



Outline Energy Assessment for Planning

New Junior School - St Helen's, Northwood

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A	A. Jones	Dr S. Ball	09/06/14	First Draft
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1.0 Introduction

In accordance with the London Borough of Hillingdon Planning Guidance, Couch Perry Wilkes (CPW) has produced an Outline Energy Assessment on behalf of St Helen's School to support a planning application for the proposed development of a new junior school building on the site totalling c. 2,211m² Gross Internal Area (GIA). This is to demonstrate how the scheme will incorporate energy efficiency measures, decentralised energy sources and Low and Zero Carbon (LZC) Technology solutions to reduce the predicted regulated CO₂ emissions of the development by at least 40.0%.

The Hillingdon Council Local Plan is aligned with Policy 5.2 of the London Plan 2011, which sets out an Energy Hierarchy for reducing CO₂ emissions in the form:

1. Be Lean: use less energy
2. Be Clean: supply energy efficiently
3. Be Green: use renewable energy

The Energy Hierarchy is further developed through Policies 5.5 and 5.6 pertaining to decentralised energy networks and Policy 5.7 pertaining to the provision of renewable energy.

This Report will address all aspects of the above in accordance with Greater London Authority (GLA) guidance.

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2.0 Energy Benchmarking – Estimated Energy Demand and CO₂ Emissions

In order to benchmark the proposed development, estimated energy demands and CO₂ emissions data have been calculated. These estimated energy consumptions are indicative only at this stage. They will, however, be used as a guidance to assess the percentage of the building's total energy consumption and CO₂ emissions that could be reduced or offset in accordance with the Energy Hierarchy.

In accordance with GLA guidance, it is prudent for this Report to reflect the benchmark data derived from approved Dynamic Simulation Model (DSM) software which uses Government and industry agreed Notional Calculation Methodology (NCM) room templates containing standard operating conditions.

To assist with the formulation of the energy strategy, the estimated regulated energy consumption and CO₂ emissions for the Notional Development have been derived from approved DSM software (IES):

- Total predicted regulated notional energy consumption: **124,113 kWh per year**
- Total predicted notional CO₂ emissions (TER): **34,832 kgCO₂ per year**
[CO₂ emissions = 15.5 kgCO₂/m² per year]

NOTE 1: CO₂ emission factors of 0.198 for Gas and 0.517 for Electricity have been used to calculate the above and have been derived from Building Regulations Approved Documents.

The BRUKL Output document associated with this model is included in *Appendix A* of this Report.

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3.0 Energy Efficiency – Be Lean

In order to deliver an environmentally responsible building, an exemplar approach is being proposed based on low energy design principles. In summary, this approach involves energy demand minimisation through effective building form and orientation, good envelop design and proficient use of services; such that the building itself is being used as the primary environmental modifier.

Long term energy benefits are best realised by reducing the inherent energy demand of the building in the first instance. These benefits are described and quantified as follows:

3.1 Building Design – Energy Efficiency

The general construction design standards to be adopted must exceed the requirements of the 2010 Edition of Part L Building Regulations, which stipulate an improvement on the CO₂ emissions of an aggregated 25% against 2006 standards.

The following table (Table 1) details the minimum building envelop thermal performance criteria that will be targeted for the proposed development:

Element	Part L 2010 U-Value (W/m ² K)	Target U-Value (W/m ² K)	% Betterment
General Glazing (inc. frame) and Roof Lights	2.20	1.50	31.8
External Walls	0.35	0.21	40.0
Roof	0.25	0.14	44.0
Ground Floor	0.25	0.18	28.0

Table 1: Summary of Building Envelop Thermal Performance Criteria

In accordance with the requirements of a low energy building, the air tightness characteristics will be addressed. With robust design, the target proposed for the building is **3.0m³/m²/hr @ 50Pa**. This compares to the current Part L Building Regulations standard of 10.0m³/m²/hr @ 50Pa and, hence, represents an improvement of 70%.

High levels of natural daylight will be provided, wherever possible, through effective window design. The glazing specifications will be optimised to ensure that glazed elements provide exemplar thermal performance, combined with optimum solar reflectance to minimise the summer solar heat gains, along with high daylight transmittance factors to maximise daylight factors. Encouraging the correct quality and quantity of daylight to penetrate the building is key to reducing the amount of light required from artificial sources and, hence energy requirements.

It is imperative that the lighting design philosophy provides the correct quality of lighting with minimum energy input and therefore reduces internal heat gains. In the building, all luminaires will utilised high frequency control gear, and lighting schemes within occupied areas will be appropriately zoned to allow control of luminaires via switches/absence detection and daylight sensors.

To complement the significant improvements in envelop design and lighting provision, the building services heating and ventilation systems being proposed will also considerably reduce the inherent energy consumption of the development.

The provision of an effective control and metering philosophy is fundamental to the efficient operation of the building's environmental services. The following provides an overview of the plant efficiency and control measures that are proposed:

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- Low NO_x high efficiency gas fired boiler plant.
- Low temperature flow and return hot water heating to maximise heat generating efficiency and minimise distribution losses.
- High efficiency hybrid heat recovery ventilation, with automatic control strategy.
- Zoning of mechanical ventilation systems
- High efficiency low energy motors to be used to drive mechanical ventilation systems
- Variable speed pumps and fans to be used to promote lower operating costs and help match energy usage with the operating profile and occupancy of the building.
- Sub-metering to be provided such that approximately 90% of the input energy from each utility service may be accounted for at end use. The building management system (BMS) will be interfaced to provide automatic monitoring and targeting of all sub-meters to promote energy management and deliver lower consumption.

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4.0 Decentralised Energy – Be Clean

Opportunities to connect the planned development to existing or future decentralised heat distribution networks, including those featuring Combined Heat and Power (CHP) plant, have been investigated with reference to the London Heat Map.

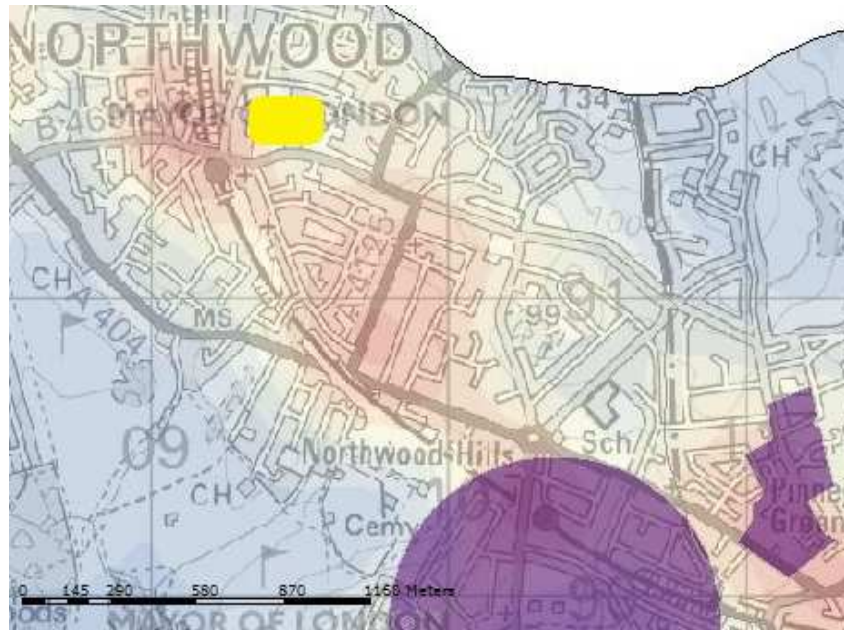


Figure 1: London Heat Map image of proposed site showing potential future network and decentralised energy potential

Investigations have been carried out into the validity of connection into the local district heating network. It was found that currently no local decentralised energy infrastructure was in place.

The areas highlighted in purple on the above extract show that the nearest decentralised energy potential is over 1km away from the school site.

Therefore, there would be no benefit to the proposed development or existing site by allowing future space provision to enable a change over at a later date.

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5.0 Appraisal of Renewable and Low Carbon Technology Energy Options – Be Green

The technical feasibility and economic viability of installing each LZC technology has been assessed in order to discount any unsuitable options at an early stage. A summary of the feasibility process is tabulated below, with an overview of each viable technology given subsequently:

Technology	Brief Description	Benefits	Issues/Limitations	Feasible for site
Solar Photovoltaic	Solar photovoltaic panels convert solar radiation into electrical energy through semiconductor cells. They are not to be confused with solar panels which use the sun's energy to heat water (or air) for water and space heating.	Low maintenance/no moving parts Easily integrated into building design No ongoing costs Income generated from Feed-in Tariff (FIT)	Any overshadowing reduces panel performance Panels ideally inclined at 30° to the horizontal facing a southerly direction	Yes
Solar Thermal	Solar thermal energy can be used to contribute towards space heating and hot water requirements. The two commonest forms of collector are panel and evacuated tube.	Low maintenance Little/no ongoing costs Income generated from Renewable Heat Incentive (RHI) scheme	Must be sized for the building hot water requirements Panels ideally inclined at 30° to the horizontal facing a southerly direction Main benefit provided over warm summer months when junior school is closed (summer holiday)	No
Ground Source Heat Pump (GSHP)	GSHP systems tap into the earth's considerable energy store to provide both heating and cooling to buildings. A number of installation methods are possible including horizontal trench, vertical boreholes, piled foundations (energy piles) or plates/pipe work submerged in a large body of water. The design, installation and operation of GSHPs is well established.	Minimal maintenance Unobtrusive technology Flexible installation options to meet available site footprint Income generated from Renewable Heat Incentive (RHI) scheme	Large area required for horizontal pipes Full ground survey required to determine geology More beneficial to the development if cooling is required Integration with piled foundations must be done at an early stage	No
Air Source Heat Pump	Electric or gas driven air source heat pumps extract thermal energy from the surrounding air and transfer it to the working fluid (air or water).	Efficient use of fuel Relatively low capital costs	Specialist maintenance More beneficial to the development if cooling is required Requires defrost cycle in extreme conditions Some additional plant space required	No
Wind Turbine (Stand-alone column mounted)	Wind generation equipment operates on the basis of wind turning a propeller, which is used to drive an alternator to generate electricity. Small scale (1kW – 15kW) wind turbines can be pole or roof mounted.	Low maintenance/ongoing costs Minimum wind speed available (www.bwea.com) Excess electricity can be exported to the grid Income generated from Feed-in Tariff (FIT)	Planning issues Aesthetic impact and background noise Space limitations on site Wind survey to be undertaken to verify 'local' viability	No

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Technology	Brief Description	Benefits	Issues/Limitations	Feasible for site
Wind Turbine (Roof Mounted)	As above	Low maintenance/ongoing costs Minimum wind speed available (www.bwea.com) Excess electricity can be exported to the grid Income generated from Feed-in Tariff (FIT)	Planning issues Aesthetic impact and background noise Structural/vibration impact on building to be assessed Proximity of other buildings raises issues with downstream turbulence Wind survey to be undertaken to verify 'local' viability	No
Gas Fired Combined Heat and Power	A Combined Heat and Power (CHP) installation is effectively a mini on-site power plant providing both electrical power and thermal heat. CHP is strictly an energy efficiency measure rather than a renewable energy technology.	Potential high CO₂ saving available Efficient use of fuel Excess electricity can be exported to the grid	Maintenance intensive Sufficient base thermal and electrical demand required Some additional plant space required	No
Bio-Renewable Energy Sources (Automated feed – wood-fuel boiler plant)	Modern wood-fuel boilers are highly efficient, clean and almost carbon neutral (the tree growing process effectively absorbs the CO ₂ that is emitted during combustion). Automated systems require mechanical fuel handling and a large storage silo.	Stable long term running costs Potential good CO₂ saving Income generated from Renewable Heat Incentive (RHI) scheme	Large area needed for fuel delivery and storage Reliable fuel supply chain required Regular maintenance required Significant plant space required	No
Fuel Cells and Fuel Cell Combined Heat and Power	Fuel cells convert the energy of a controlled chemical reaction, typically involving hydrogen and oxygen, into electricity, heat and water vapour. Fuel cell stacks operate in the temperature range 65°C – 800°C providing co-generation opportunities in the form of Combined Heat and Power (CHP) solutions.	Zero CO₂ emissions if fired on pure hydrogen and low CO₂ emissions if fired on other hydrocarbon fuels Virtually silent operation since no moving parts High electrical efficiency Excess electricity can be exported back to the grid Benefits from being part of an energy centre/district heating scheme	Expensive Pure hydrogen fuel supply and distribution infrastructure limited in the UK Sufficient base thermal and electrical demand required Some additional plant space required Reforming process, used to extract hydrogen from alternative fuels, requires energy; lowering overall system efficiency	No

Table 3: Summary of Renewable and Low Carbon Technology Energy Options

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5.1 Solar Photovoltaic (PV) Panels

Solar photovoltaic panels convert solar radiation into electrical energy through semiconductor cells. They are not to be confused with solar panels which use the sun's energy to heat water (or air) for water and space heating.



Figure 2: CPW Photovoltaic Installations: Project Epic (BREEAM Excellent Office – above left) and Castle Wood (BREEAM Excellent School – above right)

Photovoltaic panels are available in a number of forms including mono-crystalline, polycrystalline, amorphous silicon (thin film) or hybrid panels (discussed later). They are fixed or integrated into a building's un-shaded south facing façade or pitched roof ideally at an incline of 30° to the horizontal for maximum energy yield.



Figure 3: Solar PV Louvres on the South Façade

It is essential that the panels remain un-shaded, as even a small shadow can significantly reduce output. The individual modules are connected to an inverter to convert their direct current (DC) into alternating current (AC) which is usable in buildings.

Although sloping rooftops provide an ideal site for fixing PV panels using traditional mounting frames, there are a number of alternative solutions whereby PV panels can be incorporated into the actual building fabric of the development.

Solar louvres use PV panels to provide solar shading on the south façade of buildings as part of the brise soleil (see above), and this can be a highly effective way of controlling overheating and help reduce glare.

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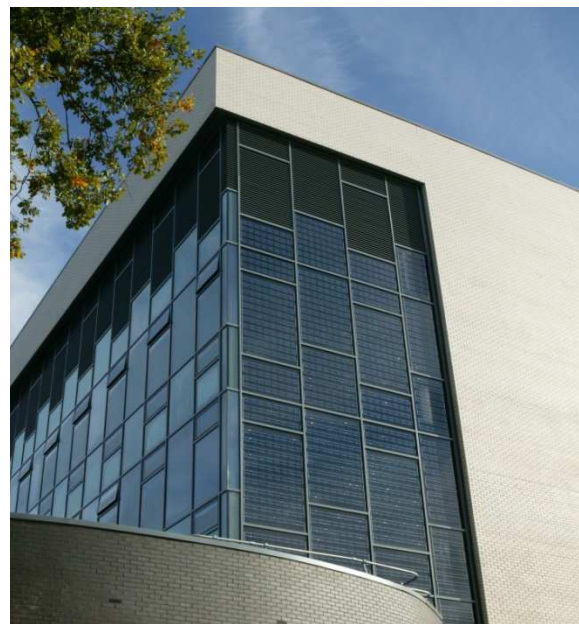
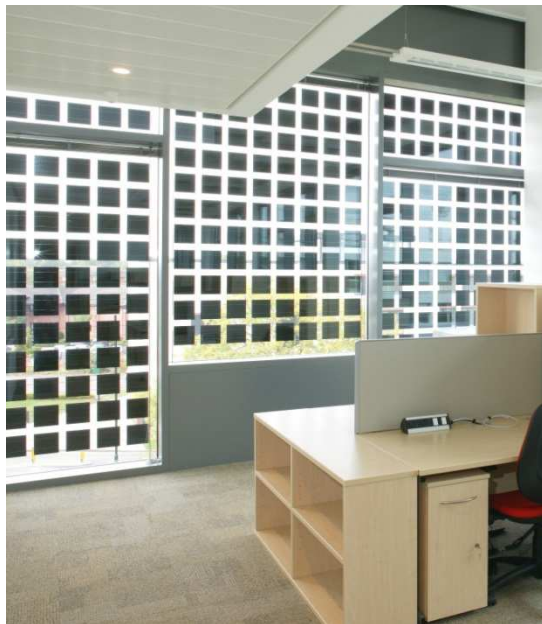


Figure 4: CPW Solar Glazing Installation, University of Warwick - Materials and Analytical Sciences Building

Solar glazing uses a combination of solar PV and glass, where the PV cells are laminated between two panes of specialised glazing (see above). The resulting glass laminate serves the dual function of creating energy and shade at the same time, reducing the risk of overheating.

Solar glazing can be used wherever conventional glass would be specified, especially in atria. Bespoke designs allow for varying light penetration by changing the spacing between individual cells. Typically, a combination of 50% PV and 50% translucent glazing is used.

Vertical solar facades can be used to directly replace conventional rain screen cladding materials providing a smooth, flat facade surface for the building. Where circumstances allow, the PV panels can be tilted towards the sun to maximize the energy yield.

As mentioned earlier, there are a number of types of PV cell:

Mono-crystalline Silicon Cells: These are made using cells saw-cut from a single cylindrical crystal of silicon. The principle advantage of mono-crystalline cells is their high efficiency, typically around 15 – 20%, although the manufacturing process required to produce mono-crystalline silicon is complicated, resulting in slightly higher costs than other competing technologies.

Polycrystalline Silicon Cells: These are made from cells cut from an ingot of melted and re-crystallised silicon. In the manufacturing process, molten silicon is cast into ingots of polycrystalline silicon. The ingots are then saw-cut into very thin wafers and assembled into complete cells giving a granular textured finish. Polycrystalline cells are cheaper to produce than mono-crystalline types, due to the simpler manufacturing process but tend to be slightly less efficient, with average efficiencies of circa 12 – 15%.

Thick-Film Silicon: This is another polycrystalline technology where the silicon is deposited in a continuous process onto a base material giving a fine grained, sparkling appearance. Like all crystalline PV, this is encapsulated in a transparent insulating polymer with a tempered glass cover and usually bound into a strong aluminium frame.

Thin-Film Amorphous Silicon: Amorphous silicon cells are composed of silicon atoms in a thin homogenous layer rather than a crystalline structure. Amorphous silicon absorbs light more effectively than crystalline silicon, so the cells can be thinner. For this reason, amorphous silicon is also known as a 'thin film' PV technology. Amorphous silicon can be deposited on a wide range of substrates, both rigid and flexible, which makes it ideal for curved surfaces and 'fold-away' modules.

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Amorphous cells are, however, less efficient than crystalline based cells, with typical efficiencies of around 6%, but they are easier and, therefore, cheaper to produce.

Other Thin Films: A number of other promising materials such as cadmium telluride (CdTe) and copper indium diselenide (CIS) are now being used for PV modules. The attraction of these technologies is that they can be manufactured by relatively inexpensive industrial processes, certainly in comparison to crystalline silicon technologies, yet they typically offer higher module efficiencies than amorphous silicon. New technologies based on the photosynthesis process are at early stages of commercialisation.

Photovoltaic technology may be feasibly incorporated into the building design with little/no maintenance or on-going costs. Installations are scaleable in terms of active area; size being restricted only by available façade and/or roof space.

A particular advantage of solar PV, even over other types of LZC technology, is that running costs are very low (requires no fossil fuel for operation) and, since there are no moving parts, very little maintenance is required.

An initial evaluation has been undertaken considering a 200m² of roof mounted PV panels with a peak output of 30.0kW.

- Capital cost circa £100,000
- Savings circa £1,231 per year + £2,426 income per year from FITs
- Simple payback 27 years
- Energy saving circa 20,000 kWhr/yr
- % Energy saving 19.2%
- CO₂ saving 10,340 kgCO₂/yr
- % CO₂ saving 30.7%

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6.0 Summary and Conclusion

A Sustainability Statement has been produced for the proposed development of the new junior school on the St Helen's School site, to address the requirements of Hillingdon Council Local Plan.

In order to deliver an environmentally responsible development, an exemplar approach is being proposed based on low energy design principles. In summary, this approach involves energy demand minimisation through effective building form and orientation, good envelop design and proficient use of services before considering the use of LZC technologies to decarbonise the energy supply – in line with the Energy Hierarchy.

It has been shown via accredited computer modelling and analysis of existing building stock and energy usage (Claremont) that, by incorporating best practise energy efficiency measures, upgrading the glazing to Claremont and installing 50m² of solar photovoltaic panels, the CO₂ emissions can be reduced by 40% compared to a notional development as follows:

	Carbon Dioxide Emissions (Tonnes CO ₂ per annum)	
	Regulated	Unregulated *
Building Regulations 2010 Part L Compliant Development	34.83	24.08
After Energy Demand Reduction	31.08	24.08
After CHP	31.08	24.08
After renewable energy (PV Array)	20.90	24.08

Table 4: CO₂ Emissions after each stage of the Energy Hierarchy - * equipment load calculated by Part L software

	Regulated Carbon Dioxide Savings	
	Tonnes CO ₂ per annum	%
Building Regulations 2010 Part L Compliant Development	0	0
Savings from Energy Demand Reduction	3.755	10.78
Savings from CHP	0	0
Saving from renewable energy (PV Array)	10.177	29.22
Total Cumulative Saving	13.932	40.00

Table 5: Regulated CO₂ Savings from each Stage of the Energy Hierarchy

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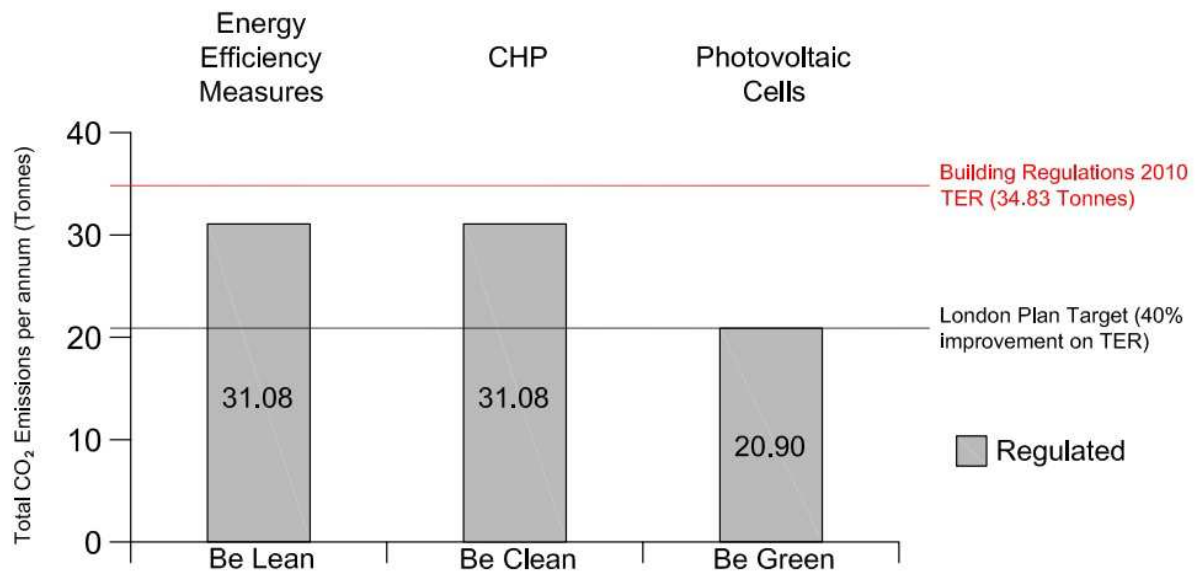


Figure 5: Regulated CO₂ Savings from each Stage of the Energy Hierarchy

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7.0 Appendix A – BRUKL Output Document

BRUKL Output Document HM Government Compliance with England and Wales Building Regulations Part L 2010

Project name

St Helens PartL

As built

Date: Mon Jul 21 10:26:31 2014

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 6.4.0.13

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 6.4.0.13

BRUKL compliance check version: v4.1.e.5

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

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

1.1	CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	15.5
1.2	Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	15.5
1.3	Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	9.3
1.4	Are emissions from the building less than or equal to the target?	BER =< TER
1.5	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

2.a Building fabric

Element	U _a -Limit	U _a -Calc	U _i -Calc	Surface where the maximum value occurs*
Wall**	0.35	0.21	0.21	0H000000:Surf[7]
Floor	0.25	0.18	0.18	0H000000:Surf[0]
Roof	0.25	0.14	0.14	0H000000:Surf[1]
Windows***, roof windows, and rooflights	2.2	1.42	1.5	0H000000:Surf[2]
Personnel doors	2.2	2.2	2.2	0X000000:Surf[2]
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building
U _a -Limit = Limiting area-weighted average U-values [W/(m ² K)] U _a -Calc = Calculated area-weighted average U-values [W/(m ² K)] U _i -Calc = Calculated maximum individual element U-values [W/(m ² K)] * There might be more than one surface where the maximum U-value occurs. ** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows. *** Display windows and similar glazing are excluded from the U-value check. N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.				

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

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2.b Building services

The building services parameters listed below are expected to be checked by the BCO against guidance. No automatic checking is performed by the tool.

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- Radiant Panels & Full Mech Vent

Heating seasonal efficiency	Cooling nominal efficiency	SFP [W/(l/s)]	HR seasonal efficiency
0.96	-	0	0.8
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system			YES

2- Radiator Heating Natural Vent

Heating seasonal efficiency	Cooling nominal efficiency	SFP [W/(l/s)]	HR seasonal efficiency
0.96	-	0	-
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system			YES

3- Radiator Heating Dirty Extract

Heating seasonal efficiency	Cooling nominal efficiency	SFP [W/(l/s)]	HR seasonal efficiency
0.96	-	0	-
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system			YES

4- Radiator Heating Hybrid Vent Vent (local units)

Heating seasonal efficiency	Cooling nominal efficiency	SFP [W/(l/s)]	HR seasonal efficiency
0.96	-	0	0.8
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system			YES

5- Radiator Heating and DX cooling and Hybrid Vent Vent (local units)

Heating seasonal efficiency	Cooling nominal efficiency	SFP [W/(l/s)]	HR seasonal efficiency
0.96	3.4	0	0.8
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system			YES

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

Local mechanical ventilation and exhaust

Zone	Supply/extract SFP [W/(l/s)]	HR seasonal efficiency	Exhaust SFP [W/(l/s)]
0 - HALL	1.5	-	-
0 - PUPIL WC	-	-	0.4
0 - CLASSROOM 01	1.5	-	-
0 - CLASSROOM 02	1.5	-	-
0 - CLASSROOM 03	1.5	-	-
0 - CLASSROOM 04	1.5	-	-
0 - CLASSROOM 05	1.5	-	-
0 - CLASSROOM 06	1.5	-	-
0 - DRAMA	1.5	-	-
0 - DT	1.5	-	-
0 - ART	1.5	-	-
0 - WC 01	-	-	0.4
0 - WC 02	-	-	0.4
1 - PUPIL WC	-	-	0.4
1 - CLASSROOM 01	1.5	-	-
1 - CLASSROOM 02	1.5	-	-
1 - CLASSROOM 03	1.5	-	-

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Local mechanical ventilation and exhaust

Zone	Supply/extract SFP [W/(l/s)]	HR seasonal efficiency	Exhaust SFP [W/(l/s)]
1 - CLASSROOM 04	1.5	-	-
1 - CLASSROOM 05	1.5	-	-
1 - CLASSROOM 06	1.5	-	-
0 - MUSIC	1.5	-	-
0 - MUSIC PRACTICE	1.5	-	-
0 - MUSIC PRACTICE	1.5	-	-
0 - MUSIC PRACTICE	1.5	-	-
0 - MUSIC PRACTICE	1.5	-	-
0 - LIBRARY	1.5	-	-
1 - SMALL CLASSROOM	1.5	-	-
1 - CLASSROOM 07	1.5	-	-
1 - CLASSROOM 08	1.5	-	-
1 - CIRCULATION 01	1.5	-	-
0 - IT	1.5	-	-

General lighting and display lighting

Zone	General lighting [W]	Display lamps efficacy [lm/W]
0 - HALL	1430	-
0 - PLANT	220	-
0 - STORE 01	60	-
0 - HALL SERVERY	60	-
0 - CIRCULATION	2440	-
0 - HYGIENE ROOM	120	-
0 - STORE 02	40	-
0 - PUPIL WC	200	-
0 - CLASSROOM 01	570	-
0 - CLASSROOM 02	580	-
0 - CLASSROOM 03	580	-
0 - CLASSROOM 04	570	-
0 - CLASSROOM 05	580	-
0 - CLASSROOM 06	580	-
0 - STAIRS	210	-
0 - LIFT	40	-
0 - DRAMA	660	-
0 - DT	660	-
0 - DT STORE	90	-
0 - ART STORE	50	-
0 - ART	650	-
0 - PLANT 02	130	-
0 - EXTERNAL STORE	130	-
0 - CIRCULATION 03	390	-
0 - STORE 03	50	-
0 - SERVER	50	-
0 - HEADS OFFICE	160	-
0 - LOBBY	130	-
0 - ADMIN	140	-
0 - CIRCULATION 04	320	-

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General lighting and display lighting

Zone	General lighting [W]	Display lamps efficacy [lm/W]
0 - STAFF OFFICE 03	140	-
0 - MEDICAL ROOM	80	-
0 - WC 01	30	-
0 - WC 02	30	-
1 - PUPIL WC	220	-
1 - CLASSROOM 01	570	-
1 - CLASSROOM 02	580	-
1 - CLASSROOM 03	580	-
1 - CLASSROOM 04	570	-
1 - CLASSROOM 05	580	-
1 - CLASSROOM 06	580	-
1 - LIFT	30	-
0 - MUSIC	660	-
0 - MUSIC PRACTICE	50	-
0 - MUSIC PRACTICE	40	-
0 - MUSIC PRACTICE	40	-
0 - MUSIC PRACTICE	40	-
0 - MUSIC CIRCULATION	60	-
0 - STAFF OFFICE	200	-
0 - LIBRARY	470	-
1 - SMALL CLASSROOM	380	-
1 - CLASSROOM 07	380	-
1 - CLASSROOM 08	380	-
1 - STAIRS	340	-
1 - CIRCULATION 01	1740	-
0 - IT	470	-

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?
0 - HALL	NO (-13.6%)	NO
0 - HYGIENE ROOM	N/A	N/A
0 - CLASSROOM 01	NO (-8.8%)	NO
0 - CLASSROOM 02	NO (-10.4%)	NO
0 - CLASSROOM 03	NO (-53%)	NO
0 - CLASSROOM 04	NO (-36.6%)	NO
0 - CLASSROOM 05	NO (-4.7%)	NO
0 - CLASSROOM 06	NO (-4.7%)	NO
0 - DRAMA	YES (+45.7%)	NO
0 - DT	NO (-47.2%)	NO
0 - ART	NO (-24.4%)	NO
0 - HEADS OFFICE	NO (-78.1%)	NO
0 - ADMIN	NO (-79.1%)	NO
0 - STAFF OFFICE 03	NO (-54.3%)	NO
0 - MEDICAL ROOM	NO (-55.1%)	NO
1 - CLASSROOM 01	NO (-8.8%)	NO

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Zone	Solar gain limit exceeded? (%)	Internal blinds used?
1 - CLASSROOM 02	NO (-10.4%)	NO
1 - CLASSROOM 03	NO (-46.7%)	NO
1 - CLASSROOM 04	NO (-36.6%)	NO
1 - CLASSROOM 05	NO (-4.7%)	NO
1 - CLASSROOM 06	NO (-4.7%)	NO
0 - MUSIC	NO (-51%)	NO
0 - MUSIC PRACTICE	NO (-25.8%)	NO
0 - MUSIC PRACTICE	NO (-19.3%)	NO
0 - MUSIC PRACTICE	NO (-24.6%)	NO
0 - MUSIC PRACTICE	NO (-22.6%)	NO
0 - STAFF OFFICE	N/A	N/A
0 - LIBRARY	YES (+48.8%)	NO
1 - SMALL CLASSROOM	NO (-1.4%)	NO
1 - CLASSROOM 07	NO (-8.2%)	NO
1 - CLASSROOM 08	NO (-2.5%)	NO
1 - CIRCULATION 01	YES (+30.8%)	NO
0 - IT	N/A	N/A

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

Separate submission

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

Separate submission

EPBD (Recast): Consideration of alternative energy systems

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

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Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters			Building Use	
	Actual	Notional	% Area	Building Type
Area [m ²]	2247.2	2247.2		A1/A2 Retail/Financial and Professional services
External area [m ²]	4471.2	4471.2		A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
Weather	LON	LON		B1 Offices and Workshop businesses
Infiltration [m ³ /hm ² @ 50Pa]	3	5		B2 to B7 General Industrial and Special Industrial Groups
Average conductance [W/K]	1702	1688.07		B8 Storage or Distribution
Average U-value [W/m ² K]	0.38	0.38		C1 Hotels
Alpha value* [%]	10	10		C2 Residential Inst.: Hospitals and Care Homes
				C2 Residential Inst.: Residential schools
				C2 Residential Inst.: Universities and colleges
				C2A Secure Residential Inst.
				Residential spaces
				D1 Non-residential Inst.: Community/Day Centre
				D1 Non-residential Inst.: Libraries, Museums, and Galleries
			100	D1 Non-residential Inst.: Education
				D1 Non-residential Inst.: Primary Health Care Building
				D1 Non-residential Inst.: Crown and County Courts
				D2 General Assembly and Leisure, Night Clubs and Theatres
				Others: Passenger terminals
				Others: Emergency services
				Others: Miscellaneous 24hr activities
				Others: Car Parks 24 hrs
				Others - Stand alone utility block

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

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	14	32.1
Cooling	2.19	0.35
Auxiliary	6.08	4.87
Lighting	7.97	9.55
Hot water	14.95	8.36
Equipment*	20.73	20.73
TOTAL**	45.18	55.23

* Energy used by equipment does not count towards the total for calculating emissions.

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

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	8.76	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO₂ Emissions Summary

	Actual	Indicative Target
Heating + cooling demand [MJ/m ²]	64.58	99.95
Primary energy* [kWh/m ²]	76.93	84.4
Total emissions [kg/m ²]	9.3	15.5

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

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HVAC Systems Performance									
System Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEFF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	24.3	0	7.5	0	8.2	0.9	0	0.96	0
Notional	99.5	0	33.1	0	7.1	0.83	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	11.4	0	3.5	0	10	0.9	0	0.96	0
Notional	25.3	0	8.4	0	9.2	0.83	0	----	----
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	65.3	162.5	19.3	18.3	5	0.94	2.47	0.96	3.4
Notional	118.7	30.2	39.5	3	4.6	0.83	2.84	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	69.2	0	21.3	0	1.7	0.9	0	0.96	0
Notional	87.3	0	29.1	0	1	0.83	0	----	----
[ST] Flued radiant heater, [HS] Radiant heater, [HFT] Natural Gas, [CFT] Electricity									
Actual	64.3	0	22.1	0	5	0.81	0	0.96	0
Notional	101.5	0	33.8	0	4.6	0.83	0	----	----

Key to terms

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

Key Features

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

Building fabric

Element	U _{i-Typ}	U _{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.21	0H000000:Surf[7]
Floor	0.2	0.18	0H000000:Surf[0]
Roof	0.15	0.14	0H000000:Surf[1]
Windows, roof windows, and rooflights	1.5	1	1C000008:Surf[13]
Personnel doors	1.5	2.2	0X000000:Surf[2]
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building
U _{i-Typ} = Typical individual element U-values [W/(m²K)]		U _{i-Min} = Minimum individual element U-values [W/(m²K)]	
* There might be more than one surface where the minimum U-value occurs.			

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	3