



READING LOGISTICS PARK

Title: Renewable /Sustainability
Energy Report

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Report Origin

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1 Executive Summary

This initial assessment has been prepared at the request of SPIE UK, to investigate low or zero carbon technologies to establish the most appropriate for the proposed development. The development is for 4 No warehouse Units which contain a portion of mezzanine office area in each.

The report considers low or zero carbon technologies which are feasible for the development in line with BREEAM ENE04 requirements.

Photovoltaic Panels provide the best solution for energy savings and the technology suites the flexibility for the shell and core proposal. This technology has low maintenance requirements and associated costs. Drawing should include an area of PV for planning application drawings.

Payback period are likely to be around 9 to 10 years for a 22 kWp system on unit 1 installed costs of approximately £20,000 + Vat.

Units 2 (39kWp @ £45,000 + Vat) should have a marginally better payback and Units 3 (13.5kWp @ £14,000 + Vat) & 4 (15.5 kWp @ £15,000 + Vat) may have a slightly longer payback.

2 Preamble

Sustainability:

“Sustainable Development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”

THE BRUNTLAND DEFINITION

Clancy's is committed to providing a service which is both forward thinking and committed to excellence. Our goal is to support clients and architects through the development of innovative and creative building designs that meet evolving environmental responsibilities.



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3 Introduction

3.1 Background

This initial assessment has been prepared at the request of SPIE UK, to investigate low or zero carbon technologies to establish the most appropriate for the proposed development

3.2 Development Area Plan

The development is for 4 No warehouse Units which contain a portion of mezzanine office area in each. The building will have the following approximate gross floor areas

Unit 1: 3550 sq m (of which 590 sq m is Mezzanine)

Unit 2: 6450 sq m (of which 700 sq m is Mezzanine)

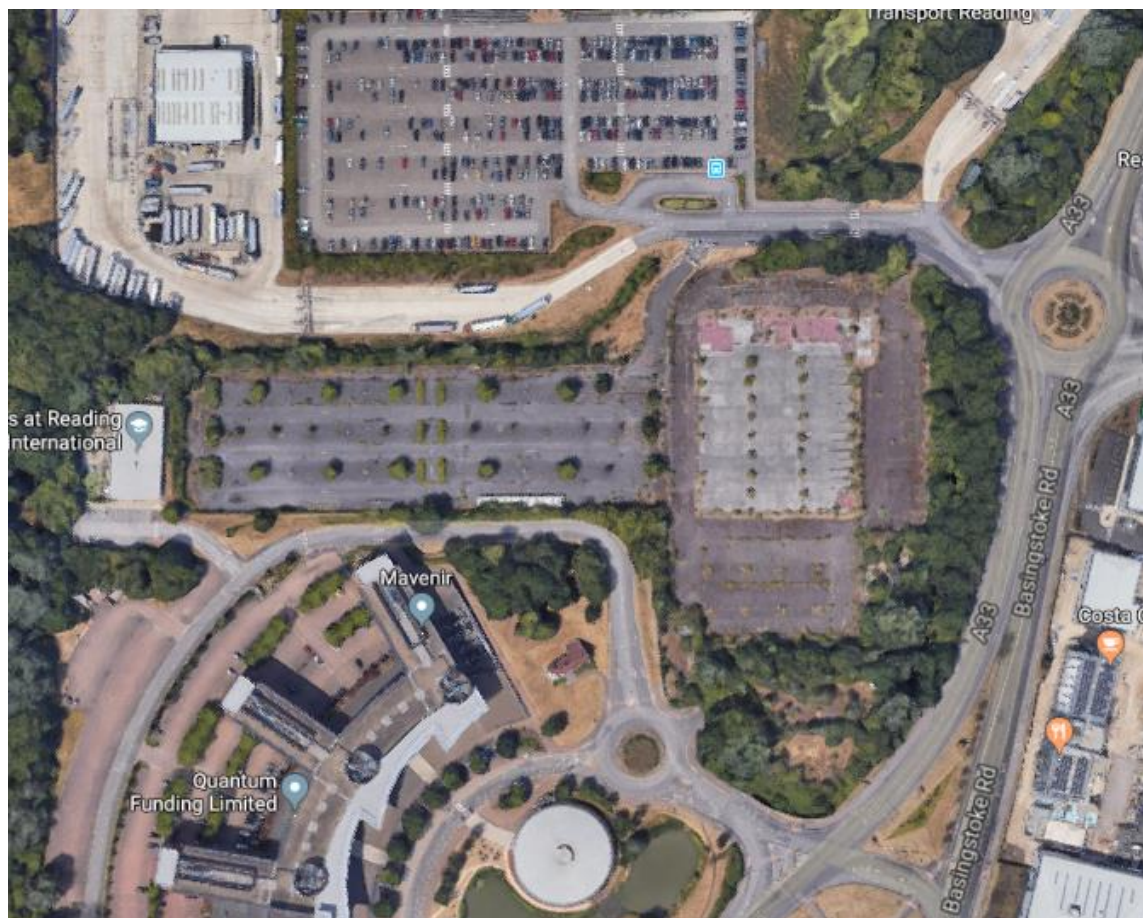
Unit 3: 2200 sq m (of which 270 sq m is Mezzanine)

Unit 4: 2500 sq m (of which 370 sq m is Mezzanine)

The site location is at Reading International Business Park, Reading RG2

3.3 Land Use

The development area is currently a brown field site which is being redeveloped. The image below shows the location of the development and its surroundings.



3.4 Local Planning Criteria

Location of proposed low/zero carbon technologies should be indicated on plans and included within the planning application.

3.5 Noise

The site is not located near any residential areas but is situated between the M4 and A33 roads. It is not expected that sound from normal building services plant would be problematic.

3.6 Presumed Building Energy Usage

The statement has been prepared with energy usage taken from a thermal model of the building, simulated in the correct location and orientation. The usage patterns are based on the national recognised 'National Calculation Methodology' (NCM) templates for this building type.

3.7 Reasons for Investigation

This investigation is to consider Low or Zero Carbon (LZC) technologies which are most appropriate for the development. BREEAM 2018 provides details of what a feasibility should cover in relation to selecting LZC technologies.

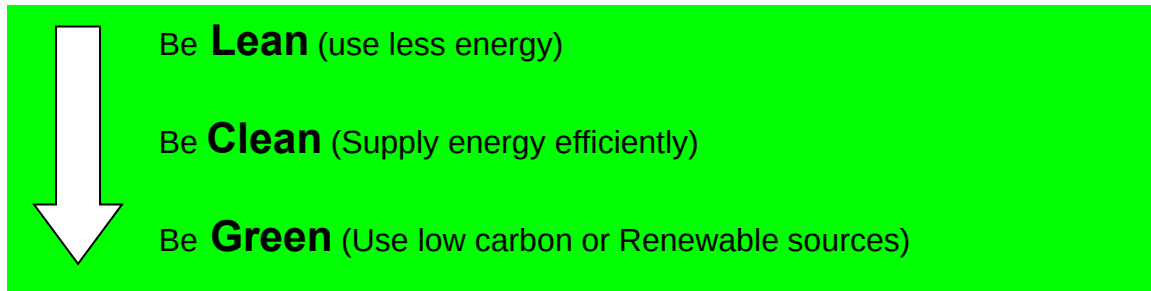
3.8 Delimitation

This report has been carried out to indicate viable solutions and to dispense with any impractical ones. A full site specific analysis has not been carried out for each low or zero carbon technology. Any viable solutions which have agreement to progress further will require additional detailed analysis and cost estimates.

4 Sustainability - Proposed Strategy

4.1 Hierarchy of measures for energy/carbon reduction

To maximise the effectiveness of low or zero carbon technologies, energy has to be minimised as much as possible. Low carbon or renewable energy sources often have a maximum or optimum size. For example PV is generally limited to flat or south east to south west facing roof. Wind turbines can be limited to a physical size and number. Therefore, the strategy for reducing carbon dioxide emissions from the development should be:



4.2 Be LEAN (Use less Energy)

4.2.1 Lighting

- ➡ To maximize daylight, use high efficiency lighting systems with photoelectric dimming and occupancy control where appropriate.

4.2.2 Heating, ventilation and air conditioning (HVAC)

- ➡ Use free cooling when external conditions permit

4.2.3 Building Fabric

- ➡ Aspire to achieve improved U-values beyond L2A requirements for building.
- ➡ Aspirational management procedures to be put in place during construction to improve the quality of the construction by ensuring that the contractors pay attention to quality control at site level.

4.3 Be CLEAN (Supply Energy Efficiently)

4.3.1 Lighting

- ➡ Provide the most energy efficient LED lighting as practically possible for each space type

4.3.2 Heating, ventilation and air conditioning (HVAC)

- ➡ Mechanical ventilation systems to aim to improve on minimum specific fan powers (SFP)
- ➡ Areas of buildings requiring mechanical ventilation would be considered for heat recovery.

- ➡ It is imperative that all of the buildings, their engineering services and renewable energy systems are properly and accurately commissioned to ensure that their performance meet the design expectations.
- ➡ In addition to the normal building operating and maintenance manuals, building log books will be prepared for the development so that the users of the building understand how the systems are intended to work and what actions they can take to influence the energy consumption and associated carbon dioxide emissions from the building during the buildings usable life time.

4.4 Be Green (Use low carbon or renewable sources)

Use of low carbon or renewable sources can be used to replace or offset carbon emissions which cannot be removed through the 'be lean' and 'be clean' options above. The options for low carbon and renewable sources are covered in the next sections.

5 Summary of the Low Carbon & Renewable Energy Options Appraisal

In this section the technical feasibility of each of the low carbon and renewable energy technologies for the site have been assessed in order to rule out unfeasible options.

Technology	Generation		Benefits	Issues Surrounding Technology Considered by this Report	Note
	Thermal	Electricity			
Wind (roof or independent mounted)		✓	- Low maintenance/ongoing costs - Excess electricity can be exported to Grid	- The wind speed data base suggests that the average wind speed for the site is 4.7m/s. When this is corrected for local terrain an average of 3.87m/s @ 10m is likely. This is below the minimum recommended wind speed of 5 m/s - Turbulence from local obstructions requires consideration - Noise needs considering - Often opposed by neighbours due to their aesthetic impact on the local environment - May require planning consent/permission	✗ (Wind speed is below the suggested minimum economic speed of 5m/s [corrected] at hub height. See appendix B for Calculation)
Solar PV		✓	- Low maintenance as no moving parts - Easily integrated into building - No ongoing costs - Excess electricity can be exported to Grid	- Expensive technology to install - Any overshadowing of panel effects output performance - East and west pitched roof reduces performance below maximum. - Fixing system required to suite roof	✓
Solar Thermal	✓		- Low maintenance - Low ongoing costs - Tested technology - Silent Operation	- Must be sized on the hot water heating requirements of building - Ideal for developments with high year-round domestic hot water loads - East and west pitched roof reduces performance below optimum. - Could be eligible for Renewable Heat Incentive. - Would not be appropriate where CHP technology was employed	✗ (Insignificant hot water use expected.)
Solar Thermal air heating	✓		- Low maintenance - Low ongoing costs - Silent Operation	- Requires mechanical ventilation system - Ideal for developments with high year-round domestic hot water loads	✗ (Insignificant hot water use expected.)

				- East and west pitched roof reduces performance below optimum. - Could be eligible for Renewable Heat Incentive. - Would not be appropriate where CHP technology was employed	
Biomass Heating	✓		- Supports local community - Reduces fuel poverty for properties off gas network - Provides further diversity of primary energy	- Space required for fuel delivery and storage and plant room (unit, hot water buffer storage etc) - Reliable fuel supply chain required - Regular maintenance required/ash disposal	✗ (often temperamental technology, Increase local pollution)
Ground Source Heating	✓		- High energy output per energy input - Unobtrusive technology - Minimal maintenance	- Large area required for horizontal pipes - Full ground survey must be carried out - Low temperature water heating circulation required for optimum performance - Areas of permeable car parking surface recommended to maintain ground moisture conditions	✗ (Would be uneconomic – high cost for ground heat exchanger)
Air Source Heating/Cooling	✓		- High energy output per energy input - Small footprint - Option where ground conditions are not suitable for GSHP	- Low temperature water heating circulation required for optimum performance - Lower COP than ground source heat pump. - Multiple systems may lead to noise issues.	✓ (Ideally suited when cooling is required – system can be reversible to provide heat. However, the system is not classed as renewable where system provides cooling.)
CHP (Non-renewable: gas fuelled)	✓	✓	- Efficient use of fuel (approx 80%) - Easily integrated into building - Excess electricity can be exported to grid - Small packaged plant good option for office buildings	- Sized to year-round base load heating or hot water requirement of development - Regular maintenance required - Must run for 4500 Hrs/Year to be viable and have a summer heat demand	✗ (No suitable base load)
Hydro electricity		✓	- Efficient energy source, only min of 2 foot drop required. - Reliable electricity supply with peak output often corresponding to peak demand (ie winter)	- Consideration of ecology impact required between extraction and where water is returned - Extraction license required when diverting water from a water course. - Planning permission is likely to be required	✗ (No suitable water course)

			System can be up to a mile from building		
CHP Community Energy	✓	✓	- Allows for more diverse heat load for the CHP - Often allows for longer running period for CHP increasing viability	- More ideal for were community heat loads are closer to CHP location - Minimise heat distribution network to keep additional capital cost low to maximise viability	x <i>(No suitable baseload)</i>

Note: ✓ = Considered a Viable Option for this site
x = Not Considered Viable
? = Detailed Study Required, Borderline Option for this site.

6 Low Carbon and Renewable Energy Options

To aid in assessing the following low carbon and renewable options, Low or Zero Carbon Technologies Calculations have been carried out in line with DCLG strategic guide. The full calculations can be seen in Appendix A.

The initial assessment of the site suggested that:-

6.1 Solar Thermal Water Heating

Insufficient hot water demand expected

6.2 Air Source Heating

It is expected that the buildings will include cooling within the office area which is likely to be provided by a multi split system.

These systems work on an air to air basis, with the internal units re-circulating air in the rooms to heat/cool the space. The system benefits from good Coefficient of Performance (COP) and Seasonal Energy Efficiency Rating (SEER) reducing heating energy requirements.

6.2.1 Grants/Allowances for ASHP

Enhanced Capital Allowances (ECAs) can be claimed for air to air systems (including splits and multi splits) and air to water systems. The air source heat pump needs to comply with the energy technology list (ETL) criteria and be on the energy technology list (ETL). A business can then claim 100% first-year capital allowances on their spending on qualifying plant and machinery. This can deliver a helpful cash flow boost and a shortened payback period.

Renewable Heat Incentive (RHI) Splits and Multi- splits systems are not covered by RHI.

6.3 Ground Source Heating

Ground source heating and cooling will be significantly more costly and is generally offered where there is in adequate space for external air condensers.

6.4 Biomass Heating

Increases local pollution and not desirable for the area

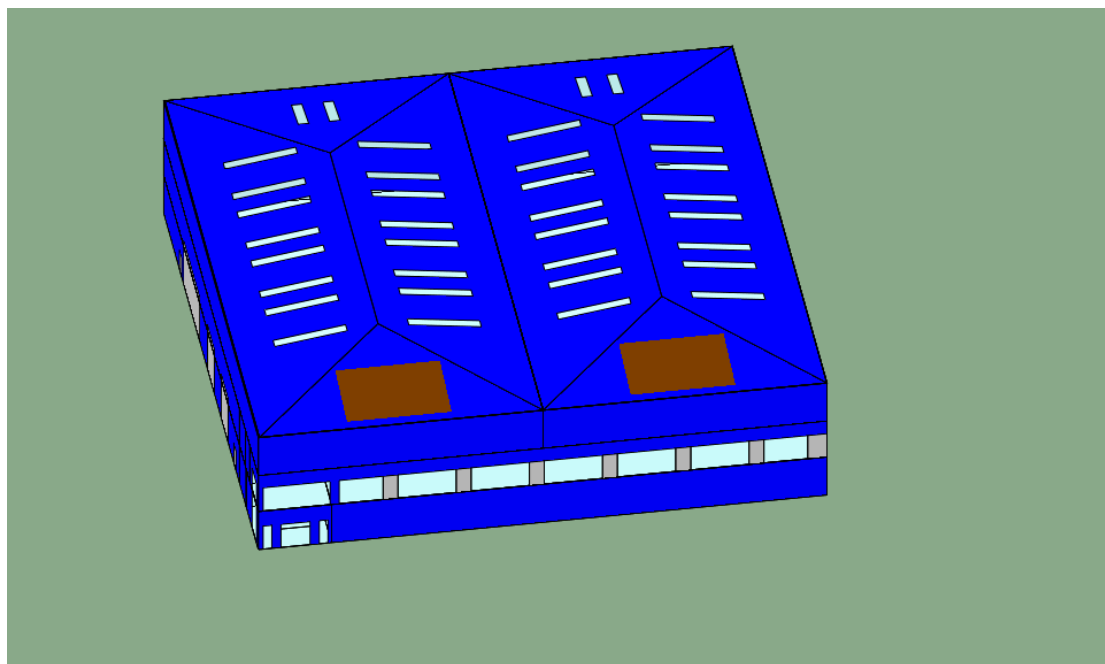
6.5 Gas Fired Micro Combined Heat & Power (CHP)

No suitable thermal based load to make a CHP viable.

6.6 Photovoltaics'

For optimum performance, photovoltaic panels should face between south-east and south west at an elevation of 30-40 degrees. The areas shown in brown on unit 1 indicates an area of 140 sq M.

Initial sizes are based on estimating the peak energy output of the panel and comparing it to the baseline predicted energy demand from the thermal model. The panel size chosen should enable all the electricity to be used within the building to maximise savings.



Details of Technology assessed Unit 1:

PV peak output – 22 kWp
PV area – 140m²
Energy Saving = 17.9 MWh per annum
CO₂ Saving = 9292 kgCO₂ per annum

Payback Information:

Installed Cost - £ 20k + VAT
Offset Elec usage = £2595
Maintenance = £500 / yr
Cost Saving - £2095 / yr (Based on 14.5p/kWh)

Simple payback – **9.5 Yrs**

The above calculation assumes that all the electricity is used within the building, which is what is reflected within the thermal model, however; should the demand be less than predicted then there may be some electricity which is exported. Current export tariff is 5.38 p/kWh which is considerably lower than the buy cost of approx. 14.5 p/kWh.

It is expected that PV panels for Units 2-4 would be sized approximately as follows:

Unit 2 – 39kWp System (approx. £45,000 + Vat)

Unit 3 – 13.5 kWp System (approx. £14,000 + Vat)

Unit 4 – 15.5 kWp System (approx. £15,000 + Vat)

The client may consider larger arrays; however, as the system becomes larger, the greater the likelihood of energy being exporting to grid

An area for solar panels would need to be included on the planning drawings so that photovoltaic can be incorporated into the design.

6.6.1 Feasibility of Exporting Energy

It is feasible to export electricity by complying with the G99 regulation.

6.6.2 Grants/Allowances for PV

Feed in Tariff (FIT) the feed in tariff scheme was closed to new applications on 31 March 2019.

7 Life Cycle Cost

The life cycle costs of the following technologies have been considered.

7.1 Photovoltaics'

The above results indicate a payback period of approximately 9 to 10 years. This payback period includes on-going maintenance. In addition to this the payback period could be reduced further dependant on salvage value of the panels.

8 Conclusions and Recommendations

Photovoltaic Panels provide the best solution for energy savings and the technology suites the flexibility for the shell and core proposal. This technology has low maintenance requirements and associated costs. Drawing should include an area of PV for planning application drawings.

Payback period are likely to be around 9 to 10 years for a 22 kWp system on unit 1 installed costs of approximately £20,000 + Vat.

Units 2 (39kWp) should have a marginally better payback and Units 3 (13.5kWp) & 4 (15.5 kWp) may have a slightly longer payback.

8.1 Limitations of the report

The energy and carbon calculations are based on usage and profiles as dictated by the National Calculation Methodology (NCM) but this may not reflect actual building usage. Therefore, savings in energy costs should only be considered as a guide. All low carbon and renewable technologies should be subject to further investigations during the design process to continually consider viability and optimum use of each technology.

The report is based on the reduction in carbon emissions achieved for a building provided with heating and hot water via a gas boiler.

9 Appendix A (Wind Speed Database Query)

Location

- Latitude: 51.414669627411236
- Longitude: -0.974376718756064
- Height above sea level: 138 m

Wind Speeds

estimates from NOABL data

- At 10m above ground level 4.7 m/s
- At 25m above ground level 5.5 m/s
- At 45m above ground level 6 m/s

Solar

falling on a optimally oriented panel

- Annual Energy per m² 1147 kWh
- Daily Energy per m² 3142 Wh



THE DECC WINDSPEED DATABASE

The windspeed database gives estimates of the annual mean wind speed throughout the UK. It uses an air flow model to estimate the effect of topography on wind speed, and makes no allowance for the effect of local winds such as sea, mountain or valley breezes. It does not take account of topography on a small scale, or local surface roughness (such as tall crops, stone walls or trees, or the built environment), which may have a considerable effect on the wind speed

To correct for local surface roughness an equation in BS 5925 has been used to derive a corrected wind speed for a height of 10, 15 and 20m

U _m	4.7	m/s free wind speed @ 10m			
K	0.52	Country with scattered wind breaks		BS 5295 Table 8	
a	0.2	Country with scattered wind breaks		BS 5295 Table 8	
z	10	15	20	m	Hub Height
u	3.87	4.20	4.45	m/s	Corrected Wind Speed