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SUSTAINABILITY
ENERGY AND SUSTAINABILITY DOCUMENT

REVISION 1 – 20 DECEMBER 2019

Audit sheet.

Rev.	Date	Description	Prepared	Verified
0	12/12/2019	Draft Issue for Comment	JE	LH/BH
1	20/12/2019	Issue for Planning Submission	LH	BH

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Document reference: 191220 GLE Energy and Sustainabililty Document Rev 1

Contents.

Executive Summary.

This report describes the Energy Strategy and Sustainability Statement for the proposed Guild Living Epsom development, in Epsom.

Figure 1 Proposed Site Image (Credit: Marchese Partners)

The development comprises of residential units, an assisted living facility, as well as retail areas and leisure facilities. There are also proposals to provide separate vehicular access and egress points on Woodcote Green Road, as well as a number of parking spaces provided at surface level throughout the site. The project has been developed with energy efficiency, environmental performance and the local context as key design parameters.

Carbon Dioxide Emissions.

The Epsom and Ewell Borough Council (EEBC) Core Strategy 2007 recognises that all development which takes place in Epsom and Ewell must contribute to addressing climate change. As such, all domestic development should contribute to a sustainable future in Epsom and, all new developments are encouraged to make use of renewable energy.

In addition to the progressively demanding standards for CO_2 emissions set through Building Regulations Part L 2013, the Core Strategy 2007 encourages the use of LZC energy technologies to reduce the total carbon emissions from the development by 10% as part of the aim to reduce pollution and climate change.

In order to demonstrate compliance with Part L 2013, energy modelling has been carried out on the proposed development. Part L 2013 compliant baseline calculations were carried out to establish the regulated carbon dioxide emissions for the development. In order to achieve Guild Living Brand standards, the development will target a 35% reduction over Part L 2013 (using SAP 10 Carbon Factors); and the development will achieve BREEAM 'Very Good', with aspirations of BREEAM 'Excellent'.

These calculations include a number of the following passive and active energy efficiency measures.

The passive measures include the specification of high performance building fabric including u-values and an air permeability that are significantly beyond the minimum requirements of the Building Regulations.

The active measures include:

- Insulated pipework to reduce circulation losses;
- High energy efficient heat recovery ventilation; and
- Low energy lighting.

Research into a possible connection to an existing District Heating Network (DHN) has been looked into via the District Heating Installation Map provided by The Association for Decentralised Energy and found that there are no nearby connections. However, some of the leisure and retail facilities are looking at the potential of connecting to the district heating network for the general hospital, this is being investigated further.

A number of renewable technologies were investigated with the view to be incorporated in the development. Following this investigation, it was decided that a photovoltaic array is the preferred strategy to meet compliance with The Core Strategy 2007 and is proposed for this development.

The assessment showed that a reduction in carbon emissions of 48% over a Part L 2013 compliant development using SAP 10 carbon factors can be achieved. In addition, 14% of the development's energy will come from LZC energy sources.

Sustainability.

Sustainability has been a key design consideration for this development from the onset of the project and consideration of the impact of design proposals and measures on the sustainable credentials of the development has been made throughout the design development to date and will continue throughout the design and construction process.

Below is a selection of some of the measures that will be incorporated into the scheme:

- Project delivery stakeholders will meet to identify and define roles and responsibilities of each of the key phases of project delivery;
- The contractor will be selected with consideration of their ability to comply with the Considerate Constructors Scheme;
- An energy assessment has been carried out in line with the requirements of The Core Strategy 2007;
- Where external lighting is required, energy efficient luminaires will be specified, and they will be automatically controlled for the prevention of operation during daylight hours;
- Any external lighting will be designed to reduce night time light pollution;
- The site benefits from being within 1 mile of Epsom Town Centre and contains cycle and mobility scooter storage;
- Water consumption will be reduced through the specification of efficient sanitary ware;
- Materials with a low environmental impact will be implemented where feasible;
- Recycled, sustainable and locally sourced materials will be used where possible;
- All timber and timber-based products will be legally harvested and traded; and
- A resource plan will be developed to minimise construction waste related to on-site construction and dedicated off-site manufacture / fabrication.

1. Introduction.

The proposed Guild Living Epsom development is situated in the town of Epsom, Surrey. The development is adjacent to Epsom Hospital, with Epsom town centre to the North East.

The development comprises of residential units, an assisted living facility, as well as retail areas and leisure facilities. There are also proposals to provide separate vehicular access and egress points on Woodcote Green Road, as well as a number of parking spaces provided at surface level throughout the site.

The site is highlighted in Figure 2.

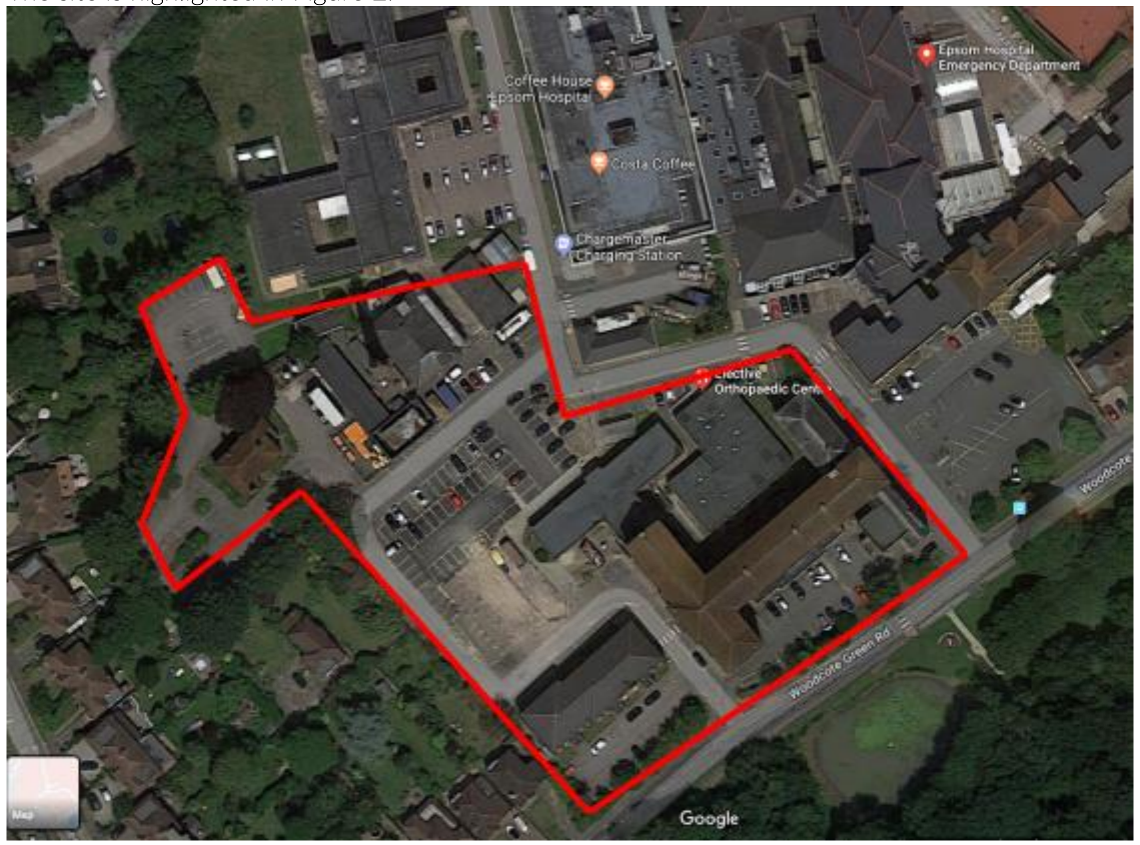


Figure 2 Aerial view of the Proposed Development site. Credit: Google

This Energy and Sustainability Document has been prepared in support of the planning application for the proposed development of Guild Living Epsom, hereafter referred to as the Proposed Development.

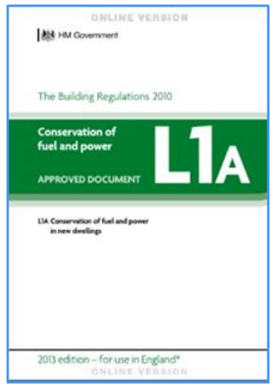
The purpose of this document is to set out the energy strategy and overall sustainability proposals for the Proposed Development. This document provides a summary of the key policies that are applicable to the Proposed Development and an energy strategy commensurate with the current building regulations as well as regional and local planning policies.

2. Policy Requirements & Building Regulations.

The policies and regulations that are required to be satisfied are summarised as follows.

2.1 The Building Regulations

Part L Conservation of Fuel and Power deals with energy efficiency requirements in the Building Regulations. New buildings will be assessed under Approved Document Part L1A (Domestic) and Part L2A (Non-Domestic) of the Building Regulations.

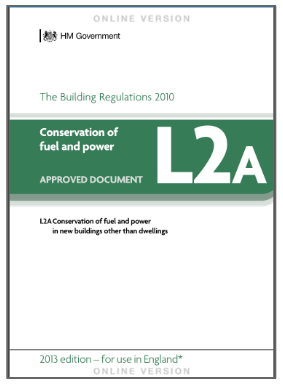


Part L1A 2013 of Building Regulations – New Domestic Elements

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).

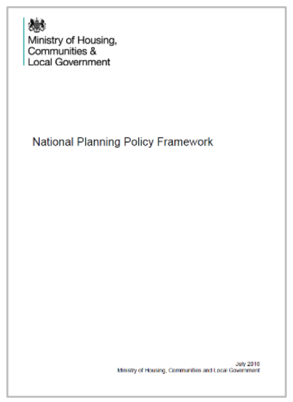


Part L2A 2013 of Building Regulations – New Non-Domestic Elements

On a national level, Part L2A of The Building Regulations sets the energy efficiency requirements in new non-domestic buildings.

Under Building Regulations Approved Document Part L2A: Conservation of Fuel and Power (2013 edition), compliance is achieved by demonstrating that the Building CO_2 Emission Rate (BER) does not exceed the Target CO_2 Emission Rate (TER).

In addition, Part L2A 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).



2.2 National Planning Guidance

The National Planning Policy Framework, February 2019

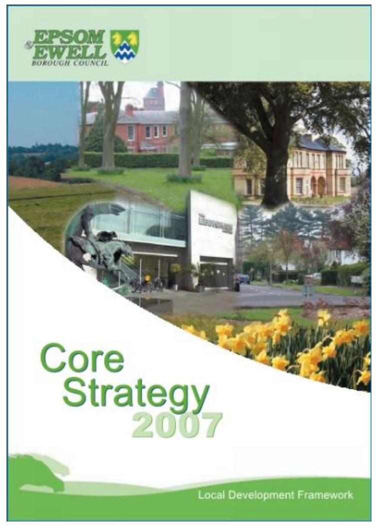
The National Planning Policy Framework (NPPF) was updated in February 2019. The NPPF sets out the Government's strategy on the delivery of sustainable development through the planning system. It provides a framework within which locally-prepared plans for housing and other development can be produced.

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.

The applicable Development Plan for the Proposed Development is The Epsom Core Strategy 2007. Please refer to the following sections for further details.

2.3 Local Planning Guidance



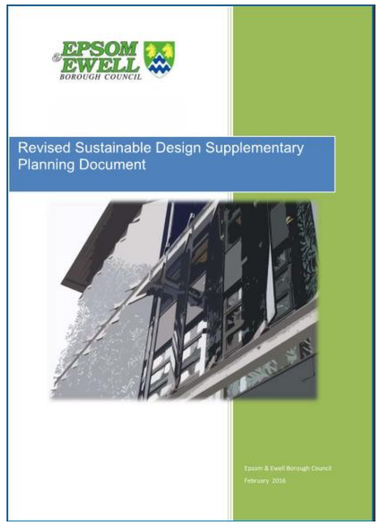
Epsom Core Strategy 2007

The Epsom Core Strategy 2007 is the overarching planning policy document, which forms part of a wider set of local planning policy documents known as the "Epsom and Ewell Borough Council (EEBC) Development Plan".

The Epsom Core Strategy has set out a vision and objectives for the development of Epsom up to 2022, and has been designed to target four broad aims:

- Conserving resources;
- Creating a quality environment and special places;
- Addressing community needs – now and in future; and
- Encouraging a prosperous economy.

Policy CS 6 states "Proposals for development should result in a sustainable environment and reduce, or have a neutral impact upon, pollution and climate change. The council will expect proposals to demonstrate how sustainable construction and design can be incorporated to improve the energy efficiency of development – both new build and conversion."



Revised Sustainable Design Guide 2016

The Sustainable Design Guide 2016 is a supplementary planning document which provides detailed information on how planning policy will be implemented, specifically Core Strategy Policy CS6. By following this guidance document, prospective developers can help ensure that their development proposals are genuinely environmentally sustainable.

To demonstrate compliance with Core Strategy Policy CS6, all minor and major development proposals are required to be accompanied by a Sustainability Statement or appropriate BREEAM Assessment.

In order to comply with the Guild Living brand standard, the nursery and retail areas have targeted BREEAM 'Very Good', with aspirations of 'Excellent'. It is important to note that the assisted living facility is not captured in the strategy.

Please refer to Appendix D for a full review of the BREEAM pre-assessment.

3. Energy Efficiency Measures and Heating Infrastructure.

3.1 Passive Measures

In order to reduce the energy demand of the development, the fabric of the development will be improved significantly beyond the minimum requirements of Criterion 2 of Part L1A and Part L2A 2013. Table 1 shows the typical envelope performance characteristics that will be incorporated into the scheme design to limit the buildings energy consumption.

Table 1 Element U-Values

Element		Domestic	Non Domestic
Floor U - Value (W/m²K)		0.13	0.15
Roof U - Value (W/m²K)		0.13	0.15
External Walls U - Value (W/m²K)		0.15	0.18
Walls between heated spaces (W/m²K)		Fully filled cavity with sealed edges	N/A
Glazing Glazed doors	U-value (W/m²K)	1.4	1.40
	Frame type	Metal	Metal
	G-value	0.35	0.35
	Fraction Glazed	0.80	0.90
Air permeability (m³/hm² (@ 50Pa)		3.00	3.00
Thermal Bridge Specification		Accredited psi values	Default

3.2 Active Measures

Energy consumption will 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 incorporated:

- Insulated pipework to reduce circulation losses;
- High energy efficient heat recovery ventilation; and
- Low energy lighting.

3.3 Overheating and Cooling

The Core Strategy 2007 considers planning for and the impacts of climate change. All development should be future proofed and able to recover from extreme weather events such as flooding, drought and heatwaves. Developments should incorporate thermal mass, shading devices and night time cooling strategy into building design in order to prevent overheating.

Below are the steps and proposals to demonstrate mitigation against overheating

1. Reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure.

   The amount of heat entering the building will be reduced by:

   a. Energy efficient facades with appropriate proportions of glazing;

   b. External shading provided by balconies; and

   c. A glazing shading coefficient carefully selected to minimise solar gain in the summer, but also to maximise solar gain in winter.

2. Minimise internal heat generation through energy efficient design.
    a. Heat generation will be minimised through the specification of energy efficient ventilation systems, insulation on pipework and low energy lighting.
3. Manage the heat within the building through exposed internal thermal mass and high ceilings.
    a. Ceiling heights in the development have been maximised within the constraints of the overall building height and massing.
4. Passive Ventilation
    a. Passive ventilation (openable windows) has been incorporated within the development. In addition, there will be a small amount of natural ventilation through infiltration
5. Mechanical Ventilation
    a. There will be a continuous extract from the kitchens and bathrooms in all units.
6. Active Cooling Systems
    a. No comfort cooling is proposed for the development.

3.4 District Heating Network (DHN)

Research into a possible connection to an existing District Heating Network (DHN) has been looked into via the District Heating Installation Map provided by The Association for Decentralised Energy and found that there are no nearby connections. However, some of the leisure and retail facilities are looking at the potential of connecting to the district heating network for the general hospital, this is being investigated further.

3.5 Proposed Heating Infrastructure

The heating infrastructure for the residential development will be via a direct electric approach. This will provide the heating and hot water loads.

For the non-residential areas, the assisted living suites will have fan coil units for the heating and cooling demand. The café and retail areas have heating and cooling provided by a VRF system, while the restaurant will have communal heating and cooling via an Air Source Heat Pump (ASHP) with MVHR units.

The Domestic Hot Water (DHW) demand is all provided by an ASHP with electric top-up.

4. Utilise Low and Zero Carbon (LZC) Technologies.

These measures are those which serve to reduce the overall emissions of the development through the inclusion of renewable technologies such as Ground Source Heat Pump (GSHP), Solar Photovoltaics array (PV panels), besides others.

This section addresses the requirements of Policy CS6 which encourages the use of renewable or low carbon energy technologies.

4.1 Appraisal of Renewable Technologies

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

4.1.1 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.

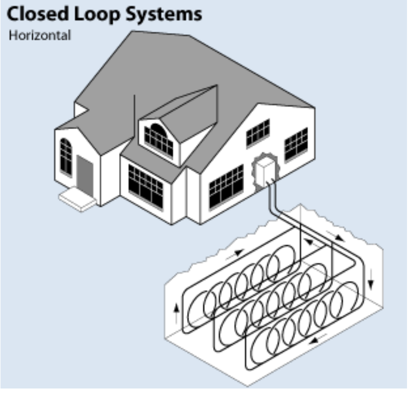
Taking the above into account, solar PV is considered an appropriate technology for this development and will be investigated further.

4.1.2 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 nature of the development, which initially makes this technology suitable for this development. However, solar water panels are more suited to individual/ standalone dwellings as the hot water produced through the panels will feed directly into the hot water storage for that particular dwelling. For a development like this, solar water panels would therefore not be suitable. 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.



4.1.3 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.

Since there is no cooling required for the development, there is an unbalanced heating and cooling demand, therefore this technology is not appropriate.

4.1.4 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.

4.1.5 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 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.

4.1.6 Air Source Heat Pumps

Air source heat pumps absorb heat from the outside air, even if the temperature is as low as -15°C. The air from the outside heats a liquid refrigerant, which is then compressed to increase the temperature. This is then condensed back into a liquid and heat is released. The heat can then be used for heating and hot water systems.

The main benefits of ASHPs are that they can provide both heating and cooling as the heat pump can be operated in reverse, and they are suitable for centralised heat networks. They are easy to install (more so than GSHP) and require very little maintenance once installed. However, this solution would require a large amount of outdoor space to accommodate enough ASHP to provide heating and hot water. This would either be at roof level and impact the overall height or number of floor levels or in the landscaping and would be difficult to conceal. Due to the hydraulic restrictions on pipework runs it is likely that the ASHPs would need to be located in a number of different areas to achieve the required pipework runs. This would also increase the bulk and massing of the development, taking away any space for a proposed PV Array.

The use of ASHPs will also impact on rights of light and outside space for tenants, whilst also being a source of noise.

Taking the above into account, ASHPs will only be considered for certain areas in the scheme, and is not considered an appropriate technology for the whole development.

To summarise, ASHPs will be considered for certain non-domestic spaces such as the restaurant, which will be investigated further. Solar Photovoltaics are considered a suitable technology for this development. Since the Core Strategy encourages LZC energy technologies to reduce the total carbon emissions from the development by 10%, and with other technologies inappropriate due to the reasons highlighted above, these are the only renewable technologies proposed.

After accounting for roof space required for heating and ventilation plant, we have identified 2772 square metres of available roof area for PV panels. This will provide approximately 281.6kWp for the residential units, assuming an efficiency of 0.2 kWp/sqm.

5. Results.

5.1 SAP 2012

With the inclusion of the contribution of ASHP and PV, the estimated reduction in regulated carbon dioxide emissions is approximately 5% below the Part L 2013 compliant baseline scheme for the domestic elements, 1% below the baseline scheme for the non-domestic elements and 5% below the baseline scheme for the site.

Please refer to Appendix A for the SAP DER Worksheets and Appendix B for the BRUKL Output Document.

5.2 SAP 10

It is becoming more widely recognised that energy derived from an electrical power source, will over time, provide a more robust carbon saving due to the decarbonisation of the grid supply. This trend is likely to continue as the carbon factor for electricity continues to reduce.

Grid electricity has significantly decarbonised since the last update of Part L in April 2014. The UK government announced that it will implement the closure of all coal-fired power stations by 2025, this is in line with the increase in renewable power generation.

2017 saw times where low-carbon generation, such as wind, solar and nuclear, generated more energy than coal and gas combined; showing very real progress towards a low-carbon future. In April 2018, Britain went for more than 3 days without the need for coal power and in May 2019 passed a week without the need for this fossil fuel; the first time since 1882.

It is clear that the grid in 2019 is much cleaner than in past years, and so it is therefore a hindrance that our new buildings still utilise the emissions rates of 2014 that give a false position of gas being less green than electricity.

5.2.1 What is a Carbon Factor?

A carbon emission factor (carbon factor) is the average emission rate of a given greenhouse gas for a given source, relative to units of activity.

5.2.2 SAP 10 Carbon Factors

In July 2018 the Government published updated carbon emission factors (SAP 10), demonstrating how the grid is decarbonising.

The table below details the carbon factors for electricity under SAP 2012, SAP 10, Actual (last 3 months), and Actual (last year).

They reflect the general decarbonisation of the grid.

Table 2: Electricity Factors

	Emissions kg CO_{2e} per kWh			
	SAP 2012 (2014)	SAP 10 (July 2018)	Actual (last 3 months)	Actual Last Year (2018)
Electricity	0.519[1]	0.233[2]	0.190[3]	0.225[4]

1: SAP 2012: https://www.bregroup.com/sap/standard-assessment-procedure-sap-2012/
2: SAP 10 (please note this is just the carbon factors not the SAP 10 methodology itself): https://www.bregroup.com/sap/sap10/
3: Britain's Electricity Demand: https://electricinsights.co.uk/#/dashboard?period=3-months&start=2019-09-18&&_k=96iyde
4. SSE's fuel mix for last year that confirms the national average of 0.225 for 2017-2018

This clearly demonstrates that the use of SAP 10 carbon factors is appropriate for current day energy modelling.

5.2.3 SAP 10 Results

The overall predicted reduction in CO_2 emissions from the baseline development model using SAP 10 carbon factors is approximately 53% for the domestic elements and 1% for the non-domestic elements, which represents a total site wide reduction of 48% and an annual saving of approximately 462 tonnes of CO_2 (see Figure 3 below).

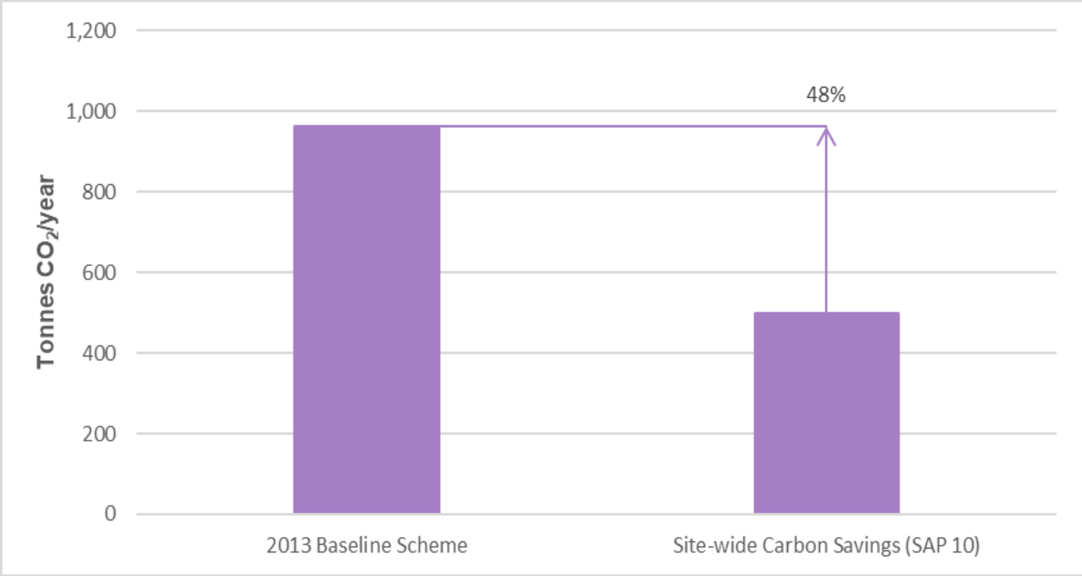


Figure 3: Proposed Development Regulated Carbon Dioxide Emissions (SAP 10 Carbon Factors)

5.3 Site Wide Energy from Low and Zero Carbon (LZC) Energy Sources

The Core Strategy details that The South East Plan encourages larger housing and commercial schemes to provide at least 10% of the development's energy from renewable sources. As a result, this development has implemented ASHP and PV panels throughout the site. Calculations have confirmed that 14% of the development's energy will come from LZC energy sources.

Appendix C shows the calculation of energy from LZC energy sources.

6. Sustainability.

Sustainability has been a key design consideration for this development from the onset of the project and consideration of the impact of design proposals and measures on the sustainable credentials of the development has been made throughout the design development to date and will continue throughout the design and construction process.

The following is a summary of the key sustainability issues that form the overall strategy for the project.

6.1 Management

To encourage an integrated design process, the project delivery stakeholders will meet to identify and define roles, responsibilities for each of the key phases of project delivery.

To ensure that the construction site is managed in an environmentally and socially considerate, responsible and accountable manner, the contractor will be selected with consideration of their ability to comply with the Considerate Constructors Scheme. The contractor will be required to significantly exceed 'compliance' with the criteria of the scheme. The Principal Contractor and subcontractors' energy and potable water consumption will be monitored and recorded.

6.2 Health and Wellbeing

The development will be designed to encourage a healthy and safe internal and external environment.

Lighting controls will be provided to all external lighting located within the development and will be designed to enhance the external environment.

All areas of the buildings acoustic performance, including plant spaces will be attenuated in order to meet the appropriate standards for this type of building.

6.3 Energy

An Energy Strategy has been devised in line with The Core Strategy 2007. Please refer to Sections 4 and 5 of this report for further details on energy performance.

A Direct Electric approach is the proposed strategy for the heating and hot water for the development.

Energy efficient light fittings will be installed for all external areas of the development.

6.4 Transport

The site is located within walking distance of Epsom town centre and within 100m of the nearest bus stop.

Secure, covered spaces for bicycles and scooter storage will be provided for residents and visitors.

6.5 Water

Reducing the consumption of potable water will be a significant consideration in the design process. Water use will be reduced as much as possible mainly through the specification of efficient sanitary ware.

A water meter will be specified on the mains water supply to the building, ensuring that water consumption can be monitored and managed and therefore encourage reductions.

6.6 Materials

Materials with low environmental impact will be implemented where feasible. Recycled, sustainable and locally sourced materials will be used where possible.

As part of the design, vulnerable parts of the building will be protected from damage, for example doors in areas of high pedestrian traffic.

Thermal insulation used in the building fabric and services will be selected with consideration of their embodied environmental impact relative to its thermal properties.

6.7 Waste

A resource plan will be developed to minimise construction waste related to on-site construction and dedicated off-site manufacture/fabrication.

Communal refuse and recyclable stores will be easily accessible to all users including children and wheelchair users, and located on hard, level surface. Storage facilities for waste and recycling will be provided in accordance with, as a minimum, BS5906.

6.8 Land Use and Ecology

An improvement in ecological value is being targeted for the site with external landscaped areas provided for the residents.

6.9 Pollution

The site is located in Flood Zone 1. Figure 4 below shows the environmental agency flood mapping, which contains more information on flood zones and flood risk assessments.

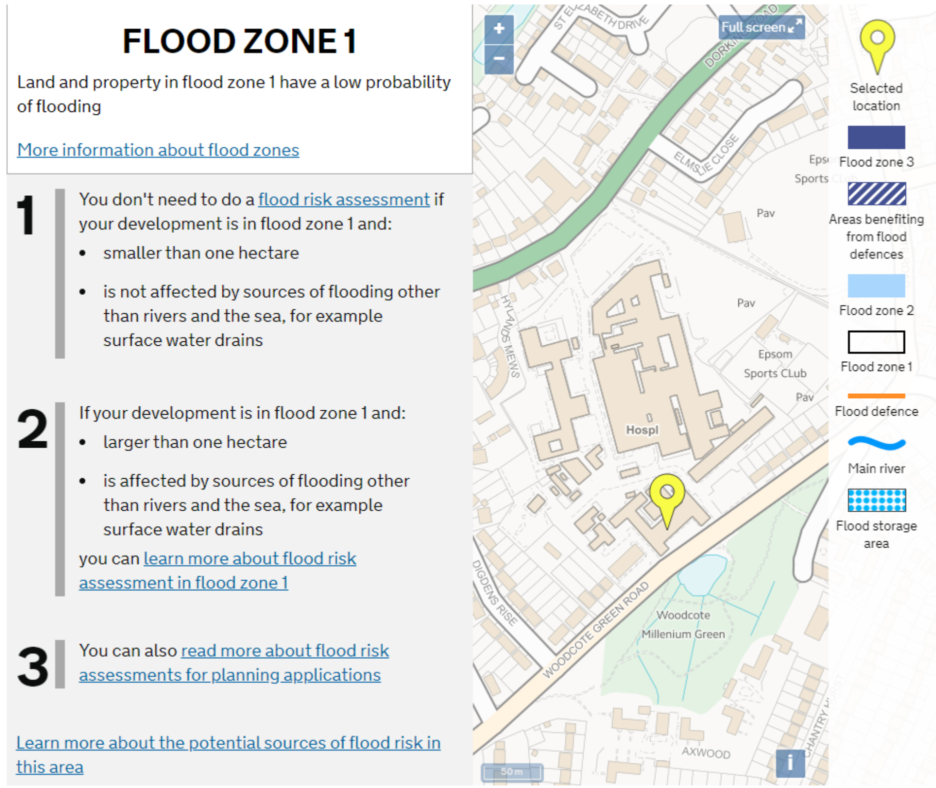


Figure 4 Environment Agency Flood Mapping

The materials used for the landscaping will be selected with consideration of reducing the flood risk. Such materials include permeable paving and other porous finishes. The types of materials and finishes will help promote infiltration into the ground.

Any external lighting provided will be designed with the consideration of reducing night time light pollution.

7. Conclusion.

An energy assessment has been carried out to show compliance with of The Core Strategy 2007. The assessment showed that a reduction in carbon emissions of 48% over a Part L 2013 compliant development can be achieved. This reduction in carbon dioxide emissions will be achieved through the incorporation of passive and active energy efficiency measures and renewable technologies.

A range of sustainable measures, such as those highlighted below have been incorporated into this development.

- Project delivery stakeholders will meet to identify and define roles, responsibilities of each of the key phases of project delivery;
- The contractor will be selected with consideration of their ability to comply with the Considerate Constructors Scheme;
- An energy assessment has been carried out in line with the requirements of The Core Strategy 2007;
- Where external lighting is required, energy efficient luminaires will be specified, and they will be automatically controlled for the prevention of operation during daylight hours;
- Any external lighting will be designed to reduce night time light pollution;
- The site benefits from close proximity to Epsom Town Centre and covered cycle and mobile scooter storage;
- Water consumption will be reduced through the specification of efficient sanitary ware;
- Materials with a low environmental impact will be implemented where feasible;
- Recycled, sustainable and locally sourced materials will be used where possible;
- All timber and timber-based products will be legally harvested and traded; and
- A resource plan will be developed to minimise construction waste related to on-site construction and dedicated off-site manufacture / fabrication.

Appendix A: Sample SAP DER Worksheets.

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	Type 01F	**Issued on Date**	17/12/2019
Assessment Reference	V02	**Prop Type Ref**	
Property	Type 01F		

SAP Rating	78 C	**DER**	26.89	**TER**	25.64
Environmental	80 C	**% DER<TER**	-4.87		
CO_2 Emissions (t/year)	1.62	**DFEE**	47.04	**TFEE**	49.51
General Requirements Compliance	Fail	**% DFEE<TFEE**	4.99		

Assessor Details	Mr. Josh Elliott, Josh Elliott, Tel: 07717220167, JoshElliott@hoarelea.com	**Assessor ID**	W974-0001
Client			

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

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

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Ground-floor flat, total floor area 78 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
--------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 25.64 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 26.89 kgCO□/m²Fail
Excess emissions =1.25 kgCO□/m²  (4.9%)
--------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)49.5 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)47.0 kWh/m²/yrOK
--------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                 Highest
External wall   0.15 (max. 0.30)        0.15 (max. 0.70)          OK
Party wall      0.00 (max. 0.20)         -                        OK
Floor           0.13 (max. 0.25)        0.13 (max. 0.70)          OK
Roof            (no roof)
Openings        1.40 (max. 2.00)        1.40 (max. 3.30)          OK
--------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
--------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:         3.00 (design value)
Maximum                                 10.0                                              OK
--------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                    Room heaters - Electric
Panel, convector or radiant heaters



Secondary heating system:               None
--------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                       Measured cylinder loss: 1.18 kWh/day
Permitted by DBSCG 1.85                           OK
Primary pipework insulated:             No primary pipework
--------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                 Programmer and room thermostat                    OK


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:                     0.53
Maximum                                 1.5                                               OK
MVHR efficiency:                        90%
Minimum:                                70%                                               OK
--------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Thames Valley):       Medium                                            OK
Based on:
Overshading:                            Average
Windows facing North East:              3.65 m², No overhang
Windows facing South East:              14.58 m², No overhang
Air change rate:                        2.00 ach
Blinds/curtains:                        Dark-coloured curtain or roller blind, closed 100% of daylight hours
--------------------------------------------------------------------------------------------
10 Key features
Party wall U-value                      0.00 W/m²K
Party wall U-value                      0.00 W/m²K
Air permeability                        3.0 m³/m²h
Photovoltaic array                      0.53 kW



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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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-----------------------------------------------------------------------------------------------------
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        Storey height            Volume
                                                                    (m2)                 (m)               (m3)
Ground floor                                                     77.6500 (1b)    x      2.7000 (2b)    =   209.6550 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)           77.6500                                            (4)
Dwelling volume                                                     (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =   209.6550 (5)


-----------------------------------------------------------------------------------------------------
2. Ventilation rate
-----------------------------------------------------------------------------------------------------
                                                    main         secondary          other             total       m3 per hour
                                                 heating           heating
Number of chimneys                                     0     +           0     +        0     =          0 * 40 =      0.0000 (6a)
Number of open flues                                   0     +           0     +        0     =          0 * 20 =      0.0000 (6b)
Number of intermittent fans                                                                              0 * 10 =      0.0000 (7a)
Number of passive vents                                                                                  0 * 10 =      0.0000 (7b)
Number of flueless gas fires                                                                             0 * 40 =      0.0000 (7c)

                                                                                                  Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =                    0.0000 / (5) =      0.0000 (8)
Pressure test                                                                                                         Yes
Measured/design AP50                                                                                               3.0000
Infiltration rate                                                                                                  0.1500 (18)
Number of sides sheltered                                                                                               2 (19)

Shelter factor                                                                       (20) =  1  -  [0.075 x (19)]  =      0.8500 (20)
Infiltration rate adjusted to include shelter factor                                        (21) = (18) x (20)  =      0.1275 (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
                 0.1626      0.1594      0.1562      0.1403      0.1371      0.1211      0.1211      0.1179      0.1275      0.1371      0.1434      0.1498 (22b)
 Balanced mechanical ventilation with heat recovery
If mechanical ventilation:                                                                                                                              0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =                                                          76.5000 (23c)

Effective ac     0.2801      0.2769      0.2737      0.2578      0.2546      0.2386      0.2386      0.2354      0.2450      0.2546      0.2609      0.2673 (25)


-----------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
-----------------------------------------------------------------------------------------------------
Element                                     Gross      Openings        NetArea      U-value         A x U      K-value         A x K
                                               m2            m2             m2        W/m2K           W/K       kJ/m2K          kJ/K
Opening Type 1 (Uw = 1.40)                                             18.2300       1.3258       24.1686                            (27)
Heat Loss Floor 1                                                      77.6500       0.1300       10.0945                            (28a)
External Wall 1                           52.6300       18.2300        34.4000       0.1500        5.1600                            (29a)
Total net area of external elements Aum(A, m2)                        130.2800                                                   (31)
Fabric heat loss, W/K = Sum (A x U)                                  (26)...(30) + (32) =        39.4231                            (33)
To Corridor                                                             6.3400       0.0000        0.0000                            (32)
To Dwelling                                                            45.9600       0.0000        0.0000                            (32)
Party Ceilings 1                                                       77.6500                                                   (32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                      175.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                              15.1040 (36)
Total fabric heat loss                                                                              (33) + (36) =      54.5271 (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           19.3764     19.1559     18.9354     17.8327     17.6122     16.5095     16.5095     16.2890     16.9506     17.6122     18.0533     18.4943 (38)
Heat transfer coeff
                73.9035     73.6830     73.4624     72.3598     72.1393     71.0366     71.0366     70.8161     71.4777     72.1393     72.5803     73.0214 (39)
Average = Sum(39)m / 12 =                                                                                                                         72.3047 (39)

                 Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
HLP              0.9518      0.9489      0.9461      0.9319      0.9290      0.9148      0.9148      0.9120      0.9205      0.9290      0.9347      0.9404 (40)
HLP (average)                                                                                                                                      0.9312 (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                                                                                                                                  2.4168 (42)
Average daily hot water use (litres/day)                                                                                                          91.5980 (43)

                 Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
Daily hot water use
               100.7578     97.0939     93.4300     89.7661     86.1021     82.4382     82.4382     86.1021     89.7661     93.4300     97.0939    100.7578 (44)
Energy conte   149.4210    130.6845    134.8547    117.5696    112.8108     97.3472     90.2065    103.5132    104.7495    122.0755    133.2549    144.7062 (45)
Energy content (annual)                                                                                            Total = Sum(45)m =   1441.1937 (45)
Distribution loss   (46)m = 0.15 x (45)m
                22.4131     19.6027     20.2282     17.6354     16.9216     14.6021     13.5310     15.5270     15.7124     18.3113     19.9882     21.7059 (46)
```


CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014


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Water storage loss:
Store volume                                                                                                                                     145.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                                      1.1800 (48)
  Temperature factor from Table 2b                                                                                                                 0.6000 (49)
Enter (49) or (54) in (55)                                                                                                                         0.7080 (55)
Total storage loss
                21.9480     19.8240     21.9480     21.2400     21.9480     21.2400     21.9480     21.9480     21.2400     21.9480     21.2400     21.9480 (56)
If cylinder contains dedicated solar storage
                21.9480     19.8240     21.9480     21.2400     21.9480     21.2400     21.9480     21.9480     21.2400     21.9480     21.2400     21.9480 (57)
Primary loss     0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000 (59)
Total heat required for water heating calculated for each month
               171.3690    150.5085    156.8027    138.8096    134.7588    118.5872    112.1545    125.4612    125.9895    144.0235    154.4949    166.6542 (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
               171.3690    150.5085    156.8027    138.8096    134.7588    118.5872    112.1545    125.4612    125.9895    144.0235    154.4949    166.6542 (64)
                                                                                                   Total per year (kWh/year) = Sum(64)m =   1699.6137 (64)
Heat gains from water heating, kWh/month
                67.2409     59.3118     62.3976     56.0839     55.0680     49.3599     47.5521     51.9766     51.8212     58.1485     61.2993     65.6732 (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          120.8380    120.8380    120.8380    120.8380    120.8380    120.8380    120.8380    120.8380    120.8380    120.8380    120.8380    120.8380 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                19.1192     16.9815     13.8103     10.4553      7.8154      6.5981      7.1295      9.2672     12.4384     15.7934     18.4332     19.6506 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               214.4590    216.6845    211.0765    199.1378    184.0673    169.9032    160.4407    158.2153    163.8232    175.7620    190.8324    204.9965 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                35.0838     35.0838     35.0838     35.0838     35.0838     35.0838     35.0838     35.0838     35.0838     35.0838     35.0838     35.0838 (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)
               -96.6704    -96.6704    -96.6704    -96.6704    -96.6704    -96.6704    -96.6704    -96.6704    -96.6704    -96.6704    -96.6704    -96.6704 (71)
Water heating gains (Table 5)
                90.3775     88.2616     83.8677     77.8943     74.0161     68.5555     63.9140     69.8610     71.9739     78.1566     85.1379     88.2705 (72)
Total internal gains
               383.2071    381.1789    368.0059    346.7387    325.1503    304.3082    290.7356    296.5948    307.4870    328.9633    353.6549    372.1689 (73)


-----------------------------------------------------------------------------------------------------
6. Solar gains
-----------------------------------------------------------------------------------------------------

[Jan]                                           Area      Solar flux             g             FF         Access          Gains
                                                  m2        Table 6a   Specific data  Specific data         factor              W
                                                                W/m2    or Table 6b    or Table 6c       Table 6d
-----------------------------------------------------------------------------------------------------
Northeast                                     3.6500         11.2829        0.3500         0.8000         0.7700         7.9911 (75)
Southeast                                    14.5800         36.7938        0.3500         0.8000         0.7700       104.0935 (77)
-----------------------------------------------------------------------------------------------------

Solar gains    112.0846    193.5759    271.9094    348.7264    401.3890    403.2310    386.7832    346.7692    298.3980    215.8436    134.7350     95.6083 (83)
Total gains    495.2918    574.7549    639.9153    695.4651    726.5393    707.5392    677.5189    643.3640    605.8850    544.8069    488.3899    467.7773 (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, ni1,m (see Table 9a)
                 Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
tau             51.0754     51.2283     51.3821     52.1651     52.3245     53.1367     53.1367     53.3022     52.8088     52.3245     52.0066     51.6924
alpha            4.4050      4.4152      4.4255      4.4777      4.4883      4.5424      4.5424      4.5535      4.5206      4.4883      4.4671      4.4462
util living area
                 0.9892      0.9786      0.9553      0.8977      0.7838      0.6089      0.4538      0.4948      0.7260      0.9213      0.9794      0.9914 (86)

MIT             19.7614     19.9610     20.2435     20.5797     20.8302     20.9599     20.9915     20.9875     20.9106     20.5843     20.1133     19.7266 (87)
Th 2            20.1237     20.1261     20.1285     20.1405     20.1429     20.1549     20.1549     20.1573     20.1501     20.1429     20.1381     20.1333 (88)
util rest of house
                 0.9868      0.9739      0.9454      0.8752      0.7393      0.5396      0.3701      0.4092      0.6611      0.8991      0.9741      0.9895 (89)
MIT 2           18.4645     18.7548     19.1614     19.6390     19.9665     20.1234     20.1505     20.1504     20.0717     19.6560     18.9861     18.4207 (90)
Living area fraction                                                                                       fLA = Living area / (4) =      0.4683 (91)
MIT             19.0718     19.3196     19.6681     20.0795     20.3709     20.5151     20.5443     20.5424     20.4645     20.0907     19.5139     19.0322 (92)
Temperature adjustment                                                                                                                             0.0000
adjusted MIT    19.0718     19.3196     19.6681     20.0795     20.3709     20.5151     20.5443     20.5424     20.4645     20.0907     19.5139     19.0322 (93)


-----------------------------------------------------------------------------------------------------
8. Space heating requirement
-----------------------------------------------------------------------------------------------------

                 Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
Utilisation      0.9830      0.9684      0.9392      0.8734      0.7518      0.5699      0.4091      0.4489      0.6864      0.8975      0.9692      0.9863 (94)
Useful gains   486.8500    556.5970    600.9898    607.4025    546.2394    403.2462    277.1887    288.8228    415.8592    488.9628    473.3567    461.3528 (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
              1091.6853   1062.4785    967.3607    808.9459    625.5144    420.1900    280.1882    293.3466    454.9209    684.6522    901.0060   1083.0648 (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
               449.9975    339.9524    272.5799    145.1113     58.9806      0.0000      0.0000      0.0000      0.0000    145.5929    307.9075    462.5537 (98)
Space heating                                                                                                                                   2182.6757 (98)
Space heating per m2                                                                                                (98) / (4) =      28.1092 (99)


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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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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 %)                                                           100.0000 (206)
Efficiency of secondary/supplementary heating system, %                                                      0.0000 (208)
Space heating requirement                                                                                  2182.6757 (211)

                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Space heating requirement
              449.9975  339.9524  272.5799  145.1113   58.9806    0.0000    0.0000    0.0000    0.0000  145.5929  307.9075  462.5537 (98)
Space heating efficiency (main heating system 1)
              100.0000  100.0000  100.0000  100.0000  100.0000    0.0000    0.0000    0.0000    0.0000  100.0000  100.0000  100.0000 (210)
Space heating fuel (main heating system)
              449.9975  339.9524  272.5799  145.1113   58.9806    0.0000    0.0000    0.0000    0.0000  145.5929  307.9075  462.5537 (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
              171.3690  150.5085  156.8027  138.8096  134.7588  118.5872  112.1545  125.4612  125.9895  144.0235  154.4949  166.6542 (64)
Efficiency of water heater                                                                                          100.0000 (216)
(217)m        100.0000  100.0000  100.0000  100.0000  100.0000  100.0000  100.0000  100.0000  100.0000  100.0000  100.0000  100.0000 (217)
Fuel for water heating, kWh/month
              171.3690  150.5085  156.8027  138.8096  134.7588  118.5872  112.1545  125.4612  125.9895  144.0235  154.4949  166.6542 (219)
Water heating fuel used                                                                                             1699.6137 (219)
Annual totals kWh/year
Space heating fuel - main system                                                                                    2182.6757 (211)
Space heating fuel - secondary                                                                                         0.0000 (215)

Electricity for pumps and fans:
    (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.6625)
   mechanical ventilation fans (SFP =       0.6625)                                                                 169.4537 (230a)
Total electricity for the above, kWh/year                                                                           169.4537 (231)
Electricity for lighting (calculated in Appendix L)                                                                 337.6507 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 0.53 * 1080 * 0.80) =                                                       -366.1748            -366.1748 (233)
Total delivered energy for all uses                                                                                 4023.2190 (238)


----------------------------------------------------------------------------------------------------
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP
----------------------------------------------------------------------------------------------------
                                                                    Energy      Emission factor         Emissions
                                                                  kWh/year         kg CO2/kWh         kg CO2/year
Space heating - main system 1                                    2182.6757             0.5190           1132.8087 (261)
Space heating - secondary                                           0.0000             0.0000              0.0000 (263)
Water heating (other fuel)                                       1699.6137             0.5190            882.0995 (264)
Space and water heating                                                                                 2014.9082 (265)
Pumps and fans                                                    169.4537             0.5190             87.9464 (267)
Energy for lighting                                               337.6507             0.5190            175.2407 (268)

 Energy saving/generation technologies
PV Unit                                                          -366.1748             0.5190           -190.0447 (269)
Total CO2, kg/year                                                                                      2088.0507 (272)
Dwelling Carbon Dioxide Emission Rate (DER)                                                               26.8900 (273)


16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES
DER                                                                                               26.8900 ZC1
Total Floor Area                                                                           TFA    77.6500
Assumed number of occupants                                                                  N     2.4168
CO2 emission factor in Table 12 for electricity displaced from grid                         EF     0.5190
CO2 emissions from appliances, equation (L14)                                                     16.3662 ZC2
CO2 emissions from cooking, equation (L16)                                                         2.2795 ZC3
Total CO2 emissions                                                                               45.5357 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                                                                                 45.5357 ZC8


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

Design SAP elmhurst energy

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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----------------------------------------------------------------------------------------------------
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        Storey height          Volume
                                                                        (m2)              (m)               (m3)
Ground floor                                                         77.6500 (1b)    x    2.7000 (2b)  =   209.6550 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)           77.6500                                             (4)
Dwelling volume                                                           (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =   209.6550 (5)


----------------------------------------------------------------------------------------------------
2. Ventilation rate
----------------------------------------------------------------------------------------------------
                                                         main        secondary          other          total      m3 per hour
                                                       heating        heating
Number of chimneys                                           0     +        0    +         0     =          0 * 40 =      0.0000 (6a)
Number of open flues                                         0     +        0    +         0     =          0 * 20 =      0.0000 (6b)
Number of intermittent fans                                                                                 3 * 10 =     30.0000 (7a)
Number of passive vents                                                                                     0 * 10 =      0.0000 (7b)
Number of flueless gas fires                                                                                0 * 40 =      0.0000 (7c)

                                                                                                     Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =                    30.0000 / (5) =      0.1431 (8)
Pressure test                                                                                                          Yes
Measured/design AP50                                                                                                5.0000
Infiltration rate                                                                                                   0.3931 (18)
Number of sides sheltered                                                                                                2 (19)

Shelter factor                                                                      (20) = 1  -  [0.075 x (19)]  =      0.8500 (20)
Infiltration rate adjusted to include shelter factor                                        (21) = (18) x (20)  =      0.3341 (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
              0.4260    0.4177    0.4093    0.3675    0.3592    0.3174    0.3174    0.3091    0.3341    0.3592    0.3759    0.3926 (22b)
Effective ac  0.5907    0.5872    0.5838    0.5675    0.5645    0.5504    0.5504    0.5478    0.5558    0.5645    0.5706    0.5771 (25)


----------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
----------------------------------------------------------------------------------------------------
Element                                          Gross      Openings      NetArea      U-value        A x U      K-value         A x K
                                                    m2            m2           m2        W/m2K          W/K       kJ/m2K          kJ/K
TER Opening Type (Uw = 1.40)                                              18.2300       1.3258      24.1686                              (27)
Heat Loss Floor 1                                                         77.6500       0.1300      10.0945                              (28a)
External Wall 1                                52.6300       18.2300      34.4000       0.1800       6.1920                              (29a)
Total net area of external elements Aum(A, m2)                           130.2800                                                    (31)
Fabric heat loss, W/K = Sum (A x U)                                             (26)...(30) + (32) =      40.4551                         (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                       250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                               12.1340 (36)
Total fabric heat loss                                                                                 (33) + (36) =     52.5891 (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         40.8713   40.6275   40.3885   39.2661   39.0561   38.0786   38.0786   37.8975   38.4551   39.0561   39.4810   39.9251 (38)
Heat transfer coeff
              93.4604   93.2166   92.9776   91.8552   91.6452   90.6676   90.6676   90.4866   91.0442   91.6452   92.0700   92.5142 (39)
Average = Sum(39)m / 12 =                                                                                                  91.8542 (39)

                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
HLP            1.2036    1.2005    1.1974    1.1829    1.1802    1.1676    1.1676    1.1653    1.1725    1.1802    1.1857    1.1914 (40)
HLP (average)                                                                                                               1.1829 (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                                                                                                           2.4168 (42)
Average daily hot water use (litres/day)                                                                                   91.5980 (43)

                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Daily hot water use
             100.7578   97.0939   93.4300   89.7661   86.1021   82.4382   82.4382   86.1021   89.7661   93.4300   97.0939  100.7578 (44)
Energy conte 149.4210  130.6845  134.8547  117.5696  112.8108   97.3472   90.2065  103.5132  104.7495  122.0755  133.2549  144.7062 (45)
Energy content (annual)                                                                               Total = Sum(45)m =  1441.1937 (45)
Distribution loss  (46)m = 0.15 x (45)m
              22.4131   19.6027   20.2282   17.6354   16.9216   14.6021   13.5310   15.5270   15.7124   18.3113   19.9882   21.7059 (46)
Water storage loss:
Store volume                                                                                                              145.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                               1.3665 (48)
  Temperature factor from Table 2b                                                                                          0.5400 (49)
Enter (49) or (54) in (55)                                                                                                  0.7379 (55)
Total storage loss
              22.8747   20.6610   22.8747   22.1368   22.8747   22.1368   22.8747   22.8747   22.1368   22.8747   22.1368   22.8747 (56)
```

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
If cylinder contains dedicated solar storage	22.8747	20.6610	22.8747	22.1368	22.8747	22.1368	22.8747	22.8747	22.1368	22.8747	22.1368	22.8747	(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	195.5580	172.3567	180.9918	162.2184	158.9479	141.9960	136.3435	149.6503	149.3983	168.2125	177.9037	190.8433	(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	195.5580	172.3567	180.9918	162.2184	158.9479	141.9960	136.3435	149.6503	149.3983	168.2125	177.9037	190.8433	(64)
Total per year (kWh/year) = Sum(64)m =												1984.4205	(64)
Heat gains from water heating, kWh/month	86.5921	76.7904	81.7489	74.8109	74.4193	68.0870	66.9033	71.3278	70.5482	77.4998	80.0263	85.0245	(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	120.8380	120.8380	120.8380	120.8380	120.8380	120.8380	120.8380	120.8380	120.8380	120.8380	120.8380	120.8380	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	19.1192	16.9815	13.8103	10.4553	7.8154	6.5981	7.1295	9.2672	12.4384	15.7934	18.4332	19.6506	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	214.4590	216.6845	211.0765	199.1378	184.0673	169.9032	160.4407	158.2153	163.8232	175.7620	190.8324	204.9965	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.0838	35.0838	35.0838	35.0838	35.0838	35.0838	35.0838	35.0838	35.0838	35.0838	35.0838	35.0838	(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)	-96.6704	-96.6704	-96.6704	-96.6704	-96.6704	-96.6704	-96.6704	-96.6704	-96.6704	-96.6704	-96.6704	-96.6704	(71)
Water heating gains (Table 5)	116.3873	114.2714	109.8775	103.9041	100.0259	94.5652	89.9238	95.8707	97.9837	104.1663	111.1476	114.2802	(72)
Total internal gains	412.2169	410.1887	397.0156	375.7485	354.1600	333.3179	319.7454	325.6046	336.4967	357.9731	382.6647	401.1787	(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	
Northeast	3.6500	11.2829	0.6300	0.7000	0.7700	12.5860	(75)
Southeast	14.5800	36.7938	0.6300	0.7000	0.7700	163.9473	(77)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	176.5333	304.8821	428.2573	549.2441	632.1877	635.0888	609.1836	546.1614	469.9769	339.9537	212.2075	150.5831	(83)
Total gains	588.7502	715.0708	825.2729	924.9925	986.3478	968.4067	928.9290	871.7660	806.4736	697.9268	594.8722	551.7618	(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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	57.6968	57.8477	57.9963	58.7050	58.8395	59.4739	59.4739	59.5929	59.2280	58.8395	58.5680	58.2869	
alpha	4.8465	4.8565	4.8664	4.9137	4.9226	4.9649	4.9649	4.9729	4.9485	4.9226	4.9045	4.8858	
util living area	0.9945	0.9855	0.9623	0.8973	0.7653	0.5794	0.4257	0.4711	0.7143	0.9314	0.9874	0.9959	(86)
MIT	19.8318	20.0459	20.3357	20.6616	20.8828	20.9769	20.9958	20.9933	20.9372	20.6355	20.1679	19.7939	(87)
Th 2	19.9171	19.9196	19.9221	19.9337	19.9358	19.9460	19.9460	19.9478	19.9421	19.9358	19.9315	19.9269	(88)
util rest of house	0.9926	0.9809	0.9503	0.8665	0.7047	0.4923	0.3257	0.3666	0.6283	0.9035	0.9825	0.9945	(89)
MIT 2	18.3818	18.6932	19.1078	19.5604	19.8307	19.9320	19.9446	19.9454	19.8976	19.5394	18.8809	18.3336	(90)
Living area fraction									fLA = Living area / (4) =			0.4683	(91)
MIT	19.0608	19.3266	19.6827	20.0760	20.3233	20.4213	20.4368	20.4360	20.3844	20.0527	19.4836	19.0174	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0608	19.3266	19.6827	20.0760	20.3233	20.4213	20.4368	20.4360	20.3844	20.0527	19.4836	19.0174	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9907	0.9777	0.9471	0.8711	0.7280	0.5325	0.3727	0.4157	0.6661	0.9071	0.9799	0.9930	(94)
Useful gains	583.2672	699.0921	781.6560	805.7446	718.0869	515.6779	346.2132	362.3889	537.2114	633.0806	582.9110	547.8791	(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	1379.5462	1344.8026	1225.6981	1026.5749	790.2848	527.7992	347.8769	365.2081	572.1577	866.2916	1140.1547	1370.8171	(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	592.4315	433.9174	330.3673	158.9978	53.7153	0.0000	0.0000	0.0000	0.0000	173.5090	401.2155	612.2659	(98)
Space heating												2756.4198	(98)
Space heating per m2										(98) / (4) =		35.4980	(99)

8c. Space cooling requirement

Not applicable

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	2948.0425	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	592.4315	433.9174	330.3673	158.9978	53.7153	0.0000	0.0000	0.0000	0.0000	173.5090	401.2155	612.2659	(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)	633.6166	464.0828	353.3340	170.0511	57.4495	0.0000	0.0000	0.0000	0.0000	185.5711	429.1075	654.8298	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	195.5580	172.3567	180.9918	162.2184	158.9479	141.9960	136.3435	149.6503	149.3983	168.2125	177.9037	190.8433	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.5855	87.1769	86.3996	84.7605	82.2565	79.8000	79.8000	79.8000	79.8000	84.8965	86.9197	87.7055	(217)
Fuel for water heating, kWh/month	223.2768	197.7091	209.4822	191.3845	193.2346	177.9398	170.8566	187.5317	187.2159	198.1383	204.6759	217.5957	(219)
Water heating fuel used												2359.0410	(219)

Annual totals kWh/year		
Space heating fuel - main system	2948.0425	(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)	337.6507	(232)
Total delivered energy for all uses	5719.7343	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2948.0425	0.2160	636.7772	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2359.0410	0.2160	509.5529	(264)
Space and water heating			1146.3300	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	337.6507	0.5190	175.2407	(268)
Total CO2, kg/m2/year			1360.4958	(272)
Emissions per m2 for space and water heating			14.7628	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.2568	(272b)
Emissions per m2 for pumps and fans			0.5013	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.7628 * 1.55) + 2.2568 + 0.5013, rounded to 2 d.p.			25.6400	(273)

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

Design SAP
elmhurst energy

Property Reference	Type 15R	**Issued on Date**	17/12/2019
Assessment Reference	V02	**Prop Type Ref**	
Property	Type 15R		

SAP Rating	81 B	**DER**	24.65	**TER**	24.67
Environmental	83 B	**% DER<TER**	0.07		
CO_2 Emissions (t/year)	1.41	**DFEE**	42.00	**TFEE**	43.85
General Requirements Compliance	Pass	**% DFEE<TFEE**	4.22		

Assessor Details	Mr. Josh Elliott, Josh Elliott, Tel: 07717220167, JoshElliott@hoarelea.com	**Assessor ID**	W974-0001
Client			

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

Design SAP
elmhurst energy

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

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Mid-floor flat, total floor area 75 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
-----------------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 24.67 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 24.65 kgCO□/m²OK
-----------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)43.8 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)42.0 kWh/m²/yrOK
-----------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                 Highest
External wall   0.15 (max. 0.30)        0.15 (max. 0.70)          OK
Party wall      0.00 (max. 0.20)         -                        OK
Floor           (no floor)
Roof            0.13 (max. 0.20)        0.13 (max. 0.35)          OK
Openings        1.40 (max. 2.00)        1.40 (max. 3.30)          OK
-----------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
-----------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:         3.00 (design value)
Maximum                                 10.0                                                OK
-----------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                    Room heaters - Electric
Panel, convector or radiant heaters



Secondary heating system:               None
-----------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                       Measured cylinder loss: 1.18 kWh/day
Permitted by DBSCG 1.85                           OK
Primary pipework insulated:             No primary pipework
-----------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                 Programmer and room thermostat                      OK


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:                     0.53
Maximum                                 1.5                                                 OK
MVHR efficiency:                        90%
Minimum:                                70%                                                 OK
-----------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Thames Valley):       Slight                                              OK
Based on:
Overshading:                            Average
Windows facing North:                   3.65 m², No overhang
Windows facing South:                   7.29 m², No overhang
Air change rate:                        4.00 ach
Blinds/curtains:                        Dark-coloured curtain or roller blind, closed 100% of daylight hours
-----------------------------------------------------------------------------------------------------
10 Key features
Party wall U-value                      0.00 W/m²K
Party wall U-value                      0.00 W/m²K
Air permeability                        3.0 m³/m²h
Photovoltaic array                      0.51 kW



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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          Storey height            Volume
                                                         (m2)               (m)                  (m3)
Ground floor                                          75.0000 (1b)   x     2.7000 (2b)   =   202.5000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)      75.0000                                    (4)
Dwelling volume                                        (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =   202.5000 (5)
```

2. Ventilation rate

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

                                                                                      Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =          0.0000 / (5) =      0.0000 (8)
Pressure test                                                                                            Yes
Measured/design AP50                                                                                  3.0000
Infiltration rate                                                                                     0.1500 (18)
Number of sides sheltered                                                                                  2 (19)

Shelter factor                                                          (20) =  1  -  [0.075 x (19)]  =      0.8500 (20)
Infiltration rate adjusted to include shelter factor                          (21) = (18) x (20)  =      0.1275 (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
               0.1626     0.1594     0.1562     0.1403     0.1371     0.1211     0.1211     0.1179     0.1275     0.1371     0.1434     0.1498 (22b)
 Balanced mechanical ventilation with heat recovery
If mechanical ventilation:                                                                                    0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =                 76.5000 (23c)

Effective ac   0.2801     0.2769     0.2737     0.2578     0.2546     0.2386     0.2386     0.2354     0.2450     0.2546     0.2609     0.2673 (25)
```

3. Heat losses and heat loss parameter

```
Element                                   Gross      Openings      NetArea      U-value        A x U      K-value       A x K
                                             m2            m2           m2        W/m2K          W/K       kJ/m2K        kJ/K
Opening Type 1 (Uw = 1.40)                                         10.9400       1.3258      14.5038                          (27)
External Wall 1                         54.3100       10.9400      43.3700       0.1500       6.5055                          (29a)
External Roof 1                         75.0000                    75.0000       0.1300       9.7500                          (30)
Total net area of external elements Aum(A, m2)                    129.3100                                                    (31)
Fabric heat loss, W/K = Sum (A x U)                           (26)...(30) + (32) =    30.7593                                 (33)
To Corridor                                                        30.6800       0.0000       0.0000                          (32)
To Dwelling                                                        22.7200       0.0000       0.0000                          (32)
Party Floor 1                                                      75.0000                                                    (32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                 175.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                         11.2224 (36)
Total fabric heat loss                                                                           (33) + (36) =     41.9817 (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         18.7152    18.5022    18.2892    17.2241    17.0111    15.9461    15.9461    15.7331    16.3721    17.0111    17.4371    17.8632 (38)
Heat transfer coeff
              60.6969    60.4839    60.2709    59.2058    58.9928    57.9278    57.9278    57.7148    58.3538    58.9928    59.4188    59.8448 (39)
Average = Sum(39)m / 12 =                                                                                          59.1526 (39)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP            0.8093     0.8065     0.8036     0.7894     0.7866     0.7724     0.7724     0.7695     0.7781     0.7866     0.7923     0.7979 (40)
HLP (average)                                                                                                       0.7887 (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                                                                                                   2.3612 (42)
Average daily hot water use (litres/day)                                                                           90.2775 (43)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
              99.3053    95.6942    92.0831    88.4720    84.8609    81.2498    81.2498    84.8609    88.4720    92.0831    95.6942    99.3053 (44)
Energy conte 147.2668   128.8005   132.9106   115.8747   111.1845    95.9438    88.9060   102.0210   103.2394   120.3156   131.3339   142.6201 (45)
Energy content (annual)                                                                       Total = Sum(45)m =  1420.4168 (45)
Distribution loss  (46)m = 0.15 x (45)m
              22.0900    19.3201    19.9366    17.3812    16.6777    14.3916    13.3359    15.3031    15.4859    18.0473    19.7001    21.3930 (46)
```



```
Water storage loss:
Store volume                                                                                                      145.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                       1.1800 (48)
  Temperature factor from Table 2b                                                                                  0.6000 (49)
Enter (49) or (54) in (55)                                                                                          0.7080 (55)
Total storage loss
              21.9480    19.8240    21.9480    21.2400    21.9480    21.2400    21.9480    21.9480    21.2400    21.9480    21.2400    21.9480 (56)
If cylinder contains dedicated solar storage
              21.9480    19.8240    21.9480    21.2400    21.9480    21.2400    21.9480    21.9480    21.2400    21.9480    21.2400    21.9480 (57)
Primary loss   0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (59)
Total heat required for water heating calculated for each month
             169.2148   148.6245   154.8586   137.1147   133.1325   117.1838   110.8540   123.9690   124.4794   142.2636   152.5739   164.5681 (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
             169.2148   148.6245   154.8586   137.1147   133.1325   117.1838   110.8540   123.9690   124.4794   142.2636   152.5739   164.5681 (64)
                                                                              Total per year (kWh/year) = Sum(64)m =  1678.8368 (64)
Heat gains from water heating, kWh/month
              66.5246    58.6854    61.7512    55.5203    54.5273    48.8933    47.1197    51.4804    51.3191    57.5633    60.6605    64.9796 (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        118.0579   118.0579   118.0579   118.0579   118.0579   118.0579   118.0579   118.0579   118.0579   118.0579   118.0579   118.0579 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              19.2562    17.1032    13.9092    10.5302     7.8714     6.6454     7.1806     9.3336    12.5275    15.9066    18.5653    19.7914 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             208.6751   210.8404   205.3837   193.7670   179.1030   165.3209   156.1136   153.9482   159.4049   171.0216   185.6856   199.4678 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              34.8058    34.8058    34.8058    34.8058    34.8058    34.8058    34.8058    34.8058    34.8058    34.8058    34.8058    34.8058 (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)
             -94.4463   -94.4463   -94.4463   -94.4463   -94.4463   -94.4463   -94.4463   -94.4463   -94.4463   -94.4463   -94.4463   -94.4463 (71)
Water heating gains (Table 5)
              89.4148    87.3294    82.9989    77.1116    73.2893    67.9074    63.3329    69.1940    71.2765    77.3701    84.2507    87.3381 (72)
Total internal gains
             375.7634   373.6904   360.7092   339.8261   318.6811   298.2910   285.0444   290.8932   301.6264   322.7157   346.9191   365.0146 (73)
```

6. Solar gains

```
[Jan]                                Area       Solar flux               g               FF          Access          Gains
                                       m2         Table 6a   Specific data   Specific data          factor              W
                                                      W/m2     or Table 6b     or Table 6c        Table 6d
------------------------------------------------------------------------------------------------------------------------
North                              3.6500          10.6334          0.3500          0.8000          0.7700         7.5311 (74)
South                              7.2900          46.7521          0.3500          0.8000          0.7700        66.1332 (78)
------------------------------------------------------------------------------------------------------------------------

Solar gains    73.6643   122.7014   162.4226   195.2148   215.4082   213.0249   205.6778   190.3397   173.5264   133.9537    87.6809    63.4234 (83)
Total gains   449.4277   496.3918   523.1318   535.0409   534.0893   511.3159   490.7222   481.2329   475.1528   456.6693   434.6000   428.4381 (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           60.0663    60.2778    60.4908    61.5790    61.8013    62.9375    62.9375    63.1698    62.4781    61.8013    61.3582    60.9214
alpha          5.0044     5.0185     5.0327     5.1053     5.1201     5.1958     5.1958     5.2113     5.1652     5.1201     5.0905     5.0614
util living area
               0.9904     0.9830     0.9682     0.9314     0.8476     0.6816     0.5110     0.5403     0.7615     0.9325     0.9816     0.9923 (86)

MIT           19.9841    20.1313    20.3425    20.6084    20.8276    20.9599    20.9925    20.9901    20.9264    20.6627    20.2833    19.9601 (87)
Th 2          20.2453    20.2477    20.2502    20.2625    20.2650    20.2773    20.2773    20.2798    20.2724    20.2650    20.2601    20.2551 (88)
util rest of house
               0.9884     0.9794     0.9612     0.9156     0.8126     0.6184     0.4309     0.4607     0.7045     0.9140     0.9770     0.9906 (89)
MIT 2         18.8749    19.0898    19.3960    19.7814    20.0773    20.2439    20.2731    20.2739    20.2052    19.8628    19.3207    18.8472 (90)
Living area fraction                                                                        fLA = Living area / (4) =     0.4211 (91)
MIT           19.3419    19.5283    19.7945    20.1296    20.3932    20.5454    20.5761    20.5754    20.5089    20.1996    19.7260    19.3158 (92)
Temperature adjustment                                                                                              0.0000
adjusted MIT  19.3419    19.5283    19.7945    20.1296    20.3932    20.5454    20.5761    20.5754    20.5089    20.1996    19.7260    19.3158 (93)
```

8. Space heating requirement

```
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation    0.9852     0.9751     0.9560     0.9123     0.8192     0.6427     0.4644     0.4939     0.7240     0.9121     0.9729     0.9879 (94)
Useful gains 442.7581   484.0276   500.1336   488.1231   437.5032   328.6117   227.9010   237.6666   344.0157   416.5362   422.8238   423.2488 (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
             912.9985   884.7778   801.2723   664.8594   512.8369   344.4024   230.3240   240.9852   373.9845   566.3079   750.2222   904.6011 (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
             349.8588   269.3041   224.0472   127.2502    56.0483     0.0000     0.0000     0.0000     0.0000   111.4301   235.7269   358.1261 (98)
Space heating                                                                                                    1731.7918 (98)
Space heating per m2                                                                               (98) / (4) =    23.0906 (99)
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

```
8c. Space cooling requirement
---------------------------------------------------------------------------------------------
Not applicable



---------------------------------------------------------------------------------------------
9a. Energy requirements - Individual heating systems, including micro-CHP
---------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                                           0.0000 (201)
Fraction of space heat from main system(s)                                                                      1.0000 (202)
Efficiency of main space heating system 1 (in %)                                                              100.0000 (206)
Efficiency of secondary/supplementary heating system, %                                                         0.0000 (208)
Space heating requirement                                                                                    1731.7918 (211)

                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Space heating requirement
               349.8588  269.3041  224.0472  127.2502   56.0483    0.0000    0.0000    0.0000    0.0000  111.4301  235.7269  358.1261 (98)
Space heating efficiency (main heating system 1)
               100.0000  100.0000  100.0000  100.0000  100.0000    0.0000    0.0000    0.0000    0.0000  100.0000  100.0000  100.0000 (210)
Space heating fuel (main heating system)
               349.8588  269.3041  224.0472  127.2502   56.0483    0.0000    0.0000    0.0000    0.0000  111.4301  235.7269  358.1261 (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
               169.2148  148.6245  154.8586  137.1147  133.1325  117.1838  110.8540  123.9690  124.4794  142.2636  152.5739  164.5681 (64)
Efficiency of water heater                                                                                                  100.0000 (216)
(217)m         100.0000  100.0000  100.0000  100.0000  100.0000  100.0000  100.0000  100.0000  100.0000  100.0000  100.0000  100.0000 (217)
Fuel for water heating, kWh/month
               169.2148  148.6245  154.8586  137.1147  133.1325  117.1838  110.8540  123.9690  124.4794  142.2636  152.5739  164.5681 (219)
Water heating fuel used                                                                                                    1678.8368 (219)
Annual totals kWh/year
Space heating fuel - main system                                                                                           1731.7918 (211)
Space heating fuel - secondary                                                                                                0.0000 (215)

Electricity for pumps and fans:
    (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.6625)
   mechanical ventilation fans (SFP =       0.6625)                                                                         163.6706 (230a)
Total electricity for the above, kWh/year                                                                                   163.6706 (231)
Electricity for lighting (calculated in Appendix L)                                                                         340.0702 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 0.51 * 1080 * 0.80) =                                                      -352.3568                     -352.3568 (233)
Total delivered energy for all uses                                                                                        3562.0125 (238)



---------------------------------------------------------------------------------------------
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP
---------------------------------------------------------------------------------------------
                                                                      Energy      Emission factor           Emissions
                                                                    kWh/year         kg CO2/kWh         kg CO2/year
Space heating - main system 1                                      1731.7918             0.5190            898.7999 (261)
Space heating - secondary                                             0.0000             0.0000              0.0000 (263)
Water heating (other fuel)                                         1678.8368             0.5190            871.3163 (264)
Space and water heating                                                                                   1770.1162 (265)
Pumps and fans                                                      163.6706             0.5190             84.9451 (267)
Energy for lighting                                                 340.0702             0.5190            176.4964 (268)

 Energy saving/generation technologies
PV Unit                                                            -352.3568             0.5190           -182.8732 (269)
Total CO2, kg/year                                                                                        1848.6845 (272)
Dwelling Carbon Dioxide Emission Rate (DER)                                                                 24.6500 (273)


16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES
DER                                                                                                         24.6500 ZC1
Total Floor Area                                                                                    TFA     75.0000
Assumed number of occupants                                                                           N      2.3612
CO2 emission factor in Table 12 for electricity displaced from grid                                  EF      0.5190
CO2 emissions from appliances, equation (L14)                                                               16.4875 ZC2
CO2 emissions from cooking, equation (L16)                                                                   2.3422 ZC3
Total CO2 emissions                                                                                         43.4798 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                                                                                           43.4798 ZC8



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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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---------------------------------------------------------------------------------------------
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        Storey height               Volume
                                                                         (m2)                  (m)                 (m3)
Ground floor                                                          75.0000 (1b)    x     2.7000 (2b)    =    202.5000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)            75.0000                                                (4)
Dwelling volume                                                          (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =    202.5000 (5)



---------------------------------------------------------------------------------------------
2. Ventilation rate
---------------------------------------------------------------------------------------------
                                                  main           secondary            other            total       m3 per hour
                                               heating             heating
Number of chimneys                                   0      +            0      +         0      =       0 * 40 =      0.0000 (6a)
Number of open flues                                 0      +            0      +         0      =       0 * 20 =      0.0000 (6b)
Number of intermittent fans                                                                              3 * 10 =     30.0000 (7a)
Number of passive vents                                                                                  0 * 10 =      0.0000 (7b)
Number of flueless gas fires                                                                             0 * 40 =      0.0000 (7c)

                                                                                                      Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =                     30.0000 / (5) =       0.1481 (8)
Pressure test                                                                                                           Yes
Measured/design AP50                                                                                                 5.0000
Infiltration rate                                                                                                    0.3981 (18)
Number of sides sheltered                                                                                                 2 (19)

Shelter factor                                                                  (20) = 1  -  [0.075 x (19)]  =       0.8500 (20)
Infiltration rate adjusted to include shelter factor                                   (21) = (18) x (20)  =       0.3384 (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
                0.4315    0.4230    0.4146    0.3723    0.3638    0.3215    0.3215    0.3130    0.3384    0.3638    0.3807    0.3977 (22b)
Effective ac    0.5931    0.5895    0.5859    0.5693    0.5662    0.5517    0.5517    0.5490    0.5573    0.5662    0.5725    0.5791 (25)



---------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
---------------------------------------------------------------------------------------------
Element                                         Gross      Openings       NetArea       U-value         A x U       K-value         A x K
                                                   m2            m2            m2         W/m2K           W/K       kJ/m2K          kJ/K
TER Opening Type (Uw = 1.40)                                              10.9400        1.3258       14.5038                              (27)
External Wall 1                               54.3100       10.9400       43.3700        0.1800        7.8066                              (29a)
External Roof 1                               75.0000                     75.0000        0.1300        9.7500                              (30)
Total net area of external elements Aum(A, m2)                           129.3100                                                      (31)
Fabric heat loss, W/K = Sum (A x U)                                   (26)...(30) + (32) =    32.0604                                  (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                    250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                             6.6612 (36)
Total fabric heat loss                                                                                (33) + (36) =   38.7216 (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          39.6334   39.3919   39.1551   38.0429   37.8349   36.8662   36.8662   36.6868   37.2393   37.8349   38.2558   38.6959 (38)
Heat transfer coeff
               78.3550   78.1135   77.8767   76.7645   76.5564   75.5878   75.5878   75.4084   75.9609   76.5564   76.9774   77.4175 (39)
Average = Sum(39)m / 12 =                                                                                              76.7635 (39)

                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
HLP             1.0447    1.0415    1.0384    1.0235    1.0208    1.0078    1.0078    1.0054    1.0128    1.0208    1.0264    1.0322 (40)
HLP (average)                                                                                                          1.0235 (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                                                                                                      2.3612 (42)
Average daily hot water use (litres/day)                                                                              90.2775 (43)

                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Daily hot water use
               99.3053   95.6942   92.0831   88.4720   84.8609   81.2498   81.2498   84.8609   88.4720   92.0831   95.6942   99.3053 (44)
Energy conte  147.2668  128.8005  132.9106  115.8747  111.1845   95.9438   88.9060  102.0210  103.2394  120.3156  131.3339  142.6201 (45)
Energy content (annual)                                                                             Total = Sum(45)m =   1420.4168 (45)
Distribution loss  (46)m = 0.15 x (45)m
               22.0900   19.3201   19.9366   17.3812   16.6777   14.3916   13.3359   15.3031   15.4859   18.0473   19.7001   21.3930 (46)
Water storage loss:
Store volume                                                                                                         145.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                          1.3665 (48)
  Temperature factor from Table 2b                                                                                     0.5400 (49)
Enter (49) or (54) in (55)                                                                                             0.7379 (55)
Total storage loss
               22.8747   20.6610   22.8747   22.1368   22.8747   22.1368   22.8747   22.8747   22.1368   22.8747   22.1368   22.8747 (56)
```

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

```
If cylinder contains dedicated solar storage
              22.8747   20.6610   22.8747   22.1368   22.8747   22.1368   22.8747   22.8747   22.1368   22.8747   22.1368   22.8747 (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
             193.4039  170.4727  179.0477  160.5235  157.3216  140.5926  135.0431  148.1580  147.8882  166.4527  175.9826  188.7571 (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
             193.4039  170.4727  179.0477  160.5235  157.3216  140.5926  135.0431  148.1580  147.8882  166.4527  175.9826  188.7571 (64)
                                                                                    Total per year (kWh/year) = Sum(64)m =    1963.6436 (64)
Heat gains from water heating, kWh/month
              85.8759   76.1639   81.1024   74.2474   73.8785   67.6203   66.4709   70.8316   70.0461   76.9146   79.3875   84.3308 (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        118.0579  118.0579  118.0579  118.0579  118.0579  118.0579  118.0579  118.0579  118.0579  118.0579  118.0579  118.0579 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              19.7823   17.5705   14.2893   10.8179    8.0865    6.8270    7.3768    9.5886   12.8698   16.3412   19.0726   20.3321 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             208.6751  210.8404  205.3837  193.7670  179.1030  165.3209  156.1136  153.9482  159.4049  171.0216  185.6856  199.4678 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              34.8058   34.8058   34.8058   34.8058   34.8058   34.8058   34.8058   34.8058   34.8058   34.8058   34.8058   34.8058 (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)
             -94.4463  -94.4463  -94.4463  -94.4463  -94.4463  -94.4463  -94.4463  -94.4463  -94.4463  -94.4463  -94.4463  -94.4463 (71)
Water heating gains (Table 5)
             115.4246  113.3392  109.0086  103.1213   99.2991   93.9171   89.3426   95.2038   97.2863  103.3798  110.2605  113.3479 (72)
Total internal gains
             405.2993  403.1675  390.0990  369.1236  347.9059  327.4823  314.2504  320.1580  330.9784  352.1600  376.4361  394.5651 (73)



---------------------------------------------------------------------------------------------------
6. Solar gains
---------------------------------------------------------------------------------------------------

[Jan]                                    Area        Solar flux              g              FF           Access              Gains
                                           m2          Table 6a   Specific data   Specific data           factor                  W
                                                           W/m2     or Table 6b     or Table 6c         Table 6d
---------------------------------------------------------------------------------------------------
North                                  3.6500           10.6334          0.6300          0.7000           0.7700            11.8614 (74)
South                                  7.2900           46.7521          0.6300          0.7000           0.7700           104.1598 (78)
---------------------------------------------------------------------------------------------------

Solar gains  116.0212  193.2547  255.8156  307.4632  339.2679  335.5142  323.9426  299.7850  273.3041  210.9770  138.0975   99.8919 (83)
Total gains  521.3205  596.4222  645.9146  676.5868  687.1738  662.9965  638.1929  619.9430  604.2825  563.1370  514.5335  494.4571 (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, ni1,m (see Table 9a)
                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
tau           66.4709   66.6765   66.8792   67.8482   68.0326   68.9044   68.9044   69.0683   68.5660   68.0326   67.6606   67.2759
alpha          5.4314    5.4451    5.4586    5.5232    5.5355    5.5936    5.5936    5.6046    5.5711    5.5355    5.5107    5.4851
util living area
               0.9959    0.9909    0.9791    0.9460    0.8616    0.6910    0.5145    0.5498    0.7816    0.9520    0.9907    0.9969 (86)

MIT           19.9923   20.1484   20.3650   20.6298   20.8462   20.9670   20.9946   20.9922   20.9335   20.6664   20.2823   19.9664 (87)
Th 2          20.0462   20.0489   20.0515   20.0638   20.0661   20.0768   20.0768   20.0788   20.0727   20.0661   20.0614   20.0566 (88)
util rest of house
               0.9946    0.9880    0.9722    0.9274    0.8157    0.6068    0.4101    0.4447    0.7061    0.9317    0.9872    0.9959 (89)
MIT 2         18.7087   18.9373   19.2514   19.6329   19.9159   20.0548   20.0748   20.0756   20.0219   19.6904   19.1425   18.6787 (90)
Living area fraction                                                                        fLA = Living area / (4) =     0.4211 (91)
MIT           19.2492   19.4473   19.7203   20.0527   20.3076   20.4389   20.4621   20.4616   20.4057   20.1014   19.6224   19.2209 (92)
Temperature adjustment                                                                                                     0.0000
adjusted MIT  19.2492   19.4473   19.7203   20.0527   20.3076   20.4389   20.4621   20.4616   20.4057   20.1014   19.6224   19.2209 (93)



---------------------------------------------------------------------------------------------------
8. Space heating requirement
---------------------------------------------------------------------------------------------------

                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Utilisation    0.9931    0.9856    0.9692    0.9272    0.8287    0.6412    0.4543    0.4892    0.7351    0.9326    0.9851    0.9947 (94)
Useful gains 517.7382  587.8149  626.0469  627.2994  569.4564  425.0905  289.9199  303.2699  444.2211  525.1728  506.8612  491.8380 (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
            1171.3432 1136.3374 1029.5548  856.1301  658.9686  441.3509  291.9253  306.2763  478.9879  727.3903  963.9431 1162.8831 (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
             486.2822  368.6072  300.2099  164.7581   66.5970    0.0000    0.0000    0.0000    0.0000  150.4498  329.0990  499.2576 (98)
Space heating                                                                                                           2365.2608 (98)
Space heating per m2                                                                                  (98) / (4) =      31.5368 (99)



---------------------------------------------------------------------------------------------------
8c. Space cooling requirement
---------------------------------------------------------------------------------------------------
Not applicable



---------------------------------------------------------------------------------------------------
```


CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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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                                                                                                 2529.6907 (211)

                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Space heating requirement
             486.2822  368.6072  300.2099  164.7581   66.5970    0.0000    0.0000    0.0000    0.0000  150.4498  329.0990  499.2576 (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)
             520.0879  394.2323  321.0801  176.2118   71.2268    0.0000    0.0000    0.0000    0.0000  160.9089  351.9776  533.9653 (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
             193.4039  170.4727  179.0477  160.5235  157.3216  140.5926  135.0431  148.1580  147.8882  166.4527  175.9826  188.7571 (64)
Efficiency of water heater                                                                                                  79.8000 (216)
(217)m        87.1740   86.8187   86.1828   84.8833   82.7084   79.8000   79.8000   79.8000   79.8000   84.5456   86.4607   87.2890 (217)
Fuel for water heating, kWh/month
             221.8597  196.3547  207.7533  189.1108  190.2124  176.1812  169.2269  185.6617  185.3235  196.8791  203.5407  216.2440 (219)
Water heating fuel used                                                                                                   2338.3481 (219)
Annual totals kWh/year
Space heating fuel - main system                                                                                          2529.6907 (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)                                                                        349.3618 (232)
Total delivered energy for all uses                                                                                       5292.4005 (238)



---------------------------------------------------------------------------------------------------
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP
---------------------------------------------------------------------------------------------------
                                                                                     Energy    Emission factor        Emissions
                                                                                   kWh/year         kg CO2/kWh     kg CO2/year
Space heating - main system 1                                                     2529.6907             0.2160        546.4132 (261)
Space heating - secondary                                                            0.0000             0.0000          0.0000 (263)
Water heating (other fuel)                                                        2338.3481             0.2160        505.0832 (264)
Space and water heating                                                                                               1051.4964 (265)
Pumps and fans                                                                      75.0000             0.5190         38.9250 (267)
Energy for lighting                                                                349.3618             0.5190        181.3188 (268)
Total CO2, kg/m2/year                                                                                                 1271.7401 (272)
Emissions per m2 for space and water heating                                                                            14.0200 (272a)
Fuel factor (electricity)                                                                                                1.5500
Emissions per m2 for lighting                                                                                            2.4176 (272b)
Emissions per m2 for pumps and fans                                                                                      0.5190 (272c)
Target Carbon Dioxide Emission Rate (TER) = (14.0200 * 1.55) + 2.4176 + 0.5190, rounded to 2 d.p.                      24.6700 (273)
```

Appendix B: BRUKL Document.

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Guild Living Epsom - Non Domestic

As designed

Date: Wed Dec 18 15:27:04 2019

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.12

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.12

BRUKL compliance check version: v5.6.a.1

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	17.7
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	17.7
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	17.4
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	Surface where the maximum value occurs*
Wall**	0.35	0.17	0.18	00000023:Surf[1]
Floor	0.25	0.15	0.15	00000022:Surf[0]
Roof	0.25	0.15	0.15	0000002A:Surf[9]
Windows***, roof windows, and rooflights	2.2	1.4	1.4	0000002A:Surf[0]
Personnel doors	2.2	2.2	2.2	00000010:Surf[0]
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]

U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]

U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.

** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

*** Display windows and similar glazing are excluded from the U-value check.

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
m³/(h.m²) at 50 Pa	10	3

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	0.9 to 0.95

1- HVAC 4 - Elect Heater + Extract

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0.2	0	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

2- HVAC 3 - DX Cooling

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3	3.4	0	0	-
Standard value	2.5*	3.2	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.

3- HVAC 5 - FCU + MVHR

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3	3.4	0	1.8	0.75
Standard value	2.5*	3.2	N/A	1.6^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

4- HVAC 1 - Elect Heater + Natural Vent

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0.2	0	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

5- HVAC 2 - All Air Heating

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3	-	0.2	1.8	0.75
Standard value	2.5*	N/A	N/A	1.5^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

"No HWS in project, or hot water is provided by HVAC system"

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
00 - Cafe	-	-	-	-	-	-	-	0.2	-	-	N/A
00 - Child Care	-	-	-	-	-	-	-	0.2	-	-	N/A
00 - Concierge & Post/WC	-	-	-	-	-	-	-	0.2	-	-	N/A
00 - Dry & Wet Wellness Multipurpose Room	-	-	-	-	-	-	-	0.2	-	-	N/A
00 - GLR Lobby Lounge	-	-	-	-	-	-	-	0.2	-	-	N/A
00 - GLR Lobby/Lounge	-	-	-	-	-	-	-	0.2	-	-	N/A
00 - Reception Community Hub and Concierge	-	-	-	-	-	-	-	0.2	-	-	N/A
00 - Resturant and Cafe	-	-	-	-	-	-	-	0.2	-	-	N/A
00 - Retail	-	-	-	-	-	-	-	0.2	-	-	N/A
00 - Retail	-	-	-	-	-	-	-	0.2	-	-	N/A
01 - Plant/BOH	-	-	-	-	-	-	-	0.2	-	-	N/A
01 - Staff/BOH	-	-	-	-	-	-	-	0.2	-	-	N/A
01 - Staff/BOH/Kitchen	-	-	-	-	-	-	-	0.2	-	-	N/A
02 - GCS	-	-	-	-	-	-	-	0.2	-	-	N/A
02 - GCS	-	-	-	-	-	-	-	0.2	-	-	N/A
02 - GCS	-	-	-	-	-	-	-	0.2	-	-	N/A
02 - GCS	-	-	-	-	-	-	-	0.2	-	-	N/A
02 - GCS	-	-	-	-	-	-	-	0.2	-	-	N/A
02 - GCS	-	-	-	-	-	-	-	0.2	-	-	N/A
02 - GCS	-	-	-	-	-	-	-	0.2	-	-	N/A
02 - GCS	-	-	-	-	-	-	-	0.2	-	-	N/A
02 - GCS	-	-	-	-	-	-	-	0.2	-	-	N/A
02 - GCS	-	-	-	-	-	-	-	0.2	-	-	N/A
02 - GCS	-	-	-	-	-	-	-	0.2	-	-	N/A
02 - GCS	-	-	-	-	-	-	-	0.2	-	-	N/A
02 - GCS	-	-	-	-	-	-	-	0.2	-	-	N/A
02 - GCS	-	-	-	-	-	-	-	0.2	-	-	N/A
02 - GCS	-	-	-	-	-	-	-	0.2	-	-	N/A
02 - GCS	-	-	-	-	-	-	-	0.2	-	-	N/A
02 - GCS	-	-	-	-	-	-	-	0.2	-	-	N/A
02 - GCS	-	-	-	-	-	-	-	0.2	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
02 - GCS	-	-	-	-	-	-	-	0.2	-	-	N/A
02 - GCS	-	-	-	-	-	-	-	0.2	-	-	N/A
02 - GCS	-	-	-	-	-	-	-	0.2	-	-	N/A
02 - GCS	-	-	-	-	-	-	-	0.2	-	-	N/A
02 - GCS	-	-	-	-	-	-	-	0.2	-	-	N/A
02 - GCS	-	-	-	-	-	-	-	0.2	-	-	N/A
02 - GCS	-	-	-	-	-	-	-	0.2	-	-	N/A
02 - GCS	-	-	-	-	-	-	-	0.2	-	-	N/A
02 - GCS	-	-	-	-	-	-	-	0.2	-	-	N/A
02 - GCS	-	-	-	-	-	-	-	0.2	-	-	N/A

General lighting and display lighting

	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
00 - Acc WC	-	80	-	53
00 - Alt Comms Room	80	-	-	46
00 - Bins	80	-	-	24
00 - Bins and Store Room	80	-	-	116
00 - BT Intake	80	-	-	71
00 - Cafe	-	80	60	345
00 - Child Care	-	80	-	1327
00 - Circulation	-	80	-	74
00 - Circulation	-	80	-	30
00 - Circulation and Stair	-	80	-	91
00 - Concierge & Post/WC	-	80	60	280
00 - Corridor	-	80	-	333
00 - Corridor	-	80	-	220
00 - Dry & Wet Wellness Multipurpose Room	-	80	-	2652
00 - Gas Meter	80	-	-	90
00 - GCR Lobby	-	80	-	152
00 - Generator	80	-	-	192
00 - GLR Lobby	-	80	-	129
00 - GLR Lobby Lounge	-	80	-	365
00 - GLR Lobby/Lounge	-	80	-	414
00 - Lift	-	80	-	31
00 - Lift Lobby	-	80	-	90
00 - Lift Lobby for GLR	-	80	-	88
00 - Lift Lobby to GCS	-	80	-	91
00 - Lift Lobby to GLR	-	80	-	90
00 - Lifts Lobby GLR	-	80	-	80
00 - LV Switch	80	-	-	85
00 - LV Switch	80	-	-	108
00 - Plantroom	80	-	-	393

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
00 - Pool	-	80	-	1400
00 - Prep-kitchen/Catering	-	80	-	765
00 - Reception Community Hub and Concierge	-	80	60	1963
00 - Resturant and Cafe	-	80	60	879
00 - Retail	-	80	60	2324
00 - Retail	-	80	60	2543
00 - Sprinkler Plantroom	80	-	-	590
00 - Stair	-	80	-	60
00 - Stair	-	80	-	77
00 - Stair	-	80	-	54
00 - Stair	-	80	-	61
00 - Stair	-	80	-	81
00 - Stair	-	80	-	55
00 - Stair	-	80	-	56
00 - Stair	-	80	-	54
00 - Stair	-	80	-	57
00 - Store	80	-	-	30
00 - Substation	80	-	-	235
00 - Toilet	-	80	-	90
00 - WC	-	80	-	66
01 - Circulation and Stair	-	80	-	57
01 - Corridor	-	80	-	510
01 - Corridor	-	80	-	536
01 - Corridor	-	80	-	281
01 - Corridor	-	80	-	227
01 - Corridor	-	80	-	237
01 - Lift Lobby to GCS	-	80	-	73
01 - Plant/BOH	80	-	-	842
01 - Staff/BOH	80	-	-	1602
01 - Staff/BOH/Kitchen	80	-	-	1407
01 - Stair	-	80	-	41
01 - Stair	-	80	-	45
01 - Stair	-	80	-	44
01 - Stair	-	80	-	46
01 - Stair	-	80	-	63
01 - Stair	-	80	-	44
01 - Stair	-	80	-	61
01 - Stair	-	80	-	42
01 - Stair	-	80	-	44
01 - Store	80	-	-	24
02 - Cleaner's Room	80	-	-	10
02 - Corridor	-	80	-	100
02 - Corridor	-	80	-	276

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
02 - Corridor	-	80	-	227
02 - Corridor	-	80	-	301
02 - Corridor	-	80	-	511
02 - Corridor	-	80	-	1334
02 - Ensuite	-	80	-	30
02 - Ensuite	-	80	-	27
02 - Ensuite	-	80	-	27
02 - Ensuite	-	80	-	27
02 - Ensuite	-	80	-	30
02 - Ensuite	-	80	-	30
02 - Ensuite	-	80	-	30
02 - Ensuite	-	80	-	30
02 - Ensuite	-	80	-	30
02 - Ensuite	-	80	-	30
02 - Ensuite	-	80	-	27
02 - Ensuite	-	80	-	27
02 - Ensuite	-	80	-	30
02 - Ensuite	-	80	-	30
02 - Ensuite	-	80	-	30
02 - Ensuite	-	80	-	30
02 - Ensuite	-	80	-	30
02 - Ensuite	-	80	-	30
02 - Ensuite	-	80	-	30
02 - Ensuite	-	80	-	30
02 - Ensuite	-	80	-	27
02 - Ensuite	-	80	-	30
02 - Ensuite	-	80	-	27
02 - Ensuite	-	80	-	30
02 - Ensuite	-	80	-	27
02 - Ensuite	-	80	-	30
02 - Ensuites	-	80	-	30
02 - GCS	-	80	-	68
02 - GCS	-	80	-	68
02 - GCS	-	80	-	69
02 - GCS	-	80	-	68
02 - GCS	-	80	-	60
02 - GCS	-	80	-	67
02 - GCS	-	80	-	68
02 - GCS	-	80	-	68
02 - GCS	-	80	-	69
02 - GCS	-	80	-	60
02 - GCS	-	80	-	68
02 - GCS	-	80	-	60

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
02 - GCS	-	80	-	68
02 - GCS	-	80	-	68
02 - GCS	-	80	-	88
02 - GCS	-	80	-	68
02 - GCS	-	80	-	67
02 - GCS	-	80	-	67
02 - GCS	-	80	-	68
02 - GCS	-	80	-	69
02 - GCS	-	80	-	60
02 - GCS	-	80	-	68
02 - GCS	-	80	-	61
02 - GCS	-	80	-	60
02 - GCS	-	80	-	67
02 - GCS	-	80	-	69
02 - GCS	-	80	-	61
02 - GCS	-	80	-	61
02 - Lift Lobby	-	80	-	75
02 - Linen and Storage	80	-	-	22
02 - Slice Room	80	-	-	11
02 - Stair	-	80	-	46
02 - Stair	-	80	-	44
02 - Stair	-	80	-	61
02 - Stair	-	80	-	63
02 - Stair	-	80	-	42
02 - Stair	-	80	-	44
02 - Stair	-	80	-	44
02 - Stair	-	80	-	43
02 - Stair	-	80	-	45
02 - Stairs	-	80	-	59
02 - Store	80	-	-	42
02 - Store	80	-	-	21
02 - Store	80	-	-	22
03 - Corridor	-	80	-	510
03 - Corridor	-	80	-	281
03 - Corridor	-	80	-	227
03 - Corridor	-	80	-	620
03 - Corridor	-	80	-	83
03 - Lift Plant Room	80	-	-	123
03 - Stair	-	80	-	45
03 - Stair	-	80	-	42
03 - Stair	-	80	-	44
03 - Stair	-	80	-	48
03 - Stair	-	80	-	44

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
03 - Stair	-	80	-	63
03 - Stair	-	80	-	61
03 - Stair	-	80	-	42
03 - Stair	-	80	-	44
03 - Stairs	-	80	-	59
03 - Store	80	-	-	30
04 - Corridor	-	80	-	281
04 - Corridor	-	80	-	450
04 - Corridor	-	80	-	377
04 - Stair	-	80	-	44
04 - Stair	-	80	-	61
04 - Stair	-	80	-	46
04 - Stair	-	80	-	44
04 - Stair	-	80	-	42
04 - Stair	-	80	-	42
05 - Corridor	-	80	-	451
05 - Corridor	-	80	-	377
05 - Stair	-	80	-	44
05 - Stair	-	80	-	42
05 - Stair	-	80	-	46
05 - Stair	-	80	-	44
05 - Stair	-	80	-	61
06 - Corridor	-	80	-	451
06 - Corridor	-	80	-	377
06 - Stair	-	80	-	44
06 - Stair	-	80	-	61
06 - Stair	-	80	-	44
06 - Stair	-	80	-	46
06 - Stair	-	80	-	42
07 - Corridor	-	80	-	393
07 - Corridor	-	80	-	469
07 - Stair	-	80	-	47
07 - Stair	-	80	-	64
07 - Stair	-	80	-	46
07 - Stair	-	80	-	48
07 - Stair	-	80	-	44
08 - Corridor	-	80	-	427
08 - Corridor	-	80	-	358
08 - Stair	-	80	-	39
08 - Stair	-	80	-	58
08 - Stair	-	80	-	42
08 - Stair	-	80	-	41
08 - Stair	-	80	-	44

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
07 - Corridor	-	80	-	269
08 - Corridor	-	80	-	249
06 - Corridor	-	80	-	260
05 - Corridor	-	80	-	260
04 - Corridor	-	80	-	260
03 - Corridor	-	80	-	260

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
00 - Alt Comms Room	N/A	N/A
00 - Cafe	NO (-9.5%)	NO
00 - Child Care	YES (+21.3%)	NO
00 - Concierge & Post/WC	YES (+56.9%)	NO
00 - Dry & Wet Wellness Multipurpose Room	NO (-46.5%)	NO
00 - GLR Lobby Lounge	NO (-7.3%)	NO
00 - GLR Lobby/Lounge	N/A	N/A
00 - Pool	NO (-31.9%)	NO
00 - Reception Community Hub and Concierge	YES (+12.4%)	NO
00 - Resturant and Cafe	NO (-19.7%)	NO
00 - Retail	NO (-45.9%)	NO
00 - Retail	NO (-37.7%)	NO
01 - Plant/BOH	NO (-53.1%)	NO
01 - Staff/BOH	NO (-36.5%)	NO
01 - Staff/BOH/Kitchen	N/A	N/A
02 - GCS	NO (-79.3%)	NO
02 - GCS	NO (-74.5%)	NO
02 - GCS	NO (-72.1%)	NO
02 - GCS	NO (-78.5%)	NO
02 - GCS	NO (-79.3%)	NO
02 - GCS	NO (-81.7%)	NO
02 - GCS	NO (-73.7%)	NO
02 - GCS	NO (-75.1%)	NO
02 - GCS	NO (-77.6%)	NO
02 - GCS	NO (-68.4%)	NO
02 - GCS	NO (-66.3%)	NO
02 - GCS	NO (-72.1%)	NO
02 - GCS	NO (-73.4%)	NO
02 - GCS	NO (-76.1%)	NO
02 - GCS	NO (-68%)	NO
02 - GCS	NO (-78.8%)	NO
02 - GCS	NO (-79%)	NO
02 - GCS	NO (-78.6%)	NO
02 - GCS	NO (-74.9%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
02 - GCS	NO (-78.8%)	NO
02 - GCS	NO (-70%)	NO
02 - GCS	NO (-79.1%)	NO
02 - GCS	NO (-71.1%)	NO
02 - GCS	NO (-65.7%)	NO
02 - GCS	NO (-76.4%)	NO
02 - GCS	NO (-77.7%)	NO
02 - GCS	NO (-75.6%)	NO
02 - GCS	NO (-76%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	11764.2	11764.2
External area [m²]	12003.7	10399.1
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	4181.44	4251.33
Average U-value [W/m²K]	0.35	0.41
Alpha value* [%]	11.78	10

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
4	**A1/A2 Retail/Financial and Professional services**
4	**A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways**
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
7	**C2 Residential Institutions: Hospitals and Care Homes**
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
61	**Residential spaces**
22	**D1 Non-residential Institutions: Community/Day Centre**
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
2	**D2 General Assembly and Leisure, Night Clubs, and Theatres**
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	4.88	6.17
Cooling	3.07	1.68
Auxiliary	8.43	6.45
Lighting	10.58	16.13
Hot water	8.34	7.05
Equipment*	26.79	26.79
TOTAL**	**35.31**	**37.47**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	62.74	56
Primary energy* [kWh/m²]	125.78	121.64
Total emissions [kg/m²]	17.4	17.7

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

System Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Other local room heater - unfanned, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity									
Actual	3.1	0	1	0	0	0.84	0	1	0
Notional	7.4	0	2.4	0	0	0.86	0	----	----
[ST] Fan coil systems, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity									
Actual	38.5	94.8	3.9	9.4	18.4	2.75	2.8	3	3.6
Notional	29.9	72.9	3.2	5.3	17.4	2.56	3.79	----	----
[ST] Other local room heater - unfanned, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity									
Actual	246.3	0	81.2	0	51.2	0.84	0	1	0
Notional	315.4	0	101.6	0	41	0.86	0	----	----
[ST] Central heating using air distribution, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity									
Actual	642.9	0	58.2	0	27.5	3.07	0	3	0
Notional	609.8	0	66.2	0	26.4	2.56	0	----	----
[ST] Single room cooling system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity									
Actual	0	3148.2	0	325	0	2.94	2.69	3	3.6
Notional	0	1844.5	0	135.2	0	2.56	3.79	----	----
[ST] No Heating or Cooling									
Actual	0	0	0	0	0	0	0	0	0
Notional	0	0	0	0	0	0	0	----	----

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.12	00000019:Surf[6]
Floor	0.2	0.1	02000000:Surf[37]
Roof	0.15	0.15	0000002A:Surf[9]
Windows, roof windows, and rooflights	1.5	1.4	0000002A:Surf[0]
Personnel doors	1.5	2.2	00000010:Surf[0]
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	Typical value	This building
$m^3/(h.m^2)$ at 50 Pa	5	3

Appendix C: Calculation of Energy from LZC Sources.

Domestic

BE LEAN (Nos from DER Worksheet)			Be Green (Nos from DER Worksheet)			Total Energy Renewables provides kWh/year	% of Energy Requirements
		kWh/year	kWh/year				
URN	TFA (m2)	Total Energy Used (238)	Total Delivered Energy (238)	Elec produced from PV (233)	Elec produced by other renewables		
Type 01F	77.65	4389.3938	4023.219	366.1748	0	366.1748	8.34%
Type 02FC	75.14	3659.8988	3307.542	352.3568	0	352.3568	9.63%
Type 03FC	91.96	4181.7541	3746.4898	435.2643	0	435.2643	10.41%
Type 04F	57.06	3262.215	2992.7657	269.4493	0	269.4493	8.26%
Type 05N	75.27	2929.9897	2577.6329	352.3568	0	352.3568	12.03%
Type 06N	59.48	2906.0001	2622.7328	283.2673	0	283.2673	9.75%
Type 07F	80.82	4196.6287	3816.636	379.9927	0	379.9927	9.05%
Type 08N	58.06	2582.456	2306.0977	276.3583	0	276.3583	10.70%
Type 09N	109.06	4443.0193	3924.8475	518.1718	0	518.1718	11.66%
Type 10R	52.49	3188.5307	2939.8082	248.7225	0	248.7225	7.80%
Type 11	75.24	3084.3294	2731.9725	352.3569	0	352.3569	11.42%
Type 12N	81.39	3667.7202	3280.8185	386.9017	0	386.9017	10.55%
Type 13N	96.77	3505.1976	3049.2064	455.9912	0	455.9912	13.01%
Type 14R	99.56	5022.0874	4552.2782	469.8092	0	469.8092	9.35%
Type 15R	75	4001.0825	3648.7256	352.3569	0	352.3569	8.81%
Modelled Floor Area	1,165	55020.3033				5499.5305	10.00%
Total Resi Floor Area	41,158	1943901.1557					

Non-Domestic

URN	TFA (m2)	Energy kWh/m2/year						Energy provided by Heat Pump	% of Energy Requirements
		Heating	Cooling	Auxiliary	Lighting	Hot Water	Total Energy		
Non Residential Lean	11764.2	4.878	3.075	8.426	10.622	8.343	35.344	10.637	30.10%

	TFA (m2)	% of Energy Requirements
Total Residential	41,158	10.00%
Total Non-Residential	11,764	30.10%

Total Percentage of Energy Requirement from LZCs	14.46%

Appendix D: BREEAM UK New Construction 2018 Pre-Assessment Document.

HOARE LEA

Guild Living Epsom.
Epsom.
Guild Living.

SUSTAINABILITY

BREEAM UK NEW CONSTRUCTION 2018 PRE-ASSESSMENT REPORT

APPROACH TO RETAIL, AND OTHER BUILDING TYPE (NURSERY) AREAS FOR GUILD LIVING EPSOM.

REVISION 0 – 20 DECEMBER 2019

Audit Sheet.

Rev.	Date	Description	Prepared	Verified
0	20/12/2019	Issue for Planning	AB	RC/GB

This document has been prepared for Guild Living only and solely for the purposes expressly defined herein. We owe no duty of care to any third parties in respect of its content. Therefore, unless expressly agreed by us in signed writing, we hereby exclude all liability to third parties, including liability for negligence, save only for liabilities that cannot be so excluded by operation of applicable law. The consequences of climate change and the effects of future changes in climatic conditions cannot be accurately predicted. This report has been based solely on the specific design assumptions and criteria stated herein.

BREEAM Audit box.

Assessment	Retail: Shell Only
	Other Building Types (Nursery): Shell Only
BRE registration number	Retail: BREEAM-0080-4120
	Other Building Types Nursery: BREEAM-0080-4146
Licensed assessor	Alexandra Bryant
Assessor support	N/A
BREEAM scheme	BREEEAM UK New Construction 2018.
BREEAM scheme version	Issue 3.0
Assessment Stage	Pre-Assessment

BREEAM Credit filtering box.

Building type and sub-group	Retail
	Other Building Types (Nursery)
Building floor area	Retail: TBC
	Other Building Types Nursery: TBC
Building services (heating)	Other type of heating system – to be installed by tenant.
Building services (cooling)	Other type of heating system – to be installed by tenant.
Building services (DHW system)	Direct Electric/Hot water cylinders - to be installed by tenant.
Building services (controls)	Standard times/controls
Commercial cold storage systems	N/A
Laboratory (type, area and size)	N/A
Laboratory containment level	N/A
Fume cupboards / containment devices	N/A
Unregulated water uses	Yes (Irrigation – TBC)

Contents.

1. Executive Summary.

This report provides an outline approach to the BREEAM 2018 New Construction (NC) Pre-Assessment strategy for the proposed commercial areas included in the Guild Living Epsom development. Upon initial review the proposed development is anticipated to include two main components: (1) Retail space, and (2) Other Building Type (OBT) areas – Nursery.

In order to demonstrate compliance with Epsom Ewell Borough Council, Core Strategy (2007) Policy CS6 and Guild Living Brand Standards, this Pre-Assessment will outline a route for each of the proposed areas to achieve 'BREEAM 'Very Good' (min. 55%>), with an aspiration for BREEAM 'Excellent' where feasible.

The current anticipated baseline score for the proposed Guild Living Epsom, Retail and Nursery areas are as follows:

- Retail - Baseline score / rating: 64.74% (BREEAM 'Very Good'); and
- Other building type (Nursery) - Baseline score / rating: 64.74% (BREEAM 'Very Good').

All assessments are currently exceeding the minimum requirements for BREEAM 'Very Good' rating by X-X%. We recommend a margin of at least 5%–7% is recommended to be attained above the minimum required score at this stage in order to secure the target rating, as well as consider potential design changes and constraints identified during the construction stage.

Figure 1 summarises a visual representation of the current anticipated 'baseline' scores for each assessment, relative to the minimum required score for each BREEAM rating threshold.

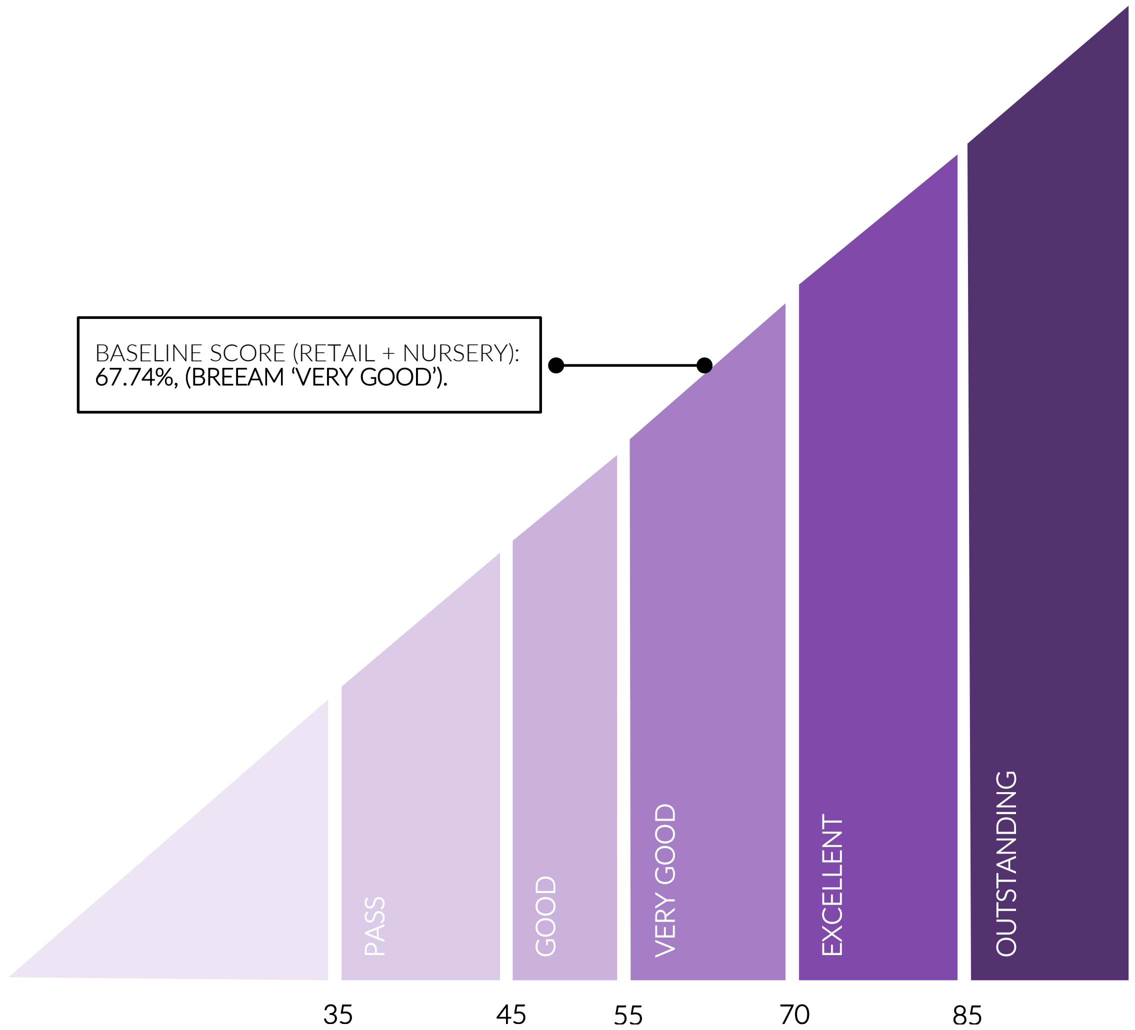

Figure 1: BREEAM 2018 Scale and Anticipated Performance Scores.

2. Assessment Details.

2.1 Introduction

This report provides an outline approach to the BREEAM 2018 New Construction Pre-Assessment strategy for the proposed commercial areas included in the Guild Living Epsom development

2.2 Assessment Type

Two BREEAM UK New Construction (NC) 2018 assessments are currently required for the proposed development. These assessments include:

- Retail: BREEAM UK NC 2018 Shell Only assessment; and
- Other building type (Nursery) BREEAM UK NC 2018 Shell Only assessment.

Figure 2 below identifies the alignment with MEP level of fit out and the BREEAM Assessment methodologies being completed.

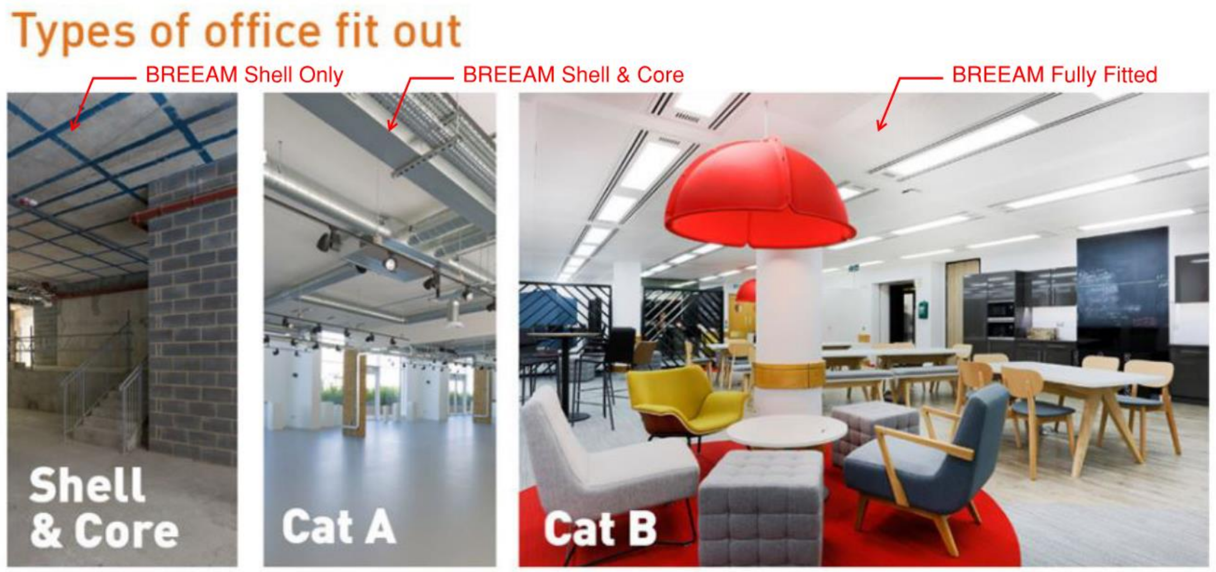

Figure 2 BREEAM Assessment Type Definitions

2.3 Assessment Rating

In line with Epsom Ewell Borough Council, Core Strategy (2007) Policy CS6 and Guild Living Brand Standards, the retail and nursery areas will be designed to achieve a BREEAM UK New Construction (NC) 2018 'Very Good' rating (55%>) with an aspiration for 'Excellent' where feasible.

2.4 Pre-Assessment

Two initial Pre-Assessment strategies were undertaken by an independently qualified BREEAM Assessor prior to review by the design team. The strategies set out a route to achieving BREEAM 'Very Good' (55%>), as well as highlighted the key stages evidence was to be received by, additional appointments, and the design team members responsible for each credit issue.

Credits currently included in the credit score have been reviewed by the design team, and each team member is expected to provide feedback regarding credits under their responsibility, identifying any relevant issues. Once comments have been raised by the project team, the report and the predicted scores will be updated.

The following predicted scores were calculated based upon experience with similar buildings and Hoare Lea's current understanding of the proposed development:

- Retail - Baseline score / rating: 64.74% (BREEAM 'Very Good'); and
- Other building type (Nursery) - Baseline score / rating: 64.74% (BREEAM 'Very Good').

All mandatory and minimum standards for the BREEAM 'Very Good' rating have been incorporated within the assessment strategy for the targeted baseline score.

3. Project Team Members.

Discipline	Organisation
Developer/Client	Guild Living
Project Manager	Cast Consultancy
Quantity Surveyor Team/Cost Consultant	Cast Consultancy
Architect	Marchese Partners
Principle Designer	Orsa
Building Services Consultant	Hoare Lea LLP
Civils / Drainage / Structural Consultant	Hydrock
Vertical Transportation Consultant	TBC
Security Consultant	TBC
Daylighting and Glare Control Consultant	Avison Young
Air Quality Consultant	TBC
Energy Assessor (Part L)	Hoare Lea LLP
Landscape Architect	TBC
Ecologist	Arup
Acoustician	Hoare Lea LLP
Planning Consultant	QED
Transport Consultant	Mayer Browne

4. Summary Score Sheet.

The summary table below highlights the list of targeted credits for the current BREEAM UK NC 2018 Pre-Assessment. Mandatory credits to achieve a 'Very Good' rating and above are highlighted by **(M).** Additional mandatory credits for an 'Excellent' or 'Outstanding' rating is highlighted by **(M_e) and (M_o)** respectively. Exemplary (innovation) credits are written in brackets, e.g. (+1).

Table 1: BREEAM Target Summary.

Category	Issue	Retail Shell Only		OBT Nursery Shell Only	
		Available	Targeted	Available	Targeted
Management	Man 01: Project brief and design	4	2	4	2
	Man 02: Lifecycle cost and service life planning	4	4	4	4
	Man 03: Responsible construction practices (M_e), (M_o)	6	6	6	6
	Man 04: Commissioning and handover (M_e), (M_o)	1	1	1	1
	Man 05: Aftercare (M_e), (M_o)	N/A	N/A	N/A	N/A
Health & Wellbeing	Hea 01: Visual comfort	4	3	4	3
	Hea 02: Indoor air quality	N/A	N/A	N/A	N/A
	Hea 04: Thermal comfort	N/A	N/A	N/A	N/A
	Hea 05: Acoustic performance	1	1	1	1
	Hea 06: Safety	1	1	1	1
	Hea 07 Safe and healthy surroundings	2	1	2	1
Energy	Ene 01: Reduction of energy use and CO_2 emissions (M_e) (M_o)	9	0	9	0
	Ene 02: Energy monitoring (M) (M_e) (M_o)	N/A	N/A	N/A	N/A
	Ene 03: External lighting	1	1	1	1
	Ene 04: Low carbon design	3	0	3	0
	Ene 05: Energy efficient cold storage	N/A	N/A	N/A	N/A
	Ene 06: Energy efficient transportation systems	N/A	N/A	N/A	N/A
	Ene 07 Energy efficient laboratory systems	N/A	N/A	N/A	N/A
	Ene 08: Energy efficient equipment	N/A	N/A	N/A	N/A
Transport	Tra 01: Transport assessment and travel plan	2	2	2	2
	Tra 02: Sustainable transport measures	10	5	10	5
Water	Wat 01: Water consumption (M) (M_e) (M_o)	N/A	N/A	N/A	N/A
	Wat 02: Water monitoring (M) (M_e) (M_o)	1	1	1	1

Category	Issue	Retail Shell Only		OBT Nursery Shell Only	
		Available	Targeted	Available	Targeted
	Wat 03: Water leak detection and prevention	1	1	1	1
	Wat 04: Water efficient equipment	1	1	1	1
Materials	Mat 01: Environmental impacts from construction products - Building life cycle assessment	7	2	7	2
	Mat 02: Environmental impacts from construction products	1	1	1	1
	Mat 03: Responsible sourcing of materials (M) (Me) (Mo)	4	2	4	2
	Mat 05: Designing for durability and resilience	1	1	1	1
	Mat 06: Material efficiency	1	0	1	0
Waste	Wst 01: Construction waste management (Mo)	5	4	5	4
	Wst 02: Use of recycled and sustainably sourced aggregates	1	0	1	0
	Wst 03: Operational waste (Me), (Mo)	1	1	1	1
	Wst 04 Speculative floor and ceiling finishes	N/A	N/A	N/A	N/A
	Wst 05: Adaptation to climate change	1	1	1	1
	Wst 06: Design for disassembly and adaptability	2	2	2	2
Land Use and Ecology	LE 01: Site selection	2	1	2	1
	LE 02: Identifying and understanding the risks and opportunities for the project	2	2	2	2
	LE 03: Managing negative impacts on ecology	3	3	3	3
	LE 04: Change and enhancement of ecological value	4	3	4	3
	LE 05: Long term ecology management and maintenance	2	2	2	2
Pollution	Pol 01: Impact of refrigerants	N/A	N/A	N/A	N/A
	Pol 02: Local air quality	N/A	N/A	N/A	N/A
	Pol 03: Flood and surface water management	5	4	5	4
	Pol 04: Reduction of night time light pollution	1	1	1	1
	Pol 05: Reduction of noise pollution	N/A	N/A	N/A	N/A

Category	Issue	Retail Shell Only		OBT Nursery Shell Only	
		Available	Targeted	Available	Targeted
Innovation	Inn 01: Approved Innovation and Exemplary Level Credits	10	1	10	1
Totals	Targeted weighted score:	64.70%		64.70%	
	Targeted weighted Rating	BREEAM Very Good (55%>)			

5. Early Action Credits.

Under the BREEAM Assessment, there are a number of credits that are time critical and require early action by the design team in order for the credits to be achieved. For these credits, the actions required prior to end of RIBA Stages 1 and 2.

It is advised the Design Team fully to review the actions required in Tables 2 and Table 3 below to understand the required evidence needed to be demonstrated prior to the completion of RIBA Stages 1 and 2.

Table 2: BREEAM NC 2018 RIBA Stage 1 Evidence Requirements

Credit Issues	RIBA Stage 1 Actions	Owner	Comment
LE 02 Ecological risks and opportunities	A Suitably Qualified Ecologist (SQE) carries out a survey and evaluation (see Methodology) for the site early enough to influence site preparation works, layout and, where necessary, strategic planning decisions. The SQE's survey and evaluation determines the site's ecological baseline (see Definitions), including: – Current and potential ecological value and condition of the site and related areas within the Zone of Influence. – Direct and indirect risks to current ecological value from the project. – Capacity and feasibility for enhancement of the site's ecological value and, where relevant, areas within the Zone of Influence.	Arup	Arup are providing Ecological Impact Assessment to support the planning application, with a Preliminary Ecological Appraisal and Bat Report appended

Table 3 BREEAM NC 2018 RIBA Stage 2 Evidence Requirements

Credit Issues	RIBA Stage 2 Actions	Owner	Comment
Man 01 Project brief and design	Prior to completion of the Concept Design, the project delivery stakeholders meet to identify and define for each key phase of project delivery: (a) Roles; (b) Responsibilities, and (c) Contributions. The project team demonstrates how the project delivery stakeholders' contributions and the consultation process outcomes influence the following: (a) Initial Project Brief; (b) Project Execution Plan; (c) Communication Strategy; and (d) Concept Design. Prior to completion of the Concept Design, the design team consult with all interested parties on matters that cover the minimum consultation content. Demonstrate how the stakeholder contributions and consultation exercise outcomes influence the Initial Project Brief and Concept Design.	Guild Living + Cast Consultancy	DAS Report to be provided alongside early stage meeting minutes, and Public Consultation Documents.
Man 02: Life cycle costing and service life planning	Stage 2 Elemental Life Cycle Cost analysis is completed in line with 'Standardised method of life cycle costing for construction procurement' PD 156865: 2008(6). The plan informs the client on: (a) Future replacement costs over a period of analysis as required by the client (e.g. 20, 30, 50 or 60 years); and (b) Includes service life, maintenance and operation cost estimates.	Cast Consultancy	Cast Consultancy to provide a fee to complete the work.
Hea 06 Security	Appoint a Suitability Qualified Security Specialist (SQSS) to conduct a Security Needs Assessment (SNA).	TBC	Security Needs Assessment to be completed ASAP.
Tra 01 Transport assessment and travel plan	A site-specific transport assessment AND draft travel plan, are provided demonstrating full compliance with Tra 01 issue.	Mayer Browne	Mayer Browne have confirmed they will be providing a Transport Assessment to comply with BREEAM criteria.
Wst 01 Construction waste management	Complete a pre-demolition audit of any existing buildings, structures or hard surfaces being considered for Demolition*. *If Demolition is not taking place at RIBA Stage 2 this documentation can be accepted at a later stage.	Demolition Contractor	Demolition is not required to take place until after Stage 3. Requirement will be captured within Demolition Specification for Contractor.
Wst 05 Adaptation to climate change	Conduct a climate change adaptation strategy appraisal. The assessment covers the installation of building services and renewable systems, as well as structural and fabric resilience aspects.	Marchese Partners + Hydrock + Hoare Lea LLP	Wst 05 Proforma document to be completed and supporting drawings to be provided.
Wst 06 Design for disassembly and adaptability	Conduct a study to explore the ease of disassembly and the functional adaptation potential of different design Scenarios. Develop recommendations or solutions based on the study during or prior to Concept Design, that aim to enable and facilitate disassembly and functional adaptation.	Marchese Partners Hydrock + Hoare Lea LLP	Wst 06 Proforma document to be completed and supporting drawings to be provided.

Credit Issues	RIBA Stage 2 Actions	Owner	Comment
LE 02 Ecological risks and opportunities	The project team liaise and collaborate with representative stakeholders early enough to influence key planning decisions to: (a) Identify the optimal ecological outcomes for the site; and (b) Identify, appraise and select measures to meet the optimal ecological outcomes for the site in line with the mitigation hierarchy of action, according to the route being used.	Arup	Arup to provide a fee in order to undertake BREEAM Ecology Report and 5-year Landscape and Habitat Management plan.
LE 03 Managing impacts on ecology	Further planning to avoid and manage negative ecological impacts on-site is carried out early enough to influence the concept design and design brief as well as site preparation planning.		

6. Conclusion.

Based upon an initial credit review, it is anticipated that the assessed areas can achieve a targeted score well within the BREEAM 'Very Good' (55%>) benchmark rating. Currently the targeted scores for each assessment are as follows:

- Retail - Baseline score / rating: 64.74% (BREEAM 'Very Good'); and
- Other building type (Nursery) - Baseline score / rating: 64.74% (BREEAM 'Very Good').

Following from this Pre-Assessment issue it is advised all early stage credits are fully reviewed and actioned as soon as possible in order to secure the strategy moving forward.

Figures 3 and 4 below provide a visual representation for the scores targeted and unachievable credit scores currently identified for each assessment.

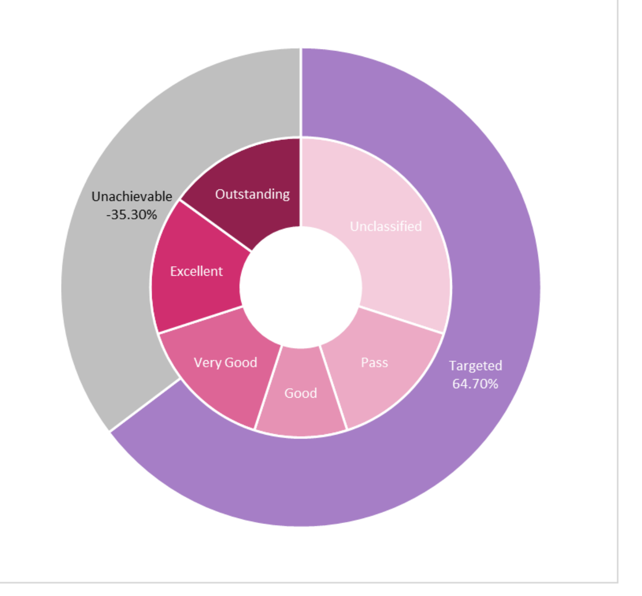

Figure 3 BREEAM Performance Summary and Targeted Credits: Retail and Nursery assessment.

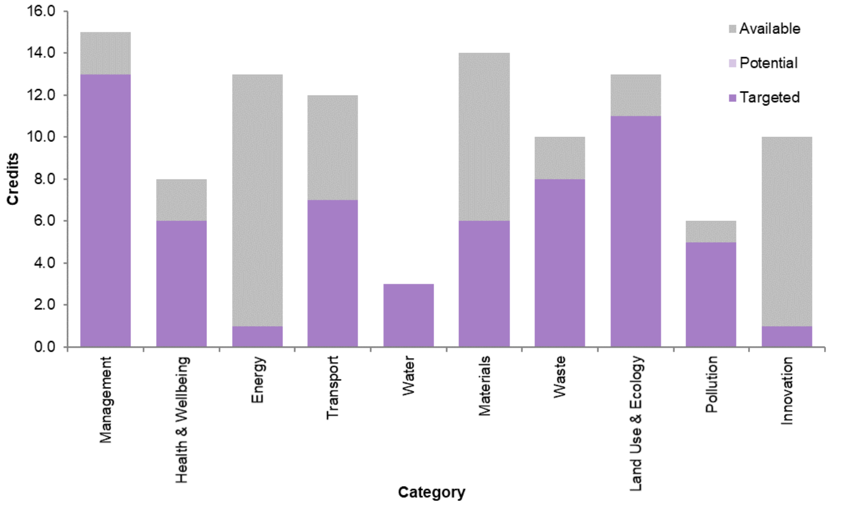

Figure 4 BREEAM Performance Summary and Targeted Credits: Retail and Nursery assessment. Bar representation.

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