Banyards

Low / Zero Carbon Technology Report

For Planning

Revision P01

Truck Servicing Facility

For British Gypsum

British Gypsum SAINT-GOBAIN

Project No. 10366-42

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Low / Zero Carbon Technology Report – For Planning

For

British Gypsum Ltd

Truck Servicing Facility

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FOREWORD

1. **This document has been prepared by Banyard Consultants Ltd with all reasonable skill, care and diligence within the terms of the contract with the Client and within the limitations of the resources devoted to it by agreement with the Client.**

Distribution Sheet

Our ref: 10366-42

Low / Zero Carbon Technology Appraisal - For Planning

For

British Gypsum Ltd

Truck Servicing Facility

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EXECUTIVE SUMMARY

The British Gypsum Truck Servicing Depot project consists of a new single storey high ceiling Warehouse of approximately 750m^2. The internal building would include MOT and Service Bays, Offices, Meeting Rooms, Staff Mess, Storage Spaces, WCs and Disabled WCs. Externally, the site will provide functional parking facilities for the Depots operational staff and the trucks to be serviced.

Banyards have appraised various technologies and servicing strategies to determine the most appropriate options for the new Truck Servicing Facility at British Gypsum.

British Gypsum are committed to developing a low energy and carbon efficient facility that will include some of the following proposals:

- Efficient building fabric - Low U values
- Low Energy ventilation systems to deliver an optimum internal environment
- LED Lighting complete with effective lighting controls to maximize use of daylight.
- A Building Energy Management System c/w Logical metering strategy

We also intend to utilise the following Low Carbon technologies:

- High efficiency air source heat pumps
- Hot Water provided by PV enabled Thermal Storage Batteries
- Waste Water Heat recovery to showers

The building will further benefit via the addition of the following:

- Photovoltaic array (location to be confirmed) for generation of clean onsite electricity

The solution proposed will comfortably surpass the requirements of Part L2A of the Building regulations resulting in an A rated EPC (minimum).

Further water saving systems, including truck wash and rainwater harvesting, will be considered during the technical stages of design.

1.0 GENERAL OVERVIEW

1.1 Heating – Fabric Efficiency

Systems will be designed inline with CIBSE Guidance to satisfy the heat losses associated with fabric, infiltration and ventilation losses as per the following building constructions.

Construction Element	U Value	G Value
External Wall	0.17	N/A
Exposed Floor	0.14	N/A
Roof	0.18	N/A
External Door	2.2	N/A
External Windows	1.6	0.4 (North), 0.35 (West, East & South)
Roof Light	1.6	0.3

Heating temperature set points:

Room Type	Normal Maintained Air Temperature during Winter (ºC)	Normal Maintained Air Temperature during Summer (ºC)
Service Workshop	16	Uncontrolled
Offices	21	23
Meeting Room	21	23
Staff Mess	20	23
WC's (inc. Dis'd)	17	Uncontrolled
Lockers	21	Uncontrolled
Storage	5	Uncontrolled

1.2 Cooling

Comfort cooling will be provided within the Offices, Meeting Room and Staff Mess areas to ensure comfort levels are maintained throughout the year.

1.3 Ventilation

The MOT & Service Bays will be naturally ventilated via the 2 No. large vehicle doors complete with exhaust fume extraction equipment (e.g. tailpipe exhaust scavenge systems or similar) inline with Health & Safety Executive guidance - HSG261, SR14 and HSG187.

The Oil Tank Store will be naturally ventilated via a fully louvred wall inline with DSEAR Regulations 2002. The size and performance of the louvred wall to be confirmed following further details from the Client.

The Offices and Meeting Room will be ventilated via a mixed mode strategy. Generally, mechanically ventilated via heat recovery units with user controlled manually openable windows to save energy in summer.

Room Type	Ventilation Rate
Offices	12 litres/sec/person
Meeting Room	12 litres/sec/person

All WC's, Cleaners Stores and areas where food is prepared (such as the Staff Mess) would be mechanically ventilated.

1.4 Building Management System (BMS)

The BMS would be an open protocol distributed intelligence building management system with local outstations controlling main plant items. The BMS system would be loaded into the Mechanical Control Panel (located within the Ground Floor Plantroom) and would achieve the following objectives:

- Control the operation of all plant to achieve the desired room performance /objectives in the most energy efficient manner
- Optimise the starting and stopping of all plant to provide the most energy efficient operation
- Report & record all meters, faults and alarms to the BMS head-end via Ethernet (location to be confirmed)

1.5 Metering

We will Include for the provision of energy metering to meet the building regulations Part L2 requirements. The metering strategy would allow separate metering of:

- General split lighting and power distribution boards
- Mechanical control panel
- External lighting board
- Each meter would be linked to the BMS system via an RS485 modbus connection.

1.6 Internal & External Lighting

LED lighting would be installed, to comply with CIBSE LG1 & LG7 to all internal areas and made up of downlights, recessed, surface mounted (ceiling, wall and within draw pit) and suspended type luminaires. LED lamps are extremely energy efficient and long lasting, whilst at the same time reducing maintenance costs and increasing safety aspects. This lamp type is also recyclable and considered 'green' and earth friendly which makes them suitable when considering key environmental features. Due to their energy efficiency consuming up to 90% less power than other lamps types, there is a large decrease in overall power costs. A lifespan of up to and in some cases exceeding 60,000 hours will also save money and energy in maintenance and lamp replacement costs.

Following completion of the ATEX review, an enhanced specification may be required within the workshops.

Lighting controls would be utilised throughout the building to enhance the performance of the lighting strategy and to save as much energy as possible. The below table provides a proposal on the control principle in each room within the Servicing Depot building:

Room Type	Lighting Control Strategy
Service Workshop	Manual Switching
Offices	Absence Detection
Meeting Room	Absence Detection
Staff Mess	Absence Detection
Circulation	PIR Detection
WC's (inc. Dis'd)	PIR Presence Detection
Lockers	Absence Detection

External LED lighting would be installed, to comply with CIBSE LG6, BS EN 12464 (Part 2) & BS 5489, to provide illumination in periods of darkness to the following areas:

- Building perimeter – utilising bulkheads & emergency fittings where required
- New car parking areas – utilising column mounted floodlights
- Signage & other features – utilising in ground uplighters and/or bollards as a feature

External lighting would be either solar powered fittings or fed off a dedicated external lighting distribution board, inclusive of Photocell to control external luminaires against pre-determined natural lighting levels, Timeclock to control external luminaires against a desired pre-set time and a Manual Override Switch.

2.0 LOW AND ZERO CARBON TECHNOLOGIES APPRAISAL

For this desktop study each technology was assessed against various criteria, including cost, pay back, and contribution to carbon reduction.

LOW OR ZERO CARBON TECHNOLOGY	TYPICAL PAY BACK PERIOD	LIFE EXPECTANCY	SPATIAL REQUIREMENTS	PLANNING REQUIREMENTS	NOISE / SHADOWING IMPACT	FURTHER COMMENTS
HYDRO-POWER	N/A	N/A	N/A	N/A	N/A	This site is not suitable.
COMBINED HEAT & POWER	15-20 years	10 -15 years	Large plant space required for heavy plant.	Banyards are unaware of any planning requirement which would preclude the use of this technology.	A CHP to serve this building would need significant noise treatment to meet the requirements.	The heating and electrical loads of the building are not suitable to support this technology.
GROUND / WATER SOURCE HEAT PUMPS	6 – 10 years (with cooling demand)	15-20 years	Deep boreholes or Large external area (e.g. Sports field) required.	Banyards are unaware of any planning requirement which would preclude the use of this technology.	N/A	Low end of payback can only be achieved with High Cooling load. High Capital cost involved, and extensive ground works required. Economically unfeasible
AIR SOURCE HEAT PUMPS	15 – 20 years	15-20 years	External plant area required.	Banyards are unaware of any planning requirement which would preclude the use of this technology.	The plant space will be acoustically shielded to ensure noise criteria.	Lower end of payback achieved with high cooling load.
WIND POWER	20 years	12 – 15 years	Large base or supporting structure.	The planners may object to this technology on the site due to the proximity to surrounding buildings.	This technology is likely to cause shadowing and flicker, to the surrounding buildings.	The site wind speeds are unlikely to support a substantial Wind powered installation. Technically unfeasible

LOW OR ZERO CARBON TECHNOLOGY	TYPICAL PAY BACK PERIOD	LIFE EXPECTANCY	SPATIAL REQUIREMENTS	PLANNING REQUIREMENTS	NOISE / SHADOWING IMPACT	FURTHER COMMENTS
BIOMASS	10-15 years	15-20 years	Large plant and fuel storage space required at ground level.	Banyards are unaware of any planning requirement which would preclude the use of this technology.	N/A	The site layout requires considerations for dedicated fuel delivery routes and storage. These Logistic issues make this technology unfeasible.
PHOTOVOLTAICS	6 - 10 years	20 years	Structurally supported roof space required with maintained access.	Discussion required with planners.	N/A	Whilst feed in tariffs make this technology commercially viable significant energy and carbon reductions require large areas for plant.
SOLAR THERMAL	15 – 20 years	15 years	Structurally supported roof space required with maintained access.	Banyards are unaware of any planning requirement which would preclude the use of this technology.	N/A	The building’s hot water load profile is unlikely to be suited to warrant a separate Solar Thermal Installation. Consider Sunamp type solution linked to PV as an alternative.
RAINWATER HARVESTING	TBC	20-30 years	Water storage required at or below ground	Banyards are unaware of any planning requirement which would preclude the use of this technology.	N/A	Potentially Economically Unfeasible. The building’s WC / grey water load profile is unlikely to result in a worthwhile investment.
WASTE WATER HEAT RECOVERY	TBC	20-30 years	Integrated within typical spatial allocation for services	Banyards are unaware of any planning requirement which would preclude the use of this technology.	N/A	Modest outlay but overall hot water usage may make this economically unfeasible

The table below demonstrates whether a technology is accepted as feasible or dismissed, with reasons given. If a technology is accepted, it shall be reviewed in further detail at the next design stage.

LOW OR ZERO CARBON TECHNOLOGY	ACCEPTED/DISMISSED AS BEING FEASIBLE	PRIMARY REASON(S) FOR DISMISSAL
HYDRO-POWER	Dismissed	The site is geographically unsuitable for this technology.
COMBINED HEAT & POWER	Dismissed	The heating and electrical loads of the building are unsuitable to support this technology.
GROUND SOURCE HEAT PUMPS	**Accepted**	Ground Source Heat Pumps have been modelled and considered in the following section
AIR SOURCE HEAT PUMPS	**Accepted**	Air Source Heat Pumps have been modelled and considered in the following section
WIND POWER	Dismissed	The site is geographically unsuitable for this technology.
BIOMASS	Dismissed	The logistics of fuel deliveries and ongoing maintenance uplift make this option unfeasible
PHOTOVOLTAICS	**Accepted**	PV panels have been modelled and considered in the following section
SOLAR THERMAL	**Accepted**	Note – Thermal Energy Batteries (typically Sunamp) to be considered
RAINWATER HARVESTING	**Accepted**	Cost benefit Analysis (not captured in Energy modelling)
WASTE WATER RECYCLING	**Accepted**	Cost benefit Analysis (not captured in Energy modelling)

3.0 PART L COMPLIANCE

Banyards have undertaken an initial Part L Calculation using IES software by building a Dynamic Thermal Model to test the preliminary building design and servicing solutions for compliance with Building Regulations 2013. The purpose of the assessment is to most energy and carbon efficient method of providing heating and hot water.

The scenarios modelled, and calculated CO_2 emission rates are summarised below:

Scenario	Target CO_2 emission rate	Building CO_2 emission rate	EPC Rating
BASELINE ONLY - Electric Heating & Thermal Batteries	28	24.5	B
Electric Heating, Thermal Batteries & PV	28	7.1 (PV on all sections of roof)	A
Air Source Heat Pump for Heating, Thermal Batteries & PV	21.5	-2.3 (PV on all sections of roof)	A+
Ground Source Heat Pump for Heating & Hot Water & PV	21.5	-3.3 (PV on all sections of roof)	A+
Ground Source Heat Pump for Heating & Hot Water & Wind Turbines	21.5	12.8	A

Out of the five scenarios, the baseline model achieves a B rating whilst the other scenarios achieve A rating or A+ which equates to Net Zero. Given the commitment from British Gypsum to invest in Low Carbon technology on this project we are confident this project will achieve an EPC of ‘A’ as a minimum standard.

4.0 SUMMARY OF TECHNOLOGIES

Below is a comparison of the accepted technologies

4.1 Ground Source Heat Pumps

Ground Source Heat Pumps are an extremely energy efficient method of providing heating and/or hot water which is demonstrated within Section 4.0 of this report. However, they are often found to be unfeasible for many projects as they require significant external space (subject to ground analysis) and capital for the excavation of bore holes or lengthy shallow trenches to install heat collecting pipes. These pipes extract low grade heat from the earth which is ‘converted’ into useful heat through the refrigeration cycle. The only parasitic power associated with Ground Source Heating is electricity required to power the circulator pump and the compressor within the heat pump itself.

4.2 Air Source Heat Pumps

Similar to Ground Source Heat Pumps without the requirement for any excavation works. Low grade heat is extracted from the air instead of from the earth. This technology is very common throughout the UK as it requires little space and external energy input (electrical supply to compressor only) and costs significantly less than a Ground Source Heat Pump installation however there is a trade-off in energy efficiency.

4.3 Photovoltaic Panels

Photovoltaic panels are one of the cleanest and most commonly installed renewable technologies used across the UK. They are, simply put, a panel made from photovoltaic cells which converts solar energy into direct current (DC) electricity. Since DC electricity has limited use in building services, it is converted into alternating current (AC) electricity to power lighting, general sockets, appliances, and plant. For a meaningful contribution, photovoltaics generally need a significant sized external area which for the purposes of this project is the roof or an adjacent plot of land (subject to the Client making it secure).

Payback period vs Grid Electricity: <7 years

Some projects opt to sell the surplus electricity generated by the PV system back to the grid. However the surplus electricity can also be stored onsite using a battery system – fully modular and virtually unlimited in terms of capacity and performance.

4.4 Solar Thermal (Thermal Batteries)

Thermal storage batteries are an excellent source of providing heating and/or hot water. For this project, the thermal storage batteries have been selected for the provision of hot water only. Thermal storage batteries require significantly less space than a traditional hot water storage vessel as the volume of stored water is significantly less (<15 litres) which inherently reduces legionella risk.

For greatest efficiency, the system is connected to and works in harmony with a Photovoltaic array, using surplus electricity to heat the thermal batteries phase change material which in turn releases its thermal energy into the stored water to provide instantaneous domestic hot water.

4.5 Rainwater Harvesting

Traditionally, rainwater is collected from surfaces such as roofs and goes to drain which in our opinion is a waste of water, especially when a large proportion of each person's daily water needs does not need to be potable. Rainwater harvesting is a process by which this rainwater is collected and stored for re-use within and around the building (e.g. for toilet flushing, vehicle washing) therefore reducing the dependence on infrastructure which in turn reduces water bills.

There are two types of rainwater harvesting systems available – above ground and below ground. The type installed is generally determined by the needs of the Client from both a space and aesthetics perspective however the below ground option is best for the prevention of legionella growth as the stored water temperature will generally be kept below 10^{o}C. Other system requirements include pump set and associative filters, valves.

4.6 Truck Wash Recycling System

Truck washing uses a lot of water which does not need to be of potable standard. A truck wash recycling system is simply put, a system which captures, treats and recycles wash water for re-washing commercial vehicles. Businesses with a fleet of trucks could see their water bill reduce by up to 95%. Whilst these systems considered closed loop, the other 5% of system water is generally lost to infrastructure due to vehicles not being completely dry when they leave, high winds etc. Not only does a truck wash recycling system save businesses money on their water bill, it also reduces the businesses impact of the environment.

A truck wash recycling system has multiple components including (but not limited to) an interceptor and wash water tank, hydro-cyclone separator, pumping station, carbon filters and a control panel. This equipment needs to be protected from the outdoor conditions therefore a plantroom is required. This does not need to be internal to the building as an external GRP enclosure would suffice.

4.7 Waste Water Heat Recovery

Waste water from showers carry thermal energy which is traditionally drained to infrastructure. As a method of saving energy, the heat from the shower waste water can be recovered via a pipe mounted heat exchanger which transfers this recovered heat to the incoming water supply.

This means that the hot water load is reduced, as there is no requirement for heating water from cold to the desired user temperature.

5.0 CONCLUSIONS

The building would be best equipped with the following in order to ensure the baseline energy demand remains low:

- Improved U-values
- High performance glazing with low G-Values
- Heat recovery on ventilation systems
- LED luminaires
- Comprehensive BMS system

Out of the technologies proposed and discussed, the following technologies have been accepted / rejected for this project:

- Ground source heat pump: Rejected - Cost prohibitive
- Air source heat pump: Accepted
- Photovoltaic panels: Accepted
- Solar thermal (Thermal batteries): Accepted
- Rainwater harvesting: TBC
- Truck Washing TBC
- Waste water heat recovery: Accepted