.9956 (86)
MIT	19.3095	19.5947	19.9802	20.4131	20.7429	20.9237	20.9798	20.9707	20.8412	20.3736	19.7421	19.2541 (87)
Th 2	19.5826	19.5845	19.5864	19.5951	19.5967	19.6043	19.6043	19.6057	19.6014	19.5967	19.5934	19.5900 (88)
util rest of house	0.9918	0.9776	0.9436	0.8623	0.7142	0.5101	0.3299	0.3740	0.6454	0.9061	0.9818	0.9940 (89)
MIT 2	17.3984	17.8119	18.3624	18.9607	19.3708	19.5605	19.5985	19.5961	19.4923	18.9285	18.0352	17.3224 (90)
Living area fraction									fLA = Living area / (4) =			0.1511 (91)
MIT	17.6872	18.0813	18.6069	19.1802	19.5781	19.7665	19.8073	19.8039	19.6962	19.1469	18.2932	17.6144 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.5372	17.9313	18.4569	19.0302	19.4281	19.6165	19.6573	19.6539	19.5462	18.9969	18.1432	17.4644 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9868	0.9675	0.9277	0.8446	0.7044	0.5112	0.3356	0.3794	0.6407	0.8885	0.9731	0.9901 (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	1881.0774	1848.8844	1693.8108	1424.5494	1085.2636	699.9426	426.5751	453.4654	761.7884	1179.1806	1555.1283	1873.3498 (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	900.3184	664.6418	517.4498	270.8665	106.9991	0.0000	0.0000	0.0000	0.0000	288.7237	624.5748	933.0629 (98)
Space heating												4306.6371 (98)
Space heating per m2												(98) / (4) = 49.7647 (99)

8c. Space cooling requirement

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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												4790.4751 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	900.3184	664.6418	517.4498	270.8665	106.9991	0.0000	0.0000	0.0000	0.0000	288.7237	624.5748	933.0629 (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)	1001.4665	739.3124	575.5838	301.2976	119.0201	0.0000	0.0000	0.0000	0.0000	321.1609	694.7440	1037.8898 (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	89.4767	89.4094	89.2743	88.9572	88.2724	86.7000	86.7000	86.7000	86.7000	88.9682	89.3654	86.7000 (216)
Fuel for water heating, kWh/month	147.9531	129.8002	135.8655	122.6619	121.0037	109.5418	105.6080	116.9310	117.0142	128.5809	135.1999	143.9270 (219)
Water heating fuel used												1514.0873 (219)
Annual totals kWh/year												4790.4751 (211)
Space heating fuel - main system												0.0000 (215)
Space heating fuel - secondary												
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												6745.7217 (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	4790.4751	0.2160	1034.7426 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1514.0873	0.2160	327.0428 (264)
Space and water heating			1361.7855 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	366.1593	0.5190	190.0367 (268)
Total CO2, kg/year			1590.7472 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			18.3800 (273)

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

DER		18.3800 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		36.3942 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		36.3942 ZC8

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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	=	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)				
	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	0.4451	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)			20.5000	1.3258	27.1780		(27)					
TER Room Window (Uw = 1.70)			1.1300	1.5918	1.7987		(27a)					
Ground floor			51.1300	0.1300	6.6469		(28a)					
Exposed floor			0.4300	0.1300	0.0559		(28b)					
External wall	140.5300	20.5000	120.0300	0.1800	21.6054		(29a)					
Flat roof	34.9800	1.1300	33.8500	0.1300	4.4005		(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) =		63.8954		(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) =	89.3584 (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	135.9132	135.6143	135.3213	133.9451	133.6877	132.4891	132.4891	132.2671	132.9507	133.6877	134.2085	134.7531 (39)
Average = Sum(39)m / 12 =												133.9439 (39)
HLP	Jan 1.5705	Feb 1.5671	Mar 1.5637	Apr 1.5478	May 1.5448	Jun 1.5310	Jul 1.5310	Aug 1.5284	Sep 1.5363	Oct 1.5448	Nov 1.5508	Dec 1.5571 (40)
HLP (average)												1.5478 (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)												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												

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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)

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	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					0.7600	10.6334	0.6300	0.7000	0.7700			2.4698 (74)
South					11.2500	46.7521	0.6300	0.7000	0.7700			160.7404 (78)
West					8.4900	19.6403	0.6300	0.7000	0.7700			50.9597 (80)
Horizontal					1.1300	26.0000	0.6300	0.7000	1.0000			11.6609 (82)
Solar gains	225.8308	391.8781	550.5834	698.5940	791.8454	788.7412	759.4498	690.4688	602.4564	437.4487	271.9202	192.2787 (83)
Total gains	630.4072	794.3467	938.4898	1063.0432	1132.3982	1106.2755	1062.4666	1000.2351	924.5961	783.2635	644.6761	584.9761 (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	44.2174	44.3148	44.4108	44.8670	44.9535	45.3601	45.3601	45.4363	45.2026	44.9535	44.7790	44.5980	
alpha	3.9478	3.9543	3.9607	3.9911	3.9969	4.0240	4.0240	4.0291	4.0135	3.9969	3.9853	3.9732	
util living area	0.9954	0.9882	0.9712	0.9272	0.8354	0.6832	0.5254	0.5733	0.7974	0.9533	0.9905	0.9966	(86)
MIT	19.3446	19.5896	19.9396	20.3574	20.6990	20.9065	20.9749	20.9644	20.8174	20.3483	19.7591	19.3018	(87)
Th 2	19.6350	19.6376	19.6401	19.6519	19.6541	19.6644	19.6644	19.6663	19.6604	19.6541	19.6496	19.6449	(88)
util rest of house	0.9938	0.9842	0.9608	0.9001	0.7740	0.5718	0.3772	0.4235	0.7027	0.9301	0.9864	0.9953	(89)
MIT 2	17.4828	17.8399	18.3446	18.9355	19.3769	19.6073	19.6565	19.6537	19.5274	18.9395	18.0967	17.4268	(90)
Living area fraction	17.7642	18.1044	18.5857	19.1504	19.5767	19.8036	19.8558	19.8518	19.7224	19.1524	18.3479	17.7102	(91)
MIT	17.7642	18.1044	18.5857	19.1504	19.5767	19.8036	19.8558	19.8518	19.7224	19.1524	18.3479	17.7102	(92)
Temperature adjustment	17.7642	18.1044	18.5857	19.1504	19.5767	19.8036	19.8558	19.8518	19.7224	19.1524	18.3479	17.7102	(93)
adjusted MIT	17.7642	18.1044	18.5857	19.1504	19.5767	19.8036	19.8558	19.8518	19.7224	19.1524	18.3479	17.7102	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9902	0.9772	0.9496	0.8872	0.7698	0.5846	0.3995	0.4457	0.7078	0.9182	0.9804	0.9925	(94)
Useful gains	624.2228	776.2631	891.1547	943.1840	871.7304	646.7148	424.4706	445.8225	654.4727	719.1894	632.0537	580.5978	(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	1829.9617	1790.7038	1635.4472	1372.9966	1053.0191	689.4249	431.3576	456.5600	747.5000	1143.3512	1509.5691	1820.5383	(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	897.0697	681.7041	553.7537	309.4651	134.8788	0.0000	0.0000	0.0000	0.0000	315.5764	631.8111	922.5157	(98)
Space heating												4446.7744	(98)
Space heating per m2												51.3840	(99)

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													4761.0004 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	897.0697	681.7041	553.7537	309.4651	134.8788	0.0000	0.0000	0.0000	0.0000	315.5764	631.8111	922.5157	(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)	960.4601	729.8759	592.8840	331.3330	144.4098	0.0000	0.0000	0.0000	0.0000	337.8762	676.4572	987.7041	(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	88.3211	88.0651	87.5861	86.5618	84.5768	80.3000	80.3000	80.3000	80.3000	86.4955	87.8651	88.4057	(216)
Fuel for water heating, kWh/month	233.8327	206.7623	216.8930	194.6494	192.8781	178.9239	171.4227	191.0962	193.2066	204.2459	214.0201	228.0566	(219)
Water heating fuel used												2425.9876	(219)
Annual totals kWh/year													
Space heating fuel - main system												4761.0004	(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												7628.1474	(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	4761.0004	0.2160	1028.3761 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2425.9876	0.2160	524.0133 (264)
Space and water heating			1552.3894 (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			1781.3511 (272)
Emissions per m2 for space and water heating			17.9384 (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) = (17.9384 * 1.00) + 2.1959 + 0.4498, rounded to 2 d.p.			20.5800 (273)

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

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Property Reference	S10385 01				Issued on Date	09/12/2022
Assessment Reference	Be green	Prop Type Ref				
Property	Denmark Street, N17 0JL					
SAP Rating	95 A	DER	5.95	TER	20.58	
Environmental	96 A	% DER<TER	71.09			
CO ₂ Emissions (t/year)	0.13	DFEE	58.67	TFEE	67.49	
General Requirements Compliance	Pass	% DFEE<TFEE	13.07			
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) 20.58 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 5.95 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)67.5 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)58.7 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	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

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

4 Heating efficiency

Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
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

Not applicable

9 Summertime temperature

Overheating risk (Thames Valley): Slight OK

Based on:

Overshading: Average
Windows facing North: 0.96 m², No overhang
Windows facing South: 14.29 m², No overhang
Windows facing West: 10.77 m², No overhang
Air change rate: 5.00 ach
Blinds/curtains: None

10 Key features

Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Exposed floor U-value 0.12 W/m²K
Door U-value 1.00 W/m²K
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	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) = 0.1274 (8)
Pressure test					Yes
Measured/design AP50					4.0000
Infiltration rate					0.3274 (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) =	0.3028 (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	0.3861	0.3785	0.3710	0.3331	0.3255	0.2877	0.2877	0.2801	0.3028	0.3255	0.3407	0.3558 (22b)
Effective ac	0.5745	0.5716	0.5688	0.5555	0.5530	0.5414	0.5414	0.5392	0.5459	0.5530	0.5580	0.5633 (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 = 1.40)			26.0200	1.3258	34.4962		(27)
Roof light (Uw = 1.40)			1.4400	1.3258	1.9091		(27a)
Ground floor			51.1300	0.1200	6.1356		(28a)
Exposed floor			0.4300	0.1200	0.0516		(28b)
External wall	140.5300	26.0200	114.5100	0.1800	20.6118		(29a)
Flat roof	34.9800	1.4400	33.5400	0.1300	4.3602		(30)
Balcony roof	17.0000		17.0000	0.1300	2.2100		(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) =		69.7745		(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 (Sum(L x Psi) calculated using Appendix K)							27.6802 (36)
Total fabric heat loss						(33) + (36) =	97.4547 (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	44.6502	44.4252	44.2047	43.1691	42.9753	42.0733	42.0733	41.9062	42.4207	42.9753	43.3673	43.7771 (38)
Heat transfer coeff	142.1049	141.8799	141.6594	140.6238	140.4300	139.5280	139.5280	139.3609	139.8754	140.4300	140.8220	141.2318 (39)
Average = Sum(39)m / 12 =												140.6229 (39)
HLP	1.6421	1.6395	1.6369	1.6250	1.6227	1.6123	1.6123	1.6104	1.6163	1.6227	1.6272	1.6320 (40)
HLP (average)												1.6249 (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	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	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:												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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	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)
Solar input (sum of months) = Sum(63)m =												0.0000 (63)
Total per year (kWh/year) = Sum(64)m =												1339.0565 (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	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)	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				0.9600	10.6334	0.6300	0.7000	0.7700	3.1197 (74)			
South				14.2900	46.7521	0.6300	0.7000	0.7700	204.1761 (78)			
West				10.7700	19.6403	0.6300	0.7000	0.7700	64.6450 (80)			
Horizontal				1.4400	26.0000	0.6300	0.7000	1.0000	14.8599 (82)			
Solar gains	286.8007	497.6720	699.2094	887.1553	1005.5610	1001.6124	964.4183	876.8308	765.0785	555.5415	345.3322	244.1908 (83)
Total gains	679.9459	888.7079	1076.1462	1241.2825	1336.4409	1310.1224	1258.4080	1176.9216	1076.8923	890.3827	706.6534	625.4557 (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	42.2907	42.3578	42.4237	42.7362	42.7951	43.0718	43.0718	43.1234	42.9648	42.7951	42.6760	42.5522		
alpha	3.8194	3.8239	3.8282	3.8491	3.8530	3.8715	3.8715	3.8749	3.8643	3.8530	3.8451	3.8368		
util living area	0.9940	0.9833	0.9581	0.8974	0.7847	0.6234	0.4719	0.5199	0.7488	0.9362	0.9872	0.9956 (86)		
MIT	19.3095	19.5947	19.9802	20.4131	20.7429	20.9237	20.9798	20.9707	20.8412	20.3736	19.7421	19.2541 (87)		
Th 2	19.5826	19.5845	19.5864	19.5951	19.5967	19.6043	19.6043	19.6057	19.6014	19.5967	19.5934	19.5900 (88)		
util rest of house	0.9918	0.9776	0.9436	0.8623	0.7142	0.5101	0.3299	0.3740	0.6454	0.9061	0.9818	0.9940 (89)		
MIT 2	17.3984	17.8119	18.3624	18.9607	19.3708	19.5605	19.5985	19.5961	19.4923	18.9285	18.0352	17.3224 (90)		
Living area fraction									fLA = Living area / (4) =					0.1511 (91)
MIT	17.6872	18.0813	18.6069	19.1802	19.5781	19.7665	19.8073	19.8039	19.6962	19.1469	18.2932	17.6144 (92)		
Temperature adjustment												-0.1500		
adjusted MIT	17.5372	17.9313	18.4569	19.0302	19.4281	19.6165	19.6573	19.6539	19.5462	18.9969	18.1432	17.4644 (93)		

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9868	0.9675	0.9277	0.8446	0.7044	0.5112	0.3356	0.3794	0.6407	0.8885	0.9731	0.9901 (94)
Useful gains	670.9720	859.8340	998.3137	1048.3459	941.4476	669.7294	422.2744	446.4768	689.9505	791.1112	687.6633	619.2331 (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	1881.0774	1848.8844	1693.8108	1424.5494	1085.2636	699.9426	426.5751	453.4654	761.7884	1179.1806	1555.1283	1873.3498 (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	900.3184	664.6418	517.4498	270.8665	106.9991	0.0000	0.0000	0.0000	0.0000	288.7237	624.5748	933.0629 (98)
Space heating												4306.6371 (98)
Space heating per m2												(98) / (4) = 49.7647 (99)

8c. Space cooling requirement

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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													4790.4751 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	900.3184	664.6418	517.4498	270.8665	106.9991	0.0000	0.0000	0.0000	0.0000	288.7237	624.5748	933.0629	(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)	1001.4665	739.3124	575.5838	301.2976	119.0201	0.0000	0.0000	0.0000	0.0000	321.1609	694.7440	1037.8898	(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	89.4767	89.4094	89.2743	88.9572	88.2724	86.7000	86.7000	86.7000	86.7000	88.9682	89.3654	86.7000	(216)
Fuel for water heating, kWh/month	147.9531	129.8002	135.8655	122.6619	121.0037	109.5418	105.6080	116.9310	117.0142	128.5809	135.1999	143.9270	(219)
Water heating fuel used												1514.0873	(219)
Annual totals kWh/year													
Space heating fuel - main system												4790.4751	(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)
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												4673.0344	(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	4790.4751	0.2160	1034.7426 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1514.0873	0.2160	327.0428 (264)
Space and water heating			1361.7855 (265)
Pumps and fans	75.0000	0.5190	38.9250 (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			515.0225 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			5.9500 (273)

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

DER		5.9500 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		23.9642 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		23.9642 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 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) =	0.1274 (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)				
	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	0.4451	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)			20.5000	1.3258	27.1780		(27)					
TER Room Window (Uw = 1.70)			1.1300	1.5918	1.7987		(27a)					
Ground floor			51.1300	0.1300	6.6469		(28a)					
Exposed floor			0.4300	0.1300	0.0559		(28b)					
External wall	140.5300	20.5000	120.0300	0.1800	21.6054		(29a)					
Flat roof	34.9800	1.1300	33.8500	0.1300	4.4005		(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) =		63.8954		(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) =	89.3584 (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	135.9132	135.6143	135.3213	133.9451	133.6877	132.4891	132.4891	132.2671	132.9507	133.6877	134.2085	134.7531 (39)
Average = Sum(39)m / 12 =												133.9439 (39)
HLP	Jan 1.5705	Feb 1.5671	Mar 1.5637	Apr 1.5478	May 1.5448	Jun 1.5310	Jul 1.5310	Aug 1.5284	Sep 1.5363	Oct 1.5448	Nov 1.5508	Dec 1.5571 (40)
HLP (average)												1.5478 (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)												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												

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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)

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	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					0.7600	10.6334	0.6300	0.7000	0.7700				2.4698 (74)
South					11.2500	46.7521	0.6300	0.7000	0.7700				160.7404 (78)
West					8.4900	19.6403	0.6300	0.7000	0.7700				50.9597 (80)
Horizontal					1.1300	26.0000	0.6300	0.7000	1.0000				11.6609 (82)

Solar gains	225.8308	391.8781	550.5834	698.5940	791.8454	788.7412	759.4498	690.4688	602.4564	437.4487	271.9202	192.2787	(83)
Total gains	630.4072	794.3467	938.4898	1063.0432	1132.3982	1106.2755	1062.4666	1000.2351	924.5961	783.2635	644.6761	584.9761	(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	44.2174	44.3148	44.4108	44.8670	44.9535	45.3601	45.3601	45.4363	45.2026	44.9535	44.7790	44.5980	
alpha	3.9478	3.9543	3.9607	3.9911	3.9969	4.0240	4.0240	4.0291	4.0135	3.9969	3.9853	3.9732	
util living area	0.9954	0.9882	0.9712	0.9272	0.8354	0.6832	0.5254	0.5733	0.7974	0.9533	0.9905	0.9966	(86)
MIT	19.3446	19.5896	19.9396	20.3574	20.6990	20.9065	20.9749	20.9644	20.8174	20.3483	19.7591	19.3018	(87)
Th 2	19.6350	19.6376	19.6401	19.6519	19.6541	19.6644	19.6644	19.6663	19.6604	19.6541	19.6496	19.6449	(88)
util rest of house	0.9938	0.9842	0.9608	0.9001	0.7740	0.5718	0.3772	0.4235	0.7027	0.9301	0.9864	0.9953	(89)
MIT 2	17.4828	17.8399	18.3446	18.9355	19.3769	19.6073	19.6565	19.6537	19.5274	18.9395	18.0967	17.4268	(90)
Living area fraction	17.7642	18.1044	18.5857	19.1504	19.5767	19.8036	19.8558	19.8518	19.7224	19.1524	18.3479	17.7102	(91)
MIT	17.7642	18.1044	18.5857	19.1504	19.5767	19.8036	19.8558	19.8518	19.7224	19.1524	18.3479	17.7102	(92)
Temperature adjustment	17.7642	18.1044	18.5857	19.1504	19.5767	19.8036	19.8558	19.8518	19.7224	19.1524	18.3479	17.7102	(93)
adjusted MIT	17.7642	18.1044	18.5857	19.1504	19.5767	19.8036	19.8558	19.8518	19.7224	19.1524	18.3479	17.7102	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9902	0.9772	0.9496	0.8872	0.7698	0.5846	0.3995	0.4457	0.7078	0.9182	0.9804	0.9925	(94)
Useful gains	624.2228	776.2631	891.1547	943.1840	871.7304	646.7148	424.4706	445.8225	654.4727	719.1894	632.0537	580.5978	(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	1829.9617	1790.7038	1635.4472	1372.9966	1053.0191	689.4249	431.3576	456.5600	747.5000	1143.3512	1509.5691	1820.5383	(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	897.0697	681.7041	553.7537	309.4651	134.8788	0.0000	0.0000	0.0000	0.0000	315.5764	631.8111	922.5157	(98)
Space heating												4446.7744	(98)
Space heating per m2										(98) / (4) =		51.3840	(99)

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													4761.0004 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	897.0697	681.7041	553.7537	309.4651	134.8788	0.0000	0.0000	0.0000	0.0000	315.5764	631.8111	922.5157	(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)	960.4601	729.8759	592.8840	331.3330	144.4098	0.0000	0.0000	0.0000	0.0000	337.8762	676.4572	987.7041	(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	88.3211	88.0651	87.5861	86.5618	84.5768	80.3000	80.3000	80.3000	80.3000	86.4955	87.8651	88.4057	(216)
Fuel for water heating, kWh/month	233.8327	206.7623	216.8930	194.6494	192.8781	178.9239	171.4227	191.0962	193.2066	204.2459	214.0201	228.0566	(219)
Water heating fuel used												2425.9876	(219)
Annual totals kWh/year													
Space heating fuel - main system												4761.0004	(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												7628.1474	(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	4761.0004	0.2160	1028.3761 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2425.9876	0.2160	524.0133 (264)
Space and water heating			1552.3894 (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			1781.3511 (272)
Emissions per m2 for space and water heating			17.9384 (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) = (17.9384 * 1.00) + 2.1959 + 0.4498, rounded to 2 d.p.			20.5800 (273)