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APPLEGARTH

RESTAURANT • COOKERY SCHOOL • DELICATESSEN

APPLEGARTH RESTAURANT AND ARITSAN MARKET, GRAYSHOTT

SUSTAINABILITY REPORT FOR THE NEW DEVELOPMENT

for the Benson Family

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Executive Summary

A Sustainability & Energy Strategy report has been carried out to support the planning application for the proposed development of the new Restaurant and Artisan Market at Applegarth Farm. The development comprises a new restaurant, farm shop and a range of on-site growing, education and leisure opportunities befitting of the site and its rural setting.

The energy and CO_2 analysis are based on full SBEM calculations.

The report established how the proposed development will meet the planning policy and compliance with building regulations. This has been achieved by following best practice procedures and has generally followed the energy hierarchy: Be Lean (improved building performance), Be Clean (centralised heating and cooling technologies) and Be Green (low and zero carbon technologies).

Reducing carbon dioxide emissions through lean measures

To maximise the energy efficiency of the development and thus reduce the energy demands, the following design principles and features have been incorporated:

- Building fabric elements and glazing specifications significantly improved to the Building Regulation requirements.
- Reduced air permeability compared to maximum required standards.
- Specification of efficient heating services and control systems.
- Energy efficient lighting through the development.

It was identified through the modelling undertaken, that the implementation of the energy efficient design aspects has the potential to reduce its CO_2 emissions by 6.1% when compared to the notional building (TER Building Regulations Target) and 25.7% when compared to the baseline building.

Reducing carbon dioxide emissions through clean measures

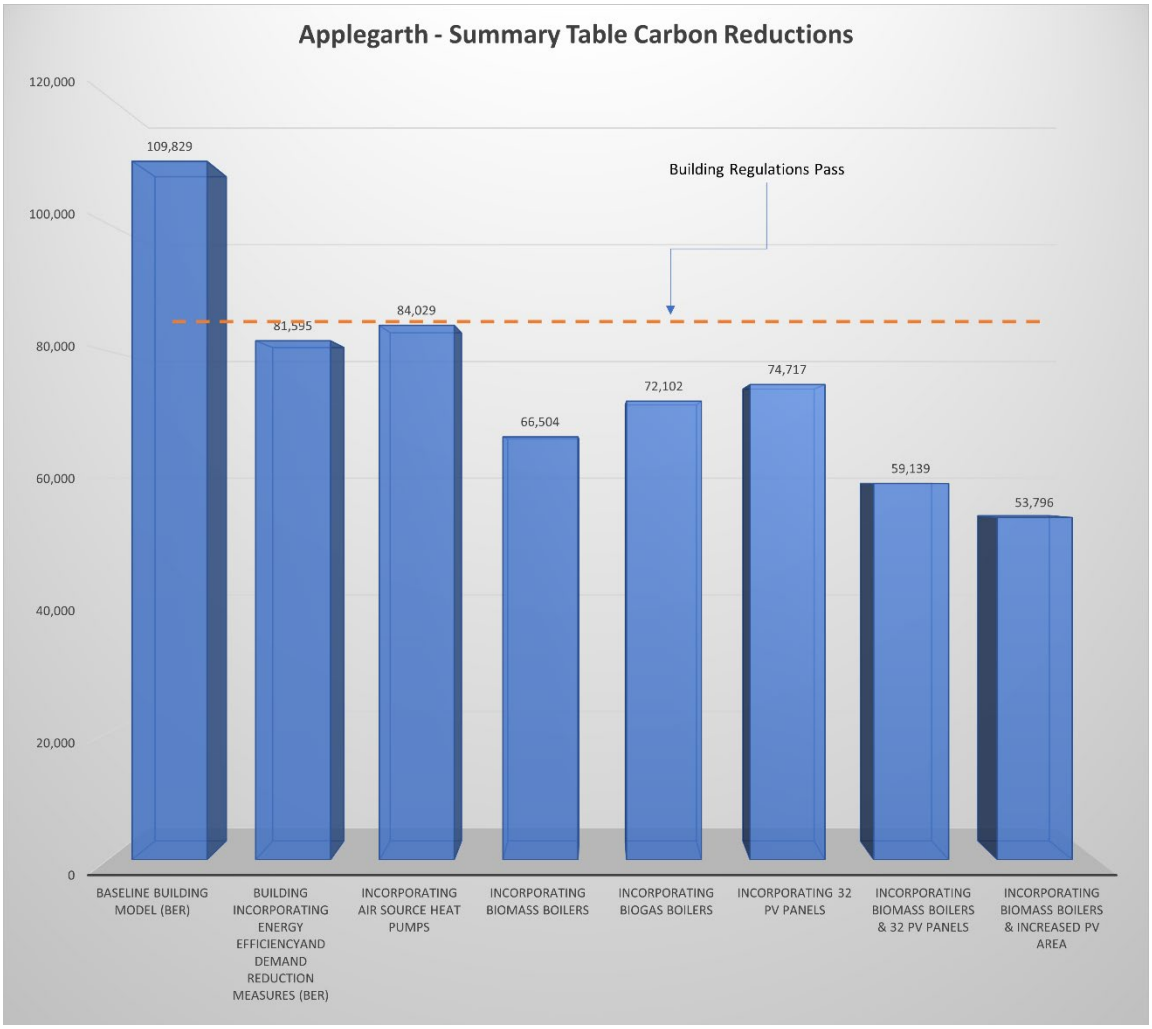
The inclusion of a site wide heating system was investigated. Potential options at the site included either connection to an area wide low carbon heat distribution network, a site wide heat network or a Combined Heat and Power (CHP) system. It was considered that the installation of either of these options was not practical or economically feasible.

Reducing carbon dioxide emissions through green measures

A low or zero carbon (LZC) technology feasibility study was completed as part of this Energy Strategy which compared the feasibility of different technologies based on the energy demand of the development. Based on this, it can be concluded that the most feasible technology for this development is inclusion of Biomass boilers to provide space heating and hot water of the development and PV array to reduce the electrical demand from the grid.

The air permeability of the proposed dwellings is targeted at 3 $m^3/(h.m^2)$ at 50 Pa.

Based on the robust approach to the energy hierarchy, the development has exceeded the required sustainability and energy targets. The assessed technologies achieves a site wide total reduction of the regulated carbon dioxide emissions of between 23.5% and 51.0%.



Summary Table of Carbon Reductions
(Note the dotted line shows the building regulations equivalent compliance level)

The scheme will incorporate facilities using a combination of biomass boilers and PV panel array to reduce carbon emissions by 38.1% when compared to the notional building (TER Building Regulations Target) and 51.0% when compared to the baseline building.

The use of Biomass boilers to provide the heating and hot water for the development equates to 87,507 kWh/annum. With the addition of the PV array, this increases to 99,799 kWh/annum which is 47.4% from low and zero carbon sources. This far exceeds the CP24 b) policy requirements of 10% of energy demand to be from decentralised and renewable or low carbon energy sources.

If the solution of biomass boilers and PV array were to be assessed under a BREEAM scheme, it would achieve 5 credits under ENE 01 Reduction of Energy Use & carbon emissions.

1.0 Introduction

Nexus Allied Ltd was commissioned to undertake a Sustainability & Energy Strategy report to support the planning application for the proposed development of the new Restaurant and Artisan Market at Applegarth Farm on behalf of the Benson family.

This report outlines the scheme and current planning context and assess the likely energy demands of the development prior to consideration of low and zero carbon technologies. The report concludes with the proposed energy strategy to support the planning application.

1.1 Scheme Overview

The proposed development is to create a new restaurant, farm shop and a range of on-site growing, education and leisure opportunities befitting of the site and its rural setting.

The current proposals offered comprise three buildings for three main uses, Restaurant & Cookery school, Farm Shop and Greenhouse. The three buildings are arranged to form a courtyard on three sides with the fourth side forming an artisan market garden area with a small number of self-contained units.

The report covers the two main Restaurant & Farm Shop buildings as the artisan market garden area will be simple stand alone un-serviced units and the greenhouse building is an annex building used for education and food growing process purposes.

The two main buildings are proposed to be constructed as vernacular barns from timber frame construction with simple pitch roof with full height glazed sections to some elevations.

1.2 Purpose of the Energy Assessment

The proposed development energy assessment will be following the energy hierarchy showing the sustainability credentials of the development which would effectively show comparable scales with BREEAM to address the planning policy requirements.

Policy CP24 within the East Hampshire District Local Plan sets out advice on sustainable construction and expectations for new building development. The Policy sets out three (a-c) key criteria to consider.

Criterion a) takes quite a broad-brush requirement for non-residential development to meet BREEAM 'excellent' standards. In reviewing of the BREEAM standards, this is not directly applicable to the proposed mix use development sought, which comprises a mix of uses within Classes E and F of the Use Class Order and horticultural growing space.

A bespoke approach has therefore been taken to the overall sustainability of the building, both during construction and once operational. The purpose of this report is to demonstrate that the development is either equivalent to the BREEAM standards, and in a number of places, significantly exceeds its requirements. Whilst this does deviate from the policy requirements, it ensures that a highly sustainable form of development is proposed.

In terms of criteria b), this requires at least 10% of energy demand to be from decentralised and renewable or low carbon energy sources. As set in this report, at least 50% of the

buildings energy demands will be provided from such sources. Criteria c) refers to major areas of development so not directly applicable to this scheme. However, the proposed does also incorporate re-use of waste produced from the site and extensive rainwater storage, so it also adheres to this requirement.

2.0 Energy Modelling – New Buildings

2.1 Method

The SBEM (Simplified Building Energy Model) is the governments recommended calculation methodology for the energy rating of non-domestic buildings. The calculation process compares the carbon emissions of the proposed building with target emissions which are based on those of a notional building which has the same shape and patterns of use as the proposed building but makes standard assumptions regarding the heating and ventilation plant, lighting and building fabric. The calculation predicts the energy demand and thus the carbon emissions of a building using standard assumptions. The energy demand calculated is relative to the Regulated Emissions which include energy consumed by power space heating, domestic hot water, ventilation and internal lighting systems. The unregulated emissions (i.e. cooking and appliances) are calculated using the iSBEM software.

The results of the indicative calculations should not be used for any other purposes other than for those for which they are intended (namely as a basis for this energy statement). Formal assessments will be required at a later stage of the design development process to satisfy building control requirements.

2.2 Approach

The proposed energy strategy approach is based on a recognised structure of reduction in carbon dioxide emissions through:

1) Reducing the building energy consumption (Be Lean) by optimising the design and construction of the building to ensure less energy is required.
2) Supplying the energy required in an efficient manner (Be Clean)
3) Supplying the energy from Low and/or Zero Carbon and Renewable Energy Sources (Be Green)

Fig 1 The three stages of the Energy Hierarchy

Overall, it becomes more expensive to implement both carbon reduction and sustainability measures the further along the design process the proposed development proceeds as the opportunities available diminish. This highlights the importance of early consideration of these measures within the design process.

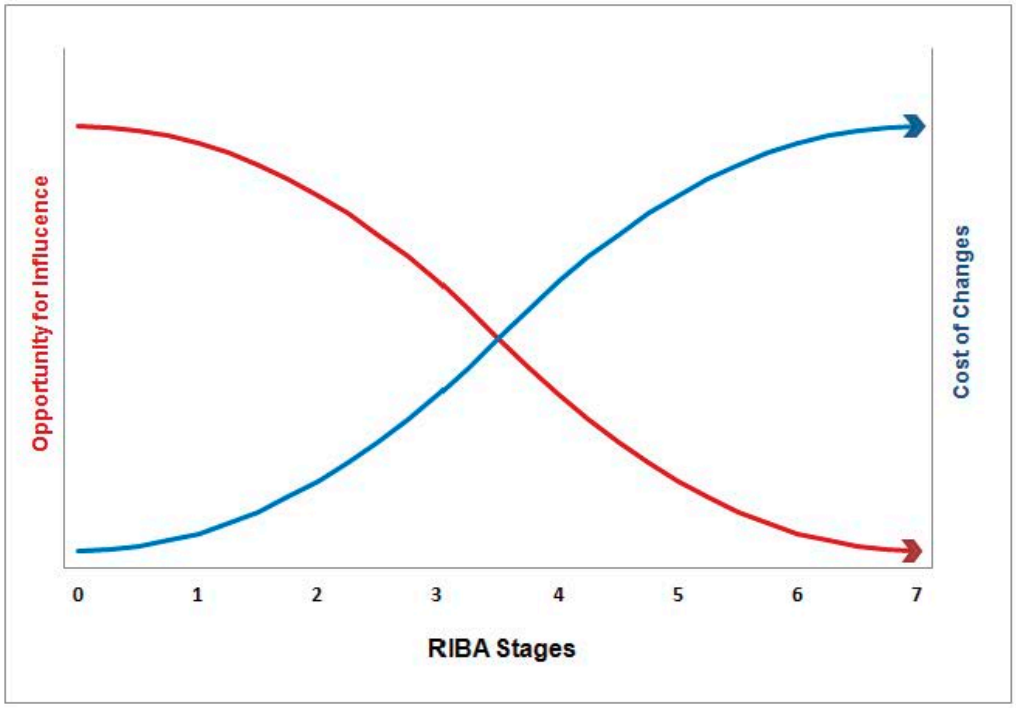


Fig 2 Opportunities to reduce CO_2 emissions and associated cost during the construction stages

A passive, well insulated envelope will last for the life of the building; with this being difficult to upgrade once building work is complete. The services installed within the building have a shorter life span and can be replaced or upgraded at a later date, when their lifetime will have expired and new more efficient services will be available. Once the most efficient building envelope and services are provided, the installation of Low and Zero Carbon technologies should be considered.

The design for this project will attain a final carbon emission rating that goes beyond the one required to comply with Part L 2013 of the Building Regulations Guide 2013; in line with the requirements of the Energy Hierarchy for which most proposed developments follow.

In line with current guidance, the carbon emissions factors have been used to present the results within the report. The carbon factors are as follows

Biomass 0.031 kgCO2/kWh
Biogas 0.098 kgCO2/kWh
Natural Gas 0.216 kgCO2/kWh
Grid Supplied Electricity 0.519 kgCO2/kWh
Grid Displaced Electricity 0.519 kgCO2/kWh

The results using the SBEM software has also been presented within the report for illustration purpose only to show the indicated energy consumption as specified in the guidance.

2.3 Building Model

An energy model has been produced to predict the energy consumption of the building.

Using the architects proposed planning drawings, the building has been modelled using the computer modelling package EDSL TAS Version 9.5.1 interfaced to SBEM Version v5.6.b.0 which is based on BRE's standard calculation tool and uses a dynamic simulation method for checking compliance and is the government's approved software. This methodology has been adopted as an acceptable and understandable method of informing energy strategies.

Images of the model are shown below.

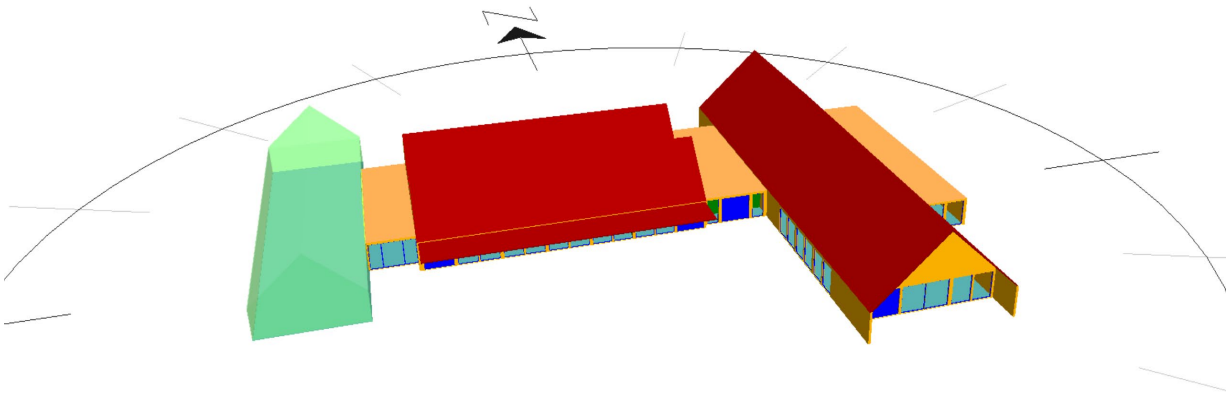


Fig 3 South West isometric view

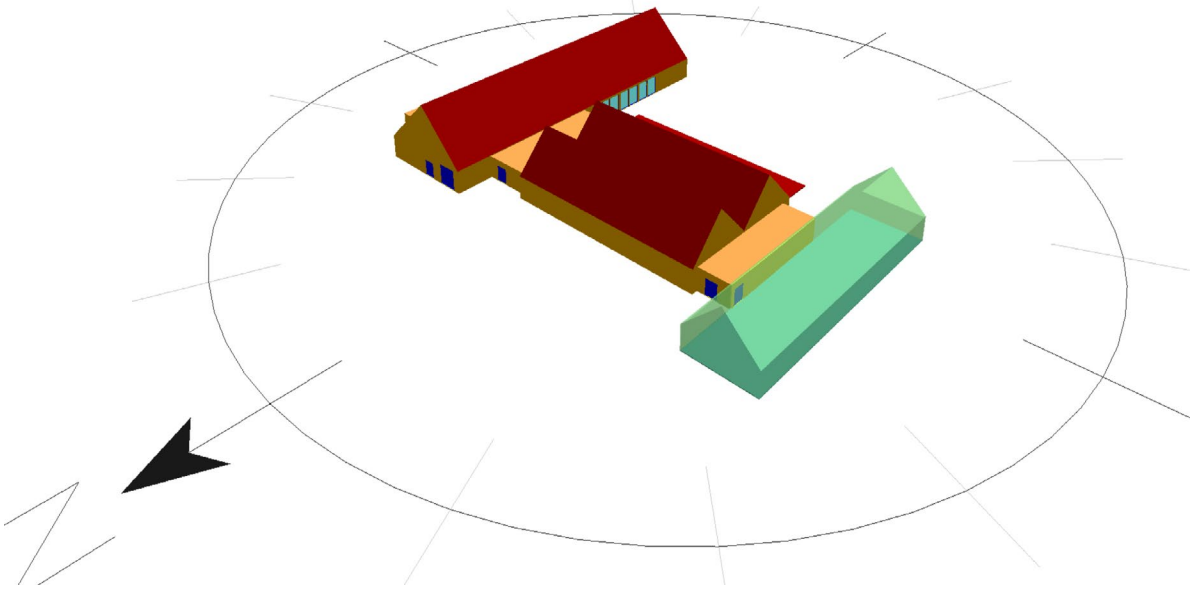


Fig 4 North West isometric view

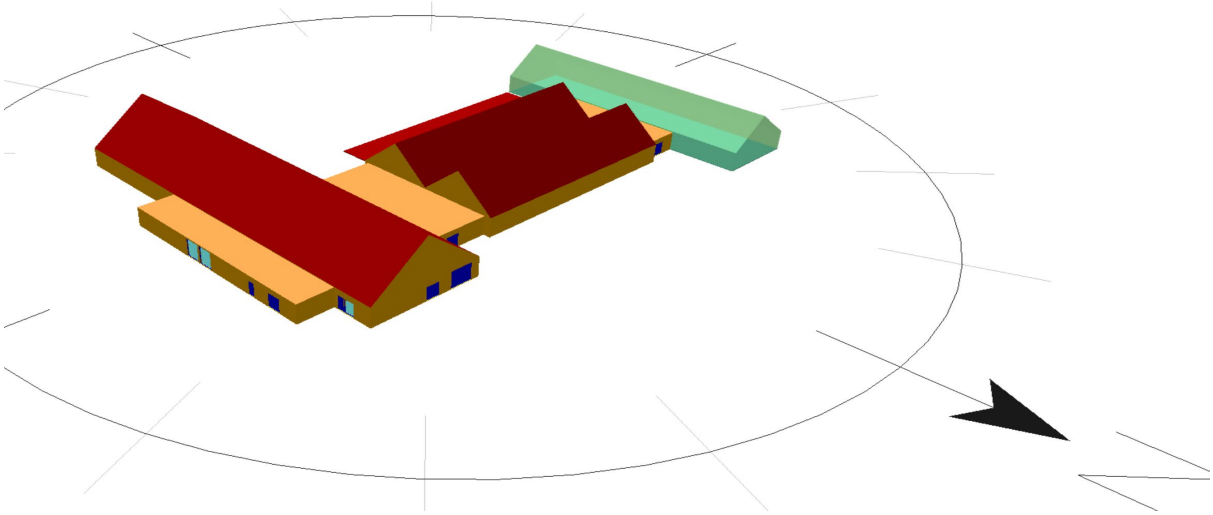


Fig 5 North East isometric view

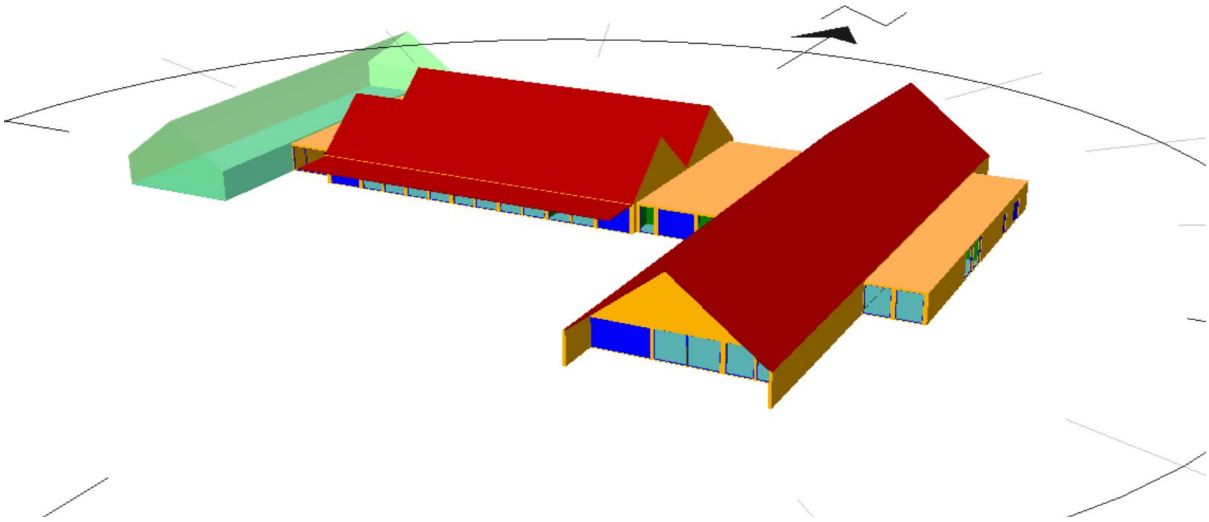


Fig 6 South East isometric view

2.4 Initial Energy Assessment - Baseline Model

Using the aforementioned software, when a simulation is performed, a 'notional' building is created. This building has the same shape and patterns of use as the actual, designed building, but makes standard assumptions regarding the heating, cooling and ventilation plant, lighting and building fabric. The energy consumption of this building is predicted using the software. The baseline building assumes a development that comprises simple and basic construction and fit out standards given the rural aspect of the development.

Energy consumption and carbon emissions are calculated based on an internal floor area of 2434m^2.

The results of the initial Building Regulations calculations are contained within Appendix One of this report.

The results of the analysis, which exclude non-controlled energy uses, are detailed below:
- Target emission rate (TER): 26.9 kgCO2/m2/annum (65,475 kgCO2/annum)
- Actual emission rate (BER): 36.3 kgCO2/m2/annum (88,354 kgCO2/annum)

It will be noted that the initial Building Regulations calculations indicate that the base development will not be Part L (2013) compliant. This result was expected and is consistent with the requirements imposed by the Building Regulations.

The Building Regulations target CO2 emission rate (TER) is equivalent to a predicted energy consumption of 76.46 kWh/m2 (186,104 kWh).

The Baseline actual CO2 emission rate (BER) is equivalent to a predicted energy consumption of 102.77 kWh/m2 (250,142 kWh).

In order to utilise this data within the energy analysis this baseline must also include energy uses not controlled by the Building Regulations. These are obtained from benchmark data.

Benchmarks for non-controlled energy uses for a retail premises have been taken from CIBSE Guide F as follows:

System	**Energy Consumption (kWh/m2)**	
	Electricity	**Gas**
Office equipment	6	0
Other	11	0

Table 2 – Non controlled energy uses by building type

Hence, the non-controlled energy usage and CO_2 emissions, based on an internal floor area of 2434 m^2 are:

System	**Energy Consumption**	**CO_2 Emissions**
	(kWh/annum)	**(kg/annum)**
Office equipment	14,604	7,579
Other	26,774	13,896
Total	**41,378**	**21,475**

Table 3 – Total energy & carbon non controlled energy uses summary

Note: A CO_2 emission factor of 0.216 $kgCO_2$/kWh has been used for fossil fuel and 0.519 $kgCO_2$/kWh has been used for grid supplied electricity demand as detailed in Part L of the Building Regulations.

Incorporating non-controlled energy usage the calculated energy consumption and CO_2 emission figures for the TER Building Regulations building are respectively

186,104 kWh & 65,475 kgCO2/annum
+ 41,378 kWh & + 21,475 kgCO2/annum
227,482 kWh & 86,950 kgCO2/annum

Incorporating non-controlled energy usage the calculated energy consumption and CO_2 emission figures for the BER baseline building are respectively

250,142 kWh & 88,354 kgCO2/annum
+ 41,378 kWh & + 21,475 kgCO2/annum
291,520 kWh & 109,829 kgCO2/annum

This baseline represents the actual annual energy consumption and carbon emissions including non-controlled building energy uses prior to the adoption of energy efficiency and demand reduction measures, decentralised energy and renewable or low carbon energy

2.5 Energy Efficiency and Demand Reduction Measures (Be Lean)

Energy demand reduction within the building can be utilised to improve compliance with Part L2A and L2B. This development has been reviewed to maximise both passive and active design measures to reduce the energy demand within the building.

The site location and weather were accounted for in the energy modelling using the London TRY local weather file, in accordance to Part L Building Regulations. The site is not deemed to be in an area with characteristics of a microclimate that would deviate from the local weather file.

To reduce the CO2 emissions of the development, it is important to minimise the heat losses through the building fabric. In order to achieve this, U-values for all building fabric elements and openings have been specified to exceed the levels required by Building Regulations. In addition, heat losses from infiltration have been minimised and a low air permeability target has been set. The details of these measures are summarised in the Table 6 and Table 7.

The building is proposed to be constructed as vernacular barns from timber frame construction with simple pitch roof. This gives a tremendous opportunity to utilise highly rated energy efficient construction methods with the following u values being targeted.

Item	**U-Value (W/m^2K)**	**Maximum Part L U-Value (W/m^2K)**	**Percentage improvement over Part L limiting values**
Ground floor	0.15	0.25	40%
Roof	0.1	0.25	60%
External Walls	0.1	0.35	71%
Windows, Glazed Doors & Rooflights	1.68 (inc frame)	2.2 (inc frame)	24%
Pedestrian Doors	0.92	2.2 (inc frame)	58%
Targeted air permeability rate	3 $m^3/(h.m^2)$ @ 50Pa	10 $m^3/(h.m^2)$ @ 50Pa	70%

Table 4 – Passive design energy saving measures

The glazing area of a building can have significant impact on heat losses, thermal comfort and daylight levels. In addition, the proposed windows will have a g-value of 0.5.

The high standard of specification for the building fabric has been used to provide passive energy saving solutions that significantly exceed the Building Regulation requirements

In addition to upgrading the insulation standards, it is important that the energy used within the building is used efficiently. Therefore, the building systems have been designed to optimise the efficiency of the systems by matching installed capacity to anticipated building demand. Items of equipment, which make up the building's mechanical building services

installation, will be specified to achieve high annual energy efficiency in operation and will be regularly serviced to maintain their performance. Please note that all systems have efficiencies and controls which will exceed the requirements of Part L2A 2013 Building Services Compliance Guide.

According to the guidance on preparing energy assessments, the 'Be Lean' case should assume that the heating is provided by natural gas fired boilers (91% for non-residential) and that any active cooling would be provided by electrically powered equipment.

Space heating within the building is proposed to be provided by high energy efficient natural gas fired boilers with a very efficient heating control system (time and temperature zone control) for all zones. This is for the Be Lean scenario with other options considered in the Be Green section.

The air quality within a building is significantly influenced by the ventilation system specified. To ensure high air quality within areas requiring statutory ventilation (i.e. toilets and kitchens), high efficiency mechanical ventilation systems are proposed with low specific fan power levels.

Electrical lighting also represents a significant energy use within a building. To maximise energy savings the installation of low energy lighting using high efficiency LED lighting is proposed across the development along with PIR on/off control to storerooms, back of house circulation spaces and toilets.

The initial building regulations energy model has been re-run to incorporate the identified energy efficiency and demand reduction measures. The results are contained within Appendix Two of this report. These results indicate the CO_2 savings over and above the initial building model as a direct result of incorporating these energy efficiency and demand reduction measures outlined above. The results so far are summarised below.

Building regulations TER	26.9 kgCO2/m2/annum
Initial BER	36.3 kgCO2/m2/annum
Energy Efficient BER	24.7 kgCO2/m2/annum (60,120 kgCO2/annum)

It is noted that the revised Building Regulation calculations indicate that the development would achieve a Part L 2013 pass and would therefore be compliant with building regulations.

The revised Energy Efficient and Demand Reduction CO_2 emission rate (BER) is equivalent to a predicted annual energy consumption of 67.21 kWh/m^2, a total of 163,589 kWh/annum.

Incorporating the non-controlled energy uses identified in section 2.4 of this report, the corrected energy consumption and CO_2 emissions are:

	Energy Consumption (kWh/annum)	**CO_2 Emissions (kg/annum)**
Building Regulations (TER)	227,482	86,950
Baseline building model (BER)	291,520	109,829
Building incorporating energy efficiency and demand reduction measures (BER)	204,967	81,595

Table 5 – Corrected Energy & Carbon Consumption

The energy consumption savings over and above the initial Baseline building model as a direct result of incorporating the energy efficiency and demand reduction measures are 86,553 kWh/annum. This represents a 29.7% reduction in energy consumption and 25.7% decrease of carbon emissions prior to the inclusion of decentralised energy and renewable energy technologies.

2.6 Decentralised Energy (Be Clean)

Connections to a decentralised energy network and the use of a communal heating system is a recognised method of generating energy more efficiently. Most planning energy policies requires development proposals to explore the opportunities to link into an existing or planned decentralised energy network. Where an existing decentralised energy network is not present, an assessment of the feasibility of establishing a decentralised energy system for the proposed development should be undertaken; including an assessment of the feasibility of a Combined Heat and Power (CHP) communal heating system. The following hierarchy on selecting an energy system has been followed:

1. Connection to local existing or planned heat network
2. Use zero emission or local secondary heat sources (in conjunction with heat pump if required)
3. Use low emission combined heat and power
4. Use ultra-low NOx gas boilers

2.6.1 Connection to an area wide heat network

The proposed development is located on the outskirts of a small village of Grayshott with a population of circa 2500. There is no heat network to connect to in the vicinity of the site, therefore this option has not been considered further.

2.6.2 Secondary Heat Sources

Again for the same reasons as the wide heat network option, there is no district heating networks located in the vicinity of the site, therefore this option has not been considered further.

2.6.3 Low emission CHP

The installation of a Combined Heat and Power (CHP) unit for the development has been considered. CHP units can achieve considerable savings in CO2 emissions when

installed and utilised correctly. To maximise the performance of a CHP, long operating hours are required, and the heating demand of the development needs to match the power generation.

To date, gas-engine CHP has been the primary technology for facilitating the development of district heat networks & individual CHP units due to its high efficiency and better carbon performance compared to electrical systems utilising grid electricity. However, the rapid decarbonisation of the electricity grid means that technologies generating onsite electricity (such as gas-engine CHP) will not achieve the carbon savings they have to date. There are also growing air quality concerns associated with combustion-based systems; with the number of smaller sites using gas-engine CHP now of particular concern.

In general, larger sites are considered more appropriate in terms of operational regime and available heat load to enable an effective operation of CHP systems, providing that any related emissions are properly abated.

Due to the small electricity demand for the proposed development, CHP installed to meet the base heat load would require the export of electricity to the grid. However, the administrative burden of managing CHP electricity sales at this small scale where energy service companies (ESCOs) are generally not active, and the low unit price available for small volumes of exported CHP electricity, means it is generally uneconomic for developers to pursue. This can lead to CHP being installed but not operated. In view of the absence of the likely energy demand required to match CHP production, *the installation of a CHP system will not be considered any further for this development.*

2.6.4 Ultra-low NOx gas boilers

The proposed development has already included low NOx gas fired boilers in the assessment for the report.

2.7 Renewable or Low Carbon Energy Technologies (Be Green)

This section discusses the feasibility of using low and zero carbon (LZC) technologies for the proposed scheme.

The feasibility of a number of potentially appropriate renewable energy technologies has been investigated for the proposed development and a summary overview is outlined in the table below.

LZC Technology	CO_2 Saving Opportunity	Capital Cost	Considered further	Observations
Air source heat pumps	Medium	Medium	Yes	Suitable for restaurant and retail area, decarbonised energy source
Ground source heat pumps	Medium	High	No	Prohibitive cost of boreholes. Large area of land required for slinky pipework system.
Biomass Heating	High	Medium	Yes	Decarbonised energy source
Biogas Heating	High	Medium	Yes	Development provides big opportunity to use anaerobic digester to dispose of food and compost waste, decarbonised energy source
Solar water heating	Low	Medium	No	Very low hot water baseload
Photovoltaics	Medium	Medium	Yes	Decarbonised energy source
Wind Turbines	Low	High	No	Planning issue, wildlife nuisance and very limited energy savings

Table 6 – Renewable or Low Carbon Energy Technologies

2.7.1 Air Source Heat Pumps (ASHP)

The following areas of the proposed development are suitable for the incorporation of air source heat pumps (comfort cooling).

Restaurant, Farm Shop, Staff Room, Office, Cookery School.

The Be Lean energy model has been re-run to incorporate air source heat pump technology to the above spaces. The results are contained within Appendix Three of this report.

These results indicate the CO_2 savings over and above the initial building model as a direct result of incorporating these energy efficiency and demand reduction measures and air source heat pumps as outlined above. The results so far are summarised below.

Building regulations TER	26.9 kgCO2/m2/annum
Initial BER	36.3 kgCO2/m2/annum
Energy Efficient BER	24.7 kgCO2/m2/annum
Be Green ASHP	25.7 kgCO2/m2/annum (62,554 kgCO2/annum)

The revised Be Green ASHP CO_2 emission rate (BER) is equivalent to a predicted annual energy consumption of 66.37 kWh/m^2, a total of 161,545 kWh/annum.

Incorporating the non-controlled energy uses identified in section 2.4 of this report, the corrected energy consumption and CO_2 emissions are:

	Energy Consumption (kWh/annum)	**CO_2 Emissions (kg/annum)**
Building Regulations (TER)	227,482	86,950
Baseline building model (BER)	291,520	109,829
Building incorporating energy efficiency and demand reduction measures (BER)	204,967	81,595
Incorporating Air Source Heat Pumps	202,923	84,029

Table 7 – Corrected Energy & Carbon Consumption

The energy consumption savings over and above the initial Baseline building model as a direct result of incorporating the energy efficiency and demand reduction measures and ASHP technology are 88,597 kWh/annum. This represents a 30.4% reduction in energy consumption and 23.5% decrease of carbon emissions.

2.7.2 Biomass Boilers

As part of the decarbonising energy plan, this option replaces the low NOx gas fired boilers used to heat the proposed development with automatic feeding pellet type biomass boilers.

The Be Lean energy model has been re-run to incorporate biomass boiler technology. The results are contained within Appendix Four of this report.

These results indicate the CO_2 savings over and above the initial building model as a direct result of incorporating these energy efficiency and demand reduction measures and biomass boilers as outlined above. The results so far are summarised below.

Building regulations TER	26.9 kgCO2/m2/annum
Initial BER	36.3 kgCO2/m2/annum
Energy Efficient BER	24.7 kgCO2/m2/annum
Be Green Biomass	18.5 kgCO2/m2/annum (45,029 kgCO2/annum)

The revised Be Green Biomass boiler CO_2 emission rate (BER) is equivalent to a predicted annual energy consumption of 69.47 kWh/m^2, a total of 169,090 kWh/annum.

Incorporating the non-controlled energy uses identified in section 2.4 of this report, the corrected energy consumption and CO_2 emissions are:

	Energy Consumption (kWh/annum)	**CO_2 Emissions (kg/annum)**
Building Regulations (TER)	227,482	86,950
Baseline building model (BER)	291,520	109,829
Building incorporating energy efficiency and demand reduction measures (BER)	204,967	81,595
Incorporating Air Source Heat Pumps	202,923	84,029
Incorporating Biomass Boilers	210,468	66,504

Table 8 – Corrected Energy & Carbon Consumption

The energy consumption savings over and above the initial Baseline building model as a direct result of incorporating the energy efficiency and demand reduction measures and biomass boiler technology are 81,052 kWh/annum. This represents a 27.8% reduction in energy consumption and 39.4% decrease of carbon emissions.

2.7.3 Biogas Boilers

The proposed development comprises restaurant, farm shop and large greenhouse facility which will produce food waste and composting material which can be used in an anaerobic digester to generate biogas as a fuel for converted gas fired appliances for the heating and hot water generation. The waste products of the anaerobic digester can then be used as fertilizer material for the wider farming and greenhouse business.

The Be Lean energy model has been re-run to incorporate biogas technology. The results are contained within Appendix Five of this report.

These results indicate the CO_2 savings over and above the initial building model as a direct result of incorporating these energy efficiency and demand reduction measures and biogas boilers as outlined above. The results so far are summarised below.

Building regulations TER	26.9 kgCO2/m2/annum
Initial BER	36.3 kgCO2/m2/annum
Energy Efficient BER	24.7 kgCO2/m2/annum
Be Green Biogas	20.8 kgCO2/m2/annum (50,627 kgCO2/annum)

The revised Be Green Biogas CO_2 emission rate (BER) is equivalent to a predicted annual energy consumption of 68.37 kWh/m^2, a total of 166,413 kWh/annum.

Incorporating the non-controlled energy uses identified in section 2.4 of this report, the corrected energy consumption and CO_2 emissions are:

	Energy Consumption (kWh/annum)	**CO_2 Emissions (kg/annum)**
Building Regulations (TER)	227,482	86,950
Baseline building model (BER)	291,520	109,829
Building incorporating energy efficiency and demand reduction measures (BER)	204,967	81,595
Incorporating Air Source Heat Pumps	202,923	84,029
Incorporating Biomass Boilers	210,468	66,504
Incorporating Biogas Boilers	207,791	72,102

Table 9 – Corrected Energy & Carbon Consumption

The energy consumption savings over and above the initial Baseline building model as a direct result of incorporating the energy efficiency and demand reduction measures and Biogas heating technology are 83,729 kWh/annum. This represents a 28.7% reduction in energy consumption and 34.4% decrease of carbon emissions.

2.7.4 PV Panels

The proposed development has large areas of south facing roof, which could be utilised for a PV array. We have estimated that 32 PV panels measuring 1.6m^2 each would fit on the south facing roof of the Restaurant building at an inclination of 45 degrees.

There is an opportunity to increase the area of PV array but it is felt that at this stage, the cost of a larger PV array needs to be balanced with the visual aspect of the proposed development and the extra capital cost to provide the additional PV panels.

The Be Lean energy model has been re-run to incorporate PV panel technology. The results are contained within Appendix Six of this report.

These results indicate the CO_2 savings over and above the initial building model as a direct result of incorporating these energy efficiency and demand reduction measures and PV panel array as outlined above. The results so far are summarised below.

Building regulations TER	26.9 kgCO2/m2/annum
Initial BER	36.3 kgCO2/m2/annum
Energy Efficient BER	24.7 kgCO2/m2/annum
Be Green PV panels	23.4 kgCO2/m2/annum (56,956 kgCO2/annum)

The revised Be Green PV panels CO_2 emission rate (BER) is equivalent to a predicted annual energy consumption of 68.37 kWh/m^2, a total of 166,413 kWh/annum but this is offset by 7,156kWh/annum generated from the PV panels.

Incorporating the non-controlled energy uses identified in section 2.4 of this report, the corrected energy consumption and CO_2 emissions are:

	Energy Consumption (kWh/annum)	**CO_2 Emissions (kg/annum)**
Building Regulations (TER)	227,482	86,950
Baseline building model (BER)	291,520	109,829
Building incorporating energy efficiency and demand reduction measures (BER)	204,967	81,595
Incorporating Air Source Heat Pumps	202,923	84,029
Incorporating Biomass Boilers	210,468	66,504
Incorporating Biogas Boilers	207,791	72,102
Incorporating 32 PV panels	200,635	74,717

Table 10 – Corrected Energy & Carbon Consumption

The energy consumption savings over and above the initial Baseline building model as a direct result of incorporating the energy efficiency and demand reduction measures and PV panel technology are 90,885 kWh/annum. This represents a 32.2% reduction in energy consumption and 32% decrease of carbon emissions.

These technologies meet all requirements as defined by Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.

2.7.5 Biomass boilers & PV Panels

The client has expressed a desire to use two of the assessed technologies for the development as a combined solution for the proposed development.

The Be Lean energy model has been re-run to incorporate biomass boilers & PV panel technologies as a combined solution. The results are contained within Appendix Seven of this report.

These results indicate the CO_2 savings over and above the initial building model as a direct result of incorporating these energy efficiency and demand reduction measures and Biomass/PV panel array as outlined above. The results so far are summarised below.

Building regulations TER	26.9 kgCO2/m2/annum
Initial BER	36.3 kgCO2/m2/annum
Energy Efficient BER	24.7 kgCO2/m2/annum
Be Green Biomass/PV panels	17.0 kgCO2/m2/annum (41,378 kgCO2/annum)

The revised Be Green Biomass/PV panels CO_2 emission rate (BER) is equivalent to a predicted annual energy consumption of 69.5 kWh/m^2, a total of 169,163 kWh/annum but this is offset by 7,156kWh/annum generated from the PV panels.

Incorporating the non-controlled energy uses identified in section 2.4 of this report, the corrected energy consumption and CO_2 emissions are:

	Energy Consumption (kWh/annum)	**CO_2 Emissions (kg/annum)**
Building Regulations (TER)	227,482	86,950
Baseline building model (BER)	291,520	109,829
Building incorporating energy efficiency and demand reduction measures (BER)	204,967	81,595
Incorporating Air Source Heat Pumps	202,923	84,029
Incorporating Biomass Boilers	210,468	66,504
Incorporating Biogas Boilers	207,791	72,102
Incorporating 32 PV panels	200,635	74,717
Incorporating Biomass & 32 PV panels	203,385	59,139

Table 11 – Corrected Energy & Carbon Consumption

The energy consumption savings over and above the initial Baseline building model as a direct result of incorporating the energy efficiency and demand reduction measures and PV panel technology are 88,135 kWh/annum. This represents a 30.2% reduction in energy consumption and 46.2% decrease of carbon emissions.

In order to show a further commitment by the client, the area of the PV panels was increased to exceed a targeted 50% carbon reduction for the development.

The Be Lean energy model has been re-run to incorporate biomass boilers & 55 PV panels as a combined solution. The results are contained within Appendix Eight of this report and summarised below.

Building regulations TER	26.9 kgCO2/m2/annum
Initial BER	36.3 kgCO2/m2/annum
Energy Efficient BER	24.7 kgCO2/m2/annum
Be Green Biomass/PV panels	15.9 kgCO2/m2/annum (38,701 kgCO2/annum)

The revised Be Green Biomass/PV panels CO_2 emission rate (BER) is equivalent to a predicted annual energy consumption of 69.5 kWh/m^2, a total of 169,163 kWh/annum but this is offset by 12,292kWh/annum generated from the PV panels.

Incorporating the non-controlled energy uses identified in section 2.4 of this report, the corrected energy consumption and CO_2 emissions are:

	Energy Consumption (kWh/annum)	**CO_2 Emissions (kg/annum)**
Building Regulations (TER)	227,482	86,950
Baseline building model (BER)	291,520	109,829
Building incorporating energy efficiency and demand reduction measures (BER)	204,967	81,595
Incorporating Air Source Heat Pumps	202,923	84,029
Incorporating Biomass Boilers	210,468	66,504
Incorporating Biogas Boilers	207,791	72,102
Incorporating 32 PV panels	200,635	74,717
Incorporating Biomass & 32 PV panels	203,385	59,139
Incorporating Biomass & 55 PV panels	198,249	53,796

Table 12 – Corrected Energy & Carbon Consumption

The energy consumption savings over and above the initial Baseline building model as a direct result of incorporating the energy efficiency and demand reduction measures and PV panel technology are 93,271 kWh/annum. This represents a 32.0% reduction in energy consumption and 51.0% decrease of carbon emissions.

It is also noted that the use of Biomass boilers to provide the heating and hot water for the development equates to 87,507kWh/annum which produces 2,713 kgCO2/annum. This is 41.5% of the annual energy demand of the development. With the addition of the PV array which produces 12,292kWh/annum this increases the percentage energy demand to 47.4% from low and zero carbon sources. This far exceeds the CP24 b) policy requirements of 10% of energy demand to be from decentralised and renewable or low carbon energy sources.

3.0 Summary

The predicted energy consumption for the proposed development is summarised below.

	Energy Consumption (kWh/annum)	**%age Improve-ment to baseline**	**CO_2 Emissions (kg/annum)**	**%age Improve-ment to baseline**
Building Regulations (TER)	227,482	21.9	86,950	20.8
Baseline building model (BER)	291,520	Baseline	109,829	Baseline
Building incorporating energy efficiency and demand reduction measures (BER) – Be Lean	204,967	29.7	81,595	25.7
Incorporating Air Source Heat Pumps	202,923	30.4	84,029	23.5
Incorporating Biomass Boilers	210,468	27.8	66,504	39.4
Incorporating Biogas Boilers	207,791	28.7	72,102	34.4
Incorporating 32 PV panels	200,635	31.2	74,717	32
Incorporating Biomass & 32 PV panels	203,385	30.2	59,139	46.2
Incorporating Biomass & 55 PV panels	198,249	32.0	53,796	51.0

Table 13 – Corrected Energy & Carbon Consumption Summary

As far as possible energy efficiency measures will be applied to the development to improve the performance compared to the minimum requirements in Part L of the Building Regulations and the baseline model.

The scheme will incorporate facilities using a combination of biomass boilers and PV panel array included within the scheme sized upon the developments heating and hot water requirements which will reduce carbon emissions by 56,033 kg CO_2/annum which is equivalent to a 51.0 % reduction compared to the Building Regulations TER.

A range of environmental design issues and opportunities for renewable energy use have been evaluated to achieve a sustainable approach to the proposed development. A combination of biomass boilers and PV panel array will be incorporated into the scheme as a source of renewable or low carbon energy.

Chart 1 below shows the reduction of energy consumption over the baseline building with the dotted line indicating the level required for Building Regulations compliance.

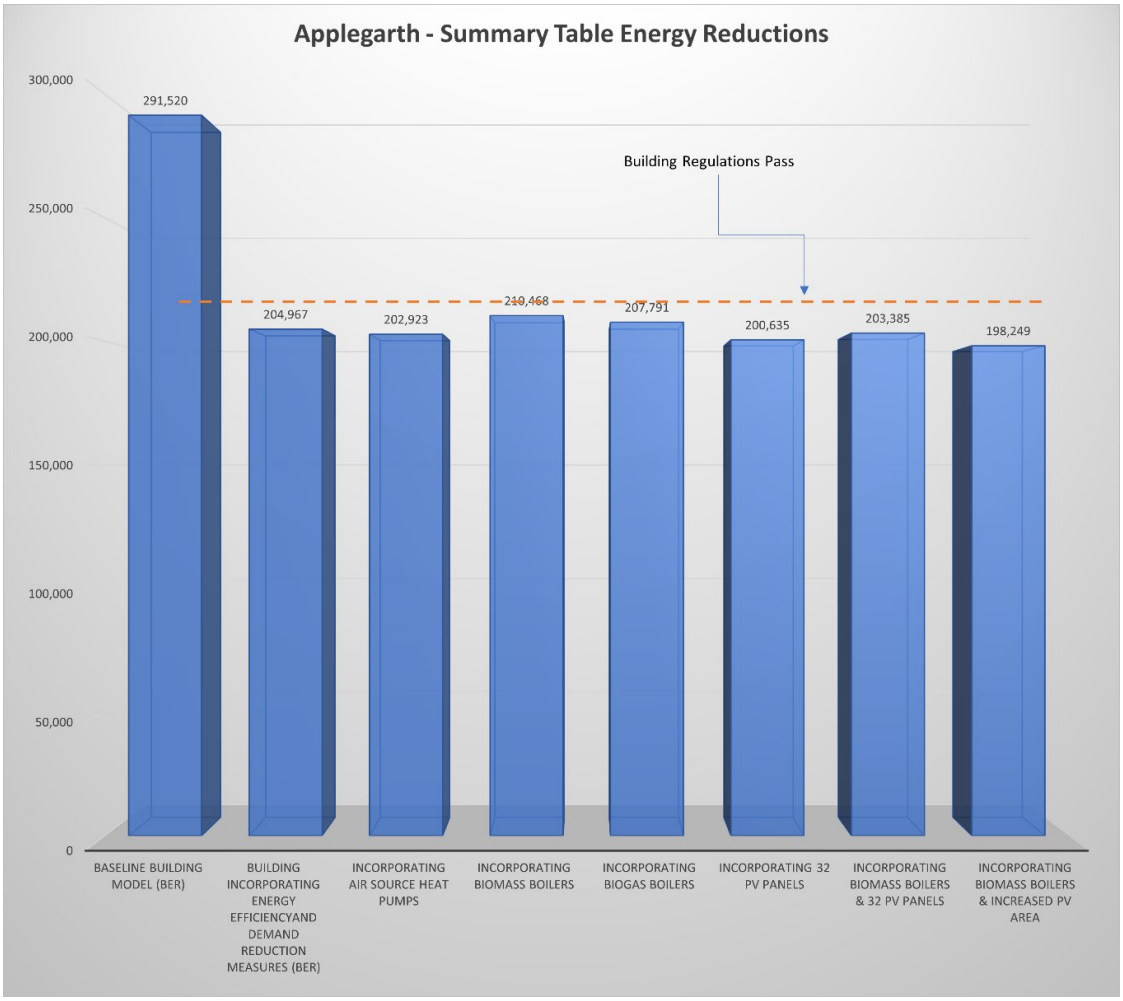


Chart 1 – Summary Table of Energy Reductions
(Note the dotted line shows the building regulations equivalent compliance level)

Chart 2 below shows the reduction of carbon emissions over the baseline building with the dotted line indicating the level required for Building Regulations compliance.

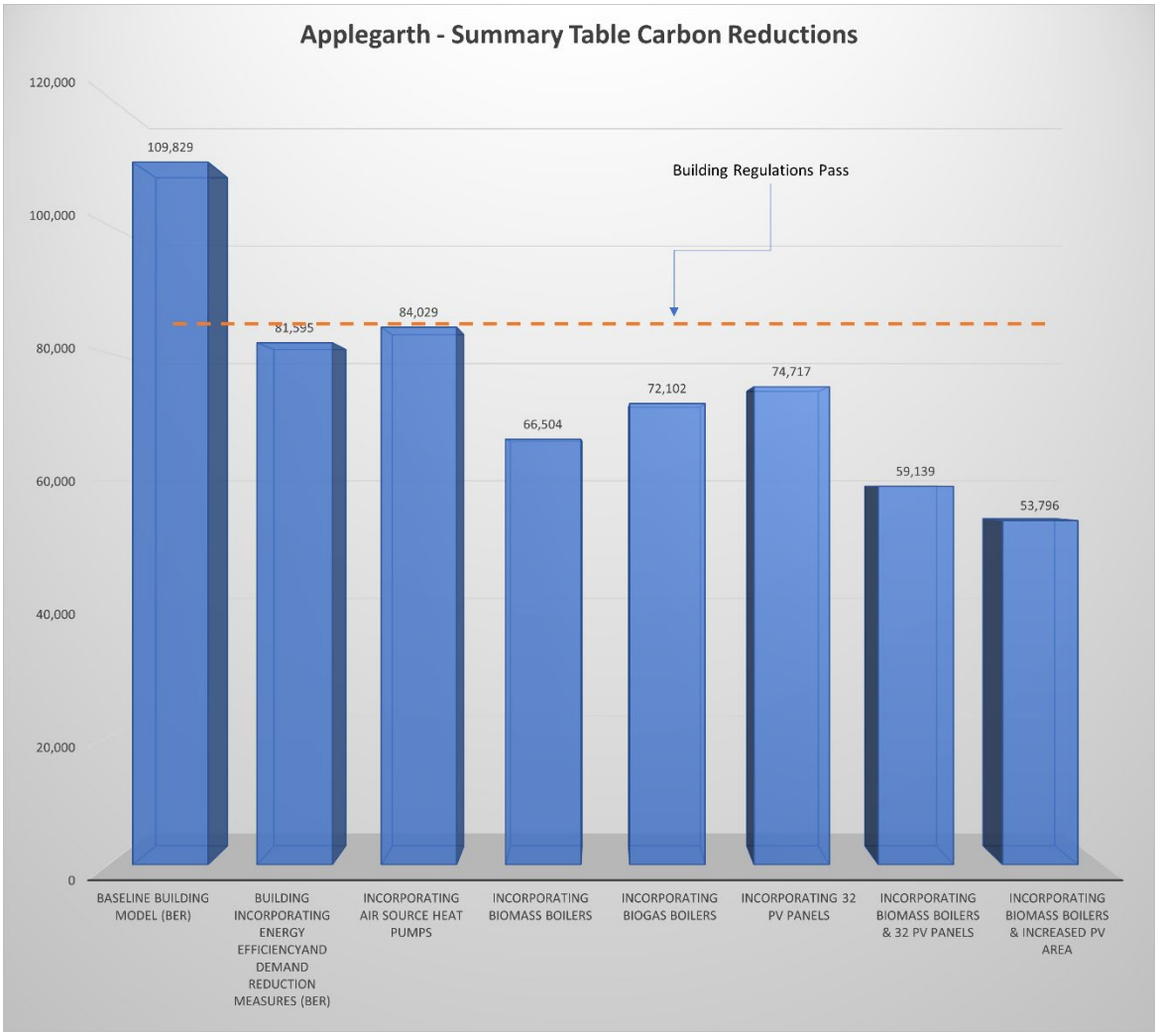


Chart 2 – Summary Table of Carbon Reductions
(Note the dotted line shows the building regulations equivalent compliance level)

The total predicted CO_2 emissions have been reduced by 38.1% (33,154 kg) over the Building Regulations compliant development target of 86,950 kgCO_2/annum and 51.0% (56,033 kg) over the Initial Baseline building model emissions of 109,829 kgCO_2/annum.

The use of Biomass boilers to provide the heating and hot water for the development equates to 87,507kWh/annum. With the addition of the PV array, this increases to 99,799 kWh/annum which is 47.4% from low and zero carbon sources. This far exceeds the CP24 b) policy requirements of 10% of energy demand to be from decentralised and renewable or low carbon energy sources.

For developments that would require a BREEAM assessment, the credit that would be assessed for Reduction of Energy Use & carbon emissions is ENE 01. As this development would be required to achieve BREEAM Excellent rating to meet Policy CP24 a), this credit would normally be required to achieve 4 credits as a minimum standard. Using a typical BREEAM assessment we can confirm this development would achieve 5 credits under this criterion thus exceeding the minimum standard.

Appendix One

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Applegarth Basebuild

As designed

Date: Mon Jan 04 19:04:52 2021

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.5.1"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.5.1

BRUKL compliance check version: v5.6.b.0

Certifier details

Name:

Telephone number:

Address: , ,

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

The building does not comply with England Building Regulations Part L 2013

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	26.9
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	26.9
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	36.3
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	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.35	0.35	External Wall
Floor	0.25	0.25	0.25	Ground Floor
Roof	0.25	0.25	0.25	Roof
Windows***, roof windows, and rooflights	2.2	1.75	1.77	Greenhouse
Personnel doors	2.2	2.18	2.18	Single Door
Vehicle access & similar large doors	1.5	-	-	No vehicle doors in project
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]

$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

* 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
$m^3/(h.m^2)$ at 50 Pa	10	10

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	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- New HVAC System

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

2- New HVAC System (3 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	-	-	-	-
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					NO

1- Hot Water Cyl

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.91	0
Standard value	0.9*	N/A

* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.

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
Retail 12 Staff Toilets	0.3	-	-	-	-	-	-	-	-	-	N/A
Restaurant 10 Female WC	0.3	-	-	-	-	-	-	-	-	-	N/A
Restaurant 11 Male WC	0.3	-	-	-	-	-	-	-	-	-	N/A

General lighting and display lighting

Zone name	Luminous efficacy [lm/W]			
	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
Retail 1 Goods In_out	-	60	-	359

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Retail 2 Stairs	-	60	-	251
Retail 3 Cold Stores	60	-	-	67
Retail 4 Dry Goods Store	60	-	-	23
Retail 5 Store Room	60	-	-	45
Retail 6 Collections Store Room	60	-	-	33
Retail 7 Retail Sales	-	60	22	9202
Retail 8 Plantroom	60	-	-	362
Retail 9 FF Circulation	-	60	-	45
Retail 10 Staff Room	60	-	-	500
Retail 11 Office	60	-	-	622
Retail 12 Staff Toilets	-	60	-	143
Restaurant 1 Chefs School Entrance	-	60	-	54
Restaurant 2 Chefs School Lobby	-	60	-	107
Restaurant 3 Chefs School	-	60	-	873
Restaurant 4 Chefs School Circulation	-	60	-	69
Restaurant 5 Cleaners	60	-	-	15
Restaurant 6 Store	60	-	-	8
Restaurant 7 Wine Tasting Room	-	60	22	143
Restaurant 8 Restaurant_Bar	-	60	22	1388
Restaurant 9 Cloak Room	60	-	-	13
Restaurant 10 Female WC	-	60	-	135
Restaurant 11 Male WC	-	60	-	137
Restaurant 12 Kitchen	-	60	-	2847
Restaurant 13 Dry Store	60	-	-	15
Restaurant 14 Store	60	-	-	54
Restaurant 15 Private Dining	-	60	22	186
Restaurant 16 Plantroom	60	-	-	1668
Retail 13 Freezer Zone	60	-	-	33

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?
Retail 7 Retail Sales	NO (-47%)	NO
Retail 10 Staff Room	N/A	N/A
Retail 11 Office	N/A	N/A
Restaurant 7 Wine Tasting Room	NO (-53%)	NO
Restaurant 8 Restaurant_Bar	NO (-44%)	NO
Restaurant 15 Private Dining	NO (-8%)	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]	2434	2434
External area [m²]	6545	6545
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	10	3
Average conductance [W/K]	3418	1764
Average U-value [W/m²K]	0.52	0.27
Alpha value* [%]	4.52	4.52

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

Building Use

% Area	Building Type
48	**A1/A2 Retail/Financial and Professional services**
52	**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
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
	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
	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	28.62	14.79
Cooling	0	0
Auxiliary	2.19	1.25
Lighting	44.25	34.37
Hot water	27.71	26.05
Equipment*	109.92	109.92
TOTAL**	**102.78**	**76.46**

* 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]	89.06	45.9
Primary energy* [kWh/m²]	211.32	156.45
Total emissions [kg/m²]	36.3	26.9

* 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] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	148.7	0	47.8	0	3.1	0.86	0	0.91	0
	Notional	76.9	0	26.1	0	1.6	0.82	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	40.5	0	13	0	13.6	0.86	0	0.91	0
	Notional	15	0	5.1	0	15.1	0.82	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	0.35	External Wall
Floor	0.2	0.25	Ground Floor
Roof	0.15	0.25	Roof
Windows, roof windows, and rooflights	1.5	1.67	Display Windows
Personnel doors	1.5	2.18	Barn Doors
Vehicle access & similar large doors	1.5	-	No vehicle doors in project
High usage entrance doors	1.5	-	No high usage entrance doors in project

$U_{i\text{-}Typ}$ = 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
m³/(h.m²) at 50 Pa	5	10

Appendix Two

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Applegarth Be Lean

As designed

Date: Mon Jan 04 21:05:52 2021

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.5.1"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.5.1

BRUKL compliance check version: v5.6.b.0

Certifier details

Name:

Telephone number:

Address: , ,

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

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	26.8
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	26.8
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	24.7
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	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.1	0.1	External Wall
Floor	0.25	0.15	0.15	Ground Floor
Roof	0.25	0.1	0.1	Roof
Windows***, roof windows, and rooflights	2.2	1.68	1.77	Greenhouse
Personnel doors	2.2	0.92	1.01	Single Door
Vehicle access & similar large doors	1.5	-	-	No vehicle doors in project
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]

$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

* 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
$m^3/(h.m^2)$ 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	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- New HVAC System

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.98	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

2- New HVAC System (3 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.98	-	-	-	-
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					NO

1- Hot Water Cyl

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.98	0
Standard value	0.9*	N/A

* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.

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**
Retail 12 Staff Toilets	0.2	-	-	-	-	-	-	-	-	-	N/A
Restaurant 10 Female WC	0.2	-	-	-	-	-	-	-	-	-	N/A
Restaurant 11 Male WC	0.2	-	-	-	-	-	-	-	-	-	N/A

General lighting and display lighting

Zone name	Luminous efficacy [lm/W]			
	Luminaire	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Retail 1 Goods In_out	-	100	-	215

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Retail 2 Stairs	-	100	-	151
Retail 3 Cold Stores	100	-	-	40
Retail 4 Dry Goods Store	100	-	-	14
Retail 5 Store Room	100	-	-	27
Retail 6 Collections Store Room	100	-	-	20
Retail 7 Retail Sales	-	100	22	5521
Retail 8 Plantroom	100	-	-	217
Retail 9 FF Circulation	-	100	-	27
Retail 10 Staff Room	100	-	-	300
Retail 11 Office	100	-	-	373
Retail 12 Staff Toilets	-	100	-	86
Restaurant 1 Chefs School Entrance	-	100	-	32
Restaurant 2 Chefs School Lobby	-	100	-	64
Restaurant 3 Chefs School	-	100	-	524
Restaurant 4 Chefs School Circulation	-	100	-	41
Restaurant 5 Cleaners	100	-	-	9
Restaurant 6 Store	100	-	-	5
Restaurant 7 Wine Tasting Room	-	100	22	86
Restaurant 8 Restaurant_Bar	-	100	22	833
Restaurant 9 Cloak Room	100	-	-	8
Restaurant 10 Female WC	-	100	-	81
Restaurant 11 Male WC	-	100	-	82
Restaurant 12 Kitchen	-	100	-	1708
Restaurant 13 Dry Store	100	-	-	9
Restaurant 14 Store	100	-	-	33
Restaurant 15 Private Dining	-	100	22	111
Restaurant 16 Plantroom	100	-	-	1001
Retail 13 Freezer Zone	100	-	-	20

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?
Retail 7 Retail Sales	NO (-48%)	NO
Retail 10 Staff Room	N/A	N/A
Retail 11 Office	N/A	N/A
Restaurant 7 Wine Tasting Room	NO (-53%)	NO
Restaurant 8 Restaurant_Bar	NO (-44%)	NO
Restaurant 15 Private Dining	NO (-9%)	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]	2434	2434
External area [m²]	6545	6545
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	2494	1764
Average U-value [W/m²K]	0.38	0.27
Alpha value* [%]	4.52	4.52

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

Building Use

% Area	Building Type
48	**A1/A2 Retail/Financial and Professional services**
52	**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
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
	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
	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	8.02	14.5
Cooling	0	0
Auxiliary	1.78	1.25
Lighting	31.68	34.37
Hot water	25.73	26.05
Equipment*	109.92	109.92
TOTAL**	**67.21**	**76.17**

* 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]	26.89	45
Primary energy* [kWh/m²]	143.91	156.1
Total emissions [kg/m²]	24.7	26.8

* 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] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	45.1	0	13.4	0	2.6	0.93	0	0.98	0
	Notional	75.4	0	25.6	0	1.6	0.82	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	8	0	2.4	0	9.7	0.93	0	0.98	0
	Notional	15	0	5.1	0	15.1	0.82	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	0.1	External Wall
Floor	0.2	0.15	Ground Floor
Roof	0.15	0.1	Roof
Windows, roof windows, and rooflights	1.5	1.21	Display Windows
Personnel doors	1.5	0.9	Barn Doors
Vehicle access & similar large doors	1.5	-	No vehicle doors in project
High usage entrance doors	1.5	-	No high usage entrance doors in project

$U_{i\text{-}Typ}$ = 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
m³/(h.m²) at 50 Pa	5	3

Appendix Three

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Applegarth

As designed

Date: Wed Jan 06 20:21:03 2021

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.5.1"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.5.1

BRUKL compliance check version: v5.6.b.0

Certifier details

Name:

Telephone number:

Address: , ,

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

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	32.4
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	32.4
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	25.7
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	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.1	0.1	External Wall
Floor	0.25	0.15	0.15	Ground Floor
Roof	0.25	0.1	0.1	Roof
Windows***, roof windows, and rooflights	2.2	1.68	1.77	Greenhouse
Personnel doors	2.2	0.92	1.01	Single Door
Vehicle access & similar large doors	1.5	-	-	No vehicle doors in project
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]

$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

* 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
$m^3/(h.m^2)$ 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	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- Nat Vent Zones

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

2- Nat Vent w Extract (3 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	-	-	-
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					NO

3- VRF & Nat Vent (7 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.5	6.5	-	-	-
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					NO

1- Hot Water Cyl

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.95	0
Standard value	0.9*	N/A
* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.		

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
Retail 12 Staff Toilets	0.3	-	-	-	-	-	-	-	-	-	N/A
Restaurant 10 Female WC	0.3	-	-	-	-	-	-	-	-	-	N/A
Restaurant 11 Male WC	0.3	-	-	-	-	-	-	-	-	-	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	
Retail 1 Goods In_out	-	100	-	215
Retail 2 Stairs	-	100	-	151
Retail 3 Cold Stores	100	-	-	40
Retail 4 Dry Goods Store	100	-	-	14
Retail 5 Store Room	100	-	-	27
Retail 6 Collections Store Room	100	-	-	20
Retail 7 Retail Sales	-	100	22	5521
Retail 8 Plantroom	100	-	-	217
Retail 9 FF Circulation	-	100	-	27
Retail 10 Staff Room	100	-	-	300
Retail 11 Office	100	-	-	373
Retail 12 Staff Toilets	-	100	-	86
Restaurant 1 Chefs School Entrance	-	100	-	32
Restaurant 2 Chefs School Lobby	-	100	-	64
Restaurant 3 Chefs School	-	100	-	524
Restaurant 4 Chefs School Circulation	-	100	-	41
Restaurant 5 Cleaners	100	-	-	9
Restaurant 6 Store	100	-	-	5
Restaurant 7 Wine Tasting Room	-	100	22	86
Restaurant 8 Restaurant_Bar	-	100	22	833
Restaurant 9 Cloak Room	100	-	-	8
Restaurant 10 Female WC	-	100	-	81
Restaurant 11 Male WC	-	100	-	82
Restaurant 12 Kitchen	-	100	-	1708
Restaurant 13 Dry Store	100	-	-	9
Restaurant 14 Store	100	-	-	33
Restaurant 15 Private Dining	-	100	22	111
Restaurant 16 Plantroom	100	-	-	1001
Retail 13 Freezer Zone	100	-	-	20

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?
Retail 7 Retail Sales	NO (-48%)	NO
Retail 10 Staff Room	N/A	N/A
Retail 11 Office	N/A	N/A
Restaurant 3 Chefs School	N/A	N/A
Restaurant 7 Wine Tasting Room	NO (-53%)	NO
Restaurant 8 Restaurant_Bar	NO (-44%)	NO
Restaurant 15 Private Dining	NO (-9%)	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]	2434	2434
External area [m²]	6545	6545
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	2494	1764
Average U-value [W/m²K]	0.38	0.27
Alpha value* [%]	4.52	4.52

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

Building Use

% Area	Building Type
48	**A1/A2 Retail/Financial and Professional services**
52	**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
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
	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
	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	3.16	10.08
Cooling	4.28	10.33
Auxiliary	0.7	0.58
Lighting	31.68	34.37
Hot water	26.55	26.05
Equipment*	109.92	109.92
TOTAL**	**66.36**	**81.4**

* 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]	120.1	207.65
Primary energy* [kWh/m²]	150.48	189.91
Total emissions [kg/m²]	25.7	32.4

* 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] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	48.2	0	14.8	0	2.4	0.9	0	0.95	0
	Notional	87.8	0	29.8	0	1.4	0.82	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	4.8	0	1.5	0	13	0.9	0	0.95	0
	Notional	9.4	0	3.2	0	15.1	0.82	0	----	----
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	29.1	193.4	1.8	8.4	0	4.41	6.37	4.5	6.5
	Notional	9	277.8	1	21.4	0	2.43	3.6	----	----

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	0.1	External Wall
Floor	0.2	0.15	Ground Floor
Roof	0.15	0.1	Roof
Windows, roof windows, and rooflights	1.5	1.21	Display Windows
Personnel doors	1.5	0.9	Barn Doors
Vehicle access & similar large doors	1.5	-	No vehicle doors in project
High usage entrance doors	1.5	-	No high usage entrance doors in project

$U_{i\text{-}Typ}$ = 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
m³/(h.m²) at 50 Pa	5	3

Appendix Four

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Applegarth Biomass

As designed

Date: Wed Jan 06 20:49:31 2021

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.5.1"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.5.1

BRUKL compliance check version: v5.6.b.0

Certifier details

Name:

Telephone number:

Address: , ,

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

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	19.7
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	19.7
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	18.5
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	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.1	0.1	External Wall
Floor	0.25	0.15	0.15	Ground Floor
Roof	0.25	0.1	0.1	Roof
Windows***, roof windows, and rooflights	2.2	1.68	1.77	Greenhouse
Personnel doors	2.2	0.92	1.01	Single Door
Vehicle access & similar large doors	1.5	-	-	No vehicle doors in project
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]

$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

* 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
$m^3/(h.m^2)$ 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	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- Nat Vent

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.92	-	-	-	-
Standard value	0.75	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

2- Nat Vent w Extract (3 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.92	-	-	-	-
Standard value	0.75	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

1- Hot Water Cyl

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.92	0
Standard value	0.9*	N/A
* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.		

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**
Retail 12 Staff Toilets	0.3	-	-	-	-	-	-	-	-	-	N/A
Restaurant 10 Female WC	0.3	-	-	-	-	-	-	-	-	-	N/A
Restaurant 11 Male WC	0.3	-	-	-	-	-	-	-	-	-	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	
Retail 1 Goods In_out	-	100	-	215
Retail 2 Stairs	-	100	-	151
Retail 3 Cold Stores	100	-	-	40

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Retail 4 Dry Goods Store	100	-	-	14
Retail 5 Store Room	100	-	-	27
Retail 6 Collections Store Room	100	-	-	20
Retail 7 Retail Sales	-	100	22	5521
Retail 8 Plantroom	100	-	-	217
Retail 9 FF Circulation	-	100	-	27
Retail 10 Staff Room	100	-	-	300
Retail 11 Office	100	-	-	373
Retail 12 Staff Toilets	-	100	-	86
Restaurant 1 Chefs School Entrance	-	100	-	32
Restaurant 2 Chefs School Lobby	-	100	-	64
Restaurant 3 Chefs School	-	100	-	524
Restaurant 4 Chefs School Circulation	-	100	-	41
Restaurant 5 Cleaners	100	-	-	9
Restaurant 6 Store	100	-	-	5
Restaurant 7 Wine Tasting Room	-	100	22	86
Restaurant 8 Restaurant_Bar	-	100	22	833
Restaurant 9 Cloak Room	100	-	-	8
Restaurant 10 Female WC	-	100	-	81
Restaurant 11 Male WC	-	100	-	82
Restaurant 12 Kitchen	-	100	-	1708
Restaurant 13 Dry Store	100	-	-	9
Restaurant 14 Store	100	-	-	33
Restaurant 15 Private Dining	-	100	22	111
Restaurant 16 Plantroom	100	-	-	1001
Retail 13 Freezer Zone	100	-	-	20

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?
Retail 7 Retail Sales	NO (-48%)	NO
Retail 10 Staff Room	N/A	N/A
Retail 11 Office	N/A	N/A
Restaurant 7 Wine Tasting Room	NO (-53%)	NO
Restaurant 8 Restaurant_Bar	NO (-44%)	NO
Restaurant 15 Private Dining	NO (-9%)	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]	2434	2434
External area [m²]	6545	6545
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	2494	1764
Average U-value [W/m²K]	0.38	0.27
Alpha value* [%]	4.52	4.52

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

Building Use

% Area	Building Type
48	**A1/A2 Retail/Financial and Professional services**
52	**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
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
	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
	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	8.54	18.85
Cooling	0	0
Auxiliary	1.84	1.25
Lighting	31.68	34.37
Hot water	27.41	33.86
Equipment*	109.92	109.92
TOTAL**	**69.47**	**88.33**

* 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]	26.89	45
Primary energy* [kWh/m²]	139.21	159.86
Total emissions [kg/m²]	18.5	19.7

* 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] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Biomass, [CFT] Electricity										
	Actual	45.1	0	14.3	0	2.6	0.87	0	0.92	0
	Notional	75.4	0	33.2	0	1.6	0.63	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Biomass, [CFT] Electricity										
	Actual	8	0	2.5	0	11.8	0.87	0	0.92	0
	Notional	15	0	6.6	0	15.1	0.63	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	0.1	External Wall
Floor	0.2	0.15	Ground Floor
Roof	0.15	0.1	Roof
Windows, roof windows, and rooflights	1.5	1.21	Display Windows
Personnel doors	1.5	0.9	Barn Doors
Vehicle access & similar large doors	1.5	-	No vehicle doors in project
High usage entrance doors	1.5	-	No high usage entrance doors in project

$U_{i\text{-}Typ}$ = 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
m³/(h.m²) at 50 Pa	5	3

Appendix Five

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Applegarth Biogas

As designed

Date: Wed Jan 06 21:06:12 2021

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.5.1"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.5.1

BRUKL compliance check version: v5.6.b.0

Certifier details

Name:

Telephone number:

Address: , ,

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

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	23.2
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	23.2
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	20.8
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	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.1	0.1	External Wall
Floor	0.25	0.15	0.15	Ground Floor
Roof	0.25	0.1	0.1	Roof
Windows***, roof windows, and rooflights	2.2	1.68	1.77	Greenhouse
Personnel doors	2.2	0.92	1.01	Single Door
Vehicle access & similar large doors	1.5	-	-	No vehicle doors in project
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]

$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

* 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
$m^3/(h.m^2)$ 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	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- Nat Vent

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

2- Nat Vent w Extract (3 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

1- Hot Water Cyl

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.95	0
Standard value	0.9*	N/A

* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.

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**
Retail 12 Staff Toilets	0.3	-	-	-	-	-	-	-	-	-	N/A
Restaurant 10 Female WC	0.3	-	-	-	-	-	-	-	-	-	N/A
Restaurant 11 Male WC	0.3	-	-	-	-	-	-	-	-	-	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	
Retail 1 Goods In_out	-	100	-	215

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Retail 2 Stairs	-	100	-	151
Retail 3 Cold Stores	100	-	-	40
Retail 4 Dry Goods Store	100	-	-	14
Retail 5 Store Room	100	-	-	27
Retail 6 Collections Store Room	100	-	-	20
Retail 7 Retail Sales	-	100	22	5521
Retail 8 Plantroom	100	-	-	217
Retail 9 FF Circulation	-	100	-	27
Retail 10 Staff Room	100	-	-	300
Retail 11 Office	100	-	-	373
Retail 12 Staff Toilets	-	100	-	86
Restaurant 1 Chefs School Entrance	-	100	-	32
Restaurant 2 Chefs School Lobby	-	100	-	64
Restaurant 3 Chefs School	-	100	-	524
Restaurant 4 Chefs School Circulation	-	100	-	41
Restaurant 5 Cleaners	100	-	-	9
Restaurant 6 Store	100	-	-	5
Restaurant 7 Wine Tasting Room	-	100	22	86
Restaurant 8 Restaurant_Bar	-	100	22	833
Restaurant 9 Cloak Room	100	-	-	8
Restaurant 10 Female WC	-	100	-	81
Restaurant 11 Male WC	-	100	-	82
Restaurant 12 Kitchen	-	100	-	1708
Restaurant 13 Dry Store	100	-	-	9
Restaurant 14 Store	100	-	-	33
Restaurant 15 Private Dining	-	100	22	111
Restaurant 16 Plantroom	100	-	-	1001
Retail 13 Freezer Zone	100	-	-	20

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?
Retail 7 Retail Sales	NO (-48%)	NO
Retail 10 Staff Room	N/A	N/A
Retail 11 Office	N/A	N/A
Restaurant 7 Wine Tasting Room	NO (-53%)	NO
Restaurant 8 Restaurant_Bar	NO (-44%)	NO
Restaurant 15 Private Dining	NO (-9%)	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]	2434	2434
External area [m²]	6545	6545
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	2494	1764
Average U-value [W/m²K]	0.38	0.27
Alpha value* [%]	4.52	4.52

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

Building Use

% Area	Building Type
48	**A1/A2 Retail/Financial and Professional services**
52	**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
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
	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
	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	8.27	18.85
Cooling	0	0
Auxiliary	1.87	1.25
Lighting	31.68	34.37
Hot water	26.55	33.86
Equipment*	109.92	109.92
TOTAL**	**68.37**	**88.33**

* 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]	26.89	45
Primary energy* [kWh/m²]	141.3	164.61
Total emissions [kg/m²]	20.8	23.2

* 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] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Biogas, [CFT] Electricity										
	Actual	45.1	0	13.9	0	2.6	0.9	0	0.95	0
	Notional	75.4	0	33.2	0	1.6	0.63	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Biogas, [CFT] Electricity										
	Actual	8	0	2.5	0	13	0.9	0	0.95	0
	Notional	15	0	6.6	0	15.1	0.63	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	0.1	External Wall
Floor	0.2	0.15	Ground Floor
Roof	0.15	0.1	Roof
Windows, roof windows, and rooflights	1.5	1.21	Display Windows
Personnel doors	1.5	0.9	Barn Doors
Vehicle access & similar large doors	1.5	-	No vehicle doors in project
High usage entrance doors	1.5	-	No high usage entrance doors in project

$U_{i\text{-}Typ}$ = 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
m³/(h.m²) at 50 Pa	5	3

Appendix Six

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Applegarth PV 32 panels

As designed

Date: Wed Jan 13 18:48:32 2021

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.5.1"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.5.1

BRUKL compliance check version: v5.6.b.0

Certifier details

Name:

Telephone number:

Address: , ,

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

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	26.8
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	26.8
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	23.4
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	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.1	0.1	External Wall
Floor	0.25	0.15	0.15	Ground Floor
Roof	0.25	0.1	0.1	Roof
Windows***, roof windows, and rooflights	2.2	1.68	1.77	Greenhouse
Personnel doors	2.2	0.92	1.01	Single Door
Vehicle access & similar large doors	1.5	-	-	No vehicle doors in project
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]

$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

* 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
$m^3/(h.m^2)$ 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	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- Nat Vent

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

2- Nat Vent w Extract (3 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

1- Hot Water Cyl

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.95	0
Standard value	0.9*	N/A

* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.

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**
Retail 12 Staff Toilets	0.3	-	-	-	-	-	-	-	-	-	N/A
Restaurant 10 Female WC	0.3	-	-	-	-	-	-	-	-	-	N/A
Restaurant 11 Male WC	0.3	-	-	-	-	-	-	-	-	-	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	
Retail 1 Goods In_out	-	100	-	215

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Retail 2 Stairs	-	100	-	151
Retail 3 Cold Stores	100	-	-	40
Retail 4 Dry Goods Store	100	-	-	14
Retail 5 Store Room	100	-	-	27
Retail 6 Collections Store Room	100	-	-	20
Retail 7 Retail Sales	-	100	22	5521
Retail 8 Plantroom	100	-	-	217
Retail 9 FF Circulation	-	100	-	27
Retail 10 Staff Room	100	-	-	300
Retail 11 Office	100	-	-	373
Retail 12 Staff Toilets	-	100	-	86
Restaurant 1 Chefs School Entrance	-	100	-	32
Restaurant 2 Chefs School Lobby	-	100	-	64
Restaurant 3 Chefs School	-	100	-	524
Restaurant 4 Chefs School Circulation	-	100	-	41
Restaurant 5 Cleaners	100	-	-	9
Restaurant 6 Store	100	-	-	5
Restaurant 7 Wine Tasting Room	-	100	22	86
Restaurant 8 Restaurant_Bar	-	100	22	833
Restaurant 9 Cloak Room	100	-	-	8
Restaurant 10 Female WC	-	100	-	81
Restaurant 11 Male WC	-	100	-	82
Restaurant 12 Kitchen	-	100	-	1708
Restaurant 13 Dry Store	100	-	-	9
Restaurant 14 Store	100	-	-	33
Restaurant 15 Private Dining	-	100	22	111
Restaurant 16 Plantroom	100	-	-	1001
Retail 13 Freezer Zone	100	-	-	20

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?
Retail 7 Retail Sales	NO (-48%)	NO
Retail 10 Staff Room	N/A	N/A
Retail 11 Office	N/A	N/A
Restaurant 7 Wine Tasting Room	NO (-53%)	NO
Restaurant 8 Restaurant_Bar	NO (-44%)	NO
Restaurant 15 Private Dining	NO (-9%)	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]	2434	2434
External area [m²]	6545	6545
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	2494	1764
Average U-value [W/m²K]	0.38	0.27
Alpha value* [%]	4.52	4.52

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

Building Use

% Area	Building Type
48	**A1/A2 Retail/Financial and Professional services**
52	**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
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
	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
	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	8.27	14.5
Cooling	0	0
Auxiliary	1.87	1.25
Lighting	31.68	34.37
Hot water	26.55	26.05
Equipment*	109.92	109.92
TOTAL**	**68.37**	**76.17**

* 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	2.94	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]	26.89	45
Primary energy* [kWh/m²]	145.48	156.1
Total emissions [kg/m²]	23.4	26.8

* 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] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	45.1	0	13.9	0	2.6	0.9	0	0.95	0
	Notional	75.4	0	25.6	0	1.6	0.82	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	8	0	2.5	0	13	0.9	0	0.95	0
	Notional	15	0	5.1	0	15.1	0.82	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	0.1	External Wall
Floor	0.2	0.15	Ground Floor
Roof	0.15	0.1	Roof
Windows, roof windows, and rooflights	1.5	1.21	Display Windows
Personnel doors	1.5	0.9	Barn Doors
Vehicle access & similar large doors	1.5	-	No vehicle doors in project
High usage entrance doors	1.5	-	No high usage entrance doors in project

$U_{i\text{-}Typ}$ = 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
m³/(h.m²) at 50 Pa	5	3

Appendix Seven

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Applegarth Biomass Biomass w PV

As designed

Date: Wed Jan 13 19:24:16 2021

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.5.1"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.5.1

BRUKL compliance check version: v5.6.b.0

Certifier details

Name:

Telephone number:

Address: , ,

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

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	19.7
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	19.7
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	17
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	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.1	0.1	External Wall
Floor	0.25	0.15	0.15	Ground Floor
Roof	0.25	0.1	0.1	Roof
Windows***, roof windows, and rooflights	2.2	1.68	1.77	Greenhouse
Personnel doors	2.2	0.92	1.01	Single Door
Vehicle access & similar large doors	1.5	-	-	No vehicle doors in project
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]

$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

* 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
$m^3/(h.m^2)$ 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	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- Nat Vent

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.92	-	-	-	-
Standard value	0.75	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

2- Nat Vent w Extract (3 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.92	-	-	-	-
Standard value	0.75	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

1- Hot Water Cyl

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.92	0
Standard value	0.9*	N/A
* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.		

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**
Retail 12 Staff Toilets	0.3	-	-	-	-	-	-	-	-	-	N/A
Restaurant 10 Female WC	0.3	-	-	-	-	-	-	-	-	-	N/A
Restaurant 11 Male WC	0.3	-	-	-	-	-	-	-	-	-	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	
Retail 1 Goods In_out	-	100	-	215
Retail 2 Stairs	-	100	-	151
Retail 3 Cold Stores	100	-	-	40

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Retail 4 Dry Goods Store	100	-	-	14
Retail 5 Store Room	100	-	-	27
Retail 6 Collections Store Room	100	-	-	20
Retail 7 Retail Sales	-	100	22	5521
Retail 8 Plantroom	100	-	-	217
Retail 9 FF Circulation	-	100	-	27
Retail 10 Staff Room	100	-	-	300
Retail 11 Office	100	-	-	373
Retail 12 Staff Toilets	-	100	-	86
Restaurant 1 Chefs School Entrance	-	100	-	32
Restaurant 2 Chefs School Lobby	-	100	-	64
Restaurant 3 Chefs School	-	100	-	524
Restaurant 4 Chefs School Circulation	-	100	-	41
Restaurant 5 Cleaners	100	-	-	9
Restaurant 6 Store	100	-	-	5
Restaurant 7 Wine Tasting Room	-	100	22	86
Restaurant 8 Restaurant_Bar	-	100	22	833
Restaurant 9 Cloak Room	100	-	-	8
Restaurant 10 Female WC	-	100	-	81
Restaurant 11 Male WC	-	100	-	82
Restaurant 12 Kitchen	-	100	-	1708
Restaurant 13 Dry Store	100	-	-	9
Restaurant 14 Store	100	-	-	33
Restaurant 15 Private Dining	-	100	22	111
Restaurant 16 Plantroom	100	-	-	1001
Retail 13 Freezer Zone	100	-	-	20

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?
Retail 7 Retail Sales	NO (-48%)	NO
Retail 10 Staff Room	N/A	N/A
Retail 11 Office	N/A	N/A
Restaurant 7 Wine Tasting Room	NO (-53%)	NO
Restaurant 8 Restaurant_Bar	NO (-44%)	NO
Restaurant 15 Private Dining	NO (-9%)	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]	2434	2434
External area [m²]	6545	6545
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	2494	1764
Average U-value [W/m²K]	0.38	0.27
Alpha value* [%]	4.52	4.52

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

Building Use

% Area	Building Type
48	**A1/A2 Retail/Financial and Professional services**
52	**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
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
	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
	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	8.54	18.85
Cooling	0	0
Auxiliary	1.87	1.25
Lighting	31.68	34.37
Hot water	27.41	33.86
Equipment*	109.92	109.92
TOTAL**	**69.51**	**88.33**

* 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	2.94	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]	26.89	45
Primary energy* [kWh/m²]	139.32	159.86
Total emissions [kg/m²]	17	19.7

* 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] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Biomass, [CFT] Electricity										
	Actual	45.1	0	14.3	0	2.6	0.87	0	0.92	0
	Notional	75.4	0	33.2	0	1.6	0.63	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Biomass, [CFT] Electricity										
	Actual	8	0	2.5	0	13	0.87	0	0.92	0
	Notional	15	0	6.6	0	15.1	0.63	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	0.1	External Wall
Floor	0.2	0.15	Ground Floor
Roof	0.15	0.1	Roof
Windows, roof windows, and rooflights	1.5	1.21	Display Windows
Personnel doors	1.5	0.9	Barn Doors
Vehicle access & similar large doors	1.5	-	No vehicle doors in project
High usage entrance doors	1.5	-	No high usage entrance doors in project

$U_{i\text{-}Typ}$ = 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
m³/(h.m²) at 50 Pa	5	3

Appendix Eight

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Applegarth Biomass Biomass w 55 PV panels

As designed

Date: Thu Jan 21 11:51:12 2021

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.5.1"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.5.1

BRUKL compliance check version: v5.6.b.0

Certifier details

Name:

Telephone number:

Address: , ,

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

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	19.7
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	19.7
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	15.9
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	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.1	0.1	External Wall
Floor	0.25	0.15	0.15	Ground Floor
Roof	0.25	0.1	0.1	Roof
Windows***, roof windows, and rooflights	2.2	1.68	1.77	Greenhouse
Personnel doors	2.2	0.92	1.01	Single Door
Vehicle access & similar large doors	1.5	-	-	No vehicle doors in project
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]

$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

* 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
$m^3/(h.m^2)$ 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	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- Nat Vent

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.92	-	-	-	-
Standard value	0.75	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

2- Nat Vent w Extract (3 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.92	-	-	-	-
Standard value	0.75	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

1- Hot Water Cyl

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.92	0
Standard value	0.9*	N/A
* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.		

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**
Retail 12 Staff Toilets	0.3	-	-	-	-	-	-	-	-	-	N/A
Restaurant 10 Female WC	0.3	-	-	-	-	-	-	-	-	-	N/A
Restaurant 11 Male WC	0.3	-	-	-	-	-	-	-	-	-	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	
Retail 1 Goods In_out	-	100	-	215
Retail 2 Stairs	-	100	-	151
Retail 3 Cold Stores	100	-	-	40

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Retail 4 Dry Goods Store	100	-	-	14
Retail 5 Store Room	100	-	-	27
Retail 6 Collections Store Room	100	-	-	20
Retail 7 Retail Sales	-	100	22	5521
Retail 8 Plantroom	100	-	-	217
Retail 9 FF Circulation	-	100	-	27
Retail 10 Staff Room	100	-	-	300
Retail 11 Office	100	-	-	373
Retail 12 Staff Toilets	-	100	-	86
Restaurant 1 Chefs School Entrance	-	100	-	32
Restaurant 2 Chefs School Lobby	-	100	-	64
Restaurant 3 Chefs School	-	100	-	524
Restaurant 4 Chefs School Circulation	-	100	-	41
Restaurant 5 Cleaners	100	-	-	9
Restaurant 6 Store	100	-	-	5
Restaurant 7 Wine Tasting Room	-	100	22	86
Restaurant 8 Restaurant_Bar	-	100	22	833
Restaurant 9 Cloak Room	100	-	-	8
Restaurant 10 Female WC	-	100	-	81
Restaurant 11 Male WC	-	100	-	82
Restaurant 12 Kitchen	-	100	-	1708
Restaurant 13 Dry Store	100	-	-	9
Restaurant 14 Store	100	-	-	33
Restaurant 15 Private Dining	-	100	22	111
Restaurant 16 Plantroom	100	-	-	1001
Retail 13 Freezer Zone	100	-	-	20

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?
Retail 7 Retail Sales	NO (-48%)	NO
Retail 10 Staff Room	N/A	N/A
Retail 11 Office	N/A	N/A
Restaurant 7 Wine Tasting Room	NO (-53%)	NO
Restaurant 8 Restaurant_Bar	NO (-44%)	NO
Restaurant 15 Private Dining	NO (-9%)	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]	2434	2434
External area [m²]	6545	6545
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	2494	1764
Average U-value [W/m²K]	0.38	0.27
Alpha value* [%]	4.52	4.52

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

Building Use

% Area	Building Type
48	**A1/A2 Retail/Financial and Professional services**
52	**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
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
	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
	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	8.54	18.85
Cooling	0	0
Auxiliary	1.87	1.25
Lighting	31.68	34.37
Hot water	27.41	33.86
Equipment*	109.92	109.92
TOTAL**	**69.51**	**88.33**

* 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	5.05	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]	26.89	45
Primary energy* [kWh/m²]	139.32	159.86
Total emissions [kg/m²]	15.9	19.7

* 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] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Biomass, [CFT] Electricity										
	Actual	45.1	0	14.3	0	2.6	0.87	0	0.92	0
	Notional	75.4	0	33.2	0	1.6	0.63	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Biomass, [CFT] Electricity										
	Actual	8	0	2.5	0	13	0.87	0	0.92	0
	Notional	15	0	6.6	0	15.1	0.63	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	0.1	External Wall
Floor	0.2	0.15	Ground Floor
Roof	0.15	0.1	Roof
Windows, roof windows, and rooflights	1.5	1.21	Display Windows
Personnel doors	1.5	0.9	Barn Doors
Vehicle access & similar large doors	1.5	-	No vehicle doors in project
High usage entrance doors	1.5	-	No high usage entrance doors in project

$U_{i\text{-}Typ}$ = 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
m³/(h.m²) at 50 Pa	5	3