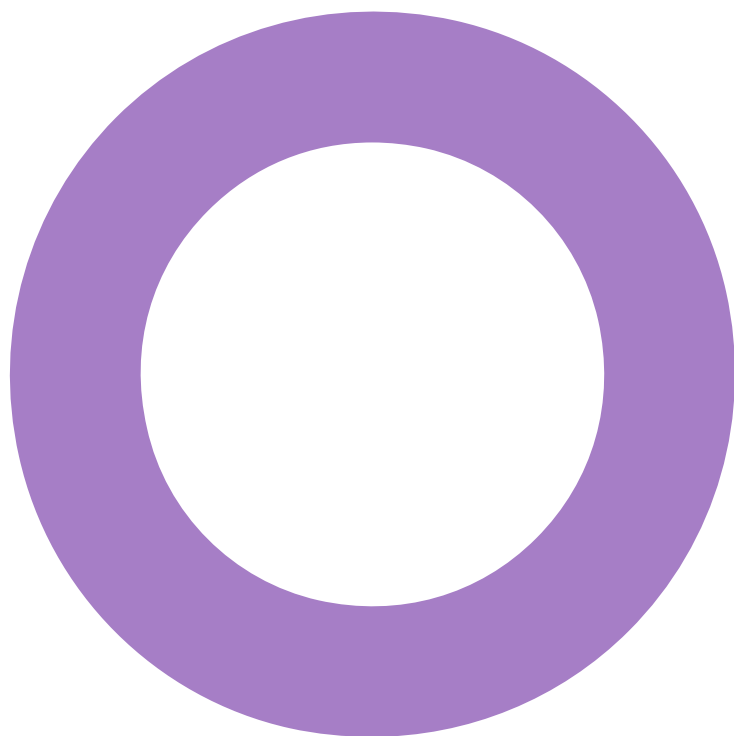


**Wensley Road.
Reading.**
Reading Borough Council.

SUSTAINABILITY
ENERGY STRATEGY

REVISION 1 – 13 DECEMBER 2019



Audit sheet.

Rev.	Date	Description of change / purpose of issue	Prepared	Reviewed	Authorised
0	02/12/2019	DRAFT issue for comment	JD	LH	PC
1	13/12/2019	Issue with updates	LH	JD	PC

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Project number: 0710186
Document reference: 191213 Wensley Road Energy Strategy Rev 1

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Executive Summary.

This report describes the Energy Strategy for the proposed Wensley Road development, located in Reading. The development consists of 46 new dwellings (28 houses and 18 flats). Hereafter referred to as the Proposed Development. The location of the development is shown in Figure 1.



Figure 1: Site Location

The project has been developed with energy efficiency, environmental performance and the local context as key design parameters.

Energy Targets

Reading Borough Council (RBC) is responsible for all local government services in Reading. The Reading Local Plan (2019) contains sustainability policies that put it at the cutting edge of authorities across the country. The Local Plan plays a major part in putting Reading in the top 5% of local authorities in Britain for cutting carbon emissions.

A summary of the key energy requirements for the Proposed Development are:

- All major new-build residential development should be designed to achieve **zero carbon homes**; and
- In meeting the sustainability requirements of this plan, developments of the sizes set out below shall demonstrate how consideration has been given to securing energy for the development from a **decentralised energy source**.

The development will be a flagship in terms of sustainability and therefore is required to not only meet but **exceed policy requirements**.

Energy Strategy

The Energy Strategy will seek to achieve targets on site where feasible and will follow the Energy Hierarchy of Be Lean, Be Clean and Be Green to reduce the carbon dioxide emissions of the entire development. The

regulated CO₂ emission reduction will be reported using the SAP 10 Carbon Factors, to represent the grid decarbonisation.

Be Lean: Passive Design and Energy Efficiency

As part of the Be Lean strategy, a range of passive and active energy efficiency measures are to be employed within the development.

The investigation into passive design addressed the issue of limiting the effects of heat gains in summer, associated cooling demand alongside the carbon emission targets.

Be Clean: Decentralised Energy

The first part of the Be Clean strategy is to establish if an area or local District Heating Network (DHN) can be used to serve the development with low carbon heating. Initial investigations have shown there are no existing or proposed DHN in proximity of the site.

Be Green: Low and Zero Carbon Technologies

With the recognition that the generation of electricity is a much cleaner fuel now than it used to be due to the decarbonisation of the grid, along with the reduction of the electricity carbon factors, it is intended that the heating and hot water for the scheme will be provided by Air Source Heat Pumps (ASHP).

The incorporation of ASHP on the scheme will provide considerable contribution to the Be Green stage of the modelling process. Roof-mounted solar photovoltaic (PV) will also be included in order to maximise the energy generation on site.

Results

The overall predicted reduction in CO₂ emissions from the Baseline development model (which is Part L1A 2013 compliant) is approximately 100%, which represents an annual saving of approximately 72 tonnes of CO₂.

Figure 2 below sets out the Proposed Development reduction in CO₂ emissions in line with the Energy Hierarchy.

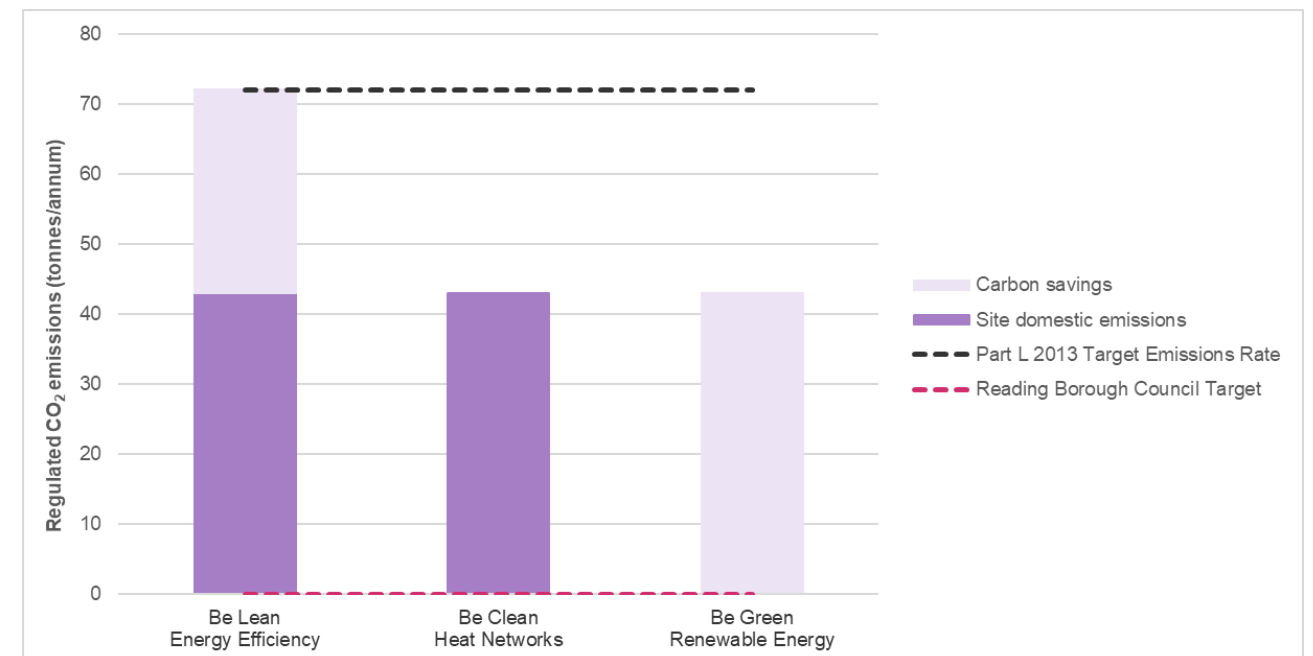


Figure 2: Proposed Development Energy Hierarchy

1. Introduction.

1.1 The Site

The proposed development consists of 46 new dwellings (28 houses and 18 flats). Hereafter referred to as the Proposed Development. The site plan is shown in Figure 3



Figure 3: Site Plan (Credit: HTA Architects).

1.2 Energy Hierarchy

The energy assessment for the Proposed Development has taken a three-step approach to reducing the building's carbon dioxide emissions:

<i>Be Lean</i>	Reduce the building's energy requirements by incorporating passive design measures and reduce the building's energy consumption through the use of energy efficient mechanical and electrical engineering systems.
<i>Be Clean</i>	Reduce the building's carbon dioxide emissions by supplying energy more efficiently
<i>Be Green</i>	Reduce the building's carbon dioxide emissions through the use of renewable technologies.

The energy assessment comprised the following stages:

- Estimating a target for total regulated and unregulated annual energy consumption and CO₂ emissions of the Proposed Development. The estimates are based primarily on Part L approved software modelling results.
- Estimating savings in regulated annual energy consumption and CO₂ emissions of the Proposed Development through the incorporation of passive and active energy efficiency measures. The estimates are based primarily on Part L approved software modelling results.
- Estimating the potential contribution to carbon dioxide reductions that could be achieved by the use of energy networks.
- Estimating the potential contribution to carbon dioxide reductions that could be achieved by the use of renewable technologies.

1.3 Establishing CO₂ Emissions

The total regulated carbon emissions at each stage of the energy hierarchy and the percentage savings in regulated emissions over Part L 2013 of the Building Regulations compliant development will be calculated for the domestic and non-domestic elements of the Proposed Development. Additionally, total regulated carbon emissions will be provided for the entire site.

The first step of this assessment is to establish the regulated CO₂ emissions assuming the development complied with Part L1A 2013 of the Building Regulations using Building Regulations approved compliance software. Elmhurst Design SAP 2012 was used to assess the domestic areas.

The TER outputs from this assessment were then used to calculate the baseline carbon dioxide emissions, these can be located in Appendix A.

1.4 SAP 10 Carbon Emission Factors

In July of 2018, the BRE released an update to the Standard Assessment Procedure (SAP) – used to assess dwellings' compliance with Building Regulations – for consultation. This SAP 10 update incorporated amended carbon emission factors to reflect the decarbonisation of the grid and other national infrastructure changes.

The next update to Building Regulations Part L (likely to be adopted in 2020) will specify a completed update to the SAP methodology alongside the carbon factors associated with natural gas and electricity.

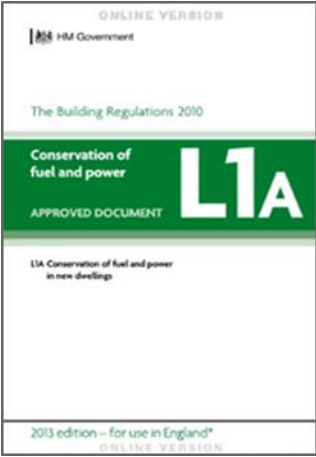
For the purpose of this energy strategy, the updated SAP 10 carbon factors have been used in order to quantify the carbon emission targets. As previously discussed, these carbon factors are a closer representation of the current carbon intensity of the electricity grid and therefore are appropriate than the Part L 2013 carbon factors for estimating potential carbon emission savings.

2. Policy Requirements & Building Regulations.

Drivers of the energy and sustainability targets for the Proposed Development include national legislations, local planning policies and client aspirations. This section of the report outlines the energy and carbon emissions related targets for the project and identifies the design approach taken to achieve them.

2.1 Building Regulations

Part L Conservation of Fuel and Power deals with energy efficiency requirements in the Building Regulations. New non-domestic buildings are assessed under Approved Document Part L1A of the Building Regulations.

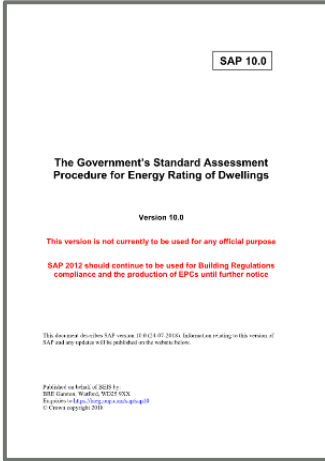


Part L1A 2013 of the Building Regulations

On a national level, Part L1A of the Building Regulations sets the energy efficiency requirements in new domestic buildings.

Under Building Regulations Approved Document Part L1A, compliance is achieved by demonstrating that the Dwelling Emission Rate (DER) does not exceed the Target Emission Rate (TER) and that the Dwelling Fabric Efficiency (DFEE) does not exceed the Target Fabric Efficiency (TFEE).

In addition, Part L1A also requires that the fabric elements and the fixed building services all meet minimum energy efficiency standards (Criterion 2), and reasonable provision for limiting solar gain through the building fabric (Criterion 3).

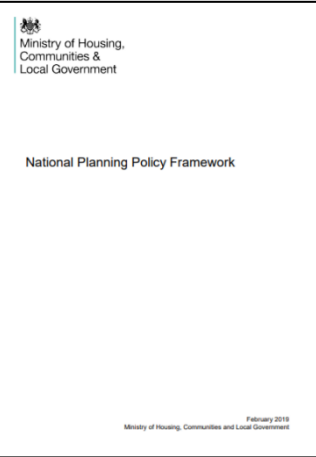


SAP 10.0

The Government's Standard Assessment Procedure for Energy Rating of Dwellings Version 10.0 was released for information in July 2018. It is not currently to be used for any official purpose. However, some Local Authorities have already adopted elements of the methodology prior to it being introduced in the next version of Part L.

The carbon factors have been updated to reflect the current decarbonisation of the grid.

2.2 National Planning Guidance

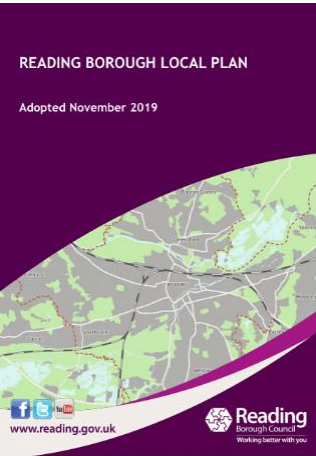


The National Planning Policy Framework, February 2019

The National Planning Policy Framework (NPPF) was published in July 2018 and updated in February 2019. The NPPF sets out the Government's strategy on the delivery of sustainable development through the planning system. It provides a framework within which locally-prepared plans for housing and other development can be produced.

Planning law requires that applications for planning permission be determined in accordance with the development plan, unless material considerations indicate otherwise. The NPPF must be considered in preparing the development plan and is a material consideration in planning decisions. Planning policies and decisions must also reflect relevant international obligations and statutory requirements. The purpose of the planning system is to contribute to the achievement of sustainable development. At a very high level, the objective of sustainable development can be summarised as meeting the needs of the present without compromising the ability of future generations to meet their own needs.

2.3 Local Planning Guidance



Reading Borough Council Local Plan, Adopted November 2019

The Local Plan has been carefully developed to address some of the key issues facing Reading. In particular, this Council declared a Climate Emergency in 2019, and set out its commitment to work towards achieving a carbon neutral Reading by 2030.

The Local Plan contains sustainability policies that put it at the cutting edge of authorities across the country.

The Local Plan plays a major part in putting Reading in the top 5% of local authorities in Britain for cutting carbon emissions.

Policy H5 "Standards for New Housing" states that all major new-build residential development should be designed to achieve zero carbon homes.

Policy CC4 "Decentralised Energy" states that any development of more than 20 dwellings shall consider the inclusion of a CHP plant, or other form of decentralised energy provision, within the site, unless it can be demonstrated that the scheme is not suitable, feasible or viable for this form of energy provision.

Further to this, where there is existing decentralised energy provision, developments of over 10 dwellings will be expected to link into this energy network or demonstrate why this is not feasible.



Supplementary Planning Document (SPD) – Revised Sustainable Design and Construction (2011)

This Supplementary Planning Document (SPD) aims to promote high standards of Sustainable Design and Construction, providing detail on how to comply with development plan policies set out in the Reading Borough Local Development Framework Core Strategy (2008).

It also provides practical advice on the forms of sustainable design and construction and how these policy requirements are applied at the local level through policy CS1: Sustainable Construction and Design of the adopted Core Strategy.

This document also states that due to changes to the Building Regulations, the requirement in the Core Strategy's Policy CS1 to 'off-set at least 20% of predicted carbon dioxide emissions' has now been superseded. This Energy Strategy will therefore not refer to this requirement.

3. Demand Reduction: Passive and Active Energy Efficient Measures (Be Lean).

A key principle of the design of this development is to provide environments that need minimal intervention of engineering systems to create comfortable spaces. All buildings should maximise the use of energy efficiently and to adopt energy conservation measures in the design, layout and orientation to reduce the overall energy demand.

To be succinct with the above, this energy strategy has considered passive design and energy efficient solutions at the forefront of the design. The Proposed Development is seeking to maximise the potential of the measures by the strategy outlined in the following sections.

3.1 Passive Measures

Passive design and energy efficiency measures form the basis for the reduction in overall energy demand and carbon emissions for the proposed development. This energy strategy aims to reduce the energy demand initially by optimising the envelope and building services within the development.

3.2 Opaque Construction

The proposal is to maximise insulation on the external walls, targeting a 600mm build up, resulting in good U-Values. Table 1 below details the U-value/construction types used within the model for the opaque constructions.

Table 1 Opaque Construction and U-values

	Exposed Floor (W/m²K)	Exposed Roof (W/m²K)	External Wall (W/m²K)	Walls to Unheated Spaces (W/m²K)	Walls to Heated Spaces
Domestic	0.10	0.10	0.13	0.15	Fully filled cavities with sealed edges

3.3 Glazing Specification

All of the glazing is to be triple glazing. Table 2 below details the glazing parameters used within the model for all glazing constructions.

Table 2 Glazing Specification

	U-Value (W/m²K)	G-Value	Fraction Glazed	Frame Factor	Light Transmittance
Domestic	0.80	0.50	90%	10%	65

3.4 Thermal Mass Parameter

Based upon assumptions of the proposed build-ups, a low/medium thermal mass parameter has been assumed based on the proposed construction details.

3.5 Thermal Bridging

The proposal for the scheme is to limit thermal bridging where possible by having a provision of continuous insulation. Where thermal bridges to occur, bespoke psi values will be required to determine the level of heat loss from these areas.

For the purpose of the modelling, the lengths of the junctions have been measured as per the drawings provided. The psi values for the junctions are specified in Table 3 below.

Table 3 Assumed psi values

Location	Psi value
E1 - Lintels	0.100
E3 – Sills	0.020
E4 - Jambs	0.025
E5 – Ground floor (normal)	0.080
E6 – Intermediate floor within a dwelling	0.035
E7 - Party floor between dwellings (in block of flats)	0.035
E10 – Eaves (insulation at ceiling level)	0.030
E11 – Eaves (insulation at rafter level)	0.020
E12 – Gable (insulation at ceiling level)	0.120
E13 – Gable (insulation at rafter level)	0.020
E16 - Corner (normal)	0.045
E18 – Party wall between dwelling	0.030
P1 – Party wall – Ground floor	0.080
P4 – Party wall – Roof (insulation at ceiling level)	0.120
P5 – Party wall – Roof (insulation at rafter level)	0.040
R4 – Ridge (vaulted ceiling)	0.040
R7 – Flat ceiling (inverted)	0.020
R8 – Roof to wall (rafter)	0.020
R9 – Roof to wall (flat ceiling)	0.020

3.6 Air Permeability

The desire for the scheme is to limit energy demand by adopting Passivhaus Principals that not only be designed in but will need to be enforced during the Construction Stage. With this in mind an air permeability of 1 m³/hm² (@ 50Pa) has been assumed for the development.

3.7 Active Measures

The energy consumption of the development could be further reduced by the incorporation of active energy efficiency measures in the design of the mechanical and electrical engineering systems. The following energy efficiency measures will be considered for this development:

- High-performance, engineered façade optimising levels of insulation and shading;
- Windows carefully designed to balance daylight, heat loss and heat gain;
- Efficient ventilation system with heat recovery;
- High Performing Pipework insulation; and
- Low energy lighting throughout.

The building fabric parameters are proposed to optimise carbon reduction taking into account the appropriate balance between heating and cooling demand of the Proposed Development.

3.8 Be Lean Results

With the inclusion of all feasible passive and active design measures as detailed in the above sections of the report, Figure 4 below shows that the regulated carbon dioxide emissions of the energy efficient scheme (Be Lean) are approximately 40% below that of the baseline scheme.

Please refer to Appendix B for the Sample Be Lean DER Work Sheets.

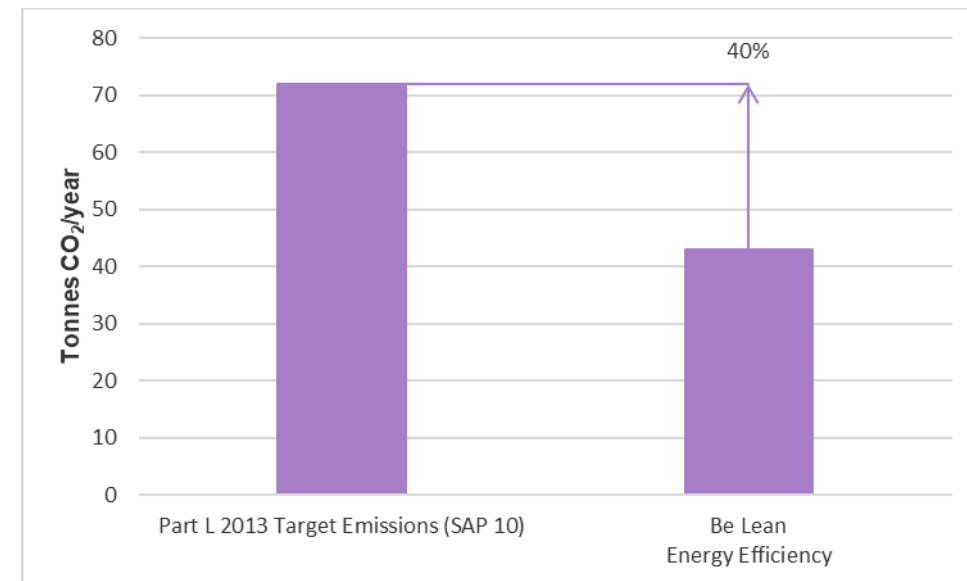


Figure 4: Proposed Development Regulated Carbon Dioxide Emissions - Be Lean

3.9 Mitigating Overheating

Policy CC3 of the Local Plan, Adaption to Climate Change states that *proposals involving both new and existing buildings shall demonstrate how they have been designed to maximise resistance and resilience to climate change for example by including measures such as solar shading, thermal mass, heating and ventilation of the building and appropriately coloured materials in areas exposed to direct sunlight, green and brown roofs, green walls, etc;*

Below are the steps of the cooling hierarchy and the proposals to demonstrate compliance:

1. **Minimise internal heat generation through energy efficient design.**
 - Heat generation will be minimised through the specification of energy efficient ventilation systems, insulation on pipework and low energy lighting.
1. **Reduce the amount of heat entering a building in summer through orientation, shading, fenestration, albedo and insulation.**
 - The amount of heat entering the building will be reduced by:
 - Energy efficient facades with appropriate proportions of glazing;
 - A glazing shading coefficient carefully selected to minimise solar gain in the summer, but also to maximise solar gain in winter; and
 - Light coloured blinds have been incorporated into the dwellings.
2. **Manage the heat within the building through exposed internal thermal mass and high ceilings.**
 - Ceiling heights in the development have been maximised within the constraints of the overall building height and massing.
3. **Passive Ventilation**
 - Passive ventilation (openable windows) will be incorporated throughout the development; and

- There will be a small amount of natural ventilation through infiltration.

4. Mechanical Ventilation

- Background ventilation will be provided by Mechanical Ventilation with Heat Recovery (MVHR). These units will incorporate a summer by-pass, which will allow the unit to supply fresh air without heat being transferred from the extract air into the supply air.

5. Active Cooling Systems

- The proposed strategy is that comfort cooling will not be provided to any areas of the development.

4. Energy Network and Combined Heat & Power (Be Clean).

The first part of the Be Clean strategy is to establish if an area or local District Heating Network (DHN) can be used to serve the development with low carbon heating. Initial investigations have shown there are no existing or proposed DHN in proximity of the site.

With the strategy to connect to a nearby DHN deemed not possible, the next strategy to consider is a site-wide heat network served by a single energy centre. This energy centre should be future proofed to connect to an off-site network should one become available.

Due to the proposed changes to the carbon emission factors in future revisions of Part L – the use of Combined Heat and Power (CHP) is likely to offer a 'negative benefit' within the next five years and therefore has not been explored as part of the energy strategy.

With the recognition that the generation of electricity is a much cleaner fuel now than it used to be due to the decarbonisation of the grid, along with the reduction of the electricity carbon factors, it is intended that the heating and hot water for the scheme will be provided by Air Source Heat Pumps (ASHP).

4.1 Be Clean Results

As detailed in Section 4 of the report there are no further measures that have been identified at the Be Clean stage therefore Figure 5 shows the regulated carbon dioxide emissions at the Be Clean stage remains the same as the Be Lean scheme, 40% below the baseline scheme.

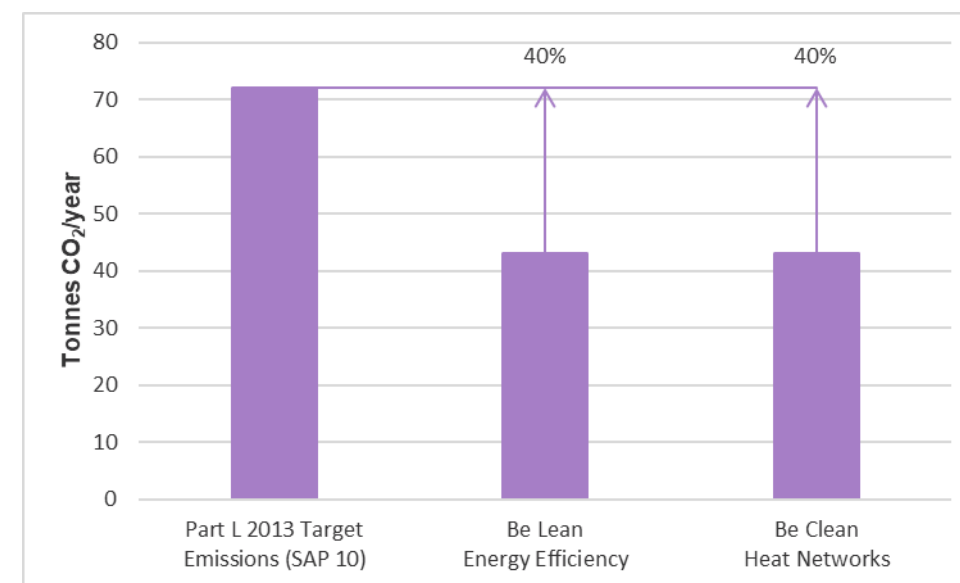


Figure 5: Proposed Development Regulated Carbon Dioxide Emissions - Be Clean

5. Renewable Energy (Be Green).

Another key principle of the design of this development is to maximise the carbon reduction over the long-term life of the building. The most effective way to achieve this is through renewable technologies. These measures are those which serve to reduce the overall emissions of the development through the inclusion of these renewable technologies such as Solar Photovoltaic array (PV panels), Ground Source Heat Pump (GSHP), besides others.

A number of renewable technologies have been appraised in terms of technical and physical feasibility as potential renewable systems for use on the project.



5.1 Solar Photovoltaics

Solar photovoltaic (PV) cells generate electricity from the sun's energy. Solid PV panels can be either roof or façade mounted (although solar modules fitted on a south facing façade have only 75% the output of roof mounted modules).

Solar PV can be seen as an on-site zero carbon energy source as it will produce useable electrical energy without requiring any energy input. Although the output from the panels is unpredictable and weather dependent, the electrical energy produced by Solar PV panels could be used to provide additional carbon emission reductions and are compatible with the use of other energy generating technologies. Once installed they are very low maintenance

and will also have a low visual impact at street level. In addition, this development has suitable south facing roof space available.

Taking the above into account, solar PV is considered an appropriate technology for this development and will be adopted into the site.



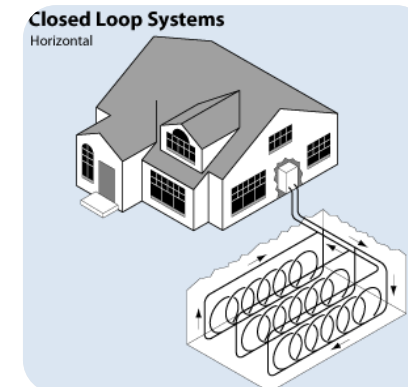
5.2 Solar Water Heating Panels

Solar water heating systems use heat from the sun to heat domestic hot water. The system requires solar panels on the roof, ideally south facing, linked to hot water storage cylinders. For solar water panels to be effective the development should have a high hot water demand.

This development has suitable south facing roof space available and has a high hot water demand due to the residential nature of the development, which initially makes this technology suitable for this development. However the panels have a higher maintenance than PV and they are highly dependent on the weather/season, arguably more so than photovoltaics, leading to unpredictability with the hot

water load. In addition, the heat gained from the panels cannot be sold back to the grid and so if the hot water is not used once it has been produced it will eventually be wasted.

Due to the reasons highlighted above, solar water heating panels are therefore not proposed for this development.



5.3 Ground Source Heat Pumps

Ground source heat pumps (GSHP) utilise either water extracted from an aquifer (open loop) or water circulated within underground pipework (closed loop) as the heat source in a refrigeration process. This enables them to produce hot water, typically at around 45°C that can be used as means of space heating in buildings. Due to the relatively constant temperature of the ground at depth (typically 10-14°C in the UK) this produces heat more efficiently in winter than an air source heat pump, and usually with lower carbon emissions than a gas-fired boiler.

Open loop systems require the water extracted to be re-injected into the aquifer at another borehole on another part of the site. A licence from the Environment Agency (EA) is required for both abstraction and

discharge although these licences cannot be obtained until a test borehole has been constructed and the appropriate EA tests undertaken.

The high capital cost and the configuration of the site makes the use of GSHPs unsuitable due to the relatively small area available for ground coupling. GSHP is therefore not proposed for the development.



5.4 Biomass Boilers

A biomass boiler uses a natural fuel such as wood chips or wood pellets for combustion. Since it uses a natural resource that can be replanted it is considered as a renewable energy source subject to the distance the fuel is transported. The carbon dioxide emitted from burning biomass is balanced by that absorbed during the fuel's production. Biomass heating therefore approaches a carbon neutral process.

The primary disadvantage of a biomass boiler is that it would require a substantial amount of fuel storage for a development of this size, which would make for an inefficient use of space. Further to this, regular deliveries are required to ensure the boiler works as efficiently and continuously as possible and biomass exhaust gases would require significant treatment to avoid degrading local air quality. In addition, the nature of the fuel within the boiler would require regular cleaning which would increase the downtime of the boiler, whilst also effecting air quality through the emissions.

Due to the reasons highlighted above, biomass boilers are therefore not proposed for the development.



5.5 Wind Turbines

Wind turbines use the wind's lift forces to turn aerodynamic blades that turn a rotor thus generating electricity. There are three basic types to consider: horizontal axis (propeller type), vertical access (helical type) and building integrated (where the building design is adapted to suit the wind turbine).

Wind turbines have a significant visual impact and the roof space will be sensitive in townscape terms, which is likely to preclude wind turbines. They can create noise and vibration problems. Additionally, there is limited roof area across the site where clean air flows and good wind speeds can be realised and which are vital to delivering a useful electrical output. Even

if a suitable location could be found, the output of a wind turbine and the consequential carbon dioxide emissions will be very limited when compared to the emissions of the whole development.

Due to the reasons highlighted above, wind turbines are therefore not proposed for the development.



5.6 Air Source Heat Pumps

Air Source Heat Pumps (ASHP) employ the same technology as Ground Source Heat Pumps (GSHP). However, instead of using heat exchangers buried in the ground, heat is extracted from the external ambient air.

The efficiency of heat pumps is very much dependent on the temperature difference between the heat source and the space required to be heated. As a result, ASHPs tend to have a lower Coefficient of Performance (COP) than GSHP. This is due to the varying levels of air temperature throughout the year when compared to the relatively stable ground temperature. The lower the difference between internal and external air temperature, the more efficient the system.

Taking the above into account, ASHP is considered an appropriate technology for this development.

5.7 Be Green Results

With the inclusion of the contribution of the ASHP and PV Arrays, Figure 6 below shows the estimated reduction in regulated carbon dioxide emissions is approximately 60% below the energy efficient (Be Lean) scheme and 100% below the baseline scheme.

Please refer to Appendix C for the Be Green DER Worksheet.

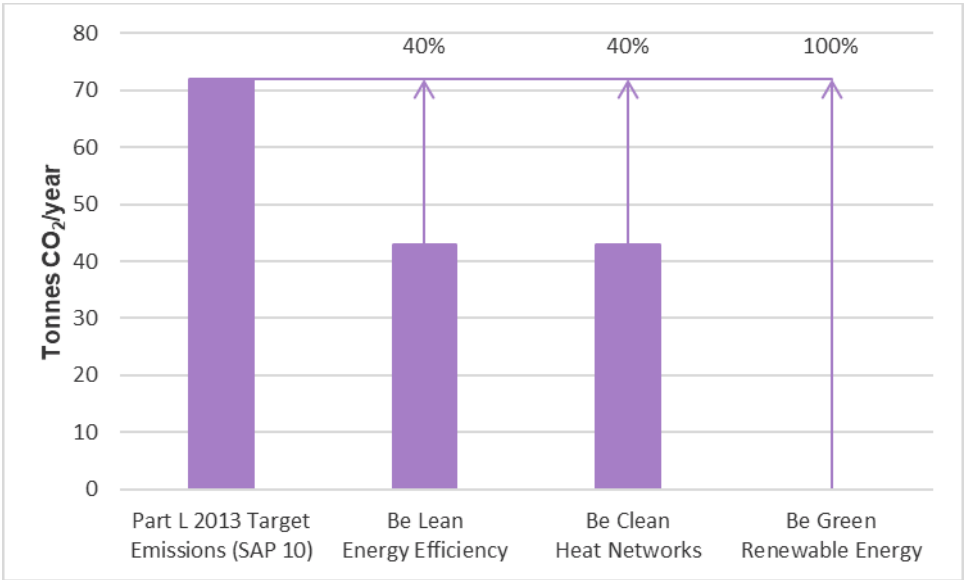


Figure 6: Proposed Development Regulated Carbon Dioxide Emissions - Be Green

6. Conclusion.

An energy assessment has been undertaken to not only demonstrate compliance with RBC Policy, but to go beyond the requirements.

6.1 Results

Through the uses of fabric first measures and high efficiency systems the proposed domestic development has been shown to achieve a 40% reduction in regulated carbon emissions when compared to a SAP 10 baseline building.

ASHP and PV have been identified as the most suitable renewable technology for the scheme. Based on initial design estimates (detailed in Appendix B) it has been shown that the Be Green measures would achieve a further 60% reduction in regulated carbon emissions, bringing the total building regulated carbon reduction to a 100% improvement, which represents an annual saving of approximately 72 tonnes of CO₂.

Figure 7 below sets out the proposed development reduction in CO₂ emissions in line with the Energy Hierarchy.

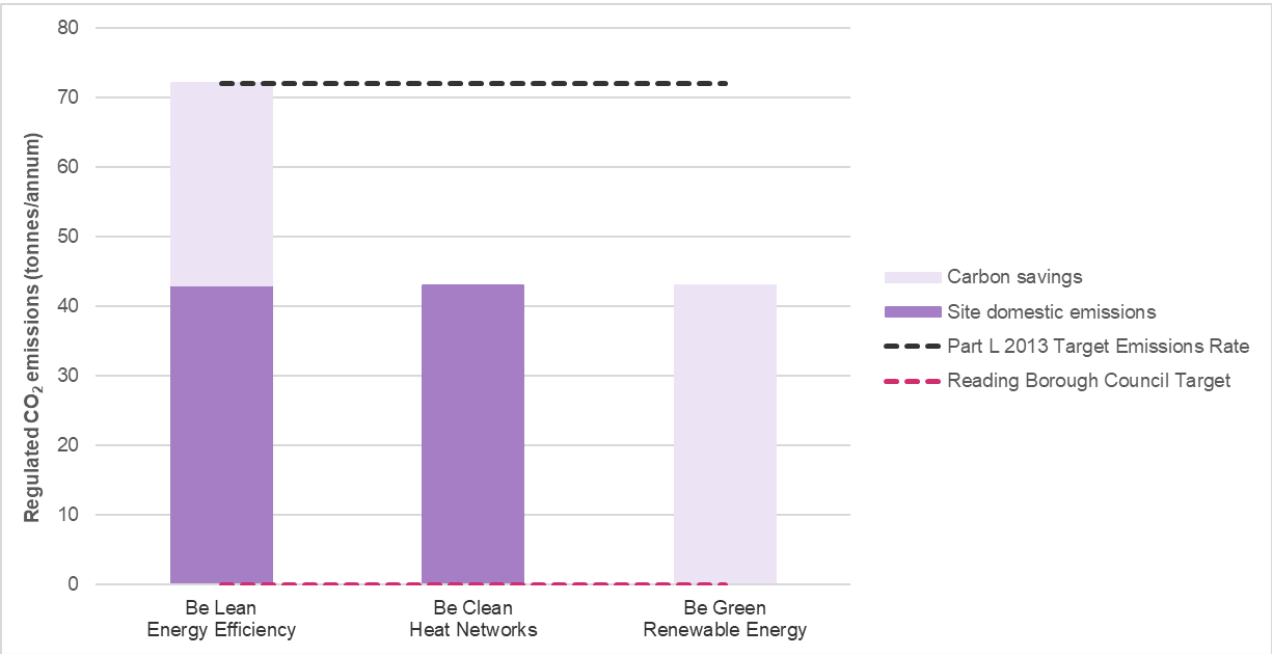


Figure 7 Proposed Development Energy Hierarchy and targets

Table 4 below shows the CO₂ emissions breakdown and Table 5 shows the percentage breakdown at each stage of the hierarchy.

Table 4: Proposed Development CO₂ Emissions Breakdown

	Carbon Dioxide Emissions (tonnes CO ₂ per annum)	
	Regulated	Unregulated
Baseline: Part L1A 2013 Compliant Development	72	50
After energy demand reduction (Be Lean)	43	50
After heat network (Be Clean)	43	50
After renewable energy (Be Green)	0	50

Table 5: Proposed Development CO₂ Emissions Breakdown

	Regulated Carbon Dioxide Savings	
	(Tonnes of CO ₂ per annum)	(%)
Savings from energy demand reduction	29	40%
Savings from heat network	0	0%
Savings from renewable energy	43	60%
Cumulative on-site savings	72	100%

The energy strategy has addressed the key elements of the Reading Local Plan on energy and will make a positive contribution to reducing the Town's CO₂ emissions.

Appendix A: TER Worksheets.

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



Property Reference	BA T1				Issued on Date	12/12/2019
Assessment Reference	V01 - Be Lean	Prop Type Ref				
Property	BA T1					
SAP Rating	86 B	DER	12.24	TER	18.65	
Environmental	90 B	% DER<TER	34.35			
CO ₂ Emissions (t/year)	1.15	DFEE	38.76	TFEE	63.09	
General Requirements Compliance	Pass	% DFEE<TFEE	38.57			
Assessor Details	Mr. Liam Holden, Liam Holden, Tel: 01202 654600, liamholden@hoarelea.com				Assessor ID	W974-0001
Client						



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



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)		Storey height (m)		Volume (m ³)
Ground floor	42.5700 (1b)	x	2.6100 (2b)	=	111.1077 (1b) - (3b)
First floor	42.5700 (1c)	x	3.0100 (2c)	=	128.1357 (1c) - (3c)
Second floor	25.0300 (1d)	x	3.3200 (2d)	=	83.0996 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	110.1700				(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	322.3430 (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							4 * 10 =	40.0000 (7a)
Number of passive vents							0 * 10 =	0.0000 (7b)
Number of flueless gas fires							0 * 40 =	0.0000 (7c)

Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =		40.0000 / (5) =	Air changes per hour	0.1241 (8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.3741 (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) =			0.3460 (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	0.4412	0.4325	0.4239	0.3806	0.3720	0.3287	0.3287	0.3201	0.3460	0.3720	0.3893	0.4066 (22b)
Effective ac	0.5973	0.5935	0.5898	0.5724	0.5692	0.5540	0.5540	0.5512	0.5599	0.5692	0.5758	0.5827 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Opaque door			2.8800	1.0000	2.8800		(26)
TER Opening Type (Uw = 1.40)			22.0400	1.3258	29.2197		(27)
Heat Loss Floor 1			42.5700	0.1300	5.5341		(28a)
External Wall 1	48.2100	13.1400	35.0700	0.1800	6.3126		(29a)
External Wall 2	55.5900	7.5300	48.0600	0.1800	8.6508		(29a)
External Wall 3	40.3200	4.2500	36.0700	0.1800	6.4926		(29a)
External Roof 1	17.6200		17.6200	0.1300	2.2906		(30)
External Roof 2	27.9000		27.9000	0.1300	3.6270		(30)
Total net area of external elements Aum(A, m ²)			232.2100				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	65.0074			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							16.5776 (36)
Total fabric heat loss						(33) + (36) =	81.5850 (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	63.5395	63.1375	62.7434	60.8926	60.5463	58.9342	58.9342	58.6357	59.5552	60.5463	61.2468	61.9792 (38)
Heat transfer coeff	145.1245	144.7225	144.3284	142.4775	142.1313	140.5192	140.5192	140.2207	141.1402	142.1313	142.8318	143.5642 (39)
Average = Sum(39)m / 12 =												142.4759 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.3173	1.3136	1.3101	1.2933	1.2901	1.2755	1.2755	1.2728	1.2811	1.2901	1.2965	1.3031 (40)
Days in month												1.2932 (40)
	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8158 (42)
Average daily hot water use (litres/day)												101.0763 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	111.1839	107.1408	103.0978	99.0547	95.0117	90.9686	90.9686	95.0117	99.0547	103.0978	107.1408	111.1839 (44)
Energy conte	164.8825	144.2073	148.8090	129.7353	124.4841	107.4203	99.5407	114.2244	115.5886	134.7074	147.0437	159.6799 (45)
Energy content (annual)										Total = Sum(45)m =		1590.3231 (45)
Distribution loss (46)m = 0.15 x (45)m	24.7324	21.6311	22.3213	19.4603	18.6726	16.1130	14.9311	17.1337	17.3383	20.2061	22.0565	23.9520 (46)



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Water storage loss:											
Store volume											
a) If manufacturer declared loss factor is known (kWh/day):											
Temperature factor from Table 2b											
Enter (49) or (54) in (55)											
Total storage loss											
31.6444 28.5820 31.6444 30.6236 31.6444 30.6236 31.6444 31.6444 30.6236 31.6444 30.6236 31.6444 (56)											
If cylinder contains dedicated solar storage											
31.6444 28.5820 31.6444 30.6236 31.6444 30.6236 31.6444 31.6444 30.6236 31.6444 30.6236 31.6444 (57)											
Primary loss 23.2624 21.0112 23.2624 22.5120 23.2624 22.5120 23.2624 23.2624 22.5120 23.2624 22.5120 23.2624 (59)											
Total heat required for water heating calculated for each month											
219.7893 193.8005 203.7158 182.8709 179.3909 160.5559 154.4475 169.1312 168.7242 189.6142 200.1793 214.5867 (62)											
Solar input 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63)											
Solar input (sum of months) = Sum(63)m = 0.0000 (63)											
Output from w/h											
219.7893 193.8005 203.7158 182.8709 179.3909 160.5559 154.4475 169.1312 168.7242 189.6142 200.1793 214.5867 (64)											
Total per year (kWh/year) = Sum(64)m = 2236.8063 (64)											
Heat gains from water heating, kWh/month											
98.7489 87.6235 93.4044 85.6455 85.3164 78.2257 77.0227 81.9051 80.9417 88.7156 91.4005 97.0190 (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 140.7921 140.7921 140.7921 140.7921 140.7921 140.7921 140.7921 140.7921 140.7921 140.7921 140.7921 (66)											
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5											
24.4012 21.6729 17.6256 13.3437 9.9746 8.4210 9.0991 11.8274 15.8747 20.1566 23.5257 25.0793 (67)											
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5											
271.8000 274.6205 267.5131 252.3823 233.2823 215.3311 203.3385 200.5181 207.6255 222.7563 241.8563 259.8075 (68)											
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5											
37.0792 37.0792 37.0792 37.0792 37.0792 37.0792 37.0792 37.0792 37.0792 37.0792 37.0792 37.0792 (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)											
-112.6337 -112.6337 -112.6337 -112.6337 -112.6337 -112.6337 -112.6337 -112.6337 -112.6337 -112.6337 -112.6337 -112.6337 (71)											
Water heating gains (Table 5)											
132.7270 130.3921 125.5436 118.9520 114.6726 108.6469 103.5252 110.0874 112.4190 119.2415 126.9451 130.4019 (72)											
Total internal gains											
497.1658 494.9231 478.9199 452.9156 426.1671 400.6365 384.2005 390.6706 404.1569 430.3920 460.5648 483.5264 (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				9.3000	10.6334	0.6300	0.7000	0.7700	30.2222 (74)			
East				5.5400	19.6403	0.6300	0.7000	0.7700	33.2529 (76)			
South				7.2000	46.7521	0.6300	0.7000	0.7700	102.8739 (78)			
Solar gains	166.3490	291.2868	419.8842	556.4415	656.5978	666.5960	636.5268	559.4967	466.7826	327.6606	200.6860	141.4328 (83)
Total gains	663.5148	786.2099	898.8041	1009.3571	1082.7649	1067.2325	1020.7273	950.1672	870.9395	758.0526	661.2508	624.9591 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)											
Utilisation factor for gains for living area, nil,m (see Table 9a)											
tau Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec											
52.7182 52.8646 53.0089 53.6975 53.8284 54.4459 54.4459 54.5618 54.2064 53.8284 53.5644 53.2911											
alpha 4.5145 4.5243 4.5339 4.5798 4.5886 4.6297 4.6297 4.6375 4.6138 4.5886 4.5710 4.5527											
util living area 0.9979 0.9951 0.9875 0.9624 0.8923 0.7456 0.5808 0.6381 0.8645 0.9767 0.9956 0.9984 (86)											
MIT 19.5428 19.7189 20.0017 20.3748 20.7043 20.9137 20.9788 20.9677 20.8160 20.3867 19.8982 19.5172 (87)											
Th 2 19.8273 19.8302 19.8330 19.8461 19.8486 19.8601 19.8601 19.8622 19.8557 19.8486 19.8436 19.8384 (88)											
util rest of house 0.9972 0.9934 0.9829 0.9472 0.8475 0.6481 0.4427 0.4996 0.7921 0.9645 0.9938 0.9979 (89)											
MIT 2 17.8987 18.1574 18.5701 19.1118 19.5558 19.8021 19.8525 19.8490 19.7063 19.1383 18.4292 17.8688 (90)											
Living area fraction fLA = Living area / (4) = 0.2946 (91)											
MIT 18.3831 18.6175 18.9919 19.4839 19.8942 20.1296 20.1843 20.1786 20.0333 19.5062 18.8620 18.3545 (92)											
Temperature adjustment 0.0000											
adjusted MIT 18.3831 18.6175 18.9919 19.4839 19.8942 20.1296 20.1843 20.1786 20.0333 19.5062 18.8620 18.3545 (93)											

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9958	0.9908	0.9782	0.9411	0.8496	0.6733	0.4838	0.5406	0.8054	0.9595	0.9914	0.9968 (94)
Ext temp.	660.7190	778.9794	879.1905	949.9536	919.9517	718.6194	493.7857	513.6233	701.4275	727.3844	655.5678	622.9386 (95)
Heat loss rate W	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)
Month fracti	2043.8030	1985.2240	1802.9392	1507.9724	1164.6519	777.0197	503.6654	529.8444	837.4232	1265.8435	1679.9863	2032.0765 (97)
Space heating kWh	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	1029.0145	810.5963	687.2691	401.7736	182.0569	0.0000	0.0000	0.0000	0.0000	400.6136	737.5813	1048.3986 (98)
Space heating per m2										(98) / (4) =		48.0830 (99)



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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												5665.5657 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	1029.0145	810.5963	687.2691	401.7736	182.0569	0.0000	0.0000	0.0000	0.0000	400.6136	737.5813	1048.3986 (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)	1100.5503	866.9479	735.0471	429.7043	194.7133	0.0000	0.0000	0.0000	0.0000	428.4638	788.8570	1121.2819 (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	219.7893	193.8005	203.7158	182.8709	179.3909	160.5559	154.4475	169.1312	168.7242	189.6142	200.1793	214.5867 (64)
Efficiency of water heater	88.4135	88.2176	87.8080	86.8572	84.8532	79.8000	79.8000	79.8000	79.8000	86.7626	87.9817	79.8000 (216)
Fuel for water heating, kWh/month	248.5924	219.6846	232.0013	210.5421	211.4133	201.1979	193.5432	211.9439	211.4339	218.5436	227.5236	88.4842 (217)
Water heating fuel used												242.5142 (219)
Annual totals kWh/year												2628.9338 (219)
Space heating fuel - main system												5665.5657 (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)												430.9322 (232)
Total delivered energy for all uses												8800.4317 (233)

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Property Reference	BB T1				Issued on Date	12/12/2019
Assessment Reference	V01 - Be Lean	Prop Type Ref				
Property	BB T1					
SAP Rating	86 B	DER	12.17	TER	18.49	
Environmental	91 B	% DER<TER	34.19			
CO ₂ Emissions (t/year)	0.80	DFEE	28.96	TFEE	51.05	
General Requirements Compliance	Pass	% DFEE<TFEE	43.26			
Assessor Details	Mr. Liam Holden, Liam Holden, Tel: 01202 654600, liamholden@hoarelea.com				Assessor ID	W974-0001
Client						

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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor			
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	72.9100	x 2.5100 (2b)	= 183.0041 (1b) - (3b)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 183.0041 (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)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				Air changes per hour 30.0000 / (5) = 0.1639 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4139 (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) =				0.3829 (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	0.4882	0.4786	0.4690	0.4212	0.4116	0.3637	0.3637	0.3542	0.3829	0.4116	0.4307	0.4499 (22b)
Effective ac	0.6192	0.6145	0.6100	0.5887	0.5847	0.5662	0.5662	0.5627	0.5733	0.5847	0.5928	0.6012 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K					
TER Opaque door			3.2400	1.0000	3.2400		(26)					
TER Opening Type (Uw = 1.40)			10.5800	1.3258	14.0265		(27)					
Heat Loss Floor 1			72.9100	0.1300	9.4783		(28a)					
External Wall 1	62.7800	10.5800	52.2000	0.1800	9.3960		(29a)					
To Corridor	7.0300	3.2400	3.7900	0.1800	0.6822		(29a)					
Total net area of external elements Aum(A, m ²)			142.7200				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	36.8230		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.6939 (36)					
Total fabric heat loss						(33) + (36) =	46.5169 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	37.3919	37.1125	36.8385	35.5520	35.3113	34.1908	34.1908	33.9833	34.6224	35.3113	35.7983	36.3073 (38)
Average = Sum(39)m / 12 =	83.9088	83.6294	83.3555	82.0689	81.8282	80.7077	80.7077	80.5002	81.1393	81.8282	82.3152	82.8243 (39)
												82.0678 (39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.1509	1.1470	1.1433	1.1256	1.1223	1.1069	1.1069	1.1041	1.1129	1.1223	1.1290	1.1360 (40)
Days in month												1.1256 (40)
	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.3147 (42)
Average daily hot water use (litres/day)												89.1729 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	98.0902	94.5233	90.9564	87.3895	83.8226	80.2556	80.2556	83.8226	87.3895	90.9564	94.5233	98.0902 (44)
Energy content (annual)	145.4650	127.2246	131.2844	114.4569	109.8241	94.7699	87.8182	100.7727	101.9762	118.8435	129.7269	140.8751 (45)
Distribution loss (46)m = 0.15 x (45)m												1403.0375 (45)
Water storage loss:	21.8197	19.0837	19.6927	17.1685	16.4736	14.2155	13.1727	15.1159	15.2964	17.8265	19.4590	21.1313 (46)
Store volume												150.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3938 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.7527 (55)

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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Total storage loss	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)
If cylinder contains dedicated solar storage	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	192.0599	169.3103	177.8793	159.5488	156.4190	139.8617	134.4131	147.3676	147.0681	165.4384	174.8188	187.4700	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum (63)m =												0.0000	(63)
Output from w/h	192.0599	169.3103	177.8793	159.5488	156.4190	139.8617	134.4131	147.3676	147.0681	165.4384	174.8188	187.4700	(64)
Heat gains from water heating, kWh/month	85.6430	75.9708	80.9280	74.1304	73.7924	67.5845	66.4755	70.7828	69.9806	76.7914	79.2077	84.1169	(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	115.7325	115.7325	115.7325	115.7325	115.7325	115.7325	115.7325	115.7325	115.7325	115.7325	115.7325	115.7325	(66)
Lighting gains (calculated in Appendix L, equation L19 or L9a), also see Table 5	19.3598	17.1952	13.9841	10.5868	7.9138	6.6812	7.2192	9.3838	12.5949	15.9922	18.6652	19.8979	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	203.9913	206.1081	200.7739	189.4179	175.0830	161.6102	152.6096	150.4928	155.8271	167.1830	181.5179	194.9907	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.5733	34.5733	34.5733	34.5733	34.5733	34.5733	34.5733	34.5733	34.5733	34.5733	34.5733	34.5733	(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)	-92.5860	-92.5860	-92.5860	-92.5860	-92.5860	-92.5860	-92.5860	-92.5860	-92.5860	-92.5860	-92.5860	-92.5860	(71)
Water heating gains (Table 5)	115.1116	113.0517	108.7742	102.9589	99.1834	93.8673	89.3488	95.1382	97.1952	103.2142	110.0107	113.0603	(72)
Total internal gains	399.1825	397.0748	384.2519	363.6834	342.8999	322.8784	309.8973	315.7346	326.3370	347.1092	370.9136	388.6686	(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	
South					5.3000	46.7521	0.6300		0.7000			0.7700			75.7266 (78)
West					5.2800	19.6403	0.6300		0.7000			0.7700			31.6922 (80)
Solar gains	107.4189	186.0174	260.0802	327.4586	368.5528	365.8712	352.8044	322.6752	283.7754	207.3323	129.2784	91.4969	(83)		
Total gains	506.6013	583.0922	644.3320	691.1420	711.4528	688.7496	662.7017	638.4098	610.1124	554.4415	500.1919	480.1655	(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	60.3416	60.5433	60.7422	61.6944	61.8759	62.7349	62.7349	62.8967	62.4012	61.8759	61.5099	61.1318		
alpha	5.0228	5.0362	5.0495	5.1130	5.1251	5.1823	5.1823	5.1931	5.1601	5.1251	5.1007	5.0755		
util living area	0.9961	0.9916	0.9801	0.9465	0.8636	0.6992	0.5258	0.5651	0.7996	0.9582	0.9917	0.9970	(86)	
MIT	19.8452	20.0099	20.2556	20.5616	20.8102	20.9546	20.9914	20.9876	20.9066	20.5860	20.1619	19.8213	(87)	
Th 2	19.9595	19.9626	19.9657	19.9800	19.9826	19.9952	19.9952	19.9975	19.9903	19.9826	19.9772	19.9716	(88)	
util rest of house	0.9949	0.9888	0.9732	0.9274	0.8158	0.6093	0.4110	0.4495	0.7215	0.9393	0.9884	0.9961	(89)	
MIT 2	18.4316	18.6731	19.0300	19.4715	19.7980	19.9651	19.9920	19.9925	19.9186	19.5144	18.9061	18.4054	(90)	
Living area fraction									FLA = Living area / (4) =			0.4942	(91)	
MIT	19.1302	19.3337	19.6357	20.0102	20.2982	20.4541	20.4859	20.4843	20.4069	20.0440	19.5267	19.1051	(92)	
Temperature adjustment												0.0000		
adjusted MIT	19.1302	19.3337	19.6357	20.0102	20.2982	20.4541	20.4859	20.4843	20.4069	20.0440	19.5267	19.1051	(93)	

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	503.2957	575.2733	625.3357	641.4423	591.9591	449.1621	310.1642	323.6167	461.3886	521.5719	493.4566	477.7254	(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	1244.3835	1207.0815	1094.9289	911.7988	703.5754	472.4695	313.6194	328.7837	511.7346	772.7830	1022.9033	1234.5064	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	551.3694	424.5751	349.3774	194.6567	83.0425	0.0000	0.0000	0.0000	0.0000	186.9011	381.2017	563.0450	(98)
Space heating												2734.1688	(98)
Space heating per m2										(98) / (4) =		37.5006	(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 %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2924.2447	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	551.3694	424.5751	349.3774	194.6567	83.0425	0.0000	0.0000	0.0000	0.0000	186.9011	381.2017	563.0450	(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)	589.6998	454.0910	373.6657	208.1890	88.8155	0.0000	0.0000	0.0000	0.0000	199.8942	407.7023	602.1872	(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	192.0599	169.3103	177.8793	159.5488	156.4190	139.8617	134.4131	147.3676	147.0681	165.4384	174.8188	187.4700	(64)
Efficiency of water heater	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(216)
(217)m	87.4700	87.1679	86.5833	85.3454	83.2118	79.8000	79.8000	79.8000	79.8000	85.1397	86.8391	87.5671	(217)
Fuel for water heating, kWh/month	219.5722	194.2347	205.4429	186.9449	187.9770	175.2653	168.4375	184.6712	184.2958	194.3140	201.3136	214.0872	(219)
Water heating fuel used												2316.5562	(219)
Annual totals kWh/year													
Space heating fuel - main system												2924.2447	(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)												341.8999	(232)
Total delivered energy for all uses												5657.7008	(238)

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

Space heating - main system 1	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - secondary	2924.2447	0.2160	631.6369	(261)
Water heating (other fuel)	0.0000	0.0000	0.0000	(263)
Space and water heating	2316.5562	0.2160	500.3761	(264)
Pumps and fans	75.0000	0.5190	1132.0130	(265)
Energy for lighting	341.8999	0.5190	38.9250	(267)
Total CO2, kg/m2/year			177.4460	(268)
Emissions per m2 for space and water heating			1348.3840	(272)
Fuel factor (mains gas)			15.5262	(272a)
Emissions per m2 for lighting			1.0000	
Emissions per m2 for pumps and fans			2.4338	(272b)
Target Carbon Dioxide Emission Rate (TER) = (15.5262 * 1.00) + 2.4338 + 0.5339, rounded to 2 d.p.			0.5339	(272c)
			18.4900	(273)



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Property Reference	BB T2				Issued on Date	12/12/2019
Assessment Reference	V01 - Be Lean	Prop Type Ref				
Property	BB T2					
SAP Rating	84 B	DER	15.05	TER	22.08	
Environmental	90 B	% DER<TER	31.84			
CO ₂ Emissions (t/year)	0.69	DFEE	35.73	TFEE	60.90	
General Requirements Compliance	Pass	% DFEE<TFEE	41.33			
Assessor Details	Mr. Liam Holden, Liam Holden, Tel: 01202 654600, liamholden@hoarelea.com				Assessor ID	W974-0001
Client						

FULL SAP CALCULATION PRINTOUT
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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor			
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.0400	x 3.3700 (2b)	= 168.6348 (1b) - (3b)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 168.6348 (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				2 * 10 =	20.0000 (7a)
Number of passive vents				0 * 10 =	0.0000 (7b)
Number of flueless gas fires				0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				Air changes per hour 20.0000 / (5) = 0.1186 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3686 (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) =				0.3410 (21)

Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind factor	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)
Adj infilt rate	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)
Effective ac	0.4347	0.4262	0.4177	0.3750	0.3665	0.3239	0.3239	0.3154	0.3410	0.3665	0.3836	0.4006 (22b)
	0.5945	0.5908	0.5872	0.5703	0.5672	0.5525	0.5525	0.5497	0.5581	0.5672	0.5736	0.5802 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K					
TER Opaque door			2.0400	1.0000	2.0400		(26)					
TER Opening Type (Uw = 1.40)			6.1000	1.3258	8.0871		(27)					
TER Room Window (Uw = 1.70)			3.9800	1.5918	6.3352		(27a)					
Heat Loss Floor 1			50.0400	0.1300	6.5052		(28a)					
External Wall 1	26.9300	6.1000	20.8300	0.1800	3.7494		(29a)					
To Corridor	15.5900	2.0400	13.5500	0.1800	2.4390		(29a)					
To stairs	11.3400		11.3400	0.1800	2.0412		(29a)					
External Roof 1	50.0400	3.9800	46.0600	0.1300	5.9878		(30)					
Total net area of external elements Aum(A, m ²)			153.9400				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	37.1849		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.9346 (36)					
Total fabric heat loss						(33) + (36) =	42.1195 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 33.0830	Feb 32.8788	Mar 32.6787	Apr 31.7386	May 31.5628	Jun 30.7440	Jul 30.7440	Aug 30.5924	Sep 31.0594	Oct 31.5628	Nov 31.9186	Dec 32.2905 (38)
Heat transfer coeff	75.2026	74.9984	74.7982	73.8582	73.6823	72.8635	72.8635	72.7119	73.1789	73.6823	74.0381	74.4101 (39)
Average = Sum(39)m / 12 =												73.8573 (39)
HLP	Jan 1.5028	Feb 1.4988	Mar 1.4948	Apr 1.4760	May 1.4725	Jun 1.4561	Jul 1.4561	Aug 1.4531	Sep 1.4624	Oct 1.4725	Nov 1.4796	Dec 1.4870 (40)
HLP (average)												1.4760 (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												1.6913 (42)
Average daily hot water use (litres/day)												74.3679 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	81.8047	78.8299	75.8552	72.8805	69.9058	66.9311	66.9311	69.9058	72.8805	75.8552	78.8299	81.8047 (44)
Energy content (annual)	121.3139	106.1019	109.4877	95.4540	91.5904	79.0356	73.2381	84.0418	85.0455	99.1123	108.1888	117.4861 (45)
Distribution loss (46)m = 0.15 x (45)m										Total = Sum(45)m =		1170.0961 (45)
Water storage loss:	18.1971	15.9153	16.4232	14.3181	13.7386	11.8553	10.9857	12.6063	12.7568	14.8668	16.2283	17.6229 (46)
Store volume												150.0000 (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):	1.3938 (48)
Temperature factor from Table 2b	0.5400 (49)
Enter (49) or (54) in (55)	0.7527 (55)
Total storage loss	
23.3325 21.0745 23.3325 22.5798 23.3325 22.5798 23.3325 23.3325 22.5798 23.3325 22.5798 23.3325 (56)	
If cylinder contains dedicated solar storage	
23.3325 21.0745 23.3325 22.5798 23.3325 22.5798 23.3325 23.3325 22.5798 23.3325 22.5798 23.3325 (57)	
Primary loss 23.2624 21.0112 23.2624 22.5120 23.2624 22.5120 23.2624 23.2624 22.5120 23.2624 22.5120 23.2624 (59)	
Total heat required for water heating calculated for each month	
167.9088 148.1877 156.0826 140.5459 138.1853 124.1274 119.8330 130.6367 130.1373 145.7072 153.2807 164.0810 (62)	
Solar input 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63)	
Solar input (sum of months) = Sum(63)m =	0.0000 (63)
Output from w/h	
167.9088 148.1877 156.0826 140.5459 138.1853 124.1274 119.8330 130.6367 130.1373 145.7072 153.2807 164.0810 (64)	
Total per year (kWh/year) = Sum(64)m =	1718.7135 (64)
Heat gains from water heating, kWh/month	
77.6128 68.9475 73.6806 67.8119 67.7297 62.3528 61.6276 65.2198 64.3511 70.2308 72.0463 76.3400 (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 84.5639 84.5639 84.5639 84.5639 84.5639 84.5639 84.5639 84.5639 84.5639 84.5639 84.5639 84.5639 (66)	
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	
13.1448 11.6751 9.4948 7.1882 5.3732 4.5363 4.9017 6.3714 8.5516 10.8582 12.6732 13.5101 (67)	
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	
147.3378 148.8667 145.0139 136.8118 126.4581 116.7270 110.2261 108.6972 112.5500 120.7521 131.1059 140.8369 (68)	
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	
31.4564 31.4564 31.4564 31.4564 31.4564 31.4564 31.4564 31.4564 31.4564 31.4564 31.4564 31.4564 (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)	
-67.6511 -67.6511 -67.6511 -67.6511 -67.6511 -67.6511 -67.6511 -67.6511 -67.6511 -67.6511 -67.6511 -67.6511 (71)	
Water heating gains (Table 5)	
104.3183 102.6004 99.0330 94.1832 91.0346 86.6011 82.8328 87.6610 89.3765 94.3962 100.0643 102.6076 (72)	
Total internal gains	
316.1701 314.5114 304.9110 289.5524 274.2351 259.2336 249.3297 254.0987 261.8473 277.3757 295.2124 308.3237 (73)	

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data FF or Table 6c	Access factor Table 6d	Gains W
South	6.1000	46.7521	0.6300	0.7000		87.1570 (78)
South	3.9800	45.6416	0.6300	0.7000	1.0000	72.0982 (82)
Solar gains	159.2553	272.7952	375.1267	464.3953	517.2226	511.5035 494.0180 455.3629 406.4010 302.2126 191.0814 136.0471 (83)
Total gains	475.4253	587.3066	680.0376	753.9477	791.4577	770.7371 743.3477 709.4616 668.2483 579.5884 486.2939 444.3708 (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 46.2085 46.3343 46.4583 47.0496 47.1619 47.6919 47.6919 47.7914 47.4864 47.1619 46.9353 46.7007												
alpha 4.0806 4.0890 4.0972 4.1366 4.1441 4.1795 4.1795 4.1861 4.1658 4.1441 4.1290 4.1134												
util living area 0.9881 0.9723 0.9393 0.8671 0.7436 0.5734 0.4239 0.4605 0.6805 0.8995 0.9756 0.9908 (86)												
MIT 19.6137 19.8769 20.2127 20.5750 20.8286 20.9567 20.9902 20.9862 20.9108 20.5658 20.0179 19.5680 (87)												
Th 2 19.6854 19.6884 19.6914 19.7056 19.7082 19.7206 19.7206 19.7229 19.7158 19.7082 19.7029 19.6973 (88)												
util rest of house 0.9842 0.9636 0.9204 0.8275 0.6734 0.4718 0.3044 0.3381 0.5810 0.8598 0.9663 0.9877 (89)												
MIT 2 17.9055 18.2845 18.7583 19.2536 19.5601 19.6958 19.7177 19.7183 19.6567 19.2595 18.5018 17.8475 (90)												
Living area fraction fLA = Living area / (4) =												0.5222 (91)
MIT 18.7975 19.1160 19.5178 19.9436 20.2225 20.3542 20.3822 20.3804 20.3116 19.9416 19.2935 18.7459 (92)												
Temperature adjustment 0.0000												
adjusted MIT 18.7975 19.1160 19.5178 19.9436 20.2225 20.3542 20.3822 20.3804 20.3116 19.9416 19.2935 18.7459 (93)												

8. Space heating requirement

Utilisation 0.9806 0.9588 0.9175 0.8356 0.7031 0.5236 0.3670 0.4022 0.6296 0.8680 0.9626 0.9847 (94)												
Useful gains 466.2220 563.1093 623.9090 630.0248 556.5058 403.5942 272.8250 285.3657 420.7435 503.1051 468.0929 437.5718 (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 1090.2482 1066.1786 973.7066 815.6606 627.9552 419.2740 275.5827 289.4209 454.5579 688.3129 902.7800 1082.3633 (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 464.2755 338.0625 260.2494 133.6578 53.1584 0.0000 0.0000 0.0000 0.0000 137.7946 312.9748 479.7248 (98)												
Space heating 2179.8979 (98)												
Space heating per m2 (98) / (4) =												43.5631 (99)

8c. Space cooling requirement



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



CALCULATION OF TARGET EMISSIONS 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 %)	93.5000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	2331.4416 (211)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 464.2755 338.0625 260.2494 133.6578 53.1584 0.0000 0.0000 0.0000 0.0000 137.7946 312.9748 479.7248 (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) 496.5514 361.5642 278.3416 142.9495 56.8539 0.0000 0.0000 0.0000 0.0000 147.3739 334.7324 513.0747 (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 167.9088 148.1877 156.0826 140.5459 138.1853 124.1274 119.8330 130.6367 130.1373 145.7072 153.2807 164.0810 (64)	
Efficiency of water heater (217)m 87.3878 86.9471 86.1684 84.6802 82.5102 79.8000 79.8000 79.8000 79.8000 84.6654 86.6792 87.5095 (216)	
Fuel for water heating, kWh/month 192.1421 170.4344 181.1366 165.9725 167.4767 155.5481 150.1666 163.7051 163.0794 172.0977 176.8368 187.5007 (219)	
Water heating fuel used 2046.0967 (219)	
Annual totals kWh/year 2331.4416 (211)	
Space heating fuel - main system 0.0000 (215)	
Space heating fuel - secondary 30.0000 (230c)	
Electricity for pumps and fans: central heating pump 45.0000 (230e)	
main heating flue fan 75.0000 (231)	
Total electricity for the above, kWh/year 232.1405 (232)	
Electricity for lighting (calculated in Appendix L) 4684.6789 (238)	
Total delivered energy for all uses	

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

Energy kWh/year 2331.4416	Emission factor kg CO2/kWh 0.2160	Emissions kg CO2/year 503.5914 (261)
Space heating - main system 1 0.0000	0.0000	0.0000 (263)
Space heating - secondary 2046.0967	0.2160	441.9569 (264)
Water heating (other fuel) 75.0000	0.5190	38.9250 (267)
Space and water heating 232.1405	0.5190	120.4809 (268)
Pumps and fans 1104.9542 (272)		
Energy for lighting 18.8958 (272a)		
Total CO2, kg/m2/year 2.4077 (272b)		
Emissions per m2 for space and water heating 0.7779 (272c)		
Fuel factor (mains gas) 22.0800 (273)		
Emissions per m2 for lighting		
Emissions per m2 for pumps and fans		
Target Carbon Dioxide Emission Rate (TER) = (18.8958 * 1.00) + 2.4077 + 0.7779, rounded to 2 d.p.		



Appendix B: Be Lean DER Worksheets.

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



Property Reference	BA T1				Issued on Date	12/12/2019
Assessment Reference	V01 - Be Lean	Prop Type Ref				
Property	BA T1					
SAP Rating	86 B	DER	12.24	TER	18.65	
Environmental	90 B	% DER<TER	34.35			
CO ₂ Emissions (t/year)	1.15	DFEE	38.76	TFEE	63.09	
General Requirements Compliance	Pass	% DFEE<TFEE	38.57			
Assessor Details	Mr. Liam Holden, Liam Holden, Tel: 01202 654600, liamholden@hoarelea.com				Assessor ID	W974-0001
Client						

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



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DWELLING AS DESIGNED

Ground-floor flat, total floor area 110 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 (c)
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.65 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 12.24 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)63.1 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)38.8 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.13 (max. 0.30)	0.13 (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	0.10 (max. 0.20)	0.10 (max. 0.35)	OK
Openings	0.82 (max. 2.00)	1.00 (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:	1.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main heating system:	Community heating scheme	-
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Secondary heating system:

None

5 Cylinder insulation

Hot water storage	Measured cylinder loss: 1.67 kWh/day	
Permitted by DBSCG 2.56	OK	
Primary pipework insulated:	Yes (assumed)	OK

6 Controls

Space heating controls:	Charging system linked to use of community heating, programmer and TRVsOK	
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Hot water controls:

Cylinderstat 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:	0.62	
Maximum	1.5	OK
MVHR efficiency:	94%	
Minimum:	70%	OK

9 Summertime temperature

Overheating risk (Thames Valley):	Not significant	OK
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Based on:

Overshading:	Average	
Windows facing North:	9.30 m ² , No overhang	
Windows facing East:	5.54 m ² , No overhang	
Windows facing South:	7.20 m ² , No overhang	
Air change rate:	8.00 ach	
Blinds/curtains:	Dark-coloured curtain or roller blind, closed 100% of daylight hours	

10 Key features

External wall U-value	0.13 W/m ² K
External wall U-value	0.13 W/m ² K
External wall U-value	0.13 W/m ² K
Party wall U-value	0.00 W/m ² K
Party wall U-value	0.00 W/m ² K
Party wall U-value	0.00 W/m ² K
Roof U-value	0.10 W/m ² K
Roof U-value	0.10 W/m ² K
Floor U-value	0.10 W/m ² K
Door U-value	1.00 W/m ² K
Window U-value	0.80 W/m ² K
Air permeability	1.0 m ³ /m ² h

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	42.5700	(1b)	x	2.6100	(2b)	= 111.1077 (1b) - (3b)
First floor	42.5700	(1c)	x	3.0100	(2c)	= 128.1357 (1c) - (3c)
Second floor	25.0300	(1d)	x	3.3200	(2d)	= 83.0996 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	110.1700					
Dwelling volume						(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 322.3430 (5)

2. Ventilation rate

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

Pressure test		Yes	
Measured/design AP50		1.0000	
Infiltration rate		0.0500	(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) =	0.0463	(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
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
Adj infilt rate	0.0590	0.0578	0.0567	0.0509	0.0497	0.0439	0.0439	0.0428	0.0463	0.0497	0.0520	0.0543
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation:												0.5000
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												79.9000
Effective ac	0.1595	0.1583	0.1572	0.1514	0.1502	0.1444	0.1444	0.1433	0.1468	0.1502	0.1525	0.1548

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 = 0.80)			22.0400	0.7752	17.0853		(27)
Opaque Door			2.8800	1.0000	2.8800		(26)
Heat Loss Floor 1			42.5700	0.1000	4.2570		(28a)
External Wall 1	48.2100	13.1400	35.0700	0.1300	4.5591		(29a)
External Wall 2	55.5900	7.5300	48.0600	0.1300	6.2478		(29a)
External Wall 3	40.3200	4.2500	36.0700	0.1300	4.6891		(29a)
External Roof 1	17.6200		17.6200	0.1000	1.7620		(30)
External Roof 2	27.9000		27.9000	0.1000	2.7900		(30)
Total net area of external elements Aum(A, m ²)			232.2100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26) ... (30) + (32) =	44.2703		(32)
To Dwelling					0.0000		(32)
Party Wall 2			29.2600	0.0000	0.0000		(32)
Party Wall 3			15.9200	0.0000	0.0000		(32)
Party Floor 1			42.5700				(32d)
Party Floor 2			25.0300				(32d)
Party Ceilings 1			42.5700				(32b)
Party Ceilings 2			24.9500				(32b)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							175.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							13.8628 (36)
Total fabric heat loss						(33) + (36) =	58.1331 (37)

4. Water heating energy requirements (kWh/year)



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



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Assumed occupancy 2.8158 (42)
Average daily hot water use (litres/day) 101.0763 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	111.1839	107.1408	103.0978	99.0547	95.0117	90.9686	90.9686	95.0117	99.0547	103.0978	107.1408	111.1839
Energy conte	164.8825	144.2073	148.8090	129.7353	124.4841	107.4203	99.5407	114.2244	115.5886	134.7074	147.0437	159.6799
Energy content (annual)										Total = Sum(45)m =		1590.3231 (45)
Distribution loss (46)m = 0.15 x (45)m	24.7324	21.6311	22.3213	19.4603	18.6726	16.1130	14.9311	17.1337	17.3383	20.2061	22.0565	23.9520

Water storage loss:												
Store volume												250.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6700 (48)
Temperature factor from Table 2b												0.6000 (49)
Enter (49) or (54) in (55)												1.0020 (55)

Total storage loss	31.0620	28.0560	31.0620	30.0600	31.0620	30.0600	31.0620	31.0620	30.0600	31.0620	30.0600	31.0620
If cylinder contains dedicated solar storage	31.0620	28.0560	31.0620	30.0600	31.0620	30.0600	31.0620	31.0620	30.0600	31.0620	30.0600	31.0620
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624

Total heat required for water heating calculated for each month	219.2069	193.2745	203.1334	182.3073	178.8085	159.9923	153.8651	168.5488	168.1606	189.0318	199.6157	214.0043
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
Solar input (sum of months) = Sum(63)m =												0.0000 (63)

Output from w/h	219.2069	193.2745	203.1334	182.3073	178.8085	159.9923	153.8651	168.5488	168.1606	189.0318	199.6157	214.0043
Heat gains from water heating, kWh/month	98.2829	87.2027	92.9385	85.1946	84.8505	77.7749	76.5568	81.4391	80.4908	88.2497	90.9496	96.5531

Total per year (kWh/year) = Sum(64)m =												2229.9491 (64)
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5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Metabolic gains (Table 5), Watts	140.7921	140.7921	140.7921	140.7921	140.7921	140.7921	140.7921	140.7921	140.7921	140.7921	140.7921	140.7921
(66)m	140.7921	140.7921	140.7921	140.7921	140.7921	140.7921	140.7921	140.7921	140.7921	140.7921	140.7921	140.7921
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	24.2312	21.5219	17.5028	13.2507	9.9051	8.3623	9.0357	11.7450	15.7641	20.0162	23.3618	24.9046

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	271.8000	274.6205	267.5131	252.3823	233.2823	215.3311	203.3385	200.5181	207.6255	222.7563	241.8563	259.8075
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0792	37.0792	37.0792	37.0792	37.0792	37.0792	37.0792	37.0792	37.0792	37.0792	37.0792	37.0792

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
Losses e.g. evaporation (negative values) (Table 5)	-112.6337	-112.6337	-112.6337	-112.6337	-112.6337	-112.6337	-112.6337	-112.6337	-112.6337	-112.6337	-112.6337	-112.6337

Water heating gains (Table 5)	132.1007	129.7659	124.9174	118.3258	114.0463	108.0206	102.8989	109.4612	111.7928	118.6152	126.3189	129.7756
Total internal gains	493.3696	491.1459	475.1709	449.1964	422.4714	396.9516	380.5108	386.9619	400.4201	426.6254	456.7746	479.7254

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North		9.3000	10.6334	0.5000		30.8390
East		5.5400	19.6403	0.5000	0.7700	33.9315
South		7.2000	46.7521	0.5000	0.7700	104.9733

Solar gains	169.7438	297.2314	428.4533	567.7975	669.9977	680.2000	649.5172	570.9150	476.3088	334.3475	204.7817	144.3192
Total gains	663.1134	788.3773	903.6242	1016.9939	1092.4691	1077.1516	1030.0280	957.8769	876.7289	760.9729	661.5563	624.0446

7. Mean internal temperature (heating season)

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

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	71.3149	71.4319	71.5493	72.1420	72.2618	72.8664	72.8664	72.9885	72.6233	72.2618	72.0227	71.7852
alpha	5.7543	5.7621	5.7700	5.8095	5.8175	5.8578	5.8578	5.8659	5.8416	5.8175	5.8015	5.7857

util living area	0.9878	0.9684	0.9182	0.7954	0.6142	0.4348	0.3137	0.3519	0.5700	0.8587	0.9716	0.9910
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MIT	20.2462	20.4417	20.6781	20.8873	20.9770	20.9974	20.9997	20.9994	20.9885	20.8521	20.5074	20.2002
Th 2	20.3571	20.3581	20.3591	20.3640	20.3650	20.3700	20.3700	20.3710	20.3680	20.3650	20.3630	20.3610

util rest of house	0.9853	0.9625	0.9042	0.7678	0.5765	0.3927	0.2689	0.3040	0.5212	0.8311	0.9652	0.9892
MIT 2	19.3390	19.6205	19.9529	20.2344	20.3422	20.3679	20.3698	20.3706	20.3583	20.1964	19.7212	19.2755

Living area fraction									fLA = Living area / (4) =			0.2946
MIT	19.6063	19.8625	20.1666	20.4268	20.5292	20.5534	20.5554	20.5559	20.5439	20.3896	19.9528	19.5479

Temperature adjustment												0.0000
adjusted MIT	19.6063	19.8625	20.1666	20.4268	20.5292	20.5534	20.5554	20.5559	20.5439	20.3896	19.9528	19.5479

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9817	0.9571	0.8996	0.7706	0.5864	0.4050	0.2821	0.3181	0.5350	0.8322	0.9603	0.9862 (94)
Useful gains	650,9790	754,5599	812,9271	783,7237	640,6304	436,2288	290,5836	304,6818	469,0241	633,2897	635,3093	615,4297 (95)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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	1149.4478	1121.7845	1022.9490	855.6927	654.3531	437.5585	290.7099	304.9341	475.1980	725.5263	955.7151	1145.0213	(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	370.8607	246.7749	156.2563	51.8177	10.2097	0.0000	0.0000	0.0000	0.0000	68.6240	230.6922	394.0162	(98)
Space heating												1529.2517	(98)
Space heating per m2										(98) / (4) =		13.8808	(99)

8c. Space cooling requirement

Not applicable

9b. Energy requirements												

Fraction of space heat from secondary/supplementary system (Table 11)											0.0000	(301)
Fraction of space heat from community system											1.0000	(302)
Fraction of heat from community Boilers											1.0000	(303a)
Fraction of total space heat from community Boilers											1.0000	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating											1.0000	(305)
Factor for control and charging method (Table 4c(3)) for community water heating											1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system											1.0500	(306)
Space heating:												
Annual space heating requirement											1529.2517	(98)
Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05											1605.7143	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)											0.0000	(308)
Space heating fuel for secondary/supplementary system											0.0000	(309)
Water heating												
Annual water heating requirement											2229.9491	(64)
Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05											2341.4466	(310a)
Electricity used for heat distribution											39.4716	(313)
Annual totals kWh/year												
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7750)												
mechanical ventilation fans (SFP = 0.7750)											304.7753	(330a)
Total electricity for the above, kWh/year											304.7753	(331)
Electricity for lighting (calculated in Appendix L)											427.9301	(332)
Total delivered energy for all uses											4679.8663	(338)

12b. Carbon dioxide emissions - Community heating scheme			

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Efficiency of heat source Boilers			90.0000 (367a)
Space heating from Boilers	4385.7344	0.2160	947.3186 (367)
Electrical energy for heat distribution	39.4716	0.5190	20.4858 (372)
Total CO2 associated with community systems (negative value allowed since DFEE <= TFEE)			967.8044 (373)
Space and water heating			967.8044 (376)
Pumps and fans	304.7753	0.5190	158.1784 (378)
Energy for lighting	427.9301	0.5190	222.0957 (379)
Total CO2, kg/year			1348.0785 (383)
Dwelling Carbon Dioxide Emission Rate (DER)			12.2400 (384)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES			
DER			12.2400 ZC1
Total Floor Area		TFA	110.1700
Assumed number of occupants		N	2.8158
CO2 emission factor in Table 12 for electricity displaced from grid		EF	0.5190
CO2 emissions from appliances, equation (L14)			14.6195 ZC2
CO2 emissions from cooking, equation (L16)			1.6936 ZC3
Total CO2 emissions			28.5531 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			28.5531 ZC8



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



Property Reference	BB T1	Issued on Date	12/12/2019
Assessment Reference	V01 - Be Lean	Prop Type Ref	
Property	BB T1		

SAP Rating	86 B	DER	12.17	TER	18.49
Environmental	91 B	% DER<TER	34.19		
CO ₂ Emissions (t/year)	0.80	DFEE	28.96	TFEE	51.05
General Requirements Compliance	Pass	% DFEE<TFEE	43.26		

Assessor Details	Mr. Liam Holden, Liam Holden, Tel: 01202 654600, liamholden@hoarelea.com	Assessor ID	W974-0001
Client			



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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DWELLING AS DESIGNED

Ground-floor flat, total floor area 73 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 (c)
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.49 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 12.17 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)51.1 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)29.0 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.13 (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	(no roof)		
Openings	0.85 (max. 2.00)	1.00 (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: 1.00 (design value)
Maximum 10.0 OK

4 Heating efficiency

Main heating system: Community heating scheme -

Secondary heating system: None

5 Cylinder insulation

Hot water storage Measured cylinder loss: 1.19 kWh/day
Permitted by DBSCG 1.89 OK
Primary pipework insulated: Yes (assumed) OK

6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and TRVsOK

Hot water controls: Cylinderstat 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: 0.62
Maximum 1.5 OK
MVHR efficiency: 93%
Minimum: 70% OK

9 Summertime temperature

Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing South: 5.30 m², No overhang
Windows facing West: 5.28 m², No overhang
Air change rate: 5.00 ach
Blinds/curtains: Dark-coloured curtain or roller blind, closed 100% of daylight hours

10 Key features

External wall U-value 0.13 W/m²K
Party wall U-value 0.00 W/m²K
Floor U-value 0.10 W/m²K
Door U-value 1.00 W/m²K
Window U-value 0.80 W/m²K
Air permeability 1.0 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 (m2)	Storey height (m)	Volume (m3)
Ground floor	72.9100 (1b)	x 2.5100 (2b)	= 183.0041 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	72.9100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 183.0041 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)
Number of intermittent fans				0 * 10 =	0.0000 (7a)
Number of passive vents				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 1.0000
Infiltration rate 0.0500 (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) = 0.0463 (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	0.0590	0.0578	0.0567	0.0509	0.0497	0.0439	0.0439	0.0428	0.0463	0.0497	0.0520	0.0543 (22b)
Balanced mechanical ventilation with heat recovery												0.5000 (23a)
If mechanical ventilation:												79.0500 (23c)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												
Effective ac	0.1637	0.1626	0.1614	0.1556	0.1545	0.1487	0.1487	0.1475	0.1510	0.1545	0.1568	0.1591 (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
Windows (Uw = 0.80)			10.5800	0.7752	8.2016		(27)
Opaque Door			3.2400	1.0000	3.2400		(26)
Heat Loss Floor 1			72.9100	0.1000	7.2910		(28a)
External Wall 1	62.7800	10.5800	52.2000	0.1300	6.7860		(29a)
To Corridor	7.0300	3.2400	3.7900	0.1500	0.5685		(29a)
Total net area of external elements Aum(A, m2)			142.7200				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		26.0871		(33)
To Dwelling			16.1900	0.0000	0.0000		(32)
Party Ceilings 1			72.9100				(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 175.0000 (35)
Thermal bridges (Sum(L x Fsi) calculated using Appendix K) 5.7584 (36)
Total fabric heat loss (33) + (36) = 31.8454 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
(38)m Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Heat transfer coeff 9.8872 9.8174 9.7475 9.3984 9.3286 8.9794 8.9794 8.9096 9.1191 9.3286 9.4682 9.6079 (38)
Average = Sum(39)m / 12 = 41.7326 41.6628 41.5929 41.2438 41.1740 40.8248 40.8248 40.7550 40.9645 41.1740 41.3136 41.4533 (39)
41.2263 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	0.5724	0.5714	0.5705	0.5657	0.5647	0.5599	0.5599	0.5590	0.5619	0.5647	0.5666	0.5686 (40)
HLP (average)												0.5654 (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 2.3147 (42)
Average daily hot water use (litres/day) 89.1729 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	98.0902	94.5233	90.9564	87.3895	83.8226	80.2556	80.2556	83.8226	87.3895	90.9564	94.5233	98.0902 (44)
Energy conte	145.4650	127.2246	131.2844	114.4569	109.8241	94.7699	87.8182	100.7727	101.9762	118.8435	129.7269	140.8751 (45)
Energy content (annual)										Total = Sum(45)m =		1403.0375 (45)
Distribution loss (46)m = 0.15 x (45)m												



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



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Water storage loss:	21.8197	19.0837	19.6927	17.1685	16.4736	14.2155	13.1727	15.1159	15.2964	17.8265	19.4590	21.1313 (46)
Store volume												150.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.1900 (48)
Temperature factor from Table 2b												0.6000 (49)
Enter (49) or (54) in (55)												0.7140 (55)
Total storage loss												
	22.1340	19.9920	22.1340	21.4200	22.1340	21.4200	22.1340	22.1340	21.4200	22.1340	21.4200	22.1340 (56)
If cylinder contains dedicated solar storage												
	22.1340	19.9920	22.1340	21.4200	22.1340	21.4200	22.1340	22.1340	21.4200	22.1340	21.4200	22.1340 (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	23.2624 (59)
Total heat required for water heating calculated for each month												
	190.8614	168.2278	176.6808	158.3889	155.2205	138.7019	133.2146	146.1691	145.9082	164.2399	173.6589	186.2715 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
								Solar input (sum of months) =	Sum(63)m =			0.0000 (63)
Output from w/h												
	190.8614	168.2278	176.6808	158.3889	155.2205	138.7019	133.2146	146.1691	145.9082	164.2399	173.6589	186.2715 (64)
								Total per year (kWh/year) =	Sum(64)m =			1937.5435 (64)
Heat gains from water heating, kWh/month												
	84.6842	75.1047	79.9692	73.2025	72.8336	66.6566	65.5167	69.8240	69.0527	75.8326	78.2798	83.1581 (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	115.7325	115.7325	115.7325	115.7325	115.7325	115.7325	115.7325	115.7325	115.7325	115.7325	115.7325	115.7325 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	18.4736	16.4081	13.3439	10.1022	7.5515	6.3753	6.8888	8.9543	12.0184	15.2601	17.8108	18.9870 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	203.9913	206.1081	200.7739	189.4179	175.0830	161.6102	152.6096	150.4928	155.8271	167.1830	181.5179	194.9907 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	34.5733	34.5733	34.5733	34.5733	34.5733	34.5733	34.5733	34.5733	34.5733	34.5733	34.5733	34.5733 (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)												
	-92.5860	-92.5860	-92.5860	-92.5860	-92.5860	-92.5860	-92.5860	-92.5860	-92.5860	-92.5860	-92.5860	-92.5860 (71)
Water heating gains (Table 5)												
	113.8229	111.7630	107.4855	101.6702	97.8947	92.5786	88.0601	93.8495	95.9065	101.9255	108.7220	111.7716 (72)
Total internal gains												
	394.0075	391.9989	379.3230	358.9100	338.2490	318.2839	305.2782	311.0163	321.4717	342.0884	365.7704	383.4691 (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			
South				5.3000	46.7521	0.5000	0.9000	0.7700	77.2720 (78)			
West				5.2800	19.6403	0.5000	0.9000	0.7700	32.3390 (80)			
Solar gains	109.6111	189.8137	265.3879	334.1414	376.0743	360.0045	329.2604	289.5668	211.5636	131.9167	93.3642 (83)	
Total gains	503.6186	581.8126	644.7109	693.0515	714.3233	691.6218	665.2826	640.2768	611.0385	553.6520	497.6871	476.8333 (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)												
tau	84.9273	85.0696	85.2124	85.9338	86.0795	86.8157	86.8157	86.9644	86.5197	86.0795	85.7885	85.4995
alpha	6.6618	6.6713	6.6808	6.7289	6.7386	6.7877	6.7877	6.7976	6.7680	6.7386	6.7192	6.7000
util living area	0.9653	0.9227	0.8390	0.6961	0.5323	0.3775	0.2700	0.2928	0.4612	0.7375	0.9238	0.9737 (86)
MIT	20.5871	20.7376	20.8782	20.9673	20.9947	20.9996	21.0000	20.9999	20.9984	20.9609	20.7753	20.5448 (87)
Th 2	20.4549	20.4558	20.4566	20.4610	20.4619	20.4662	20.4662	20.4671	20.4645	20.4619	20.4601	20.4584 (88)
util rest of house	0.9594	0.9115	0.8200	0.6696	0.5025	0.3461	0.2372	0.2589	0.4259	0.7068	0.9108	0.9690 (89)
MIT 2	19.9070	20.1179	20.3078	20.4244	20.4567	20.4659	20.4662	20.4670	20.4631	20.4195	20.1767	19.8499 (90)
Living area fraction									fLA =	Living area / (4) =		0.4942 (91)
MIT	20.2431	20.4241	20.5897	20.6927	20.7226	20.7296	20.7300	20.7304	20.7276	20.6871	20.4725	20.1933 (92)
Temperature adjustment												0.0000
adjusted MIT	20.2431	20.4241	20.5897	20.6927	20.7226	20.7296	20.7300	20.7304	20.7276	20.6871	20.4725	20.1933 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9569	0.9109	0.8248	0.6811	0.5170	0.3616	0.2534	0.2756	0.4433	0.7199	0.9112	0.9665 (94)
Useful gains	481.8992	529.9447	531.7616	472.0641	369.3049	250.0791	168.5935	176.4644	270.8734	398.5582	453.4768	460.8558 (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												
	665.3451	646.7790	586.0314	486.3766	371.4953	250.2400	168.6048	176.4845	271.4972	415.3242	552.4679	662.9744 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh												
	136.4837	78.5127	40.3767	10.3050	1.6297	0.0000	0.0000	0.0000	0.0000	12.4739	71.2736	150.3763 (98)
Space heating												501.4315 (98)
Space heating per m2									(98) / (4) =			6.8774 (99)



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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (301)
Fraction of space heat from community system	1.0000 (302)
Fraction of heat from community Boilers	1.0000 (303a)
Fraction of total space heat from community Boilers	1.0000 (304a)
Factor for control and charging method (Table 4c(3)) for community space heating	1.0000 (305)
Factor for control and charging method (Table 4c(3)) for community water heating	1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system	1.0500 (306)
Space heating:	
Annual space heating requirement	501.4315 (98)
Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05	526.5031 (307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0.0000 (308)
Space heating fuel for secondary/supplementary system	0.0000 (309)

Water heating

Annual water heating requirement	1937.5435 (64)
Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05	2034.4207 (310a)
Electricity used for heat distribution	25.6092 (313)
Annual totals kWh/year	

Electricity for pumps and fans:

(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7750)	
mechanical ventilation fans (SFP = 0.7750)	173.0304 (330a)
Total electricity for the above, kWh/year	173.0304 (331)
Electricity for lighting (calculated in Appendix L)	326.2491 (332)
Total delivered energy for all uses	3060.2034 (338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Efficiency of heat source Boilers			90.0000 (367a)
Space heating from Boilers	2845.4709	0.2160	614.6217 (367)
Electrical energy for heat distribution	25.6092	0.5190	13.2912 (372)
Total CO2 associated with community systems (negative value allowed since DFEE <= TFEE)			627.9129 (373)
Space and water heating			627.9129 (376)
Pumps and fans	173.0304	0.5190	89.8028 (378)
Energy for lighting	326.2491	0.5190	169.3233 (379)
Total CO2, kg/year			887.0390 (383)
Dwelling Carbon Dioxide Emission Rate (DER)			12.1700 (384)

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

DER		12.1700 ZC1
Total Floor Area	TFA	72.9100
Assumed number of occupants	N	2.3147
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190
CO2 emissions from appliances, equation (L14)		16.5795 ZC2
CO2 emissions from cooking, equation (L16)		2.3941 ZC3
Total CO2 emissions		31.1435 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		31.1435 ZC8



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Calculation Type: New Build (As Designed)



Property Reference	BB T2				Issued on Date	12/12/2019
Assessment Reference	V01 - Be Lean	Prop Type Ref				
Property	BB T2					
SAP Rating	84 B	DER	15.05	TER	22.08	
Environmental	90 B	% DER<TER	31.84			
CO ₂ Emissions (t/year)	0.69	DFEE	35.73	TFEE	60.90	
General Requirements Compliance	Pass	% DFEE<TFEE	41.33			
Assessor Details	Mr. Liam Holden, Liam Holden, Tel: 01202 654600, liamholden@hoarelea.com				Assessor ID	W974-0001
Client						



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DWELLING AS DESIGNED

Mid-floor flat, total floor area 50 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 (c)
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 22.08 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.05 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)60.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)35.7 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.14 (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	0.10 (max. 0.20)	0.10 (max. 0.35)	OK
Openings	0.83 (max. 2.00)	1.00 (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:	1.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main heating system: Community heating scheme -

Secondary heating system: None

5 Cylinder insulation

Hot water storage	Measured cylinder loss: 1.19 kWh/day	
Permitted by DBSCG 1.89	OK	
Primary pipework insulated:	Yes (assumed)	OK

6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and TRVsOK

Hot water controls: Cylinderstat

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:	0.62	
Maximum	1.5	OK
MVHR efficiency:	93%	
Minimum:	70%	OK

9 Summertime temperature

Overheating risk (Thames Valley): Slight

OK

Based on:

Overshading: Average

Windows facing South: 6.10 m², No overhang

Air change rate: 5.00 ach

Blinds/curtains: Dark-coloured curtain or roller blind, closed 100% of daylight hours

10 Key features

External wall U-value	0.13 W/m ² K
Party wall U-value	0.00 W/m ² K
Roof U-value	0.10 W/m ² K
Floor U-value	0.10 W/m ² K
Door U-value	1.00 W/m ² K
Window U-value	0.80 W/m ² K
Roof window U-value	0.80 W/m ² K
Thermal bridging y-value	0.020 W/m ² K
Air permeability	1.0 m ³ /m ² h



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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor			
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.0400		
Dwelling volume			

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			1.0000
Infiltration rate			0.0500 (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) =	0.0463 (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	0.0590	0.0578	0.0567	0.0509	0.0497	0.0439	0.0439	0.0428	0.0463	0.0497	0.0520	0.0543 (22b)
Balanced mechanical ventilation with heat recovery												0.5000 (23a)
If mechanical ventilation:												79.0500 (23c)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												

Effective ac	0.1637	0.1626	0.1614	0.1556	0.1545	0.1487	0.1487	0.1475	0.1510	0.1545	0.1568	0.1591 (25)
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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
Windows (Uw = 0.80)			6.1000	0.7752	4.7287		(27)
Opaque Door			2.0400	1.0000	2.0400		(26)
Roof Lights (Uw = 0.80)			3.9800	0.7752	3.0853		(27a)
Heat Loss Floor 1			50.0400	0.1000	5.0040		(28a)
External Wall 1	26.9300	6.1000	20.8300	0.1300	2.7079		(29a)
To Corridor	15.5900	2.0400	13.5500	0.1500	2.0325		(29a)
To stairs	11.3400		11.3400	0.1500	1.7010		(29a)
External Roof 1	50.0400	3.9800	46.0600	0.1000	4.6060		(30)
Total net area of external elements Aum(A, m2)			153.9400				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		25.9054		(33)
To Dwelling			42.3200	0.0000	0.0000		(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							175.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							3.1186 (36)
Total fabric heat loss						(33) + (36) =	29.0240 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	9.1109	9.0465	8.9822	8.6605	8.5961	8.2744	8.2744	8.2100	8.4031	8.5961	8.7248	8.8535 (38)
Average = Sum(39)m / 12 =	38.1348	38.0705	38.0061	37.6844	37.6201	37.2983	37.2983	37.2340	37.4270	37.6201	37.7487	37.8774 (39)
												37.6683 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	0.7621	0.7608	0.7595	0.7531	0.7518	0.7454	0.7454	0.7441	0.7479	0.7518	0.7544	0.7569 (40)
HLP (average)												0.7528 (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												1.6913 (42)
Average daily hot water use (litres/day)												74.3679 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	81.8047	78.8299	75.8552	72.8805	69.9058	66.9311	66.9311	69.9058	72.8805	75.8552	78.8299	81.8047 (44)
	121.3139	106.1019	109.4877	95.4540	91.5904	79.0356	73.2381	84.0418	85.0455	99.1123	108.1888	117.4861 (45)



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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)																	Total = Sum(45)m =	1170.0961 (45)
Distribution loss (46)m = 0.15 x (45)m	18.1971	15.9153	16.4232	14.3181	13.7386	11.8553	10.9857	12.6063	12.7568	14.8668	16.2283	17.6229	(46)					
Water storage loss:																		
Store volume																	150.0000 (47)	
a) If manufacturer declared loss factor is known (kWh/day):																	1.1900 (48)	
Temperature factor from Table 2b																	0.6000 (49)	
Enter (49) or (54) in (55)																	0.7140 (55)	
Total storage loss	22.1340	19.9920	22.1340	21.4200	22.1340	21.4200	22.1340	22.1340	21.4200	22.1340	21.4200	22.1340	(56)					
If cylinder contains dedicated solar storage	22.1340	19.9920	22.1340	21.4200	22.1340	21.4200	22.1340	22.1340	21.4200	22.1340	21.4200	22.1340	(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	22.5120	(59)					
Total heat required for water heating calculated for each month	166.7103	147.1051	154.8841	139.3860	136.9868	122.9676	118.6345	129.4382	128.9775	144.5087	152.1208	162.8825 (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	166.7103	147.1051	154.8841	139.3860	136.9868	122.9676	118.6345	129.4382	128.9775	144.5087	152.1208	162.8825 (64)						
Heat gains from water heating, kWh/month	76.6540	68.0815	72.7218	66.8841	66.7709	61.4249	60.6688	64.2610	63.4232	69.2720	71.1184	75.3812 (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	84.5639	84.5639	84.5639	84.5639	84.5639	84.5639	84.5639	84.5639	84.5639	84.5639	84.5639	84.5639 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	13.1353	11.6666	9.4879	7.1830	5.3694	4.5330	4.8981	6.3668	8.5454	10.8504	12.6640	13.5003 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	147.3378	148.8667	145.0139	136.8118	126.4581	116.7270	110.2261	108.6972	112.5500	120.7521	131.1059	140.8369 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.4564	31.4564	31.4564	31.4564	31.4564	31.4564	31.4564	31.4564	31.4564	31.4564	31.4564	31.4564 (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)	-67.6511	-67.6511	-67.6511	-67.6511	-67.6511	-67.6511	-67.6511	-67.6511	-67.6511	-67.6511	-67.6511	-67.6511 (71)
Water heating gains (Table 5)	103.0296	101.3117	97.7443	92.8945	89.7459	85.3124	81.5441	86.3723	88.0878	93.1075	98.7755	101.3189 (72)
Total internal gains	311.8719	310.2142	300.6154	285.2585	269.9425	254.9417	245.0374	249.8054	257.5524	273.0792	290.9146	304.0253 (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			
South				6.1000	46.7521	0.5000	0.9000	0.7700	88.9358 (78)			
South				3.9800	45.6416	0.5000	0.9000	1.0000	73.5696 (82)			
Solar gains	162.5054	278.3625	382.7823	473.8728	527.7782	521.9423	504.1000	464.6560	414.6949	308.3802	194.9810	138.8236 (83)
Total gains	474.3772	588.5767	683.3977	759.1313	797.7207	776.8840	749.1374	714.4615	672.2473	581.4594	485.8956	442.8488 (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	63.7869	63.8947	64.0028	64.5492	64.6597	65.2174	65.2174	65.3301	64.9931	64.6597	64.4392	64.2203	
alpha	5.2525	5.2596	5.2669	5.3033	5.3106	5.3478	5.3478	5.3553	5.3329	5.3106	5.2959	5.2814	
util living area	0.9355	0.8568	0.7385	0.5839	0.4355	0.3069	0.2190	0.2396	0.3827	0.6436	0.8716	0.9501 (86)	
MIT	20.4764	20.7053	20.8741	20.9655	20.9933	20.9992	20.9999	20.9998	20.9974	20.9538	20.7251	20.4146 (87)	
Th 2	20.2863	20.2874	20.2886	20.2942	20.2953	20.3009	20.3009	20.3021	20.2987	20.2953	20.2931	20.2908 (88)	
util rest of house	0.9250	0.8383	0.7123	0.5533	0.4034	0.2735	0.1842	0.2033	0.3443	0.6065	0.8513	0.9415 (89)	
MIT 2	19.6078	19.9203	20.1406	20.2570	20.2889	20.3003	20.3009	20.3020	20.2966	20.2473	19.9574	19.5252 (90)	
Living area fraction									fLA = Living area / (4) =			0.5222 (91)	
MIT	20.0614	20.3302	20.5236	20.6269	20.6567	20.6653	20.6659	20.6664	20.6625	20.6162	20.3583	19.9896 (92)	
Temperature adjustment												0.0000	
adjusted MIT	20.0614	20.3302	20.5236	20.6269	20.6567	20.6653	20.6659	20.6664	20.6625	20.6162	20.3583	19.9896 (93)	

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9213	0.8394	0.7212	0.5679	0.4199	0.2909	0.2024	0.2223	0.3643	0.6237	0.8533	0.9374 (94)
Useful gains	437.0350	494.0685	492.8583	431.0873	334.9415	226.0053	151.6274	158.8149	244.8885	362.6466	414.6343	415.1421 (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	601.0573	587.4345	532.9833	441.9227	336.9525	226.2239	151.6510	158.8542	245.6156	376.8100	500.4827	598.0702 (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	122.0326	62.7419	29.8531	7.8015	1.4962	0.0000	0.0000	0.0000	0.0000	10.5375	61.8109	136.0985 (98)
Space heating												432.3721 (98)
Space heating per m2											(98) / (4) =	8.6405 (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

9b. Energy requirements			

Fraction of space heat from secondary/supplementary system (Table 11)		0.0000	(301)
Fraction of space heat from community system		1.0000	(302)
Fraction of heat from community Boilers		1.0000	(303a)
Fraction of total space heat from community Boilers		1.0000	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.0000	(305)
Factor for control and charging method (Table 4c(3)) for community water heating		1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system		1.0500	(306)
Space heating:			
Annual space heating requirement		432.3721	(98)
Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05		453.9908	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0.0000	(308)
Space heating fuel for secondary/supplementary system		0.0000	(309)
Water heating			
Annual water heating requirement		1704.6021	(64)
Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05		1789.8322	(310a)
Electricity used for heat distribution		22.4382	(313)
Annual totals kWh/year			
Electricity for pumps and fans:			
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7750)			
mechanical ventilation fans (SFP = 0.7750)		159.4442	(330a)
Total electricity for the above, kWh/year		159.4442	(331)
Electricity for lighting (calculated in Appendix L)		231.9731	(332)
Total delivered energy for all uses		2635.2402	(338)

12b. Carbon dioxide emissions - Community heating scheme			

	Energy	Emission factor	Emissions
	kWh/year	kg CO2/kWh	kg CO2/year
Efficiency of heat source Boilers			90.0000 (367a)
Space heating from Boilers	2493.1367	0.2160	538.5175 (367)
Electrical energy for heat distribution	22.4382	0.5190	11.6454 (372)
Total CO2 associated with community systems			550.1630 (373)
(negative value allowed since DFEE <= TFEE)			
Space and water heating			550.1630 (376)
Pumps and fans	159.4442	0.5190	82.7515 (378)
Energy for lighting	231.9731	0.5190	120.3940 (379)
Total CO2, kg/year			753.3085 (383)
Dwelling Carbon Dioxide Emission Rate (DER)			15.0500 (384)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES			
DER			15.0500 ZC1
Total Floor Area		TFA	50.0400
Assumed number of occupants		N	1.6913
CO2 emission factor in Table 12 for electricity displaced from grid		EF	0.5190
CO2 emissions from appliances, equation (L14)			17.4479 ZC2
CO2 emissions from cooking, equation (L16)			3.1893 ZC3
Total CO2 emissions			35.6872 ZC4
Residual CO2 emissions offset from biofuel CHP			0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year			0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation			0.0000 ZC7
Net CO2 emissions			35.6872 ZC8

Appendix C: Be Green DER Worksheets.

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



Property Reference	BA T1				Issued on Date	12/12/2019
Assessment Reference	V02 - Be Green	Prop Type Ref				
Property	BA T1					
SAP Rating	99 A	DER	-1.65	TER	27.59	
Environmental	103 A	% DER<TER	105.98			
CO ₂ Emissions (t/year)	-0.41	DFEE	38.76	TFEE	63.09	
General Requirements Compliance	Pass	% DFEE<TFEE	38.57			
Assessor Details	Mr. Liam Holden, Liam Holden, Tel: 01202 654600, liamholden@hoarelea.com				Assessor ID	P624-0001
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

Ground-floor flat, total floor area 110 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 (c)
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 27.59 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) -1.65 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)63.1 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)38.8 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.13 (max. 0.30)	0.13 (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	0.10 (max. 0.20)	0.10 (max. 0.35)	OK
Openings	0.82 (max. 2.00)	1.00 (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:	1.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main heating system: Community heating scheme -

Secondary heating system:

None

5 Cylinder insulation

Hot water storage Measured cylinder loss: 1.67 kWh/day
Permitted by DBSCG 2.56 OK
Primary pipework insulated: Yes (assumed) OK

6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and TRVsOK

Hot water controls:

Cylinderstat

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: 0.62
Maximum 1.5 OK
MVHR efficiency: 94%
Minimum: 70% OK

9 Summertime temperature

Overheating risk (Thames Valley): Not significant OK

Based on:

Overshading: Average

Windows facing North: 9.30 m², No overhang

Windows facing East: 5.54 m², No overhang

Windows facing South: 7.20 m², No overhang

Air change rate: 8.00 ach

Blinds/curtains: Dark-coloured curtain or roller blind, closed 100% of daylight hours

10 Key features

External wall U-value	0.13 W/m ² K
External wall U-value	0.13 W/m ² K
External wall U-value	0.13 W/m ² K
Party wall U-value	0.00 W/m ² K
Party wall U-value	0.00 W/m ² K
Party wall U-value	0.00 W/m ² K
Roof U-value	0.10 W/m ² K
Roof U-value	0.10 W/m ² K
Floor U-value	0.10 W/m ² K
Door U-value	1.00 W/m ² K
Window U-value	0.80 W/m ² K
Air permeability	1.0 m ³ /m ² h
Photovoltaic array	3.68 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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	42.5700	(1b)	x	2.6100	(2b)	= 111.1077 (1b) - (3b)
First floor	42.5700	(1c)	x	3.0100	(2c)	= 128.1357 (1c) - (3c)
Second floor	25.0300	(1d)	x	3.3200	(2d)	= 83.0996 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	110.1700					
Dwelling volume						(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 322.3430 (5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							0 * 10 =		0.0000	(7a)
Number of passive vents							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	1.0000
Infiltration rate	0.0500 (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) = 0.0463 (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	0.0590	0.0578	0.0567	0.0509	0.0497	0.0439	0.0439	0.0428	0.0463	0.0497	0.0520	0.0543 (22b)
Balanced mechanical ventilation with heat recovery												0.5000 (23a)
If mechanical ventilation:												79.9000 (23c)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												
Effective ac	0.1595	0.1583	0.1572	0.1514	0.1502	0.1444	0.1444	0.1433	0.1468	0.1502	0.1525	0.1548 (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	
Windows (Uw = 0.80)			22.0400	0.7752	17.0853			(27)
Opaque Door			2.8800	1.0000	2.8800			(26)
Heat Loss Floor 1			42.5700	0.1000	4.2570			(28a)
External Wall 1	48.2100	13.1400	35.0700	0.1300	4.5591			(29a)
External Wall 2	55.5900	7.5300	48.0600	0.1300	6.2478			(29a)
External Wall 3	40.3200	4.2500	36.0700	0.1300	4.6891			(29a)
External Roof 1	17.6200		17.6200	0.1000	1.7620			(30)
External Roof 2	27.9000		27.9000	0.1000	2.7900			(30)
Total net area of external elements Aum(A, m2)			232.2100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)... (30) + (32) =	44.2703			(32)
To Dwelling				25.3700	0.0000			(32)
Party Wall 2				29.2600	0.0000	0.0000		(32)
Party Wall 3				15.9200	0.0000	0.0000		(32)
Party Floor 1				42.5700				(32d)
Party Floor 2				25.0300				(32d)
Party Ceilings 1				42.5700				(32b)
Party Ceilings 2				24.9500				(32b)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							175.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							13.8628	(36)
Total fabric heat loss						(33) + (36) =	58.1331	(37)

4. Water heating energy requirements (kWh/year)



FULL SAP CALCULATION PRINTOUT
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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Assumed occupancy 2.8158 (42)
Average daily hot water use (litres/day) 101.0763 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	111.1839	107.1408	103.0978	99.0547	95.0117	90.9686	90.9686	95.0117	99.0547	103.0978	107.1408	111.1839 (44)
Energy conte	164.8825	144.2073	148.8090	129.7353	124.4841	107.4203	99.5407	114.2244	115.5886	134.7074	147.0437	159.6799 (45)
Energy content (annual)										Total = Sum(45)m =		1590.3231 (45)
Distribution loss (46)m = 0.15 x (45)m	24.7324	21.6311	22.3213	19.4603	18.6726	16.1130	14.9311	17.1337	17.3383	20.2061	22.0565	23.9520 (46)

Water storage loss:												
Store volume												250.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6700 (48)
Temperature factor from Table 2b												0.6000 (49)
Enter (49) or (54) in (55)												1.0020 (55)

Total storage loss	31.0620	28.0560	31.0620	30.0600	31.0620	30.0600	31.0620	31.0620	30.0600	31.0620	30.0600	31.0620 (56)
If cylinder contains dedicated solar storage	31.0620	28.0560	31.0620	30.0600	31.0620	30.0600	31.0620	31.0620	30.0600	31.0620	30.0600	31.0620 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)

Total heat required for water heating calculated for each month	219.2069	193.2745	203.1334	182.3073	178.8085	159.9923	153.8651	168.5488	168.1606	189.0318	199.6157	214.0043 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Solar input (sum of months) = Sum(63)m =												0.0000 (63)

Output from w/h	219.2069	193.2745	203.1334	182.3073	178.8085	159.9923	153.8651	168.5488	168.1606	189.0318	199.6157	214.0043 (64)
Heat gains from water heating, kWh/month	98.2829	87.2027	92.9385	85.1946	84.8505	77.7749	76.5568	81.4391	80.4908	88.2497	90.9496	96.5531 (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	140.7921	140.7921	140.7921	140.7921	140.7921	140.7921	140.7921	140.7921	140.7921	140.7921	140.7921	140.7921 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	24.2312	21.5219	17.5028	13.2507	9.9051	8.3623	9.0357	11.7450	15.7641	20.0162	23.3618	24.9046 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	271.8000	274.6205	267.5131	252.3823	233.2823	215.3311	203.3385	200.5181	207.6255	222.7563	241.8563	259.8075 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0792	37.0792	37.0792	37.0792	37.0792	37.0792	37.0792	37.0792	37.0792	37.0792	37.0792	37.0792 (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)	-112.6337	-112.6337	-112.6337	-112.6337	-112.6337	-112.6337	-112.6337	-112.6337	-112.6337	-112.6337	-112.6337	-112.6337 (71)
Water heating gains (Table 5)	132.1007	129.7659	124.9174	118.3258	114.0463	108.0206	102.8989	109.4612	111.7928	118.6152	126.3189	129.7756 (72)
Total internal gains	493.3696	491.1459	475.1709	449.1964	422.4714	396.9516	380.5108	386.9619	400.4201	426.6254	456.7746	479.7254 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North		9.3000	10.6334	0.5000		30.8390 (74)
East		5.5400	19.6403	0.5000	0.7700	33.9315 (76)
South		7.2000	46.7521	0.5000	0.7700	104.9733 (78)

Solar gains	169.7438	297.2314	428.4533	567.7975	669.9977	680.2000	649.5172	570.9150	476.3088	334.3475	204.7817	144.3192 (83)
Total gains	663.1134	788.3773	903.6242	1016.9939	1092.4691	1077.1516	1030.0280	957.8769	876.7289	760.9729	661.5563	624.0446 (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	71.3149	71.4319	71.5493	72.1420	72.2618	72.8664	72.8664	72.9885	72.6233	72.2618	72.0227	71.7852
alpha	5.7543	5.7621	5.7700	5.8095	5.8175	5.8578	5.8578	5.8659	5.8416	5.8175	5.8015	5.7857

util living area	0.9878	0.9684	0.9182	0.7954	0.6142	0.4348	0.3137	0.3519	0.5700	0.8587	0.9716	0.9910 (86)
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MIT	20.2462	20.4417	20.6781	20.8873	20.9770	20.9974	20.9997	20.9994	20.9885	20.8521	20.5074	20.2002 (87)
Th 2	20.3571	20.3581	20.3591	20.3640	20.3650	20.3700	20.3700	20.3710	20.3680	20.3650	20.3630	20.3610 (88)

util rest of house	0.9853	0.9625	0.9042	0.7678	0.5765	0.3927	0.2689	0.3040	0.5212	0.8311	0.9652	0.9892 (89)
MIT 2	19.3390	19.6205	19.9529	20.2344	20.3422	20.3679	20.3698	20.3706	20.3583	20.1964	19.7212	19.2755 (90)

Living area fraction									fLA = Living area / (4) =			0.2946 (91)
MIT	19.6063	19.8625	20.1666	20.4268	20.5292	20.5534	20.5554	20.5559	20.5439	20.3896	19.9528	19.5479 (92)

Temperature adjustment												0.0000
adjusted MIT	19.6063	19.8625	20.1666	20.4268	20.5292	20.5534	20.5554	20.5559	20.5439	20.3896	19.9528	19.5479 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9817	0.9571	0.8996	0.7706	0.5864	0.4050	0.2821	0.3181	0.5350	0.8322	0.9603	0.9862 (94)
Useful gains	650.9790	754.5599	812.9271	783.7237	640.6304	436.2288	290.5836	304.6818	469.0241	633.2897	635.3093	615.4297 (95)

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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	1149.4478	1121.7845	1022.9490	855.6927	654.3531	437.5585	290.7099	304.9341	475.1980	725.5263	955.7151	1145.0213	(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	370.8607	246.7749	156.2563	51.8177	10.2097	0.0000	0.0000	0.0000	0.0000	68.6240	230.6922	394.0162	(98)
Space heating												1529.2517	(98)
Space heating per m2												13.8808	(99)

8c. Space cooling requirement

Not applicable

----- 9b. Energy requirements -----												
Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (301)
Fraction of space heat from community system												1.0000 (302)
Fraction of heat from community Heat pump												1.0000 (303a)
Fraction of total space heat from community Heat pump												1.0000 (304a)
Factor for control and charging method (Table 4c(3)) for community space heating												1.0000 (305)
Factor for control and charging method (Table 4c(3)) for community water heating												1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system												1.0500 (306)
Space heating:												
Annual space heating requirement												1529.2517 (98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.05												1605.7143 (307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)												0.0000 (308)
Space heating fuel for secondary/supplementary system												0.0000 (309)
Water heating												
Annual water heating requirement												2229.9491 (64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.05												2341.4466 (310a)
Electricity used for heat distribution												39.4716 (313)
Annual totals kWh/year												
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7750)												
mechanical ventilation fans (SFP = 0.7750)												304.7753 (330a)
Total electricity for the above, kWh/year												304.7753 (331)
Electricity for lighting (calculated in Appendix L)												427.9301 (332)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 3.68 * 1080 * 0.80) =												-2542.4964 (333)
Total delivered energy for all uses												2137.3699 (338)

12b. Carbon dioxide emissions - Community heating scheme			
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Efficiency of heat source Heat pump			278.0000 (367a)
Space heating from Heat pump	1419.8421	0.5190	736.8980 (367)
Electrical energy for heat distribution	39.4716	0.5190	20.4858 (372)
Total CO2 associated with community systems (negative value allowed since DFEE <= TFEE)			757.3838 (373)
Space and water heating			757.3838 (376)
Pumps and fans	304.7753	0.5190	158.1784 (378)
Energy for lighting	427.9301	0.5190	222.0957 (379)
Energy saving/generation technologies			
PV Unit	-2542.4964	0.5190	-1319.5556 (380)
Total CO2, kg/year			-181.8977 (383)
Dwelling Carbon Dioxide Emission Rate (DER)			-1.6500 (384)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES												
DER												
Total Floor Area		TFA	110.1700									
Assumed number of occupants		N	2.8158									
CO2 emission factor in Table 12 for electricity displaced from grid		EF	0.5190									
CO2 emissions from appliances, equation (L14)			14.6195 ZC2									
CO2 emissions from cooking, equation (L16)			1.6936 ZC3									
Total CO2 emissions			14.6631 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			14.6631 ZC8									



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Calculation Type: New Build (As Designed)



Property Reference	BB T1		Issued on Date	12/12/2019
Assessment Reference	V02 - Be Green	Prop Type Ref		
Property	BB T1			

SAP Rating	91 B	DER	4.50	TER	27.03
Environmental	97 A	% DER<TER	83.35		
CO ₂ Emissions (t/year)	0.24	DFEE	28.96	TFEE	51.05
General Requirements Compliance	Pass	% DFEE<TFEE	43.26		

Assessor Details	Mr. Liam Holden, Liam Holden, Tel: 01202 654600, liamholden@hoarelea.com	Assessor ID	P624-0001
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Client	
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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

Ground-floor flat, total floor area 73 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 (c)
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 27.03 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 4.50 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)51.1 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)29.0 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.13 (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	(no roof)		
Openings	0.85 (max. 2.00)	1.00 (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:	1.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main heating system:	Community heating scheme	-
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Secondary heating system:

	None	
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5 Cylinder insulation

Hot water storage	Measured cylinder loss: 1.19 kWh/day	
Permitted by DBSCG 1.89	OK	
Primary pipework insulated:	Yes (assumed)	OK

6 Controls

Space heating controls:	Charging system linked to use of community heating, programmer and TRVsOK	
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Hot water controls:

	Cylinderstat	OK
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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:	0.62	
Maximum	1.5	OK
MVHR efficiency:	93%	
Minimum:	70%	OK

9 Summertime temperature

Overheating risk (Thames Valley):	Slight	OK
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Based on:

Overshading:	Average	
Windows facing South:	5.30 m², No overhang	
Windows facing West:	5.28 m², No overhang	
Air change rate:	5.00 ach	
Blinds/curtains:	Dark-coloured curtain or roller blind, closed 100% of daylight hours	

10 Key features

External wall U-value	0.13 W/m²K	
Party wall U-value	0.00 W/m²K	
Floor U-value	0.10 W/m²K	
Door U-value	1.00 W/m²K	
Window U-value	0.80 W/m²K	
Air permeability	1.0 m³/m²h	
Photovoltaic array	1.08 kW	



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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor			
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	72.9100	x 2.5100 (2b)	= 183.0041 (1b) - (3b)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 183.0041 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)
Number of intermittent fans				0 * 10 =	0.0000 (7a)
Number of passive vents				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			1.0000
Infiltration rate			0.0500 (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) =	0.0463 (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	0.0590	0.0578	0.0567	0.0509	0.0497	0.0439	0.0439	0.0428	0.0463	0.0497	0.0520	0.0543 (22b)
Balanced mechanical ventilation with heat recovery												0.5000 (23a)
If mechanical ventilation:												79.0500 (23c)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												
Effective ac	0.1637	0.1626	0.1614	0.1556	0.1545	0.1487	0.1487	0.1475	0.1510	0.1545	0.1568	0.1591 (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
Windows (Uw = 0.80)			10.5800	0.7752	8.2016		(27)
Opaque Door			3.2400	1.0000	3.2400		(26)
Heat Loss Floor 1			72.9100	0.1000	7.2910		(28a)
External Wall 1	62.7800	10.5800	52.2000	0.1300	6.7860		(29a)
To Corridor	7.0300	3.2400	3.7900	0.1500	0.5685		(29a)
Total net area of external elements Aum(A, m2)			142.7200				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		26.0871		(33)
To Dwelling			16.1900	0.0000	0.0000		(32)
Party Ceilings 1			72.9100				(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							175.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							5.7584 (36)
Total fabric heat loss						(33) + (36) =	31.8454 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	9.8872	9.8174	9.7475	9.3984	9.3286	8.9794	8.9794	8.9096	9.1191	9.3286	9.4682	9.6079 (38)
Average = Sum(39)m / 12 =	41.7326	41.6628	41.5929	41.2438	41.1740	40.8248	40.8248	40.7550	40.9645	41.1740	41.3136	41.4533 (39)
												41.2263 (39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.5724	0.5714	0.5705	0.5657	0.5647	0.5599	0.5599	0.5590	0.5619	0.5647	0.5666	0.5686 (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												2.3147 (42)
Average daily hot water use (litres/day)												89.1729 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	98.0902	94.5233	90.9564	87.3895	83.8226	80.2556	80.2556	83.8226	87.3895	90.9564	94.5233	98.0902 (44)
Energy content (annual)	145.4650	127.2246	131.2844	114.4569	109.8241	94.7699	87.8182	100.7727	101.9762	118.8435	129.7269	140.8751 (45)
Distribution loss (46)m = 0.15 x (45)m										Total = Sum(45)m =		1403.0375 (45)



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Calculation Type: New Build (As Designed)



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Water storage loss:	21.8197	19.0837	19.6927	17.1685	16.4736	14.2155	13.1727	15.1159	15.2964	17.8265	19.4590	21.1313 (46)
Store volume												150.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.1900 (48)
Temperature factor from Table 2b												0.6000 (49)
Enter (49) or (54) in (55)												0.7140 (55)
Total storage loss												
	22.1340	19.9920	22.1340	21.4200	22.1340	21.4200	22.1340	22.1340	21.4200	22.1340	21.4200	22.1340 (56)
If cylinder contains dedicated solar storage												
	22.1340	19.9920	22.1340	21.4200	22.1340	21.4200	22.1340	22.1340	21.4200	22.1340	21.4200	22.1340 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month												
	190.8614	168.2278	176.6808	158.3889	155.2205	138.7019	133.2146	146.1691	145.9082	164.2399	173.6589	186.2715 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
								Solar input (sum of months) =	Sum(63)m =			0.0000 (63)
Output from w/h												
	190.8614	168.2278	176.6808	158.3889	155.2205	138.7019	133.2146	146.1691	145.9082	164.2399	173.6589	186.2715 (64)
								Total per year (kWh/year) =	Sum(64)m =			1937.5435 (64)
Heat gains from water heating, kWh/month												
	84.6842	75.1047	79.9692	73.2025	72.8336	66.6566	65.5167	69.8240	69.0527	75.8326	78.2798	83.1581 (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	115.7325	115.7325	115.7325	115.7325	115.7325	115.7325	115.7325	115.7325	115.7325	115.7325	115.7325	115.7325 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	18.4736	16.4081	13.3439	10.1022	7.5515	6.3753	6.8888	8.9543	12.0184	15.2601	17.8108	18.9870 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	203.9913	206.1081	200.7739	189.4179	175.0830	161.6102	152.6096	150.4928	155.8271	167.1830	181.5179	194.9907 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	34.5733	34.5733	34.5733	34.5733	34.5733	34.5733	34.5733	34.5733	34.5733	34.5733	34.5733	34.5733 (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)												
	-92.5860	-92.5860	-92.5860	-92.5860	-92.5860	-92.5860	-92.5860	-92.5860	-92.5860	-92.5860	-92.5860	-92.5860 (71)
Water heating gains (Table 5)												
	113.8229	111.7630	107.4855	101.6702	97.8947	92.5786	88.0601	93.8495	95.9065	101.9255	108.7220	111.7716 (72)
Total internal gains												
	394.0075	391.9989	379.3230	358.9100	338.2490	318.2839	305.2782	311.0163	321.4717	342.0884	365.7704	383.4691 (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			
South				5.3000	46.7521	0.5000	0.9000	0.7700	77.2720 (78)			
West				5.2800	19.6403	0.5000	0.9000	0.7700	32.3390 (80)			
Solar gains	109.6111	189.8137	265.3879	334.1414	376.0743	373.3379	360.0045	329.2604	289.5668	211.5636	131.9167	93.3642 (83)
Total gains	503.6186	581.8126	644.7109	693.0515	714.3233	691.6218	665.2826	640.2768	611.0385	553.6520	497.6871	476.8333 (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	84.9273	85.0696	85.2124	85.9338	86.0795	86.8157	86.8157	86.9644	86.5197	86.0795	85.7885	85.4995
alpha	6.6618	6.6713	6.6808	6.7289	6.7386	6.7877	6.7877	6.7976	6.7680	6.7386	6.7192	6.7000
util living area	0.9653	0.9227	0.8390	0.6961	0.5323	0.3775	0.2700	0.2928	0.4612	0.7375	0.9238	0.9737 (86)
MIT	20.5871	20.7376	20.8782	20.9673	20.9947	20.9996	21.0000	20.9999	20.9984	20.9609	20.7753	20.5448 (87)
Th 2	20.4549	20.4558	20.4566	20.4610	20.4619	20.4662	20.4662	20.4671	20.4645	20.4619	20.4601	20.4584 (88)
util rest of house	0.9594	0.9115	0.8200	0.6696	0.5025	0.3461	0.2372	0.2589	0.4259	0.7068	0.9108	0.9690 (89)
MIT 2	19.9070	20.1179	20.3078	20.4244	20.4567	20.4659	20.4662	20.4670	20.4631	20.4195	20.1767	19.8499 (90)
Living area fraction									fLA =	Living area / (4) =		0.4942 (91)
MIT	20.2431	20.4241	20.5897	20.6927	20.7226	20.7296	20.7300	20.7304	20.7276	20.6871	20.4725	20.1933 (92)
Temperature adjustment												0.0000
adjusted MIT	20.2431	20.4241	20.5897	20.6927	20.7226	20.7296	20.7300	20.7304	20.7276	20.6871	20.4725	20.1933 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9569	0.9109	0.8248	0.6811	0.5170	0.3616	0.2534	0.2756	0.4433	0.7199	0.9112	0.9665 (94)
Useful gains	481.8992	529.9447	531.7616	472.0641	369.3049	250.0791	168.5935	176.4644	270.8734	398.5582	453.4768	460.8558 (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												
	665.3451	646.7790	586.0314	486.3766	371.4953	250.2400	168.6048	176.4845	271.4972	415.3242	552.4679	662.9744 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh												
	136.4837	78.5127	40.3767	10.3050	1.6297	0.0000	0.0000	0.0000	0.0000	12.4739	71.2736	150.3763 (98)
Space heating												501.4315 (98)
Space heating per m2										(98) / (4) =		6.8774 (99)



FULL SAP CALCULATION PRINTOUT
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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (301)
Fraction of space heat from community system	1.0000 (302)
Fraction of heat from community Heat pump	1.0000 (303a)
Fraction of total space heat from community Heat pump	1.0000 (304a)
Factor for control and charging method (Table 4c(3)) for community space heating	1.0000 (305)
Factor for control and charging method (Table 4c(3)) for community water heating	1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system	1.0500 (306)
Space heating:	
Annual space heating requirement	501.4315 (98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.05	526.5031 (307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0.0000 (308)
Space heating fuel for secondary/supplementary system	0.0000 (309)

Water heating

Annual water heating requirement	1937.5435 (64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.05	2034.4207 (310a)
Electricity used for heat distribution	25.6092 (313)
Annual totals kWh/year	

Electricity for pumps and fans:

(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7750)	
mechanical ventilation fans (SFP = 0.7750)	173.0304 (330a)
Total electricity for the above, kWh/year	173.0304 (331)
Electricity for lighting (calculated in Appendix L)	326.2491 (332)

Energy saving/generation technologies (Appendices M ,N and Q)

PV Unit 0 (0.80 * 1.08 * 1080 * 0.80) =	-746.1674	-746.1674 (333)
Total delivered energy for all uses		2314.0359 (338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Efficiency of heat source Heat pump			300.0000 (367a)
Space heating from Heat pump	853.6413	0.5190	443.0398 (367)
Electrical energy for heat distribution	25.6092	0.5190	13.2912 (372)
Total CO2 associated with community systems (negative value allowed since DFEE <= TFEE)			456.3310 (373)
Space and water heating			456.3310 (376)
Pumps and fans	173.0304	0.5190	89.8028 (378)
Energy for lighting	326.2491	0.5190	169.3233 (379)
Energy saving/generation technologies			
PV Unit	-746.1674	0.5190	-387.2609 (380)
Total CO2, kg/year			328.1962 (383)
Dwelling Carbon Dioxide Emission Rate (DER)			4.5000 (384)

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

DER	4.5000 ZC1
Total Floor Area	TFA 72.9100
Assumed number of occupants	N 2.3147
CO2 emission factor in Table 12 for electricity displaced from grid	EF 0.5190
CO2 emissions from appliances, equation (L14)	16.5795 ZC2
CO2 emissions from cooking, equation (L16)	2.3941 ZC3
Total CO2 emissions	23.4735 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	23.4735 ZC8



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Property Reference	BB T2				Issued on Date	12/12/2019
Assessment Reference	V02 - Be Green	Prop Type Ref				
Property	BB T2					
SAP Rating	90 B	DER	4.31	TER	32.47	
Environmental	97 A	% DER<TER	86.73			
CO ₂ Emissions (t/year)	0.15	DFEE	35.73	TFEE	60.90	
General Requirements Compliance	Pass	% DFEE<TFEE	41.33			
Assessor Details	Mr. Liam Holden, Liam Holden, Tel: 01202 654600, liamholden@hoarelea.com				Assessor ID	P624-0001
Client						



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

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

DWELLING AS DESIGNED

Mid-floor flat, total floor area 50 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 (c)
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 32.47 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 4.31 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)60.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)35.7 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.14 (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	0.10 (max. 0.20)	0.10 (max. 0.35)	OK
Openings	0.83 (max. 2.00)	1.00 (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:	1.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main heating system: Community heating scheme -

Secondary heating system: None

5 Cylinder insulation

Hot water storage	Measured cylinder loss: 1.19 kWh/day	
Permitted by DBSCG 1.89	OK	
Primary pipework insulated:	Yes (assumed)	OK

6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and TRVsOK

Hot water controls: Cylinderstat

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:	0.62	
Maximum	1.5	OK
MVHR efficiency:	93%	
Minimum:	70%	OK

9 Summertime temperature

Overheating risk (Thames Valley): Slight OK

Based on:

Overshading: Average

Windows facing South: 6.10 m², No overhang

Air change rate: 5.00 ach

Blinds/curtains: Dark-coloured curtain or roller blind, closed 100% of daylight hours

10 Key features

External wall U-value	0.13 W/m ² K
Party wall U-value	0.00 W/m ² K
Roof U-value	0.10 W/m ² K
Floor U-value	0.10 W/m ² K
Door U-value	1.00 W/m ² K
Window U-value	0.80 W/m ² K
Roof window U-value	0.80 W/m ² K
Thermal bridging y-value	0.020 W/m ² K
Air permeability	1.0 m ³ /m ² h
Photovoltaic array	1.08 kW



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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor			
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.0400		
Dwelling volume			

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					Air changes per hour
Pressure test					0.0000 / (5) = 0.0000 (8)
Measured/design AP50					Yes
Infiltration rate					1.0000
Number of sides sheltered					0.0500 (18)
Shelter factor					1 (19)
Infiltration rate adjusted to include shelter factor					(20) = 1 - [0.075 x (19)] = 0.9250 (20)
					(21) = (18) x (20) = 0.0463 (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												
	0.0590	0.0578	0.0567	0.0509	0.0497	0.0439	0.0439	0.0428	0.0463	0.0497	0.0520	0.0543 (22b)
Balanced mechanical ventilation with heat recovery												0.5000 (23a)
If mechanical ventilation:												79.0500 (23c)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												
Effective ac	0.1637	0.1626	0.1614	0.1556	0.1545	0.1487	0.1487	0.1475	0.1510	0.1545	0.1568	0.1591 (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
Windows (Uw = 0.80)			6.1000	0.7752	4.7287		(27)
Opaque Door			2.0400	1.0000	2.0400		(26)
Roof Lights (Uw = 0.80)			3.9800	0.7752	3.0853		(27a)
Heat Loss Floor 1			50.0400	0.1000	5.0040		(28a)
External Wall 1	26.9300	6.1000	20.8300	0.1300	2.7079		(29a)
To Corridor	15.5900	2.0400	13.5500	0.1500	2.0325		(29a)
To stairs	11.3400		11.3400	0.1500	1.7010		(29a)
External Roof 1	50.0400	3.9800	46.0600	0.1000	4.6060		(30)
Total net area of external elements Aum(A, m2)			153.9400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	25.9054		(33)
To Dwelling			42.3200	0.0000	0.0000		(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	175.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	3.1186 (36)
Total fabric heat loss	(33) + (36) = 29.0240 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)	
(38)m	Jan 9.1109 Feb 9.0465 Mar 8.9822 Apr 8.6605 May 8.5961 Jun 8.2744 Jul 8.2744 Aug 8.2100 Sep 8.4031 Oct 8.5961 Nov 8.7248 Dec 8.8535 (38)
Heat transfer coeff	38.1348 38.0705 38.0061 37.6844 37.6201 37.2983 37.2983 37.2340 37.4270 37.6201 37.7487 37.8774 (39)
Average = Sum(39)m / 12 =	37.6683 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	0.7621	0.7608	0.7595	0.7531	0.7518	0.7454	0.7454	0.7441	0.7479	0.7518	0.7544	0.7569 (40)
HLP (average)												0.7528 (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												1.6913 (42)
Average daily hot water use (litres/day)												74.3679 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	81.8047	78.8299	75.8552	72.8805	69.9058	66.9311	66.9311	69.9058	72.8805	75.8552	78.8299	81.8047 (44)
Energy conte	121.3139	106.1019	109.4877	95.4540	91.5904	79.0356	73.2381	84.0418	85.0455	99.1123	108.1888	117.4861 (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 = 1170.0961 (45)
Distribution loss (46)m = 0.15 x (45)m	18.1971	15.9153	16.4232	14.3181	13.7386	11.8553	10.9857	12.6063	12.7568	14.8668	16.2283	17.6229 (46)						
Water storage loss:																		
Store volume																		150.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):																		1.1900 (48)
Temperature factor from Table 2b																		0.6000 (49)
Enter (49) or (54) in (55)																		0.7140 (55)
Total storage loss	22.1340	19.9920	22.1340	21.4200	22.1340	21.4200	22.1340	22.1340	21.4200	22.1340	21.4200	22.1340 (56)						
If cylinder contains dedicated solar storage	22.1340	19.9920	22.1340	21.4200	22.1340	21.4200	22.1340	22.1340	21.4200	22.1340	21.4200	22.1340 (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	23.2624 (59)						
Total heat required for water heating calculated for each month	166.7103	147.1051	154.8841	139.3860	136.9868	122.9676	118.6345	129.4382	128.9775	144.5087	152.1208	162.8825 (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	166.7103	147.1051	154.8841	139.3860	136.9868	122.9676	118.6345	129.4382	128.9775	144.5087	152.1208	162.8825 (64)						
Heat gains from water heating, kWh/month	76.6540	68.0815	72.7218	66.8841	66.7709	61.4249	60.6688	64.2610	63.4232	69.2720	71.1184	75.3812 (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	84.5639	84.5639	84.5639	84.5639	84.5639	84.5639	84.5639	84.5639	84.5639	84.5639	84.5639	84.5639 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	13.1353	11.6666	9.4879	7.1830	5.3694	4.5330	4.8981	6.3668	8.5454	10.8504	12.6640	13.5003 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	147.3378	148.8667	145.0139	136.8118	126.4581	116.7270	110.2261	108.6972	112.5500	120.7521	131.1059	140.8369 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.4564	31.4564	31.4564	31.4564	31.4564	31.4564	31.4564	31.4564	31.4564	31.4564	31.4564	31.4564 (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)	-67.6511	-67.6511	-67.6511	-67.6511	-67.6511	-67.6511	-67.6511	-67.6511	-67.6511	-67.6511	-67.6511	-67.6511 (71)
Water heating gains (Table 5)	103.0296	101.3117	97.7443	92.8945	89.7459	85.3124	81.5441	86.3723	88.0878	93.1075	98.7755	101.3189 (72)
Total internal gains	311.8719	310.2142	300.6154	285.2585	269.9425	254.9417	245.0374	249.8054	257.5524	273.0792	290.9146	304.0253 (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			
South				6.1000	46.7521	0.5000	0.9000	0.7700	88.9358 (78)			
South				3.9800	45.6416	0.5000	0.9000	1.0000	73.5696 (82)			
Solar gains	162.5054	278.3625	382.7823	473.8728	527.7782	521.9423	504.1000	464.6560	414.6949	308.3802	194.9810	138.8236 (83)
Total gains	474.3772	588.5767	683.3977	759.1313	797.7207	776.8840	749.1374	714.4615	672.2473	581.4594	485.8956	442.8488 (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)													
tau	63.7869	63.8947	64.0028	64.5492	64.6597	65.2174	65.2174	65.3301	64.9931	64.6597	64.4392	64.2203	
alpha	5.2525	5.2596	5.2669	5.3033	5.3106	5.3478	5.3478	5.3553	5.3329	5.3106	5.2959	5.2814	
util living area	0.9355	0.8568	0.7385	0.5839	0.4355	0.3069	0.2190	0.2396	0.3827	0.6436	0.8716	0.9501 (86)	
MIT	20.4764	20.7053	20.8741	20.9655	20.9933	20.9992	20.9999	20.9998	20.9974	20.9538	20.7251	20.4146 (87)	
Th 2	20.2863	20.2874	20.2886	20.2942	20.2953	20.3009	20.3009	20.3021	20.2987	20.2953	20.2931	20.2908 (88)	
util rest of house	0.9250	0.8383	0.7123	0.5533	0.4034	0.2735	0.1842	0.2033	0.3443	0.6065	0.8513	0.9415 (89)	
MIT 2	19.6078	19.9203	20.1406	20.2570	20.2889	20.3003	20.3009	20.3020	20.2966	20.2473	19.9574	19.5252 (90)	
Living area fraction									fLA = Living area / (4) =			0.5222 (91)	
MIT	20.0614	20.3302	20.5236	20.6269	20.6567	20.6653	20.6659	20.6664	20.6625	20.6162	20.3583	19.9896 (92)	
Temperature adjustment												0.0000	
adjusted MIT	20.0614	20.3302	20.5236	20.6269	20.6567	20.6653	20.6659	20.6664	20.6625	20.6162	20.3583	19.9896 (93)	

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9213	0.8394	0.7212	0.5679	0.4199	0.2909	0.2024	0.2223	0.3643	0.6237	0.8533	0.9374 (94)
Useful gains	437.0350	494.0685	492.8583	431.0873	334.9415	226.0053	151.6274	158.8149	244.8885	362.6466	414.6343	415.1421 (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	601.0573	587.4345	532.9833	441.9227	336.9525	226.2239	151.6510	158.8542	245.6156	376.8100	500.4827	598.0702 (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	122.0326	62.7419	29.8531	7.8015	1.4962	0.0000	0.0000	0.0000	0.0000	10.5375	61.8109	136.0985 (98)
Space heating												432.3721 (98)
Space heating per m2										(98) / (4) =		8.6405 (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			

9b. Energy requirements			

Fraction of space heat from secondary/supplementary system (Table 11)		0.0000	(301)
Fraction of space heat from community system		1.0000	(302)
Fraction of heat from community Heat pump		1.0000	(303a)
Fraction of total space heat from community Heat pump		1.0000	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.0000	(305)
Factor for control and charging method (Table 4c(3)) for community water heating		1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system		1.0500	(306)
Space heating:			
Annual space heating requirement		432.3721	(98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.05		453.9908	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0.0000	(308)
Space heating fuel for secondary/supplementary system		0.0000	(309)
Water heating			
Annual water heating requirement		1704.6021	(64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.05		1789.8322	(310a)
Electricity used for heat distribution		22.4382	(313)
Annual totals kWh/year			
Electricity for pumps and fans:			
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7750)			
mechanical ventilation fans (SFP = 0.7750)		159.4442	(330a)
Total electricity for the above, kWh/year		159.4442	(331)
Electricity for lighting (calculated in Appendix L)		231.9731	(332)
Energy saving/generation technologies (Appendices M ,N and Q)			
PV Unit 0 (0.80 * 1.08 * 1080 * 0.80) =	-746.1674	-746.1674	(333)
Total delivered energy for all uses		1889.0728	(338)

12b. Carbon dioxide emissions - Community heating scheme			

	Energy	Emission factor	Emissions
	kWh/year	kg CO2/kWh	kg CO2/year
Efficiency of heat source Heat pump			300.0000 (367a)
Space heating from Heat pump	747.9410	0.5190	388.1814 (367)
Electrical energy for heat distribution	22.4382	0.5190	11.6454 (372)
Total CO2 associated with community systems			399.8268 (373)
(negative value allowed since DFEE <= TFEE)			
Space and water heating			399.8268 (376)
Pumps and fans	159.4442	0.5190	82.7515 (378)
Energy for lighting	231.9731	0.5190	120.3940 (379)
Energy saving/generation technologies			
PV Unit	-746.1674	0.5190	-387.2609 (380)
Total CO2, kg/year			215.7115 (383)
Dwelling Carbon Dioxide Emission Rate (DER)			4.3100 (384)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES			
DER			4.3100 ZC1
Total Floor Area		TFA	50.0400
Assumed number of occupants		N	1.6913
CO2 emission factor in Table 12 for electricity displaced from grid		EF	0.5190
CO2 emissions from appliances, equation (L14)			17.4479 ZC2
CO2 emissions from cooking, equation (L16)			3.1893 ZC3
Total CO2 emissions			24.9472 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			24.9472 ZC8



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