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CLIENT

London Borough of Hillingdon

PROJECT

Building Sustainability/Energy Report
For Northwood Road School Northwood Road Harefield Uxbridge UB9 6ET

FOR PLANNING

Project No.: 21/168
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CONTENTS

SECTION 1

1 INTRODUCTION

1.1 EXECUTIVE SUMMARY

The existing biomass and gas boilers in the existing building will be stripped out and removed.

5No. new Air Source Heat Pumps (ASHPs) will be installed to heat the existing and extended building.

ASHP's have been selected as this option has the most significant carbon saving over gas boilers, whilst being significantly less expensive than Ground Source Heat Pumps.

1.2 GENERAL

This report has been produced to support the planning application submission for the refurbishment of and extension to the existing (Lord Adonis House) accommodation block that will form Northwood School. The report will outline the environmental strategies for the development in compliance with the current planning requirements relating to energy use and carbon emissions for the mix of existing non-residential building.

The existing accommodation block was built around 2011, hence the building fabric and building services provision are of a reasonably modern standard and, the energy source of the heating and hot water is two gas boilers. The boilers are located in a container that will now impact the landscaping proposals. The container also houses a Biomass Boiler, installed under the original scheme without space for a wood pellet store or automatic pellet feeder.

The current government policy is to move away from using gas as a heating source by 2030. To achieve this, renewable energy or low energy sources need to be considered for the energy source for the building, although since this is classified as a refurbishment the London Borough of Hillingdon have not included any particular requirements in the planning requirements; however, good practise should be considered.

An example of the good practise approach employed in reducing the energy usage of the property follows the London Plan 2021 Policy SI2 hierarchy listed below:

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

1.3 BUILDING DETAILS

The current building is Lord Adonis House, built under Building Regulation of 2006 and aspired to meet a BREEAM “very good” rating. The most notable sustainable element was the provision of a biomass boiler with a gas boiler installed for peak loads and redundancy in the case of the biomass boiler failure or non-use. The original plans only show the container for the biomass boiler with no space provided for the wood pellet store or automatic pellet feeder.

Without the store and the feeder, the Biomass boiler cannot operate.

The current building is a three-storey block designed for residential boarding constructed from cross laminated timber (CLT) with curtain wall external fabric with double glazed VELFAC windows. The new extension will be designed to meet the current building regulations and the LETI 'unconstrained Retrofit' document.

The new extension will be built to the current building regulation with improved "U" values and air tightness levels. The existing building fabric will not be improved due to costs. There are no requirements from the London Borough of Hillingdon to achieve a BREEAM rating although all measures that are cost effective will be used. There are no particular requirements for the use of renewables, however as good practise, renewables/low energy options will be considered.

The Existing Floor area is	1,613 M^2
The Extension Floor area is	622 M^2
Total	2,235 M^2

The school will become a secondary special school for approximately 72 pupils and associated staff. The refurbishment needs to cater for these SEND pupils based upon BB104 and discussion with the school staff. The school will be occupied for 5 days a week during normal term times, with limited out of hours activities.

The new extension brings the building closer to the Northwood Road and due to the special acoustic needs of the pupils' natural ventilation in the classrooms couldn't be used and a hybrid ventilation would be used to provide ventilation and assist with avoidance of overheating.

Given the change of use the water consumption within the existing and new buildings will need to be consider and be reduced to be inline for Building Regulations Part G.

1.4 DEFINING ENERGY TARGETS

At this planning stage, full modelling has not been carried out for the building, hence estimated energy consumption and resulting CO2 emissions have been lifted from the Benchmarks outlined in CIBSE Guide F: Energy Efficiency in Buildings, TM46 Energy Benchmarks and the Energy Benchmark tool on the CIBSE website.

The Energy Benchmark tool outlines the industry standard benchmarks for the various types of buildings using a mix of fossil and electric fuels. For the purposes of this report the figures for 'Typical Practice' – Education (School) – Special Schools. The gas load includes for heating items only.

Estimation of Annual Energy Consumption and Carbon Emissions.
The Energy Benchmark tool (on line access 01/04/22)

Item	**Consumption (kWh/M²/Year)**	**Consumption (kWh/Year)**	**CO_2 emissions (kG/ CO_2 per year)**
Gas	157	350,895 *	73,688 *
Electricity	51	113,985 **	15,502 **
TOTAL		464,880	89,190

* Based on kWh x Fuel Factor of gas at 0.210

** Based on kWh x Fuel Factor of electricity at 0.136

This estimates the annual CO2 emissions to be 39.91 kG/ CO_2/M² per year

SECTION 2

2 MINIMISING CARBON DIOXIDE EMISSIONS

2.1 BE LEAN – GENERAL

The existing building fabric is a fixed element as the building construction is reasonably modern and any improvements would likely not be cost effective in terms of payback period.

The new extension will be designed to meet the current Building Regulation requirements, Part L2B. This will include any reasonable measures to Limit heat gains and losses through the new thermal elements an hence minimise energy consumption whilst ensuring the new classrooms do not overheat and that sufficient ventilation is provided to ensure good indoor air quality.

2.2 BE CLEAN - GENERAL

Policy SI2 of the London Plan encourages the move to decentralised generation (off-site) of heat and power seeking to reduce the losses and inefficiencies of reliance upon a centralised system, where this is feasible. This would be achieved by using zero / low emission system or where available, heat networks. There are no current plans for a heat network in the area, and therefore this can be discounted.

The current arrangement of using gas boilers is no longer considered the cleanest method of providing heating to the building hence consideration is being given to new on-site zero/low emission technologies.

2.3 BE GREEN - GENERAL

Policy SI2 of the London plan states “The Mayor seeks to maximise the proportion of energy generated from renewable sources for use on site and if possible storing energy.”

The aim in considering renewable technologies is to reduce the carbon dioxide emissions where feasible and achieve improvement over the Building Regulations targets. The choice of system will need to provide a reasonable payback period over alternative schemes.

Air or Ground Source Heat Pumps

These offer the most realistic approach to provide heating for the building and we are considering 3 options for this scheme.

1) Replace the gas boilers with Air Source Heat Pump (ASHP's) for the whole project.

2) Retain the gas boilers of the existing building, with an Air Source Heat Pump (ASHP) for the extension. We would consider relocating the gas boilers into the current plant room and possibly include for new boilers.

3) Replace the gas boilers with Ground Source Heat Pumps (GSHP's).

NOx is emitted from the burning of fossil fuels and contribute to both acid rain and to global warming in the upper atmosphere The approach with all ASHPs & GSHPs will assist with reducing the pollution levels as this equipment has on NOx discharges on site.

In the case of ASHP's, the installation will have to consider noise and vibration issues to comply with Planning requirements.

Typical Ecodan CAHV P500-YB

The CAHV P500-YB is 1,978mm Wide x 759mm Deep x 1,710 High

The monobloc heat pump draws heat from the air by applying the thermal processes of a 'reverse' heat engine with a vapour compress extract low grade heat from the air and delivering heat at a high temperature by means of a

circulating working fluid of refrigerant. The process of transferring the heat from air to water using R32 refrigerant gas takes place with-in the unit. No refrigerant gas enter the building from this system.

Photovoltaic Panels

There is sufficient un-shaded roof space orientated south to install the panels. The flat roof on the existing building as having enough space to position PV panels without being in intermitted shading. These would generate electricity which will be used to help power the school equipment. An initial approximation of 50 panels has been made which would generate approximately 23kW of electricity.

Further assessment will be required during the detailed design phase, and the need to submit a g99 application to the DNO and time frame for the approval.

Biomass Boilers

The use of biomass boilers has not been considered due to:

- space restrictions – there is a need to provide fuel storage and an automatic feeder which will double the current space taken up by the biomass boiler

- the age of the biomass boiler. The boiler is at least 10-years old and we assume the warranty has long since expired. The condition of this boiler is unknown and there is no guarantee that it would operate and/or keep operating for the expected economic lifespan.

Solar Thermal Panels

Solar hot water has not been considered due to the proposal to provide local electric hot water heaters, and the expected low hot water demand from the building.

Wind Turbine

Wind turbines have been excluded on the basis of planning and aesthetics.

2.4 BE SEEN - GENERAL

Policy SI2 of the London plan states “The Mayor seeks to monitor, verify and report on energy performance.”

The aim is to ensure that the actual energy performance is in line with design of the system by meter of the systems and providing displays of the energy being used.

This could be expanded to become a teaching tool for the pupils.

2.5 WATER

Water consumption and conservation is becoming an increasingly important issue with water becoming more expensive to produce in both financial and energy terms and s included in the London Plan under Policy SI 5. This refurbishment/extension will need to consider the use of fixed fittings which reduce water use in WCs, taps and showers. The Water Efficiency for Dwellings to Building Regulations Part G allows for 125 litres per person per day target, which can be achieved by using modern water-efficient fittings alone such as low flush toilets, flow restrictors on taps, low-flow showers and low water-use baths.

- Showers — Limited to 9 litres / m with flow restrictor.
- WCs — 6 / 4 litre dual flush.
- Basin Taps — Limited to 3 litres / m with flow restrictor.
- Kitchen Tap — Limited to 8 litres / m with flow restrictor.
- Baths — Max. 200 litres to overflow.
- Washing Machine — Max. 8.17 litres / kg dry load.
- Dishwasher — Max. 1.25 litres / place setting.

SECTION 3

3 REVIEW OF OPTIONS

3.1 HEATING / HOT WATER ARRANGEMENT

The existing gas boilers presently provide heating and hot water for the accommodation block.

There are 2No 1000 litre calorifiers and this quantity of hot water is far in excess of the needs of a modern school without full catering facilities, and we recommend to reduce / remove this storage.

The heating is provided by a wet underfloor heating system. This will have to be replaced because of the internal wall changes.

It is proposed that the existing hot water calorifiers and cold-water storage tank are removed. The refurbished and extended school will be provided with domestic water services via a direct cold water main feed and local electric water heaters. There will be no storage of cold or hot water on-site.

The new extension consisting of classrooms and breakout spaces will be heating only to be provided by underfloor heating.

3.2 REVIEW OF HEATING APPLICATION

This section briefly outlines the three options to be considered, firstly, the outline installation costs, second potential payback period against simple relocating and replacing the existing boilers and, thirdly to cover the new extension and the potential carbon dioxide savings against providing 3No new gas boilers to provide the heating.

The potential payback period is a difficult figure to predict, given the rising energy costs. In addition, consideration needs to be given to future proofing of the scheme against changing Government targets on carbon dioxide emission and reducing the use of fossil fuels.

The budget cost is for the primary equipment, associated with each option and do not take into account the amount of space required in each building, the changes to the domestic water services, removal of redundant equipment and any structural modification. The running costs are only applicable to the heating source and not the rest of building.

3.3 OPTION 1: AIR SOURCE HEAT PUMPS ONLY

This option would remove the need for fossil fuel and allow the removal of the current boiler container.

The scheme would require 5No ASHPs (Ecodan CAHV P500-YB) to be located on the roof, split between the existing and new roof. However, given that we will require a thermal store, pipework and existing pumps, it may be more practical to have the units all on one roof with a suitable enclosure and to avoid noise disturbance the units would need to be on antivibration mounts.

Typical Ecodan CAHV P500-YB

The Budget Cost:

1) Base Scheme with 3No Gas boilers (Quinta Ace 90) + Ancillaries
£30,000.00
2) 5No Ecodan CAHV P500-YB
£126,736.00

Item	Annual Consumption (kW/Year)	Annual CO_2 emissions (kG/ CO_2 per year)	Annual Running Cost £
Base Option 3No Gas Boiler	336,800	70,700 *	15,700 *
Option 1 5No ASHP	77,900	10,595 **	16,000 **
DIFFERENCE BETWEEN THE OPTIONS	**-258,900**	**-60,105**	**300**

* Based on kWh x fuel factor of gas at 0.210 and cost of 0.0465 p/kWh

** Based on kWh x fuel factor of electricity at 0.136 and cost of 0.206 p/kWh

The overall emissions would be reduction by 60,105 kG/ CO2 per year, against the theorical base building installation of 3No. Gas Boilers. However, based current fuel price mix the running cost would be similar. This arrangement would mean that there are no fossil fuels being used on-site which could be considered as future proofing the project.

3.4 OPTION 2: EXISTING GAS BOILERS AND NEW ASHPs FOR EXTENSION

The current gas boilers are 11-12 years old with a life expectancy of 15 to 20 years. Due to the low usage and good maintenance, these boilers could last another 8 years. If the boilers are relocated into the existing plantroom however, the installation Contractor would not be able to provide a warranty. In addition, the Government currently plan to stop the installation of gas boilers by around 2030 and therefore it would be difficult to replace the gas boilers when they fail. It would seem sensible to replace the boilers with new ones in this scheme.

The Air Source Heat Pump (ASHP) system would provide the heating for the new extension. The ASHP would be located on the roof of the new extension, with an acoustic screen to shield the second floor along with a small plant room to house the buffer vessel, pumps and controls.

The Budget Cost:

3) 2No Gas boilers (Quinta Ace 90) + 1No Ecodan CAHV P500YB+ Ancillaries

£50,000.00

Item	Annual Consumption (kW/Year)	Annual CO_2 emissions (kG/ CO_2 per year)	Annual Running Cost £
Existing Building New Gas Boilers	218,000 *	45.800 *	12,200 *
Extension ASHP (COP 3.39)	15,600 *	2,122 **	3,200 **
TOTAL	233,600	47,922	15,400

* Based on kWh x fuel factor of gas at 0.210 and cost of 0.0465 p/kWh

** Based on kWh x fuel factor of electricity at 0.136 and cost of 0.206 p/kWh

If compared against the "Base building" which would be 3No gas boilers for the new and existing parts of the building

Item	Annual Consumption (kW/Year)	Annual CO_2 emissions (kG/ CO_2 per year)	Annual Running Cost £
3No New Gas Boilers- whole building	336,800	70,700 *	15,700 *
2No Gas Boilers- 1No ASHP	233,600	47,922	13,600
DIFFERENCE BETWEEN THE OPTIONS	**-103,200**	**-22,778**	**-2,100**

The overall emissions would be reduced by 22,778 kG/ CO2 per year against the theorical base building installation of 3No. Gas Boilers. To add 1No. ASHP and include for 2No. new gas fired boilers would provide a simple payback of around 9 years at the current fuel price however this would mean that there are still fossil fuels being used on-site.

3.5 OPTION 3: GROUND SOURCE HEAT PUMPS

In this option, it is proposed to replace fossil fuels gas boilers with 2No Ground Source Heat Pumps (GSHP's) with associated thermal store pipework, pumps, controls, etc.

There would be 3No 150m deep boreholes with 40mm single loop pipework in the ground as a closed loop system. The boreholes would be spaced at 8 metre centres and located under the MUGA area. The GSHP and thermal store would be located in the existing plantroom following the removal of the existing cold water storage tank and 2No hot water calorifiers. The hot water temperature from the GSHP is suitable for underfloor heating.

The GSHP's being located in the plantroom reduces the need for any noise control.

The Budget Cost:

4) 2No GSHP's, 30No boreholes construction, thermal stores Associated pipework pumps controls

£425,800.00

Item	Annual Consumption (kW/Year)	Annual CO_2 emissions (kG/ CO_2 per year)	Annual Running Cost £
Base Option 3No Gas Boiler	336,800	70,700 *	15,700 *
Option 3 2No GSHP Thermal Store	77,700	10,567 **	16,000 **
DIFFERENCE BETWEEN THE OPTIONS	**-259,200**	**-60,133**	**300**

* Based on kWh x fuel factor of gas at 0.210 and cost of 0.0465 p/kWh

** Based on kWh x fuel factor of electricity at 0.136 and cost of 0.206 p/kWh

The overall emissions would be reduction by 60,133 kG/ CO2 per year, against the theorical base building installation of 3No. Gas Boilers. However, based current fuel price mix there running cost would be similar. This arrangement would mean that there are no fossil fuels being used on-site which could be consider as future proofing the project.

3.6 EMISSIONS AND RUNNING COSTS BASED ON BUILDING REGUALTIONS PART L 2021

The Fuel factor of electricity has been significantly reduced under the new Building Regulations and this reduction is reflected in this report.

Whilst this improves the Carbon saving since the fuel prices are not part of Building Regulations this does not impact the running costs.

Item	**Annual Consumption (kW/Year)**	**Annual CO_2 emissions (kG/ CO_2 per year)**	**Annual Running Cost £**
Base Option 3No Gas Boiler	336,800	70,700 *	15,700 *
Option 1 5No ASHP	77,900	10,595 **	16,000 **
Option 2 2No Gas Boilers 1No ASHP	233,600	47,922 * / **	13,600 * / **
Option 3 2No GSHP Thermal Store	77,600	10,567 **	16,000 **

* Based on kWh x fuel factor of gas at 0.210 and cost of 0.0456 p/kWh

** Based on kWh x fuel factor of electricity at 0.136 and cost of 0.206 p/kWh

The overall emission reduction is far more significant with the all ASHP and GSHP options

Option 1 Carbon Emission is reduced by reduction by **22,788 kG/ CO_2 per year**
Option 2 Carbon Emission is reduced by reduction by **60,105 kG/ CO_2 per year**
Option 3 Carbon Emission is reduced by reduction by **60,133 kG/ CO_2 per year**

SECTION 4

4 CONCLUSION

The current boiler arrangement will not be able to cope with the new extension without adding another heat source. It is sensible to look at the newer low carbon alternatives other than gas boilers. In addition, the current boiler house location does not suit the proposed landscape so there is scope for relocating the gas boilers and to include for a longer life and manufacturers warranties then new boilers would be best approach.

expensive to run is just to add a new ASHP for the extension only, whilst the other two option have similar running costs. Based against the theorical use of a third boiler, the only option that is less

This is based on assumed current prices for gas and electricity and the quoted COP from the manufacturers. In the longer term the both the all ASHP & GSHP have significant lower energy inputs and if relative price of electricity improves against the price of gas (at the moment electricity is 4.4 times as expensive) then both option 2&3 would be more viable.

The government also plans to stop the use of gas as a heating source by 2030.

Given the above, the existing boilers on-site will be stripped out and replaced with 5No. ASHPs. This option has the most significant carbon saving compared to gas boilers, whilst being significant less expensive than the GSHP option.