The Hall School

Energy Strategy Report

December 2020

ELEMENTA

Document Control

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03	PV layout update	08/03/19	MT/KA	KA
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1 Executive Summary

1.1 Introduction and site description

Elementa Consulting have been commissioned by The Hall School ('the Client') to produce an energy strategy in support of the planning submission for the new school building ('the proposed development'). This report sets out how the proposed development will meet the school's energy aspirations, through energy efficient measures, low carbon energy supply from decentralised sources and the integration of renewable energy technologies.

The proposed development is an extensive redevelopment of a boy's prep school in Belsize Park, a conservation area. The redevelopment will include the demolition of Wathen Hall and teaching spaces to permit the development of a new building incorporating new teaching and social spaces and a new hall

Under the emerging local planning requirements, new build developments are expected to reduce carbon emissions by 35% against part L2A target emission rate. The local planning authority is Camden Council.

This report details only the new buildings not the existing, retained building.

1.2 Proposed Energy strategy

The energy strategy for the site is:

- Energy efficient fabric and building services design, the proposal aims to target a 10% (achieved with both SAP10 and 2012 emissions factors) improvement over the baseline target of the existing building, through energy efficiency alone
- Air Source Heat Pumps (ASHP) serving the space heating and cooling for the school, as well as the DHW, offering a 47% savings.

The site-wide results indicate a regulated carbon saving of 11 tCO_2/year, which is 47% of the site regulated carbon emissions of 24 tCO_2/year.

1.3 Carbon emissions and savings

The calculated carbon emissions and regulated savings at each stage of the energy hierarchy of the site are outlined in Table 1.1 and Figure 1.1 below.

Table 1.1, Carbon Emissions after demand reduction (SAP 10)

	Total regulated emissions (tCO_2/yea)	**CO_2 savings (tCO_2/yea)**	**Percentage Savings (%)**
Baseline	24	-	-
Be Lean	22	2	10%
Be Clean	22	0	0%
Be Green	13	9	37%
Total	-	**11**	**47%**

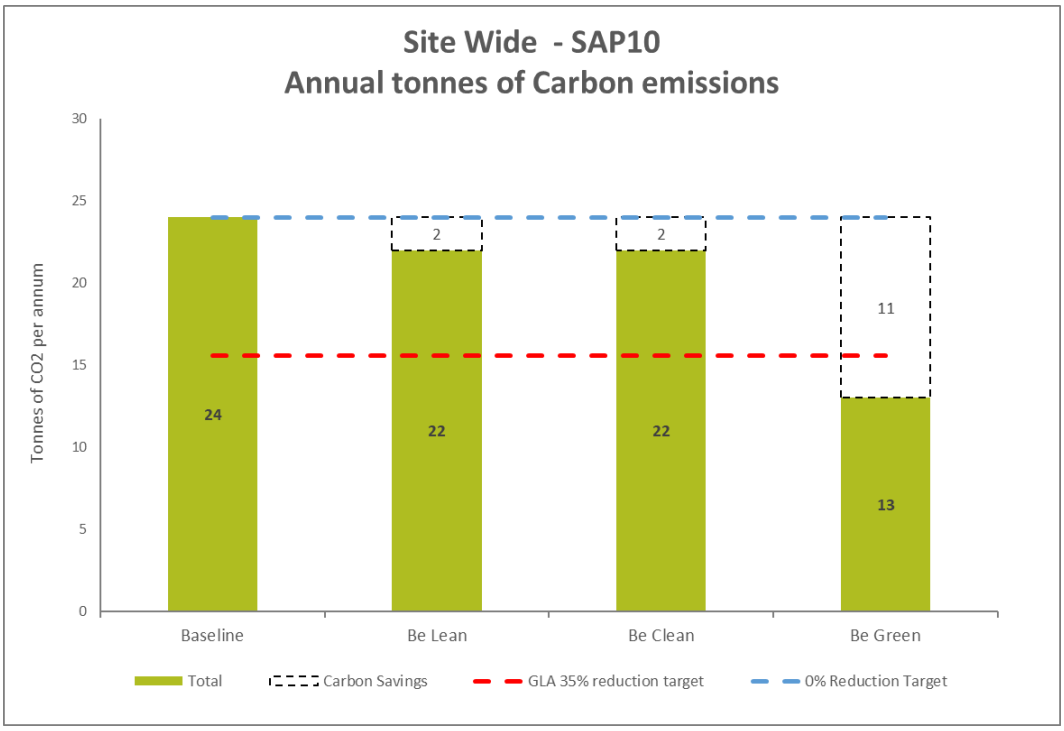


Figure 1.1, Energy Hierarchy CO_2 baseline, emissions and savings for the proposed development.

2 Introduction

Elementa Consulting have been commissioned by The Hall School ('the Client') to produce an energy strategy in support of the planning submission for the new school building ('the proposed development'). This report sets out how the proposed development will meet the school's energy aspirations, through energy efficient measures, low carbon energy supply from decentralised sources and the integration of renewable energy technologies.

2.1 The Project

The scheme involves the demolition of school accommodation that no longer meets the needs of the School and the refurbishment of existing accommodation.

The refurbishment scope is generally limited to minor internal adaptions, with no change to the heating, cooling or power systems; new lighting is being provided where required in these spaces. These works are not included within this assessment as they do not meet the threshold for assessment under Part L2

The only major item of refurbishment in the scheme is the 2nd floor art space – the roof is being removed to allow an increase in space. For the purposes of this application we have treated this area as "new build"

- Existing Floor Area -3245m^2
- Proposed Floor Area – 3690m^2
- Net Increase in Area – 445m^2

2.2 Policy requirements

The proposed development was assessed in accordance to the following policies during Stage 3;

- London Borough of Camden
- National Planning Policy Framework (2018)

2.3 Building Regulations and SAP10

Part L of the Building Regulations in England sets standards for the energy performance of new and existing buildings; the current version is Part L 2013 with 2016 amendments.
At the end of November 2016 BEIS published a consultation on proposed changes to SAP 2012. On 24th July 2018 BRE published SAP 10 which provides an indication of the expected future carbon emission factors that will inform and potentially be adopted in any future update to Building Regulations. One of the key changes was the adjustment of the carbon factors of electricity and (to a lesser extent) natural gas, as shown in Table 2.1 below:
Table 2.1, Sap 2012 and SAP 10 Carbon factors

	SAP 2012 / Part L 2013	SAP 10
Grid Electricity ($kgCO_2/kWh$)	0.519	**0.233**
Natural Gas ($kgCO_2/kWh$)	0.216	**0.210**

The results in this report will present the CO_2 emissions based on SAP 10 carbon factors.

2.4 Energy targets

The London Borough of Camden Local Plan refers to the following Energy Hierarchy; with non-domestic buildings over 500m^2 required to demonstrate how the energy hierarchy has been applied to make the fullest contribution to CO_2 reduction.

- Be Lean: Use Less Energy
- Be Clean: Supply Energy Efficiency
- Be Green: Use Renewable Energy

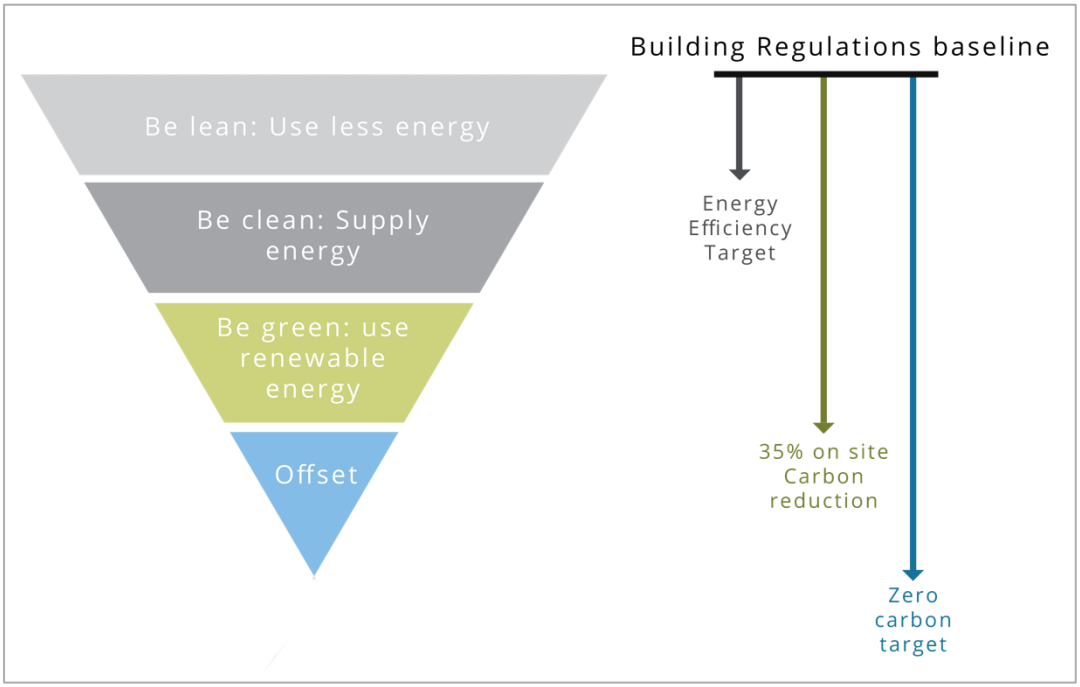


Figure 2.1, Energy Hierarchy diagram

The London Borough of Camden planning policy also expects developments with over 500m^2 of any gross internal floor space to achieve a 20% reduction in carbon emissions via renewables.
The aspiration of near net zero carbon can be achieved through the implementation of the following energy strategy:

1. Energy efficient fabric and building services design, the proposal aims to target a 10% improvement over the baseline target of the existing building, through energy efficiency alone
2. Air Source Heat Pumps (ASHP) serving the space heating and cooling for the school, as well as the, offering a 37% savings.

3 Baseline

The proposed development of the school was modelled to establish the baseline regulated emissions. This was determined by the Target Emission Rate (TER), calculated from the notional results of the compliance assessment.

The new carbon emission reporting spreadsheet introduced by the GLA in January 2019, was used to calculate the building carbon emissions using SAP 10 carbon factors. Dacorum's Local Planning Framework, although does not require to follow the London Plan, with the decarbonisation of the grid it is most suitable to show results with the representative SAP10 carbon factors. The new SAP10.1 carbon factors that are currently under consultation include a lower 'electricity' carbon factors than the SAP10.

In order to comply with the methodology using the GLA's SAP 10 energy calculation spreadsheet, a gas boiler has been used for all spaces of the baseline, in order to meet the heating and hot water demands.

The VE compliance module of IES Virtual Environment version 2019 was used to model the existing building and establish the regulated Buildings Energy Rate (BER), which is used as the baseline.

Unregulated emissions from electricity use were estimated from the BRUKL output sheet, using the equipment load prediction.

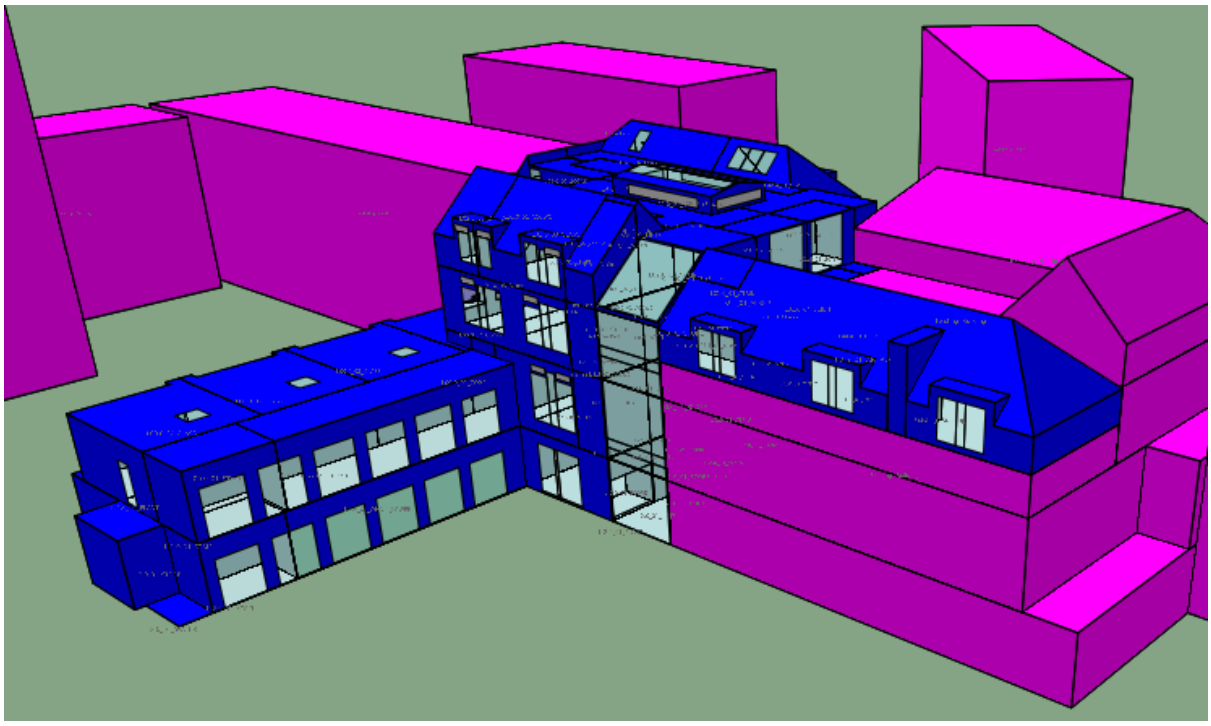


Figure 3.1, 3D view of IES energy model showing the new building (left hand side) and remodelled art room (right hand side) in blue

3.1 Inputs and Assumptions

The building fabric for the baseline building is set by the inputs automatically assigned to the notional buildings of the model. Table 3.1 highlights the Part L2A limiting values and the Part L2A notional values.

Table 3.1, Building Part L2A limiting fabric and inputs for the baseline building

	Elements	Part L2A limiting values	Part L2A notional values
Opaque elements	Wall U-Value (W/m^2.K)	**0.35**	**0.26**
	Ground/ Exposed Floor U-Value (W/m^2.K)	**0.25**	**0.22**
	Flat Roof U-Value (W/m^2.K)	**0.25**	**0.18**
	Pitched roof insulated at ceiling U-values (W/m^2.K)	**0.25**	**0.18**
	External Door U-Value (W/m^2.K)	**2.20**	**2.20**
Glazing	Window / Glazed Door U-Value U-Value (W/m^2.K)	**2.20**	**1.60**
	Glazing G-Value	**-**	**0.40**
	Building Air Permeability (m^3/(h.m^2) at 50 Pa)	**10**	**3**

The building services automatically assigned for the baseline model are listed in Table 3.2 below.

Table 3.2, Building systems for the existing building

		Baseline (notional values)
Ventilation	Ventilation	**Mechanical Ventilation with Heat Recovery (MVHR) units**
	Specific Fan Power (SFP)	**1.8 W/l/s**
	Heat Recovery	**70%**
Heating	Heating System	**Gas Boiler**
	Heating efficiency (as per lean case of ES)	**91%**
	Distribution Efficiency for Heting system	**5% losses Included in efficiency**
Cooling	Cooling System	**Electric VRV with MVHR**
	Cooling Efficiency (EER)	**5.00**
	Distribution Efficiency for Cooling system	**10% losses Included in efficiency**
DHW	DHW type	**Gas Boiler**
	DHW Efficiency	**91%**

	Distribution Efficiency for DHW system	**5% losses Included in efficiency**
Lighting	Lighting efficacy	**60 lm/cw**
	Daylight areas - Dimming	**Photo-electric dimming**
	Daylight areas - Sensor controls	**No back-sensor**
	Occupancy sensing	**Manual on – Auto off**

3.2 Carbon Emissions

The regulated carbon emissions for the baseline of the school was calculated to be, 24 tCO_2/year using the SAP 10 carbon factors, as shown in Table 3.3.
Unregulated emissions from small power and equipment are calculated to be 13 tCO_2/year

Table 3.3, Baseline Carbon Emissions

Carbon dioxide emissions (tonnes CO_2 per annum)	**Regulated**	**Unregulated**
Baseline	24	13

4 Be Lean

The London Borough of Camden Local Plan does not set any targets for CO_2 reductions through energy efficiency alone. However, it mentions that the proposals should demonstrate how passive design measures including the development orientation, form, mass and window sizes and positions have been taken into consideration to reduce energy demand.

A target of 10% reduction is recommended with a consideration to passive measures and energy efficient equipment, including energy efficient lighting and ventilation systems, as outlined the London Plan. The BRUKL input document can be found in Appendix A.

4.1 Target U-Values

The full fabric specification used when modelling the savings from energy efficiency, under the 'Be Lean' case, is listed in Table 4.1 below. The proposed fabric energy efficiency for the school gives an overall specification that meets Criterion 1 of Building Regulations Part L through energy efficiency alone.

Table 4.1, Building fabric inputs for the proposed building

	Elements	Proposed values
Opaque elements	Wall U-Value (W/m^2.K)	**0.13**
	Ground/ Exposed Floor U-Value (W/m^2.K)	**0.12**
	Roof U-Value (W/m^2.K)	**0.10**
	External Door U-Value (W/m^2.K)	**1.40**
Glazing	Frame factor	**10%**
	Window / Glazed Door / Glazing Screen U-Value (W/m^2.K)	**1.20**
	Window Glazing G-Value	**0.40 (N/E/S)** **0.3 (W)**
	Glazing Screen G-Value	**0.2**
	Roofights U-Value (W/m^2.K)	**1.20**
	Rooflight - G-Value	**0.40 (All spaces except Atrium – 0.18)**
	Building Air Permeability (m^3/(h.m^2) at 50 Pa)	**3**
	Shading	**Internal blinds have been used**

4.2 Building systems

The full building systems specification used when modelling the savings from energy efficiency, under the 'Be Lean' case, is listed in Table 4.2 below.

Table 4.2, Building systems for the proposed building

Ventilation	Ventilation	**Mechanical Ventilation with Heat Recovery (MVHR) units**
	Specific Fan Power (SFP)	**Ground and First Floor: 1.3 W/l/s** **Second Floor: 1.0 W/l/s**
	Heat Recovery	**80%**
Heating	Heating System	**Gas Boiler**
	Heating efficiency (as per lean case of ES)	**91%**
	Distribution Efficiency for Heating system	**95%**
Cooling	Cooling System	**ASHP (VRF Condenser)**
	Cooling Efficiency	**3.93**
	Distribution Efficiency for Cooling system	**95%**
DHW	DHW type	**Gas Boiler**
	DHW Efficiency	**91%**
	Distribution Efficiency for DHW system	**95%**
Lighting	Lighting efficacy	**90 lm/cw in Classrooms and Offices** **75 lm/cw in Atrium, Storage spaces and Circulation**
	Daylight areas - Dimming	**Daylight Dimming in all classrooms, office, meeting rooms, communal study spaces, atrium.**
	Daylight areas - Sensor controls	**No back-sensor**
	Non-Daylight areas – Controls	**Local manual switch**
	Occupancy sensing	**Presence Detection throughout**

4.3 Carbon Emissions

The regulated carbon emissions for the proposed development, including the energy efficient measures listed above, for the 'Be Lean' case are calculated to be 22 tCO_2/year using the SAP 10 carbon factors, as shown in Table 4.3.

Table 4.3, Carbon Emissions after demand reduction

Carbon dioxide emissions (tonnes CO_2 per annum)	**Regulated**	**Unregulated**
Baseline	24	13
After energy demand reduciton	22	13

This represents a saving of 2 tCO_2/year or 10% of baseline regulated emissions achieved by improving on Building Regulations emissions rate targets through energy efficiency alone, as shown in Table 4.4.

Table 4.4, Carbon Emissions after demand reduction

Regulated carbon dioxide savings	**(Tonnes CO_2 per annum)**	**(%)**
Savings from energy demand reduction	2	**10%**

4.4 Cooling demand

The school will have mixed mode ventilation with VRF coils and floor mounted VRF convectors providing the cooling. The chilled beams will be connected to the Air Source Heat Pump (ASHP), which will deliver heating and cooling loads. The cooling hierarchy considers the following measures;

- efficient lighting and dimming where possible
- high solar control glazing with a solar transmittance (g-value) of 0.4 for all glazing type, except West facing windows with a g-value of 0.3 and atrium rooflight with a g-value of 0.18
- mechanical ventilation

Despite using very good solar controlled glazing, the cooling load of the building has increased in respect to the notional building, as shown in Table 4.3 below.

Table 4.3, Carbon Emissions after demand reduction

	Building cooling demand (area weighted) (MJ/m^2)
Notional	**6.5**
Actual	**7.9**

5 Be Clean

The availability of district heat and electricity networks within the local areas was investigated using the London heat map and it was identified that there are no viable/planned local networks in the vicinity (within 500 meters) for this development to derive heat from.

Figure 5.1, Local network map

The heating and hot water annual energy graphs are shown below. This development is not near an existing district heating network, and has a low constant demand for hot water throughout the year, therefore there is insufficient demand to make a CHP system a viable option.

6 Be Green

This section includes the energy reduction through the use of low and zero carbon technologies incorporated into the proposed development.

6.1 Air Source Heat Pumps

Air source heat pumps (ASHPs) will be used to provide heating, cooling and hot water to the proposed development.

The SEER and SCOP values used in the modelling of the heat pump system is shown in Table 6.1 below.

Table 6.1, ASHP efficiencies

	Kitchen/Café Areas
ASHP Heating SCOP	3.93
ASHP Cooling SEER	3.77

6.2 Carbon Emissions

The regulated carbon emissions for the proposed development, including the low zero carbon technology listed above, for the 'Be Green' case of the energy hierarchy are calculated to be 13 tCO_2/year using the SAP 10 carbon factors, as shown in Table 6.2.

Table 6.2, Carbon Emissions after demand reduction

Carbon dioxide emissions (tonnes CO_2 per annum)	**Regulated**	**Unregulated**
Baseline	24	13
After energy demand reduciton	22	13
After renewable technology	13	13

This represents a saving of 11 tCO_2/year or 37% of baseline regulated emissions achieved by improving on Building Regulations emissions rate targets through low zero carbon technologies, as shown in Table 6.3.

Table 6.3, Carbon Emissions after demand reduction

Regulated carbon dioxide savings	**(Tonnes CO_2 per annum)**	**(%)**
Savings from energy demand reduction	2	**10%**
Saving from renewable technology	9	**37%**

7 BREEAM CREDIT - ENE 01

The energy performance of the proposed development has been checked against the BREEAM New Construction (NC) 2018, ENE01 credit. The Energy Performance Ratio (EPR_{ED}) for the buildings heating and cooling demand is calculated and compared against the Energy Performance Ratio (EPR_{NC}) benchmark scale.

The '_brukl.inp' file for the proposed building has been uploaded on the BREEAM online tool. A screenshot of the BREEAM online calculation tool with the generated outputs is provided in the appendix.

Table 7.1, Ene 01 BREEAM Output

Key Performance Indicator	**Ene 01 Output**
Building Floor Area (m2)	2174
Notional Building Energy Demand (MJ/m2/yr)	20.78
Actual Building Energy Demand (MJ/m2/yr)	15.02
Notional Building Primary Consumption (kWh/m2/yr)	127.54
Actual Building Primary Consumption (kWh/m2/yr)	98.32
Target Emissions Rate, TER (kgCO2/m2.yr)	16.88
Building Emissions Rate, BER (kgCO2/m2.yr)	13.38
Building Improvement over TER %	20.7
Heating and Cooling Demand Energy Performance Ratio, EPRed	0.242
Primary Consumption Energy Performance Ratio, EPRpc	0.303
Overall Energy Performance Ratio, EPRnc	0.778
Total BREEAM 'Ene 1' Credits Achievable	10

8 BREEAM CREDIT - ENE 04

8.1 Low zero carbon (LZC) feasibility study (1 NO CREDIT)

The ENE04 credit covers Passive Design Analysis, Free Cooling and the Low and Zero Carbon (LZC) feasibility study. However, as the two first credits were previously not targeted, this section is only focusing on the Low and Zero Carbon (LZC) feasibility study. This was carried out at RIBA Stage 2 by a suitably qualified energy specialist and establish the most appropriate recognised local low or zero carbon energy sources for the development. The Low Zero Carbon technologies assessed are outlined in Table 8.1 below.

Local LZC technologies will be specified for the development in line with the recommendations of this feasibility study, and this method of supply will result in a meaningful reduction in regulated carbon dioxide emissions (i.e. minimum of 5% reduction).

Table 8.1, Low Zero Carbon technologies assessed

Technology	Technically Feasible	Recommended	Notes
Hydrogen technology	No	No	Technology not yet technically viable at this scale
Tri-Generation	No	No	Limited cooling demand and structural issues
CHP	No	No	A sufficient year round hot water base load is required therefore it is not recommended for this site.
ASHP	Yes	Yes	ASHP (VRF Condensers) have been used to provide heating and cooling.
PV	Yes	No	This technology was deemed to expensive for the site.
GSHP	No	No	Technically viable, however, may not be the most cost effective solution due to the need for an underfloor heating system.
Wind power	No	No	Not viable due to the urban nature of the development.
Solar thermal	Yes	No	Could be used on the southern roofs. However, the DHW load is low and PVs would provide greater carbon savings.
Biomass	Yes	No	Biomass heating requires additional plant and storage

			space, with fuel delivery logistics and local air pollution issues to consider.

The following table demonstrates a 15.7% reduction in regulated carbon emissions through the use of renewables.

Table 8.2, Ene 04 Carbon emissions improvement

Carbon Factors	**Carbon emissions of Actual Building (Be Green) (kgCO2/m2)**	**Carbon emissions of Actual Building (Be Lean) (kgCO2/m2)**	**Percentage Improvement (%)**
SAP2012	13.38	15.87	**15.7%**
SAP10	22	13	**40.6%**

9 Conclusion

9.1 Baseline

Energy demand and carbon emissions associated with the proposed development were calculated using the VE Compliance module of IES Virtual Environment version 2019. The regulated Target Emission Rate (TER) was calculated to determine the base case used in this Energy Strategy. Gas boilers were assumed as the heating system for the baseline case.

The GLA emission reporting spreadsheet was used to convert the output from the modelling to use the SAP 10 carbon emissions factors. SAP 10 emissions factors are used throughout this report.

An estimate of unregulated electricity and gas use and the associated carbon emissions was also made.

The school's regulated baseline carbon emissions were calculated to be 24 tCO_2/year.

The site-wide unregulated emissions were calculated to be 13 tCO_2/year.

9.2 Be Lean

The proposed design approach is to minimise the energy consumption through passive design, fabric performance and energy efficiency alone. Internal heat gains will be limited through the use of energy efficient lighting, plant and appliances.

Based on the proposed fabric and energy efficiency measures, the buildings regulated carbon emissions were calculated to be 22 tCO_2/year.

Carbon savings from the "be lean" stage of the energy hierarchy are calculated to be 2 tCO_2/year, 10% of the regulated baseline emissions.

9.3 Be Green

The use of low and zero carbon technologies have been incorporated into the proposed development, for further energy reductions. Air source heat pumps (ASHPs) will be used to provide heating, cooling and part of the hot water to the proposed development.

After the use of renewable technology, the buildings regulated carbon emissions were calculated to be 13 tCO_2/year.

Carbon savings from the "be green" stage of the energy hierarchy is calculated to be 9 tCO_2/year, 37% of the regulated baseline emissions.

9.4 Carbon emissions and savings

The carbon emissions for the 'Be Lean' and 'Be Green' stages of the energy hierarchy are summarised in the tables below. The calculated carbon emissions and regulated savings at each of these stages of the energy hierarchy of the site are outlined in Table 9.1 and Table 9.2 below.

Table 9.1, Carbon Emissions after demand reduction

Carbon dioxide emissions (tonnes CO_2 per annum)	**Regulated**	**Unregulated**
Baseline	24	13
After energy demand reduciton	22	13
After heat networks/CHP	22	13
After renewable technology	13	13

This represents a saving of a total of 13 tCO_2/year or 47% of baseline regulated emissions achieved by improving on the Baselines emissions rate targets through energy efficiency and low zero carbon technologies, as shown in Table 9.2.

Table 9.2, Regulated carbon dioxide savings from the Be Lean and Be Green stages and the total cumulative savings.

Regulated carbon dioxide savings	**(Tonnes CO_2 per annum)**	**(%)**
Savings from energy demand reduction	2	**10%**
Savings from heat networks/CHP	0	**0%**
Saving from renewable technology	9	**37%**
Total	11	**47%**

The regulated carbon emissions for the proposed development is presented in Figure 9.1.

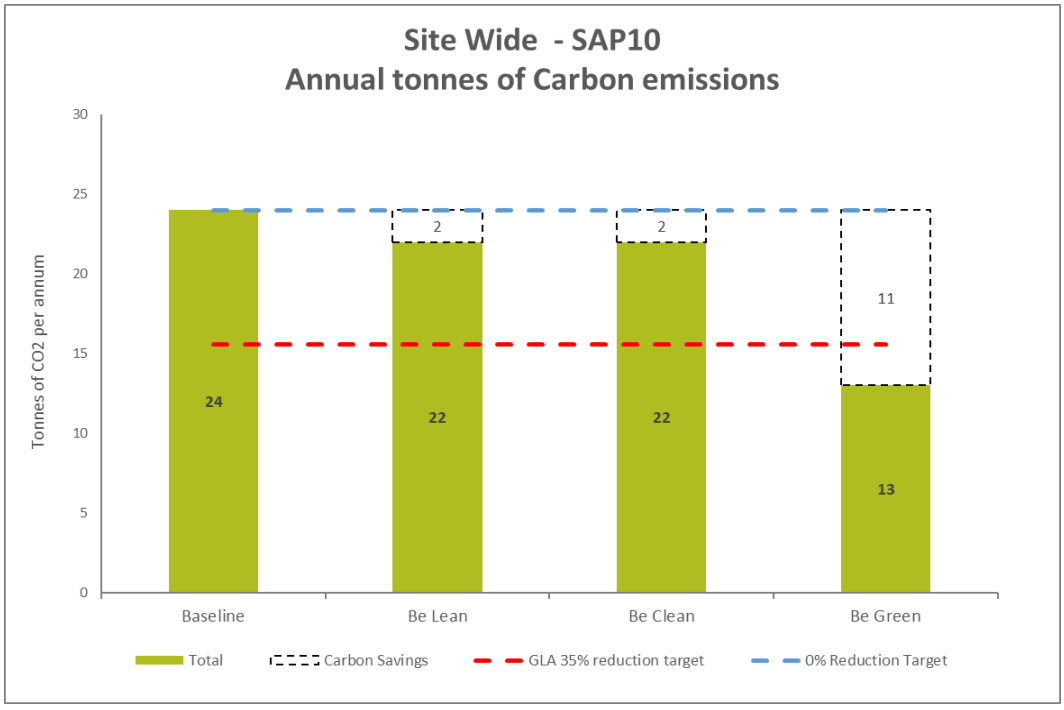
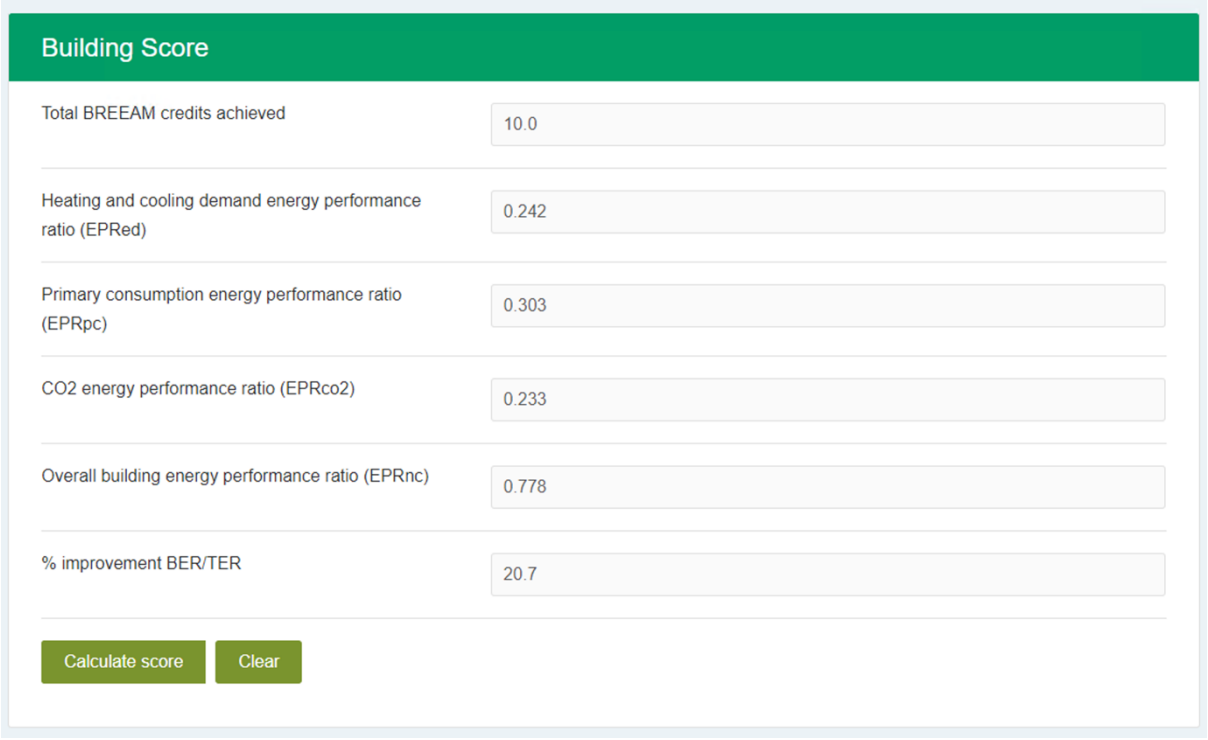


Figure 9.1, Energy Hierarchy CO_2 baseline, emissions and savings for the proposed development.

10 APPENDIX A – ENE01

10.1 Appendix A1 - Hall School – BREEAM ENE 01 assessment

The BREEAM online calculation tool was used to determine the number of ENE01 credits



awarded to this project. Figure 10.1 shows a screenshot of the results, with the project achieving 10 credits.

Figure 10.1, ENE01 Credit

11 APPENDIX B – BRUKLS

11.1 Appendix B1 - Hall School - Be Lean_brukl

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

The Hall School (Be Lean)

As designed

Date: Fri Dec 11 12:05:17 2020

Administrative information

Building Details

Address: 23 Crossfield Road, London, NW34NU

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.12

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.12

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

Owner Details

Name: The Hall School

Telephone number:

Address: 23 Crossfield Road, London, NW34NU

Certifier details

Name: Marguerita Chorafa

Telephone number: +447471996022

Address: 80 Cheapside, London, EC2V6EE

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

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	18.1
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	18.1
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	15.9
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

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

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

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.13	0.13	L1000001:Surf[1]
Floor	0.25	0.12	0.12	BS000000:Surf[0]
Roof	0.25	0.1	0.18	L000001E:Surf[1]
Windows***, roof windows, and rooflights	2.2	1.17	1.2	L1000000:Surf[2]
Personnel doors	2.2	-	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	1.18	1.18	L1000004:Surf[6]
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	3

Building services

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

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

1- Nat Vent - Gas B

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	-	0	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- L00-L01 - MVHR ceiling + VRF_1.0 w Cooling - Gas B

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	3.93	0	1	0.8
Standard value	0.91*	2.55	N/A	1.6^	0.45
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.

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

3- Extract only - Gas B

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	-	0	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- L02 - MVHR ceiling + VRF_1.3 w Cooling - Gas B

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	3.93	0	1.3	0.8
Standard value	0.91*	2.55	N/A	1.6^	0.45
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.

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

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

Local mechanical ventilation, exhaust, and terminal units

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

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
L-2.0_01_LOBBY	-	-	-	-	-	-	-	0.3	-	-	N/A
L-2.0_01_OFFIC	-	-	-	-	-	-	-	0.3	-	-	N/A
L-1.0_01_OFFIC	-	-	-	-	-	-	-	0.3	-	-	N/A
L-1.0_02_OFFIC	-	-	-	-	-	-	-	0.3	-	-	N/A
L-1.0_03_OFFIC	-	-	-	-	-	-	-	0.3	-	-	N/A
L-1.0_04_OFFIC	-	-	-	-	-	-	-	0.3	-	-	N/A
L-1.0_01_STAFF	-	-	-	-	-	-	-	0.3	-	-	N/A
L00.0_01_CLASS	-	-	-	-	-	-	-	0.3	-	-	N/A
L00.0_02_CLASS	-	-	-	-	-	-	-	0.3	-	-	N/A
L00.0_01_LOBBY	-	-	-	-	-	-	-	0.3	-	-	N/A
L00.0_03_CLASS	-	-	-	-	-	-	-	0.3	-	-	N/A
L00.0_05_CLASS	-	-	-	-	-	-	-	0.3	-	-	N/A
L00.0_06_CLASS	-	-	-	-	-	-	-	0.3	-	-	N/A
L00.0_07_CLASS	-	-	-	-	-	-	-	0.3	-	-	N/A
L00.0_01_SCIEN	-	-	-	-	-	-	-	0.3	-	-	N/A
L00.0_04_CLASS	-	-	-	-	-	-	-	0.3	-	-	N/A
L01.0_01_SCIEN	-	-	-	-	-	-	-	0.3	-	-	N/A
L01.0_02_SCIEN	-	-	-	-	-	-	-	0.3	-	-	N/A
L01.0_03_SCIEN	-	-	-	-	-	-	-	0.3	-	-	N/A
L02.0_02_CLASS	-	-	-	-	-	-	-	0.3	-	-	N/A
L02.0_01_CLASS	-	-	-	-	-	-	-	0.3	-	-	N/A
L02.0_03_SUPPO	-	-	-	-	-	-	-	0.3	-	-	N/A
L02.0_01_OFFIC	-	-	-	-	-	-	-	0.3	-	-	N/A
L02.0_01_SUPPO	-	-	-	-	-	-	-	0.3	-	-	N/A
L02.0_02_SUPPO	-	-	-	-	-	-	-	0.3	-	-	N/A
L01.0_04_SCIEN	-	-	-	-	-	-	-	0.3	-	-	N/A
L02.0_03_CLASS	-	-	-	-	-	-	-	0.3	-	-	N/A
L00.0_01_OFFIC	-	-	-	-	-	-	-	0.3	-	-	N/A
L-1.0_01_ENTRA	-	-	-	-	-	-	-	0.3	-	-	N/A
L02.5_01_CHIMN	-	-	-	-	-	-	-	0.3	-	-	N/A
L02.5_01_APREP	-	-	-	-	-	-	-	0.3	-	-	N/A
L02.5_01_ARTRO	-	-	-	-	-	-	-	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	
L-2.0_01_WATER	75	-	-	70
L-2.0_01_STORE	75	-	-	22
L-2.0_01_STAIR	-	75	-	45
L-2.0_01_PLANT	75	-	-	44
L-2.0_01_SCORE	-	75	-	77
L-2.0_01_LIFTS	-	75	-	20
L-2.0_01_LOBBY	-	75	-	18

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
L-2.0_01_TOILE	-	75	-	101
L-2.0_01_ACCWC	-	75	-	29
L-2.0_01_CHANG	-	75	-	208
L-2.0_01_OFFIC	90	-	-	99
L-2.0_01_CORRI	-	75	-	40
L-1.0_01_PLANT	75	-	-	71
L-1.0_01_STAIR	-	75	-	69
L-1.0_01_ATRIU	75	-	-	708
L-1.0_01_OFFIC	90	-	-	126
L-1.0_02_OFFIC	90	-	-	200
L-1.0_03_OFFIC	90	-	-	104
L-1.0_04_OFFIC	90	-	-	91
L-1.0_01_SCORE	-	75	-	63
L-1.0_01_LIFTS	-	75	-	21
L-1.0_02_SCORE	-	75	-	80
L-1.0_01_STAFF	-	90	-	112
L-1.0_02_PLANT	75	-	-	49
L-1.0_03_SCORE	-	75	-	60
L-1.0_01_ACCWC	-	75	-	39
L00.0_01_CLASS	90	-	-	234
L00.0_02_CLASS	90	-	-	264
L00.0_01_SCORE	-	75	-	6
L00.0_01_LOBBY	-	75	-	29
L00.0_01_LIFTS	-	75	-	26
L00.0_03_CLASS	90	-	-	213
L00.0_01_ACCWC	-	75	-	42
L00.0_01_PLANT	75	-	-	12
L00.0_02_SCORE	-	75	-	59
L00.0_05_CLASS	90	-	-	218
L00.0_06_CLASS	90	-	-	213
L00.0_07_CLASS	90	-	-	209
L00.0_01_STAIR	-	75	-	39
L01.0_01_STORE	75	-	-	11
L00.0_01_SCIEN	90	-	-	165
L00.0_01_CORRI	-	75	-	137
L00.0_04_CLASS	90	-	-	280
L01.0_02_STORE	75	-	-	12
L01.0_01_SCORE	-	75	-	6
L01.0_01_SCIEN	90	-	-	921
L01.0_02_SCIEN	90	-	-	977
L01.0_01_PLANT	75	-	-	12
L01.0_02_SCORE	-	75	-	52
L01.0_01_ACCWC	-	75	-	38

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
L01.0_01_LIFTS	-	75	-	21
L01.0_03_SCIEN	90	-	-	947
L02.0_02_CLASS	90	-	-	326
L02.0_01_CLASS	90	-	-	204
L02.0_03_SUPPO	90	-	-	85
L02.0_01_OFFIC	90	-	-	118
L02.0_01_ACCWC	-	75	-	34
L02.0_01_LIFTS	-	75	-	22
L02.0_01_SUPPO	90	-	-	87
L02.0_02_SUPPO	90	-	-	87
L01.0_04_SCIEN	90	-	-	142
L02.0_02_SCORE	-	75	-	42
L02.0_03_CLASS	90	-	-	212
L02.0_02_STORE	75	-	-	10
L02.0_01_SCORE	-	75	-	6
L02.0_01_STORE	75	-	-	5
L-2.0_02_STORE	75	-	-	24
L-1.0_01_WHALL_UPPER	-	90	-	20
L-1.0_01_WHALL_LOWER	-	90	-	1425
L00.0_01_OFFIC	90	-	-	144
L-1.0_01_ENTRA	-	75	-	104
L00.0_01_ATRIU (Stack)	-	75	-	26
L00.0_01_ATRIU	-	75	-	240
L01.0_01_ATRIU (Stack)	-	75	-	7
L01.0_01_ATRIU	-	75	-	193
L02.0_01_ATRIU	-	75	-	175
L02.0_01_ATRIU (Stack)	-	75	-	7
L02.5_01_CHIMN	90	-	-	30
L02.5_01_APREP	90	-	-	81
L02.5_01_ARTRO	90	-	-	527

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?
L-2.0_01_LOBBY	N/A	N/A
L-2.0_01_OFFIC	N/A	N/A
L-1.0_01_ATRIU	NO (-99.5%)	NO
L-1.0_01_OFFIC	NO (-54.6%)	NO
L-1.0_02_OFFIC	NO (-73%)	YES
L-1.0_03_OFFIC	N/A	N/A
L-1.0_04_OFFIC	NO (-75.9%)	YES
L-1.0_01_STAFF	NO (-77.9%)	YES
L00.0_01_CLASS	NO (-57.6%)	YES
L00.0_02_CLASS	NO (-73.5%)	YES

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
L00.0_01_LOBBY	N/A	N/A
L00.0_03_CLASS	NO (-59.2%)	YES
L00.0_05_CLASS	NO (-82.7%)	NO
L00.0_06_CLASS	NO (-81.2%)	NO
L00.0_07_CLASS	NO (-87.9%)	YES
L00.0_01_SCIEN	N/A	N/A
L00.0_04_CLASS	NO (-88%)	NO
L01.0_01_SCIEN	NO (-52%)	YES
L01.0_02_SCIEN	NO (-66%)	YES
L01.0_03_SCIEN	NO (-73.6%)	YES
L02.0_02_CLASS	NO (-71.6%)	YES
L02.0_01_CLASS	NO (-63%)	YES
L02.0_03_SUPPO	N/A	N/A
L02.0_01_OFFIC	NO (-79.8%)	YES
L02.0_01_SUPPO	NO (-53.3%)	NO
L02.0_02_SUPPO	NO (-51.7%)	NO
L01.0_04_SCIEN	N/A	N/A
L02.0_03_CLASS	NO (-33.2%)	YES
L-1.0_01_WHALL_UPPER	NO (-28.2%)	NO
L-1.0_01_WHALL_LOWER	NO (-93.5%)	NO
L00.0_01_OFFIC	NO (-29.9%)	NO
L-1.0_01_ENTRA	NO (-8.3%)	NO
L02.5_01_CHIMN	N/A	N/A
L02.5_01_APREP	N/A	N/A
L02.5_01_ARTRO	NO (-69%)	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?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	2174	2174
External area [m^2]	3206.9	3206.9
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	4
Average conductance [W/K]	782.41	0
Average U-value [W/m^2K]	0.24	0
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 Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
9	**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
91	**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	10.35	16.14
Cooling	2.2	1.81
Auxiliary	9.5	7.55
Lighting	8.35	14.77
Hot water	16.16	11.27
Equipment*	17	17
TOTAL**	**46.56**	**51.54**

* 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	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/m^2]	54.09	74.8
Primary energy* [kWh/m^2]	92.36	105.68
Total emissions [kg/m^2]	15.9	18.1

* 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] Fan coil systems, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	25.1	56.3	8.9	5.1	18.5	0.78	3.05	0.91	3.93
	Notional	37.5	54	12.1	4	14.9	0.86	3.79	----	----
[ST] Fan coil systems, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	30	51.2	10.8	4.6	15.9	0.77	3.11	0.91	3.93
	Notional	47.2	53	15.2	3.9	15.1	0.86	3.79	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	13.1	0	4.5	0	2.5	0.81	0	0.91	0
	Notional	43.2	0	13.9	0	1.2	0.86	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	40.2	0	13.7	0	2.2	0.81	0	0.91	0
	Notional	62.8	0	20.2	0	1.1	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	0.13	L1000001:Surf[1]
Floor	0.2	0.12	BS000000:Surf[0]
Roof	0.15	0.1	BS000000:Surf[1]
Windows, roof windows, and rooflights	1.5	0.9	L000000E:Surf[0]
Personnel doors	1.5	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	1.18	L1000004:Surf[6]
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	3

11.2Appendix B2 - Hall School - Be Green_brukl

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

The Hall School (Be Green)

As designed

Date: Fri Dec 11 11:51:35 2020

Administrative information

Building Details

Address: 23 Crossfield Road, London, NW34NU

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.12

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.12

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

Owner Details

Name: The Hall School

Telephone number: Phone

Address: 23 Crossfield Road, London, NW34NU

Certifier details

Name: Marguerita Chorafa

Telephone number: +447471996022

Address: 80 Cheapside, London, EC2V6EE

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

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	16.9
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	16.9
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	13.4
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	0.13	0.13	L1000001:Surf[1]
Floor	0.25	0.12	0.12	BS000000:Surf[0]
Roof	0.25	0.1	0.18	L000001E:Surf[1]
Windows***, roof windows, and rooflights	2.2	1.17	1.2	L1000000:Surf[2]
Personnel doors	2.2	-	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	1.18	1.18	L1000004:Surf[6]
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	3

Building services

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

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

1- Nat Vent - ASHP

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.77	-	0	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.

2- L00-L01 - MVHR ceiling + VRF_1.0 w Cooling - ASHP

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.77	3.93	0	1	0.8
Standard value	2.5*	2.55	N/A	1.6^	0.45
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.

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

3- Extract only - ASHP

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.77	-	0	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.

4- L02 - MVHR ceiling + VRF_1.3 w Cooling - ASHP

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.77	3.93	0	1.3	0.8
Standard value	2.5*	2.55	N/A	1.6^	0.45
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.

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

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

Local mechanical ventilation, exhaust, and terminal units

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

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
L-2.0_01_LOBBY	-	-	-	-	-	-	-	0.3	-	-	N/A
L-2.0_01_OFFIC	-	-	-	-	-	-	-	0.3	-	-	N/A
L-1.0_01_OFFIC	-	-	-	-	-	-	-	0.3	-	-	N/A
L-1.0_02_OFFIC	-	-	-	-	-	-	-	0.3	-	-	N/A
L-1.0_03_OFFIC	-	-	-	-	-	-	-	0.3	-	-	N/A
L-1.0_04_OFFIC	-	-	-	-	-	-	-	0.3	-	-	N/A
L-1.0_01_STAFF	-	-	-	-	-	-	-	0.3	-	-	N/A
L00.0_01_CLASS	-	-	-	-	-	-	-	0.3	-	-	N/A
L00.0_02_CLASS	-	-	-	-	-	-	-	0.3	-	-	N/A
L00.0_01_LOBBY	-	-	-	-	-	-	-	0.3	-	-	N/A
L00.0_03_CLASS	-	-	-	-	-	-	-	0.3	-	-	N/A
L00.0_05_CLASS	-	-	-	-	-	-	-	0.3	-	-	N/A
L00.0_06_CLASS	-	-	-	-	-	-	-	0.3	-	-	N/A
L00.0_07_CLASS	-	-	-	-	-	-	-	0.3	-	-	N/A
L00.0_01_SCIEN	-	-	-	-	-	-	-	0.3	-	-	N/A
L00.0_04_CLASS	-	-	-	-	-	-	-	0.3	-	-	N/A
L01.0_01_SCIEN	-	-	-	-	-	-	-	0.3	-	-	N/A
L01.0_02_SCIEN	-	-	-	-	-	-	-	0.3	-	-	N/A
L01.0_03_SCIEN	-	-	-	-	-	-	-	0.3	-	-	N/A
L02.0_02_CLASS	-	-	-	-	-	-	-	0.3	-	-	N/A
L02.0_01_CLASS	-	-	-	-	-	-	-	0.3	-	-	N/A
L02.0_03_SUPPO	-	-	-	-	-	-	-	0.3	-	-	N/A
L02.0_01_OFFIC	-	-	-	-	-	-	-	0.3	-	-	N/A
L02.0_01_SUPPO	-	-	-	-	-	-	-	0.3	-	-	N/A
L02.0_02_SUPPO	-	-	-	-	-	-	-	0.3	-	-	N/A
L01.0_04_SCIEN	-	-	-	-	-	-	-	0.3	-	-	N/A
L02.0_03_CLASS	-	-	-	-	-	-	-	0.3	-	-	N/A
L00.0_01_OFFIC	-	-	-	-	-	-	-	0.3	-	-	N/A
L-1.0_01_ENTRA	-	-	-	-	-	-	-	0.3	-	-	N/A
L02.5_01_CHIMN	-	-	-	-	-	-	-	0.3	-	-	N/A
L02.5_01_APREP	-	-	-	-	-	-	-	0.3	-	-	N/A
L02.5_01_ARTRO	-	-	-	-	-	-	-	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	
L-2.0_01_WATER	75	-	-	70
L-2.0_01_STORE	75	-	-	22
L-2.0_01_STAIR	-	75	-	45
L-2.0_01_PLANT	75	-	-	44
L-2.0_01_SCORE	-	75	-	77
L-2.0_01_LIFTS	-	75	-	20
L-2.0_01_LOBBY	-	75	-	18

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
L-2.0_01_TOILE	-	75	-	101
L-2.0_01_ACCWC	-	75	-	29
L-2.0_01_CHANG	-	75	-	208
L-2.0_01_OFFIC	90	-	-	99
L-2.0_01_CORRI	-	75	-	40
L-1.0_01_PLANT	75	-	-	71
L-1.0_01_STAIR	-	75	-	69
L-1.0_01_ATRIU	75	-	-	708
L-1.0_01_OFFIC	90	-	-	126
L-1.0_02_OFFIC	90	-	-	200
L-1.0_03_OFFIC	90	-	-	104
L-1.0_04_OFFIC	90	-	-	91
L-1.0_01_SCORE	-	75	-	63
L-1.0_01_LIFTS	-	75	-	21
L-1.0_02_SCORE	-	75	-	80
L-1.0_01_STAFF	-	90	-	112
L-1.0_02_PLANT	75	-	-	49
L-1.0_03_SCORE	-	75	-	60
L-1.0_01_ACCWC	-	75	-	39
L00.0_01_CLASS	90	-	-	234
L00.0_02_CLASS	90	-	-	264
L00.0_01_SCORE	-	75	-	6
L00.0_01_LOBBY	-	75	-	29
L00.0_01_LIFTS	-	75	-	26
L00.0_03_CLASS	90	-	-	213
L00.0_01_ACCWC	-	75	-	42
L00.0_01_PLANT	75	-	-	12
L00.0_02_SCORE	-	75	-	59
L00.0_05_CLASS	90	-	-	218
L00.0_06_CLASS	90	-	-	213
L00.0_07_CLASS	90	-	-	209
L00.0_01_STAIR	-	75	-	39
L01.0_01_STORE	75	-	-	11
L00.0_01_SCIEN	90	-	-	165
L00.0_01_CORRI	-	75	-	137
L00.0_04_CLASS	90	-	-	280
L01.0_02_STORE	75	-	-	12
L01.0_01_SCORE	-	75	-	6
L01.0_01_SCIEN	90	-	-	921
L01.0_02_SCIEN	90	-	-	977
L01.0_01_PLANT	75	-	-	12
L01.0_02_SCORE	-	75	-	52
L01.0_01_ACCWC	-	75	-	38

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
L01.0_01_LIFTS	-	75	-	21
L01.0_03_SCIEN	90	-	-	947
L02.0_02_CLASS	90	-	-	326
L02.0_01_CLASS	90	-	-	204
L02.0_03_SUPPO	90	-	-	85
L02.0_01_OFFIC	90	-	-	118
L02.0_01_ACCWC	-	75	-	34
L02.0_01_LIFTS	-	75	-	22
L02.0_01_SUPPO	90	-	-	87
L02.0_02_SUPPO	90	-	-	87
L01.0_04_SCIEN	90	-	-	142
L02.0_02_SCORE	-	75	-	42
L02.0_03_CLASS	90	-	-	212
L02.0_02_STORE	75	-	-	10
L02.0_01_SCORE	-	75	-	6
L02.0_01_STORE	75	-	-	5
L-2.0_02_STORE	75	-	-	24
L-1.0_01_WHALL_UPPER	-	90	-	20
L-1.0_01_WHALL_LOWER	-	90	-	1425
L00.0_01_OFFIC	90	-	-	144
L-1.0_01_ENTRA	-	75	-	104
L00.0_01_ATRIU (Stack)	-	75	-	26
L00.0_01_ATRIU	-	75	-	240
L01.0_01_ATRIU (Stack)	-	75	-	7
L01.0_01_ATRIU	-	75	-	193
L02.0_01_ATRIU	-	75	-	175
L02.0_01_ATRIU (Stack)	-	75	-	7
L02.5_01_CHIMN	90	-	-	30
L02.5_01_APREP	90	-	-	81
L02.5_01_ARTRO	90	-	-	527

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?
L-2.0_01_LOBBY	N/A	N/A
L-2.0_01_OFFIC	N/A	N/A
L-1.0_01_ATRIU	NO (-99.5%)	NO
L-1.0_01_OFFIC	NO (-54.6%)	NO
L-1.0_02_OFFIC	NO (-73%)	YES
L-1.0_03_OFFIC	N/A	N/A
L-1.0_04_OFFIC	NO (-75.9%)	YES
L-1.0_01_STAFF	NO (-77.9%)	YES
L00.0_01_CLASS	NO (-57.6%)	YES
L00.0_02_CLASS	NO (-73.5%)	YES

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
L00.0_01_LOBBY	N/A	N/A
L00.0_03_CLASS	NO (-59.2%)	YES
L00.0_05_CLASS	NO (-82.7%)	NO
L00.0_06_CLASS	NO (-81.2%)	NO
L00.0_07_CLASS	NO (-87.9%)	YES
L00.0_01_SCIEN	N/A	N/A
L00.0_04_CLASS	NO (-88%)	NO
L01.0_01_SCIEN	NO (-52%)	YES
L01.0_02_SCIEN	NO (-66%)	YES
L01.0_03_SCIEN	NO (-73.6%)	YES
L02.0_02_CLASS	NO (-71.6%)	YES
L02.0_01_CLASS	NO (-63%)	YES
L02.0_03_SUPPO	N/A	N/A
L02.0_01_OFFIC	NO (-79.8%)	YES
L02.0_01_SUPPO	NO (-53.3%)	NO
L02.0_02_SUPPO	NO (-51.7%)	NO
L01.0_04_SCIEN	N/A	N/A
L02.0_03_CLASS	NO (-33.2%)	YES
L-1.0_01_WHALL_UPPER	NO (-28.2%)	NO
L-1.0_01_WHALL_LOWER	NO (-93.5%)	NO
L00.0_01_OFFIC	NO (-29.9%)	NO
L-1.0_01_ENTRA	NO (-8.3%)	NO
L02.5_01_CHIMN	N/A	N/A
L02.5_01_APREP	N/A	N/A
L02.5_01_ARTRO	NO (-69%)	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?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	2174	2174
External area [m^2]	3206.9	3206.9
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	4
Average conductance [W/K]	782.41	0
Average U-value [W/m^2K]	0.24	0
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 Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
9	**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
91	**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	2.5	5.44
Cooling	2.2	1.81
Auxiliary	9.5	7.55
Lighting	8.35	14.77
Hot water	3.9	3.8
Equipment*	17	17
TOTAL**	**26.45**	**33.37**

* 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	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/m^2]	54.09	74.8
Primary energy* [kWh/m^2]	98.32	127.54
Total emissions [kg/m^2]	13.4	16.9

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Fan coil systems, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	25.1	56.3	2.1	5.1	18.5	3.25	3.05	3.77	3.93
	Notional	37.5	54	4.1	4	14.9	2.56	3.79	----	----
[ST] Fan coil systems, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	30	51.2	2.6	4.6	15.9	3.19	3.11	3.77	3.93
	Notional	47.2	53	5.1	3.9	15.1	2.56	3.79	----	----
[ST] Central heating using water: radiators, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	13.1	0	1.1	0	2.5	3.36	0	3.77	0
	Notional	43.2	0	4.7	0	1.2	2.56	0	----	----
[ST] Central heating using water: radiators, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	40.2	0	3.3	0	2.2	3.36	0	3.77	0
	Notional	62.8	0	6.8	0	1.1	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	0.13	L1000001:Surf[1]
Floor	0.2	0.12	BS000000:Surf[0]
Roof	0.15	0.1	BS000000:Surf[1]
Windows, roof windows, and rooflights	1.5	0.9	L000000E:Surf[0]
Personnel doors	1.5	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	1.18	L1000004:Surf[6]
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	3

12 Appendix C – GLA SAP 10 Spreadsheet