Weycock Cross Redevelopment, Barry
Energy Statement Report

For Cardiff & Vale College

Date: *28 September 2023*

Doc ref: *CVC-HYD-XX-XX-RP-MEP-0001*

DOCUMENT CONTROL SHEET

Issued by	Hydrock Consultants Limited Wharton Place 13 Wharton Street Cardiff CF10 1GS United Kingdom T +44(0) 2920 023665 E cardiff@hydrock.com www.hydrock.com	Client	Cardiff & Vale College
		Project name	Weycock Cross Redevelopment, Barry
		Title	Energy Statement Report
		Doc ref	CVC-HYD-XX-XX-RP-MEP-0001
		Project no.	C-30653
		Status	S2 -
		Date	28/09/2023

Document Production Record

Issue Number	P01	Name
Prepared by		Manas Sharma
Checked by		Jonathan Milne
Approved by		Andrew Haines

Document Revision Record

Hydrock Consultants Limited has prepared this report in accordance with the instructions of the above-named client for their sole and specific use. Any third parties who may use the information contained herein do so at their own risk.

CONTENTS

Tables

Figures

1. INTRODUCTION

Hydrock Consultants have been appointed by Cardiff & Vale College to provide Energy assessment statements in relation to the design of the new Weycock Cross housing Redevelopment in Barry. This document forms part of an outline planning application for the site and will inform Vale of Glamorgan Council of the design intent for the building in relation to energy efficiency.

Policy Context

This section provides an overview of the relevant sustainability planning policy and guidance from both a national and local perspective.

1.1 National Planning Policy

The National Planning Policy for Wales includes the following documents: Planning Policy Wales (PPW), Technical Advice Notes (TANs), Minerals Technical Advice Notes (MTANs) and Policy Clarification Letters (PCLs). The primary objective of these documents is to ensure that the planning system contributes towards the delivery of sustainable development and improves the social, economic, environmental and cultural well-being of Wales, as required by the Planning (Wales) Act 2015, the Well-being of Future Generations (Wales) Act 2015 and other key legislation and resultant duties such as the Socio-economic Duty.

All planning decisions must align with the above documents and decisions must seek to promote sustainable development and support the well-being of people and communities across Wales.

Planning Policy Wales defines five Key Planning Principles:

- Growing our economy in a sustainable manner
- Making best use of resources
- Facilitating accessible and healthy environments
- Creating & sustaining communities
- Maximising environmental protection and limiting environmental impact

Every development plan must take forward the national sustainable placemaking outcomes and use them to develop an overarching set of outcomes. Each development plan will consider the scale at which they will contribute, through policies and allocations, to achieving an outcome. Collectively, the focus on achieving these outcomes across all development plans will ensure the planning system plays its role in delivering sustainable places.

Ideally all developments in Wales should have the following outcomes: meet appropriate development densities, generate their own renewable energy, promote clean air and reduce overall pollution, promote physical and mental health and well-being.

1.2 Practice Guidance (Planning for Sustainable Buildings)

PPW (4.4.3, 4.7, and 4.12) sets out the Welsh Government's land use planning policies in respect of planning for sustainable buildings in development plans and development management. It does not establish a higher national building standard than Building Regulations, but encourages local planning authorities (LPAs) to seek opportunities to do so on strategic sites. TAN 12: Design, is the primary guide to achieving good quality sustainable design.

1.3 Technical Advice Note 12 – Objectives of Good Design

TAN 12 defines five key Objectives of Good Design: Access, Character, Community Safety, Environmental Sustainability, Movement. Environmental Sustainability is defined as "achieving efficient use and protection of natural resources; enhancing biodiversity; designing for change". To achieve Environmental Sustainability in design TAN 12 suggests that developments seek to minimise energy demand and carbon emissions through the implementation of energy hierarchy and zero carbon standards.

1.4 Local Development Plan (LDP)

The Vale of Glamorgan has laid out a Local Development Plan that will govern/guide all development in the Vale of Glamorgan going forward. Of particular relevance to this energy statement are the following two policies:

» MD2 – Design of New Development

» MD19 – Low Carbon and Renewable Energy Generation

1.4.1 MD2 – Design of New Development

The following section of MD2 is relevant to this energy statement:

> *"Mitigate the causes of climate change by minimising carbon and other greenhouse gas emissions associated with their design, construction, use and eventual demolition, and include features that provide effective adaptation to, and resilience against, the current and predicted future effects of climate change."*

1.4.2 MD19 – Low Carbon and Renewable Energy Generation

Policy MD19 seeks to favour low carbon and renewable energy schemes where appropriate. This energy statement (and development generally) is compliant with this in that a number of low carbon/ renewable energy technologies are proposed to be implemented for this development, following a high-level assessment of viable technologies (refer to Table 2 in this report).

2. ENERGY STRATEGY

The aim is to design an efficient building using a "fabric first" approach and the energy shall be supplied by an appropriate low carbon technology.

2.1 Methodology

As a first step, the recommended approach is to adopt a largely passive design (fabric-first approach) which involves designing to reduce the need for energy consumption from the outset. This includes aspects such as improved insulation and air permeability standards to reduce the need for heating and cooling and the use of natural ventilation where possible in place of fans.

The second step is to deliver the building's energy as efficiently as possible, providing efficient building services and high-performance appliances, such as high-efficiency lighting, demand-controlled ventilation, and ventilation heat recovery strategies.

The final step is to generate energy from low or zero-carbon technologies. This should only be considered as a final measure following the 'insulate then generate' philosophy due to capital cost and the complexity of technology. The most appropriate solutions are considered in terms of technical, functional, and economic viability.

2.1.1 Fabric First Approach

The building will be designed to achieve better fabric efficiency than the backstop values stated within Approved Document Part L: Volume 1 (refer to the table below for proposed U-values for Weycock Cross Redevelopment). The fabric efficiency proposed for this development has taken into consideration the minimum standard and the impact that it will have on the energy efficiency of the development.

Table 1:Building Fabric Efficiency.

Thermal Element	U-value [W/m²K]		
External Wall	0.13		
External Floor	0.12		
Roof	0.12		
All Glazing	1.4	G-value	0.4
Air Tightness (at 50 Pa)	2		

2.2 Low and zero carbon technologies

This section of the report discusses the potential renewable technologies and low-carbon technologies that could be included in the development.

2.2.1 Potential Renewable Technologies

An initial desktop study of a wide variety of technologies has been carried out and for clarity, a summary of potential renewable technologies is shown in the following table. A detailed description and review of each viable technology can be seen on the following page.

Table 2: Summary of low or zero carbon technology options

Technology	Building Characteristics	Uses	Scale	Considerations	Viability
Photovoltaic Panels	Roof-mounted panels.	Suitable for use to reduce electrical loading in all dwellings.	All scales.	To maximise potential, it is important to consider orientation. Pairs well with electric heating and/or hot water.	Viable
Solar Thermal	Roof faces east to west (through south), additional hot water tank(s) required.	All uses.	Smaller scale.	Needs a demand for hot water – domestic or canteens, showers, washrooms.	Not viable, due to lack of scalability.
Wind Energy	Unobstructed fields, roofs	Suitable where there is a large electrical load, opportunity for export or battery storage.	All scales	To maximise potential unobstructed wind paths, need to be available Large surrounding area around the turbine to be maintained	Not viable due to location.
Air Source Heat Pumps	Sited on external walls, within rooftop enclosures or well-ventilated plant rooms.	All uses.	All scales	Careful siting needed to reduce aesthetic impact. Potential noise impact. Powered by electricity, so lower carbon reduction than other technologies. Can also be used to provide cooling, especially in building with no openable windows.	Viable
Ground Source Heat Pumps	External space for horizontal trench or vertical boreholes.	Any.	Medium to large.	Archaeology. More effective if cooling and heating used in the building to balance the ground.	Viable
Water Source Heat Pumps	Water source required nearby.	Any.	Medium to large.	No water source nearby	Not Viable
Biomass	Space needed for plant, fuel storage and deliveries.	Mixed use, colleges, offices, commercial, residential- especially multi-residential – best where constant energy demand.	Medium to large, viable where heat demand is above 15 kW, can be combined with gas for summer / backup use.	Air quality impact. Impact of deliveries on residents. Fuel source (is supply secured?) Distance transported.	Not Viable

2.2.2 Photovoltaic Panels

Solar PV works by converting light into electricity using a semi-conductor material. PV panels do not need direct sunlight to work; electricity can still be generated on a cloudy day.

Solar irradiance, which is the power per unit area (W/m^2), received from the sun is measured annually. Monthly irradiation figures are shown in the following figures.

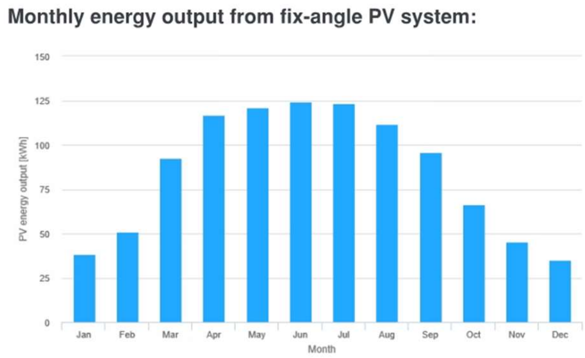

Figure 1: Monthly energy output from solar PV.

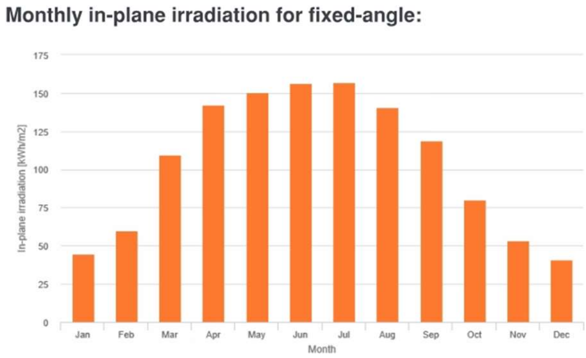

Figure 2: Monthly irradiation for solar PV.

PV panels themselves vary in efficiency from 10-20% (average) to 25% (most efficient). The spacing of rows of panels should minimise over-shading of each other and also account for maintenance space required.

In terms of location and orientation, there should be no overshadowing of the panels, as this reduces their overall efficiency. Even shading a small part of a PV panel could significantly reduce its efficiency and the efficiency of other PV panels connected in the string.

2.2.3 Solar Thermal Panels

Figure 3: Solar thermal hot water panels.

Solar thermal panels collect heat from the sun via a series of tubes, called collectors, that are filled with a heat transfer fluid. The warm fluid is then pumped through a coil in a water cylinder, warming the water; typically providing a 60°C output at the tap. Solar thermal is not as flexible as PV in terms of installation location; as it will require a roof. A double-coiled hot water storage tank would also be required.

Typically, solar thermal is used in collaboration with a secondary heat source as it cannot provide all of a development hot water; (typically 50-60%). A heat pump or boiler back-up would also be used to top up the temperature of the water if it isn't high enough, or to provide hot water at night.

Solar thermal is also eligible for payments via the renewable heat incentive (RHI). RHI payments combined with fuel savings make the payback time for a commercial solar thermal system very short, usually between 5 and 10 years. However, this scheme is due to end in April 2021.

Although heat from solar hot water collectors can be stored in hot water cylinders, during the summer, when hot water production will be at its peak, a high proportion of this can be wasted if there is not a dedicated heat sink.

2.2.4 Wind Energy

Wind turbines convert the winds energy into electricity through the spinning of the turbine blades. The higher the wind speed the more effective this is. Wind turbines need unobstructed paths for the wind to approach the turbine for maximum efficiency. Wind turbines generally need sufficient areas of open land away from residential development in case of disturbance of noise or flickering.

2.2.5 Heat Pumps

Heat pumps work by extracting thermal energy from a low-grade source (air, soil or water) to a heating element with a higher temperature. Heat pumps use a liquid refrigerant that is pumped into pipes which absorbs heat, that later is passed through a compressor where its further heated and moved to heating and hot water circuits.

Heat pumps operate with a typical Seasonal Coefficient of Performance (SCoP) of 2.5 to 4 (depending on heat source/sink); meaning that for every 1kW of electric in, 2.5kW of heat is generated (for air source heat pumps) and up to 4kW (for some ground or water source heat pumps). This efficiency of a heat pump is governed by both the temperatures of the heat source and the heat emitter as shown below.

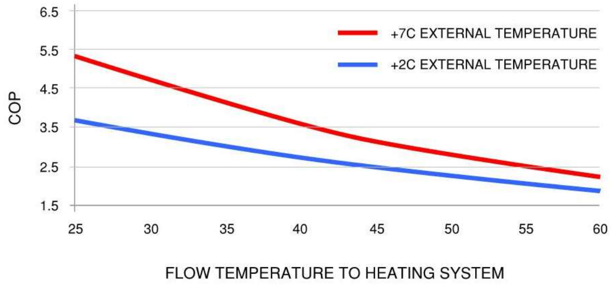

Figure 4: COP as a function of flow temperature for typical ASHP

If used for space heating, heat pumps are, therefore, best suited to low temperature systems such as underfloor heating. If radiators are used with heat pumps it is likely that they would be twice the as large as those used with conventional radiators.

Heat pumps are suited to individual buildings as well as within an energy centre to form part of a wider strategy. Heat pumps are powered by electricity, so are considered low-carbon rather than zero-carbon/renewable, however, they can be powered by electricity from renewable sources – PV, wind etc.

Heat pumps can also raise water temperatures to one suitable for domestic hot water; this is typically done as part of a 'two stage' approach, to maximise the efficiency of the heat pumps.

2.2.5.1 Air Source Heat Pumps (ASHPs)

ASHPs work by using ambient air as their heat source. The heat pump system is sited externally; either on external walls, in external compounds or within a well-ventilated plant room allowing air to be drawn over the evaporator part of the unit. Acoustic treatment, or shrouding, may be required depending on where the units are sited.

Figure 5: ASHP external unit

Ground Source Heat Pumps (GSHPs)

GSHPs require a condenser (usually located at ground level) and associated buried pipe work; either horizontally or vertically, to extract heat from the ground. As radiation from the sun heats the earth, the earth then stores the heat and maintains a temperature of around 10°C (below roughly two metres down) even throughout the winter. The higher winter extraction temperature is what makes GSHPs more efficient than ASHPs.

GSHPs are better suited to larger schemes due to the cost of borehole installation. External space is required for horizontal trenching or vertical boreholes.

One of the biggest drawbacks of GSHPs is the high capital cost (typically 45% more than ASHPs) namely due to digging/bore-holing and the large amount of pipework required.

2.2.5.2 Water Source Heat Pumps (WSHPs)

WSHPs have the potential to be the most efficient heat pump technology; with SCoP's varying from 5:1 to 15:1 depending on the water source. WSHPs work by extracting heat from large bodies of water which, due water's ability to absorb approximately 50% of incident solar radiation, are maintained at a stable temperature of around 11-12°C throughout the year. Because of a lack of appropriate water source close to Weycock Cross, this option has been discounted.

2.2.6 Biomass

Biomass boilers work in a similar way to a standard boiler, however rather than having a gas connection they are fuelled through biomass such as wood chips / pellets and liquid biofuel.Wood chips/pellets fuelled boilers require many deliveries and storage. Liquid biofuel requires less storage. Clean air regulations will prevent the use of biomass boilers at the Weycock Cross site.

2.3 Considered Low Carbon Technology

Considering the site constraints, solar photovoltaic panels and air source heat pumps (ASHP) are considered the most viable low carbon technology solution for this project.

3. BUILDING SERVICES STRATEGY

The following MEP services strategy has been assumed for the Weycock Cross development:

Table 3: Ventilation Strategy

Ventilation	-	Value	Units
	System Type	MVHR	
	Vent details	Nuaire MRXBOX-ECO2B	
	SFP (if applicable.)	0.55	W/l/s
	Heat Recovery Efficiency	90%	
	Air Permeability	2	m3/m2/hr @ 50Pa

Table 4: Heating Strategy

Heating	-	Value
	Heating Source	ASHP
	Proposed Unit details	Mitsubishi Electric Ecodan 5 kW (PUZ-W50VHA)

Table 5: Lighting Strategy

Lighting	Room	Power (W)	Efficacy (lm/W)
	Bedroom	16	100
	Bathroom	10-20	100
	Living Room	30-40	100
	Kitchen	40	100
	Corridor	8-24	100
	Dining	8-24	100
	Utility	8-15	100

Table 6: Domestic Hot Water Strategy

Domestic Hot Water	Water Heating Served by	ASHP + DWH tank	
	Hot Water Cylinder Volume	200	litres
	Storage Loss	1.9	kWh/day

4. CONCLUSION

This report has demonstrated that the development and systems have been designed with a fabric first approach to ensure the building is efficient enough and complies with both relevant national regulations and the Vale of Glamorgan planning policies .

The results of the Dwelling Emission Rating (DER) and Building Primary Energy calculation are shown below. As the BER is less than the Target Emission Rate (TER), and the Dwelling Primary Energy Rate (DPER) is less than Target Primary Energy Rate (TPER), the proposed dwellings shall comply with Criterion 1 of Part L: Volume 1 2022 which states;

"A new dwelling must be built to a minimum standard of total energy performance. This is evaluated by comparing calculations of the performance of the 'actual dwelling' against calculations of the performance of a theoretical dwelling called the 'notional dwelling'. This must be carried out both at the design stage and when work is complete.

The notional dwelling is the same size and shape as the actual dwelling and has standardised properties for fabric and services. The full properties of the notional dwelling are set out in the Government's Standard Assessment Procedure (SAP) for energy rating of dwellings."

The energy performance of the notional dwelling is described using the following metrics:

- The target primary energy rate (TPER), in kWhPE/m^2 per year: this is influenced by the fabric and fuel.
- The target emission rate (TER), in kgCO2 /m^2 per year: this is influenced by the fabric and fuel.
- The target fabric energy efficiency rate, in kWh/m^2 per year: this is influenced by the fabric only.

The target primary energy rate, target emission rate and target fabric energy efficiency rate for individual dwellings must be calculated using the Government's Standard Assessment Procedure, Appendix R.

Table 7: Indicative SAP Results

House Type	Solar Photovoltaic (PV) Array (kWp)	Domestic Battery (kWh)	Dwelling Emission Rate (DER) (kgCO2/yr/m^2)	Target Emission Rate (TER) (kgCO2/yr/m^2)	%DER<TER	Dwelling Primary Energy Rate (DPER) (kWh/m^2/yr)	Target Primary Energy Rate (TPER) (kWh/m^2/yr)	%DPER<TPER	SAP Rating
2 Bedroom Semi Detached	10	5	-1.1	12.6	108.73	-13.95	66.48	120.98	106 A
3 Bedroom Semi-Detached	10	5	-0.71	13.36	105.39	-10.04	70.21	114.4	105 A
4 Bed House	13	5	0.56	14.2	96.06	3.64	75.15	95.16	100 A
1 Bedroom Apartment-Ground floor	4	5	-0.08	11.96	100.67	-3.41	62.59	105.44	102 A