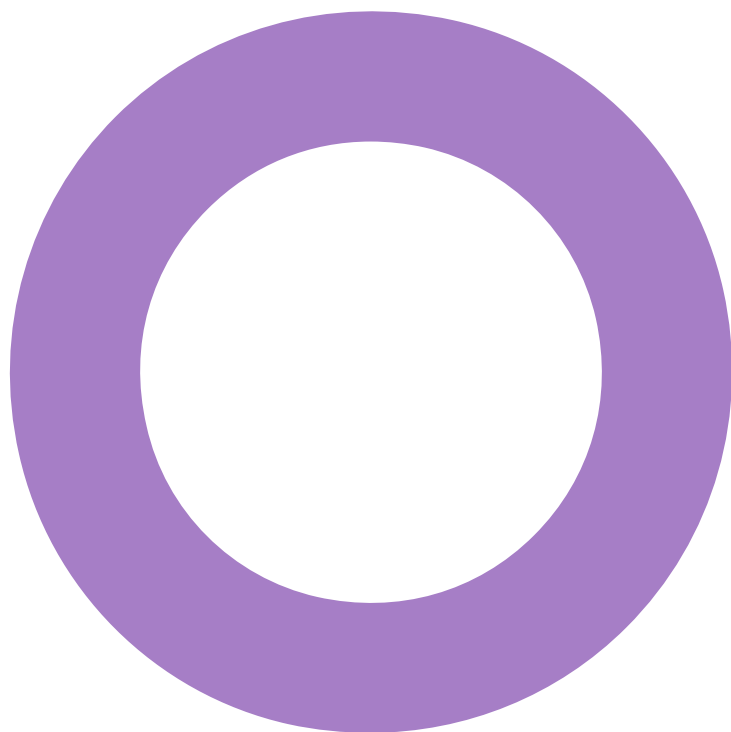


University of Chichester - Student Accommodation Phase 1. Bognor Regis. University of Chichester.

SUSTAINABILITY
ENERGY STATEMENT

REVISION 0 – 16 NOVEMBER 2018



Audit Sheet.

Rev.	Date	Description	Prepared	Verified
0	16/11/2018	Issue for Comment	LH	JD/JH

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

Document reference: 181116 UoCTP SA - Energy Statement Rev 0

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1. Introduction.

The proposed Student Residential building at the University of Chichester is situated within the Technology Park campus in Bognor Regis.

The development includes the erection of a new Student Accommodation building comprising a mix of student bedroom/study rooms, student communal social areas, car parking and associated landscaping.

The site is highlighted in Figure 1.



Figure 1 CGI image of the Proposed Development site (Credit: Stride Treglown)

This Energy Statement has been prepared in support of the planning application for the proposed student residential development of the University of Chichester Technology Park, hereafter referred to as the Proposed Development.

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

2. Policy Requirements & Building Regulations.

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

2.1 Building Regulations

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



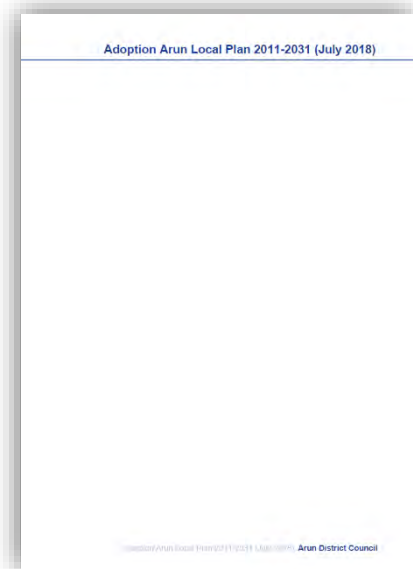
Part L2A 2013 of Building Regulations – New Non-Domestic Elements

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

Under Building Regulations Approved Document Part L2A: Conservation of Fuel and Power (2013 edition), compliance is achieved by demonstrating that the Building CO₂ Emission Rate (BER) does not exceed the Target CO₂ Emission Rate (TER).

In addition, Part L2A also requires that the fabric elements and the fixed building services all meet minimum energy efficiency standards (Criterion 2), and reasonable provision for limiting solar gain through the building fabric (Criterion 3).

2.2 Local Planning Guidance



Arun Local Plan 2011-2031 (July 2018)

The Local Plan sets out the vision for the future of Arun and guides development to achieve that vision.

The purpose of the Local Plan is to encourage sustainable development and manage future growth whilst ensuring that change across the District is appropriate to meet local need. It will support the strategic provision of homes, employment and shops and will look to ensure that these are carefully co-ordinated with the services and facilities that communities rely on and which are essential to wellbeing and quality of life.

The Local Plan's 'strategic policies' (where policy references are prefixed with the initials 'SP') set out the overall strategy for the Arun Local Planning Authority with regard to:

- The amount of new employment, retail and housing development that will take place in the District up to 2031;
- A strategic framework to help determine planning applications;
- The framework for neighbourhood development; and
- A statutory guide to help local communities deliver local change.

Policy ECC SP2, Energy and climate change mitigation, states that all new residential and commercial development (including conversions, extensions and changes of use) will be expected to be energy efficient and to demonstrate how they will:

- Achieve energy efficiency measures that reflect the current standards applicable at the time of submission (Part L 2013 as a minimum);
- Use design and layout to promote energy efficiency; and
- Incorporate decentralised, renewable and low carbon energy supply systems, for example small scale renewable energy systems such as solar panels.

All major developments must produce 10% of the total predicted energy requirements from renewable or low carbon energy generation on site, unless it can be demonstrated that this is unviable. Energy efficiency measures will be taken into consideration when the total predicted energy requirements are calculated. The Council will consider 'allowable solutions' where it is clearly demonstrated that the provision of on site renewable or low carbon energy generation is unviable or not feasible.

3. Energy Efficiency Measures.

3.1 Establishing CO₂ Emissions

The total regulated carbon emissions at each stage of the energy hierarchy and the percentage savings in regulated emissions over Part L 2013 of the Building Regulations compliant development will be calculated for the Proposed Development.

IES VE 2018.1.0.0 using the dynamic simulation modelling (DSM) methodology was used to assess the non-domestic areas.

The first step of design is to ensure that all new developments provide passive measures and energy efficient solutions. The Proposed Development is seeking to maximise the potential of the measures by the strategy outlined in the following sections.

3.2 Passive Measures

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

Table 1 Element Parameters

Element		Value
Floor U - Value (W/m²K)		0.15
Roof U - Value (W/m²K)		0.15
External Walls U - Value (W/m²K)		0.15
Walls between heated spaces (W/m²K)		Fully filled cavity with sealed edges
Walls between corridors/stairs/lifts/risers (W/m²K)		Fully filled cavity with sealed edges
Glazing	U-value (W/m2K)	1.60
	Frame type	Metal
	G-value	0.40
	Fraction Glazed	0.90
	Opaque Door/Spandrel Panel (W/m2K)	1.60
Air permeability (m³/hm² (@ 50Pa)		3
Thermal Bridge Specification		Default

3.3 Active Measures

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

- Windows carefully designed to balance daylight, heat loss and heat gain;
- High energy efficient central plant; and
- Low energy lighting.

3.4 Mitigating Against Climate Change

The Council will support development which is located and appropriately designed to adapt to impacts arising from climate change such as the increased probability of tidal and fluvial flooding; water stress; health impacts as a result of extreme temperatures and a decline in the quality of habitats and richness of biodiversity.

Development in the District must also be designed to mitigate against the impacts of climate change by reducing the emissions of greenhouse gas in line with the Energy Hierarchy:

- Reduce the use of energy;
- Use energy more efficiently;

- Move to energy from renewable sources; and
- Use remaining fossil fuels cleanly.

The following list shows the proposals the development will include to mitigate against the impacts of climate change:

- Heat generation will be minimised through the specification of energy efficient ventilation systems, insulation on pipework and low energy lighting.
- The amount of heat entering the building will be reduced by:
 - o Energy efficient facades with appropriate proportions of glazing; and
 - o A glazing shading coefficient carefully selected to minimise solar gain in the summer, but also to maximise solar gain in winter.
- Ceiling heights in the development have been maximised within the constraints of the overall building height and massing.
- Passive ventilation (openable windows) has been incorporated within the development. In addition, there will be a small amount of natural ventilation through trickle vents and infiltration
- There will be a continuous extract from the kitchens and bathrooms in all units.
- No comfort cooling is proposed for the development.

4. Renewable Energy Generation.

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

This section addresses the requirements of Policy ECC DM1 (Renewable Energy) of The Local Plan. The supporting text states the following:

The Council will support renewable energy development subject to the criteria in this Policy. Schemes will be expected to contribute to the social, economic and environmental development and overall regeneration of the District. Within areas of protected landscapes, areas or buildings, development should generally be small scale or community based..

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

4.1 Solar Water Heating Panels

Solar water heating systems use heat from the sun to produce domestic hot water. The system requires solar panels on the roof, ideally south facing, linked to hot water storage cylinders.

This development will have a high domestic hot water demand and therefore the CO₂ reduction from a solar thermal system can be maximised. In addition, there is an area of flat roof with an opportunity for south facing panels. For these reasons, solar water heating panels are proposed for this development.

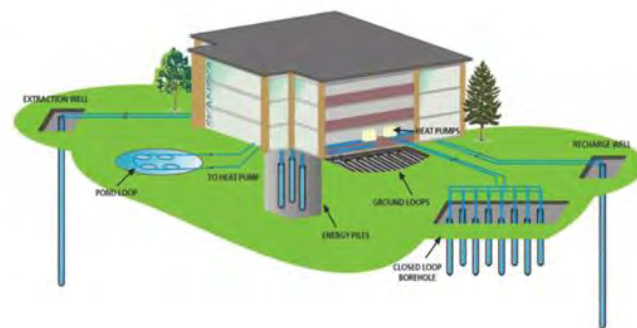


4.2 Ground Source Heat Pumps

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

Open loop systems require the water extracted to be re-injected into the aquifer at another borehole on another part of the site. A licence from the Environment Agency (EA) is required for both abstraction and discharge although these licences cannot be obtained until a test borehole has been constructed and the appropriate EA tests undertaken.

The imbalance of heating and cooling loads (as no cooling is proposed) makes the use of GSHPs unsuitable, therefore none are proposed for this development.



4.3 Biomass Boilers

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



The primary disadvantage of a biomass boiler is that it would require a central energy centre and heat distribution network. In addition, large storage volumes are required for fuel along with regular deliveries. Biomass exhaust gases would also require significant treatment to avoid degrading local air quality. There are concerns that the number of deliveries and large vehicle numbers would cause alarm and a hazard to residents and users of the premises.

Biomass boilers are therefore not proposed for the development.

4.4 Wind Turbines

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

Wind turbines have a significant visual impact and the roof space will be sensitive in townscape terms, which is likely to preclude wind turbines. They can create noise and vibration problems. Additionally, there is limited roof area across the site where clean air flows and good wind speeds can be realised and which are vital to delivering a useful electrical output. Even if a suitable location could be found, the output of a wind turbine and the consequential carbon dioxide emissions will be very limited when compared to the emissions of the whole development.



Wind turbines are therefore not proposed for the development.

4.5 Solar Photovoltaics

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



This development has a low demand for electricity during the day which would mean a portion of the energy produced will be exported back to the grid resulting in less benefit to the development than a solar thermal system. For this reason PV is not proposed for the development.

5. Results.

5.1 Energy Efficiency Iteration

The regulated CO₂ emissions for the energy efficient case has been compared against a Part L2A compliant development. Figure 2 below shows that the regulated carbon dioxide emissions of the energy efficient scheme are approximately 5% below that of the baseline scheme.

The BRUKL Document for the Energy Efficient model can be found in Appendix A.

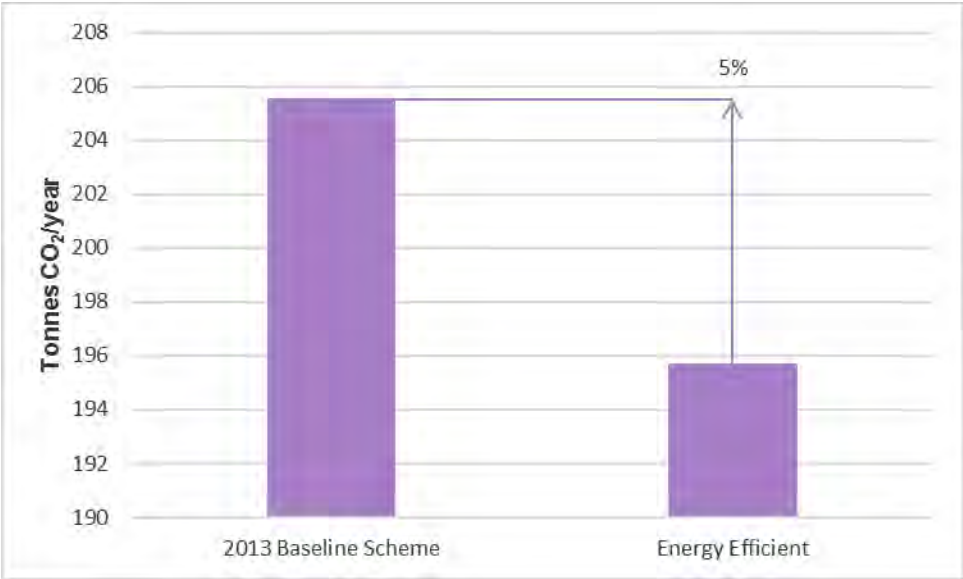


Figure 2 - Regulated Carbon Dioxide Emissions - Energy Efficient Scheme

5.2 Solar Water Heating (SWH) Iteration

Figure 3 below shows the revised estimated reduction in domestic regulated carbon dioxide emissions taking into account the contribution of the solar thermal system is approximately 5% below the energy efficient scheme and 10% below the baseline scheme.

The BRUKL Document for the SWH model can be found in Appendix B.

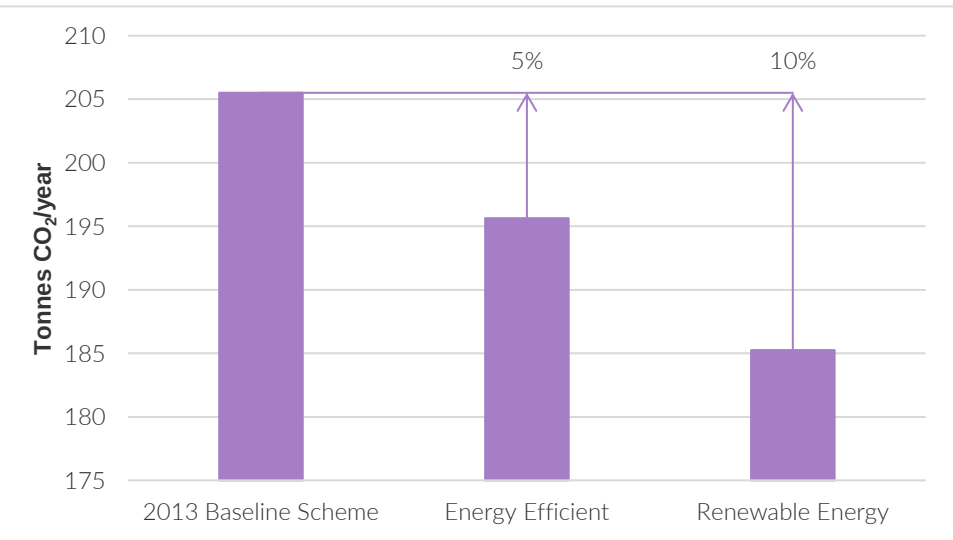


Figure 3 - Regulated Carbon Dioxide Emissions- Renewable Energy Iteration

6. Conclusion.

An energy assessment has been carried out to show compliance with local policy. The assessment showed that a reduction in carbon emissions of 10% over a Part L 2013 compliant development can be achieved. This reduction in carbon dioxide emissions will be achieved through the incorporation of passive and active energy efficiency measures and is in line with Arun’s local plan requirements.

Further to this, in response to Policy ECC SP2, all major developments must produce 10% of the total predicted energy requirements from renewable or low carbon energy generation on site, unless it can be demonstrated that this is unviable. Energy efficiency measures will be taken into consideration when the total predicted energy requirements are calculated. Table 2 below shows the total predicted energy consumption for both the energy efficient scheme (without solar water heating) and the renewable energy scheme. From this table it can be seen that the percentage requirement from renewables is 6.0% for regulated and 4.8% for unregulated.

Table 2 - Regulated and unregulated total predicted energy consumption

	Regulated (kWh/m ²)	Unregulated (kWh/m ²)
Total Predicted Energy Consumption (TPEC) (Energy Efficient Iteration)	158.04	195.59
Total Predicted Energy Consumption (Renewable Iteration)	148.57	186.12
Change in TPEC	9.47	9.47
Percentage of the total predicted energy requirements from renewable or low carbon energy generation on site	6.0%	4.8%

The development is achieving 6.0% of regulated energy from renewable sources, however, in practice this is likely to be much higher.

The dynamic thermal modelling uses a set occupancy and hot water profile for student residential buildings. This gives an artificially high hot water demand. In reality, with the inclusion of low water demand sanitary fittings and a more accurate occupancy profile, the total hot water demand will be less than 50% of that calculated by the modelling software.

A more detailed solar hot water calculation has also been undertaken for the proposed development (see Appendix C). When this is taken into account, with the more realistic hot water demand, the estimated contribution from the solar water system increases to 12.1%.

Appendices.

Appendix A – BRUKL Document: Energy Efficient Scheme.

BRUKL Output Document



Compliance with England Building Regulations Part L 2013

Project name

UoC Tech Park - Student Resi

As designed

Date: Wed Nov 07 11:48:39 2018

Administrative information

Building Details

Address: ,

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.10

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.10

BRUKL compliance check version: v5.4.b.0

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Criterion 1: The calculated CO₂ emission rate for the building must not exceed the target

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	39.6
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	39.6
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	37.7
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 -Limit	U _a -Calc	U _i -Calc	Surface where the maximum value occurs*
Wall**	0.35	0.15	0.15	SH000052:Surf[4]
Floor	0.25	0.15	0.15	SH000052:Surf[5]
Roof	0.25	0.15	0.15	00000061:Surf[9]
Windows***, roof windows, and rooflights	2.2	1.6	1.6	SH000052:Surf[2]
Personnel doors	2.2	1.6	1.6	SH00003D:Surf[1]
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

U_a-Limit = Limiting area-weighted average U-values [W/(m²K)]

U_a-Calc = Calculated area-weighted average U-values [W/(m²K)]

U_i-Calc = Calculated maximum individual element U-values [W/(m²K)]

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

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

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

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

Air Permeability	Worst acceptable standard	This building
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 to 0.95

1- System 1: 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 YES

* 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.

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

Local mechanical ventilation, exhaust, and terminal units

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

Zone name	SFP [W/(l/s)]										HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		Zone	Standard
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1			
00 - Accessible En suite	-	-	0.3	-	-	-	-	-	-	-	-	N/A
00 - Kitchen	-	-	0.6	-	-	-	-	-	0.6	-	-	N/A
00 - Kitchen	-	-	0.6	-	-	-	-	-	0.6	-	-	N/A
00 - Kitchen	-	-	0.6	-	-	-	-	-	0.6	-	-	N/A
00 - Kitchen	-	-	0.6	-	-	-	-	-	0.6	-	-	N/A
01 - Accessible En Suite	-	-	0.3	-	-	-	-	-	-	-	-	N/A
01 - Accessible En suite	-	-	0.3	-	-	-	-	-	-	-	-	N/A
01 - Kitchen	-	-	0.6	-	-	-	-	-	0.6	-	-	N/A
01 - Kitchen	-	-	0.6	-	-	-	-	-	0.6	-	-	N/A
01 - Kitchen	-	-	0.6	-	-	-	-	-	0.6	-	-	N/A
01 - Kitchen	-	-	0.6	-	-	-	-	-	0.6	-	-	N/A
02 - Accessible En Suite	-	-	0.3	-	-	-	-	-	-	-	-	N/A
02 - Accessible En suite	-	-	0.3	-	-	-	-	-	-	-	-	N/A
02 - Kitchen	-	-	0.6	-	-	-	-	-	0.6	-	-	N/A
02 - Kitchen	-	-	0.6	-	-	-	-	-	0.6	-	-	N/A
02 - Kitchen	-	-	0.6	-	-	-	-	-	0.6	-	-	N/A
02 - Kitchen	-	-	0.6	-	-	-	-	-	0.6	-	-	N/A
03 - Accessible En Suite	-	-	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	
00 - En Suite		-	84	-	22
00 - Kitchen		-	82	-	433
00 - Kitchen		-	82	-	391
00 - Kitchen		-	82	-	458
00 - Kitchen		-	79	-	301
00 - M&E Plant Room		138	-	-	197
00 - Stairs		-	100	-	75
00 - Stairs		-	100	-	75
00 - WC		-	104	-	27
00 - WC		-	104	-	31
01 - Accessible Bedroom		-	108	-	33
01 - Accessible Bedroom		-	108	-	34
01 - Accessible En Suite		-	84	-	33
01 - Accessible En suite		-	84	-	32
01 - Bedroom		-	108	-	21
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01 - Bedroom		-	108	-	21
01 - Bedroom		-	108	-	21
01 - Bedroom		-	108	-	21
01 - Bedroom		-	108	-	21
01 - Bedroom		-	108	-	21
01 - Bedroom		-	108	-	21
01 - Bedroom		-	108	-	21
01 - Bedroom		-	108	-	21
01 - Bedroom		-	108	-	21
01 - Bedroom		-	108	-	21
01 - Bedroom		-	108	-	21
01 - Bedroom		-	108	-	21
01 - Bedroom		-	108	-	21
01 - Bedroom		-	108	-	21
01 - Bedroom		-	108	-	21
01 - Bedroom		-	108	-	21
01 - Bedroom		-	108	-	21
01 - Bedroom		-	108	-	21
01 - Bedroom		-	108	-	21
01 - Bedroom		-	108	-	21
01 - Bedroom		-	108	-	21
01 - Bedroom		-	108	-	21
01 - Bedroom		-</			

General lighting and display lighting		Luminous efficacy [lm/W]			
Zone name		Luminaire	Lamp	Display lamp	General lighting [W]
	Standard value	60	60	22	
01 - Circulation		-	104	-	47
01 - Circulation		-	104	-	30
01 - Cleaners Cupboard		-	104	-	26
01 - Cleaners Cupboard		-	104	-	25
01 - Comms		127	-	-	20
01 - Comms		127	-	-	20
01 - En suite		-	84	-	22
01 - En suite		-	84	-	23
01 - En suite		-	84	-	22
01 - En suite		-	84	-	22
01 - En suite		-	84	-	22
01 - En suite		-	84	-	22
01 - En suite		-	84	-	22
01 - En suite		-	84	-	22
01 - En suite		-	84	-	22
01 - En suite		-	84	-	22
01 - En Suite		-	84	-	22
01 - En suite		-	84	-	22
01 - En suite		-	84	-	22
01 - En Suite		-	84	-	23
01 - En Suite		-	84	-	22
01 - En suite		-	84	-	22
01 - En suite		-	84	-	22
01 - En Suite		-	84	-	22
01 - En suite		-	84	-	22
01 - En Suite		-	84	-	23
01 - En suite		-	84	-	23
01 - En suite		-	84	-	23
01 - En Suite		-	84	-	22
01 - En Suite		-	84	-	22
01 - En suite		-	84	-	22
01 - En Suite		-	84	-	23
01 - Kitchen		-	82	-	433
01 - Kitchen		-	82	-	433
01 - Stairs		-	103	-	36
01 - Stairs		-	103	-	36
01 - Kitchen		-	82	-	468
01 - Kitchen		-	82	-	405
01 - Circulation		-	104	-	50
01 - Circulation		-	104	-	32

[illegible]

General lighting and display lighting		Luminous efficacy [lm/W]			
Zone name		Luminaire	Lamp	Display lamp	General lighting [W]
	Standard value	60	60	22	
02 - Comms		127	-	-	20
02 - Comms		127	-	-	20
02 - En suite		-	84	-	22
02 - En suite		-	84	-	23
02 - En suite		-	84	-	22
02 - En suite		-	84	-	22
02 - En suite		-	84	-	22
02 - En suite		-	84	-	22
02 - En suite		-	84	-	22
02 - En suite		-	84	-	22
02 - En suite		-	84	-	22
02 - En suite		-	84	-	22
02 - En suite		-	84	-	22
02 - En Suite		-	84	-	22
02 - En suite		-	84	-	22
02 - En suite		-	84	-	22
02 - En suite		-	84	-	22
02 - En suite		-	84	-	22
02 - En Suite		-	84	-	23
02 - En Suite		-	84	-	22
02 - En suite		-	84	-	22
02 - En suite		-	84	-	22
02 - En Suite		-	84	-	22
02 - En suite		-	84	-	22
02 - En Suite		-	84	-	23
02 - En suite		-	84	-	23
02 - En suite		-	84	-	23
02 - En suite		-	84	-	22
02 - En Suite		-	84	-	22
02 - En Suite		-	84	-	22
02 - En suite		-	84	-	22
02 - En Suite		-	84	-	23
02 - Kitchen		-	82	-	433
02 - Kitchen		-	82	-	433
02 - Stairs		-	103	-	36
02 - Stairs		-	103	-	36
02 - Kitchen		-	82	-	468
02 - Kitchen		-	82	-	405
02 - Circulation		-	104	-	50
02 - Circulation		-	104	-	32
02 - Circulation		-	104	-	47
02 - En-suite		-	104	-	12
02 - Bedroom		-	108	-	21
02 - En Suite		-	84	-	22

[illegible]

General lighting and display lighting		Luminous efficacy [lm/W]			
Zone name		Luminaire	Lamp	Display lamp	General lighting [W]
	Standard value	60	60	22	
03 - En suite		-	84	-	22
03 - En suite		-	84	-	22
03 - En suite		-	84	-	22
03 - En suite		-	84	-	22
03 - En suite		-	84	-	22
03 - En suite		-	84	-	22
03 - En suite		-	84	-	22
03 - En suite		-	84	-	22
03 - En Suite		-	84	-	22
03 - En suite		-	84	-	22
03 - En suite		-	84	-	22
03 - En suite		-	84	-	22
03 - En Suite		-	84	-	23
03 - En Suite		-	84	-	22
03 - En suite		-	84	-	22
03 - En suite		-	84	-	22
03 - En Suite		-	84	-	22
03 - En Suite		-	84	-	22
03 - En suite		-	84	-	22
03 - En Suite		-	84	-	23
03 - En suite		-	84	-	23
03 - En suite		-	84	-	23
03 - En suite		-	84	-	22
03 - En Suite		-	84	-	22
03 - En Suite		-	84	-	22
03 - En suite		-	84	-	22
03 - En Suite		-	84	-	23
03 - Kitchen		-	82	-	433
03 - Kitchen		-	82	-	433
03 - Stairs		-	103	-	36
03 - Stairs		-	103	-	36
03 - Kitchen		-	82	-	468
03 - Kitchen		-	82	-	405
03 - Circulation		-	104	-	50
03 - Circulation		-	104	-	32
03 - Circulation		-	104	-	47
03 - En-suite		-	104	-	12
03 - Bedroom		-	108	-	21
03 - En Suite		-	84	-	22
03 - Bedroom		-	108	-	21
03 - Bedroom		-	104	-	27
04 - Accessible Bedroom		-	108	-	33
04 - Accessible Bedroom		-	108	-	34

[illegible]

General lighting and display lighting		Luminous efficacy [lm/W]			
Zone name		Luminaire	Lamp	Display lamp	General lighting [W]
	Standard value	60	60	22	
04 - En suite		-	84	-	22
04 - En suite		-	84	-	22
04 - En suite		-	84	-	22
04 - En suite		-	84	-	22
04 - En suite		-	84	-	22
04 - En Suite		-	84	-	22
04 - En suite		-	84	-	22
04 - En suite		-	84	-	22
04 - En Suite		-	84	-	23
04 - En Suite		-	84	-	22
04 - En suite		-	84	-	22
04 - En suite		-	84	-	22
04 - En Suite		-	84	-	22
04 - En suite		-	84	-	22
04 - En Suite		-	84	-	23
04 - En suite		-	84	-	23
04 - En suite		-	84	-	23
04 - En suite		-	84	-	22
04 - En Suite		-	84	-	22
04 - En Suite		-	84	-	22
04 - En suite		-	84	-	22
04 - En Suite		-	84	-	23
04 - Kitchen		-	82	-	433
04 - Kitchen		-	82	-	433
04 - Stairs		-	103	-	36
04 - Stairs		-	103	-	36
04 - Kitchen		-	82	-	468
04 - Kitchen		-	82	-	405
04 - Circulation		-	104	-	50
04 - Circulation		-	104	-	32
04 - Circulation		-	104	-	47
04 - En-suite		-	104	-	12
04 - Bedroom		-	108	-	21
04 - En Suite		-	84	-	22
04 - Bedroom		-	108	-	21
04 - Bedroom		-	104	-	27
05 - Cleaners Cupboard		-	104	-	26
05 - Comms		127	-	-	20
05 - Circulation		-	104	-	25
05 - Stairs		-	103	-	30
05 - Circulation		-	104	-	31
05 - Accessible Bedroom		-	108	-	33

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
05 - Accessible Bedroom	-	108	-	34
05 - Accessible En Suite	-	84	-	33
05 - Accessible En suite	-	84	-	32
05 - Bedroom	-	108	-	21
05 - Bedroom	-	108	-	21
05 - Bedroom	-	108	-	21
05 - Bedroom	-	108	-	21
05 - Bedroom	-	108	-	21
05 - Bedroom	-	108	-	21
05 - Bedroom	-	108	-	21
05 - Bedroom	-	108	-	21
05 - Bedroom	-	108	-	21
05 - Bedroom	-	108	-	21
05 - Bedroom	-	108	-	21
05 - Bedroom	-	108	-	21
05 - Bedroom	-	108	-	21
05 - Bedroom	-	108	-	22
05 - Circulation	-	104	-	49
05 - Circulation	-	104	-	47
05 - Circulation	-	104	-	30
05 - Cleaners Cupboard	-	104	-	25
05 - Comms	127	-	-	20
05 - En suite	-	84	-	22
05 - En suite	-	84	-	22
05 - En suite	-	84	-	22
05 - En Suite	-	84	-	22
05 - En suite	-	84	-	22
05 - En Suite	-	84	-	23
05 - En Suite	-	84	-	22
05 - En Suite	-	84	-	22
05 - En Suite	-	84	-	23
05 - En suite	-	84	-	23
05 - En suite	-	84	-	23
05 - En Suite	-	84	-	22
05 - En Suite	-	84	-	22
05 - En Suite	-	84	-	23
05 - Kitchen	-	82	-	433
05 - Stairs	-	103	-	36
05 - Kitchen	-	82	-	468

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
00 - Accessible Bedroom	NO (-82%)	NO
00 - Bedroom	NO (-78.6%)	NO
00 - Bedroom	NO (-82.4%)	NO
00 - Bedroom	NO (-81.6%)	NO
00 - Bedroom	NO (-75.7%)	NO
00 - Bedroom	NO (-76.2%)	NO
00 - Bedroom	NO (-87.4%)	NO
00 - Bedroom	NO (-75.1%)	NO
00 - Bedroom	NO (-80.9%)	NO
00 - Bedroom	NO (-78.8%)	NO
00 - Bedroom	NO (-75.9%)	NO
00 - Bedroom	NO (-75.9%)	NO
00 - Bedroom	NO (-85.2%)	NO
00 - Bedroom	NO (-82.2%)	NO
00 - Bedroom	NO (-79.9%)	NO
00 - Bedroom	NO (-83.4%)	NO
00 - Bedroom	NO (-82.4%)	NO
00 - Bedroom	NO (-82.2%)	NO
00 - Bedroom	NO (-84.1%)	NO
00 - Bedroom	NO (-76.2%)	NO
00 - Bedroom	NO (-75.9%)	NO
00 - Bedroom	NO (-82.7%)	NO
00 - Bedroom	NO (-75.5%)	NO
00 - Bedroom	NO (-83.8%)	NO
00 - Bedroom	NO (-84.9%)	NO
00 - Bedroom	NO (-82.9%)	NO
00 - Bedroom	NO (-87.8%)	NO
00 - Bedroom	N/A	N/A
01 - Accessible Bedroom	NO (-80.9%)	NO
01 - Accessible Bedroom	NO (-81.9%)	NO
01 - Bedroom	NO (-77.4%)	NO
01 - Bedroom	NO (-78.4%)	NO
01 - Bedroom	NO (-78.6%)	NO
01 - Bedroom	NO (-82.4%)	NO
01 - Bedroom	NO (-81.6%)	NO
01 - Bedroom	NO (-75.7%)	NO
01 - Bedroom	NO (-76.1%)	NO
01 - Bedroom	NO (-86.4%)	NO
01 - Bedroom	NO (-75%)	NO
01 - Bedroom	NO (-80.7%)	NO
01 - Bedroom	NO (-78.7%)	NO
01 - Bedroom	NO (-75.9%)	NO
01 - Bedroom	NO (-75.9%)	NO
01 - Bedroom	NO (-84.9%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
01 - Bedroom	NO (-82.9%)	NO
01 - Bedroom	NO (-79.3%)	NO
01 - Bedroom	NO (-83.2%)	NO
01 - Bedroom	NO (-82.4%)	NO
01 - Bedroom	NO (-82.2%)	NO
01 - Bedroom	NO (-84.1%)	NO
01 - Bedroom	NO (-75.4%)	NO
01 - Bedroom	NO (-76.2%)	NO
01 - Bedroom	NO (-75.9%)	NO
01 - Bedroom	NO (-82.7%)	NO
01 - Bedroom	NO (-75.5%)	NO
01 - Bedroom	NO (-82.2%)	NO
01 - Bedroom	NO (-87.8%)	NO
01 - Bedroom	NO (-77.9%)	NO
01 - Bedroom	NO (-84.4%)	NO
01 - Bedroom	NO (-83.1%)	NO
02 - Accessible Bedroom	NO (-80.8%)	NO
02 - Accessible Bedroom	NO (-81.7%)	NO
02 - Bedroom	NO (-77.3%)	NO
02 - Bedroom	NO (-78.4%)	NO
02 - Bedroom	NO (-78.6%)	NO
02 - Bedroom	NO (-82.4%)	NO
02 - Bedroom	NO (-81.6%)	NO
02 - Bedroom	NO (-75.7%)	NO
02 - Bedroom	NO (-76.1%)	NO
02 - Bedroom	NO (-86.4%)	NO
02 - Bedroom	NO (-74.9%)	NO
02 - Bedroom	NO (-80.6%)	NO
02 - Bedroom	NO (-78.4%)	NO
02 - Bedroom	NO (-75.9%)	NO
02 - Bedroom	NO (-75.9%)	NO
02 - Bedroom	NO (-84.8%)	NO
02 - Bedroom	NO (-82.8%)	NO
02 - Bedroom	NO (-78.8%)	NO
02 - Bedroom	NO (-82.9%)	NO
02 - Bedroom	NO (-82.4%)	NO
02 - Bedroom	NO (-82.2%)	NO
02 - Bedroom	NO (-84.1%)	NO
02 - Bedroom	NO (-75.4%)	NO
02 - Bedroom	NO (-76.2%)	NO
02 - Bedroom	NO (-75.9%)	NO
02 - Bedroom	NO (-82.7%)	NO
02 - Bedroom	NO (-75.5%)	NO
02 - Bedroom	NO (-82.2%)	NO
02 - Bedroom	NO (-87.8%)	NO
02 - Bedroom	NO (-77.9%)	NO
02 - Bedroom	NO (-84.4%)	NO
02 - Bedroom	NO (-83.1%)	NO
03 - Accessible Bedroom	NO (-80.8%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
03 - Accessible Bedroom	NO (-81.2%)	NO
03 - Bedroom	NO (-77.1%)	NO
03 - Bedroom	NO (-78.4%)	NO
03 - Bedroom	NO (-78.5%)	NO
03 - Bedroom	NO (-82.4%)	NO
03 - Bedroom	NO (-81.6%)	NO
03 - Bedroom	NO (-75.7%)	NO
03 - Bedroom	NO (-75.9%)	NO
03 - Bedroom	NO (-86.4%)	NO
03 - Bedroom	NO (-74.7%)	NO
03 - Bedroom	NO (-80.1%)	NO
03 - Bedroom	NO (-77.9%)	NO
03 - Bedroom	NO (-75.9%)	NO
03 - Bedroom	NO (-75.9%)	NO
03 - Bedroom	NO (-84.4%)	NO
03 - Bedroom	NO (-82.7%)	NO
03 - Bedroom	NO (-78.3%)	NO
03 - Bedroom	NO (-82.5%)	NO
03 - Bedroom	NO (-82.4%)	NO
03 - Bedroom	NO (-82.2%)	NO
03 - Bedroom	NO (-84.1%)	NO
03 - Bedroom	NO (-75.4%)	NO
03 - Bedroom	NO (-76.2%)	NO
03 - Bedroom	NO (-75.9%)	NO
03 - Bedroom	NO (-82.7%)	NO
03 - Bedroom	NO (-75.5%)	NO
03 - Bedroom	NO (-82.2%)	NO
03 - Bedroom	NO (-87.8%)	NO
03 - Bedroom	NO (-77.9%)	NO
03 - Bedroom	NO (-84.4%)	NO
03 - Bedroom	NO (-83.1%)	NO
04 - Accessible Bedroom	NO (-80.7%)	NO
04 - Accessible Bedroom	NO (-80.7%)	NO
04 - Bedroom	NO (-77%)	NO
04 - Bedroom	NO (-78.3%)	NO
04 - Bedroom	NO (-77.8%)	NO
04 - Bedroom	NO (-82.4%)	NO
04 - Bedroom	NO (-81.6%)	NO
04 - Bedroom	NO (-75.7%)	NO
04 - Bedroom	NO (-75.3%)	NO
04 - Bedroom	NO (-86.4%)	NO
04 - Bedroom	NO (-74.6%)	NO
04 - Bedroom	NO (-79%)	NO
04 - Bedroom	NO (-77.3%)	NO
04 - Bedroom	NO (-75.9%)	NO
04 - Bedroom	NO (-75.9%)	NO
04 - Bedroom	NO (-84%)	NO
04 - Bedroom	NO (-82.7%)	NO
04 - Bedroom	NO (-77.6%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
04 - Bedroom	NO (-81.6%)	NO
04 - Bedroom	NO (-82.4%)	NO
04 - Bedroom	NO (-82.2%)	NO
04 - Bedroom	NO (-84.1%)	NO
04 - Bedroom	NO (-75.4%)	NO
04 - Bedroom	NO (-76.2%)	NO
04 - Bedroom	NO (-75.9%)	NO
04 - Bedroom	NO (-82.7%)	NO
04 - Bedroom	NO (-75.5%)	NO
04 - Bedroom	NO (-82.2%)	NO
04 - Bedroom	NO (-87.8%)	NO
04 - Bedroom	NO (-77.9%)	NO
04 - Bedroom	NO (-84.4%)	NO
04 - Bedroom	NO (-83.1%)	NO
05 - Accessible Bedroom	NO (-80.6%)	NO
05 - Accessible Bedroom	NO (-77.7%)	NO
05 - Bedroom	NO (-76.7%)	NO
05 - Bedroom	NO (-77.2%)	NO
05 - Bedroom	NO (-75.7%)	NO
05 - Bedroom	NO (-86.4%)	NO
05 - Bedroom	NO (-77.6%)	NO
05 - Bedroom	NO (-76.4%)	NO
05 - Bedroom	NO (-75.9%)	NO
05 - Bedroom	NO (-75.9%)	NO
05 - Bedroom	NO (-75.4%)	NO
05 - Bedroom	NO (-76.2%)	NO
05 - Bedroom	NO (-75.9%)	NO
05 - Bedroom	NO (-82.7%)	NO
05 - Bedroom	NO (-75.5%)	NO
05 - Bedroom	NO (-77.9%)	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			Building Use	
	Actual	Notional	% Area	Building Type
Area [m²]	5189.5	5189.5		A1/A2 Retail/Financial and Professional services
External area [m²]	5091.7	5091.7		A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
Weather	SOU	SOU		B1 Offices and Workshop businesses
Infiltration [m³/hm²@ 50Pa]	3	3		B2 to B7 General Industrial and Special Industrial Groups
Average conductance [W/K]	1704.11	2883.05		B8 Storage or Distribution
Average U-value [W/m²K]	0.33	0.57		C1 Hotels
Alpha value* [%]	10.14	10		C2 Residential Institutions: Hospitals and Care Homes
* Percentage of the building's average heat transfer coefficient which is due to thermal bridging			100	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	34.26	44.59
Cooling	0	0
Auxiliary	2.55	2.45
Lighting	9.5	12.39
Hot water	111.73	103.96
Equipment*	37.55	37.55
TOTAL **	158.04	163.39

* 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 & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	111.14	138.38
Primary energy* [kWh/m²]	214.72	225.65
Total emissions [kg/m²]	37.7	39.6

* 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 SSEF	Cool SSEER	Heat gen SEFF	Cool gen SEER	
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	148	0	45.6	0	2.1	0.9	0	0.96	0
	Notional	0	0	0	0	0	0	0	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	184.3	0	59.4	0	2.1	0.86	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-Typ}	U _{i-Min} Surface where the minimum value occurs*
Wall	0.23	0.15 SH000052:Surf[4]
Floor	0.2	0.15 SH000052:Surf[5]
Roof	0.15	0.15 00000061:Surf[9]
Windows, roof windows, and rooflights	1.5	1.6 SH000052:Surf[0]
Personnel doors	1.5	1.6 SH00003D:Surf[1]
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-Typ} = Typical individual element U-values [W/(m²K)]		U _{i-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 B – BRUKL Document: Solar Water Heating Iteration.