OMEGA ZONE 8, ST HELENS

Omega St Helens Ltd / T. J. Morris Limited

Detailed Plot: Sustainability Statement inc. BREEAM pre-assessment

Document No. UNIT 1 DOC.1

Omega St Helens Ltd / T. J. Morris Limited

Unit 1

Omega Zone 8

190081

UNIT 1 DOC.1 Sustainability Statement inc. BREEAM pre-assessment

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couchperrywilkes
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1.0 Introduction

Couch Perry Wilkes has been appointed to appraise the renewable and low carbon technology energy options currently available for the proposed Project Harvard's New Distribution Hub in Warrington. The client is keen to target a BREEAM 'Very Good' rating for the building. The BREEAM pre-assessment is included in the Appendices.

The planned new development of approximately 878,012 sq ft Gross Internal Area (GIA), comprises warehouse facilities space with an associated three-floor office space. With the current emphasis placed on energy conservation and the use of Low and Zero Carbon (LZC) technologies, the client is keen to enhance the development's sustainability credentials both from an estate and public perspective.

As the brief is to attain a BREEAM 'Very Good' rating for the building, and in-line with St. Helen's council plan CP1 the development will seek to minimise the consumption of energy with an initial target of 10% renewable energy generation. This shall be the target contribution for technology considered within this report, wherever feasible.

The general construction design standards to be adopted must exceed the requirements of the current (2013 Edition) Part L Building Regulations which stipulate an improvement on the CO_2 emissions of an aggregated 9% against 2010 standards.

To this end, the proposed design shall promote reduced CO_2 emissions from delivered energy consumption by minimising operational energy demand through passive and best-practice measures. The LZC technology energy options presented herein will potentially provide an energy contribution over and above the measures included as an integral part of the project design. A summary of the findings is presented below.

2.0 Energy Benchmarking

2.1 Estimated Energy Demands and CO_2 Emissions

In order to benchmark the proposed new development, estimated energy demands and CO_2 emissions data have been calculated. These estimated energy consumptions are indicative only at this stage. They will, however, be used as a guideline to assess the percentage of the building's total energy consumption and CO_2 emissions that could be reduced or offset by applying suitable renewable and/or low carbon technology energy options.

For the purposes of BREEAM, 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 National Calculation Methodology (NCM) room templates containing standard operating conditions. This is due to the fact that BRE Global will only accept results from the approved models when verifying the percentage reduction in CO_2 emissions from the building for credits Ene 1 and Ene 4 (BREEAM 2014).

The estimated energy consumption and CO_2 emissions for the development, including passive low energy features but no renewable or LZC technologies, derived from approved DSM software (IES), are shown below and the output data is included in the appendices:

The total predicted building energy consumption is: 3,019,204.8kWhr per year

The Building Emission Rate (BER) is: 949,212CO_2 per year

[CO_2 emissions = 18.7kgCO_2/m^2 per year]

Note 1. CO_2 emission factors of 0.216 for Gas and 0.519 for Electricity have been used to calculate the above and are taken from Building Regulations Approved Documents.

2.2 Assumed Utility Costs

The following utility costs have been assumed in order to assess payback periods only:

Gas	= £0.03/kWhr
Electricity	= £0.09/kWhr
Wood Pellets	= £0.03/kWhr

2.3 Indicative Payback and Feed-in Tariffs/Renewable Heat Incentive

At this stage, it is very difficult to measure precisely the payback period of any investment in sustainability particularly when a number of measures are included within the design. Estimating payback periods for LZC technologies is even less precise due to both the volatility of the current fuel markets and rapidly changing cost of the technology.

For the purpose of this report, simple payback periods are considered which are based on current prices with no consideration for future value and comparing just annual savings against initial outlay. This is not necessarily an accurate prediction of payback; however, it does provide a constant form of comparison between the different options under consideration.

In addition, consideration has been given to the revenue generated through Renewable Heat Incentive (RHI) scheme, which is open to compliant heat generation systems. RHI tariffs work alongside the existing Renewable Obligation Certificate (ROC) scheme and the Green Deal.

The RHI scheme is funded from general Government spending and is open to eligible installations in the domestic and all non-domestic sectors including; the industrial and commercial sector, the public sector and not-for-profit organisations and communities in England, Scotland and Wales.

The long term (20 year) tariffs for the RHI scheme have been levied as follows (tariffs to be inflated annually):

1) £0.0305/kWhr for Tier 1 biomass installations - all capacities
2) £0.0214/kWhr for Tier 2 biomass installations - all capacities
3) £0.0442/kWhr for solid biomass Combined Heat and Power (CHP) installations - all capacities
4) £0.0936/kWhr for Tier 1 ground/water source heat pump installations - all capacities
5) £0.0279/kWhr for Tier 2 ground/water source heat pump installations - all capacities
6) £0.0269/kWhr for air source heat pump installations - all capacities
7) £0.0538/kWhr for deep geothermal installations all capacities
8) £0.1075/kWhr for solar thermal installations up to 200kWth
9) £0.0464/kWhr for small-scale biogas combustion installations up to 200kWth
10) £0.0364/kWhr for medium-scale biogas combustion installations 200kWth – 600kWth
11) £0.0136/kWhr for large-scale biogas combustion installations in excess of 600kWth

Note: Tier 1 applies annually up to the Tier Break, Tier 2 above the Tier Break.
The Tier Break is: Installed Capacity x 1,314 peak load hours i.e.: kWth x 1,314

The previously available Feed-In-Tariff (FIT) scheme for electrical generation, has been closed by the UK Government from 1st April 2019.

It should be noted that when considering LZC technologies, payback period should not be a primary aim or main focus of comparison. Generally speaking, none of the options considered will offer a good economic incentive; therefore, payback is used only as a simple form of comparing these technologies against each other.

2.4 Noise

Most LZC technologies considered in this report are silent in operation with the exception of wind turbines and CHP installations. In order to quantify the effects of mechanical and/or aerodynamic noise, manufacturers must undertake an environmental noise impact assessment. The main findings of these noise impact assessments are presented in the relevant sections of this report.

In addition, a site noise survey can be undertaken in accordance with the requirements of BS 4141:1997. If necessary, suitable noise attenuation measures can be specified to reduce the likelihood of complaint.

2.5 Local Planning Requirements

In order to reduce the resource consumption of new developments, many Councils are now producing their own specific documents and policies on sustainable construction. LZC technologies such as solar photovoltaic panels, solar thermal systems and in particular wind turbines are highly visible and have an aesthetic impact on the local environment. For example, large stand-alone column mounted wind turbines are likely to meet with major objections from local residents.

Local authorities need to be consulted at an early stage to establish any local planning policies that may apply to the proposed development. Planning issues associated with each LZC technology are conveyed, where relevant, in the main body of this report.

2.6 Available Grants

Until recently (May 2010), The Government Department of Energy and Climate Change (DECC) provided grants for the installation of micro-generation technologies under the Low Carbon Buildings Programme Phase 2 Extended (LCBP2E) [see www.lowcarbonbuildingsphase2.org.uk]. This scheme is now closed to all new applications, as of 24th May 2010.

2.7 BREEAM

BREEAM or Building Research Establishment's Environmental Assessment Method is a voluntary scheme that aims to quantify and reduce the environmental burdens of buildings by rewarding those designs that take positive steps to minimise their environmental impacts. Projects are assessed using a system of credits. The credits are grouped within the following categories:

- Management
- Health and Wellbeing
- Energy
- Transport
- Water
- Materials
- Waste
- Land Use and Ecology
- Pollution

The assessment process results in a report covering the issues assessed together with a formal certification giving a rating on a scale of UNCLASSIFIED, PASS, GOOD, VERY GOOD, EXCELLENT and OUTSTANDING.

The diagram and text below describes how BREEAM scores and rates an assessed building:

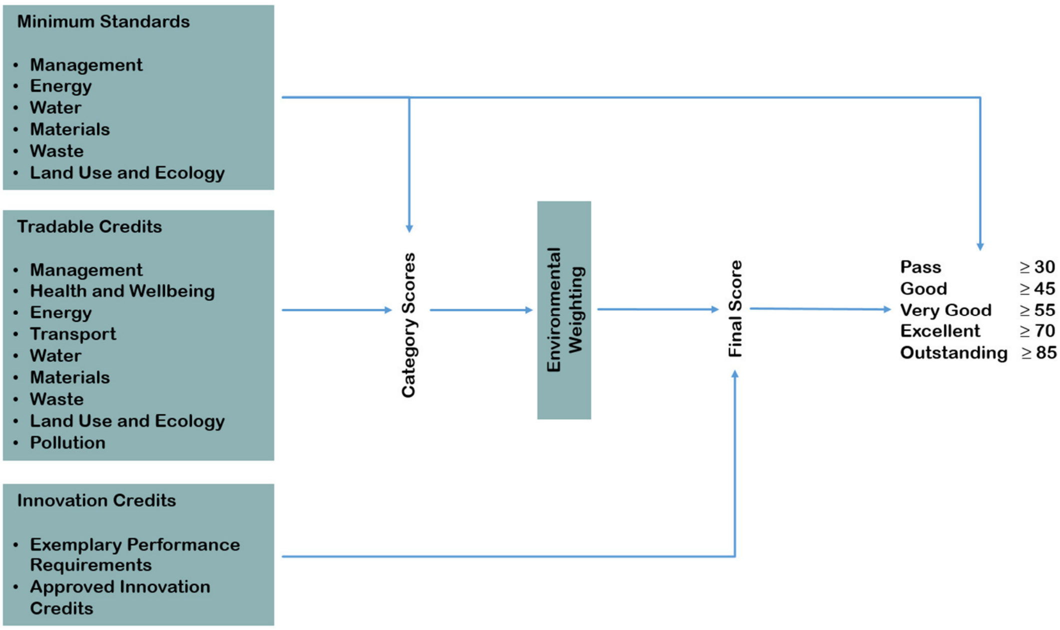

Figure 1 - Process for awarding a BREEAM rating

The BREEAM categories contain a number of environmental issues, which reflect the options available when designing, procuring and constructing a building.

Tradable Credits

Each environmental issue has a set number of 'credits' available and these credits are awarded where the building demonstrates that it complies with the requirements of that issue.

Minimum Standards

A number of issues within a category have set minimum standards, i.e. a minimum number of credits that must be achieved in order for a particular BREEAM rating level to be met.

Innovation Credits

Innovation credits provide additional recognition for a building that innovates in the field of sustainable performance, above and beyond the level that is currently recognised and rewarded by standard BREEAM issues. Innovation credits are awarded for either complying with pre-defined BREEAM issue exemplary level requirements, or via application to BRE Global to have a particular building feature, system or process recognised as 'innovative'.

Within each of the BREEAM categories outlined above, there are a number of credit requirements that reflect the options available to designers and managers of buildings.

An environmental weighting is applied to the scores achieved under each category, as shown below, in order to calculate the final BREEAM score. The weighting factors have been derived from consensus based research with various groups such as government, material suppliers and lobbyists. This research was carried out by BRE Global to establish the relative importance of each environmental issue.

The environmental weightings are as follows:

BREEAM Section	Weighting (%)	BREEAM Section	Weighting (%)
Management	11.0	Materials	15.0
Health and Wellbeing	14.0	Waste	6.0
Energy	16.0	Land Use and Ecology	13.0
Transport	10.0	Pollution	8.0
Water	7.0	Innovation (additional)	10.0

Table 1 - BREEAM 2018 New Construction section weighting

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The BREEAM rating bands are as follows:

BREEAM Rating	Score (%)
UNCLASSIFIED	<30
PASS	≥30
GOOD	≥45
VERY GOOD	≥55
EXCELLENT	≥70
OUTSTANDING	≥85

Table 2 - BREEAM rating bands

Although, at this stage, it is very difficult to predict exactly the number of BREEAM credits likely to be achieved by each LZC technology when applied to the current development, it is worth noting that these technologies have an influence over the following:

Ene 01 **Reduction of CO_2 Emissions** – Up to 9 (+5 Innovation) credits are available.

Ene 04 **Low Carbon Design** – One credit is available.

Pol 02 **NO_x Emissions** – Up to 3 credits are available.

The BREEAM pre-assessment tracker is located in the appendix at the back of this document.

3.0 Appraisal of Renewable and Low Carbon Technology Energy Options

3.1 Financial Expenditure Available for Renewable and Low Carbon Technology Energy Options

The current budget for expenditure specifically on LZC technologies has not yet been defined or approved. For the purposes of this report, various options will be given, where relevant, to target varying levels of energy/CO_2 reduction.

3.2 Summary of the Technical Feasibility Assessment of Renewable and Low Carbon Technology Energy Options

The technical feasibility of installing each LZC technology at the Project Harvard's New Distribution Hub has been assessed in order to discount any unsuitable options at an early stage. A summary of the feasibility process is tabulated below and an overview of each technology is given in Section 3.3.

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	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 most common 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 30º to the horizontal facing a southerly direction	Yes
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 Income generated from Renewable Heat Incentive (RHI) scheme	Specialist maintenance More beneficial to the development if cooling is required	yes

Technology	Brief Description	Benefits	Issues/Limitations	Feasible for site
			Requires defrost cycle in extreme conditions Some additional plant space required	
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	Planning issues Aesthetic impact and background noise Space limitations on site Wind survey to be undertaken to verify 'local' viability	No
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	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 CO_2 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-fuel Fired Combined Heat and Power	As above.	Potential high CO_2 saving available Efficient use of fuel Excess electricity can be exported back to the grid Benefits from being part of an energy centre/district heating scheme Income generated from Renewable Obligation Certificates (ROCs) and Renewable Heat Incentive (RHI) scheme	Maintenance intensive Sufficient base thermal and electrical demand required Significant plant space required Large area needed for fuel delivery and storage Reliable biomass fuel supply chain 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	Stable long term running costs Potential good CO_2 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	No

Technology	Brief Description	Benefits	Issues/Limitations	Feasible for site
	handling and a large storage silo.		Significant plant space required	
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 CO_2 emissions if fired on pure hydrogen and low CO_2 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

3.3 Technical Feasibility Study of Renewable and Low Carbon Technology Energy Options

3.3.1 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

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 30º to the horizontal for maximum energy yield.

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.

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.

Figure 3 - CPW Solar Glazing Installation, University of Warwick - Materials and Analytical Sciences Building

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. 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. For this comparative study, assume that a 10% reduction in the building's total CO_2 emissions is the target to be met partly by a PV installation.

Consider 2600m^2 of roof mounted mono-crystalline PV panels with a peak output of 390kW.

- Capital cost circa £910,000
- Savings circa £26,725.14 per year
- Simple payback 34 years
- Energy saving circa 296,946kWhr/yr
- % Energy saving 9.84%
- CO_2 saving 154,115kgCO_2/yr
- % CO_2 saving 13.95%

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.

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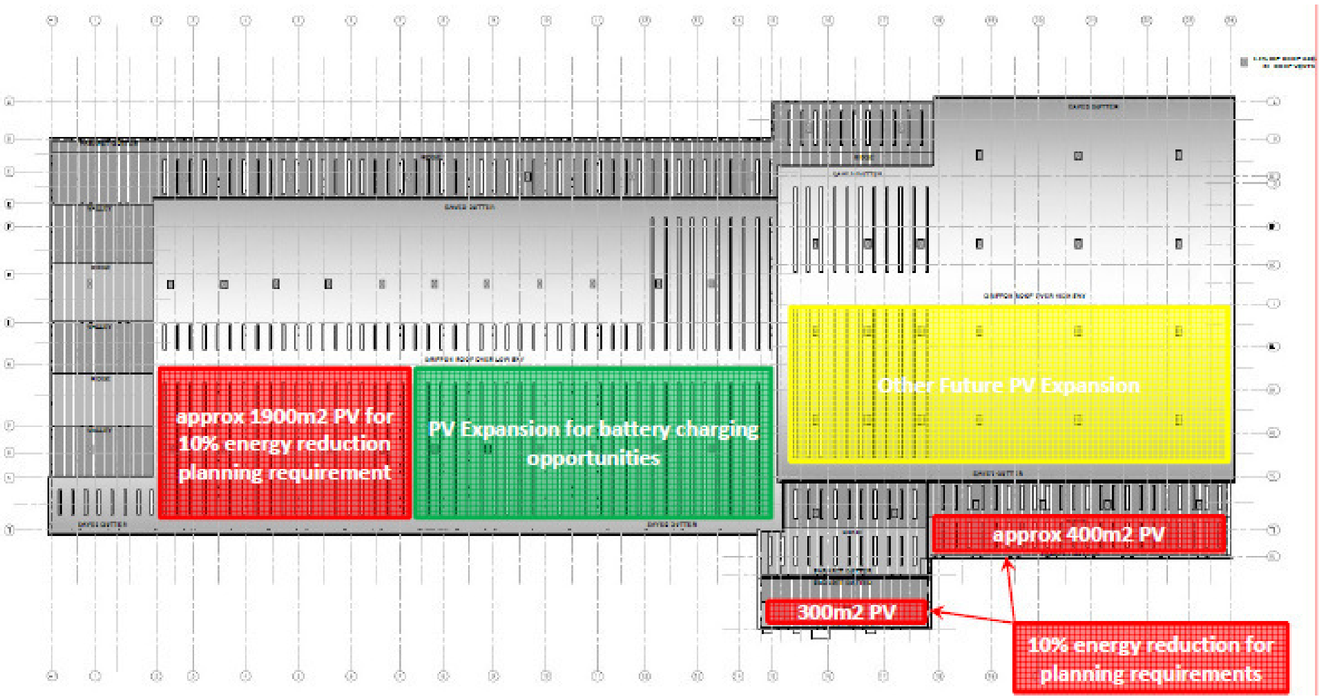

3.3.2 *Solar Thermal*

Solar thermal energy can be used to contribute towards space heating and hot water requirements. In the UK, most applications focus on hot water installation as the solar availability during the space heating season is limited.

Figure 4 - CPW Solar Thermal Evacuated Tube Systems: William Brookes School (above left) and

The use of solar water heating installations is widespread throughout Europe. The systems use a heat collector, generally located at roof level on support frames, orientated in a southerly direction to maximise solar heat absorption.

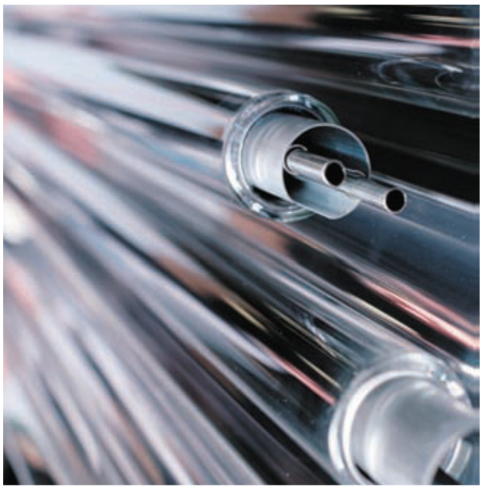

Figure 5 - Evacuated Tube Type Collectors

A working fluid is used to heat water that is stored in either a separate hot water cylinder or more commonly a twin coil hot water cylinder with the second coil providing top-up heating from a conventional boiler.

The two most common forms of collector are panel and evacuated tube.

The panel type collectors are generally more robust and reliable while manufacturers claim that the evacuated tube versions offer better winter all-round performance.

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The design of the flat plate panels is relatively straightforward; consisting of water tubes arranged behind solar glass and an absorber plate. The absorber plate absorbs the sun's rays and transfers energy to the water flowing through the tubes. In contrast, the evacuated tube type collectors are more complicated consisting of double wall glass tubes with a space in the centre containing a heat pipe and a liquid.

Coatings on the inner glass ensure that around 93% of the absorbed heat is retained within the system and the vacuum prevents loss of heat through conduction and convection. The circular design helps maximise the potential to collect solar energy all year round when the sun is at different angles.

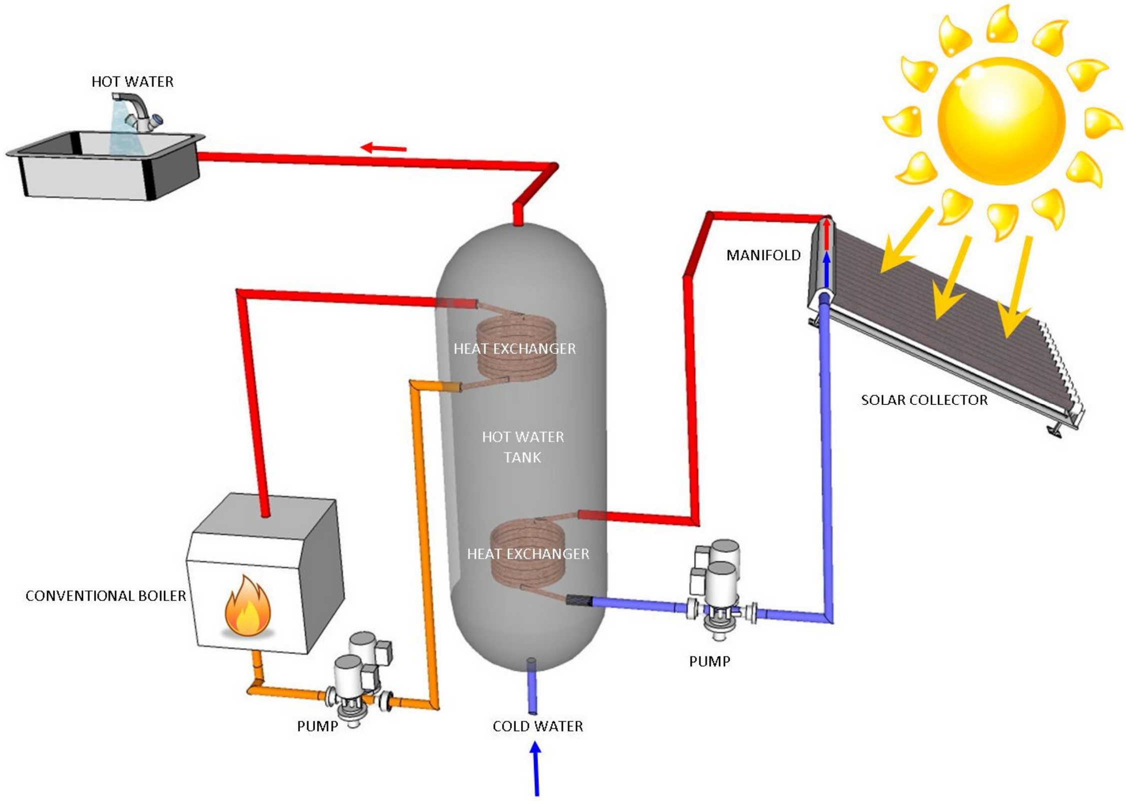

Figure 6 - Schematic Diagram of Solar Thermal Energy Transfer and System Operation

The heat pipes are connected to a manifold containing circulating water (see Figure 6 above). The liquid in the heat pipe is evaporated by the suns energy and rises to a heat exchanger within the manifold where it condenses and gives up its latent heat energy to the water. This heated water is then pumped to a coil in the hot water cylinder sized to meet the demand of the installation. Evacuated tube systems deliver higher temperature water than flat plate types, with little decrease in efficiency, making them more effective with thermal storage solutions.

As a general rule, the evacuated tube collectors can deliver around 700kWhr/m^2/yr when in optimum orientation (inclined at 30° to the horizontal facing a southerly direction). This compares to around 580kWhr/m^2/yr for the flat plate collectors under similar conditions.

Solar thermal installations can be designed to fit the available roof space and/or building façade. Each evacuated tube is approximately 2m in length with an external diameter of 58mm. They weigh around 2kg each and can be spaced from 10mm to 500mm apart in an array. A typical panel array, 2.1m x 1.0m, will provide around 1.33m^2 of absorber area and weigh approximately 45kg. Bespoke mounting frames can be fashioned to provide the ideal inclination of 30º to the horizontal facing a southerly direction. Access to the roof mounted solar collectors will be necessary for occasional cleaning of the active tubes.

For this Project, any system should be sized to meet the domestic hot water demands of the building to prevent the risk of overheating during the summer months.

Consider, therefore, a 10m^2 solar thermal installation with a peak output of 7kW.

- Capital cost circa £10,000
- Savings circa £182.74 per year + £654.8 income per year from RHIs
- Simple payback 12 years
- Energy saving circa 6,091.2kWhr/yr
- % Energy saving 0.2%
- CO_2 saving 1,315.7 kgCO_2/yr
- % CO_2 saving 0.12%

Solar thermal systems generally come with a 10-year warranty. Very little maintenance is required and a check by a professional installer of pumps, valves and anti-freeze mixture every 3 – 5 years is usually sufficient.

3.3.3 Ground Source Heating and Cooling

The design, installation and operation of Ground Source Heat Pumps (GSHPs) is well established. These geothermal systems tap into the earth's considerable energy store to provide both heating and cooling to buildings. They take advantage of the fact that at a depth of a few metres, the temperature of the ground remains at a constant 12ºC throughout the year.

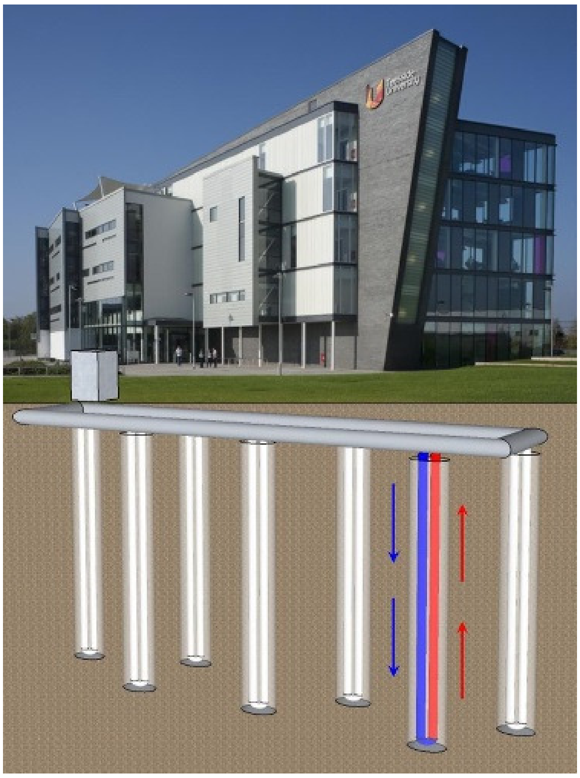

Figure 7 - Ground Source Heat Pump Schematic

In heating mode, GSHPs absorb energy from the earth and transfer it into the building using highly efficient heat pumps. The effectiveness of heat pumps is measured by the ratio of the heating capacity to the power input, referred to as the Coefficient of Performance (COP). Typically, manufacturers state that for every 1 unit of electrical energy used to drive the pump, around 4 to 5 units of thermal energy can be produced. When operating in cooling mode, during the summer months, the system reverses its cycle and heat is extracted from the building and dissipated into the earth.

The ground loops can be installed either vertically in boreholes (typically 50m – 100m deep), or horizontally in trenches at a depth of 1.5m – 2.0m. Either method is dependent upon local geology conditions and space available. The system also benefits from the fact that most of the components are hidden below ground or in plant room enclosures.

Costs for drilling vary according to the location and ground conditions. A preliminary site investigation, by means of a desktop study, can usually determine the viability of a ground source heating and cooling system. Fine tuning of the design may be required once actual site ground conditions are established.

It should be noted that GSHPs generally deliver water at a temperature approaching 50ºC (which would be ideal for under floor heating). Additional heat sources would be needed to satisfy the requirements for domestic hot water to raise the temperature well above 60ºC.

The design intention is not to employ under floor heating on the scheme. This, coupled with the fact that there is no available space on site for sinking of boreholes and/or trenching for pipe work, means that a GSHP system cannot be considered further on this project.

3.3.4 Air Source Heat Pumps

Electric driven air source heat pumps extract thermal energy from the surrounding air and transfer it to the working fluid (air or water). Like GSHPs they can provide both heating and cooling to buildings and have an associated Coefficient of Performance (COP). This is typically around 3 to 4 for heat pumps driven by compressors powered by electric motors and incorporating Variable Refrigerant Flow (VRF) technology. With VRF technology, there is an opportunity to heat and cool separate spaces and recover the heat between them.

Figure 8 - Air Source Heat Pumps

Care should be taken when mounting the units to avoid any acoustic problems associated with operating the fans. The outdoor units normally operate with sound levels typically in the range 55 - 60dB(A).

A downside of electric driven air source heat pumps is that they require a defrost cycle in extreme conditions which impacts on the system efficiency. Heating capacity also falls off as the ambient temperature drops below 5ºC but still maintains 80% capacity at -5ºC.

Stiebel Eltron offer a small footprint (1.7m width x 2.0m depth x 1.5m height) air-to-water unit, rated at 30kW (ambient air temperature of +2ºC and a flow temperature of +35ºC to the heating system – ideally under floor). Units are either roof or ground mounted and coupled to a thermal buffer store with additional back-up electric immersion heaters in the cylinder, to make up any shortfall. Alternative heat pump solutions can be supplied for internal installation within a plant room.

Air source heat pumps as VRF air conditioning arrangements are being incorporated into the appropriate office areas.

3.3.5 Wind Turbines

Wind generation equipment operates on the basis of wind turning a propeller, which is used to drive an alternator to generate electricity. Small scale wind turbines are typically in the range of 1kW – 15kW, with rotor diameters of 2.5m – 9.0m respectively. These systems can be stand-alone or, in some cases, building mounted.

Figure 9 - CPW Designed Helical Roof Mounted

The efficiency and effectiveness of wind turbines depends on many factors, not least the average wind speed and wind pattern of the proposed site. Exposed sites, free from obstacles such as buildings and greenery, are more viable than sheltered sites. Column mounted (stand-alone) wind turbines installed at a suitable height above the building line are more effective than wind turbines located at roof level. There are often some planning difficulties associated with the use of wind turbines. Background noise and a phenomenon known as shadow flicker are also potential issues.

Typical noise levels measured 20m from the base of an operating 5kW wind turbine (both upstream and downstream) in the range 4m/s to 8m/s are 48 – 50dB(A). At 100m, the predicted noise level would be below 35dB(A).

The use of wind turbines is often seen as an obvious statement of a development's dedication to the use of sustainable technologies.

The proposed development does not lend itself to small-scale stand-alone or roof mounted wind turbines due to the high density of multi-storey buildings, obstacles and greenery causing problems with downstream turbulence. At this stage, assume that a large stand-alone column mounted wind turbine will meet with major objections from local residents. For the reasons outlined above, the installation of wind turbines on the site is not practical and will not be considered further.

3.3.6 Combined Heat and Power (CHP)

A CHP installation is effectively an on-site mini power plant providing both electrical power and thermal heat. CHP is strictly an energy efficiency measure rather than a renewable energy technology. A CHP system operates by burning a primary fuel (normally natural gas) by use of either a reciprocating engine or turbine, which in turn drive an alternator to generate electrical power. The heat emitted by the engine and exhaust gases is recovered and used to heat the building or to provide hot water.

Figure 10 - Gas Fired CHP System

The viability of CHP is dependent upon the building base load requirements for both heat and power. 24 hour buildings with high heat demands and constant power demands lend themselves to CHP.

The noise levels associated with a CHP installation should not be overlooked. Typically, acoustic enclosures and upgraded low noise attenuators are employed to ensure noise levels don't exceed 65dBA when 1m from the unit. On confined sites, the plant room structure can be enhanced and attenuators fitted to the mechanical ventilation to prevent any noise issues.

An initial evaluation indicates that a CHP system with a thermal capacity of circa 15kW would be viable for the scheme given the envisaged load profile and domestic hot water requirements.

Baxi-Senertec supply a packaged unit with an electrical output of 5.5kW and a thermal output of 15.5kW (with condenser option) coupled to a 750 litre thermal buffer store. (The thermal buffer is important to prevent the CHP engine shutting down unnecessarily when the heating load demand falls during the course of the day). The system has an integrated G83/1 interface which enables the 3-phase output to be connected directly to the grid. Excess generated electricity can be exported to the grid when circumstances allow.

As the CHP units and thermal stores are relatively compact, plant room space provision would be approximately 3m x 2m. Noise emissions are of the order of 52dBA – 56dBA. Additional CHP plant can be easily (1 day) retrofitted and connected to the existing buffer store if capacity dictates and plant room space allows.

An initial evaluation indicates that the base heating load, associated with the domestic hot water requirements, does not support the installation of a CHP system. As such, CHP plant will not be considered further on this project.

3.3.7 Bio-fuel CHP

Consideration has been given to the possibility of utilising a bio-gas, bio-diesel or dual fuel CHP engine.

Figure 11 - Schnell Dual-Fuel Biomass CHP System

A dual fuel engine (normally based on field-proven diesel engine technology) can run on oil alone, or a mixture of gas and oil.

It should be noted that the engine cannot run on gas alone because it doesn't have a spark ignition system.

Schnell (Germany) supply a range of dual fuel 6 cylinder Scania turbo CHP engines that can be driven on diesel oil, vegetable oil or a mixture of biogas and oil.

ENER-G supply a series of 6 to 20-cylinder turbo charged reciprocating CHP engines for biogas applications. As an option, natural gas can be connected into the system, albeit via a separate unit, to provide back-up electrical and heat energy, if required. Dual fuel engine options (biogas and natural gas) are available, but this requires a special upgrade on the engine management system.

Fleetsolve Ltd supply a range of 8-cylinder turbo charged reciprocating CHP engines with power options from 18kWe to 2,500kWe. The engines run on a wide range of liquid biomass fuels including a version produced by Fleetsolve from waste vegetable oil and fish oils. This fuel is accredited by Ofgem as a renewable source and is supplied at £0.76 per litre. Due to the nature of the source fuel, the electricity generated qualifies for double ROCs at approximately £94 per MWhr produced.

The Fleetsolve CHP unit is housed in its own plant enclosure measuring approximately 4.5m long by 2.0m wide and 2.4m high. The engine is fuelled via a 2,500 heated fuel tank, held at 40^0C, providing 30 days run time between fill-ups from a road tanker. An exhaust particulate filter and a De-NOx catalytic converter are fitted in the exhaust system. Dry air coolers provide a means of dumping heat energy during periods of over production.

The engine is optimised at 1,500rpm with 100% modulation, and operates with a noise level of 45dBA at 10m. Hot water is supplied at 95^0C with a return temperature of 80^0C.

Figure 12 - Fleetsolve Liquid Biomass CHP System

An initial evaluation indicates that the base heating load, associated with the domestic hot water requirements, does not support the installation of a CHP system. As such, CHP plant will not be considered further on this project.

3.3.8 Bio-Renewable Energy Sources – Wood-fuel Boiler Plant

Bio-renewable energy sources are considered to be those which are grown, harvested and replaced by new stock. Modern wood-fuel boilers are highly efficient, clean and smokeless. Wood-fuel is almost carbon neutral as an energy source (the tree growing process effectively absorbs the CO_2 that is emitted during combustion).

Figure 13 - CPW Designed Biomass Boiler House, Conkers YHA

The viability of installing an automated feed wood-fuel boiler at the development has been considered to meet 100% of the total peak heating and hot water demand. Biomass boilers require bulk fuel storage on site to avoid constant deliveries and mechanical handling systems between storage silo and boiler plant are recommended.

These requirements create the need for a substantial amount of external plant space (typically 150m^2). A large area would have to be sacrificed to accommodate the wood-fuel facilities. An underground fuel bunker 5m x 5m x 3m deep would be needed for a boiler of 500kW capacity. Furthermore, the logistics of fuel deliveries and ongoing maintenance costs could be a potential issue.

Ultimately, the lack of available space on site for the wood fuel storage facilities means that the installation of a biomass boiler system cannot be recommended in this case and will not be pursued further.

3.3.9 *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. Direct electrochemical conversion is environmentally attractive because of the inherently low emissions and high electrical efficiency (c. 40% – 50%). Fuel cell stacks operate in the temperature range 65°C – 800°C, so thermal management systems are required. This provides co-generation opportunities in the form of Combined Heat and Power (CHP) solutions that can be implemented in buildings.

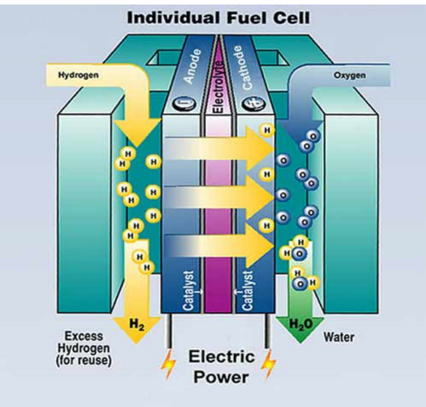

Figure 14 - Fuel Cell Operational Schematic and Fuel Cell CHP Installation

Fuel cell CHP systems generally have a heat to power ratio of approximately 1:1, with overall efficiencies in the region of 80% when fired on pure hydrogen.

Pure hydrogen fuel cells have zero CO_2 emissions but the hydrogen supply and distribution infrastructure is somewhat limited in the UK. As a result, commercially viable systems use alternative fuels in the form of natural gas, LPG and bio-fuels from which hydrogen is derived through a process called reforming. Extracting hydrogen in this manner, comes at the expense of system efficiency and an increase in emissions due to the presence of impurities in the fuel.

High temperature fuel cell systems typically use an internal reforming process where the source fuel is introduced directly to the anode plate. Lower temperature fuel cells rely upon an integrated fuel processor that converts the source fuel into a hydrogen rich reformate needed by the cell stack.

There are a number of commercially available fuel cell CHP systems, classified by the type of electrolyte they employ, and these include; Proton Exchange Membrane (PEM), Molten Carbonate, Alkaline, Phosphoric Acid and Solid Oxide. Systems range in capacity from those that produce a few kilowatts (PEM type) to those that are capable of generating several megawatts (phosphoric acid and molten carbonate-based arrangements).

Logan Energy Limited supply a range of phosphoric acid and molten carbonate fuel cell CHP systems suitable for use in buildings. However, these systems are in the early stages of commercialisation and so projects have substantial technology risk. For this reason, fuel cell CHP systems have not been considered for use on this project.

4.0 Energy Storage

Storage of both electrical and thermal energy is becoming increasingly common, particularly on large scale developments.

The obvious advantage of storing energy is to solve the intermittency problem of renewables, the wind is not always blowing, and the sun is not always shining when there is demand for electricity. The converse is also true in that the demand can be low when the renewable sources are highly active. Typically, extra electricity produced is sold back to the power company in grid connected systems. However, energy storage lets the user decide when to buy and use power from the grid which means that they can purchase electricity at off-peak prices and use energy from their own storage during peak times (this is a method called peak shaving).

Energy storage also addresses the variation of supply and demand of heat. The most common example of this is the domestic hot water tank, which stores hot water so it is available at any time and does not require a boiler to start up when there is a sudden demand. Heat demand has a large seasonal variation from summer to winter; seasonal storage of heat underground is a growing method used to store excess heat in the summer for heating in winter.

4.1 Battery Storage

Battery Energy Storage Systems (BESS) can be used to balance the site energy requirements through mechanisms known as renewable firming, load shifting and peak shaving, thereby modulating the use of grid electricity and, in turn, reducing costs. There are a number of battery types available including Redox-Flow, Metal-air, Sodium-nickel Chloride, however the most common is Lithium ion (Li-ion) batteries.

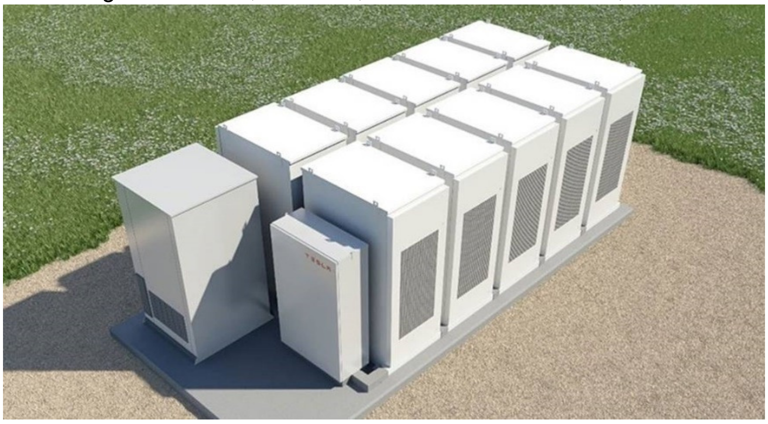

Figure 15 - Battery Energy Storage System (BESS)

Lithium ion (Li-ion) batteries are a type of rechargeable battery in which lithium ions move from the negative electrode to the positive electrode during discharge and back when charging. They are commonly used in consumer electronic products, where a high energy density is required and now are also commonly used in electric vehicles. Many companies are now developing larger-format cells for use in energy-storage applications. The deployment of which is expected to drive down cost and improve performance.

The efficiency of lithium-ion battery system is high, about 90-95% and it has a high energy density in comparison to other storage technologies. They have been deployed in a wide range of energy-storage applications, ranging from batteries of a few kWh in residential systems with rooftop photovoltaic arrays, to multi MWh containerised batteries for the provision of grid ancillary services. However, their cost/performance characteristics make them unlikely to be further developed for large grid scale storage projects.

The energy demands of the project are being developed to determine if electrical battery storage is viable and will be utilised if this is the case.

4.2 Thermal Storage

The best-known thermal energy storage technology is the hot water tank which is common and fully commercialised. Water is stored in an insulated tank where it can be heated via a heat exchanger by a variety of sources (usually a boiler). They are already widely used at a building scale in combination with electrical or solar thermal water heating systems. Hot water storage can also be used in conjunction with district heating (DH) systems when heat is provided from CHP, biomass boilers and/or largescale solar water heating. High temperatures can be stored in tanks (90°C) which means that the water can be used directly for space heating. Water is the most common storage medium because of its abundancy and high heat capacity, but gravel, concrete and ceramics are also sometimes used. When solids such as gravel or concrete are used for heat storage, a liquid or gas will be ran through them to add or extract thermal energy.

Using hot water tank storage is particularly useful when use in conjunction with CHP and biomass burners. Log burning biomass systems need to be loaded by hand and so by using a tank as a thermal buffer means that the burner may only need to be fired once a day or less. A thermal store will also reduce the time lag between lighting the burner and the demand for hot water, as the hot water was stored when the boiler was lit. Also wood fuelled burners are generally more efficient when ran at full output rather than kept ticking over, a thermal store mitigates the need to keep a burner on low throughout the day.

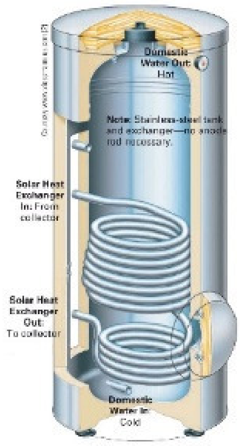

Figure 16 - Tank Cross-section

Tanks are used in a wide range of demands from the domestic hot water tank, to large tanks used to heat communities which are common in Scandinavia. Due to economies of scale, large storage tanks are cheaper per unit volume of storage and the heat losses are lower. Large-scale buffer stores can serve a number of functions but are particularly suited to developments with diverse building stock served via a central CHP/boiler house and district heating system.

Project Harvard is not expected to have a high enough lthw demand to make a thermal store viable.

5.0 Water Use Reduction and Rainwater Harvesting

5.1 Water Use Reduction

Water use within the building will be minimised through careful selection of sanitaryware selection. This is likely to incorporate the specification of low volume flush WCs, low flow urinals, and flow restricted showers and taps.

5.2 Water Recycling

The total water demand of the building is expected to be minimal, however, rainwater collectors have been considered. The rainwater downpipes for the building will be located internally. It is proposed that a commercial underground rain water harvesting tank is installed to collect an appropriate amount of rainwater from the roof areas that can be efficiently utilised.

The collected water has a number of potential uses including WC flushing, washing down of external areas or irrigation of the external planting.

The commercial vehicle wash will also use recycled water.

6.0 Summary of Capital Cost and Energy/CO_2 Saving Data

The table below summarises the approximate capital cost and estimated energy/CO_2 saving associated with each technology when applied to the New Distribution Hub development. The table also shows the percentage of the building's total annual energy demand that could be met by each LZC technology and the potential CO_2 saving per pound of capital investment.

The BRUKL and EPC outputs are attached in the appendix at the back of this document.

Technology and Description	Capital Cost (£)	Revenue Saving (£/yr)	Simple Payback (Years)	Energy Saving (kWhr/yr)	Energy met by LZC Technology (%)	CO_2 Saving ($kgCO_2$/yr)	CO_2 Saving (%)	CO_2 Saving per £ Investment (kg)	Recommended for Further Consideration
Solar Photovoltaic *2600m^2 of roof mounted PV panels*	910,000	26,725.14	34	296,946	9.84	154,115	13.95	0.17	Yes, with reduced capacity
Solar Thermal *10m^2 of roof mounted solar collectors*	10,000	182 + 654.8 from RHIs	12	6,091	0.2	1,315.7	0.12	0.13	Yes, in lieu of CHP

Table 4 - Summary of Capital Cost and Energy/CO_2 Saving Data

7.0 Recommendations

A high-level report has been compiled to appraise the renewable energy options currently available for a 10% contribution to the proposed New Distribution facility in Warrington.

Solar photovoltaic (PV) mono-crystalline roof panels can be incorporated into the building design with little/no maintenance or ongoing costs. PV installations are scale able in terms of active area; size being restricted only by available façade and/or roof space. On the current scheme, an installation of circa 2600m^2 could achieve the necessary contribution to the energy usage. Large amounts of un-used roof space, however, and the natural pitch of the roof indicated that PV would be suitable for this site.

A roof mounted solar thermal installation could be installed to contribute towards the domestic hot water load of the building. An installation of 10m^2 of roof mounted solar thermal tubes, sized to meet the domestic hot water demands of the building, would also contribute to a reduction in energy demands.

A BREEAM (2014) pre-assessment has been completed for the project achieving Very Good with a target score of 59.1%.

Appendices

Life Cycle Costs

Solar Thermal Life Cycle Costings

	2019	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	
Initial Capital and Additional Costs	£10,000	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	
Maintenance/Servicing/Fuel	£300	315	£331	£347	£365	£383	£402	£422	£443	£465	£489	
Total	£10,300	£315	£331	£347	£365	£383	£402	£422	£443	£465	£489	
		Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	
		£0	£0	£0	£0	£400	£0	£0	£0	£0	£0	
		£513	£539	£566	£594	£624	£655	£688	£722	£758	£796	
		£513	£539	£566	£594	£1,024	£655	£688	£722	£758	£796	
		Year 21	Year 22	Year 23	Year 24	Year 25	Year 26	Year 27	Year 28	Year 29	Year 30	Total
		£0	£0	£0	£0	£10,000	£0	£0	£0	£0	£0	
		£836	£878	£921	£968	£1,016	£1,067	£1,120	£1,176	£1,235	£1,297	
		£836	£878	£921	£968	£11,016	£1,067	£1,120	£1,176	£1,235	£1,297	£41,628

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	Targeted	Achieved		Potential
BREEAM SCORE %:	59.1	0.0		64.1
Score % and Minimum Standards met for Classification:	Very Good	Unclassified		Very Good
BREEAM-0000-0000	-	-		
Last Updated: 02/12/19	E √	-	Not Pursuing	
Initials: DF	VG √	-	Pursuing	
Revision: - A	G √	-	Possible Target	
Date of issue: 2/12/19	P √	-	Achieved	

Industrial unit with operational areas and office space (SD 5076 5.0 - 2014) **BREEAM 2014 Tracker**

Job Title: Omega Zone 8 **New Build:** **m²** **%**
Job Number: 190081 **Refurbishment:** **m²** **%**

Name	Item	Responsibility	Comment/Action	Potential Additional	Available Credits	Targeted Credits	Achieved Credits	Target Score %	Achieved Score %
			Actions required to secure the points given in the assessment	**5.01%**	**128**	**70**	**0**	**59.10**	**0.00**
Management		Weighting: 0.120		**0.57%**	**21**	**15**	**0**	**8.57**	**0.00**
Man 01	**Project brief and Design**								
	Stakeholder Consultation (project delivery)	**Client/PM**	Consultation plan showing scope and process Documentation (e.g. meeting minutes, responsibilities schedule) confirming: - Collaboration began prior to end of RIBA Stage 2. - Roles and responsibilities have been defined, covering all points in Criterion 2. - Comments from consultations have influenced the initial project brief.		1	1	-		
	Stakeholder consultation (third party)	**Client/PM**	Evidence (e.g. meeting minutes) confirming all relevant third parties were consulted prior to completion of Concept Design (RIBA Stage 2). Evidence that feedback regarding points raised in the consultation has been given to third parties prior to completion of the Technical Design (RIBA Stage 4). *For Education, Healthcare, Law Courts and Major Transport Node Buildings, an independent third party must carry out the design stage consultation.*		1	-	-		
	Sustainability Champion (design)	**PM/Client/AP**	Evidence/Letter confirming a Sustainability Champion was appointed for RIBA stage 1. Evidence showing performance target was contractually agreed by the end of RIBA stage 2. A copy of the design stage report showing these targets have been met.		1	1	-		
	Sustainability Champion (monitoring progress)	**PM/Client/AP**	Previous credits are achieved Evidence confirming the sustainability champion has been appointed for RIBA Stages 2-4. Evidence showing the sustainability champion has formally reported progress to the client and design team		1	1	-		
Man 02	**Life cycle cost and service life planning**								
	Elemental life cycle cost (LCC)	**QS**	Copy of a BREEAM compliant Elemental life cycle cost plan Evidence the ELCC was completed at RIBA Stage 2		2	-	-		
	Component level LCC Plan	**QS**	Copy of a BREEAM compliant component life cycle cost plan Evidence the CLCC was completed by the end of RIBA Stage 4 Examples of how the CLCC has influenced building and systems design or specification		1	-	-		
	Capital cost reporting	**QS**	Evidence showing the predicted capital cost for the building in £k/ m²		1	1	-		
Man 03	**Responsible construction practices**								
	All site timber used in the project is sourced in accordance with the UK government's Timber Procurement Policy	**Main Contractor**	Letter/Supplier Certificates confirming all timber is legally harvested and traded timber.		N/A	Y	N		
	Environmental management	**Main Contractor**	Copy of the contractor's ISO14001 Cert/ evidence of compliance with BS8555 Or if not yet appointed, a letter confirming the contractor chosen will comply		1	1	-		
	Construction stage Sustainability Champion	**Main Contractor**	Spec or letter confirming a Sustainability Champion has been appointed to monitor the project to ensure ongoing compliance with the criteria.		1	1	-		
	Considerate construction **(Minimum Standard 1 credit for Excellent, 2 for Outstanding)**	**Main Contractor**	CCS Scores 1- 25-34 (5/5), 2-35-39(7/5)		2	2	-		
	Monitoring of construction site impacts	**Main Contractor**	Signed and dated letter to confirm commitment to meet relevant criteria		2	2	-		
Man 04	**Commissioning and handover**								
	Commissioning schedule and responsibilities	**Main Contractor**	Spec or letter confirming commissioning responsibilities, commissioning schedule, and relevant codes to be adhered to. A copy of the main contractors programme of works confirming commissioning has been accounted for.		1	1	-		
	Commissioning building services	**Main Contractor**	Spec or letter confirming a specialist commissioning manager has been appointed during the installation works for the building services systems.		1	1	-		
	Commissioning building fabric	**Main Contractor**	First credit has been achieved Copy of the project programme of works to confirm thermographic survey, airtightness testing and inspection has been accounted for. Copy of appointment letter or similar for surveyor	1	1	0	-		
	A BUG and Training covering the building's design intent has been produced **(Minimum standard for Excellent)**	**Main Contractor**	Letter or Spec confirming commitment to produce BUG and contents.		N/A	y	N		
	Handover	**Main Contractor**	Evidence for BUG as well as Letter/spec/programme confirming occupier training		1	1	-		
Man 05	**Aftercare**								
	Aftercare support	**Main Contractor**	Evidence or Letter confirming a commitment to provide compliant aftercare support including energy and water monitoring for 12 months		1	1	-		
	Seasonal commissioning **(Minimum standard for Excellent)**	**Main Contractor**	Spec or letter confirming commissioning extends to seasonal commissioning.		1	1	-		
	Post occupancy evaluation	**Client**	Letter of commitment signed and dated by client/developer to carry out one year POE.		1	0	-		
Health and Wellbeing		Weighting: 0.150		**3.53%**	**17**	**6**	**0**	**5.29**	**0.00**
Hea 01	**Visual comfort**								
	Glare control	**Architect**	Drawings/Spec confirming glare has been designed out or controlled, eg blinds.		1	1	-		
	Daylighting (building type dependent)	**M&E/Main Contractor**	Design drawings Daylight calcs		1	0	-		
	View out (building type dependent)	**Architect**	Drawings/Plans showing room layouts and distances to windows Drawings and calcs showing size of windows Site plan showing distance from windows to external objects		1	0	-		
	Internal and external lighting	**M&E/Main Contractor**	Copy of spec/Letter confirming adherence to relevant codes Drawings showing internal lighting zones Drawings showing external lighting		1	0	-		

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	Targeted	Achieved		Potential
BREEAM SCORE %:	59.1	0.0		64.1
Score % and Minimum Standards met for Classification:	Very Good	Unclassified		Very Good
BREEAM-0000-0000	-	-		
Last Updated: 02/12/19	E √	-	Not Pursuing	
Initials: DF	VG √	-	Pursuing	
Revision: - A	G √	-	Possible Target	
Date of issue: 2/12/19	P √	-	Achieved	

Industrial unit with operational areas and office space (SD 5076 5.0 - 2014) **BREEAM 2014 Tracker**

Job Title: Omega Zone 8 **New Build:** m² %
Job Number: 190081 **Refurbishment:** m² %

Name	Item	Responsibility	Comment/Action	Potential Additional	Available Credits	Targeted Credits	Achieved Credits	Target Score %	Achieved Score %
Hea 02	**Indoor air quality**								
	Minimising sources of air pollution - Indoor air quality (IAQ) plan	**M&E/Main Contractor**	Copy of the compliant indoor air quality plan.		1	1	-		
	Minimising sources of air pollution - Ventilation	**M&E/Main Contractor**	Confirmation building has been designed to provide fresh air and minimise internal pollutants in accordance with relevant ventilation standards Drawings showing location of intakes and extracts Confirmation that compliant CO2/Air quality sensors will be specified in areas of variable occupancy Where relevant, confirmation HVAC filtration is compliant with specified codes		1	-	-		
	VOC emission levels (products)	**Prelims/Main Contractor**	NBS Spec or letter confirming the relevant products will meet the testing standards set out in Table 18		1	1	-		
	VOC emission levels (post construction)	**Main Contractor**	Evidence confirming commitment to carry out necessary testing	1	1	0	-		
	Adaptability - Potential for natural ventilation (building type dependent)	**M&E**	Letter/spec confirming details of ventilation strategy Calcs/results from software modelling tool Manufacturer/Supplier's literature		1	0	-		
Hea 04	**Thermal comfort**								
	Thermal modelling	**Main Contractor**	Copy of the thermal modelling results Where relevant, including the PMV and PPD values		1	1	-		
	Adaptability - for a projected climate change scenario	**Main Contractor**	Previous credit is achieved Evidence confirming the building will or can be adapted to withstand effects of climate change Where relevant, the PMV and PPD values for the climate change scenario	1	1	-	-		
	Thermal zoning and controls	**Main Contractor**	Copy of the compliant thermal comfort strategy Design drawings showing heating zones		1	1	-		
Hea 05	**Acoustic performance**								
	Acoustic performance standards (building type dependent)	**Acoustician**	Copy of acoustician's report Copy of acoustician's qualifications (may be in report) Spec/Letter confirming pre-completion testing will be carried out and any remediations will be completed		3	1	-		
Hea 06	**Safety and security**								
	Safe access - pedestrians and cyclists, deliveries and parking	**Architect**	Letter/Evidence confirming cycle lanes have been designed in accordance to either LTN 2/08 or the NCN Guidelines Issue 2. Copy of the landscape plans Letter/Spec confirming lighting meets required standards	1	1	0	-		
	Security of site and building	**Client**	Correspondence from ALO/CPDA/Security Consultant Design drawings showing implementation of recommendations	1	1	0	-		
Energy		Weighting:	0.150	**0.00%**	**23**	**13**	**0**	**8.47**	**0.00**
Ene 01	**Reduction of energy use & carbon emissions**								
C	Energy Performance Ratio for New Constructions calculated **(Minimum Standard 5 credits for Excellent, 8 for Outstanding)**	**M&E/Main Contractor**	Copy of the design stage .inp file Output from assessor's calculator		12	6	-		
Ene 02	**Energy monitoring**								
	Sub-metering of major energy consuming systems **(Minimum Standard V.Good)**	**M&E/Main Contractor**	Drawings showing location of meters. Copy of spec/metering schematics confirming what has been metered, and that meters are labelled and connected to BMS		1	1	-		
	Sub-metering of high energy load and tenancy areas	**M&E/Main Contractor**			1	1	-		
Ene 03	**External lighting**								
	Lamp/luminaire efficiency and lighting control	**M&E/Main Contractor**	External lighting drawings Confirmation of lights to be installed (could be on drawing) Confirmation of switching and PIR if necessary		1	1	-		
Ene 04	**Low carbon design**								
	Passive design analysis	**Architect**	Hea 04 first credit has been awarded. Copy of the analysis results and evidence confirming it is compliant, and was completed at RIBA Stage 2		1	-	-		
	Free cooling strategy utilised	**M&E/Main Contractor**	First credit has been awarded. Evidence as above confirming the analysis covers free cooling Correspondence from the building services engineer summarising the employed free cooling		1	-	-		
	Low zero carbon technologies	**M&E**	Copy of the feasibility report		1	1	-		
Ene 06	**Energy efficient transportation systems** (building facility dependent)								
	Energy consumption	**M&E/Main Contractor**	Copy of transport analysis including confirmation of whether a regenerative drive would be worthwhile. Letter/Evidence confirming lowest energy usage lift has been specified		1	1	-		
	Energy efficient features	**M&E/Main Contractor**	Criterion 1 is achieved. Manufacturer's details confirming standby, variable controls, and energy efficiency lighting.		2	2	-		
Ene 08	**Energy efficient equipment**								
	Standards or control used to minimise consumption or environmental impact	**Client**	List of appliances to be installed and manufacturer's details confirming low energy OR letter confirming compliance		2	-	-		
Transport		Weighting:	0.090	**0.00%**	**9**	**3**	**0**	**3.00**	**0.00**
Tra 01	**Public transport accessibility** (building type dependent)								

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	Targeted	Achieved		Potential
BREEAM SCORE %:	59.1	0.0		64.1
Score % and Minimum Standards met for Classification:	Very Good	Unclassified		Very Good
BREEAM-0000-0000	-	-		
Last Updated: 02/12/19	E √	-	Not Pursuing	
Initials: DF	VG √	-	Pursuing	
Revision: - A	G √	-	Possible Target	
Date of issue: 2/12/19	P √	-	Achieved	

Industrial unit with operational areas and office space (SD 5076 5.0 - 2014) **BREEAM 2014 Tracker**

Job Title: Omega Zone 8 **New Build:** m² %

Job Number: 190081 **Refurbishment:** m² %

Name	Item	Responsibility	Comment/Action	Potential Additional	Available Credits	Targeted Credits	Achieved Credits	Target Score %	Achieved Score %
C	The public transport Accessibility Index (AI) is calculated	Architect	Scaled map showing a safe walking path to transport nodes from the building's main entrance and the distance in meters Bus/train timetables for all services at each stop Copy of the Tra 1 calculator OR FOR BUILDINGS IN LONDON a copy of the summary report from the http://webptals.org.uk/ website		3	0	-		
	A dedicated bus service is provided for fixed shift pattern buildings (building facility dependent)	Client	A formal letter from the future building occupier confirming the details for the dedicated service		0	-	-		
Tra 02	**Proximity to amenities** (building type dependent)								
	Building is 500m or 1000m from a range of amenities	Client/Architect	Scaled map showing a safe walking path to each amenity and the distance in meters OR if the amenities to do not currently exist, a letter confirming the location and type to be provided, and the timescale for their development		1	0	-		
Tra 03	**Cyclist facilities** (building type dependent)								
	Provision of cycle storage, or cycle storage and other cyclist facilities	Landscape Architect/Main Contractor	Evidence confirming the number of building users Drawings showing location, size and number of cycle spaces/changing facilities/lockers/drying space If provided Letter/Spec/Manufacturer's details confirming cycle shelters will be compliant (covered, secured etc.) Where relevant - evidence confirming size, location, and number of wheelchair, buggy and charging facilities		2	2	-		
Tra 04	**Maximum car parking capacity** (building type dependent)								
	Car parking capacity is limited to encourage other forms of transport	Landscape Architect/Main Contractor	Evidence confirming the number of building users Evidence confirming the Accessibility Index (see TRA 01) Plans/Spec/Letter confirming number of spaces and their uses (disabled, parent and baby etc.) Where relevant - drawings showing number of consulting, examination, treatment, A&E cubicles and therapy rooms Where relevant - plans/spec confirming number of patient/residential beds		2	0	-		
Tra 05	**Travel Plan**								
	A travel survey and plan have influenced project design	Client	Copy of the travel survey and travel plan Drawings/spec/letter confirming implementation of plan		1	1	-		
Water			Weighting: 0.070	**0.00%**	**9**	**7**	**0**	**5.44**	**0.00**
Wat 01	**Water consumption (Minimum standard 1 credit for Good; 2 for Outstanding)**								
C	Water consumption (litres/person/day) is reduced by use of efficient fittings and recycling	M&E/Architect/Main Contractor	Spec/Manufacturers details confirming cisterns, WCs, urinals, taps, showers and baths to be installed or a letter confirming the specified flush/flow rates of each. Details of the greywater/rainwater system including calcs and confirmation of compliance with relevant codes. Copy of the WAT01 Calculator		5	3	-		
Wat 02	**Water monitoring**								
	A water meter is specified on the mains to each building **(Minimum standard for Good)**	M&E/Main Contractor	Drawings showing location of meters. Copy of spec/metering schematics confirming what has been metered, and that meters are labelled and connected to BMS		N/A	y	N		
	Consumption is monitored by a suitable meter (and, if appropriate, sub meters)	M&E/Main Contractor			1	1	-		
Wat 03	**Water leak detection**								
	Leak detection system	M&E/Main Contractor	Technical details of the leak detection system to be installed, confirming that it is programmable by the user, designed to avoid false alarms, and confirming when and how it is activated		1	1	-		
	Flow control devices to each sanitary area/facility	M&E/Main Contractor	Design drawings showing type and location of flow control devices and sensors.		1	1	-		
Wat 04	**Water efficient equipment**								
	Large water consuming systems are designed to minimise unregulated consumption	Client/Landscape Architect	Evidence confirming the building's unregulated water demands and how they will be mitigated/reduced		1	1	-		
Materials			Weighting: 0.135	**0.00%**	**10**	**7**	**0**	**9.45**	**0.00**
Mat 01	**Life cycle impacts** (building type dependent)								
C	The Green Guide is used to assess the environmental impact of materials used	Architect/Main Contractor	Area, description, and Green Guide number/rating of each external wall, window, upper floor slab, internal wall, floor and roof element. Any available Environmental Product Declarations. Elevations showing location of each element A copy of the Mat01 Calculator		2	2	-		
Mat 02	**Hard landscaping and boundary protection**								
	The Green Guide rating of 80% of these materials (by area) should be A or A+	Landscape Architect/Main Contractor	Area, description, and Green Guide number/rating of each external landscaping and border element. Site plan showing location of each element. Calculation showing % of elements A or A+ rated		1	1	-		
Mat 03	**Responsible sourcing of materials**								
	All timber used on the project is 'Legally harvested and traded timber'. **(Minimum Standard for Pass)**	Main Contractor	Letter/Supplier Certificates confirming all timber is legally harvested and traded timber.		N/A	Y	N		
	Main contractor has a sustainable procurement plan	Main Contractor	Copy of the contractor's sustainable procurement plan.		1	1	-		

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	Targeted	Achieved		Potential
BREEAM SCORE %:	59.1	0.0		64.1
Score % and Minimum Standards met for Classification:	Very Good	Unclassified		Very Good
BREEAM-0000-0000	-	-		
Last Updated: 02/12/19	E √	-	Not Pursuing	
Initials: DF	VG √	-	Pursuing	
Revision: - A	G √	-	Possible Target	
Date of issue: 2/12/19	P √	-	Achieved	

Industrial unit with operational areas and office space (SD 5076 5.0 - 2014) **BREEAM 2014 Tracker**

Job Title: Omega Zone 8 **New Build:** m² %

Job Number: 190081 **Refurbishment:** m² %

Name	Item	Responsibility	Comment/Action	Potential Additional	Available Credits	Targeted Credits	Achieved Credits	Target Score %	Achieved Score %
	Materials making up key building elements are assessed using calculator tool	**Main Contractor**	A copy of the Mat03 calculator, Plan/spec/letter detailing the materials making up each building element A copy of the responsible sourcing scheme certificates for each material's manufacturer OR - if materials/manufacturers are not know - a letter of intent confirming the products will be sourced from responsible suppliers		3	1	-		
Mat 04	**Insulation**								
C	**(Pre-requisite) Ground floor, external walls, roof and services all assessed**	**Main Contractor**	Design drawings showing location of insulation. Either a letter confirming intent to comply OR Areas of wall, floor and roof insulation and Volumes of building service insulation. Manufacturer, type, thickness and thermal conductivity of all insulation. Green Guide ratings & any Environmental Product Declarations for all products.		N/A	y	N		
	Embodied impact is assessed using Green Guide and material properties				1	1	-		
Mat 05	**Designing for durability and resilience**								
	Need has been identified and fulfilled for adequate protection of building elements	**Architect/Main Contractor**	Drawings (internal and external) showing areas where vehicles, pedestrians and trolley movements occur. Design drawings/spec confirming durability measures which will be implemented. Evidence confirming how each applicable building element is protected from potential degradation.		1	1	-		
Mat 06	**Material efficiency**								
	Opportunities and measures to optimise the use of materials have been identified, investigated & implemented.	**Architect/Main Contractor**	Letter/spec confirming designing for materials efficiency in accordance with BS 8895 &/or WRAP.		1	-	-		
Waste		Weighting:	0.085	**0.00%**	**8**	**7**	**0**	**7.43**	**0.00**
Wst 01	**Construction waste management (Minimum Standard 1 credit for Outstanding)**								
	Construction resource efficiency - the amount of waste generated	**Main Contractor**	Copy of a compliant Resource Management Plan		3	3	-		
	Diversion of resources from landfill - the amount of material recycled or re-used	**Main Contractor**			1	1	-		
Wst 02	**Recycled aggregates**								
	Minimum percentage targets for local recycled aggregates are achieved	**Structural Engineer**	Letter/spec confirming intent to comply OR Documentation confirming: Source of aggregates Required amount can be provided Calculations showing amount required/% achieved		1	-	-		
Wst 03	**Operational Waste (Minimum Standard 1 credit for Excellent)**								
	Clearly labelled, accessible areas of sufficient size are provided for recycled waste	**Architect/Landscape Architect /Main Contractor**	Design drawings showing location and area of recycling Evidence confirming recycling will be clearly labelled Where relevant - facilities are compliant with HTM07-01 Where relevant - spec/letter/manufacturer's details of compliant internal storage containers and plan showing location Where relevant - spec/letter/plan confirming home composting facilities and info will be provided		1	1	-		
Wst 05	**Adaptation to climate change**								
	Structural and fabric resilience	**Architect**	Copy of a systematic risk assessment confirming where feasible mitigate against the impact of the expected hazard/risk over the project life-cycle of the building has been accounted for.		1	1	-		
Wst 06	**Functional adaptability**								
	Functional adaptation strategy and implementation plan	**Architect**	Copy of building specific functional adaptation strategy Letter or Spec confirming commitment to implement functional adaptation measures.		1	1	-		
Land Use and Ecology		Weighting:	0.100	**0.00%**	**10**	**5**	**0**	**5.00**	**0.00**
LE 01	**Site selection**								
	Re-use of land previously 75% developed for the previous 50 years	**Architect**	Plan/photos showing type and area of previous land Proposed site plan showing location and size of proposed development and temporary works		1	-	-		
	Treatment and re-use of land revealed by site survey to be significantly contaminated	**Structural Engineer**	Copy of the contamination report plan/drawings showing location of contamination Letter from the contractor/remediation company/client confirming remediation strategy		1	-	-		
LE 02	**Ecological value of site and protection of ecological features**								
	Land is defined as being of "low ecological value"	**Ecologist/Principal Contractor**	EITHER: Completed copy of Table 30 signed and dated by client/design team and Plans/Photos/Spec confirming ecological features (or lack thereof) OR: Copy of Ecologist's report		1	1	-		
	Protection of ecology on and surrounding site during construction	**Ecologist/Principal Contractor**	Plan/ecologists report detailing ecological features on and surrounding site Confirmation from design team/contractor that protection measures will be completed in line with SQE recommendations and BS42020		1	1	-		
LE 03	**Minimising impact on existing site ecology (Minimum Standard 1 Credit for V.Good)**								

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	Targeted	Achieved		Potential
BREEAM SCORE %:	59.1	0.0		64.1
Score % and Minimum Standards met for Classification:	Very Good	Unclassified		Very Good
BREEAM-0000-0000	-	-		
Last Updated: 02/12/19	E √	-	Not Pursuing	
Initials: DF	VG √	-	Pursuing	
Revision: - A	G √	-	Possible Target	
Date of issue: 2/12/19	P √	-	Achieved	

Industrial unit with operational areas and office space (SD 5076 5.0 - 2014) **BREEAM 2014 Tracker**

Job Title: Omega Zone 8 **New Build:** m² %
Job Number: 190081 **Refurbishment:** m² %

Name	Item	Responsibility	Comment/Action	Potential Additional	Available Credits	Targeted Credits	Achieved Credits	Target Score %	Achieved Score %
	The reduction in ecological value of the site due to the development is minimised	**Ecologist/Principal Contractor**	Copy of the ecologist's report Copy of the ecologist's credentials confirming they meet the BREEAM Requirements (can be part of the report) Copy of the landscape plans Copy of the LE3 Calculator		2	1	-		
LE 04	**Enhancing site ecology**								
C	Implementation of an ecologist's recommendations for enhancing site ecological value	**Ecologist/Principal Contractor**	Copy of the ecologist's report Copy of the ecologist's credentials confirming they meet the BREEAM Requirements (can be part of the report) Copy of the landscape plans Letter confirming ecologist's recommendations will be adhered to Copy of the LE4 calculator		1	1	-		
	Ecologist confirms that number of plant species will be increased by six or more	**Ecologist/Principal Contractor**			1	-	-		
LE 05	**Long term impact on biodiversity** (building type dependent)								
C	(Pre-Requisite) Ecologist confirms regulations were observed; management plan produced	**Ecologist**	Copy of the ecologist's report Copy of the ecologist's credentials confirming they meet the BREEAM Requirements (can be part of the report). Confirmation a 5 year management plan in accordance with BS will be drawn up. Letter from the main contractor confirming which of the additional criteria will be targeted.		N/A	Y	N		
	Contractor's effects on biodiversity minimised, new habitat created, wildlife partnership	**Ecologist/Principal Contractor**			2	1	-		
Pollution		Weighting:	0.100	**0.91%**	**11**	**6**	**0**	**5.45**	**0.00**
Pol 01	**Impact of refrigerants**								
	(Pre-requisite) All systems must comply with the requirements of BS EN 378:2008 & the Institute of Refrigeration Ammonia Refrigeration Systems Code of Practice.				N/A	N	N		
C	Minimising the adverse effects of refrigerants by avoidance, choice or leak control	**M&E/ Refrigeration Specialist**	Spec/Letter confirming type of refrigerant (or lack thereof) Copy of the Pol01 Calculator		2	1	-		
	Leak detection system	**M&E/ Refrigeration Specialist**	Technical details of the refrigerant leak detection system to be installed.		1	-	-		
Pol 02	**NOx emissions** (building type dependent)								
	Minimising NOx pollution by choosing heating & cooling systems with low emissions	**M&E/Main Contractor**	Letter/spec/plans confirming heating source/s for space heating and water (e.g. boilers, CHP, POU etc.) Manufacturer's details detailing NOx emissions of installed systems Where relevant - calcs showing NOx conversions Where relevant - calcs showing DHW is <10% OR - if boilers unknown - letter/spec confirming NOx emissions targeted		1	1	-		
Pol 03	**Surface water run off**								
	Flood risk zone: an assessment (FRA) confirms that the site is unlikely to flood	**Structural Engineer/ Flood Risk Consultant**	Copy of the compliant FRA		2	2	-		
	(Pre-requisite) surface water run-off: consultant engaged to investigate	**Structural Engineer/ Flood Risk Consultant**	Copy of the consultant's credentials (Can be part of the report)		N/A	N	N		
	Surface water run-off: will be no greater after the development than it was before	**Structural Engineer/ Flood Risk Consultant**	Copy of the drainage plans and calculations confirming (where relevant): type and amount of water storage, total area of hard surfaces, peak flow rates pre and post development, impact of a local drainage system failure, specification of pollution prevention measures, and evidence supporting the 5mm rainfall discharge criteria. Also, a letter confirming the Pollution prevention systems are in line with PPG3 and the SUDS requirements	1	1	-	-		
	Surface water run-off: local drainage system failure will not cause flooding	**Structural Engineer/ Flood Risk Consultant**			1	-	-		
	Specified measures are taken to minimise the risk of watercourse pollution	**Structural Engineer/ Flood Risk Consultant**			1	-	-		
Pol 04	**Reduction of night time light pollution**								
	Standards are followed and appropriate switching is employed	**M&E/Main Contractor**	Design drawings of external lighting. Spec/Letter confirming lighting complies with BREEAM Criteria		1	1	-		
Pol 05	**Reduction of noise pollution**								
	Noise from the building is controlled sufficiently to prevent nuisance to neighbours	**Acoustician/Main Contractor**	Plan showing locations of noise sensitive buildings, source(s) of noise from new development and distance between the two. Copy of the SQA's compliant report and qualifications OR a letter confirming an SQA will be Appointed to carry out a compliant report. Plan showing the recommended attenuation measures have been carried out OR A letter confirming they will be.		1	1	-		
Innovation		Maximum:	10	**0.00%**	**10**	**1**	**0**	**1**	**0**
Inn 01	Man 03 - Responsible construction practices - CCS	**Main Contractor**	Letter confirming participation in CCS and targeted score / Not targeted because		1	-	-		
	Man 05 - Aftercare - POE	**Client**	Letter of commitment signed and dated by client/developer to carry out occupant, water, and energy monitoring over three years / Not targeted because		1	-	-		
	Hea 01 - Visual comfort - Daylighting	**M&E/Main Contractor**	Design drawings Daylight calcs / Not targeted because		1	-	-		
	Hea 02 - Indoor air quality - Product VOCs	**Main Contractor**	Letter from the manufacturer confirming the results of testing they carried out. / Not targeted because		2	-	-		
	Ene 01 - Reduction of energy use and carbon emissions	**M&E/Main Contractor**	Copy of the design stage .inp file Output from assessor's calculator / Not targeted because		5	-	-		
	Wat 01 - Water consumption - improvement by 65% or more on baseline performance	**M&E/Architect/Main Contractor**	Spec/Manufacturers details confirming cisterns, WCs, urinals, taps, showers and baths to be installed or a letter confirming the specified flush/flow rates of each. Details of the greywater/rainwater system including calcs, and confirmation of compliance with relevant codes. Copy of the WAT01 Calculator / Not targeted because		1	-	-		

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	Targeted	Achieved		Potential
BREEAM SCORE %:	59.1	0.0		64.1
Score % and Minimum Standards met for Classification:	Very Good	Unclassified		Very Good
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Industrial unit with operational areas and office space (SD 5076 5.0 - 2014) **BREEAM 2014 Tracker**

Job Title: Omega Zone 8 **New Build:** m² %
Job Number: 190081 **Refurbishment:** m² %

Name	Item	Responsibility	Comment/Action	Potential Additional	Available Credits	Targeted Credits	Achieved Credits	Target Score %	Achieved Score %
	Mat 01 - Life Cycle Impacts - Points scored using Mat 1 calculator reach exemplary level	**Architect/Main Contractor**	Area, description, and Green Guide number of each external wall, window, upper floor slab, internal wall, floor, and roof element. Results of IMPACT assessment (where relevant) Elevations showing location of each element A copy of the Mat01 Calculator		3	1	-		
	Mat 03 - Responsible Sourcing of Materials - 70% of the available responsible sourcing of materials (RSM) points are achieved	**Main Contractor**	A copy of the Mat03 calculator, Plan/spec/letter detailing the materials making up each building element A copy of the responsible sourcing scheme certificates for each material's manufacturer OR - if materials/manufacturers are not know - a letter of intent confirming the products will be sourced from responsible suppliers / Not targeted because		1	-	-		
	Wst 01 - Construction Waste Management - exceptional diversion from landfill and low waste production	**Main Contractor**	Copy of a compliant Resource Management Plan OR letter confirming targets and that a compliant RMP will be created / Not targeted because		1	-	-		
	Wst 02 - Recycled Aggregates - exceed 35% of total for project, from within 30mile radius	**Structural Engineer**	Letter/spec confirming intent to comply OR Documentation confirming: Source of aggregates Required amount can be provided Calculations showing amount required/% achieved Evidence confirming source of aggregate was within 30 miles / Not targeted because		1	-	-		
	Wst 05 - Adaptation to climate change	**See Relevant Credits**	Following credits have been achieved: First credit, Hea 4 (criterion 6), Ene 1 (8 credits), Ene 4 (first credit), Wat 1 (3 credits) Mat 5 (criterion 2), Pol 3 (Flood risk - one credit, Surface water - two credits) / Not targeted because		1	-	-		

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

HARVARD CONCEPT STAGE 2600m2 PV SOLAR SHADING

As designed

Date: Wed Nov 27 17:21:54 2019

Administrative information

Building Details

Address: HARVARD CONCEPT STAGE 2600m2 PV SOLAR SHADING, ,

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.12

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.12

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

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name:

Telephone number:

Address: , ,

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

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	24.3
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	24.3
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	18.7
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

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

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

Building fabric

Element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	Surface where the maximum value occurs*
Wall**	0.35	0.35	0.35	00000000:Surf[2]
Floor	0.25	0.25	0.25	00000000:Surf[0]
Roof	0.25	0.25	0.25	0000001D:Surf[1]
Windows***, roof windows, and rooflights	2.2	1.06	1.61	00000000:Surf[1]
Personnel doors	2.2	2.2	2.2	0000001F:Surf[48]
Vehicle access & similar large doors	1.5	1.5	1.5	0000001F:Surf[47]
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]
U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

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

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

Building services

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

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- VRF HEATING AND COOLING

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4	4.25	0	0	0.7
Standard value	2.5*	3.2	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	NO				

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.

2- LTHW BOILER FEEDING RADIATORS PLUS MECH VENTILATION

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.92	-	0.3	0	0.7
Standard value	0.91*	N/A	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	NO				

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

3- LTHW BOILER FEEDING RADIATORS PLUS NO VENTILATION

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.92	-	0.3	0	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	NO				

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

4- ELECTRIC PANEL HEATER FOR WAREHOUSE WC

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0.3	0	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	NO				

5- COMMS ROOM SYSTEM

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.5	3.5	0	0	-
Standard value	2.5*	3.2	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	NO				

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.

6- KITCHEN- LTHW BOILER FEEDING RADIATORS PLUS KITCHEN EXTRACT AT 40ACH

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.92	-	-	0	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	NO				

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

7- CANTEEN VRF HEATING/COOLING PLUS MECH VENTILATION

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4	4	0	0	-
Standard value	2.5*	3.2	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

1- GAS FIRED DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.92	-
Standard value	0.9*	N/A
* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.		

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**
00: LOCKERS / DRIVERS RECEPTION		-	-	1.9	-	-	-	-	-	-	N/A
00: INTERVIEW ROOM	-	-	-	1.9	-	-	-	-	-	-	N/A
00: LOSS PREVENTION OFFICE	-	-	-	1.9	-	-	-	-	-	-	N/A
00: FIRST AID	-	-	-	1.9	-	-	-	-	-	-	N/A
00: TRANSPORT OFFICE	-	-	-	1.9	-	-	-	-	-	-	N/A
00: TOILETS	-	-	0.5	-	-	-	-	-	-	-	N/A
00: DIS WC	-	-	0.5	-	-	-	-	-	-	-	N/A
00: MEETING ROOM 1	-	-	-	1.9	-	-	-	-	-	-	N/A
00: INTERVIEW ROOM 1	-	-	-	1.9	-	-	-	-	-	-	N/A
00: MEETING ROOM 2	-	-	-	1.9	-	-	-	-	-	-	N/A
00: INTERVIEW ROOM 2	-	-	-	1.9	-	-	-	-	-	-	N/A
00: TOILETS	-	-	0.5	-	-	-	-	-	-	-	N/A
00: CONTRACTORS COMPOUND	-	-	-	1.9	-	-	-	-	-	-	N/A
00: WAREHOUSE CONFERENCE ROOM		-	-	1.9	-	-	-	-	-	-	N/A
00: STOCK CONTROL OFFICE	-	-	-	1.9	-	-	-	-	-	-	N/A
00: RECEPTION	-	-	-	1.9	-	-	-	-	-	-	N/A
00: TOILETS	-	-	0.5	-	-	-	-	-	-	-	N/A
00: OFFICE SPACE	-	-	-	1.9	-	-	-	-	-	-	N/A
00: WAITING AREA	-	-	-	1.9	-	-	-	-	-	-	N/A

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
00: GOODS IN OFFICE	-	-	-	1.9	-	-	-	-	-	-	N/A
00: WAREHOUSE WC	0.3	-	-	-	-	-	-	-	-	-	N/A
00: WAREHOUSE WC	0.3	-	-	-	-	-	-	-	-	-	N/A
00: WAREHOUSE WC	0.3	-	-	-	-	-	-	-	-	-	N/A
01: CONFERENCE ROOM 3	-	-	-	1.9	-	-	-	-	-	-	N/A
01: CONFERENCE ROOM 2	-	-	-	1.9	-	-	-	-	-	-	N/A
01: CONFERENCE ROOM 1	-	-	-	1.9	-	-	-	-	-	-	N/A
01: CONFERENCE ROOM 5	-	-	-	1.9	-	-	-	-	-	-	N/A
01: CONFERENCE ROOM 4	-	-	-	1.9	-	-	-	-	-	-	N/A
01: CONFERENCE ROOM 7	-	-	-	1.9	-	-	-	-	-	-	N/A
01: CONFERENCE ROOM 6	-	-	-	1.9	-	-	-	-	-	-	N/A
01: WC	-	-	0.5	-	-	-	-	-	-	-	N/A
01: MALE WC	-	-	0.5	-	-	-	-	-	-	-	N/A
01: KITCHEN	-	-	-	-	-	-	-	-	1	-	N/A
01: CANTEEN	-	-	-	1.1	-	-	-	-	-	-	N/A
01: IT FACILITY OPEN PLAN OFFICE	-	-	-	1.9	-	-	-	-	-	-	N/A
02: WC	-	-	0.5	-	-	-	-	-	-	-	N/A
02: MALE WC	-	-	0.5	-	-	-	-	-	-	-	N/A
02: OPEN PLAN OFFICE 1	-	-	-	1.9	-	-	-	-	-	-	N/A
02: OPEN PLAN OFFICE 2	-	-	-	1.9	-	-	-	-	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
00: LOCKERS / DRIVERS RECEPTION	-	80	22	178
00: INTERVIEW ROOM	80	-	-	121
00: LOSS PREVENTION OFFICE	80	-	-	184
00: FIRST AID	80	-	-	102
00: TRANSPORT OFFICE	80	-	-	831
00: TOILETS	-	80	-	138
00: MAIN STAIRS	-	80	-	161
00: CLEANERS	80	-	-	45
00: DIS WC	-	80	-	36
00: MEETING ROOM 1	80	-	-	132
00: INTERVIEW ROOM 1	80	-	-	112
00: MEETING ROOM 2	80	-	-	138
00: INTERVIEW ROOM 2	80	-	-	106
00: TOILETS	-	80	-	146
00: CONTRACTORS COMPOUND	80	-	-	475
00: WAREHOUSE CONFERENCE ROOM	80	-	-	415
00: ESCAPE STAIRS	-	80	-	90
00: STOCK CONTROL OFFICE	80	-	-	1231
00: CHANGING ROOMS	-	80	-	565

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
00: LINK CORRIDOR	-	80	-	382
00: RECEPTION	-	80	22	131
00: TOILETS	-	80	-	50
00: OFFICE SPACE	80	-	-	887
00: CORRIDOR	-	80	-	840
00: WAITING AREA	-	80	22	413
00: GOODS IN OFFICE	80	-	-	962
00: WAREHOUSE WC	-	80	-	131
00: WAREHOUSE WC	-	80	-	134
00: WAREHOUSE WC	-	80	-	132
00: MEDIUM BAY AREA	80	-	-	21474
00: MEDIUM BAY AREA	80	-	-	42216
01: MAIN STAIRS	-	80	-	0
01: ESCAPE STAIRS	-	80	-	0
01: SERVER ROOM	80	-	-	145
01: PLANT ROOM	80	-	-	510
01: CONFERENCE ROOM 3	80	-	-	354
01: CONFERENCE ROOM 2	80	-	-	308
01: CONFERENCE ROOM 1	80	-	-	354
01: CONFERENCE ROOM 5	80	-	-	120
01: CONFERENCE ROOM 4	80	-	-	119
01: CONFERENCE ROOM 7	80	-	-	119
01: CONFERENCE ROOM 6	80	-	-	134
01: WC	-	80	-	111
01: CLEANER	80	-	-	43
01: STORE	80	-	-	61
01: PROTECTED CORRIDOR	-	80	-	166
01: MALE WC	-	80	-	140
01: KITCHEN	-	80	-	393
01: CANTEEN	-	80	-	1879
01: IT FACILITY OPEN PLAN OFFICE	80	-	-	3985
02: PROTECTED CORRIDOR	-	80	-	163
02: CLEANERS	80	-	-	44
02: WC	-	80	-	112
02: MAIN STAIRS	-	80	-	0
02: ESCAPE STAIRS	-	80	-	0
02: SERVER ROOM	80	-	-	145
02: MALE WC	-	80	-	140
02: OPEN PLAN OFFICE 1	80	-	-	2280
02: OPEN PLAN OFFICE 2	80	-	-	6354
01: CONFERENCE ROOM LOBBY	-	80	-	60
00: ESCAPE STAIRS	-	80	-	0
01: MAIN STAIRS	-	80	-	0

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
01: ESCAPE STAIRS	-	80	-	0
01: AEROSOL AREA	80	-	-	13893
01: WAREHOUSE AREA	80	-	-	177144

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
00: LOCKERS / DRIVERS RECEPTION	NO (-18.9%)	NO
00: INTERVIEW ROOM	NO (-87%)	NO
00: LOSS PREVENTION OFFICE	NO (-63.5%)	NO
00: FIRST AID	N/A	N/A
00: TRANSPORT OFFICE	N/A	N/A
00: MEETING ROOM 1	NO (-21%)	NO
00: INTERVIEW ROOM 1	NO (-20.8%)	NO
00: MEETING ROOM 2	NO (-73%)	NO
00: INTERVIEW ROOM 2	N/A	N/A
00: CONTRACTORS COMPOUND	NO (-49%)	NO
00: WAREHOUSE CONFERENCE ROOM	NO (-67.2%)	NO
00: STOCK CONTROL OFFICE	N/A	N/A
00: RECEPTION	NO (-41.3%)	NO
00: OFFICE SPACE	NO (-47.7%)	NO
00: WAITING AREA	NO (-11.9%)	NO
00: GOODS IN OFFICE	N/A	N/A
00: MEDIUM BAY AREA	NO (-51.2%)	NO
00: MEDIUM BAY AREA	NO (-45.4%)	NO
01: SERVER ROOM	N/A	N/A
01: CONFERENCE ROOM 3	N/A	N/A
01: CONFERENCE ROOM 2	N/A	N/A
01: CONFERENCE ROOM 1	N/A	N/A
01: CONFERENCE ROOM 5	N/A	N/A
01: CONFERENCE ROOM 4	N/A	N/A
01: CONFERENCE ROOM 7	N/A	N/A
01: CONFERENCE ROOM 6	N/A	N/A
01: CANTEEN	NO (-28.8%)	NO
01: IT FACILITY OPEN PLAN OFFICE	NO (-13.8%)	NO
02: SERVER ROOM	NO (-30.8%)	NO
02: OPEN PLAN OFFICE 1	NO (-51.3%)	NO
02: OPEN PLAN OFFICE 2	NO (-43.5%)	NO
01: AEROSOL AREA	NO (-36%)	NO
01: WAREHOUSE AREA	NO (-30.7%)	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?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	50760	50760
External area [m^2]	199228	199228
Weather	MAN	MAN
Infiltration [m^3/hm^2@ 50Pa]	3	3
Average conductance [W/K]	61148.3	53545
Average U-value [W/m^{2}K]	0.31	0.27
Alpha value* [%]	10.78	10

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

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
100	**B8 Storage or Distribution**
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
	D1 Non-residential Institutions: Community/Day Centre
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	2.17	1.42
Cooling	0.54	0.51
Auxiliary	0.71	0.4
Lighting	27.46	35.86
Hot water	28.6	24.69
Equipment*	44.29	44.29
TOTAL**	**59.48**	**62.89**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	5.85	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0.12	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	14.25	12.02
Primary energy* [kWh/m^2]	127.17	142.37
Total emissions [kg/m^2]	18.7	24.3

* 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] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	34.2	88.2	2.5	8.1	8	3.73	3.02	4	4.25
	Notional	15.4	109	1.7	8	3.6	2.56	3.79	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	283.4	0	95.9	0	2.4	0.82	0	0.92	0
	Notional	212.6	0	68.5	0	1.4	0.86	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	69.5	0	23.5	0	19.2	0.82	0	0.92	0
	Notional	30.5	0	9.8	0	20.7	0.86	0	----	----
[ST] Other local room heater - unfanned, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
	Actual	383.7	0	133.2	0	10.2	0.8	0	1	0
	Notional	221.1	0	71.2	0	12.9	0.86	0	----	----
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	0	1095.2	0	122.4	0	3.26	2.49	3.5	3.5
	Notional	0	1192	0	87.4	0	2.56	3.79	----	----
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	165.1	39.3	12.3	3.8	8.6	3.73	2.84	4	4
	Notional	6	52.6	0.7	3.9	4.2	2.56	3.79	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	0	0	0	0	103.8	0.82	0	0.92	0
	Notional	0.2	0	0.1	0	59.2	0.86	0	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----

Key to terms

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

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	**U_{i-Typ}**	**U_{i-Min}**	**Surface where the minimum value occurs***
Wall	0.23	0.35	00000000:Surf[2]
Floor	0.2	0.25	00000000:Surf[0]
Roof	0.15	0.25	0000001D:Surf[1]
Windows, roof windows, and rooflights	1.5	1	0000001F:Surf[1]
Personnel doors	1.5	2.2	0000001F:Surf[48]
Vehicle access & similar large doors	1.5	1.5	0000001F:Surf[47]
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**
$m^3/(h.m^2)$ at 50 Pa	5	3

Energy Performance Certificate
Non-Domestic Building

HM Government

Address 3
Address 4

Certificate Reference Number:
0000-0040-0030-9000-0803

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 in the guidance document *Energy Performance Certificates for the construction, sale and let of non-dwellings* available on the Government's website at www.gov.uk/government/collections/energy-performance-certificates.

Energy Performance Asset Rating

More energy efficient

A+

Net zero CO_2 emissions

A 0-25

20 This is how energy efficient the building is.

B 26-50

C 51-75

D 76-100

E 101-125

F 126-150

G Over 150

Less energy efficient

Technical information

Main heating fuel:	Natural Gas
Building environment:	Air Conditioning
Total useful floor area (m^2):	50759.953
Building complexity (NOS level):	5
Building emission rate ($kgCO_2/m^2$ per year):	18.65
Primary energy use (kWh/m^2 per year):	127.17

Benchmarks

Buildings similar to this one could have ratings as follows:

26 If newly built

70 If typical of the existing stock

Administrative information

This is an Energy Performance Certificate as defined in the Energy Performance of Buildings Regulations 2012 as amended.

Assessment Software:	Virtual Environment v7.0.12 using calculation engine ApacheSim v7.0.12
Property Reference:	000000000000
Assessor Name:	
Assessor Number:	ABCD123456
Accreditation Scheme:	Information not available
Employer/Trading Name:	Trading Name
Employer/Trading Address:	Trading Address
Issue Date:	25 Nov 2019
Valid Until:	24 Nov 2029 (unless superseded by a later certificate)
Related Party Disclosure:	Not related to the owner

Recommendations for improving the energy performance of the building are contained in the associated Recommendation Report: 0040-0000-0408-0900-0004

About this document and the data in it

This document has been produced following an energy assessment undertaken by a qualified Energy Assessor, accredited by Information not available. You can obtain contact details of the Accreditation Scheme at Information not available.

A copy of this certificate has been lodged on a national register as a requirement under the Energy Performance of Buildings Regulations 2012 as amended. It will be made available via the online search function at www.ndepcregister.com. The certificate (including the building address) and other data about the building collected during the energy assessment but not shown on the certificate, for instance heating system data, will be made publicly available at www.opendatacommunities.org.

This certificate and other data about the building may be shared with other bodies (including government departments and enforcement agencies) for research, statistical and enforcement purposes. For further information about how data about the property are used, please visit www.ndepcregister.com. To opt out of having information about your building made publicly available, please visit www.ndepcregister.com/optout.

There is more information in the guidance document *Energy Performance Certificates for the construction, sale and let of non-dwellings* available on the Government website at: www.gov.uk/government/collections/energy-performance-certificates. It explains the content and use of this document and advises on how to identify the authenticity of a certificate and how to make a complaint.

Opportunity to benefit from a Green Deal on this property

The Green Deal can help you cut your energy bills by making energy efficiency improvements at no upfront costs. Use the Green Deal to find trusted advisors who will come to your property, recommend measures that are right for you and help you access a range of accredited installers. Responsibility for repayments stays with the property - whoever pays the energy bills benefits so they are responsible for the payments.

To find out how you could use Green Deal finance to improve your property please call 0300 123 1234.