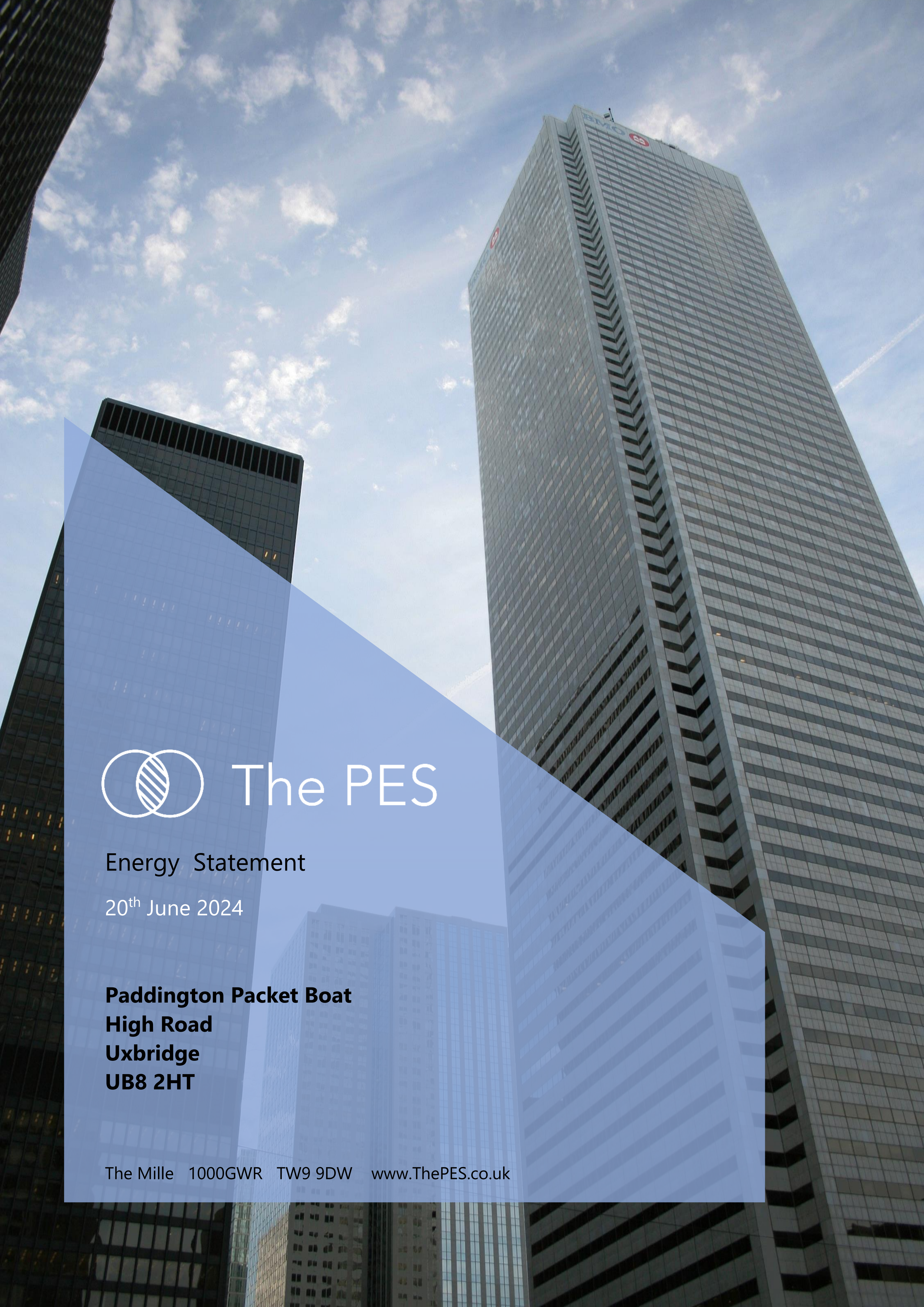

The PES

Energy Statement

20th June 2024

Paddington Packet Boat
High Road
Uxbridge
UB8 2HT

The Mille 1000GWR TW9 9DW www.ThePES.co.uk

Contents

Appendices

Version Control

V1	20-06-24	

1.0 Executive Summary

The proposed development project at Paddington Packet Boat involves the redevelopment of the existing site to provide purpose-built student accommodation.

It has been designed to achieve the highest of environmental performance standards following the Energy Hierarchy as set down by the London Plan and the London Borough of Hillingdon's local plan policies.

The report takes on board the latest GLA guidance on writing energy statements (June 2022) as well as taking into account matters raised within the London Plan 2021. Guidance now seeks a minimum on-site improvement over Part L 2021 at 35%, with a benchmark improvement over Part L 2021 at 50%.

A 'Lean, Clean, Green' has been adopted and the development achieves an improvement in build fabric at **10%** at the "Be Lean" stage and an overall improvement (DER/TER) in regulated emissions at over **42%** above Part L 2021 standard, through the adoption of very high standards of insulation, heat pump driven heating and hot water systems and a roof mounted PV array.

The adoption of the above strategy, along with a carbon off-set payment of **£14,116** for this major scheme will meet with London Plan "Zero Carbon" requirements.

2.0 The Site & Proposal

The redevelopment proposals at the Paddington Packet Boat

Demolition of the public house (Sui Generis) and erection of purpose-built student accommodation (Sui Generis) and associated common areas and facilities, landscaping, amenity space, bicycle and motorcycle parking, and refuse storage.

2.1 Local Planning Context

The site sits within the London Borough of Hillingdon

In September 2023, Hillingdon resolved to grant planning permission under application Ref: 1058/APP/2021/3423.

The permission is subject to conditions; specific to this report, is Condition 6:-

Prior to commencement of the development hereby approved (including demolition), an Updated Energy Strategy shall be submitted to, and approved in writing by, the Local Planning Authority. The assessment shall set out the annual baseline regulated energy demand (kwh) as per 2013 Building Regulations (or subsequent amendments) and associated carbon emissions (kgCO2 and tCO2).

The assessment shall then set out the measures and technology required to achieve a 100% reduction (zero carbon) in the CO2 associated with the baseline regulated energy demand; these measures must be sufficiently evidenced with corresponding details and specifications including the location of low and zero carbon technology (i.e. roof plans showing the inclusion of PV panels).

The Energy Strategy must clearly set out any shortfall (tCO2) of the zero-carbon requirement, with a minimum on-site reduction of at least 35% beyond Building Regulations.

The development must proceed in accordance with the approved Updated Energy Assessment.

The assessment will be undertaken to align with the Energy Hierarchy as set out within The London Plan:-

2.2 The London Plan

Chapter 9 deals with Sustainable Infrastructure:-

Policy SI2 Minimising greenhouse gas emissions

Major development should be net zero-carbon. This means reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand in accordance with the following energy hierarchy:

1) be lean: use less energy and manage demand during operation
2) be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly
3) be green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site
4) be seen: monitor, verify and report on energy performance.

B Major development should include a detailed energy strategy to demonstrate how the zero-carbon target will be met within the framework of the energy hierarchy and will be expected to monitor and report on energy performance.

C In meeting the zero-carbon target a minimum on-site reduction of at least 35 per cent beyond Building Regulations is expected. Residential development should aim to achieve 10 per cent, and non-residential development should aim to achieve 15 per cent through energy efficiency measures. Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided:

1) through a cash in lieu contribution to the relevant borough's carbon offset fund, and/or
2) off-site provided that an alternative proposal is identified and delivery is certain.

The project at Paddington Packet Boat would be considered a major, scheme and this report is informed accordingly.

The design team at utilising SAP10.2 emissions data and Part L 2021, in line with the latest GLA guidance.

The GLA Part L 2021 reporting spreadsheet is attached at **Appendix D**.

3.0 Baseline energy results

The first stage of the Mayor's Energy Hierarchy is to consider the baseline energy model.

The following section details the baseline energy requirements for the development – the starting point when considering the energy hierarchy.

3.2 Commercial Space

The energy requirements for space heating, water heating and ventilation within the proposed new build care facility have been calculated using the National Calculation Method (NCM) in line with AD L2 of the Building Regulations 2021.

The Government approved assessment methodology is the Simplified Building Energy Model (SBEM), The PES Ltd use an advanced modelling software - Design Builder - which enables accurate SBEM models to be created, as well as heat loss and cooling load calculations and full M&E design to be undertaken.

To consider the subject building performance against The Building Regulations (Approved Document L2 2021) SBEM first creates the notional reference building, the characteristics of which are defined in within NCM and the minimum fabric values and fixed services efficiencies set down by AD L2.

This creates the target Emission Rate (TER) and should be considered as stage 'zero' of the energy hierarchy as described earlier and sets the benchmark for the worst performing, but legally permissible, development against which, SBEM assesses the "actual" design, fabric values, heating lighting and ventilation systems and creates the Building Emissions Rate (BER).

As noted above, SAP10.2 emissions data has been used for gas and electrical consumption; mains gas at 0.210kg/kWh and electricity at 0.136kg/kWh.

In line with the GLA guidance the assessment will assume centralised plant, LTHW distribution and natural ventilation at the baseline stage.

3.3 Unregulated Energy Use

The baseline un-regulated energy use for cooking & appliances in the residential units have been taken from the SBEM BRUKL outputs under "equipment".

The emissions associated with unregulated energy use per sqm is summarised in Table 1 below

Table 1 – Unregulated Energy Use

Unit	CO_2 emissions - Unregulated Energy Use SAP10.2 Kg/Annum
Paddington Packet Boat	3,099

The un-regulated emission rates are added to the baseline regulated emission rates (as calculated under 3.1 above) in order to set the total baseline emission rates before then applying the energy hierarchy in line with The London Plan and Hillingdon policies.

3.4 Baseline Results

The baseline building results have been calculated in line with SAP10.2 emission standards and are presented in Table 2 below. The Baseline SBEM outputs (which summarise the key data) are attached at **Appendix A**, with the GLA Part L 2021 Reporting Spreadsheet attached at **Appendix D.**

Table 2 – Baseline energy consumption and CO2 emissions

Unit	Total Regulated Emissions Kg/Annum	Total Unregulated Emissions Kg/Annum	Total Baseline Emissions Kg/Annum
Paddington Packet Boat	8,593	3,099	11692
Development Total	**8,593**	**3,099**	**11692**

4.0 Design for energy efficiency

The first step in the Mayor's 'Energy Hierarchy' as laid out in Chapter 9 of The London Plan, requests that buildings be designed to use improved energy efficiency measures – Be Lean. This will reduce demand for heating, cooling, and lighting, and therefore reduce operational costs while also minimizing associated carbon dioxide emissions.

This section sets out the measures included within the design of the development, to reduce the demand for energy, both gas and electricity (not including energy from renewable sources). The table at the end of this section details the amount of energy used and CO_2 produced by the building after the energy efficiency measures have been included. From these figures the overall reduction in CO_2 emissions, as a result of passive design measures, can be calculated. To achieve reductions in energy, demand the following measures have been included within the design and specification of the building:

4.1 Heating System

The "notional" heating system considered under the "be lean – use less energy" section of the Energy Hierarchy, will consist of high efficiency heat pump driven systems, aligning with the latest GLA guidance providing under floor heating and domestic hot water to the project.

The system incorporates highly insulated primary and secondary pipework to prevent distribution heat losses. And controls will include weather compensation and delayed start thermostats.

4.3 Fabric heat loss

Insulation measures will be utilised to ensure the calculated U-values exceed the Building Regulations minima, with specific guidance taken from the design team: -

- New wall constructions will be of a brick and block construction and will target a U-Value of 0.20W/m^{2}k or better.
- New pitched roof constructions will achieve a U-Value of 0.12W/m^{2}k, whilst flat roof, and insulated ceilings will achieve 0.12W/m^{2}k
- The newly laid floors will achieve a minimum u value of 0.12W/m^{2}k subject to perimeter/area ratios

Glazing

- The new glazing for windows and doors will be double glazed with an area weighted average U-Value of 1.4W/m^{2}K.

Air Tightness

- The project be tested to $5m^3/hr/m^2$ in line with very best practice for naturally ventilated buildings

Construction Details

- Heat loss via non-repeating thermal bridging within the new build elements will be minimised by the use of bespoke details calculated in line with the SAP10.2 conventions.

4.4 Ventilation

The student accommodation is to utilise low energy naturally ventilation with localised MEV in bathrooms and kitchen areas.

4.5 Lighting and appliances

The development will incorporate high efficiency light fittings utilising LED lamps and common/circulation areas will also have an absence detection system to ensure lights cannot be left on when not in occupation.

The use of LED lighting will also minimise the internal gains commonly associated with tungsten and fluorescent lighting systems and thereby further reduce the potential for the flats to overheat.

External lighting will utilise daylight controls to ensure lights are not active during the day.

4.6 Energy efficiency results

The above data has been used to update the SBEM models, the Building Emission Rate outputs of which are attached at **Appendix B**, whilst Table 3 sets out the total emissions using SAP10.2 data.

Table 3 – Energy Efficient emission levels

Unit	Total Regulated Emissions Kg/Annum	Total Unregulated Emissions Kg/Annum	Total Be Lean Emissions Kg/Annum
Paddington Packet Boat	7,745	3,099	10,844
Development Total	**7,745**	**3,099**	**10,844**

The results show that the energy efficiency measures introduced have resulted in the reduction in regulated and unregulated CO_2 emissions from the development of **7.25%.**

Regulated emissions have been reduced by **9.87%** via the passive design measures highlighted above.

5.0 Supplying Energy Efficiently

5.1 Community Heating/Combined Heat and Power (CHP)

The London Plan, Chapter 9, requires that major developments exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly.

Development in Heat Network Priority Areas should follow the heating hierarchy in Policy SI3 Energy infrastructure.

Therefore, this report must consider the availability of heat networks in the Hillingdon area.

The map below shows the location of the site, and it is NOT located in any Potential Heat Network Project Areas. There are currently no existing schemes to connect to, nor any indicated on the attached map:

Extract from London Heat Map

It is considered unlikely that a local heat network will become available in the foreseeable future and is unlikely to be instigated via ad-hoc development in the area, given distances between such developments, the capital cost associated and the lack of critical mass to overcome the transmission losses in any such proposals.

The project will not have the opportunity to connect to a DEN, however consideration must be given for an on-site district heating/CHP solution for the subject development.

5.2 On-site CHP/District Heating

The heat production facility for a district heating scheme is generally considered to include heat only boilers (HOB) and/or the production of both electricity and heat i.e. CHP.

CHP is, as a rule of thumb, only operated as a base load as, depending on the technology, it may be difficult and/or inefficient to operate according to daily variations in demand. In a well-designed district heating network heat from CHP will provide between 60% and 80% of the annual baseline heat (heating and hot water) requirement with heat-only boiler plants providing the peak load and back-up. To maximise efficiency of the engine it needs to run for at least 17 hours a day; therefore, the heat load needs to be present for this period.

The key benefit from running a CHP engine is that it produces electricity, which can displace grid supplied electricity, which has significant carbon savings. It is for this reason that CHP is designed to run for as many hours of the year as possible.

GLA Guidance states non-domestic developments providing a substantial coincidence of demand for heat and power for the majority of hours in the year (5,000 hours per annum) and the heat to power ratio is low (e.g. 1:1), will still be expected to include on-site CHP as part of their energy strategy to meet the London Plan CO_2 reduction targets.

A small scale student bed development – at 61 units – will not provide the constant heat demand required during the summer months and as such, the potential use of on-site CHP is dismissed.

6.0 Renewable Energy Options

The final element of the Mayor's 'Energy Hierarchy' requires development proposals should provide a reduction in expected carbon dioxide emissions through the use of on-site renewable energy generation, where feasible – Be Green.

Renewable energy can be defined as energy taken from naturally occurring or renewable sources, such as sunlight, wind, wave's tides, geothermal etc. Harnessing these energy sources can involve a direct use of natural energy, such as solar water heating panels, or it can be a more indirect process, such as the use of Biofuels produced from plants, which have harnessed and embodied the suns energy through photosynthesis.

The energy efficiency measures and the sourcing the energy efficiently outlined above have the most significant impact on the heating and hot water energy requirements for the development, and the associated reduction in energy consumption.

This section then sets out the feasibility of implementing different energy technologies in consideration of: -

- Potential for Carbon savings
- Capital costs
- Running costs
- Payback period as a result of energy saved/Government incentives
- Maturity/availability of technology
- Reliability of the technology and need for back up or alternative systems.

6.1 Government incentives

6.1.1 Smart Export Guarantee (SEG)

Introduced in 2020, the SEG will enable solar photovoltaic (PV), wind, hydro and anaerobic digestion (AD) installations up to 5MW and micro-combined heat and power (micro-CHP) up to 50kW will be able to receive an export tariff under the policy.

The SEG is a market-led initiative, requiring electricity supply licensees to offer export tariffs to eligible generators. Suppliers are free to set their own SEG compliant tariff price (provided it is above zero pence at all times) and decide how their tariffs work.

Installation owners are able to shop around and select the Licensee of their choice based upon an offer of the most appropriate tariff.

Payment are made against metered exports only.

6.1.1 Renewable Heat Incentive

The Renewable Heat Incentive (RHI) was formally withdrawn to all projects in March 2022.

6.2 Wind turbines

Wind turbines come in two main types'- horizontal axis and vertical axis. The more traditional horizontal axis systems rotate around the central pivot to face into the wind, whilst vertical axis systems work with wind from all directions.

The potential application of wind energy technologies at a particular site is dependent upon a variety of factors. But mainly these are: -

- Wind speed
- Wind turbulence
- Visual impact
- Noise impact
- Impact upon ecology

The availability and consistency of wind in urban environments is largely dependent upon the proximity, scale and orientation of surrounding obstructions. The site is surrounded by similar height buildings in all direction. To overcome these obstructions and to receive practical amounts of non-turbulent wind, the blades of a wind turbine would need to be placed significantly above the roof level of the surrounding buildings and the proposed project at Paddington Packet Boat itself.

It is inconceivable that any wind turbines of this size would be considered acceptable in this location.

6.3 Solar Energy

The proposed development has areas of flat roof that could accommodate solar panels orientated to the south.

In general, the roofs will have an unrestricted aspect, so there is scope therefore to site solar photovoltaic (PV) or water heating equipment at roof level.

6.3.1 Solar water heating

Solar water heating panels come in two main types; flat plate collectors and evacuated tubes. Flat plate collectors feed water, or other types of fluid used specifically to carry heat, through a roof mounted collector and into a hot water storage tank. Evacuated tube collectors are slightly more advanced as they employ sealed vacuum tubes, which capture and harness the heat more effectively.

Both collector types can capture heat whether the sky is overcast or clear. Depending on location, approximately 900–1100 kWh of solar energy falls on each m^2 of unshaded UK roof surface annually. The usable energy output per m^2 of solar panel as a result of this amount of insolation ranges from between 380 – 550 kWh/yr.

Solar hot water systems are of course, displacing heat pumps for DHW provision (as noted below), and due to the efficiency as a source of energy, solar thermal systems tend to have a very poor pay back model unless there is a reliable and consultant demand for hot water; a medium size residential scheme simply does not provide this.

Accordingly, given the limited roof space available and the strategy to off-set the electrical use, solar PV may be a stronger candidate (see below) and offer a greater return in terms of a return on investment.

6.3.2 Photovoltaics (PV)

A 1kWp (1 kilowatt peak) system in the UK could be expected to produce between 790-800kWh of electricity per year based upon a southeast orientation according to SAP2005 methodology used by the Microgeneration Certification Scheme (MCS). The figure given in the London Renewables Toolkit is 783 kWh per year for a development in London.

Despite the withdrawal of the Feed in Tariff, the returns on PV installations are still able to achieve 6-7% returns via the reduction in (ever more expensive) electricity consumption.

Accordingly, the design team are proposing to utilise the available roof space to install a 30 panel PV array to the south-east facing pitched roofs, utilising high power 440w panels, a total 13.2kWp array generating some 10,106kWh/annum.

6.4 Biomass heating

Biomass is a term given to fuel derived directly from biological sources for example rapeseed oil, wood chip/pellets or gas from anaerobic digestion. It can only be considered as a renewable energy source if the carbon dioxide emitted from burning the fuel is later recaptured in reproducing the fuel source (i.e. trees that are grown to become wood fuel, capture carbon as they grow).

Biomass heating systems require space to site a boiler and fuel hopper along with a supply of fuel – which can be very bulky items. There also needs to be a local source of biomass fuel that can be delivered on a regular basis. There are also issues with fuel storage and delivery which mitigate against this technology.

Additionally, a boiler of this type would replace the need for a conventional gas boiler and therefore offset all the gas energy typically used for space and water heating. However, biomass releases high levels of NO_x emissions and particulate matters, as well as other pollutants and would therefore have to be considered carefully against the high standard of air quality requirements within Hillingdon's Borough wide AQMA. Accordingly, the use of biomass is not considered appropriate for this project.

6.5 Ground source heat pump

All heat pump technologies utilise electricity as the primary fuel source – in this case displacing gas, as such, the overall reduction in emissions when using this technology can be less effective when opposed to a technology that is actually displacing electricity.

Ground source heating or cooling requires a source of consistent ground temperature, which could be a vertical borehole or a spread of pipework loops and a 'heat pump'. The system uses a loop of fluid to collect the more constant temperature in the ground and transport it to a heat pump. In a cooling system this principle works in reverse and the heat is distributed into the ground.

The heat pump then generates increased temperatures by 'condensing' the heat taken from the ground, producing hot water temperatures in the region of 45°C. This water can then be used as pre-heated water for a conventional boiler or to provide space heating with an under-floor heating system.

The use of a ground source heating/cooling system will therefore require:

- Vertical borehole or ground loop
- Use of under floor heating
- Space for heat pump unit

Clearly, there is insufficient land area to install low level collector loops, leaving deep bore GSHP as the only potential option.

Normally the boreholes would need to be 6 to 8 metres apart and a 100-metre-deep borehole will only provide about 5kw of heat. The borehole should also be formed around 3m away from the perimeter of the building and most specialists don't recommend using the structural boreholes.

Clearly, in the case of the proposed development, there is little scope for the locating of the ground collector devices and as such, ground source heating cannot be considered.

6.6 Air source heat pump

Air source heating or cooling also employs the principle of a heat pump. This time either, upgrading the ambient external air temperature to provide higher temperatures for water and space heating, or taking warmth from within the building and dissipating it to the outdoor air.

It must be remembered that heat pumps utilise grid-based electricity, so calculations base the benefits on SAP10.2 emissions data

Assuming a seasonal system efficiency of 320% (Coefficient of Performance of 3.2) and that the air source heat pump will replace 100% of the space heating/hot water demand, then the system would reduce the overall CO_2 emissions by approximately 70%. The table below demonstrates, on the assumption of a demand of 10,000Kwh/year for heating and hot water.

Table 4 – Air Source Heat Pump Performance

Type of Array	Energy Consumption (kWh/yr.)	Emission factor ($kgCO_2/h$)	Total CO_2 emissions (kg/annum)
90% efficient gas boiler	11111	0.210	2333
320% efficient ASHP	2813	0.136	383
100% efficient immersion (back-up)	1000	0.136	136

A theoretical carbon saving of 77%

With the above data in mind, clearly an ASHP could be an option and the "be green" proposals include the use of air source heat pumps, connected to plant room based heat exchange equipment, to provide the heat source for the building based centralised LTHW heating and DHW systems.

6.7 Final Emissions Calculation

Given the outcome of the feasibility study above, the developer is proposing the use the above noted air source heat pump system to deliver the heating and hot water demands to the development, as well as a roof mounted 30 panel PV array, a total 13.2kWp array generating some 10,106kWh/annum**.**

The final table – Table 5 – summarises the final outputs from the SBEM models; attached at **Appendix C.**

Table 5 – "Be Green" emission levels

Unit	Total Regulated Emissions Kg/Annum	Total Unregulated Emissions Kg/Annum	Total Be Green Emissions Kg/Annum
Paddington Packet Boat	4,953	3,099	8,052
Development Total	**4,953**	**3,099**	**8,052**

The data at Table 5 confirms that overall emissions – including unregulated energy use - have been reduced by **31.13%** over and above the baseline model, with a **23.88%** reduction in emissions directly from the use of energy generating and renewable technologies, i.e. over and above the energy efficient model.

Excluding the un-regulated use, i.e. considering emissions controlled under AD Part L, then the final reduction in BER/TER equates to **42.36%.**

The Energy Use Intensity and space heating demand of the development are also reported – Table 6 below

Table 6 – Energy and Heat Demands

Building Type	Energy Use Intensity ($kWh/m^2/year$)	Space Heating ($kWh/m^2/year$)
Commercial	33.47	39.78

7.0 Conclusions

This report has detailed the baseline energy requirements for the proposed development, the reduction in energy demand as a result of energy efficiency measures and the potential to achieve further CO_2 reductions using renewable energy technologies.

The baseline results have shown that if the development was built to a standard to meet only the minimum requirements of current building regulations, the total amount of CO_2 emissions would be **11,692Kg/year**.

Following the introduction of passive energy efficiency measures into the development, as detailed in section 4, the total amount of CO_2 emissions would be reduced to **10,844Kg/year**

There is also a requirement to reduce CO_2 emissions across the development using renewable or low-carbon energy sources. Therefore, the report has considered the feasibility of the following technologies:

- Wind turbines
- Solar hot water
- Photovoltaic systems
- Biomass heating
- CHP (Combined heat and power)
- Ground & Air source heating

The results of the assessment of suitable technologies relative to the nature, locations and type of development suggest that the most suitable solution to meeting reduction in CO_2 emissions would be via the use of heat pump driven, centrally based heating and hot water systems and the generation of electricity on site via an 13.2kWp PV array.

This has been used in the SBEM models (reproduced at **Appendix C**) for the development which have also been detailed above in Table 5, which show a final gross emission level of **8,052Kg/year**, representing a total reduction in emission over the baseline model, taking into account unregulated energy, of **31.13%.**

In addition, the final SAP outputs at Appendix C demonstrate that the building achieves an overall improvement in regulated emissions over the Building Regulations Part L standards for regulated emissions of minimum of 42.36%.

The GLA Part L 2021 Spreadsheet is attached at **Appendix D.**

Tables 7-8 Demonstrate how the Paddington Packet Boat project complies with the London Plan requirements and the GLA guidance relating to zero carbon development based up SAP10.2 emissions data.

Table 7 – Carbon Emission Reductions – Non-domestic Buildings

Key	Tonnes/annum
Baseline CO_2 emissions (Part L 2013 of the Building Regulations Compliant Development)	8.6
CO2 emissions after energy demand reduction (be lean)	7.7
CO2 emissions after energy demand reduction (be lean) AND heat network (be clean)	7.7
CO2 emissions after energy demand reduction (be lean) AND heat network (be clean) AND renewable energy (be green)	5.0

Table 8 – Regulated Emissions Savings – Non-domestic Buildings

	Regulated Carbon Dioxide Savings	
	(Tonnes CO2 per annum)	%
Savings from energy demand reduction	0.8	10%
Savings from heat network	0.0	0%
Savings from renewable energy	2.8	32%
Total Cumulative Savings	**3.6**	**42%**
	(Tonnes CO_2)	
Carbon Shortfall	5.0	
Cumulative savings for off-set payment	**149**	
Cash-in-lieu Contribution	**£14,116**	

Appendix A

Baseline/Un-regulated Energy Use:-

SBEM Outputs & Target Emission Rates

Appendix B

Energy Efficient Design:-

SBEM Outputs Building Emission Rates

Appendix C

Generating energy on-site:-

SBEM Outputs Building Emission Rates

Appendix D

GLA Part L 2021 Reporting Spreadsheet