UCS – Lodge Extension Project

Energy Statement

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1.0 Executive Summary

The design of the UCS – Lodge extension and refurbishment has shown that by implementing the Energy Hierarchy set out within the London Borough of Camden CPG3 Sustainability Guide that it will be able to reduce its amount of carbon emissions over the Part L 2013 Building Regulations by the required 35%.

1.1 Entire Development

When considered as an entire development, with a 7 KW (28 panel) photovoltaic system installed on the nearby North Block Building roof, it will produce carbon emissions of 12.69 kgCO2/m^2 per annum. This equates to a 35.2% reduction over the Part L 2013 Building Regulations and therefore satisfies the requirement of the London Plan and London Borough of Camden CPG3 Sustainability guide.

The actual carbon emissions from the 'Be Lean' stage was found to be 27.51 kgCO2/m^2 and with the inclusion of a 7 KW (28 panel) PV system this has been reduced to 12.69 kgCO2/m^2, this shows a 53.87% reduction in carbon emissions from the use of a renewable technology. This therefore also satisfies the CPG3 guides target of a 20% reduction through the use of renewables.

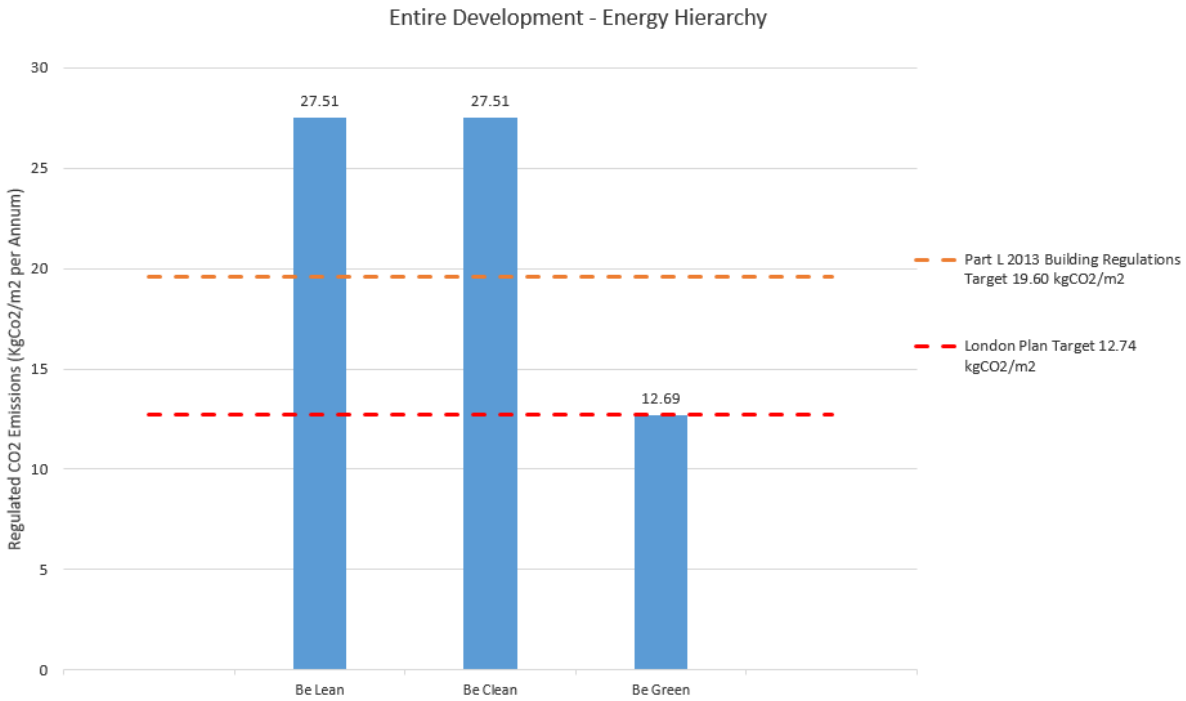


Figure 1 – The Energy Hierarchy for the UCS Lodge Entire Development

1.2 New Extension Only

When considered as the new extension only, with a 2 KW (8 panel) photovoltaic system laid flat on the new extension roof, it will produce carbon emissions of 12.31 kgCO2/m^2 per annum. This equates to a 37.8% reduction over the Part L 2013 Building Regulations and therefore satisfies the requirement of the London Plan and London Borough of Camden CPG3 Sustainability guide.

The actual carbon emissions from the 'Be Lean' stage was found to be 18.47 kgCO2/m^2 and with the inclusion of a 2 KW (8 panel) PV system this has been reduced to 12.31 kgCO2/m^2, this shows a 33.35% reduction in carbon emissions from the use of a renewable technology. This therefore also satisfies the CPG3 guides target of a 20% reduction through the use of renewables.

Figure 2 – The Energy Hierarchy for the UCS Lodge New Extension Only

1.3 Carbon Emissions Comparison

Please note that the figures in the table below have now been converted into Tonnes of CO2 per annum instead of kgCO2/m^2 per annum as requested by the London Plan. To arrive at Tonnes of CO2 from kgCO2/m^2 the results in the graphs above have been multiplied by their respective floor areas and divided by 1,000.

Table 1 – CO2 Emissions after each Stage in the Energy Hierarchy

Stage in Energy Hierarchy	Carbon Dioxide Emissions (Tonnes CO2 per annum)	
	Entire Development	New Extension Only
Part L 2013 Building Regulations Target	4.27	2.75
London Plan Target	2.78	1.79
After Energy Demand Reduction (Be Lean)	6.00	2.57
After CHP (Be Clean)	6.00	2.57
After Renewable Energy (Be Green)	2.77	1.71

Table 2 – CO2 Savings from each Stage of the Energy Hierarchy

Stage in Energy Hierarchy	Entire Development		New Extension Only	
	CO2 Savings		CO2 Savings	
	(Tonnes CO2 per annum)	(%)	(Tonnes CO2 per annum)	(%)
Savings from Energy Demand Reduction (Be Lean)	-1.73	-40.52	0.18	6.55
Savings from CHP (Be Clean)	0	0	0	0
Savings from Renewable Energy (Be Green)	3.23	75.64	0.86	31.27
Total Cumulative Savings	**1.5**	**35.12**	**1.04**	**37.82**
Total Target Savings	**1.49**	**35**	**0.96**	**35**
Annual Surplus	**0.01**		**0.08**	

The results show that when the entire development is examined, with a 7 KW (28 panel) photovoltaic system installed on the nearby North Block Building roof, it surpasses its Tonnes of CO2 emissions target by approximately 0.01 Tonnes, equating to an overall carbon reduction of 35.12% over the Part L 2013 Building Regulations target emissions.

When the new extension is investigated separately, with a 2 KW (8 panel) photovoltaic system laid flat on the new extension roof, it shows that it surpasses its Tonnes of CO2 emissions target by approximately 0.08 Tonnes, equating to a carbon reduction of 37.82% over the Part L 2013 Building Regulations target emissions.

The use of a PV system also qualifies as a renewable energy technology and has been shown to reduce the level of carbon emissions by 53.87% when 7 KW are installed for the entire development or 33.35% when 2 KW are installed for the new extension only, in comparison to a gas boiler system only with no PV. Both scenarios will therefore satisfy the requirement within the CPG3 guide of a 20% reduction through the use of renewables.

2.0 Introduction

The Lodge, No. 56 Frognal, is located on the UCS (University College School) Senior School Campus in Hampstead, London NW3 6XH.

Figure 3 – Existing Lodge Location

The existing Lodge is a Grade II listed building, which is to be refurbished with a new single story extension to the north side of the property. Currently the Lodge is being used as a residential premise but will be repurposed and put to better use by the school as administrative offices. The new extension to the north of the property will also be used as office and meeting spaces, and it will be connected to the existing property by way of a fully glazed link area.

The Lodge is located within the Greater London area and therefore would usually be expected to comply with the latest version of the London Plan. However, as the development is below 1,000m^2 it would not be deemed a major development and therefore should not need to follow the London Plan regarding the carbon emissions target.

However, it will still have to comply with the sustainability policies under the London Borough of Camden. The Camden Planning Guidance for Sustainability (CPG3) outlines the targets it expects new buildings to meet in order to comply with their regulations.

The CPG3 guide asks for new developments to follow the Be Lean, Be Clean and Be Green energy hierarchy. It also considers a best practice carbon reduction target for new developments built between the years 2013 – 2016 to be a 40% reduction over the 2010 Building Regulations. (This equates to a 35% reduction over the current 2013 Building Regulations)

The Camden CPG3 planning guidance also states that developments are to also target a 20% reduction in carbon emissions from the use of on-site renewable energy technologies. This report

will briefly investigate the possible renewables in terms of their technological and economic feasibility to the proposed site.

As the proposed development consists of both a new extension and a refurbishment, which is also Grade II listed, there is a limit to the amount of improvement work that can be carried out on the existing building. This may affect the level of Carbon reduction possible over the entire site however every effort will be made to try and meet the 35% carbon reduction target.

For this reason, the proposed development will be simulated as both the combined existing and new extension, and as the new extension only in this report. The results for each configuration will follow the same energy hierarchy and their final carbon emission results will be compared.

In order to simulate the developments proposed energy usage and carbon emissions a dynamic thermal model of the development will be created using EDSL TAS software.

The model is based on the following architectural information provided to us:

Table 3 – Architectural Information Provided

Drawing No. / Report Date	Title
26 September 2016	Pre-App Drawings
1117C / GA / 011	Proposed Ground Floor Plan
1117C / GA / 012	Proposed First Floor / Roof Plan
1117B / D / 001 - 005	Draft Detail Sections

3.0 TAS Model Views

The following images are taken from the Environmental Design Solutions Ltd TAS software used to calculate the buildings energy consumption, carbon emissions and levels of overheating.

3.1 Ground Floor from TAS Model

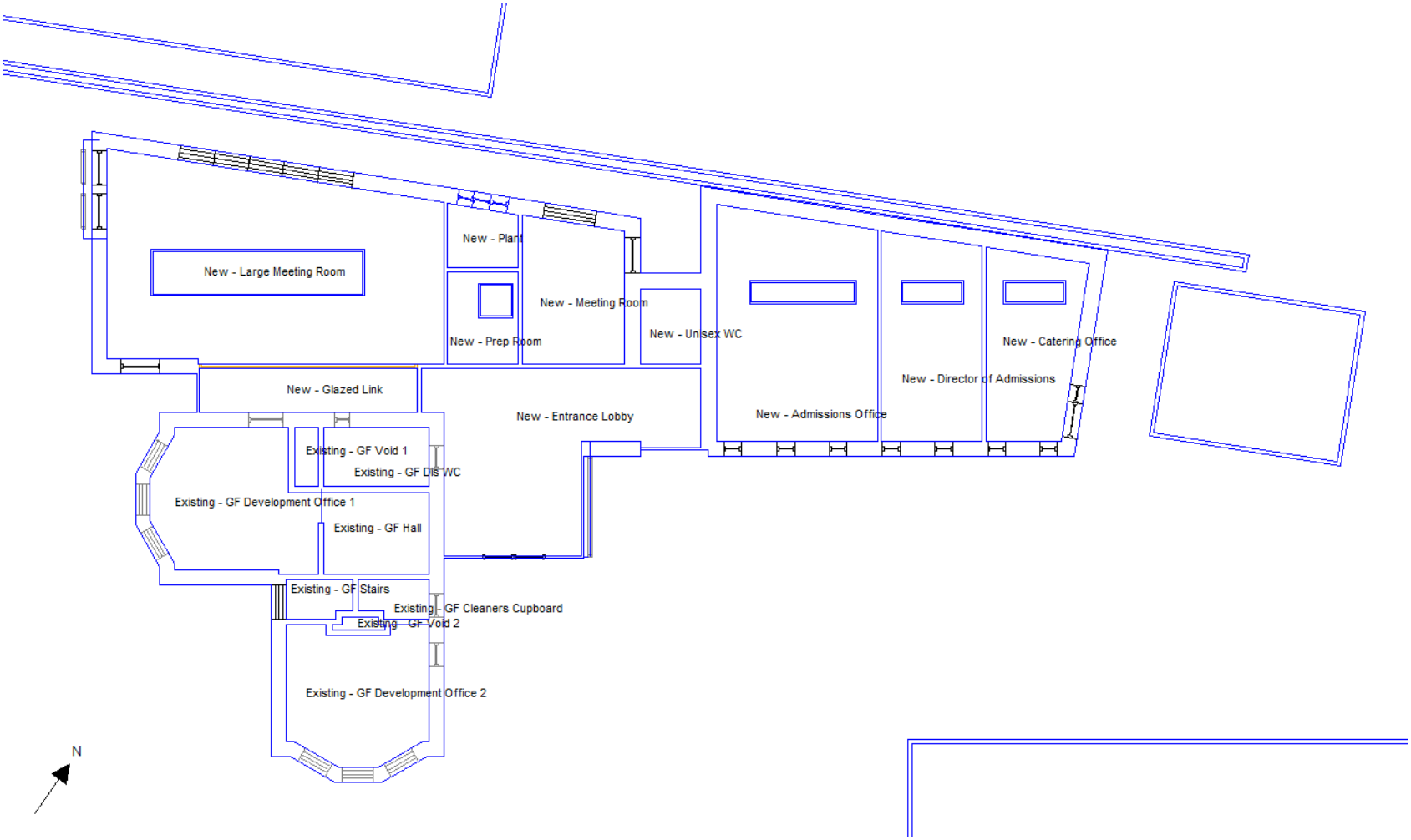


Figure 4 – Ground Floor Plan from TAS Model

3.2 First Floor from TAS Model

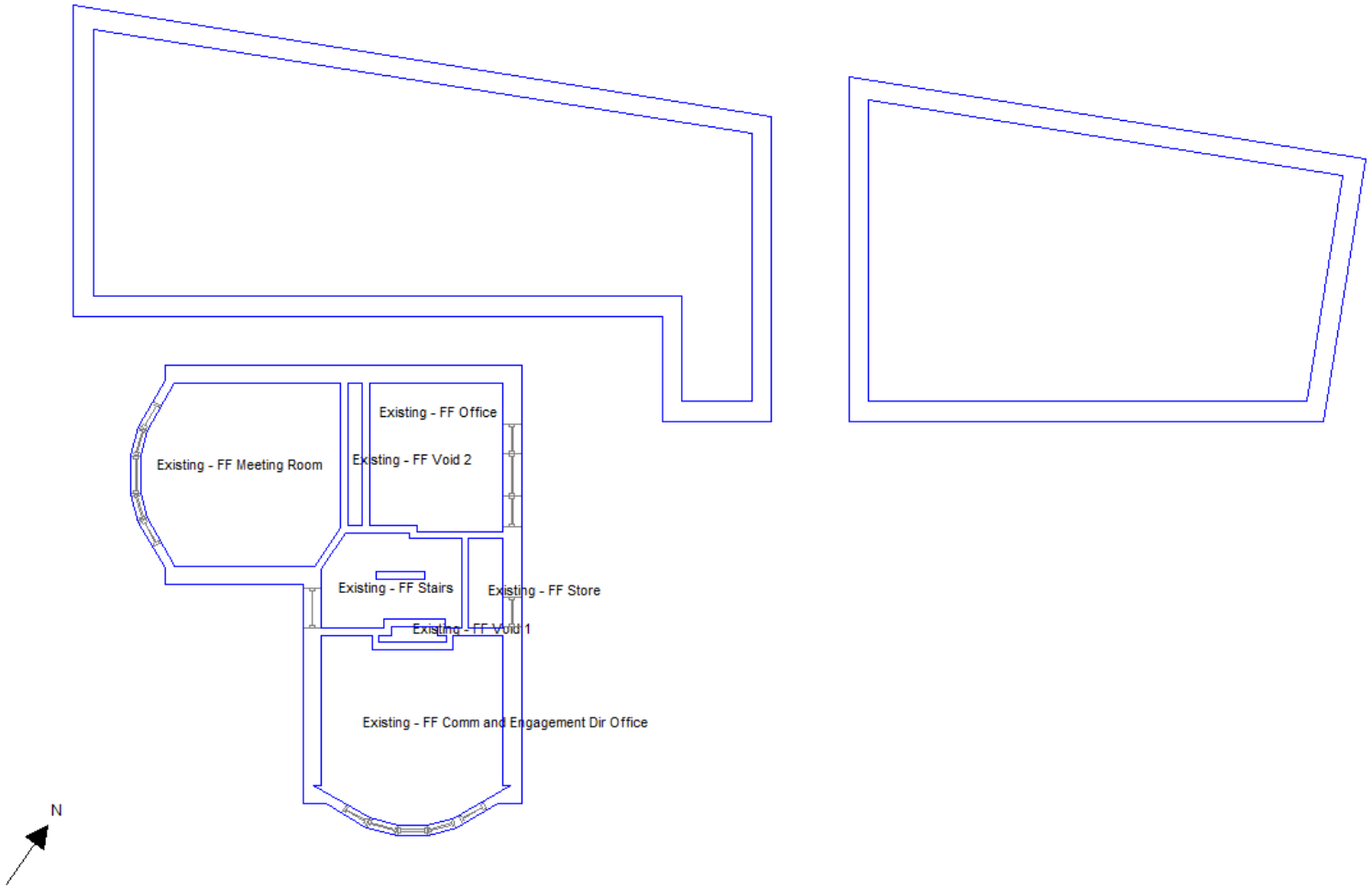


Figure 5 – First Floor Plan from TAS Model

3.3 3D Views of TAS Model

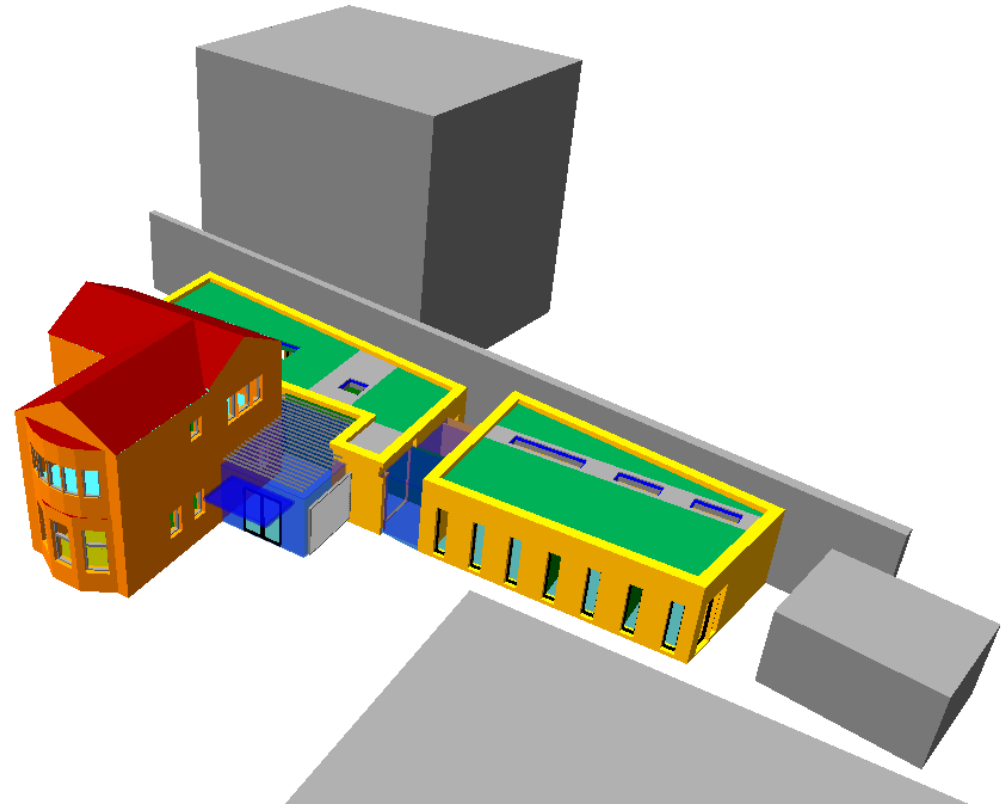


Figure 6 – View of Eastern Side of 3D Model

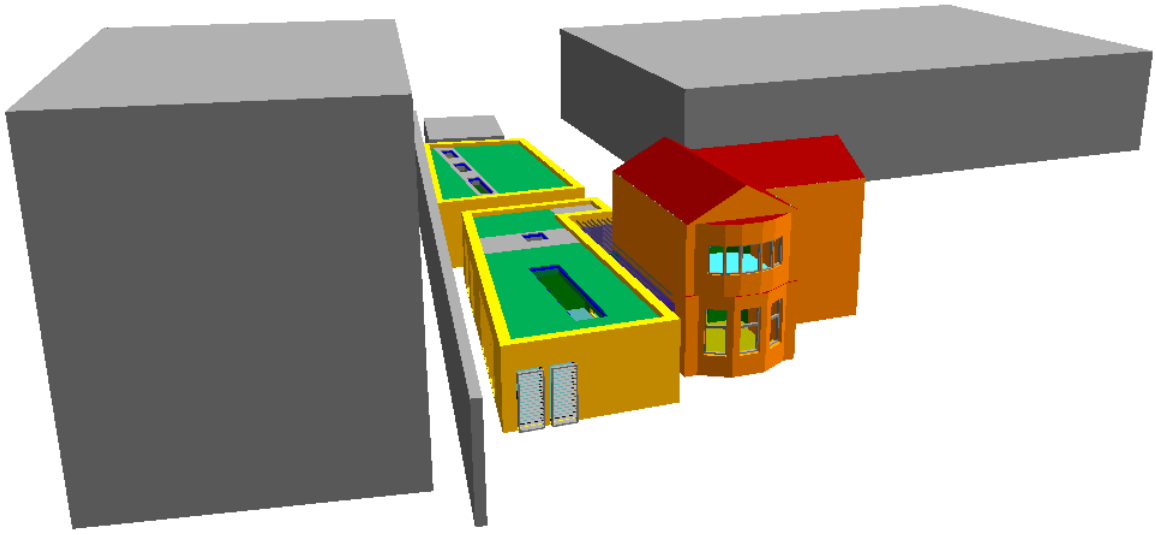


Figure 7 – View of Western Side of 3D Model

4.0 Energy Efficient Measures (Be Lean)

The first step in the energy hierarchy is to Be Lean, i.e. to reduce the demand for energy in the development through the use of energy efficient measures. The calculation data used in the design has been compared to both the current building regulation requirements and the Camden CPG3 guide standards below.

Table 4 – Comparison of Calculation Data Used to Planning Policy and Building Regulation Standards.

Element	Calculation Data	Camden CPG3 Standards	2013 Building Regulations
External Wall ($W/m^2.K$)	0.24	0.20	0.35
Roof ($W/m^2.K$)	0.2	0.13	0.25
Floor ($W/m^2.K$)	0.25	0.20	0.25
Windows / Doors ($W/m^2.K$)	1.8	1.5	2.2
Air Permeability ($m^3/h.m^2$ at 50 Pa)	5	3	10
Lighting Efficacy (Lumens/Circuit Watt)	90	100% Energy Efficient	60

In addition to the lighting data all offices, meeting rooms and circulation areas will have photocell control dimming whereas the stores, cupboards, prep room and WC will have manual on/ auto off presence detection control. All light fittings will also have constant illuminance control.

The calculation data in the above table only compares the element efficiencies for the new build part of the development. This is because the existing building is Grade II listed and therefore restricted in the improvement works that can be carried out. Table 5 below shows the estimated U-values for the existing building and the improvements that can be made in order to reduce energy consumption.

Table 5 – Comparison of the Existing Building U-values and Improved U-values

Element	Existing Building	Improved Existing Building
External Wall ($W/m^2.K$)	1.91	1.91
Roof ($W/m^2.K$)	2.5	0.13
Floor ($W/m^2.K$)	1.07	1.07
Windows / Doors ($W/m^2.K$)	5.8	3.3
Air Permeability ($m^3/h.m^2$ at 50 Pa)	25	15

Under the ‘Be Lean’ approach the existing building will have its lighting improved as well as 300mm mineral wool insulation added to the roof void to improve its U-Value. Secondary glazing will be added to the windows and the air permeability will also be improved from an estimated 25 $m^3/h.m^2$ at 50 Pa to 15 $m^3/h.m^2$ at 50 Pa. This ensures that improvement work on the existing building is carried out without effecting the Grade II status.

The entire development is naturally ventilated except for the WC’s which have extract only ventilation with specific fan powers of 0.3 W/l/s, this is equal to the maximum standard allowed under current regulations.

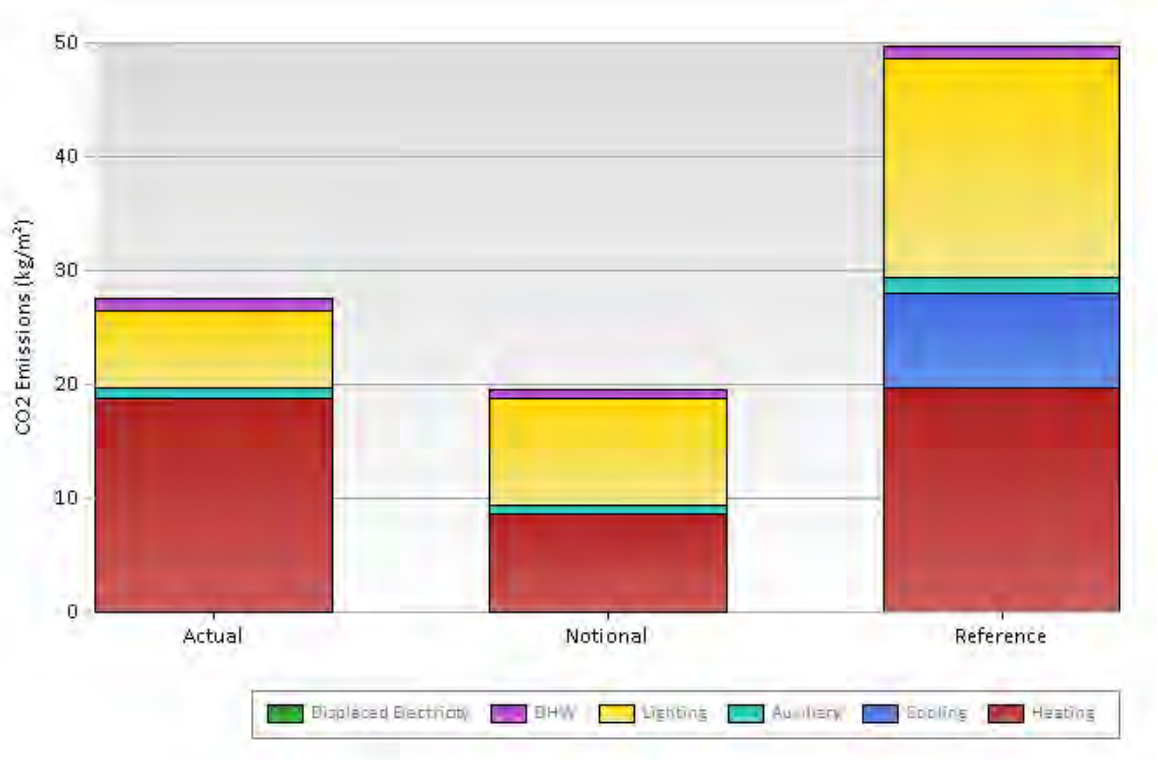
Hot water is provided by point of use electric water heaters, which have an efficiency of 100%. The development has also been simulated with the inclusion of smart meters with automatic readings to allow for continued monitoring of energy use and power factor correction greater than 0.95.

Under the ‘Be Lean’ step in the energy hierarchy, the building must be simulated with a gas boiler with an efficiency of 91% providing the heating. This is so only the energy efficient measures stated above are considered at this stage.

The figures below show the carbon emission results for the ‘Be Lean’ stage of the energy hierarchy, it also shows the Part L2 2013 Building Regulations Notional Building emissions. The notional carbon emission is the target to beat in order to pass Building regulations and will also be the baseline that our 35% carbon reduction is taken from.

The reference emissions are for a typical building of this type and are used to generate the EPC value and banding of the proposed development.

4.1 'Be Lean' Results for the Entire Development



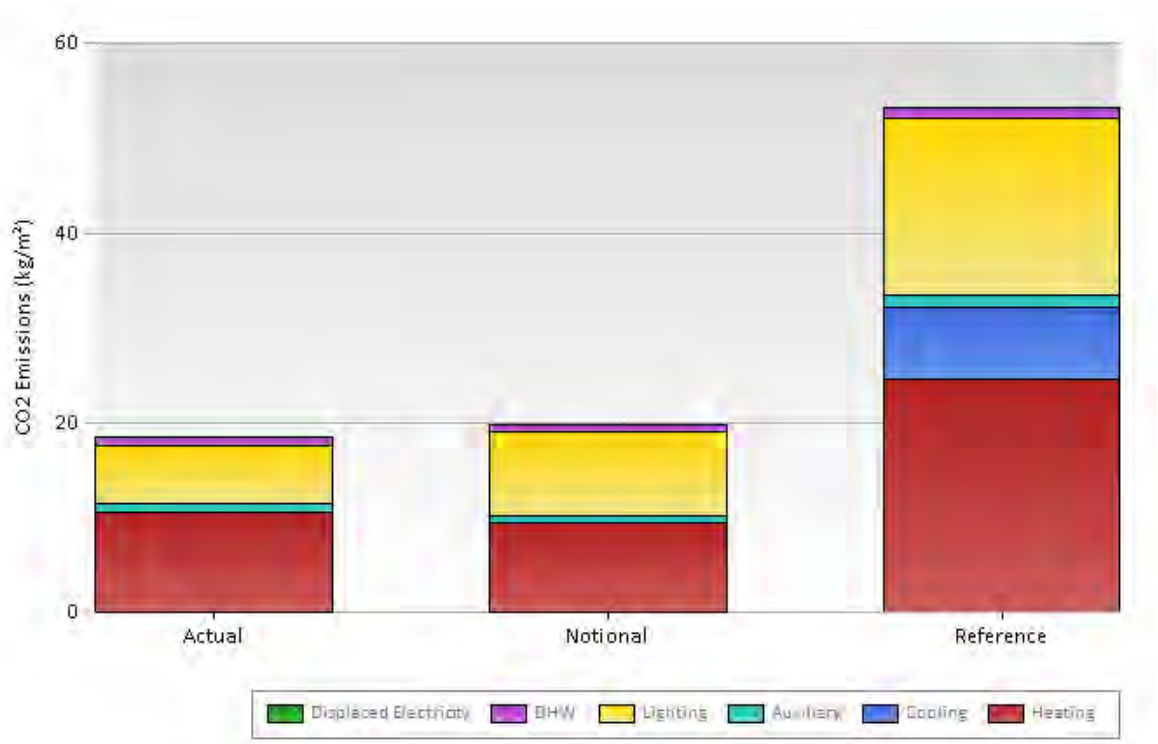
	Actual	*Notional*	*Reference*
Heating (kgCO2/m²)	18.78	8.67	19.67
Cooling (kgCO2/m²)	0.00	0.00	8.43
Auxiliary (kgCO2/m²)	0.97	0.70	1.38
Lighting (kgCO2/m²)	6.74	9.49	19.20
DHW (kgCO2/m²)	1.02	0.74	1.01
Displaced Electricity (kgCO2/m²)	0.00	0.00	0.00
Equipment (kgCO2/m²) *	*17.72*	*17.72*	*18.17*
Total (kgCO2/m²)	27.51	19.60	49.70
Total Floor Area (m²)	217.79	217.79	217.79

** Energy used by equipment does not contribute to total value - it is presented here for comparison only*

Figure 8 – Chart Comparing the Emissions for the Actual. Notional and Reference Buildings for the Entire Development at the 'Be Lean' Stage of the Energy Hierarchy

With a Notional target emission of 19.60 kgCO2/m^2 and an actual emission of 27.51 kgCO2/m^2, the carbon emission results for the 'Be Lean' stage of the energy hierarchy show that the entire development, with energy efficient measures alone, is not efficient enough to meet the current Part L 2013 Building regulations.

4.2 'Be Lean' Results for the New Extension Only



	Actual	*Notional*	*Reference*
Heating (kgCO2/m²)	10.59	9.43	24.67
Cooling (kgCO2/m²)	0.00	0.00	7.43
Auxiliary (kgCO2/m²)	0.93	0.65	1.32
Lighting (kgCO2/m²)	5.96	8.99	18.76
DHW (kgCO2/m²)	0.99	0.72	0.99
Displaced Electricity (kgCO2/m²)	0.00	0.00	0.00
Equipment (kgCO2/m²) *	*18.14*	*18.14*	*18.60*
Total (kgCO2/m²)	18.47	19.79	53.17
Total Floor Area (m²)	138.79	138.79	138.79

** Energy used by equipment does not contribute to total value - it is presented here for comparison only*

Figure 9 – Chart Comparing the Emissions for the Actual. Notional and Reference Buildings for the New Extension Only at the 'Be Lean' Stage of the Energy Hierarchy

With a Notional target emission of 19.79 kgCO2/m^2 and an actual emission of 18.47 kgCO2/m^2, the carbon emission results for the 'Be Lean' stage of the energy hierarchy show that the new extension only, with energy efficient measures alone, will satisfy Part L 2013 Building regulations but only show a 6.67% improvement. Far outside the 35% improvement required by the Camden CPG3 sustainability guide.

5.0 Heating and Cooling Infrastructure (Be Clean)

Once demand for energy consumption has been minimized under the 'Be Lean' stage, the next consideration in the energy hierarchy is 'Be Clean'. Under the 'Be Clean' stage the buildings proposed heating and cooling infrastructure is required to follow the order preference set out in Policy 5.6 B of the London Plan.

Policy 5.6 B states that major development proposals should select energy systems in accordance with the following hierarchy:

1. Connection to existing heating or cooling networks
2. Site wide CHP network
3. Communal heating and cooling

Although we have already established that the proposed works to do not clarify as a major development and therefore the Policy can be disregarded, we will still assess the potential for any heating and cooling infrastructure to be included as they would help to improve the overall carbon emissions.

5.1 Existing Heating or Cooling Networks

To determine if any potential existing, or even possible, heating or cooling networks are within the vicinity of the proposed site we have investigated the area using the London Heat Map. (http://www.londonheatmap.org.uk/Content/home.aspx)

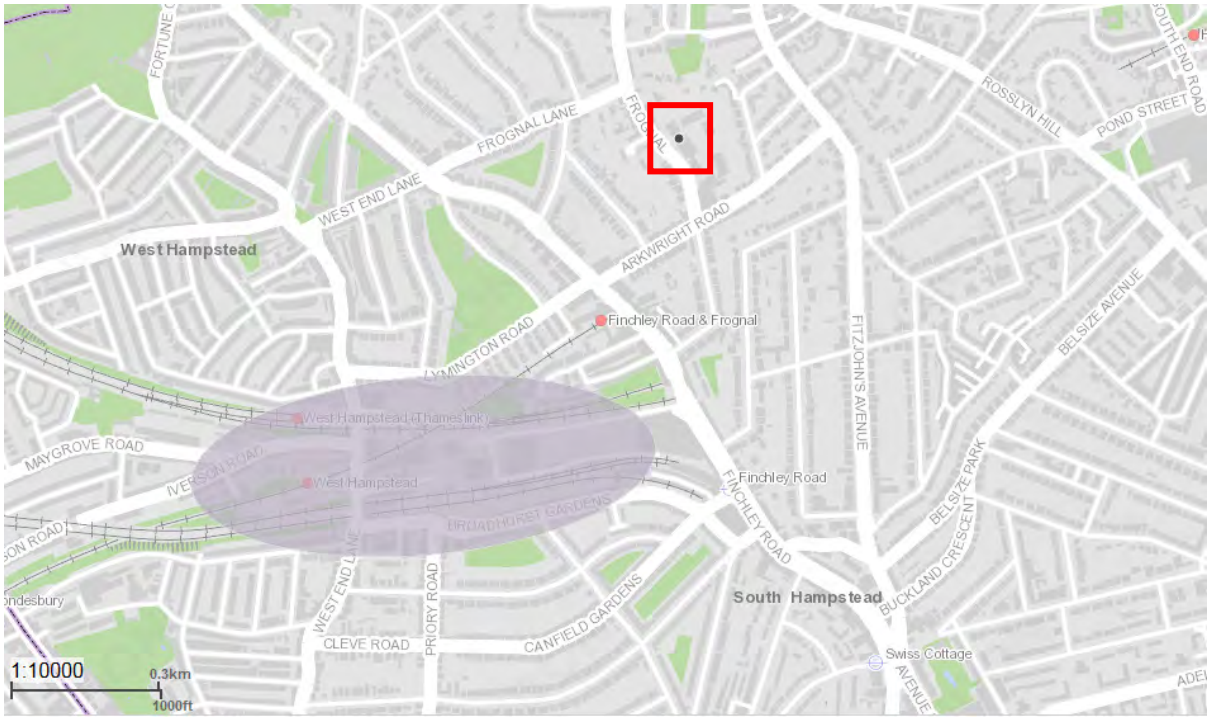


Figure 10 – London Heat Map for the Proposed Site and Surrounding Area

The London Heat Map shows that there are no existing heating or cooling networks close to the proposed site area (red rectangle). It does show that there is decentralised energy potential (purple oval) approximately half a mile away at the West Hampstead over and under ground stations. However as this is only indicating the potential for decentralised energy and as our site is over half a mile away with a small heat load in comparison to many of the closer buildings, it would be unfeasible to include the development in any such scheme.

5.2 Site Wide CHP Network

The next heating and cooling infrastructure to be considered after the connection to an existing network is the possibility of using a site wide CHP network. A combined heat and power network would supply the proposed development and any other suitable buildings on the site with both heating and power from a local energy centre.

The consideration of whether on-site CHP is an appropriate energy solution for the proposed development is largely dependent on the type of heating and electrical loads associated with the School and the proposed size of the CHP system itself.

CHP systems are generally considered economical if they are able to run for more than 5,000 hours per annum. Due to the nature of the site being a School, it is only fully operational for certain hours of the day, for example 8am – 4pm, and for certain periods of the year. This makes it very unlikely that any reasonably sized CHP system would be able to run for more than the required 5,000 hours and therefore a site wide CHP network can be deemed unfeasible.

The London Plan also agrees with this analysis as it states that:

"Non-domestic developments with a simultaneous demand for heat and power for less than 5,000 hours per annum. Examples of such developments may include offices and schools need not install on-site CHP."

5.3 Communal Heating and Cooling

A communal heating or cooling system is a general term where heat or cooling is supplied to multiple buildings from a central source on the site. For example a large gas boiler located within the main school could also be used to heat the proposed development.

This would be considered a feasible idea due to the close proximity of the main school to the Lodge building and an in-depth survey would be required on the main school's existing plant to determine if this would indeed be a possibility. However, it may not provide any further carbon reductions and may even increase the amount of carbon emissions associated with the proposed development.

This is because any plant located within the main school is likely to older and therefore less efficient than new heating systems that would be installed within the proposed development. Although the main school is located close to the Lodge Building there would also be distribution losses associated with running heating pipes to it and therefore the efficiency of the system would be decreased further.

For these reasons, we would also deem any communal heating or cooling systems to be unfeasible for this development.

After investigating the three proposed heating and cooling infrastructure systems set in Policy 5.6 B of the London plan we have concluded that none of these would be a feasible installation in order to reduce the amount of carbon emissions associated with the new development and therefore there will be no further carbon reductions under the 'Be Clean' stage of the energy hierarchy.

6.0 Renewable Energy (Be Green)

Policy 5.7 of the London Plan and section 6 of the London Borough of Camden CPG3 Sustainability guide ask for the inclusion of renewables, where feasible, in order to reduce the carbon emissions of the development. The CPG3 guide also asks for at least 20% reduction in carbon emissions from on-site renewable energy technologies.

Due to the existing Lodge being a Grade II listed building and within the setting of other listed buildings and boundary treatments, the type and extent of possible renewable energy technologies is likely to be limited. However, each possible renewable will be assessed for their feasibility to the proposed development.

6.1 Solar Hot Water Panels

Solar hot water panels are similar in size and appearance to photovoltaic panels. There are two main types of solar hot water panels, Flat Plate or Evacuated Tube, each with their own benefits and drawbacks. For example, the flat plate systems are generally cheaper but also less efficient than the evacuated tubes, therefore more panels may be required.

Figure 11 – Evacuated Tube and Flat Plate Solar Hot Water Panels

Due to the development being within a listed area it would be unlikely that the inclusion of solar hot water panels would be allowed for on the roof of either the existing building or new extension. There is also very minimal hot water demand within the proposed development and therefore their inclusion would be unfeasible.

6.2 Photovoltaic Panels

Photovoltaic panels are probably the most well-known and adopted of all the renewable technologies. There are 3 main types of PV panel available Amorphous, Polycrystalline and Monocrystalline.

Amorphous (Thin Film) are the least efficient at around 5% and also least expensive, they are also flexible and therefore can be made to fit any curved parts of a wall or roof where they could be installed.

Polycrystalline (Poly Silicon) is the middle of the range PV panel with average cost and average efficiency of around 10 – 12%. Unlike Amorphous they are rigid in their construction and are mounted in a frame that you would see on any typical PV installation.

Monocrystalline (Mono Silicon) are the most efficient type of PV panel with efficiencies of around 15% or above and are therefore also the most expensive. Like Polycrystalline panels they too are rigid and must be mounted within a frame.

Although these are the three main types of PV panel available, some manufacturers may use a combination of these to further increase the efficiency of their panels.

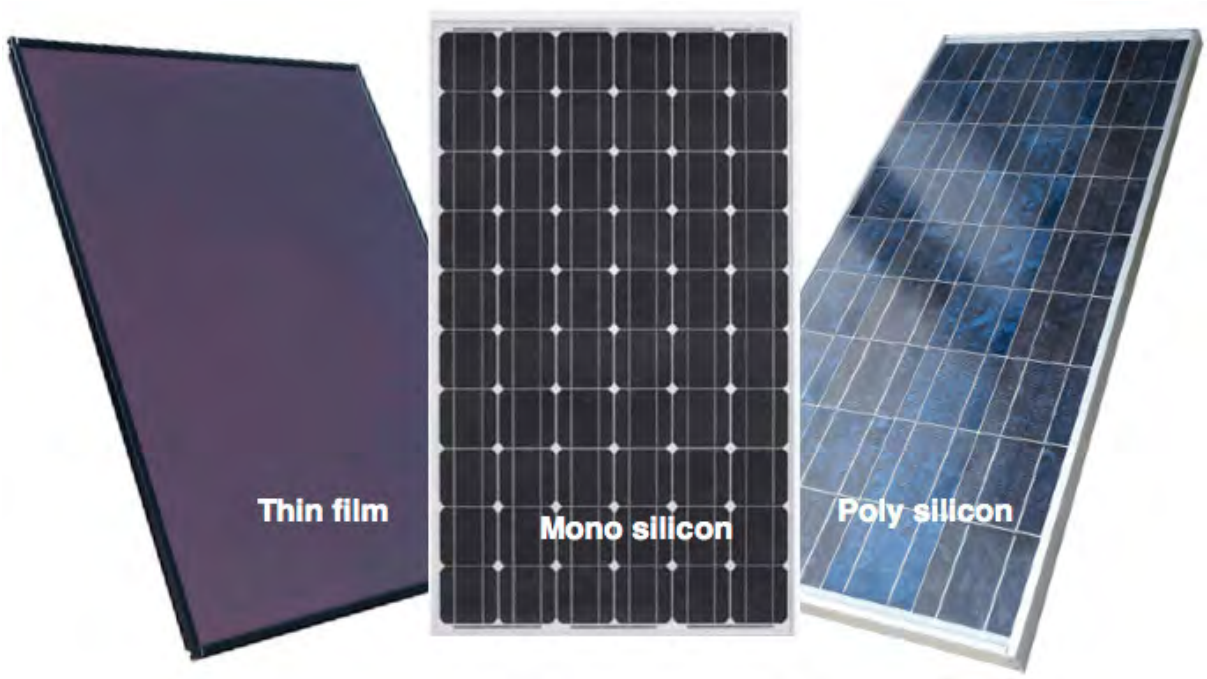


Figure 12 – Amorphous, Monocrystalline and Polycrystalline types of PV Panels

As with the solar hot water panels due to the Grade II listing status of the building and surrounding area their inclusion on the development is down to the decision of the planners. However, if they were to be granted planning permission we believe the addition of a Photovoltaic system could have a considerable effect on reducing the carbon emissions of the building.

Figure 13 below shows the possible location where a 2 KW (8 Panel) PV system could be included on to the new extension roof.

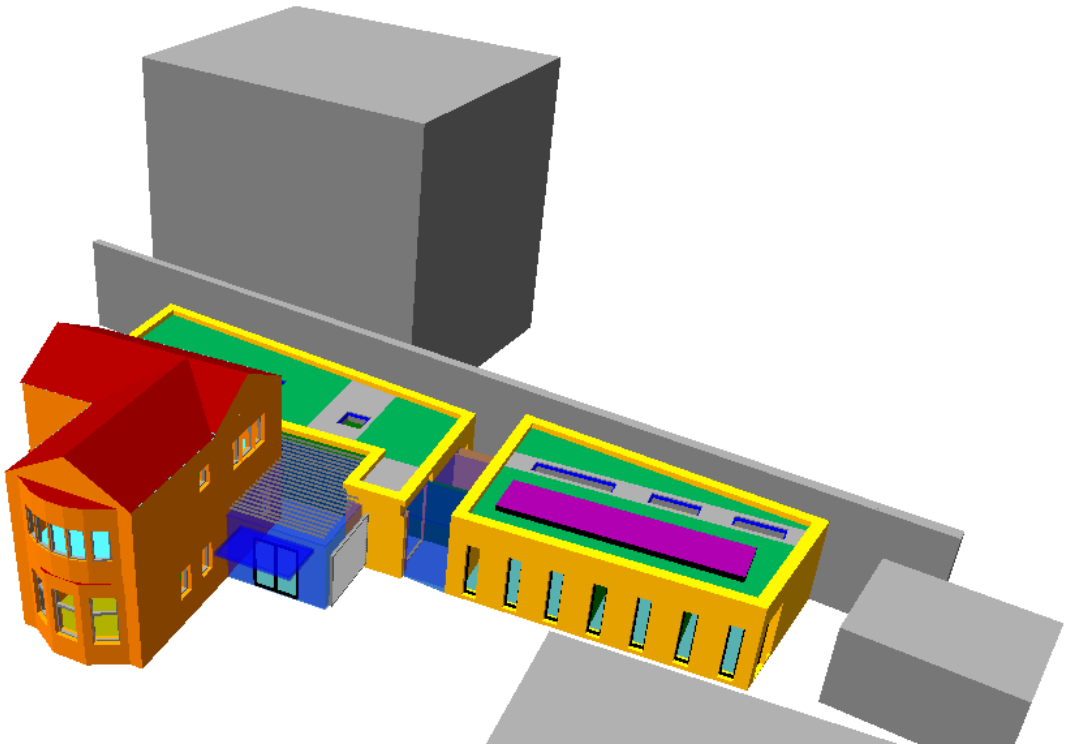


Figure 13 – Possible Location of a 2 KW (8 Panel) PV System

The PV system could either be installed lying flat on the new extension roof or at an optimum angle (around 30°) to maximise the solar energy received.

Initial simulations into both options showed that with the PV lying flat there would be around an 8% reduction in the electricity produced from the PV system. As this only a minimal drop off in efficiency and as the PV system would be much better suited visually if laid flat on the roof of the new extension, this option will be simulated going forward.

If, for any reason, the PV system could not be feasibly installed on the roof of the new extension building, then it may be possible to install the PV system locally on the site on the North Block Building roof.

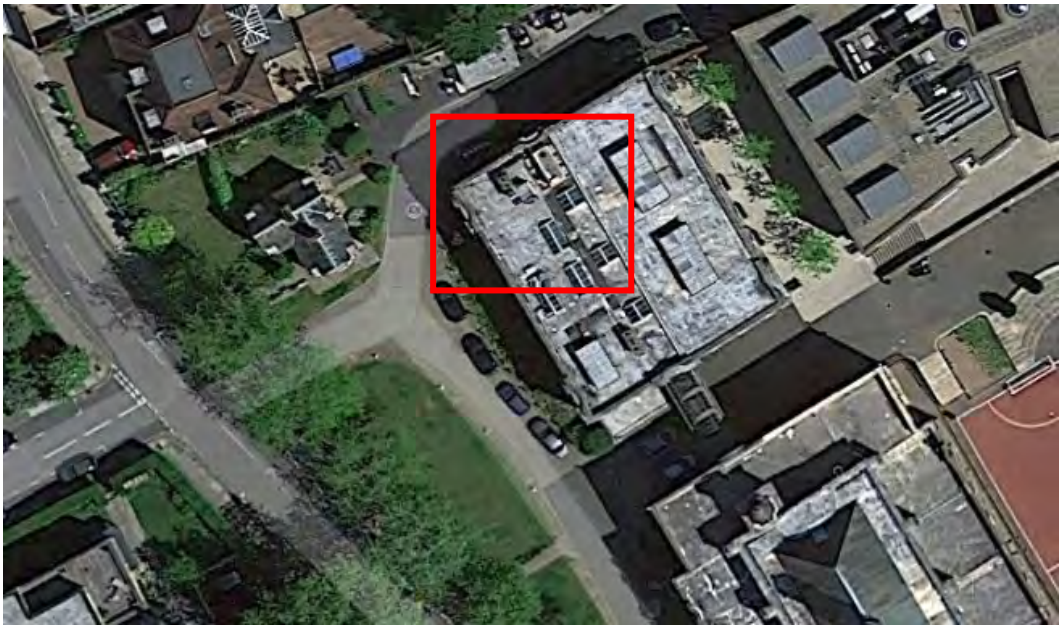


Figure 14 – Possible Location of PV System on the UCS North Block Roof

6.3 Ground Source Heat Pump (GSHP)

Ground Source Heat Pumps can either be open or closed loop and work by extracting heat from the ground, upgrading it using a compressor and then transfers the heat to the buildings heating system. In the summer the GSHP system can be reversed with the heat being extracted from the building and transferred to the ground, in effect providing the building with cooling.

There are two main types of GSHP, vertical bore holes or horizontal trenches. Vertical bore holes may be required to go down to depths of greater than 100m and therefore a ground survey is required to determine their suitability. Whereas horizontal trenches will typically be laid only a few metres under the ground but will require a large horizontal run to ensure sufficient heat is exchanged.

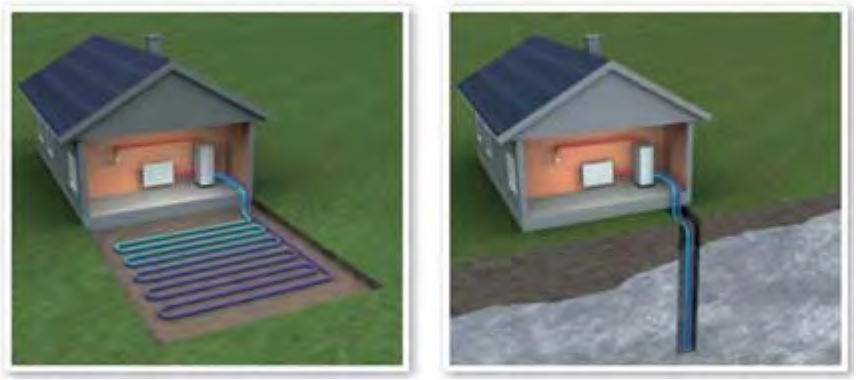


Figure 15 – Horizontal and Vertical Ground Source Heat Pump Types

Due to the area of land required for a horizontal GSHP and the depth, cost and results of a land survey for the vertical GSHP, we would consider the inclusion of either GSHP as unfeasible for the proposed development. The GSHP would also require, at minimum, a COP of at least 4 in order to be qualified as a renewable under the CPG3 Sustainability guide.

6.4 Air Source Heat Pump (ASHP)

Air Source Heat Pumps work in a similar way to Ground Source except that they extract heat from the outside air instead of the ground. They can also be run in reverse during the summer to provide the building with cooling, if it is required.

ASHP can either be air to air, where the heat extracted from the outside air is transferred to air inside the building to provide heating, for example an air conditioning unit. Or they can be air to water, where the heat extracted is transferred to the wet heating system within the building, for example radiator heating.

Figure 16 – Typical Air Source Heat Pump External Condenser

An ASHP could be considered as a feasible technology to install within the proposed development to provide the required heating load and any cooling if it is essential.

However, this would mean that an condenser would be need to be located somewhere externally on the site. A COP of 4 is also required for the ASHP to be considered as a renewable energy technology under the CPG3 Sustainability Guide.

6.5 Biomass Heating

A biomass boiler works in a similar way to a typical gas boiler except that it burns organic materials such as wood chips, wood pellets, energy crops or bio-fuels to produce heat. It is considered a renewable energy technology as any emissions from the burning of the fuels is assumed to be offset when they are grown.

Biomass boilers tend to be larger, noisier and produce higher levels of emissions such as nitrogen oxides (NOx) than conventional gas boilers and as a result an increased plant space and detailed air quality studies are required.

Figure 17 – Typical Biomass Boiler for Small Commercial Applications

Due to the limited access on site, which would be required in order for bulk deliveries of fuel to be made, and the close proximity of surrounding buildings, which would be affected by the increased levels of emissions, we would deem biomass heating as unfeasible for the proposed development.

6.6 Wind Turbines

Wind Turbines can be vertical or horizontal axis, and generate electricity using their blades to turn a turbine. Further to this the wind turbines can either be building mounted or free-standing, they also come in a range of different sizes with different blade lengths.

The feasibility of wind turbines is very dependent on the wind profile of the site, with low speeds not producing enough electricity or even too high wind speeds making the turbine unsafe to use.

Figure 18 – Vertical and Horizontal Axis Wind Turbines

Dues to the site being Grade II listed the possibility of having a local wind turbine being accepted by planners is unlikely. The close proximity of the site to neighbouring buildings also makes the use of a wind turbine impracticable. For these reasons, we would deem the use of a wind turbine on the site as unfeasible.

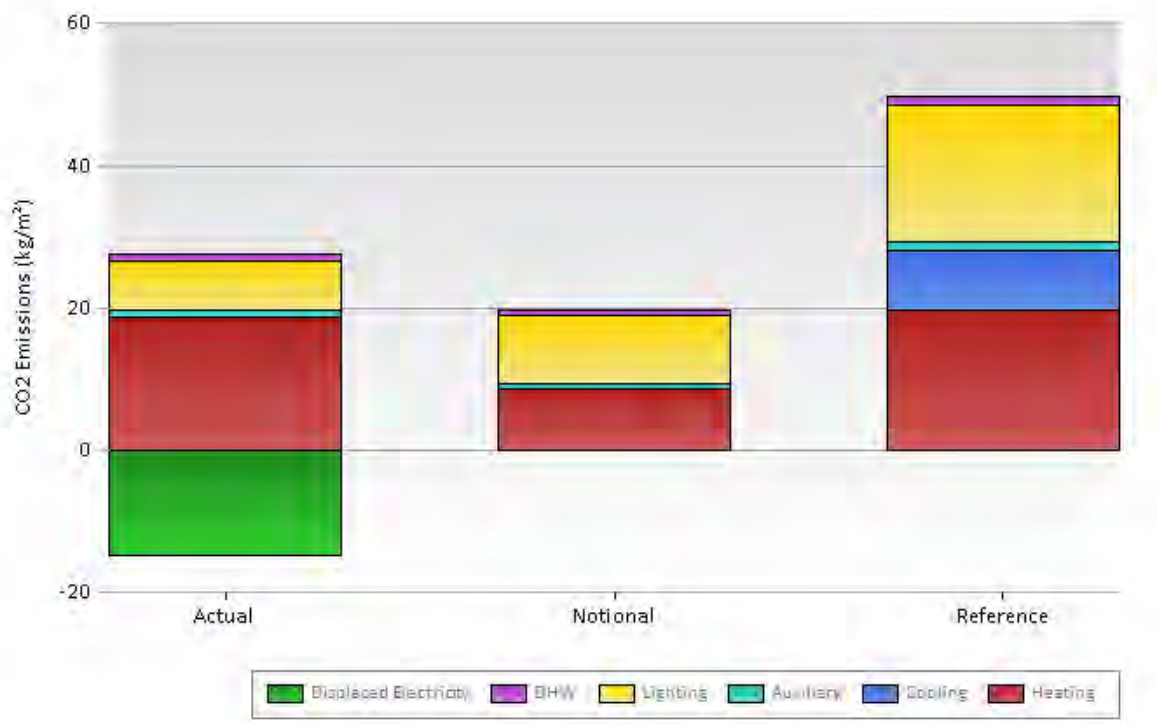
6.7 Be Green Carbon Emission Results

Investigating the possible renewable energy technologies for the site has shown that one feasible technology worth investigating is the inclusion of a PV system, installed on the new extension itself or on the nearby North Block Building.

As before the development will be simulated twice, once as the combined existing and new development, and then again as the new extension only.

The building simulation will be set up with the same energy efficient measures as described in the 'Be Lean' stage, except that now a 7 KW (28 panel) PV system will be simulated on the North Block roof to serve the entire development and a 2 KW (8 Panel) PV system will be simulated laid flat on the extension roof to serve the new extension only.

6.8 'Be Green' Results for the Entire Development



	Actual	*Notional*	*Reference*
Heating (kgCO2/m²)	18.80	8.68	19.71
Cooling (kgCO2/m²)	0.00	0.00	8.32
Auxiliary (kgCO2/m²)	0.97	0.70	1.38
Lighting (kgCO2/m²)	6.74	9.49	19.20
DHW (kgCO2/m²)	1.02	0.74	1.01
Displaced Electricity (kgCO2/m²)	-14.84	0.00	0.00
Equipment (kgCO2/m²) *	*17.72*	*17.72*	*18.17*
Total (kgCO2/m²)	12.69	19.60	49.63
Total Floor Area (m²)	217.79	217.79	217.79

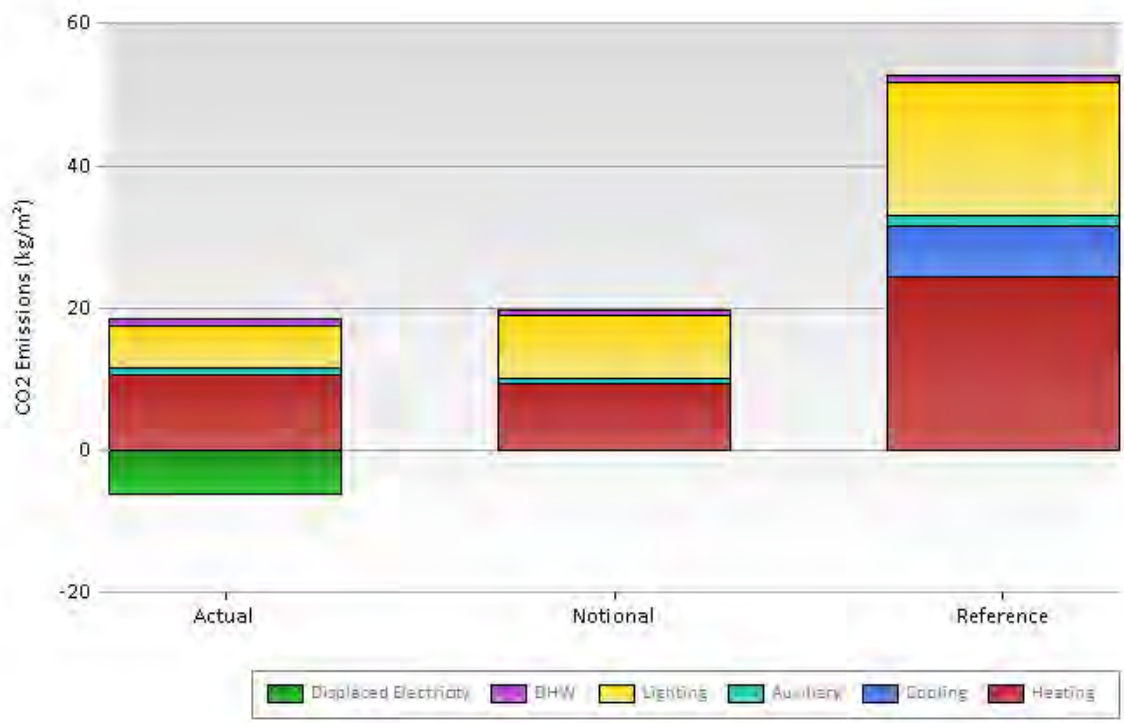
** Energy used by equipment does not contribute to total value - it is presented here for comparison only*

Figure 19 – Chart Comparing the Emissions for the Actual. Notional and Reference Buildings for the Entire Development at the 'Be Green' Stage of the Energy Hierarchy

With carbon emissions of 12.69 kgCO2/m^2 for the entire development under the 'Be Green' stage and a baseline Part L 2013 Building Regulations target of 19.60 kgCO2/m^2, we can see that the building is now passing the Part L requirements. It also has a carbon reduction over the baseline target of 35.2%, satisfying the required 35% reduction under the London Plan and London Borough of Camden CPG3 Sustainability guide.

The initial actual carbon emissions from the 'Be Lean' stage was 27.51 kgCO2/m^2 and with the inclusion of a 7 KW (28 Panel) PV system this has been reduced to 12.69 kgCO2/m^2, this shows a 53.87% reduction in carbon emissions from the use of a renewable technology. Therefore meeting the CPG3 guides target of a 20% reduction through the use of renewables.

6.9 'Be Green' Results for the New Extension Only



	Actual	*Notional*	*Reference*
Heating (kgCO2/m²)	10.57	9.34	24.28
Cooling (kgCO2/m²)	0.00	0.00	7.28
Auxiliary (kgCO2/m²)	0.93	0.65	1.32
Lighting (kgCO2/m²)	5.96	8.99	18.76
DHW (kgCO2/m²)	0.99	0.72	0.99
Displaced Electricity (kgCO2/m²)	-6.14	0.00	0.00
Equipment (kgCO2/m²) *	*18.14*	*18.14*	*18.60*
Total (kgCO2/m²)	12.31	19.71	52.63
Total Floor Area (m²)	138.79	138.79	138.79

** Energy used by equipment does not contribute to total value - it is presented here for comparison only*

Figure 20 – Chart Comparing the Emissions for the Actual. Notional and Reference Buildings for the New Extension Only at the 'Be Green' Stage of the Energy Hierarchy

The results show that the actual emissions for the extension only are now 12.31 kgCO2/m^2. They also show that the notional building results have also changed, however the London Plan states that we should still compare the new actual results to the initial Notional Building result under the 'Be Lean' stage, this is because this was our baseline target for the 35% reduction.

With carbon emissions of 12.31 kgCO2/m^2 for the new extension only under the 'Be Green' stage and a baseline Part L 2013 Building Regulations target of 19.79 kgCO2/m^2, we can see that the building is now passing the Part L requirements. It also has a carbon reduction over the baseline target of 37.80%, satisfying the required 35% under the London Plan and London Borough of Camden CPG3 Sustainability guide.

The initial actual carbon emissions from the 'Be Lean' stage was 18.47 kgCO2/m^2 and with the inclusion of a 2 KW PV system this has been reduced to 12.31 kgCO2/m^2, this shows a 33.35% reduction in carbon emissions from the use of a renewable technology. This therefore also satisfies the CPG3 guides target of a 20% reduction through the use of renewables.

7.0 Cooling and Overheating

Policy 5.9 of the London Plan outlines the recommended overheating and cooling strategy for major developments. As mentioned previously, although this building is not considered a major development it will still follow the London Plan and CPG3 guides as closely as possible to reduce its overall level of carbon emissions.

Policy 5.9 outlines its cooling hierarchy which new developments should follow in order to remove the need for cooling entirely or reduce the amount required. The cooling hierarchy and how the building is designed to follow this are defined below.

1. Minimising internal heat generation through energy efficient design:

Internal heat generation has been minimised through the use of energy efficient lighting and equipment.

2. Reducing the amount of heat entering the building in summer:

Brise Soleil is installed around the entirety of the glazed entrance area and on the large south-west facing windows of the new extension. The rooflights are tinted/translucent to provide less solar gain and internal blinds have also been used throughout the entire development.

3. Use of thermal mass and high ceilings to manage the heat within the building:

The Cedum roof will help to minimise solar gain heat transfer through the roof of the new extension.

4. **Passive ventilation**:

All windows are assumed to have at least a 40% free opening area. On the peak summer days, the external doors within the meeting rooms and offices will also be required to open.

5. Mechanical ventilation:

The entire building is naturally ventilated except for the small WC areas which has local extract ventilation. This helps to keep energy usage and therefore carbon emissions of the building to a minimum.

With the cooling hierarchy implemented within the development the levels of solar gain and overheating were checked with relevant industry standards to assume their compliance. The BRUKL document for the final 'Be Clean' stage shows that the solar gain limit for each of the rooms has not been exceeded and therefore this satisfies the current Part L 2013 Building regulations.

To determine if the building was suffering from overheating it was tested against the CIBSE TM 52 overheating guidance.

7.1 CIBSE TM52 Overheating

CIBSE TM 52 is the latest guidance on the subject of overheating and is thought to be far superior to other industry standard overheating calculation methodologies such as BB 101 or CIBSE Guide A (2006).

This is because the TM 52 calculation uses the CIBSE DSY (Design Summer Year) weather data which consists of an actual 1-year sequence of hourly data, selected from the 20-year (1983-2004) data sets to represent a year with a hot summer. The selection is based on dry bulb temperatures during the period April–September. The year selected is the mid-year of the upper quartile. This enables designers to simulate building performance during a year with a hot, but not extreme, summer.

The TM52 calculation is also an adaptive overheating calculation meaning that the ideal comfort temperature inside a building will be related to the outdoor air temperature. Whereas other overheating calculations such as CIBSE Guide A suggest a fixed upper limit of 28°C that cannot be exceeded for 1% of the occupied time, TM 52 has an adaptive comfort temperature limit that responds to the outdoor temperature at that time.

TM 52 has 3 criteria to assess the level of overheating and it has to pass 2 of the 3 in order to pass the guidance overall. The TM52 overheating compliance criteria is as follows;

Criterion 1: Hours of Exceedance – The number of hours during which Δ*T* is greater than or equal to one degree (K) during the period May to September inclusive shall not be more than 3 per cent of occupied hours.

Criterion 2: Daily Weighted Exceedance – To allow for the severity of overheating the weighted exceedance shall be less than or equal to 6 in any one day.

Criterion 3: Upper Limit Temperature – To set an absolute maximum value for the indoor operative temperature the value of Δ*T* shall not exceed 4 K.

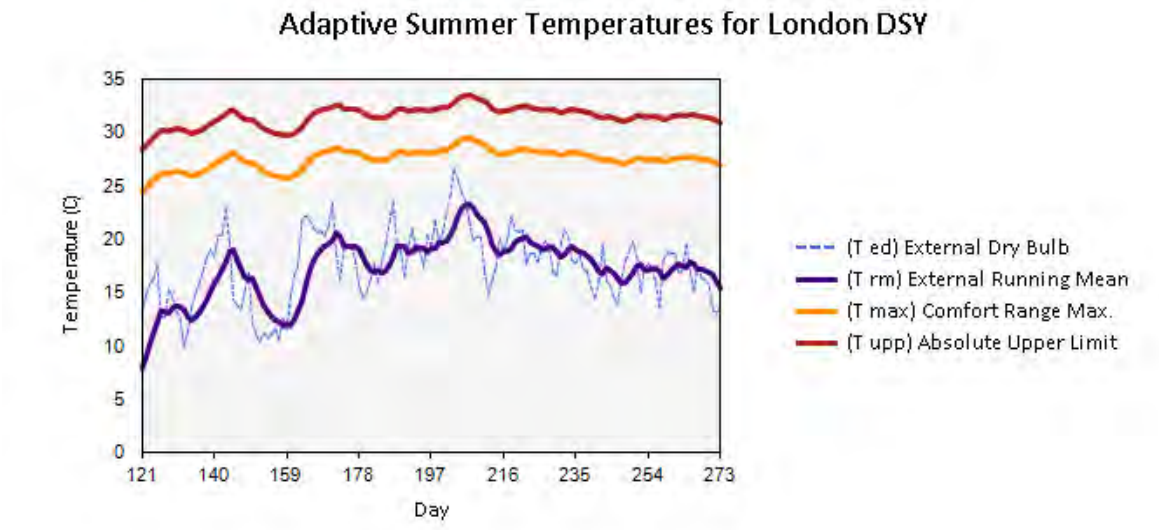


Figure 21 – CIBSE TM 52 Adaptive Summer Temperatures for London DSY

7.2 CIBSE TM 52 Overheating Results

The TM52 simulation was set up using the energy efficient measures listed under the 'Be Lean' stage. It also had all the measures stated in the cooling hierarchy. The results can be seen below.

Table 6 – CIBSE TM52 Overheating Results

Zone Name	Occupied Summer Hours	Max. Exceedable Hours (3%)	#Hours Exceeding Comfort Range	Peak Daily Weighted Exceedance	#Hours Exceeding Absolute Limit	Result
Existing - GF Development Office 1	981	29	0	0.0	0	Pass
Existing - GF Development Office 2	981	29	0	0.0	0	Pass
Existing - FF Office	981	29	4	4.0	0	Pass
Existing - FF Meeting Room	981	29	12	10.0	0	Pass
Existing - FF Comm and Engagement Dir Office	981	29	11	8.0	0	Pass
New - Admissions Office	981	29	13	6.0	0	Pass
New - Director of Admissions	981	29	15	7.0	0	Pass
New - Large Meeting Room	981	29	38	6.0	0	Pass
New - Meeting Room	981	29	24	9.0	0	Pass
New - Catering Office	981	29	12	6.0	0	Pass

As the results show, all of the occupied areas within the new extension and existing building will satisfy at least 2 of the 3 TM52 criteria, resulting in a pass.

Please note that the cooling hierarchy only demonstrates one way in which the building could be designed to prevent overheating. If the any of the measures stated, such as the use of internal blinds or tinted/translucent rooflights, were not installed then the offices/meeting rooms will overheat.

Some areas are not required to meet TM 52, such as the entrance lobby or WC, as they are considered to have a transient occupancy.

8.0 Energy Hierarchy Results

The design of the UCS – Lodge extension and refurbishment has shown that by implementing the Energy Hierarchy set out within the London Borough of Camden CPG3 Sustainability Guide that it will be able to reduce its amount of carbon emissions over the Part L 2013 Building Regulations by the required 35%.

8.1 Entire Development

When considered as an entire development, with a 7 KW (28 panel) photovoltaic system installed on the nearby North Block Building roof, it will produce carbon emissions of 12.69 kgCO2/m^2 per annum. This equates to a 35.2% reduction over the Part L 2013 Building Regulations and therefore satisfies the requirement of the London Plan and London Borough of Camden CPG3 Sustainability guide.

The actual carbon emissions from the 'Be Lean' stage was found to be 27.51 kgCO2/m^2 and with the inclusion of a 7 KW (28 panel) PV system this has been reduced to 12.69 kgCO2/m^2, this shows a 53.87% reduction in carbon emissions from the use of a renewable technology. This therefore also satisfies the CPG3 guides target of a 20% reduction through the use of renewables.

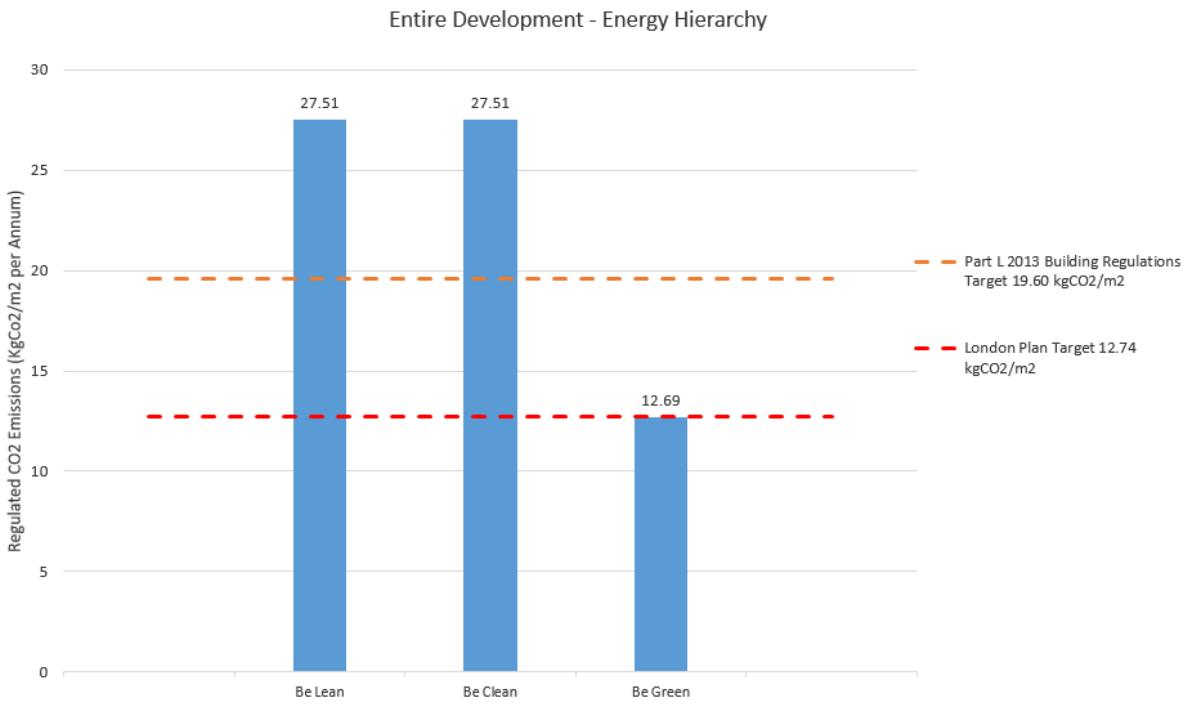


Figure 22 – The Energy Hierarchy for the UCS Lodge Entire Development

8.2 New Extension Only

When considered as the new extension only, with a 2 KW (8 panel) photovoltaic system laid flat on the new extension roof, it will produce carbon emissions of 12.31 kgCO2/m^2 per annum. This equates to a 37.8% reduction over the Part L 2013 Building Regulations and therefore satisfies the requirement of the London Plan and London Borough of Camden CPG3 Sustainability guide.

The actual carbon emissions from the 'Be Lean' stage was found to be 18.47 kgCO2/m^2 and with the inclusion of a 2 KW (8 panel) PV system this has been reduced to 12.31 kgCO2/m^2, this shows a 33.35% reduction in carbon emissions from the use of a renewable technology. This therefore also satisfies the CPG3 guides target of a 20% reduction through the use of renewables.

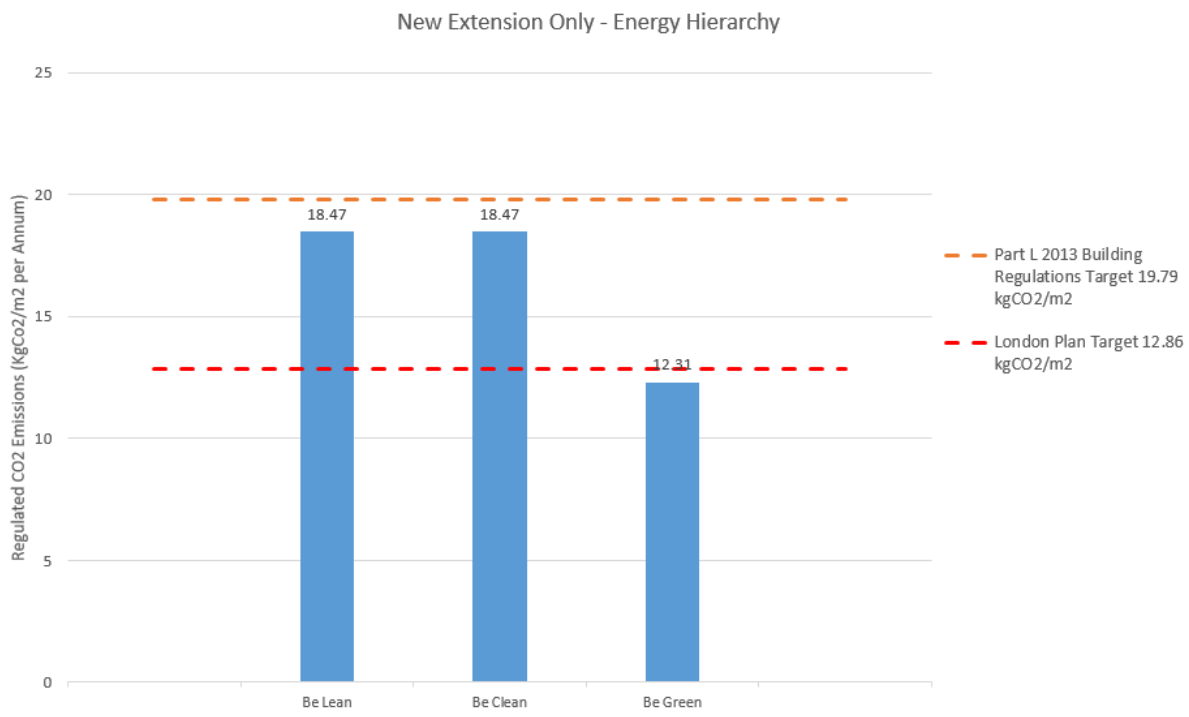


Figure 23 – The Energy Hierarchy for the UCS Lodge New Extension Only

8.3 Carbon Emissions Comparison

Please note that the figures in the table below have now been converted into Tonnes of CO2 per annum instead of kgCO2/m^2 per annum as requested by the London Plan. To arrive at Tonnes of CO2 from kgCO2/m^2 the results in the graphs above have been multiplied by their respective floor areas and divided by 1,000.

Table 7 – CO2 Emissions after each Stage in the Energy Hierarchy

Stage in Energy Hierarchy	Carbon Dioxide Emissions (Tonnes CO2 per annum)	
	Entire Development	New Extension Only
Part L 2013 Building Regulations Target	4.27	2.75
London Plan Target	2.78	1.79
After Energy Demand Reduction (Be Lean)	6.00	2.57
After CHP (Be Clean)	6.00	2.57
After Renewable Energy (Be Green)	2.77	1.71

Table 8 – CO2 Savings from each Stage of the Energy Hierarchy

Stage in Energy Hierarchy	Entire Development		New Extension Only	
	CO2 Savings		CO2 Savings	
	(Tonnes CO2 per annum)	(%)	(Tonnes CO2 per annum)	(%)
Savings from Energy Demand Reduction (Be Lean)	-1.73	-40.52	0.18	6.55
Savings from CHP (Be Clean)	0	0	0	0
Savings from Renewable Energy (Be Green)	3.23	75.64	0.86	31.27
Total Cumulative Savings	**1.5**	**35.12**	**1.04**	**37.82**
Total Target Savings	**1.49**	**35**	**0.96**	**35**
Annual Surplus	**0.01**		**0.08**	

The results show that when the entire development is examined, with a 7 KW (28 panel) photovoltaic system installed on the nearby North Block Building roof, it surpasses its Tonnes of CO2 emissions target by approximately 0.01 Tonnes, equating to an overall carbon reduction of 35.12% over the Part L 2013 Building Regulations target emissions.

When the new extension is investigated separately, with a 2 KW (8 panel) photovoltaic system laid flat on the new extension roof, it shows that it surpasses its Tonnes of CO2 emissions target by approximately 0.08 Tonnes, equating to a carbon reduction of 37.82% over the Part L 2013 Building Regulations target emissions.

The use of a PV system also qualifies as a renewable energy technology and has been shown to reduce the level of carbon emissions by 53.87% when 7 KW are installed for the entire development or 33.35% when 2 KW are installed for the new extension only, in comparison to a gas boiler system only with no PV. Both scenarios will therefore satisfy the requirement within the CPG3 guide of a 20% reduction through the use of renewables.

Appendices

Appendix A – Entire Development

‘Be Lean’ BRUKL Document and Energy Performance Certificate

‘Be Green’ BRUKL Document and Energy Performance Certificate

Appendix B – New Extension Only

‘Be Lean’ BRUKL Document and Energy Performance Certificate

‘Be Green’ BRUKL Document and Energy Performance Certificate

Appendix A – Entire Development

‘Be Lean’ BRUKL Document and Energy Performance Certificate

‘Be Green’ BRUKL Document and Energy Performance Certificate

Appendix B – New Extension Only

‘Be Lean’ BRUKL Document and Energy Performance Certificate

‘Be Green’ BRUKL Document and Energy Performance Certificate

Appendices

Appendix A – Entire Development

‘Be Lean’ BRUKL Document and Energy Performance Certificate

‘Be Green’ BRUKL Document and Energy Performance Certificate

Appendix B – New Extension Only

‘Be Lean’ BRUKL Document and Energy Performance Certificate

‘Be Green’ BRUKL Document and Energy Performance Certificate

Appendix A – Entire Development

‘Be Lean’ BRUKL Document and Energy Performance Certificate

‘Be Green’ BRUKL Document and Energy Performance Certificate

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

University College School Lodge Extension

As designed

Date: Wed Dec 07 10:54:24 2016

Administrative information

Building Details

Address: The Lodge, 56 Frognal, UCS Senior School Campus, Hampstead, London, NW3 6XH

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.4.0"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.4.0

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

Owner Details

Name: Unversity College School London

Telephone number: 020 74353068

Address: 11 Holly Hill, London, NW3 6QN

Certifier details

Name: Jason Welsh

Telephone number: 01206 273 000

Address: The Energy Practice Ltd, Unit 4 Woodhouse Business Centre, Coach Road Great Horkesley, Colchester, CO6 4BB

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

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

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	19.6
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	19.6
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	27.5
Are emissions from the building less than or equal to the target?	BER > TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and 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	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	1.15	1.91	Extg External Wall
Floor	0.25	0.44	1.07	Extg Ground Floor
Roof	0.25	0.18	0.21	Green Roof
Windows***, roof windows, and rooflights	2.2	2.3	3.33	Extg 1 (t)
Personnel doors	2.2	2.42	3.33	Extg Door (b)
Vehicle access & similar large doors	1.5	-	-	No vehicle doors in project
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

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

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	8.8

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

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.91	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

2- Extract Only (2 Zones)

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.91	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

1- Direct Electric

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	1	0
Standard value	1	N/A

Local mechanical ventilation, exhaust, and terminal units

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

Zone name	**SFP [W/(l/s)]**									**HR efficiency**	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
Existing - GF Dis WC	0.3	-	-	-	-	-	-	-	-	-	N/A
New - Unisex WC	0.3	-	-	-	-	-	-	-	-	-	N/A

General lighting and display lighting	**Luminous efficacy [lm/W]**			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Existing - GF Development Office 1	90	-	-	117

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Existing - GF Dis WC	-	90	-	26
Existing - GF Hall	-	90	-	14
Existing - GF Development Office 2	90	-	-	108
Existing - GF Cleaners Cupboard	90	-	-	4
Existing - GF Stairs	-	90	-	8
Existing - FF Office	90	-	-	68
Existing - FF Meeting Room	90	-	-	108
Existing - FF Comm and Engagement Dir Office	90	-	-	105
Existing - FF Store	90	-	-	3
Existing - FF Stairs	-	90	-	15
New - Entrance Lobby	-	90	-	51
New - Admissions Office	90	-	-	175
New - Prep Room	90	-	-	6
New - Director of Admissions	90	-	-	111
New - Large Meeting Room	90	-	-	292
New - Plant	90	-	-	19
New - Meeting Room	90	-	-	83
New - Unisex WC	-	90	-	20
New - Catering Office	90	-	-	94
New - Glazed Link	-	90	-	19

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?
Existing - GF Development Office 1	NO (-49%)	NO
Existing - GF Development Office 2	NO (-60%)	NO
Existing - FF Office	NO (-72%)	NO
Existing - FF Meeting Room	NO (-74%)	NO
Existing - FF Comm and Engagement Dir Office	NO (-75%)	NO
New - Admissions Office	NO (-70%)	NO
New - Director of Admissions	NO (-65%)	NO
New - Large Meeting Room	NO (-1%)	NO
New - Meeting Room	NO (-42%)	NO
New - Catering Office	NO (-65%)	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?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	218	218
External area [m^2]	3720	3720
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	9	5
Average conductance [W/K]	6430	1019
Average U-value [W/m^2K]	1.73	0.27
Alpha value* [%]	8.84	8.84

* 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
100	**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
	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/m^2]

	Actual	Notional
Heating	86.96	40.16
Cooling	0	0
Auxiliary	1.92	1.38
Lighting	13.31	18.75
Hot water	2.01	2.32
Equipment*	35.02	35.02
TOTAL**	**104.2**	**62.6**

* 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/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]	272.59	124.63
Primary energy* [kWh/m^2]	157.69	111.79
Total emissions [kg/m^2]	27.5	19.6

* 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 SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	288.2	0	96.8	0	1.8	0.83	0	0.91	0
	Notional	131.5	0	44.6	0	1.1	0.82	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	211.2	0	70.9	0	11.7	0.83	0	0.91	0
	Notional	104.4	0	35.4	0	14.4	0.82	0	----	----

Key to terms

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

Key Features

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

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.24	External Wall
Floor	0.2	0.13	Exposed Floor
Roof	0.15	0.13	Extg Roof
Windows, roof windows, and rooflights	1.5	1.82	Rooflight 1
Personnel doors	1.5	1.86	New D1
Vehicle access & similar large doors	1.5	-	No vehicle doors in project
High usage entrance doors	1.5	-	No high usage entrance doors in project

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

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

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	8.8

Energy Performance Certificate

Non-Domestic Building

HM Government

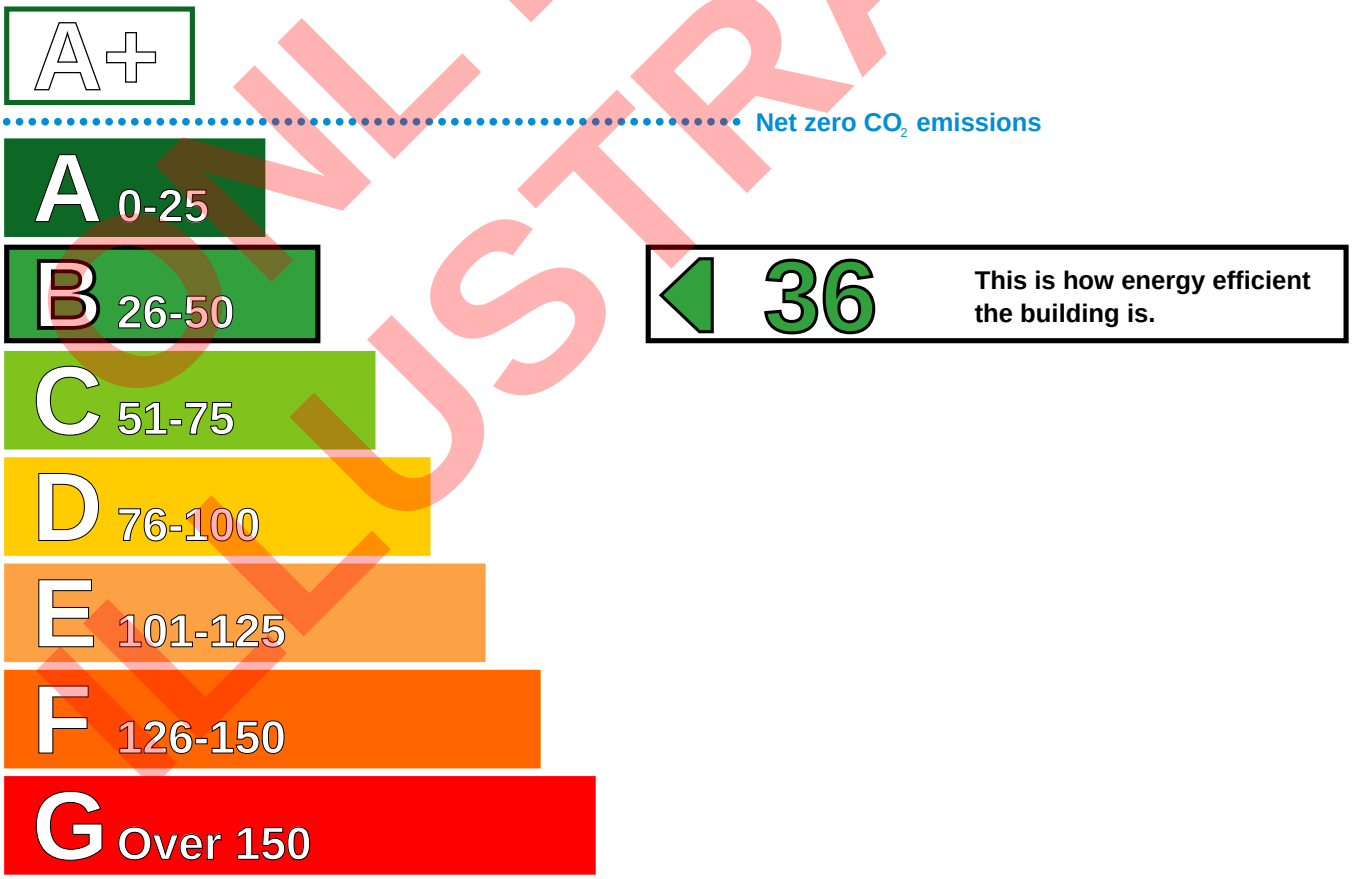
The Lodge
56 Frognal
UCS Senior School Campus
Hampstead
London
NW3 6XH

Certificate Reference Number:
0592-0628-3731-3499-1623

This certificate shows the energy rating of this building. It indicates the energy efficiency of the building fabric and the heating, ventilation, cooling and lighting systems. The rating is compared to two benchmarks for this type of building: one appropriate for new buildings and one appropriate for existing buildings. There is more advice on how to interpret this information on the Government's website www.communities.gov.uk/epbd.

Energy Performance Asset Rating

More energy efficient



Less energy efficient

Technical information

Main heating fuel:	Natural Gas
Building environment:	Heating and Natural Ventilation
Total useful floor area (m^2):	218
Building complexity (NOS level):	5
Building emission rate ($kgCO_2/m^2$):	27.51

Benchmarks

Buildings similar to this one could have ratings as follows:

26 If newly built

76 If typical of the existing stock

Administrative information

This is an Energy Performance Certificate as defined in SI2007:991 as amended

Assessment Software:	TAS v9.4.0 using calculation engine TAS v9.4.0
Property Reference:	123456789012
Assessor Name:	Jason Welsh
Assessor Number:	LCEA122167
Accreditation Scheme:	CIBSE Certification Limited
Employer/Trading Name:	The Energy Practice Ltd
Employer/Trading Address:	Unit 4, Woodhouse Business Centre,Coach Road, Great Horkesley,Colchester,CO6 4BB
Issue Date:	07 Dec 2016
Valid Until:	06 Dec 2026 (unless superseded by a later certificate)
Related Party Disclosure:	Not related to the owner

Recommendations for improving the property are contained in Report Reference Number: 9020-1945-9436-8372-6124

If you have a complaint or wish to confirm that the certificate is genuine

Details of the assessor and the relevant accreditation scheme are on the certificate. You can get contact details of the accreditation scheme from the Government's website at www.communities.gov.uk/epbd, together with details of the procedures for confirming authenticity of a certificate and for making a complaint.

CARBON TRUST

For advice on how to take action and to find out about technical and financial assistance schemes to help make buildings more energy efficient visit **www.carbontrust.co.uk** or call us on **0800 085 2005**

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

University College School Lodge Extension

As designed

Date: Wed Jan 18 07:56:04 2017

Administrative information

Building Details

Address: The lodge, 56 Frognal, UCS Senior School Campus, Hampstead, London, NW3 6XH

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.4.0"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.4.0

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

Owner Details

Name: Unversity College School London

Telephone number: 020 74353068

Address: 11 Holly Hill, London, NW3 6QN

Certifier details

Name: Jason Welsh

Telephone number: 01206 273 000

Address: The Energy Practice Ltd, Unit 4 Woodhouse Business Centre, Coach Road Great Horkesley, Colchester, CO6 4BB

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

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	19.6
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	19.6
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	12.7
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and 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	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	1.15	1.91	Extg External Wall
Floor	0.25	0.44	1.07	Extg Ground Floor
Roof	0.25	0.18	0.21	Green Roof
Windows***, roof windows, and rooflights	2.2	2.3	3.33	Extg 1 (t)
Personnel doors	2.2	2.42	3.33	Extg Door (b)
Vehicle access & similar large doors	1.5	-	-	No vehicle doors in project
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

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

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	8.8

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

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.91	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

2- Extract Only (2 Zones)

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.91	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

1- Direct Electric

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	1	0
Standard value	1	N/A

Local mechanical ventilation, exhaust, and terminal units

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

Zone name	**SFP [W/(l/s)]**									**HR efficiency**	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
Existing - GF Dis WC	0.3	-	-	-	-	-	-	-	-	-	N/A
New - Unisex WC	0.3	-	-	-	-	-	-	-	-	-	N/A

General lighting and display lighting	**Luminous efficacy [lm/W]**			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Existing - GF Development Office 1	90	-	-	117

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Existing - GF Dis WC	-	90	-	26
Existing - GF Hall	-	90	-	14
Existing - GF Development Office 2	90	-	-	108
Existing - GF Cleaners Cupboard	90	-	-	4
Existing - GF Stairs	-	90	-	8
Existing - FF Office	90	-	-	68
Existing - FF Meeting Room	90	-	-	108
Existing - FF Comm and Engagement Dir Office	90	-	-	105
Existing - FF Store	90	-	-	3
Existing - FF Stairs	-	90	-	15
New - Entrance Lobby	-	90	-	51
New - Admissions Office	90	-	-	175
New - Prep Room	90	-	-	6
New - Director of Admissions	90	-	-	111
New - Large Meeting Room	90	-	-	292
New - Plant	90	-	-	19
New - Meeting Room	90	-	-	83
New - Unisex WC	-	90	-	20
New - Catering Office	90	-	-	94
New - Glazed Link	-	90	-	19

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?
Existing - GF Development Office 1	NO (-49%)	NO
Existing - GF Development Office 2	NO (-60%)	NO
Existing - FF Office	NO (-72%)	NO
Existing - FF Meeting Room	NO (-74%)	NO
Existing - FF Comm and Engagement Dir Office	NO (-75%)	NO
New - Admissions Office	NO (-70%)	NO
New - Director of Admissions	NO (-65%)	NO
New - Large Meeting Room	NO (-1%)	NO
New - Meeting Room	NO (-42%)	NO
New - Catering Office	NO (-65%)	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]	218	218
External area [m^2]	3748	3748
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	9	5
Average conductance [W/K]	6537	1025
Average U-value [W/m^2K]	1.74	0.27
Alpha value* [%]	8.87	8.87

* 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
100	**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
	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/m^2]

	Actual	Notional
Heating	87.05	40.18
Cooling	0	0
Auxiliary	1.92	1.38
Lighting	13.31	18.75
Hot water	2.01	2.32
Equipment*	35.02	35.02
TOTAL**	**104.28**	**62.63**

* 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/m^2]

	Actual	Notional
Photovoltaic systems	28.59	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]	272.84	124.7
Primary energy* [kWh/m^2]	157.79	111.82
Total emissions [kg/m^2]	12.7	19.6

* 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 SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	288.4	0	96.9	0	1.8	0.83	0	0.91	0
	Notional	131.6	0	44.6	0	1.1	0.82	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	211.2	0	70.9	0	11.7	0.83	0	0.91	0
	Notional	104.4	0	35.4	0	14.4	0.82	0	----	----

Key to terms

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

Key Features

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

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.24	External Wall
Floor	0.2	0.13	Exposed Floor
Roof	0.15	0.13	Extg Roof
Windows, roof windows, and rooflights	1.5	1.82	Rooflight 1
Personnel doors	1.5	1.86	New D1
Vehicle access & similar large doors	1.5	-	No vehicle doors in project
High usage entrance doors	1.5	-	No high usage entrance doors in project

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

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

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	8.8

Energy Performance Certificate

Non-Domestic Building

HM Government

The lodge
56 Frognal
UCS Senior School Campus
Hampstead
London
NW3 6XH

Certificate Reference Number:
0612-9636-8439-2702-5196

This certificate shows the energy rating of this building. It indicates the energy efficiency of the building fabric and the heating, ventilation, cooling and lighting systems. The rating is compared to two benchmarks for this type of building: one appropriate for new buildings and one appropriate for existing buildings. There is more advice on how to interpret this information on the Government's website www.communities.gov.uk/epbd.

Energy Performance Asset Rating

More energy efficient

A+

Net zero CO_2 emissions

A 0-25

B 26-50

C 51-75

D 76-100

E 101-125

F 126-150

G Over 150

17 This is how energy efficient the building is.

Less energy efficient

Technical information

Main heating fuel:	Grid Supplied Electricity
Building environment:	Heating and Natural Ventilation
Total useful floor area (m^2):	218
Building complexity (NOS level):	5
Building emission rate ($kgCO_2/m^2$):	12.69

Benchmarks

Buildings similar to this one could have ratings as follows:

26 If newly built

76 If typical of the existing stock

Administrative information

This is an Energy Performance Certificate as defined in SI2007:991 as amended

Assessment Software:	TAS v9.4.0 using calculation engine TAS v9.4.0
Property Reference:	123456789012
Assessor Name:	Jason Welsh
Assessor Number:	LCEA122167
Accreditation Scheme:	CIBSE Certification Limited
Employer/Trading Name:	The Energy Practice Ltd
Employer/Trading Address:	Unit 4, Woodhouse Business Centre,Coach Road, Great Horkesley,Colchester,CO6 4BB
Issue Date:	18 Jan 2017
Valid Until:	17 Jan 2027 (unless superseded by a later certificate)
Related Party Disclosure:	Not related to the owner

Recommendations for improving the property are contained in Report Reference Number: 9020-1945-9436-8672-6120

If you have a complaint or wish to confirm that the certificate is genuine

Details of the assessor and the relevant accreditation scheme are on the certificate. You can get contact details of the accreditation scheme from the Government's website at www.communities.gov.uk/epbd, together with details of the procedures for confirming authenticity of a certificate and for making a complaint.

CARBON TRUST

For advice on how to take action and to find out about technical and financial assistance schemes to help make buildings more energy efficient visit **www.carbontrust.co.uk** or call us on **0800 085 2005**

Appendix B – New Extension Only

‘Be Lean’ BRUKL Document and Energy Performance Certificate

‘Be Green’ BRUKL Document and Energy Performance Certificate

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

University College School Lodge Extension

As designed

Date: Wed Dec 07 15:03:08 2016

Administrative information

Building Details

Address: The Lodge, 56 Frognal, UCS Senior School Campus, Hampstead, London, NW3 6XH

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.4.0"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.4.0

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

Owner Details

Name: Unversity College School London

Telephone number: 020 74353068

Address: 11 Holly Hill, London, NW3 6QN

Certifier details

Name: Jason Welsh

Telephone number: 01206 273 000

Address: The Energy Practice Ltd, Unit 4 Woodhouse Business Centre, Coach Road Great Horkesley, Colchester, CO6 4BB

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

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	19.8
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	19.8
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	18.5
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and 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	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.24	0.24	External Wall
Floor	0.25	0.25	0.25	Ground Floor
Roof	0.25	0.2	0.2	Roof
Windows***, roof windows, and rooflights	2.2	1.86	1.95	New W2 (t)
Personnel doors	2.2	1.86	1.86	New D1
Vehicle access & similar large doors	1.5	-	-	No vehicle doors in project
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

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

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	5

Building services

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

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

1- Nat Vent

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

2- Extract Only (New - Unisex WC)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

1- Direct Electric

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	0
Standard value	1	N/A

Local mechanical ventilation, exhaust, and terminal units

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

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
New - Unisex WC	0.3	-	-	-	-	-	-	-	-	-	N/A

General lighting and display lighting

	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
New - Entrance Lobby	-	90	-	51
New - Admissions Office	90	-	-	175

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
New - Prep Room	90	-	-	6
New - Director of Admissions	90	-	-	111
New - Large Meeting Room	90	-	-	292
New - Plant	90	-	-	19
New - Meeting Room	90	-	-	83
New - Unisex WC	-	90	-	20
New - Catering Office	90	-	-	94
New - Glazed Link	-	90	-	19

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?
New - Admissions Office	NO (-70%)	NO
New - Director of Admissions	NO (-65%)	NO
New - Large Meeting Room	NO (-1%)	NO
New - Meeting Room	NO (-42%)	NO
New - Catering Office	NO (-65%)	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?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	139	139
External area [m^2]	3720	3720
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	5	5
Average conductance [W/K]	6430	994
Average U-value [W/m^2K]	1.73	0.27
Alpha value* [%]	8.84	8.84

* 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
100	**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
	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/m^2]

	Actual	Notional
Heating	49.02	43.65
Cooling	0	0
Auxiliary	1.84	1.28
Lighting	11.77	17.76
Hot water	1.96	2.27
Equipment*	35.84	35.84
TOTAL**	**64.6**	**64.97**

* 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/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]	153.68	135.47
Primary energy* [kWh/m^2]	106.43	112.76
Total emissions [kg/m^2]	18.5	19.8

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	162.4	0	54.5	0	1.8	0.83	0	0.91	0
	Notional	142.2	0	48.2	0	1.1	0.82	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	139.7	0	46.9	0	13.6	0.83	0	0.91	0
	Notional	164.1	0	55.7	0	16.8	0.82	0	----	----

Key to terms

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

Key Features

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

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.24	External Wall
Floor	0.2	0.25	Ground Floor
Roof	0.15	0.2	Green Roof
Windows, roof windows, and rooflights	1.5	1.82	Rooflight 1
Personnel doors	1.5	1.86	New D1
Vehicle access & similar large doors	1.5	-	No vehicle doors in project
High usage entrance doors	1.5	-	No high usage entrance doors in project

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

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

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

Energy Performance Certificate

Non-Domestic Building

HM Government

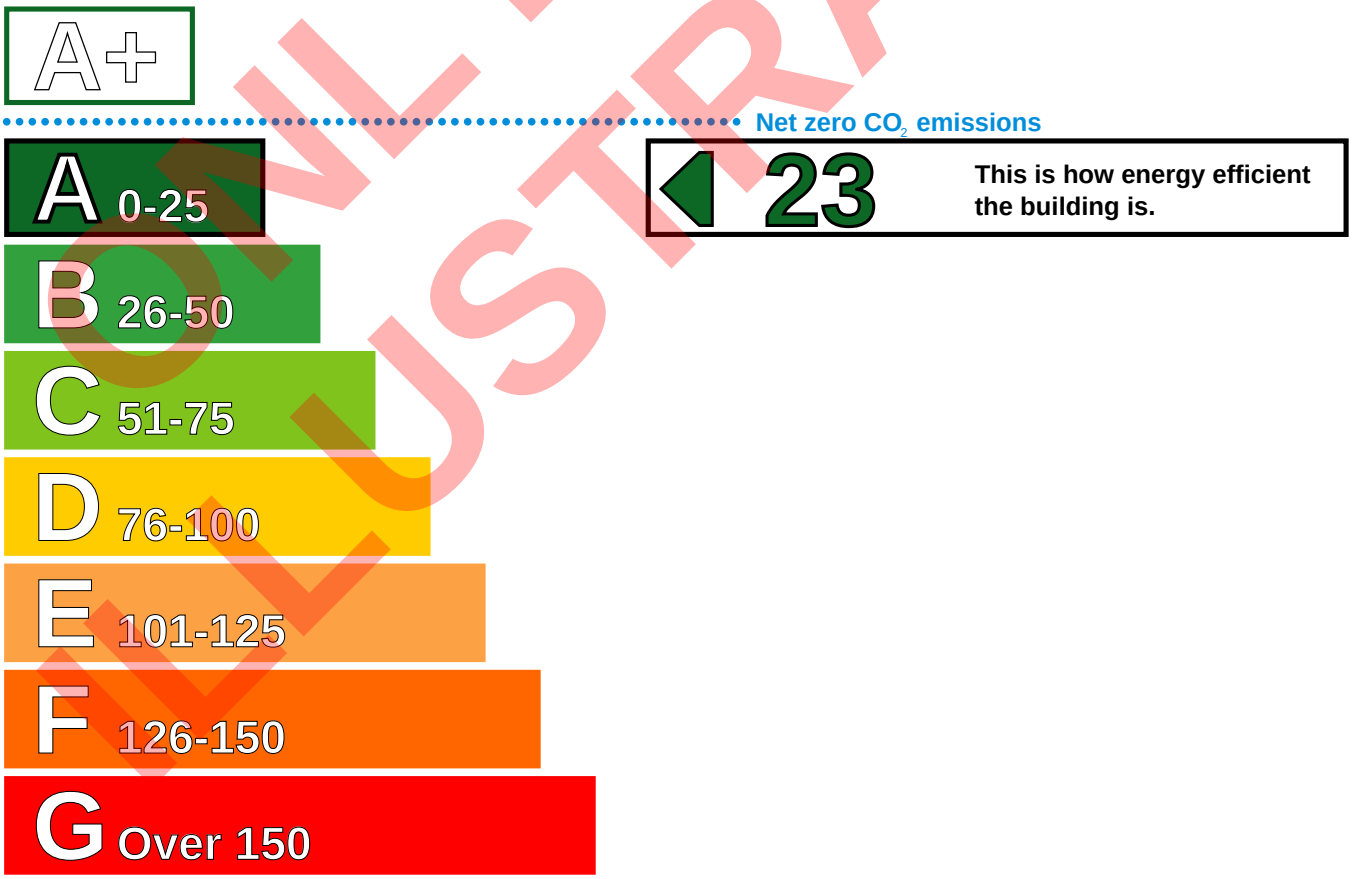
The Lodge
56 Frognal
UCS Senior School Campus
Hampstead
London
NW3 6XH

Certificate Reference Number:
0592-0628-3731-3499-1623

This certificate shows the energy rating of this building. It indicates the energy efficiency of the building fabric and the heating, ventilation, cooling and lighting systems. The rating is compared to two benchmarks for this type of building: one appropriate for new buildings and one appropriate for existing buildings. There is more advice on how to interpret this information on the Government's website www.communities.gov.uk/epbd.

Energy Performance Asset Rating

More energy efficient



Less energy efficient

Technical information

Main heating fuel:	Natural Gas
Building environment:	Heating and Natural Ventilation
Total useful floor area (m^2):	139
Building complexity (NOS level):	5
Building emission rate ($kgCO_2/m^2$):	18.47

Benchmarks

Buildings similar to this one could have ratings as follows:

24 If newly built

71 If typical of the existing stock

Administrative information

This is an Energy Performance Certificate as defined in SI2007:991 as amended

Assessment Software:	TAS v9.4.0 using calculation engine TAS v9.4.0
Property Reference:	123456789012
Assessor Name:	Jason Welsh
Assessor Number:	LCEA122167
Accreditation Scheme:	CIBSE Certification Limited
Employer/Trading Name:	The Energy Practice Ltd
Employer/Trading Address:	Unit 4, Woodhouse Business Centre,Coach Road, Great Horkesley,Colchester,CO6 4BB
Issue Date:	07 Dec 2016
Valid Until:	06 Dec 2026 (unless superseded by a later certificate)
Related Party Disclosure:	Not related to the owner

Recommendations for improving the property are contained in Report Reference Number: 9020-1945-9436-8372-6124

If you have a complaint or wish to confirm that the certificate is genuine

Details of the assessor and the relevant accreditation scheme are on the certificate. You can get contact details of the accreditation scheme from the Government's website at www.communities.gov.uk/epbd, together with details of the procedures for confirming authenticity of a certificate and for making a complaint.

CARBON TRUST

For advice on how to take action and to find out about technical and financial assistance schemes to help make buildings more energy efficient visit **www.carbontrust.co.uk** or call us on **0800 085 2005**

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

University College School Lodge Extension

As designed

Date: Thu Dec 08 08:00:40 2016

Administrative information

Building Details

Address: The lodge, 56 Frognal, UCS Senior School Campus, Hampstead, London, NW3 6XH

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.4.0"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.4.0

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

Owner Details

Name: Unversity College School London

Telephone number: 020 74353068

Address: 11 Holly Hill, London, NW3 6QN

Certifier details

Name: Jason Welsh

Telephone number: 01206 273 000

Address: The Energy Practice Ltd, Unit 4 Woodhouse Business Centre, Coach Road Great Horkesley, Colchester, CO6 4BB

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

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	19.7
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	19.7
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	12.3
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and 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	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.24	0.24	External Wall
Floor	0.25	0.25	0.25	Ground Floor
Roof	0.25	0.2	0.2	Roof
Windows***, roof windows, and rooflights	2.2	1.86	1.95	New W2 (t)
Personnel doors	2.2	1.86	1.86	New D1
Vehicle access & similar large doors	1.5	-	-	No vehicle doors in project
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

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

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	5

Building services

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

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

1- Nat Vent

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

2- Extract Only (New - Unisex WC)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

1- Direct Electric

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	0
Standard value	1	N/A

Local mechanical ventilation, exhaust, and terminal units

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

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
New - Unisex WC	0.3	-	-	-	-	-	-	-	-	-	N/A

General lighting and display lighting

	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
New - Entrance Lobby	-	90	-	51
New - Admissions Office	90	-	-	175

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
New - Prep Room	90	-	-	6
New - Director of Admissions	90	-	-	111
New - Large Meeting Room	90	-	-	292
New - Plant	90	-	-	19
New - Meeting Room	90	-	-	83
New - Unisex WC	-	90	-	20
New - Catering Office	90	-	-	94
New - Glazed Link	-	90	-	19

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?
New - Admissions Office	NO (-70%)	NO
New - Director of Admissions	NO (-65%)	NO
New - Large Meeting Room	NO (-1%)	NO
New - Meeting Room	NO (-42%)	NO
New - Catering Office	NO (-65%)	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]	139	139
External area [m^2]	3723	3723
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	5	5
Average conductance [W/K]	6462	994
Average U-value [W/m^2K]	1.74	0.27
Alpha value* [%]	8.89	8.89

* 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
100	**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
	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/m^2]

	Actual	Notional
Heating	48.94	43.25
Cooling	0	0
Auxiliary	1.84	1.28
Lighting	11.77	17.76
Hot water	1.96	2.27
Equipment*	35.84	35.84
TOTAL**	**64.51**	**64.57**

* 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/m^2]

	Actual	Notional
Photovoltaic systems	11.84	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]	153.4	134.24
Primary energy* [kWh/m^2]	106.32	112.28
Total emissions [kg/m^2]	12.3	19.7

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	162.1	0	54.4	0	1.8	0.83	0	0.91	0
	Notional	140.9	0	47.8	0	1.1	0.82	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	139.7	0	46.9	0	13.6	0.83	0	0.91	0
	Notional	164.1	0	55.7	0	16.8	0.82	0	----	----

Key to terms

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

Key Features

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

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.24	External Wall
Floor	0.2	0.25	Ground Floor
Roof	0.15	0.2	Green Roof
Windows, roof windows, and rooflights	1.5	1.82	Rooflight 1
Personnel doors	1.5	1.86	New D1
Vehicle access & similar large doors	1.5	-	No vehicle doors in project
High usage entrance doors	1.5	-	No high usage entrance doors in project

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

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

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

Energy Performance Certificate

Non-Domestic Building

HM Government

The lodge
56 Frognal
UCS Senior School Campus
Hampstead
London
NW3 6XH

Certificate Reference Number:
0592-0628-3731-3499-1623

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Energy Performance Asset Rating

More energy efficient

A+

Net zero CO_2 emissions

A 0-25

B 26-50

C 51-75

D 76-100

E 101-125

F 126-150

G Over 150

15 This is how energy efficient the building is.

Less energy efficient

Technical information

Main heating fuel:	Natural Gas
Building environment:	Heating and Natural Ventilation
Total useful floor area (m^2):	139
Building complexity (NOS level):	5
Building emission rate ($kgCO_2/m^2$):	12.31

Benchmarks

Buildings similar to this one could have ratings as follows:

24 If newly built

72 If typical of the existing stock

Administrative information

This is an Energy Performance Certificate as defined in SI2007:991 as amended

Assessment Software:	TAS v9.4.0 using calculation engine TAS v9.4.0
Property Reference:	123456789012
Assessor Name:	Jason Welsh
Assessor Number:	LCEA122167
Accreditation Scheme:	CIBSE Certification Limited
Employer/Trading Name:	The Energy Practice Ltd
Employer/Trading Address:	Unit 4, Woodhouse Business Centre,Coach Road, Great Horkesley,Colchester,CO6 4BB
Issue Date:	08 Dec 2016
Valid Until:	07 Dec 2026 (unless superseded by a later certificate)
Related Party Disclosure:	Not related to the owner

Recommendations for improving the property are contained in Report Reference Number: 9020-1945-9436-8372-6124

If you have a complaint or wish to confirm that the certificate is genuine

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CARBON TRUST

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