Engineering
Services Design

Project	The Homestead
Report	Sustainability & Energy Strategy
Ref	HDC_ESD_XX_XX_RP_1000
Client.	

Produced	B. Lancashire
Approved	R. Gordon
Date	24.01.2022

Document Revision Sheet

REV	CHANGES	PRODUCED	CHECKED	APPROVED	DATE
P1	-	B.Lancashire	R.Gordon	R.Gordon	28.09.2021
P2	Change in fuel strategy	B.Lancashire	R.Gordon	R.Gordon	24.01.2022

1.0 EXECUTIVE SUMMARY

This report outlines the scheme approach to delivering sustainability and energy / carbon reduction for The Homestead, Almondbury.

A review of the National and Local planning requirements as well as Kirklees design standards has been undertaken as part of this process in order to demonstrate that careful consideration has been given with regards to any prescriptive energy reduction and low zero carbon technology related policies and requirements.

A holistic energy hierarchy approach based on first principals and sound engineering judgement together with a fabric first approach has been followed for the scheme to provide an integrated sustainability strategy for the scheme (Figure 1).

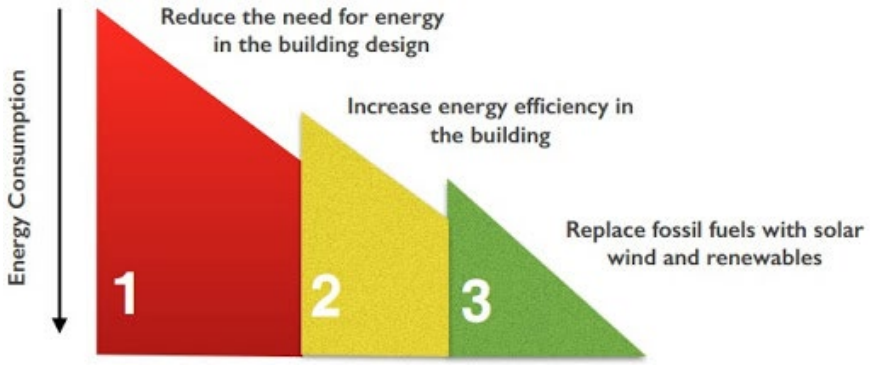

Figure 1: Energy Hierarchy Approach

The new building has been designed to minimise its energy consumption following a fabric first approach. Building U-values will exceed the current Part L2A standards, maximising daylight will be balanced with minimising excessive solar gain and the building will look to achieve high levels of air tightness reducing heat loss. Where the new building does draw energy it will do so efficiently making benefit of technologies such as; LED lighting and automatic controls and air source heat pumps (ASHP) providing heating and hot water. The building will be fossil fuel free.

In order to meet the LZC aspirations in Kirklees Metropolitan Council Policy LP 26 (Renewable and Low Caron Energy) and Building Regulation 25B this report has assessed the impact of incorporating a roof mounted photovoltaic array to offset grid supplied electricity consumption and ASHP to meet the buildings heating and hot water demands.

2.0 INTRODUCTION

The purpose of this document is to present the holistic sustainability strategy for The Homestead, whilst outlining the background planning and Kirklees design requirements that will need to be complied with alongside defining the potential suitable LZC technologies and the predicted energy benefits as a result of these installations.

The project will comprise the construction of a new single storey Dementia Day Care Centre that will provide dementia day care places in the Almondbury. The surrounding plot will be extensively landscaped to provide secure outdoor garden spaces and car parking.

An integrated approach has been taken to sustainability throughout the initial design process in order that the scheme can maximise the potential for energy reduction, meeting the requirements of the Local Planning Authority whilst achieving the Client and End User brief. The subsequent sections of this report detail the approach to meet the above requirements and in addition detail the

key features of the building services strategy.

3.0 PLANNING POLICY REVIEW

3.1 ENGLAND NATIONAL PLANNING POLICY

The National Planning Policy Framework (NPPF) requires local plans to plan positively to deliver renewable and low carbon technology developments. This is to help tackle climate change and address the environmental role of planning as set out in the NPPF. This is to help to meet the UK's legally binding target to reduce carbon emissions to Net Zero on 1990 levels by 2050. It is estimated that almost half of the UK's carbon emissions comes from energy use in buildings.

The National Planning Policy Guidance (NPPG) provides further clarity, stating that policies should be set to promote renewable and low carbon technologies, and these should be based on evidence that considers the opportunities for different types of technologies, the possible opportunities for district heat networks and consideration of the landscape impacts of these technologies.

3.1 KIRKLEES COUNCIL LOCAL PLANNING POLICY

This section summarises the key Kirklees Local planning requirements that will need to be integrated into the scheme in order to meet the specific requirements with regards to sustainability and providing low energy building as part of the scheme design procurement.

In the context of the local Sustainable Planning Guidance the following local policies from the Kirklees Local Plan are summarised below:

- LP24 - Design
- LP26 - Renewable and Low Carbon Energy

<u>LP24 - Design</u>

This policy states that:
"Proposals should promote good design by ensuring… high levels of sustainability, to a degree proportionate to the proposal… where practicable, minimising resource use in the building by orientating buildings to utilise passive solar design. This includes encouraging the incorporation of vegetation and tree planting to assist heating and cooling and considering the use of renewable energy"

<u>LP26 - Renewable and Low Carbon Energy</u>

This policy states that:
"Renewable and low carbon energy proposals (excluding wind) will be supported and planning permission granted where the following criteria are met:

a) the proposal would not have an unacceptable impact on landscape character and visual appearance of the local area, including the urban environment;
b) the proposal would not have either individually or cumulatively an unacceptable impact on protected species, designated sites of importance for biodiversity or heritage assets;
c) the statutory protection of any area would not be compromised by the development;
d) any noise, odour, traffic or other impact of development is mitigated so as not to cause unacceptable detriment to local amenity;
e) any significant adverse effects of the proposal are mitigated by wider environmental, social and economic benefits."

3.1 KIRKLEES COUNCIL SUSTAINABLE DESIGN STANDARDS

The scheme design is also required to meet the sustainable design requirements set out within the Kirklees Council Dementia Day Care standards document. The key sustainable design requirement within this document states "*The premises shall comply with the Statutory guidance 'Conservation of fuel and power: Approved Document L' without any LZC Technologies installed*."

The primary focus on achieving this requirement is:

- Achieving better than standard U-values and air permeability rates,
- Incorporation of energy efficient building services,
- Optimising performance of the selected building services.

The secondary focus on achieving this requirement and to contribute to 'Kirklees Council Climate Emergency' is:

- The incorporation of suitable Low Zero Carbon Technologies.

4.0 SUSTAINABILITY STRATEGY

In order to address the requirements of sustainability within the scheme design, as part of the National and Local planning strategy guidance as well as the wider End User brief, the following general approach has been taken that considers the specific requirement's as well as wider view with regards to sustainable design:

Figure 2: Sustainable Integrated Design Approach for the Scheme

Sustainable design has become a key issue within the UK and with particular focus on the construction industry and with the ever-increasing targets in relation to reducing energy consumption and CO_2 emissions.

In order for the building to meet the necessary targets, it is essential that certain measures be implemented during design and procurement process. Sustainability is a critical focus of the design and the scheme will implement an approach based upon the "Energy Hierarchy Approach" to sustainable building design in order to minimise the potential impact of the building on the environment.

The Energy Hierarchy Approach that will be followed in this context is described below:

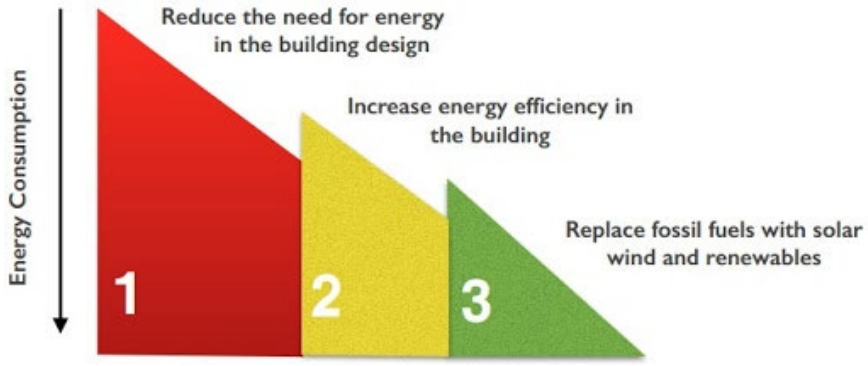

Figure 3: Sustainable Design and the Energy Hierarchy Approach

The following sections below detail the proposed specific approach to integrated sustainable building design for the scheme outlining the strategy for following each of the stages indicated in the figure above.

4.1 SITE ANALYSIS

The proposed site is located off Hurst Knowle, Almondbury in West Yorkshire. The site is located adjacent to a housing estate and a park with access both by vehicle and on foot from Hurst Knowle to the East of the development. The location does present constraints but still provides opportunity to maximise sustainability.

4.2 STEP 1 – REDUCE BUILDING ENERGY DEMAND

The first stage of the Sustainable Design and the Energy Hierarchy Approach to meet Kirklees Sustainability Design Standard is to limit the buildings energy demand through a 'fabric first' approach which will ensure an integrated approach to sustainability is provided. The key features undertaken to reduce demand are as follows:

- Low Building Air Permeability with 60% improvement upon the minimum Building Regulations 2013 requirements.
- High performance building fabric with façade and fenestration with 27-40% improvement upon the minimum Building Regulations 2013 requirements.
- High performance fenestration in terms of solar control and day lighting with low emissivity (low-e) glass and high light transmittance value in order that the scheme can maximise daylight benefits throughout the year without increased risk of overheating,
- Strategic location of glazing upon the facade and roofing together with integrated solar shading,
- Maximising the potential where practicable for natural ventilation within the building, so as to further reduce the need and energy consumption of the building through operation of fans and other mechanical ventilation,
- Utilising the maximum amount of daylight to limit the energy consumption through lighting.

The table below summarises the key enhancements proposed for the building as part of an integrated sustainable approach to the design:

Table 1: Building Fabric and Fenestration Approximate Improvements

Building Element	Building Regulations Limiting U- Values*	Proposed U- Values	% Improvement above Building Regulations
Walls	0.35 W/m^{2}K	0.21 W/m^{2}K	40%
Floor	0.25 W/m^{2}K	0.15 W/m^{2}K	40%
Roof	0.25 W/m^{2}K	0.15 W/m^{2}K	40%
Glazing / Roof Lights and Doors	2.2 W/m^{2}K	1.6 W/m^{2}K	27%
Infiltration	10 m^3/h @ 50 Pa	4 m^3/h @ 50 Pa	60%

*Building Regulations Part L

4.3 STEP 2 – MAXIMISING ENERGY EFFICIENCY

The second stage of the Sustainable Design and the Energy Hierarchy Approach to meet the Kirklees Sustainability Design Standard is to incorporate energy efficient systems into the building's design. The Homestead will incorporate the following energy efficient technologies and measures to meet this requirement:

- New LED lighting and automatic controls,
- Variable speed pumps,
- Mechanical ventilation with heat recovery, utilising low energy fans / motors.
- Inclusion of a summer bypass to the Mechanical Ventilation Heat Recovery (MVHR) units where installed,
- Incorporation of a BMS Control System,
- Inclusion of daylight dimming controls to all spaces with direct access to daylight.

All new services will be designed to achieve the standards set out within the Non Domestic Building Services Guide as a minimum.

4.4 STEP 3 – ASSESS VIABLE ON-SITE LOW ZERO CARBON (LZC) OPTIONS

To meet the third stage of the Sustainable Design and the Energy Hierarchy Approach and meet Kirklees Sustainability Design Standard this report has assessed the suitability of several Low Zero Carbon (LZC) Technologies to further aid carbon emission improvements for the proposed premises and contribute to Kirklees Council Climate Emergency.

The incorporation of LZC technologies into the scheme will also favour the planning application in line with Kirklees Local Plan policy LP26.

This section of the document sets out the analysis and option appraisal as part of determining the most suitable and optimum LZC technologies for integration within the building services solution.

To this end a systematic approach has been utilised assessing each of the standard industry recognised LZC renewable technologies for commercial buildings. The methodology for LZC assessment in the initial stages has followed the CIBSE TM38 approach in order to ensure only the most appropriate technologies are explored as part of the assessment.

The key drivers in line with CIBSE TM38 initial assessment criteria for the assessment of as follows:

0 - Cost effectiveness
1 - Energy/$CO2_e$ savings
2 - Technology Risk
3 - Image and Marketing

Table 2 below outlines the justification for discounting particular on site renewable energy technologies as part of the design process and technical appraisal and Figure 4 provides a diagram summary from the CIBSE TM38 Renewable Assessment Tool:

Table 2: On-Site Renewable Viability Building Specific Appraisal

Technology	Initial Viability Appraisal	Justification / Notes
Biomass	☒	Site constraints and limited space for a large fuel store make this option unviable.
On Shore Wind	☒	Local wind speeds and urban environment mean that this option isn't viable. Additional concern that system could create noise pollution and vibrations.

Solar Thermal	☑	A constant hot water demand is available due to the kitchen and therefore solar thermal technologies is considered viable.
Air Source Heat Pump (GSHP/ASHP)	☑	Air Source Heat Pumps are a viable option due to availability of flat roof space and ability to utilise underfloor heating. Ground Source is also considered a technically viable option for the building but it has been withdrawn on cost constraints.
Combined Heat and Power (CHP)	☒	Limited constant high temperature heat demand means a CHP system would not be recommended.
Ground Water Cooling	☒	Limited building cooling requirements mean that this technology is not suitable for this scheme.
Photovoltaics (PV)	☑	Building orientation and available roof space means that roof mounted PV array would be a viable option

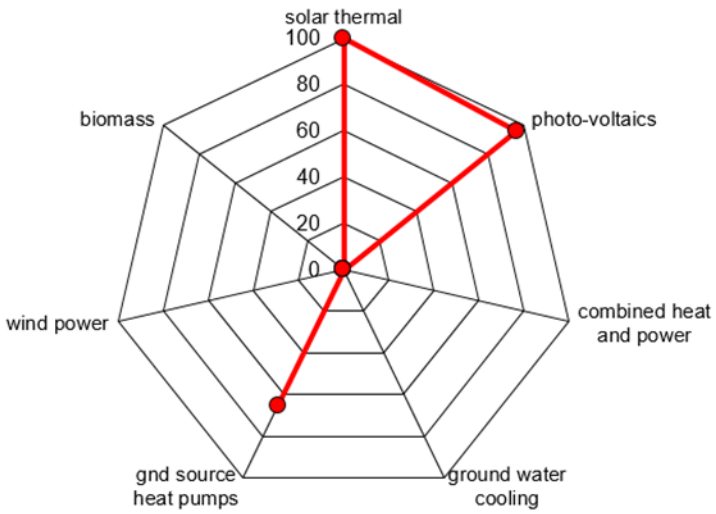

Figure 4: Summary Assessment Results from the CIBSE TM38 Renewable Assessment Tool

Table 2 shows that Solar Thermal, Air Source Heat Pumps and Photovoltaics are LZC technologies potentially viable for the HDC scheme. The section below undertakes a further more detailed assessment of these three LZC technologies considered viable from the initial CIBSE TM38 assessment. This assessment comparatively assesses key influences factors such as cost effectiveness, reliability and maintenance as well as energy/CO_2 impact.

Viable LZC Technology 1: Air Source Heat Pump

Air Source Heat Pumps extract heat stored in outdoor air to drive the heat pump cycle. As air is utilised as the energy source the heat pumps and collector are packaged together and located externally in condenser units connected to the building via flow and return pipework. ASHP's are suitable for generating both space heating and domestic hot water. For this scheme it is proposed to located the ASHP array on the flat roof area in a similar configuration to that shown in Figure 5 below.

Figure 5: Typical Centralised ASHP Cascade within External Enclosure

Space Heating

ASHPs work most efficiently when generating low grade heat (>45°C) and therefore are particularly well suited to applications where low grade heat emitters such as underfloor heating (UFH) can be widely utilised as is possible within HDC. Standard radiators can be used but due to the lower temperature difference between the water and the surrounding air temperature larger radiators are required, typically twice the size compared to radiators driven by a traditional gas fired system.

Domestic Hot Water Generation

Water temperatures of 45°C and below are not suitable for the generation of safe domestic hot water due to the risk of legionella growth. To achieve safe conditions and prevent the growth of legionella, hot water must be stored at temperatures in excess of 60°C. To achieve this, 'high temperature' ASHPs are used to generate the safe water temperatures required but at a reduced efficiency. The addition of calorifiers with immersion elements incorporated enable the ASHPs to work efficiently, provide for peak demand and offer back up in the event of a failure of the primary system for relatively low capital and ongoing maintenance costs.

Viable LZC Technology 2: Photovoltaics

Installation of a Photovoltaic (PV) array can be a useful LZC technology to assist a building to lower its carbon emissions and thus meet building regulations. Approximately 6m^2 of roof space is required per 1kW of PV array installed. A PV array is well suited to this building as:

- Suitable roof space is available,
- Roof orientation is suitable,
- Reasonable distance from tall trees; minimising shading,
- PV array can be connected to the central landlord system, maximising utilisation of power generated by the array.

It should be noted that battery storage solutions can also be paired with PV arrays where it is deemed beneficial to offer storage of some or all of the power generated by the PV array for use at a later time when the buildings energy demand is less than that generated by the PV array.

Viable LZC Technology 3: Solar Thermal

Installation of a Solar Thermal system enables solar energy to be harnessed to generate hot water either directly or more commonly by heating the incoming cold water to reduce the energy demand of the primary heating system. This technology is not suitable for space heating applications.

A solar thermal system is suited to this building as:

- Suitable roof space is available,
- Roof orientation is suitable,
- Reasonable distance from tall trees, minimising shading,
- There is reasonable demand for hot water.

Solar Thermal systems can be incorporated into direct electric calorifers to reduce electricity demand for DHW generation. The main disadvantage for these systems is their performance is dependent on the solar energy available and ongoing maintenance requirements are higher than with PV arrays.

Table 3 below gives a summary of the detailed LZC system appraisal based on the constraints and requirements of The Homestead building. Both PV and ASHPs are recommended based on the functionality and advantages stated above, but due to the relatively high ongoing maintenance requirements and potential conflict for roof space with that of the PV array and crossover of functionality with that of the ASHP, Solar Thermal Systems are not considered ideal for the strategy being considered and have therefore been discounted.

Table 3: Detailed LZC System Building Specific Appraisal

Technology	Cost Effectiveness	Reliability	Maintenance Requirements	Energy / CO2 Savings	Final Viability Appraisal
Photovoltaics (PV)	High (Low Cost)	High	Low	High	☑
Solar Thermal	High (Low Cost)	Medium	Medium	Medium	☒
Air Source Heat Pump	Medium	Medium	High	Medium	☑

4.5 BUILDING ENERGY ANALYSIS – BASELINE

Tables 4 and 5 below present the estimated energy consumption and CO2e emissions for the following four configurations modelled:

1. Baseline design (gas) without LZC /on-site renewable technology provision
2. Baseline design (gas) with PV array
3. Gas plus ASHP with PV array
4. ASHP with PV array

Table 4 shows that the baseline configuration passes the Part L assessment.

Table 4: Building Carbon Emissions Comparison

Scenario	Notional Building Carbon Emission ($kgCO_2/m2$)	Target CO_2 Emission Rate (TER) ($kgCO_2/m2$)	Building CO_2 Emission Rate (BER) ($kgCO_2/m2$)
Gas (Baseline)	22.1	22.1	21.5
Gas + PV	22.1	22.1	12.4
Gas + ASHP + PV	21.1	21.1	10.9
ASHP + PV	19.3	19.3	9.0

Table 5: Building Energy Consumption Comparison

Scenario	Notional Building Energy Consumption (KWh/m^2)	Actual Building Energy Consumption (kWh/m^2)
Gas (Baseline)	79.96	84.05
Gas + PV	79.96	84.05
Gas+ ASHP + PV	65.48	65.03
ASHP + PV	38.08	34.71

*The BRUKL for each option is presented in Appendix A.

4.6 PHOTOVOLTAIC APPRAISAL

The PV array, if selected, will be sized based on the available and viable roof space area for a simple to access and maintain system. The Energy Saving Trust Solar Energy Calculator (https://energysavingtrust.org.uk/scotland/tools-

calculators/solar-energy-calculator) has been used to establish the size and output of the array.

The following data has been used as basis for the calculation:

Postcode: HD5 8SG / Orientation: South West facing
Inclination 30° / Shading: <20%
Peak Output: ~16.5kWp based on 45 panels (circa 90m^2) at 0.370kW/panel.

Total Estimated Annual Yield = 13,650kWh/yr reduction which equates to 3.75 TCO_2/yr reduction. *It should be noted that the energy production rate stated within the associated BRUKL's is based on the Part L assessment methodology which does not necessary reflect real world conditions.

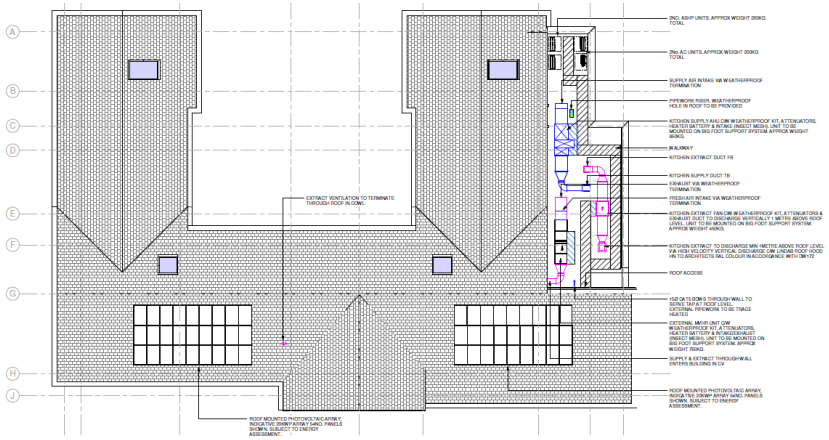

Figure 6: Proposed PV Area Layout

5.0 BREEAM

As part of the developments energy strategy Kirklees Council have requested the new building is assessed against BRE's Environmental Assessment Method Energy Criteria. Below we have highlighted how the scheme could perform.

ENE 01 - Reduction of Energy Use and Carbon Emissions

Aim: To minimise operational energy demand, primary energy consumption and CO_2 emissions.

Proposal: To establish how the building may perform against the BREEAM criteria we have run each energy strategy option through the ENE 01 calculator (please refer to Appendix B for further information).

Table 6: ENE 01 Performance Table

Scenario	BREEAM ENE 01 Result
Baseline: Gas	0 Credits
Option 1: Gas + PV	4 Credits (Very Good)
Option 2: Gas + ASHP + PV	4 Credits (Excellent)
Option 3: ASHP + PV	6 Credits (Excellent)

ENE 02 – Energy Monitoring

Aim: To encourage the installation of energy sub-metering to facilitate the monitoring of operational energy consumption. To enable managers and consultant's post-handover to compare actual performance with targets in order to inform ongoing management and help in reducing the performance gap.

Proposal: As the scheme is developed the design will include energy metering systems so that at least 90% of the estimated annual energy consumption of

each fuel is assigned to the end-use categories including Sub-metering of high energy load and tenancy areas.

ENE 02 Credits = 2 of 2

ENE 03 – External Lighting

Aim: To reduce energy consumption through the specification of energy efficient light fittings for external areas of the development.

Proposal: The lighting design will be developed to ensure external light fittings within the construction zone with: Average initial luminous efficacy of not less than 70 luminaire lumens per circuit Watt, Automatic control to prevent operation during daylight hours; and presence detection in areas of intermittent pedestrian traffic.

ENE 03 Credits = 1 of 1

ENE 04 – Low Carbon Design

Aim: To encourage the adoption of design measures, which reduce building energy consumption and associated carbon emissions and minimise reliance on active building services systems.

Proposal: Passive Design - The project team will analyse the proposed building design and development during Concept Design to identify opportunities for the implementation of passive design measures.

Free cooling – the design team will Include a free cooling analysis in the passive design analysis, identify opportunities for the implementation of free cooling solutions and ensure the building is naturally ventilated or uses any combination of the free cooling strategies listed in Free cooling.

Low and zero carbon feasibility study - Establish the most appropriate recognised local (on-site or near-site) low and zero carbon (LZC) energy sources for the building or development, based on the feasibility study.
ENE 04 Credits = 1 of 3

ENE 05 – Energy Efficient Cold Storage – N/A

ENE 06 – Energy Efficient Transportation Systems – N/A

ENE 07 – Energy Efficient Laboratory Systems – N/A

ENE 08 – Energy Efficient Equipment

Aim: To encourage installation of energy efficient equipment to ensure optimum performance and energy savings in operation.

Proposal: The Client will be required to ensure any white goods, must achieve the following ratings (or better) under the EU Energy Efficiency Labelling Scheme:

1. Fridges, fridge-freezers: A+ rating
2. Washing machines: A++ rating
3. Dishwashers: A+ rating
4. Washer-dryers: A rating
5. Tumble dryers: A Rating

ENE 08 Credits – 2 of 2

It is estimated that it is possible to achieve a total of 12 of 17 credits under the BREEAM Energy Criteria.

6.0 CONCLUSION

This report has illustrated that careful consideration has been given throughout the initial design stages with regards to sustainability and in particular the simple amalgamation of such features into the building in order to provide a simple to

use, operate and maintain installation that also permits low energy targets to be realised in operation.

An outline of the likely planning requirements at both National and a Local level has been given, along with an overlay of the approach to sustainability from a holistic viewpoint with the primary focus on maximising the efficiency of the building fabric, passive design measures and incorporation of energy efficient building services.

An assessment of the potential suitable LZC technologies has shown that Photovoltaics and Air Source Heat Pumps would be the most suitable LZC technologies for this scheme.

The traditional gas fired (baseline) configuration passes the Part L assessment due to the fabric first approach and use of energy efficient building services.

The carbon reduction provided by the incorporation of the following scenarios over the baseline gas driven configuration is presented in Appendix A for review and consideration:

- Gas plus PV array,
- Gas plus PV array and ASHP array,
- PV array plus ASHP array (no gas)

The report also demonstrates that it is possible to achieve up to 6 credits when assessed under BREEAM ENE 01 (Excellent status) and a total of 12 credits under the entire Energy section.

7.0 APPENDIX A – BRUKLS

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Homestead (Baseline)

As designed

Date: Fri Sep 24 11:34:40 2021

Administrative information

Building Details

Address: Hurst Knowle, Huddersfield, HD5 8SG

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.13

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.13

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, $kgCO_2/m^2.annum$	22.1
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	22.1
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	21.5
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	0.24	0.24	CN000000:Surf[9]
Floor	0.25	0.15	0.15	CN000000:Surf[0]
Roof	0.25	0.24	0.31	CN000000:Surf[19]
Windows***, roof windows, and rooflights	2.2	1.8	1.8	CN000000:Surf[1]
Personnel doors	2.2	1.8	1.8	CN000000:Surf[10]
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

$U_{a\text{-}Limit}$ = 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	5

Building services

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

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

1- Boilers Mech Vent (Radiators)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	-	0.2	0	0.75
Standard value	0.91*	N/A	N/A	N/A	0.5
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- Boilers Nat Vent (radiators)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	-	0.2	0	-
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.

3- DX Cooling

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	6	6	0	0	-
Standard value	2.5*	3.2	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

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

1- Hot Water

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.93	-
Standard value	0.8	N/A

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
Cinema / Sensory	-	-	-	1.2	-	-	-	-	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
Hygiene	-	-	0.4	-	-	-	-	-	-	-	N/A
Faith	-	-	-	1.2	-	-	-	-	-	-	N/A
Spa Centre	-	-	-	1.2	-	-	-	-	-	-	N/A
Shop	-	-	-	1.2	-	-	-	-	-	-	N/A
Office	-	-	-	1.2	-	-	-	-	-	-	N/A
Reprographics	-	-	0.4	-	-	-	-	-	-	-	N/A
Acc Shower	-	-	0.4	-	-	-	-	-	-	-	N/A
Acc Shower	-	-	0.4	-	-	-	-	-	-	-	N/A
Laundry	-	-	0.4	-	-	-	-	-	-	-	N/A
Dining Room	-	-	-	1.2	-	-	-	-	-	-	N/A
Activity & Crafts	-	-	-	1.2	-	-	-	-	-	-	N/A
Hygiene	-	-	0.4	-	-	-	-	-	-	-	N/A
Home Therapy	-	-	-	1.2	-	-	-	-	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
Cinema / Sensory	80	-	-	308
Store	80	-	-	8
Store	80	-	-	8
WC	-	80	-	39
Hygiene	80	-	-	22
Corridor	-	80	-	59
Office	80	-	-	134
Faith	80	-	-	113
Spa Centre	80	-	-	144
WC	-	80	-	47
Server	80	-	-	10
Store	80	-	-	6
Corridor	-	80	-	26
Store	80	-	-	19
Shop	-	80	80	250
Cloaks	-	80	-	28
WC	-	80	-	47
Reception	-	80	80	188
Staffroom	80	-	-	200
Office	80	-	-	135
Corridor	-	80	-	66
Reprographics	80	-	-	10
Acc Shower	-	98	-	66
Acc Shower	-	97	-	68
Laundry	-	80	-	81
Roof Acc	80	-	-	10

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Med. Strore	80	-	-	8
WC	-	80	-	32
Cleaner Store	80	-	-	9
COSSH	80	-	-	8
Store	80	-	-	7
Store	80	-	-	6
Store	80	-	-	7
Dining Room	-	80	-	187
Corridor	-	80	-	225
Activity & Crafts	80	-	-	404
WC	-	80	-	48
Kitchen	-	80	-	500
Hygiene	80	-	-	18
Lobby	-	80	-	14
WC	-	80	-	28
WC	-	80	-	49
Store	80	-	-	12
Plant	80	-	-	97
Store	80	-	-	4
Store	80	-	-	5
Store	80	-	-	4
Home Therapy	80	-	-	523

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?
Cinema / Sensory	NO (-71.3%)	YES
Office	NO (-58.7%)	YES
Faith	N/A	N/A
Spa Centre	NO (-57%)	YES
Server	N/A	N/A
Shop	N/A	N/A
Reception	NO (-53.8%)	YES
Staffroom	NO (-44.2%)	YES
Office	N/A	N/A
Dining Room	NO (-53.6%)	YES
Activity & Crafts	NO (-48.2%)	YES
Home Therapy	NO (-65.5%)	YES

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?	YES
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]	792.4	792.4
External area [m²]	2345	2107.6
Weather	LEE	LEE
Infiltration [m³/hm²@ 50Pa]	5	3
Average conductance [W/K]	819.48	705.62
Average U-value [W/m²K]	0.35	0.33
Alpha value* [%]	12.1	10

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

Building Use

% Area	Building Type
2	**A1/A2 Retail/Financial and Professional services**
	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
98	**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	54.91	45.58
Cooling	0.01	0.01
Auxiliary	3.17	1.84
Lighting	7.64	14.75
Hot water	18.31	17.78
Equipment*	27.28	27.28
TOTAL**	**84.05**	**79.96**

* 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]	171.29	142.8
Primary energy* [kWh/m²]	122.76	127.33
Total emissions [kg/m²]	21.5	22.1

* 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	213.3	0	69.2	0	1.8	0.86	0	0.96	0
	Notional	185.9	0	59.9	0	1.1	0.86	0	----	----
[ST] Single room cooling system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	256.7	22.9	12.8	1.5	0	5.59	4.26	6	6
	Notional	217.3	21.1	23.6	1.5	0	2.56	3.79	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	158.7	0	51.5	0	6	0.86	0	0.96	0
	Notional	119.7	0	38.6	0	2.9	0.86	0	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----

Key to terms

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

Key Features

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

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.24	CN000000:Surf[9]
Floor	0.2	0.15	CN000000:Surf[0]
Roof	0.15	-	CN000000:Surf[17]
Windows, roof windows, and rooflights	1.5	1.8	CN000000:Surf[1]
Personnel doors	1.5	1.8	CN000000:Surf[10]
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building

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

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

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	5

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Homestead (Gas + 90m2 PV)

As designed

Date: Fri Sep 24 12:09:48 2021

Administrative information

Building Details

Address: Hurst Knowle, Huddersfield, HD5 8SG

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.13

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.13

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, $kgCO_2/m^2.annum$	22.1
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	22.1
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	12.4
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	0.24	0.24	CN000000:Surf[9]
Floor	0.25	0.15	0.15	CN000000:Surf[0]
Roof	0.25	0.24	0.31	CN000000:Surf[19]
Windows***, roof windows, and rooflights	2.2	1.8	1.8	CN000000:Surf[1]
Personnel doors	2.2	1.8	1.8	CN000000:Surf[10]
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

$U_{a\text{-}Limit}$ = 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	5

Building services

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

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

1- Boilers Mech Vent (Radiators)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	-	0.2	0	0.75
Standard value	0.91*	N/A	N/A	N/A	0.5
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- Boilers Nat Vent (radiators)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	-	0.2	0	-
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.

3- DX Cooling

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	6	6	0	0	-
Standard value	2.5*	3.2	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

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

1- Hot Water

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.93	-
Standard value	0.8	N/A

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
Cinema / Sensory	-	-	-	1.2	-	-	-	-	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
Hygiene	-	-	0.4	-	-	-	-	-	-	-	N/A
Faith	-	-	-	1.2	-	-	-	-	-	-	N/A
Spa Centre	-	-	-	1.2	-	-	-	-	-	-	N/A
Shop	-	-	-	1.2	-	-	-	-	-	-	N/A
Office	-	-	-	1.2	-	-	-	-	-	-	N/A
Reprographics	-	-	0.4	-	-	-	-	-	-	-	N/A
Acc Shower	-	-	0.4	-	-	-	-	-	-	-	N/A
Acc Shower	-	-	0.4	-	-	-	-	-	-	-	N/A
Laundry	-	-	0.4	-	-	-	-	-	-	-	N/A
Dining Room	-	-	-	1.2	-	-	-	-	-	-	N/A
Activity & Crafts	-	-	-	1.2	-	-	-	-	-	-	N/A
Hygiene	-	-	0.4	-	-	-	-	-	-	-	N/A
Home Therapy	-	-	-	1.2	-	-	-	-	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
Cinema / Sensory	80	-	-	308
Store	80	-	-	8
Store	80	-	-	8
WC	-	80	-	39
Hygiene	80	-	-	22
Corridor	-	80	-	59
Office	80	-	-	134
Faith	80	-	-	113
Spa Centre	80	-	-	144
WC	-	80	-	47
Server	80	-	-	10
Store	80	-	-	6
Corridor	-	80	-	26
Store	80	-	-	19
Shop	-	80	80	250
Cloaks	-	80	-	28
WC	-	80	-	47
Reception	-	80	80	188
Staffroom	80	-	-	200
Office	80	-	-	135
Corridor	-	80	-	66
Reprographics	80	-	-	10
Acc Shower	-	98	-	66
Acc Shower	-	97	-	68
Laundry	-	80	-	81
Roof Acc	80	-	-	10

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Med. Strore	80	-	-	8
WC	-	80	-	32
Cleaner Store	80	-	-	9
COSSH	80	-	-	8
Store	80	-	-	7
Store	80	-	-	6
Store	80	-	-	7
Dining Room	-	80	-	187
Corridor	-	80	-	225
Activity & Crafts	80	-	-	404
WC	-	80	-	48
Kitchen	-	80	-	500
Hygiene	80	-	-	18
Lobby	-	80	-	14
WC	-	80	-	28
WC	-	80	-	49
Store	80	-	-	12
Plant	80	-	-	97
Store	80	-	-	4
Store	80	-	-	5
Store	80	-	-	4
Home Therapy	80	-	-	523

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?
Cinema / Sensory	NO (-71.3%)	YES
Office	NO (-58.7%)	YES
Faith	N/A	N/A
Spa Centre	NO (-57%)	YES
Server	N/A	N/A
Shop	N/A	N/A
Reception	NO (-53.8%)	YES
Staffroom	NO (-44.2%)	YES
Office	N/A	N/A
Dining Room	NO (-53.6%)	YES
Activity & Crafts	NO (-48.2%)	YES
Home Therapy	NO (-65.5%)	YES

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?	YES
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]	792.4	792.4
External area [m²]	2345	2107.6
Weather	LEE	LEE
Infiltration [m³/hm²@ 50Pa]	5	3
Average conductance [W/K]	819.48	705.62
Average U-value [W/m²K]	0.35	0.33
Alpha value* [%]	12.1	10

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

Building Use

% Area	Building Type
2	**A1/A2 Retail/Financial and Professional services**
	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
98	**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	54.91	45.58
Cooling	0.01	0.01
Auxiliary	3.17	1.84
Lighting	7.64	14.75
Hot water	18.31	17.78
Equipment*	27.28	27.28
TOTAL**	**84.05**	**79.96**

* 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	17.41	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]	171.29	142.8
Primary energy* [kWh/m²]	122.76	127.33
Total emissions [kg/m²]	12.4	22.1

* 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	213.3	0	69.2	0	1.8	0.86	0	0.96	0
	Notional	185.9	0	59.9	0	1.1	0.86	0	----	----
[ST] Single room cooling system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	256.7	22.9	12.8	1.5	0	5.59	4.26	6	6
	Notional	217.3	21.1	23.6	1.5	0	2.56	3.79	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	158.7	0	51.5	0	6	0.86	0	0.96	0
	Notional	119.7	0	38.6	0	2.9	0.86	0	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----

Key to terms

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

Key Features

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

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.24	CN000000:Surf[9]
Floor	0.2	0.15	CN000000:Surf[0]
Roof	0.15	-	CN000000:Surf[17]
Windows, roof windows, and rooflights	1.5	1.8	CN000000:Surf[1]
Personnel doors	1.5	1.8	CN000000:Surf[10]
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building

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

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

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	5

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Homestead (Heat Pump + Gas + 90m2 PV) As designed

Date: Fri Sep 24 12:02:18 2021

Administrative information

Building Details

Address: Hurst Knowle, Huddersfield, HD5 8SG

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.13

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.13

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, $kgCO_2/m^2.annum$	21.1
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	21.1
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	10.9
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	0.24	0.24	CN000000:Surf[9]
Floor	0.25	0.15	0.15	CN000000:Surf[0]
Roof	0.25	0.24	0.31	CN000000:Surf[19]
Windows***, roof windows, and rooflights	2.2	1.8	1.8	CN000000:Surf[1]
Personnel doors	2.2	1.8	1.8	CN000000:Surf[10]
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

$U_{a\text{-}Limit}$ = 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	5

Building services

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

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

1- Heat Pump Mech Vent (Underfloor)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.1	-	0.2	0	0.75
Standard value	2.5*	N/A	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

2- Boilers Nat Vent (radiators)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	-	0.2	0	-
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.					

3- Boilers Mech Vent (Radiators)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	-	0.2	0	0.75
Standard value	0.91*	N/A	N/A	N/A	0.5
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.					

4- DX Cooling

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	6	6	0	0	-
Standard value	2.5*	3.2	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

5- Heat Pump Nat Vent (underfloor)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.1	-	0.2	0	-
Standard value	2.5*	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 all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

1- Hot Water

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.93	-
Standard value	0.8	N/A

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
Cinema / Sensory	-	-	-	1.2	-	-	-	-	-	-	N/A
Hygiene	-	-	0.4	-	-	-	-	-	-	-	N/A
Faith	-	-	-	1.2	-	-	-	-	-	-	N/A
Spa Centre	-	-	-	1.2	-	-	-	-	-	-	N/A
Shop	-	-	-	1.2	-	-	-	-	-	-	N/A
Office	-	-	-	1.2	-	-	-	-	-	-	N/A
Reprographics	-	-	0.4	-	-	-	-	-	-	-	N/A
Acc Shower	-	-	0.4	-	-	-	-	-	-	-	N/A
Acc Shower	-	-	0.4	-	-	-	-	-	-	-	N/A
Laundry	-	-	0.4	-	-	-	-	-	-	-	N/A
Dining Room	-	-	-	1.2	-	-	-	-	-	-	N/A
Activity & Crafts	-	-	-	1.2	-	-	-	-	-	-	N/A
Hygiene	-	-	0.4	-	-	-	-	-	-	-	N/A
Home Therapy	-	-	-	1.2	-	-	-	-	-	-	N/A

General lighting and display lighting

Zone name	Luminous efficacy [lm/W]			General lighting [W]
	Luminaire	Lamp	Display lamp	
Standard value	60	60	22	
Cinema / Sensory	80	-	-	308
Store	80	-	-	8
Store	80	-	-	8
WC	-	80	-	39
Hygiene	80	-	-	22
Corridor	-	80	-	59
Office	80	-	-	134
Faith	80	-	-	113
Spa Centre	80	-	-	144
WC	-	80	-	47
Server	80	-	-	10
Store	80	-	-	6

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Corridor	-	80	-	26
Store	80	-	-	19
Shop	-	80	80	250
Cloaks	-	80	-	28
WC	-	80	-	47
Reception	-	80	80	188
Staffroom	80	-	-	200
Office	80	-	-	135
Corridor	-	80	-	66
Reprographics	80	-	-	10
Acc Shower	-	98	-	66
Acc Shower	-	97	-	68
Laundry	-	80	-	81
Roof Acc	80	-	-	10
Med. Strore	80	-	-	8
WC	-	80	-	32
Cleaner Store	80	-	-	9
COSSH	80	-	-	8
Store	80	-	-	7
Store	80	-	-	6
Store	80	-	-	7
Dining Room	-	80	-	187
Corridor	-	80	-	225
Activity & Crafts	80	-	-	404
WC	-	80	-	48
Kitchen	-	80	-	500
Hygiene	80	-	-	18
Lobby	-	80	-	14
WC	-	80	-	28
WC	-	80	-	49
Store	80	-	-	12
Plant	80	-	-	97
Store	80	-	-	4
Store	80	-	-	5
Store	80	-	-	4
Home Therapy	80	-	-	523

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?
Cinema / Sensory	NO (-71.3%)	YES
Office	NO (-58.7%)	YES
Faith	N/A	N/A
Spa Centre	NO (-57%)	YES

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Server	N/A	N/A
Shop	N/A	N/A
Reception	NO (-53.8%)	YES
Staffroom	NO (-44.2%)	YES
Office	N/A	N/A
Dining Room	NO (-53.6%)	YES
Activity & Crafts	NO (-48.2%)	YES
Home Therapy	NO (-65.5%)	YES

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?	YES
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]	792.4	792.4
External area [m²]	2345	2107.6
Weather	LEE	LEE
Infiltration [m³/hm²@ 50Pa]	5	3
Average conductance [W/K]	819.48	705.62
Average U-value [W/m²K]	0.35	0.33
Alpha value* [%]	12.1	10

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

Building Use

% Area	Building Type
2	**A1/A2 Retail/Financial and Professional services**
	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
98	**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	35.89	31.1
Cooling	0.01	0.01
Auxiliary	3.17	1.84
Lighting	7.64	14.75
Hot water	18.31	17.78
Equipment*	27.28	27.28
TOTAL**	**65.03**	**65.48**

* 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	17.41	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]	171.28	142.8
Primary energy* [kWh/m²]	115.34	122.72
Total emissions [kg/m²]	10.9	21.1

* 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	190.2	0	61.7	0	1.7	0.86	0	0.96	0
	Notional	169.6	0	54.6	0	1.1	0.86	0	----	----
[ST] Single room cooling system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	256.7	22.9	12.8	1.5	0	5.59	4.26	6	6
	Notional	217.3	21.1	23.6	1.5	0	2.56	3.79	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	128.5	0	41.7	0	6.4	0.86	0	0.96	0
	Notional	88.5	0	28.5	0	3.2	0.86	0	----	----
[ST] Central heating using water: floor heating, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	166.5	0	16.7	0	5.9	2.77	0	3.1	0
	Notional	127.8	0	13.9	0	2.8	2.56	0	----	----
[ST] Central heating using water: floor heating, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	277.3	0	27.9	0	2	2.77	0	3.1	0
	Notional	231.3	0	25.1	0	1.2	2.56	0	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----

Key to terms

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

Key Features

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

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.24	CN000000:Surf[9]
Floor	0.2	0.15	CN000000:Surf[0]
Roof	0.15	-	CN000000:Surf[17]
Windows, roof windows, and rooflights	1.5	1.8	CN000000:Surf[1]
Personnel doors	1.5	1.8	CN000000:Surf[10]
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building

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

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

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	5

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Homestead (ASHP Heating and HW + 90m2 PV)

As designed

Date: Tue Jan 11 14:54:34 2022

Administrative information

Building Details

Address: Hurst Knowle, Huddersfield, HD5 8SG

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.13

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.13

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, $kgCO_2/m^2.annum$	19.3
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	19.3
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	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	0.24	0.24	CN000000:Surf[9]
Floor	0.25	0.15	0.15	CN000000:Surf[0]
Roof	0.25	0.24	0.31	CN000000:Surf[19]
Windows***, roof windows, and rooflights	2.2	1.8	1.8	CN000000:Surf[1]
Personnel doors	2.2	1.8	1.8	CN000000:Surf[10]
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

$U_{a\text{-}Limit}$ = 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	5

Building services

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

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

1- Heat Pump Mech Vent (Underfloor)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.1	-	0.2	0	0.75
Standard value	2.5*	N/A	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

2- ASHP Nat Vent (radiators)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.1	-	0.2	0	-
Standard value	2.5*	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 all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

3- ASHP Mech Vent (Radiators)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.1	-	0.2	0	0.75
Standard value	2.5*	N/A	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

4- DX Cooling

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	6	6	0	0	-
Standard value	2.5*	3.2	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

5- Heat Pump Nat Vent (underfloor)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.1	-	0.2	0	-
Standard value	2.5*	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 all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

1- Hot Water

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	2.5	-
Standard value	1	N/A

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
Cinema / Sensory	-	-	-	1.2	-	-	-	-	-	-	N/A
Hygiene	-	-	0.4	-	-	-	-	-	-	-	N/A
Faith	-	-	-	1.2	-	-	-	-	-	-	N/A
Spa Centre	-	-	-	1.2	-	-	-	-	-	-	N/A
Shop	-	-	-	1.2	-	-	-	-	-	-	N/A
Office	-	-	-	1.2	-	-	-	-	-	-	N/A
Reprographics	-	-	0.4	-	-	-	-	-	-	-	N/A
Acc Shower	-	-	0.4	-	-	-	-	-	-	-	N/A
Acc Shower	-	-	0.4	-	-	-	-	-	-	-	N/A
Laundry	-	-	0.4	-	-	-	-	-	-	-	N/A
Dining Room	-	-	-	1.2	-	-	-	-	-	-	N/A
Activity & Crafts	-	-	-	1.2	-	-	-	-	-	-	N/A
Hygiene	-	-	0.4	-	-	-	-	-	-	-	N/A
Home Therapy	-	-	-	1.2	-	-	-	-	-	-	N/A

General lighting and display lighting

Zone name	Luminous efficacy [lm/W]			General lighting [W]
	Luminaire	Lamp	Display lamp	
Standard value	60	60	22	
Cinema / Sensory	80	-	-	308
Store	80	-	-	8
Store	80	-	-	8
WC	-	80	-	39
Hygiene	80	-	-	22
Corridor	-	80	-	59
Office	80	-	-	134
Faith	80	-	-	113
Spa Centre	80	-	-	144
WC	-	80	-	47
Server	80	-	-	10
Store	80	-	-	6

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Corridor	-	80	-	26
Store	80	-	-	19
Shop	-	80	80	250
Cloaks	-	80	-	28
WC	-	80	-	47
Reception	-	80	80	188
Staffroom	80	-	-	200
Office	80	-	-	135
Corridor	-	80	-	66
Reprographics	80	-	-	10
Acc Shower	-	98	-	66
Acc Shower	-	97	-	68
Laundry	-	80	-	81
Roof Acc	80	-	-	10
Med. Strore	80	-	-	8
WC	-	80	-	32
Cleaner Store	80	-	-	9
COSSH	80	-	-	8
Store	80	-	-	7
Store	80	-	-	6
Store	80	-	-	7
Dining Room	-	80	-	187
Corridor	-	80	-	225
Activity & Crafts	80	-	-	404
WC	-	80	-	48
Kitchen	-	80	-	500
Hygiene	80	-	-	18
Lobby	-	80	-	14
WC	-	80	-	28
WC	-	80	-	49
Store	80	-	-	12
Plant	80	-	-	97
Store	80	-	-	4
Store	80	-	-	5
Store	80	-	-	4
Home Therapy	80	-	-	523

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?
Cinema / Sensory	NO (-71.3%)	YES
Office	NO (-58.7%)	YES
Faith	N/A	N/A
Spa Centre	NO (-57%)	YES

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Server	N/A	N/A
Shop	N/A	N/A
Reception	NO (-53.8%)	YES
Staffroom	NO (-44.2%)	YES
Office	N/A	N/A
Dining Room	NO (-53.6%)	YES
Activity & Crafts	NO (-48.2%)	YES
Home Therapy	NO (-65.5%)	YES

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?	YES
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 [m^2]	792.4	792.4
External area [m^2]	2345	2107.6
Weather	LEE	LEE
Infiltration [m^3/hm^2@ 50Pa]	5	3
Average conductance [W/K]	819.48	705.62
Average U-value [W/m^2K]	0.35	0.33
Alpha value* [%]	12.1	10

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

Building Use

% Area	Building Type
2	**A1/A2 Retail/Financial and Professional services**
	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
98	**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/m^2]

	Actual	Notional
Heating	17.08	15.49
Cooling	0.01	0.01
Auxiliary	3.17	1.84
Lighting	7.64	14.75
Hot water	6.81	5.99
Equipment*	27.28	27.28
TOTAL**	**34.71**	**38.08**

* 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/m^2]

	Actual	Notional
Photovoltaic systems	17.41	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/m^2]	171.28	142.8
Primary energy* [kWh/m^2]	106.57	113.99
Total emissions [kg/m^2]	9	19.3

* 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] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	190.2	0	19.1	0	1.7	2.77	0	3.1	0
	Notional	169.6	0	18.4	0	1.1	2.56	0	----	----
[ST] Single room cooling system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	256.7	22.9	12.8	1.5	0	5.59	4.26	6	6
	Notional	217.3	21.1	23.6	1.5	0	2.56	3.79	----	----
[ST] Central heating using water: radiators, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	128.5	0	12.9	0	6.4	2.77	0	3.1	0
	Notional	88.5	0	9.6	0	3.2	2.56	0	----	----
[ST] Central heating using water: floor heating, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	166.5	0	16.7	0	5.9	2.77	0	3.1	0
	Notional	127.8	0	13.9	0	2.8	2.56	0	----	----
[ST] Central heating using water: floor heating, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	277.3	0	27.9	0	2	2.77	0	3.1	0
	Notional	231.3	0	25.1	0	1.2	2.56	0	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----

Key to terms

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

Key Features

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

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.24	CN000000:Surf[9]
Floor	0.2	0.15	CN000000:Surf[0]
Roof	0.15	-	CN000000:Surf[17]
Windows, roof windows, and rooflights	1.5	1.8	CN000000:Surf[1]
Personnel doors	1.5	1.8	CN000000:Surf[10]
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building

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

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

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	5

8.0 APPENDIX B – ENE 01 Calculations

Baseline (Gas) Results

Methodology used	Standard
Total BREEAM credits achieved	0.0
Heating and cooling demand energy performance ratio (EPRdem)	0.0
Primary consumption energy performance ratio (EPRpc)	0.027
CO_2-eq energy performance ratio (EPRco2-eq)	0.025
Overall building energy performance ratio (EPRnc)	0.051
% improvement BER/TER	3.0

Baseline (Gas) + PV Results

Methodology used	Standard
Total BREEAM credits achieved	4.0
Heating and cooling demand energy performance ratio (EPRdem)	0.0
Primary consumption energy performance ratio (EPRpc)	0.195
CO_2-eq energy performance ratio (EPRco2-eq)	0.254
Overall building energy performance ratio (EPRnc)	0.448
% improvement BER/TER	43.8

Boiler, ASHP + PV Results

Methodology used	Standard
Total BREEAM credits achieved	4.0
Heating and cooling demand energy performance ratio (EPRdem)	0.0
Primary consumption energy performance ratio (EPRpc)	0.21
CO_2-eq energy performance ratio (EPRco2-eq)	0.269
Overall building energy performance ratio (EPRnc)	0.479
% improvement BER/TER	48.4

ASHP + PV Results

Prediction of operational energy consumption

Has a design workshop focusing on operational energy performance been carried out?	No

Post-occupancy stage (exemplary credits)

Maximum credits achieved in Ene 02 Energy monitoring?	No
The client or building occupier commits funds to pay for the post-occupancy stage?	Yes
The energy model is submitted to BRE and retained by the building owner?	Yes

Credits available	Credits awarded
13	6