

ENERGY STATEMENT



THE HEIGHTS PRIMARY FREE SCHOOL

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1.0 Executive Summary

Building Services Design have carried out an assessment of the low carbon and renewable energy solutions for proposed new school building at Mapledurham Playing Fields, Reading. This report demonstrates compliance with the building regulations and local planning conditions.

The existing site is approximately 25 acres comprising tennis courts, wooded areas and a playground and is held in trust by Reading Borough Council. The new school shall be constructed on land purchased by the EFA and shall comprise 8no. Classrooms, WC facilities, a commercial kitchen and main hall.

By adopting the passive design measures and the on site renewable energy generation outlined below, the overall CO₂ emissions of the proposed development will be designed to emit 20.38% less CO₂ than a Building Regulations 2013 compliant building.

Passive Design Measures

The proposed new development will incorporate the following mechanical and electrical elements that are highly energy efficient and will ensure that the development will emit less CO₂.

- Low energy LED lighting utilized throughout
- Intelligent lighting control (utilizing absence detection, presence detection and daylight controls)
- Low energy EC fan motors on AHUs
- Variable speed drive fans on the main ventilation plant so that the fresh air ventilation ramps up and down to meet the building occupancy load.
- Variable speed drive controls on all heating pumps so that the pumps ramp up and down speed to meet the building heat load.
- BMS which monitors all energy usage within the building and warns of out of range energy usage.
- Natural ventilation in all classrooms designed to meet the requirements of the Facilities Output Specification as issued by the Education Funding Agency.

In addition, the school is being designed to the Facilities Output Specification as issued by the Education Funding Agency, which provides enhancements to the design of daylighting, acoustics, ventilation and heating over and above that of a typical new school.

Renewable Technology

A wide range of renewable energy technologies have been considered for the proposed development and a detailed appraisal of each technology is discussed in section 4 of this report. Solar Photovoltaic was considered the most suitable technology for the site and was capable of achieving the 20% CO₂ reduction of the sites total energy use.

The tables and graph below summarise the carbon savings calculated for the proposed option.

Table 1: Carbon dioxide emissions after each stage of the Energy Assessment

Carbon dioxide emissions		
	(Tonnes CO ₂ per annum)	%
Baseline: Building Regulations 2013 Part L Compliant Development	26.99	100.00%
Carbon Dioxide emissions offset from energy efficiency	3.21	11.90%
Carbon Dioxide emissions offset from renewable energy	2.29	8.47%
Carbon dioxide emissions of the occupied building	21.49	79.62%

Graph 1: Carbon dioxide emissions of the development when compared against Building Regulations 2013 Part L

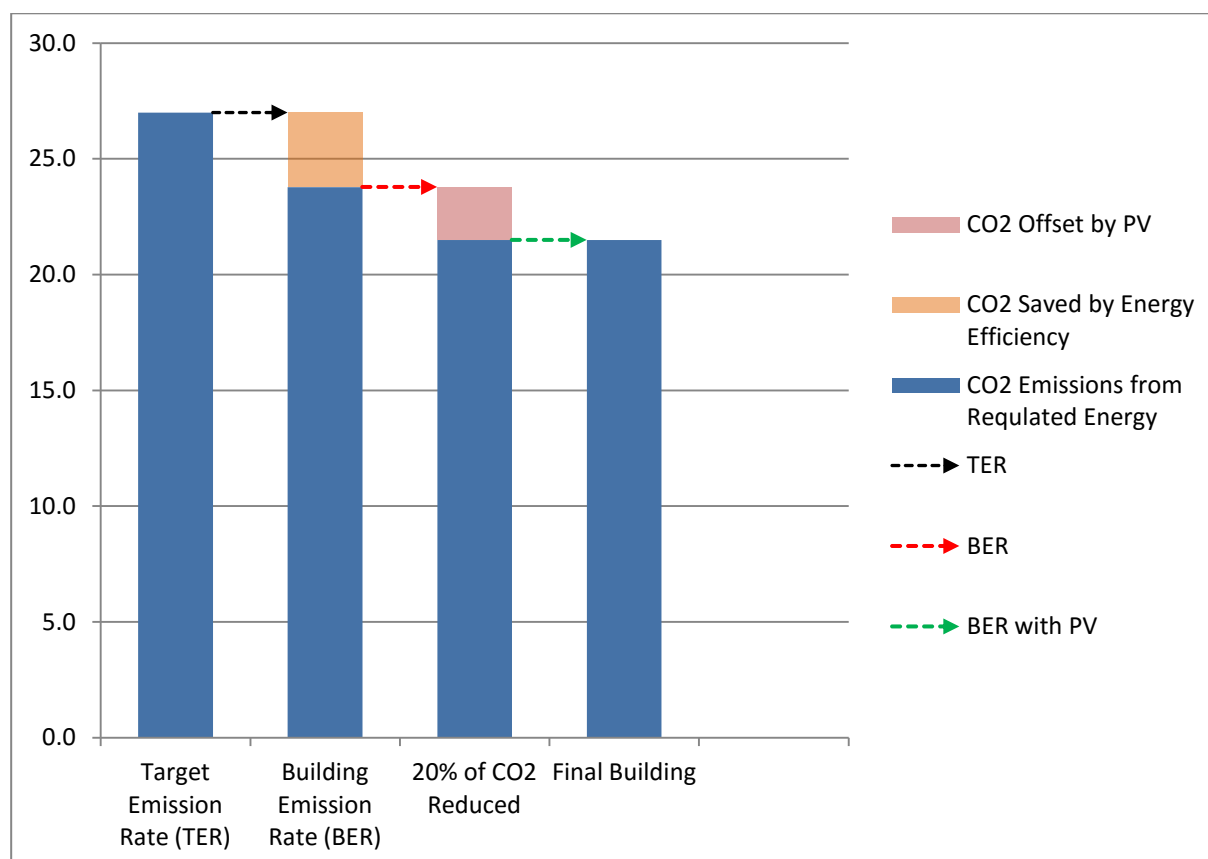


Table 2: Carbon dioxide emissions reduction incorporating low energy passive design measures

TER (kgCO ₂ /m ² /annum)	BER incorporating low energy passive design measures (kgCO ₂ /m ² /annum)	Total % reduction in CO ₂
12.60	11.10	11.90%

Table 3: Carbon dioxide emissions reduction from renewable and low energy passive design measures.

BER incorporating low energy passive design measures (kgCO ₂ /m ² /annum)	BER incorporating low energy passive design measures & contribution from Solar PV system (kgCO ₂ /m ² /annum)	Total % reduction in CO ₂
11.10	10.03	8.47%

2.0 Introduction

BSD have been employed by Townsend and Turner to carry out an energy and renewables report for the proposed new school building at Mapledurham Playing Fields, Reading.

The purpose of this report is to look at the most appropriate renewable / low /zero carbon energy source to serve the proposed redevelopment and outline the most suitable in line with the policies of Reading Borough Council, for the new school building.

Reading Borough Council Core Strategy Document (Revised Jan 2015) Policy CS1: Sustainable Construction and Design states the following:

- On larger developments of more than 10 dwellings or 1,000m² of floorspace, ensure that 50% of the provision meets the most up to date Eco-Homes and BREEAM 'Excellent' standards;
- All developments of more than 10 dwellings or 1,000m² floorspace incorporate on-site generation of energy from renewable sources and energy efficient design measures (including the use of CHP where appropriate) to off-set at least 20% of predicted carbon dioxide emissions from the estimated energy usage of the completed and occupied development;
- All developments reduce mains water use and demonstrate that water conservation measures are incorporated so that predicted per capita consumption does not exceed the appropriate levels set out in the Code for Sustainable Homes or BREEAM Standards

This report presents the findings of a preliminary energy demand and carbon reduction assessment for the proposed development. Energy efficient measures, low carbon and renewable energy technologies are explored to assess the impact in the reduction of the carbon emissions of the scheme when compared with the current building regulations.

The following hierarchy has been used to structure our approach to energy assessment :

1. Calculate baseline energy demand & carbon dioxide emissions. The energy assessment shall include a calculation of the energy demand and carbon dioxide emissions covered by the Building Regulations and the energy demand and carbon dioxide emissions from any other part of the development, including equipment, that are not covered by the Building Regulations (i.e small power loads, cooking loads etc.)
2. Reduce carbon dioxide emissions through energy efficient design of site, building and services.
3. Reduce carbon dioxide emissions through the use of renewable technologies.

3.0 Energy Demand Assessment

The development has been modelled by a CIBSE Registered Low Carbon Consultant using the National Calculation Methodology (NCM), in IES Virtual Environment 2015 Software. This software is in accordance with CIBSE AM11 Building Energy and Environmental Modelling. Furthermore, the building has been assessed for compliance with the Facilities Output Specification (FOS) as issued by the Education Funding Agency (ECA), dated June 2013.

3.1 Energy Demand and CO₂ Emissions

The assessment compared the CO₂ emissions from the proposed development against the total emissions from the Notional Building of the 2013 Building Regulations. The output calculation from the NCM calculations indicated that the proposed development would achieve a Building Emission Rating (BER) of **11.1 kg CO₂/m²/annum**. The calculation also indicated that the Target Emission Rating (TER) for an equivalent building regulations compliant building would be **12.6 kg CO₂/m²/annum**.

The results demonstrate that the proposed development will emit 20.38% less CO₂ than an equivalent 2013 Building Regulations compliant building of which 11.9% is attributed to energy efficiency measures and a further 8.47% attributed to on site renewable energy generation.

3.2 Energy Efficiency – Passive Design Measures

The entire development will meet the performance required by Building Regulations 2013 Part L and will also meet the recommendations of the Reading Borough Council Core Strategy Document.

The following low energy design principles will be utilised in the building's construction, and the development will incorporate at least the following energy efficiency measures:

- All internal lighting shall be low energy LED light fittings to minimise emissions.
- Automatic lighting control and daylight dimming will be utilized throughout. All circulation areas and occupied areas shall be fitted with microwave presence detectors and daylight sensors to minimise lighting use when not required.
- Improved u-values in excess of Building Regulations
 - External walls 0.18 – 0.20 W/m² K
 - Ground floor 0.15W/m² K
 - Roof 0.13W/m² K
 - Glazing 1.3 - 1.4W/m² K + 'g' value 0.41
 - Roof lights 1.3 W/m² K
- Improving air-tightness beyond minimum standards to all areas. The building shall achieve an air permeability of 5 m³/(h.m²) @ 50Pa or better upon completion of the works
- Hybrid natural/mechanical ventilation systems for the classrooms which will be able to provide night time cooling using the thermal mass of the building.
- Demand control mechanical ventilation to internal spaces. This will consist of variable speed drive motors and sensors and shall speed up/slow down to match the occupancy. This considerably reduces the amount of air that needs to be heated/cooled as it enter the building.
- Demand controlled natural ventilation to the assembly halls consisting of roof mounted natural ventilation units complete with automatic opening vents, to modulate fresh air intake based on the CO₂ levels and temperature within the space.

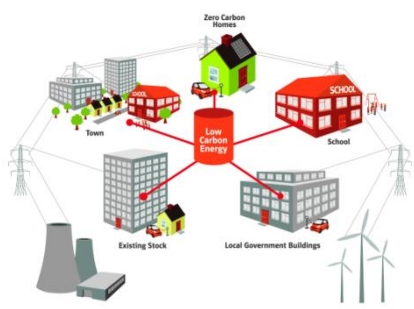
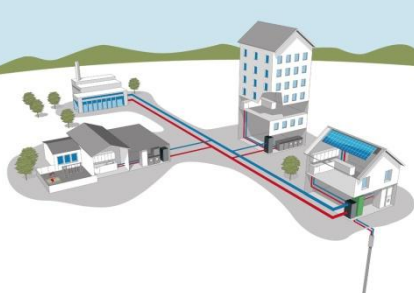
3.3 Achievable Emissions Reductions

By incorporating the above measures the development is able to achieve a reduction of 20.38% CO₂ emitted by the development. This is in line with the 20% target as required by the Reading Borough Council Core Strategy Policy

4.0 Renewable Energy Evaluation

A range of renewable energy and low carbon technologies have been considered for the proposed development and their feasibility has been assessed. The tables below present a summary of the technologies considered it is clear that some are not well suited for the development.

Table appraisal of renewable technologies options

TECHNOLOGY	COMMENTS
 DECENTRALISED ENERGY	Decentralised Energy is the cooperative use of local energy. Energy is imported or exported from the site and imported or exported to adjacent buildings, applications and processes. The Heights Free Primary School shall provide decentralized energy generation. Initially this has been identified as solar photovoltaic which allows the energy produced to be exported to the National Grid and distributed locally via the electricity distribution network. Good Viability - Suitable
 COMBINED HEAT AND POWER	A CHP unit can be installed within the plant room of the building or externally. The unit primarily produces electricity to meet or exceed the baseload of the school, with the heat produced used to supply the heating and hot water systems. CHP is not well suited to a school environment (unless connected to a district heating scheme) because the heat produced in summer must be dumped as the building is unoccupied. Furthermore, it is anticipated that the significant capital and O&M costs are unsuitable for The Heights Free Primary School Viable - Not Suitable
 DISTRICT HEATING	The Heights Free Primary School would benefit being connected to a local district heating network as this would allow on site plant to be sized for a smaller demand in the winter months and permanently switched off during summer months. There are no local district heating networks within the vicinity of the development. Not Viable – Suitable



WIND TURBINES

Micro wind turbines can be fitted to the roof of a building. This technology is not considered suitable due to the relatively low wind speed prevailing in the area (4.6m/s at 10m). The site is surrounded by trees and buildings so would need to extend above these to generate a significant output; extending the turbine to such a height would have considerable impacts on the structure of the building.

Turbines can generate a reasonably high degree of noise during their operation. This noise could create nuisance to the surrounding neighbours.

Whilst turbines give a strong visual representation of renewable energy, it would significantly detract from the visual amenity of the area, this combined with their insignificant output in this location means that this technology will not be considered further for this redevelopment.

Low Viability - Not Suitable



BIOMASS HEATING

The combustion of wood chip or pellets creates heat for space heating and hot water loads.

However, in the suburban environment, access for biomass delivery lorries is very difficult and allocating adequate storage space is a major issue. Typically a biomass boiler would need a huge space to be set aside as fuel store which takes up most of the plant area or extends externally.

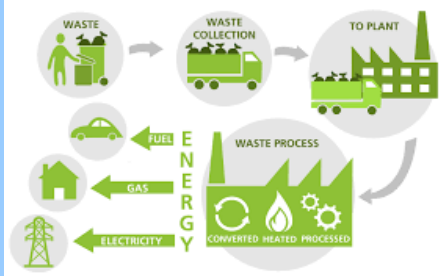
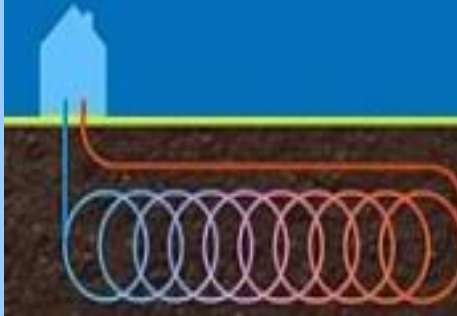
Typically, a baseload that is available across the year is required for biomass, as biomass plants have limited capacity to operate at part load. The school would be vacant throughout the summer, meaning no generation can be undertaken.

Emissions would need to be carefully controlled considering the immediate locality to playing fields. Furthermore, a biomass plant incurs a considerable O&M cost.

For the above reasons we believe this option is not suitable.

Low Viability – Low Suitability

 PHOTO VOLTAIC CELLS	Photovoltaic (PV) Cell technology involves the conversion of the sun's energy into electricity. The roof of the building is large enough to accommodate a large number of PV panels. The incorporation of PV is definitely viable and would make an excellent choice of renewable considering the large roof space available and the ability to export the excess electricity to the grid. It is anticipated that the entire 20% requirement for on site renewable generation can be met with a PV array. Good Viability - Suitable
 SOLAR THERMAL – HOT WATER	Solar Thermal panels could be utilized to generate a small proportion of the buildings energy. Solar thermal panels utilize their energy to generate hot water and are most effective during the summer months. The school will be empty and therefore not present a load for the solar panels during the summer months. Furthermore since PV is proposed these technologies would compete for available roof space and PV represents a better option since it will allow excess energy to be exported if overproduced on site. Low Viability - Not Suitable
 SMALL SCALE HYDRO	Small Scale Hydro requires an on site source of flowing water that has either a large flow volume or a high head. Despite the proximity of the River Thames, small scale hydro would not be suitable as there is no on site water source. Any works on the Thames River would require significant capital cost and planning with other authorities, far beyond the scope of this project. No Viability – Not Suitable

 ENERGY FROM WASTE	Energy from waste can comprise either direct combustion of waste or biological decomposition of waste and combustion of the by product. Energy from waste plants require a guaranteed level of waste to be generated from the site (or imported from the surroundings). This in itself can present a legislative burden on small operators whose core business is not waste handling. Energy from waste plants require a considerable capital cost, incur air pollution and require significant O&M procedures. Therefore, these have been considered unsuitable for The Heights Primary Free School Viable - Not Suitable
 GROUND SOURCE HEAT PUMPS	GSHP technologies exploit seasonal temperature differences between ground and air temperatures. Pipe work is placed either horizontally or vertically in the ground. Fluid pumped through the pipes takes up heat which is then extracted by the heat pump and released at a higher temperature to drive a space heating system. The school is surrounded by open space which would be ideal for either horizontal or vertical boreholes. The surrounding space is not owned by the school however hence further planning and coordination would be required; it should also be noted that vertical boreholes can be extremely expensive to install, depending on ground conditions. Good Viability - Suitable



AIR SOURCE HEAT PUMPS

ASHP technologies exploit temperature differences between the system refrigerant and external air temperatures. Air is passed over refrigerant from which heat is extracted by the heat pump and released at a higher temperature to drive a space heating system.

Air source heat pumps are well suited to the school environment, and offer efficient heat output typically to -5°C. ASHPs require a low temperature heat emitter within the building in order for them to be effective – this typically means installing UFH.

There is sufficient space around the building to house the units (acoustics can be an issue).

Good Viability - Suitable

It can be seen from the above table that the most suitable low carbon technology that is practical and feasible for incorporation into the scheme is PV. Approximately 4.5kW (peak) of PV panels shall be provided to give an annual generation of 4,300kWh to achieve the required carbon dioxide emission reduction targets. The proposed roof PV layout is shown on the architects' roof drawings demonstrating the proposed quantity that can be installed on the available roof space.

5.0 BREEAM Compliance

In order to demonstrate compliance with Reading Borough Council Core Strategy Policy CS1, a BREEAM pre-assessment has been undertaken by Zero Energy Design Ltd which details that the building shall achieve 5 points for the ENE01 credit.

The results of the modelling undertaken using the National Calculation Methodology (NCM), in IES Virtual Environment 2015 Software are indicated below and the resulting Overall EPR_{NC} calculated.

Energy & CO2 emissions		
	Actual	Notional
Heating + cooling demand (MJ/m ²)	44.93	43.47
Primary Energy (kWh/m ²)	64.1	73.21
Total Emissions (kg/m ²)	11.1	12.6
Overall EPR_{NC} :		0.3251
BREEAM Credits:		5

6.0 Summary

The results demonstrate that the proposed development will emit 20.38% less CO₂ than an equivalent 2013 Building Regulations compliant building of which 11.9% is attributed to energy efficiency measures and a further 8.47% attributed to on site renewable energy generation.

7.0 APPENDIX 1 Energy Calculations (SBEM Results)

BRUKL Output Document



Compliance with England Building Regulations Part L 2013

Project name

The Heights School

As designed

Date: Tue Mar 14 09:51:09 2017

Administrative information

Building Details

Address: Reading, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.6

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.6

BRUKL compliance check version: v5.2.g.3

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

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

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	12.6
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	12.6
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	11.1
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 the building services should achieve reasonable overall standards of energy efficiency

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

Building fabric

Element	U _o -Limit	U _o -Calc	U _i -Calc	Surface where the maximum value occurs*
Wall**	0.35	0.18	0.18	YR000002:Surf[4]
Floor	0.25	0.15	0.15	YR000002:Surf[0]
Roof	0.25	0.13	0.13	YR000027:Surf[0]
Windows***, roof windows, and rooflights	2.2	2.03	2.03	YR000002:Surf[1]
Personnel doors	2.2	2.2	2.2	YR000002:Surf[3]
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 _o -Limit = Limiting area-weighted average U-values [W/(m ² K)] U _o -Calc = Calculated area-weighted average U-values [W/(m ² K)] U _i -Calc = Calculated maximum individual element U-values [W/(m ² K)]				
* 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	4

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- Classrooms zone 1

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	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.					

2- Offices zone 2

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	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- Toilets zone 3

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	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.					

4- Circulations zone 4

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	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.					

5- Sports zone 5

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	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.					

6- Kitchen zone 7

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	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.					

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

Local mechanical ventilation, exhaust, and terminal units

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

Zone name	SFP [W/(l/s)]										HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I			
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1		Zone	Standard
Year 1	-	0.2	-	-	-	-	-	-	-	-	-	N/A
Year 2	-	0.2	-	-	-	-	-	-	-	-	-	N/A
Reception Classroom 2	-	0.2	-	-	-	-	-	-	-	-	-	N/A
Reception Classroom 1	-	0.2	-	-	-	-	-	-	-	-	-	N/A
Year 1	-	0.2	-	-	-	-	-	-	-	-	-	N/A
Year 2	-	0.2	-	-	-	-	-	-	-	-	-	N/A
Year 6	-	0.2	-	-	-	-	-	-	-	-	-	N/A
Year 5	-	0.2	-	-	-	-	-	-	-	-	-	N/A
Year 4	-	0.2	-	-	-	-	-	-	-	-	-	N/A
Year 11	-	0.2	-	-	-	-	-	-	-	-	-	N/A
Year 3	-	0.2	-	-	-	-	-	-	-	-	-	N/A
Year 3	-	0.2	-	-	-	-	-	-	-	-	-	N/A
Year 6	-	0.2	-	-	-	-	-	-	-	-	-	N/A
Year 5	-	0.2	-	-	-	-	-	-	-	-	-	N/A
Reception WC	-	-	0.3	-	-	-	-	-	-	-	-	N/A
Pupil WC	-	-	0.3	-	-	-	-	-	-	-	-	N/A
Acc WC	-	-	0.3	-	-	-	-	-	-	-	-	N/A
Acc WC	-	-	0.3	-	-	-	-	-	-	-	-	N/A
Staff WC	-	-	0.3	-	-	-	-	-	-	-	-	N/A
Acc WC	-	-	0.3	-	-	-	-	-	-	-	-	N/A
Female WC	-	-	0.3	-	-	-	-	-	-	-	-	N/A
Male WC	-	-	0.3	-	-	-	-	-	-	-	-	N/A
Kitchen	-	-	0.3	-	-	-	-	-	-	-	-	N/A

"LENI calculation for lighting energy provided in a separate submission."

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?
Year 1	NO (-64%)	NO
Year 2	NO (-82.2%)	NO
Reception Classroom 2	NO (-88.5%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Reception Classroom 1	NO (-79%)	NO
Year 1	NO (-77.5%)	NO
Year 2	NO (-83.3%)	NO
Year 6	NO (-73.1%)	NO
Year 5	NO (-82.4%)	NO
Year 4	NO (-66.4%)	NO
Year 11	NO (-71.3%)	NO
Year 3	NO (-66.4%)	NO
Year 3	NO (-82.4%)	NO
Year 6	NO (-75%)	NO
Year 5	NO (-43.6%)	NO
Medical/Inspection Room	N/A	N/A
Ass Head Teacher Office 1	NO (-35.1%)	NO
Staff Work Room	NO (-73.8%)	NO
Head Teachers Office	NO (-63.8%)	NO
Main Admin Office	NO (-72.3%)	NO
Sick Bay	N/A	N/A
Interview Room	NO (-83.9%)	NO
Bursar	NO (-50%)	NO
FM Office	NO (-45.1%)	NO
Staff Room	NO (-58.9%)	NO
Group Room 1	NO (-67.1%)	NO
Group Room 2	NO (-81.4%)	NO
Library	NO (-50.5%)	NO
Ass Head Teacher	N/A	N/A
SEN Resource Base	N/A	N/A
Sports	NO (-85.6%)	NO
Store 1	N/A	N/A
Store 2	N/A	N/A
Central Stock	NO (-35.1%)	NO
Store 3	N/A	N/A
Store 4	N/A	N/A
Store 5	N/A	N/A
Store 6	N/A	N/A
PE Store	N/A	N/A
PE Store	N/A	N/A
Specialist Store	N/A	N/A
Lift	N/A	N/A
Plant Room	NO (-87.9%)	NO
Store 7	N/A	N/A
Store 9	N/A	N/A
Store 9	N/A	N/A
Store 10	N/A	N/A
Store 11	N/A	N/A
Store 13	N/A	N/A
Store 14	N/A	N/A
Lift	N/A	N/A
General Store	N/A	N/A
Store 8	N/A	N/A

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

Separate submission

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

Separate submission

EPBD (Recast): Consideration of alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m ²]	2142.3	2142.3
External area [m ²]	3470	3470
Weather	LON	LON
Infiltration [m ³ /hm ² @ 50Pa]	4	4
Average conductance [W/K]	928.04	1355.9
Average U-value [W/m ² K]	0.27	0.39
Alpha value* [%]	10	10

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

Building Use

% Area	Building Type
	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 Inst.: Hospitals and Care Homes
	C2 Residential Inst.: Residential schools
	C2 Residential Inst.: Universities and colleges
	C2A Secure Residential Inst.
	Residential spaces
	D1 Non-residential Inst.: Community/Day Centre
	D1 Non-residential Inst.: Libraries, Museums, and Galleries
100	D1 Non-residential Inst.: Education
	D1 Non-residential Inst.: Primary Health Care Building
	D1 Non-residential Inst.: 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	15.18	13.91
Cooling	0	0
Auxiliary	2.6	2.59
Lighting	8.75	13.08
Hot water	8.81	7.65
Equipment*	16.43	16.43
TOTAL**	35.33	37.23

* Energy used by equipment does not count towards the total for 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/m ²]	44.93	43.47
Primary energy* [kWh/m ²]	64.1	73.21
Total emissions [kg/m ²]	11.1	12.6

* 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 SSEFF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	49.6	0	16.8	0	2.5	0.82	0	0.95	0
Notional	45.1	0	13.8	0	0	0.91	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	124.7	0	42.2	0	1.5	0.82	0	0.95	0
Notional	33	0	10.6	0	4	0.86	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	9.8	0	3.3	0	4.8	0.82	0	0.95	0
Notional	126.2	0	40.7	0	0.7	0.86	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	12.6	0	4.1	0	2.6	0.85	0	0.95	0
Notional	16.3	0	5.2	0	5.4	0.86	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	12.7	0	4.3	0	2.1	0.82	0	0.95	0
Notional	21.5	0	6.9	0	1.2	0.86	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	11.9	0	3.9	0	1.9	0.85	0	0.95	0
Notional	19.6	0	6.3	0	2.3	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

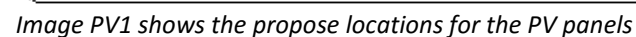
The BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

Element	U _{i-Typ}	U _{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.18	YR000002:Surf[4]
Floor	0.2	0.15	YR000002:Surf[0]
Roof	0.15	0.13	YR000027:Surf[0]
Windows, roof windows, and rooflights	1.5	2.03	YR000002:Surf[1]
Personnel doors	1.5	2.2	YR000002:Surf[3]
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/(m ² K)]			U _{i-Min} = Minimum individual element U-values [W/(m ² K)]
* There might be more than one surface where the minimum U-value occurs.			

Air Permeability	Typical value	This building
m ³ /(h.m ²) at 50 Pa	5	4

It is proposed to install 22.96m² of Photovoltaic panels - 14No high efficiency PV panels each capable of peak generation of 320W(peak) giving a total installed power of 4.48kWpeak.



LG NeON™ 2 LG320N1C-G4

Mechanical Properties

Cells	6 x 10
Cell Vendor	LG
Cell Type	Monocrystalline / N-type
Cell Dimensions	156.75 x 156.75 mm / 6 inches
# of Busbar	12 (Multi Wire Busbar) 
Dimensions (L x W x H)	1640 x 1000 x 40 mm 64.57 x 39.37 x 1.57 inch
Front Load	6000 Pa / 125 psf 
Rear Load	5400 Pa / 113 psf 
Weight	17.0 ± 0.5 kg / 37.48 ± 1.1 lbs
Connector Type	MC4, MC4 Compatible, IP67
Junction Box	IP67 with 3 Bypass Diodes
Length of Cables	2 x 1000 mm / 2 x 39.37 inch
Glass	High Transmission Tempered Glass
Frame	Anodized Aluminum

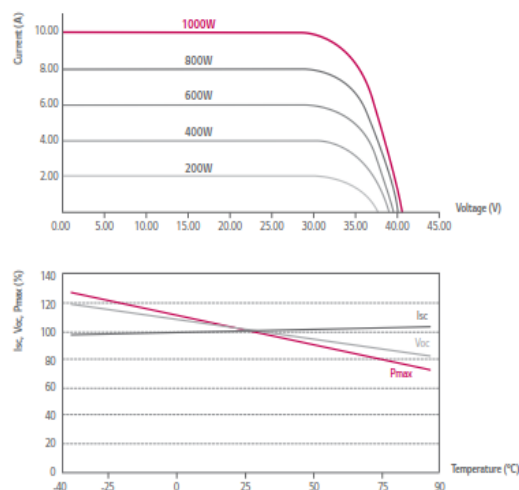
Certifications and Warranty

Certifications	IEC 61215, IEC 61730-1/-2 IEC 62716 (Ammonia Test) IEC 61701 (Salt Mist Corrosion Test) ISO 9001 UL 1703
Module Fire Performance (USA)	Type 2 (UL 1703)

Temperature Characteristics

NOCT	46 ± 3 °C
Pmpp	-0.38 %/°C 
Voc	-0.28 %/°C
Isc	0.03 %/°C

Characteristic Curves



Electrical Properties (STC *)

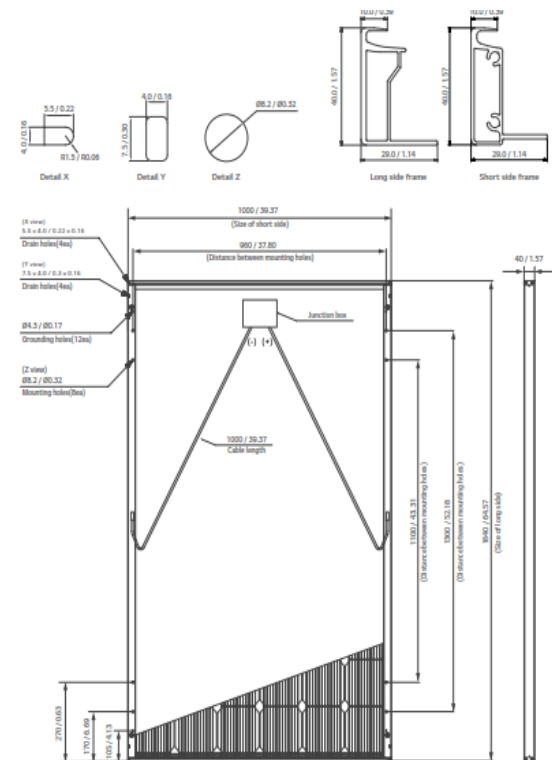
Module Type	320 W
MPP Voltage (Vmpp)	33.6
MPP Current (Impp)	9.53
Open Circuit Voltage (Voc)	40.9
Short Circuit Current (Isc)	10.05
Module Efficiency (%)	19.5
Operating Temperature (°C)	-40 ~ +90
Maximum System Voltage (V)	1000
Maximum Series Fuse Rating (A)	20
Power Tolerance (%)	0 ~ +3

* STC (Standard Test Condition): Irradiance 1000 W/m², Module Temperature 25 °C, AM 1.5
* The nameplate power output is measured and determined by LG Electronics at its sole and absolute discretion.
* The typical change in module efficiency at 200 W/m² in relation to 1000 W/m² is -2.0%.

Electrical Properties (NOCT*)

Module Type	320 W
Maximum Power (Pmax)	234
MPP Voltage (Vmpp)	30.7
MPP Current (Impp)	7.60
Open Circuit Voltage (Voc)	37.9
Short Circuit Current (Isc)	8.10

* NOCT (Nominal Operating Cell Temperature): Irradiance 800 W/m², ambient temperature 20 °C, wind speed 1 m/s



* The distance between the center of the mounting/grounding holes.

Image PV2 shows details of proposed PV panels