Energy Strategy Report

Pencoed Campus – Proposed LDP Allocation

Contents

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1. Introduction

1.1. Purpose of the report

1.1.1. This report has been prepared by Savills on behalf of Bridgend College to support the promotion of the Pencoed Campus for future development as a proposed allocation in the Bridgend County Borough Council (BCBC) Replacement Local Development Plan (RLDP).

1.1.2. Bridgend College is a Further Education (FE) College supporting over 6,000 students and employing over 600 members of staff across its five campuses in Bridgend, Pencoed, Queens Road, Maesteg and Cardiff (although the majority of vocational areas are delivered at its Cowbridge Road site in Bridgend and its Pencoed Campus). The existing buildings at the Campus will remain as per their current use, as part of the College's estate. The land adjacent to the Pencoed campus is being promoted as a housing-led mixed use development in the RLDP.

1.1.3. This report sets out the renewable energy options for development of the land adjacent to the Pencoed Campus, to inform decision-making and policy development as it relates to promotion of the proposed allocation as a sustainable growth area.

1.1.4. The Energy Strategy Report is structured as follows:

- Section 2 sets out the policy context;
- Section 3 presents an analysis of options for supporting energy efficiency, renewable energy generation and low carbon objectives at the site;
- Section 4 considers the feasibility of the options and further considerations;
- Section 5 provides a conclusion and recommendations.

1.2. **Site Description**

1.2.1. The Pencoed Campus is located to the north east of Bridgend, to the north of the M4 motorway (Junction 35). It is located within the administrative boundary of BCBC, but directly adjacent to the boundary with Rhondda Cynon Tadd County Borough Council. The site comprises approximately 52 hectares (127 acres) and is arranged in two parts: the main site (land and buildings to the east of the A473) comprising 46 hectares (113 acres) and additional land of 6 hectares (14 acres) to the west of the A473.

Figure 1: The Pencoed College Campus site

1.3. Replacement Local Development Plan

1.3.1. BCBC is in the process of replacing their RLDP which, once adopted, will replace the present LDP. To date, a call for sites has been undertaken and a Preferred Strategy subject to consultation.

1.3.2. The site was submitted as a Candidate Site as part of the Call for Sites in November 2018 as a mixed use development (ref. 219.C1) and was shown as the sole Strategic Option for Growth within Pencoed in the Preferred Strategy document published for consultation in September 2019. Further technical documentation was provided at the request of BCBC in April 2020, including a masterplan (see figure 2 below).

1.3.3. The indicative masterplan shows that the Site can deliver:

- Up to 770 homes across a mixture of different types and tenures of housing. The masterplan shows higher densities (possibly in the form of apartments) closer to the A473 and lower densities closer to the site's more rural eastern and southern fringes. The homes are arranged in clusters with a perimeter of houses of wide frontages to create a strong street presence and identity;

- A 1.25ha parcel of land to deliver a 1 form entry primary school to serve the development. There is potential for primary school to be a focal point for the community with out of hours community use of facilities;

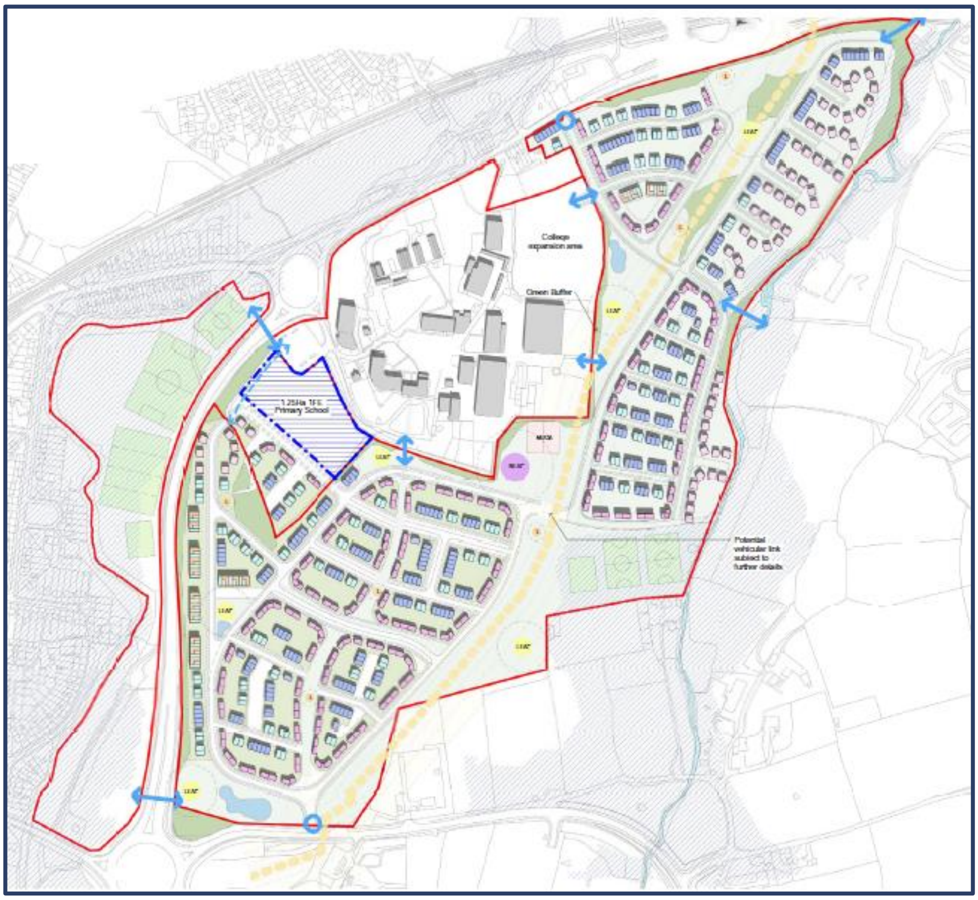
- The retention of the existing buildings at the campus to facilitate the College's continued operation. The masterplan includes an element of expansion land to the north east of the college campus to allow for the further development of additional education facilities if required;

- Two site access points, one from the A473 to the north and a second from Felindre Road to the south. Within the development there will be a range of primary and secondary streets;

- A range of green and blue infrastructure measures. Blue infrastructure, in the form of swales and attenuation ponds, has an important SuDS role whilst green infrastructure forms public open space as well as having a landscape and ecology function; and

- Various ecological mitigation measures including the retention of existing woodland and the strengthening of the north to south tree belt and formation of an east to west nature corridor.

Figure 2: Draft Masterplan (prepared by Austin-Smith: Lord)



2. Policy Context

2.1. Decarbonisation and Energy

2.1.1. Welsh Government set out its proposals for transitioning to a sustainable, low carbon economy in Energy Wales: A Low Carbon Transition (2012). As part of the transition, the Welsh Government stated that its aims were to maximise the long-term economic benefits of the transition, ensure that communities benefit from energy infrastructure developments, and carefully plan and manage the relationship between energy development and the natural environment. The priorities for a low carbon transition are i) reducing the amount of energy used in Wales; ii) reducing reliance on energy generated from fossil fuels; iii) actively managing the transition to a low carbon economy.

2.1.2. The Environment (Wales) Act 2016 sets a legal target of reducing greenhouse gas emissions by at least 80% by 2050. The Act also requires a series of interim targets (for 2020, 2030 and 2040) and associated carbon budgets for key sectors. The budgets will set limits on the total amount of greenhouse gas emissions emitted in Wales over a 5 year period to serve as stepping stones and ensure progress is made towards the 2050 target. By aiming for Net Zero by 2050 the Welsh Government declared an ambition to do better than the recommended 95% reduction recommended by the Committee on Climate Change, a recommendation based on Wales' capacity to meet Net Zero.

2.1.3. The Natural Resources Policy (NRP)_ sets out national priorities, opportunities and challenges for managing Wales' natural resources sustainably. One of the three national priorities under the NRP is to increase renewable energy and resource efficiency.

2.1.4. The Climate Change (Carbon Budgets) (Wales) (Regulations) 2018 sets a carbon budget for the 2016 to 2022 budgetary period limited to emissions an average of 23% lower than the baseline, and a carbon budget for the 2021 to 2025 budgetary period with emissions limited to an average of 33% lower than the baseline. The Committee on Climate Change is due to provide recommendations to the Welsh Government in September 2020 on the third carbon budget (the period 2026 to 2030).

2.1.5. To support the carbon budgets, the Welsh Government published its emissions reduction delivery plan for its first carbon budget period (2016-2020). Prosperity for All: A Low Carbon Wales (2019) looks at emissions reduction pathways, policies and proposals across a broad range of sectors. The emissions pathway for the building sector, which includes residential, is for a reduction by 40% from baseline levels by the year 2030 as a result of i) energy efficiency measures, ii) low carbon heating measures, and iii) behavioural change measures. These objectives are supported by a suite of policy proposals relevant to new build, including innovative construction techniques, setting higher energy efficiency standards and supporting utilisation of waste heat and low carbon heat.

2.1.6. The Committee on Climate Change's recent Net Zero report (2019) provides a clearer illustration of the challenge for the energy system, advising that to meet net zero emissions by 2050 it would involve four times the amount of renewables generation capacity than is presently the case. Prosperity for All: A Low Carbon Wales (2019) does not prescribe any specific additional targets for renewable energy generation, but emphasises the need for the need to facilitate new projects of community, local and nationally significant scales.

2.1.7. The Welsh Government has set targets for the generation of renewable energy:

- for new renewable energy projects to have at least an element of local ownership by 2020;
- for Wales to generate 70% of its electricity consumption from renewable energy by 2030; and
- for one Gigawatt of renewable electricity capacity in Wales to be locally owned by 2030.

2.1.8. Also, from April 2017, public services in Wales will use 100% renewable electricity, 50% of which will be generated in Wales.

2.1.9. The Well-Being of Future Generations (Wales) Act 2015 is about improving the social, economic, environmental and cultural well-being of Wales in accordance with the sustainable development principle. Public bodies listed in the Act must work towards seven well-being goals, three of which are directly linked to climate change. Low carbon energy relates to several of the national indicators which are used to monitor progress including indicators 12 - the capacity of renewable energy equipment installed and 41 - emissions of greenhouse gases within Wales. This serves to embed support for renewable energy across public bodies in Wales, including Welsh Government, local authorities and Natural Resources Wales.

2.2. Housing

2.2.1. The Independent Review of Affordable Housing Supply for Wales included recommendations in the final report (April 2019) relating to energy efficiency and Net Zero in recognition of the significance of energy to affordability of running a home and drivers for decarbonising in a cost effective way. The expert Panel recommended that the Welsh Government should introduce a requirement for all new affordable homes to be near zero carbon / EPC 'A' using a fabric first approach from 2021, supplemented by technology (renewables) if required.

2.2.2. In 2020, the Welsh Government announced that all new homes in Wales are to be heated and powered from clean energy sources from 2025. The proposals included:

- Improved energy efficiency from 2020 which will lead to a 37% reduction in CO2 from new dwellings, compared with current standards, and save homeowners £180 a year on energy bills (based on a semi-detached home).
- Phasing out the use of high-carbon fossil fuels and moving to cleaner ways to heat our homes though the introduction of low carbon heating and energy generation, such as renewable energy sources (photovoltaic panels), heat pumps or district heat networks, which involve heating and hot water to multiple buildings from a central heat source.
- Improving energy efficiency thorough introducing measures that limit heat loss and reduce the demand for heat, such as triple glazing and higher standard fabrics for walls, roofs, floors, and windows.
- Improving air quality by ensuring the supply and removal of air to and from a space or spaces in a building provides good air quality.

2.2.3. In line with this announcement the Welsh Government consulted on a review of Building Regulations Part L (Conservation of Fuel and Power) and Part F (Ventilation) for new dwellings. This consultation sets out improved energy efficiency requirements for new homes in 2020 ('Part L 2020'), and for future new homes in 2025 (referred to as 'Future Part L'), proposed for adoption in Autumn 2020.

2.2.4. Part L 2020 is expected to require a 37% or 56% reduction of CO2 emissions. It is intended that the emissions reduction will result from improved performance from fabric, retaining gas boilers as the main heat generation for homes.

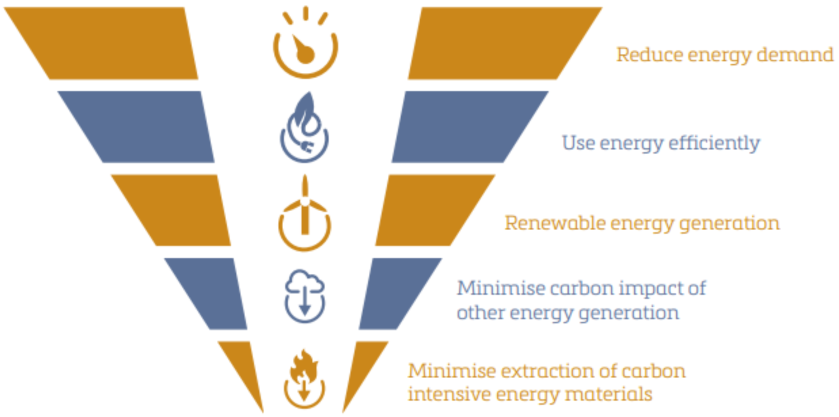
2.2.5. When the new building standards are implemented in full in 2025 ('Future Part L'), homes should produce 75-80% less CO2 emissions than ones built to current requirements. In addition to the fabric efficiencies achieved by 'Part L 2020', additional triple glazing will be required, and heat generation will focus on low carbon heat solutions, including heat pumps and heat networks. Heat networks are to be advocated because of economies of scale and ease of replacing technology at this scale rather than for each dwelling.

2.3. National Planning Policy

2.3.1. Planning Policy Wales (PPW) continues to provide a positive policy framework for decision-making on renewable energy generation projects and facilitating energy efficiency (see figure 3 below). It states that the planning system should secure an appropriate mix of energy provision, which maximises benefits to our economy and communities whilst minimising potential environmental and social impacts.

2.3.2. The latest edition of PPW (Edition 10, December 2018) emphasises the need to 'maximise renewable and low carbon energy generation' and incorporates the renewable energy targets. PPW states that planning authorities should facilitate all forms of renewable and low carbon) energy development, in doing so should seek to ensure their areas' full potential for renewable energy is maximised, and that planning authorities should plan positively for grid developments to facilitate projects.

Figure 3: The Energy Hierarchy



(source: Planning Policy Wales Edition 10, December 2018)

2.3.3. Welsh Government is preparing the National Development Framework which, upon adoption, will be a development plan document. Consultation on the "Draft" version took place in Quarters 2 and 3 of 2019 with scrutiny from Members of the Senedd anticipated in late 2020 and publication in early 2021. Given that the document will have development plan status, it contains a series of policies, those of relevance are replicated below:

2.3.4. Policy 7 (Ultra Low Emission Vehicles) encourages the rolling out of electric vehicle charging points across existing and new development.

2.3.5. Policy 10 (Wind and Solar in Priority Areas) sets a presumption in favour of wind and solar energy developments in the 15 identified priority areas. The site is not within one of the 15 designated priority areas.

2.3.6. Policy 11 (Wind and Solar outside Priority Areas) states that, proposals for wind and solar energy generation developments outside of the priority areas will be supported where there is no unacceptable adverse effects.

2.3.7. Policy 13 (Other Renewable Energy Developments) offers support for other forms of renewable energy developments.

2.3.8. Policy 14 (Priority Areas for District Heat Networks) encourages local planning authorities to identify opportunities for district heating networks to be integrated with new and existing developments. Bridgend, but not Pencoed, is identified as a priority area for district heat networks.

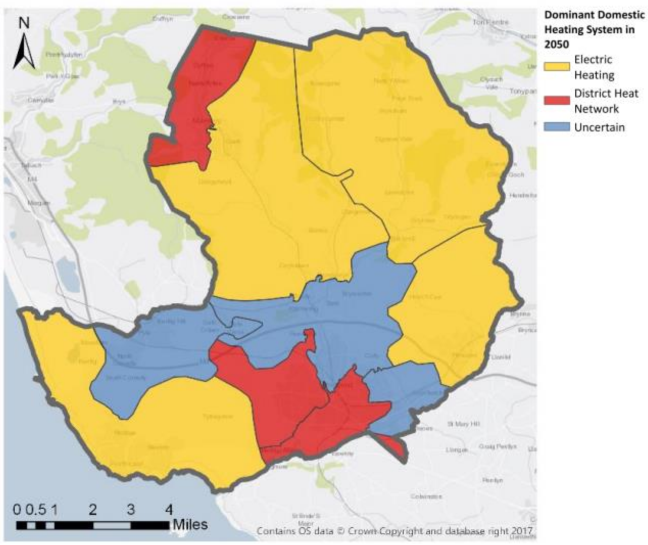
2.3.9. Policy 15 (Masterplanning for District Heat Networks) requires that in the masterplanning process for large scale developments explore the feasibility of the use of district heat networks.

2.4. **Bridgend County Borough Council Policy**

2.4.1. BCBC has a vision to make Bridgend a decarbonised, digitally connected smart County Borough. The Bridgend Local Area Energy Strategy (2018) sets out an aim of transitioning from the current national, centralised energy system to a future low carbon, decentralised energy system that works for its individuals, communities and businesses. As a result, there are a number of relevant policies, plans and initiatives.

2.4.2. The Bridgend Local Energy Strategy (2018) requires a 95% reduction in carbon emissions from buildings by 2050. The Strategy identifies the likely dominant domestic heating types in BCBC – see figure 4 below. District heating solutions are identified for the more densely populated areas of Bridgend. In some areas, where no one heating type dominates, a mix of electricity and district heat solutions are identified.

Figure 4: Dominant Domestic Heating Transitions by 2050



(Source: BCBC Local Area Energy Strategy)

2.4.3. The Smart Energy Plan (2018) aims to frame delivery of the first phase of the Local Energy Strategy. This includes innovative initiatives to facilitate acceleration of decarbonised heating solutions, including collaboration on demonstration projects. The Smart Energy Plan objectives are as follows:

- to be a test bed for new energy system ideas and concepts; providing real-life case studies;
- to lead the decarbonisation agenda; by introducing new products and concepts to consumers;
- to attract new and existing energy and digitalisation businesses to trial ideas and grow within the county;
- to stimulate the local economy and develop employment opportunities through innovation; and
- deployment of low carbon energy projects, to develop a joined-up approach to the energy transition engaging local academia, communities and businesses.

2.4.4. The Renewable Energy Assessment Report (2020) by the Carbon Trust identifies wind and solar as the main renewable energy resources in BCBC. The report also recommended a target of 30% of domestic properties in the county borough to be heated by low carbon heat sources by 2030.

2.4.5. BCBC's LDP was adopted in September 2013 and covers the period up to 2021. Its scope is, understandably, very broad but the following three policies are considered relevant in the context of this Energy strategy Report:

2.4.6. Policy PLA4 (Climate Change and Peak Oil) requires all development to tackle the causes of, and be adaptable to, climate change. Developments should reduce energy usage, utilise local materials, encourage onsite renewable energy generation, encourage efficient resource use, and promote sustainable building methods.

2.4.7. Strategic Policy SP8 (Renewable Energy) supports developments which help meet national renewable energy and energy efficiency targets.

2.4.8. ENV17 (Renewable Energy and Low/Zero Carbon Technology) encourages major developments to incorporate low or zero carbon technologies. Energy Assessments are required for any "major" development.

2.4.9. The adopted LDP is accompanied by a number of pieces of Supplementary Planning Guidance, including SPG12 which relates to Sustainable Energy and builds upon energy related policies within the LDP, particularly Policy ENV17. With regards to Energy Statements, Note 5 identifies those forms of renewable energy generation means that should be considered. These are solar photovoltaics & hot water (thermal), ground and air source heat pumps, wind turbines, biomass boilers, combined heat and power, hydroelectricity and district heating.

3. Options Analysis

3.1. Introduction

3.1.1. The 'fabric first' principle establishes the importance of fabric efficiency to building performance. Fabric efficiency of dwellings is addressed at 3.3 (below), and also provides an indication of general improvements in standards expected over time in line with Building Regulations.

3.1.2. Consideration of the technology options to improve building performance is vital, in terms of energy efficiency, consumption of energy, and reducing CO2 emissions. These technologies are considered below, including renewable energy options. It should be noted that the masterplan design process for the Pencoed College site has been informed by sustainability objectives, with a preferred layout incorporating a north - south orientation capable of maximising light and solar energy potential on site.

3.2. Carbon accounting

3.2.1. In considering the options, it should be noted that accounting of carbon intensity should be kept under review. The current Part L 2014 uses an electricity carbon factor (CF) of 0.519 kgCO2/kWh which is outdated. The National Grid Energy System Operator's carbon intensity forecast tool for the GB system indicates a carbon intensity in the region of 0.207 kgCO2/kWh on 9th July 2020 (which will vary throughout the day in response to demand and generation). Although this tool is unable to give a precise carbon intensity or carbon factor, it provides a clear indication that the current Part L 2014 provides an inflated CF for electrification of heating solutions which means in accounting terms they do not currently perform as well as they do in real terms.

3.2.2. In lieu of a formal update to the CF, the draft Standard Assessment Procedure (SAP) 10 carbon factor (CF) of 0.224 kgCO2/kWh is often used to approximate the actual carbon impact of a technology. However, even the draft SAP10 CF is unrepresentative of the carbon intensity of the grid as it has reduced below the carbon intensity of gas, and will continue to reduce as the grid, both the national grid and the distribution network, continue to progress towards 'deeper' decarbonisation of the power sector.

3.2.3. The impact of the reduction in carbon intensity and carbon factor (CF) of the electricity grid, is a shift in the hierarchy of low carbon technologies. Electric heating, formerly the most carbon intensive heating option now ranks slightly better than gas condensing boilers. As a result, electric heat pumps would only emit a third of the CO2 of a gas boiler. Future carbon intensity should be kept in mind, and kept under review, for appraising options for future development sites.

3.3. **Fabric Efficiency**

3.3.1. Subject to the site being allocated, it is anticipated that development at the proposed development of the site could come forward from 2023 to 2024. Accordingly, it may be possible for the development to come forward under Part L 2020, however any slippage would result in the development coming forward under the proposed future standards Part L 2025. In either scenario, energy efficiency requirements are equivalent to or exceeding PassivHaus Standard, as illustrated in the following table (figure 5).

Figure 5: Fabric efficiency scenarios for dwellings

Fabric efficiency measure	Part L 2020	Part L 2025	PassivHaus
Regulated CO_2 reduction (% improvements compared to Part L 2014 standards).	Option 1: 36% Option 2: 56%	75 – 80%	80 – 100%
MVHR required	In Option 2	Yes	Yes
Wall U-value	0.13	Unknown, but likely to exceed Part L 2020	<0.15
Floor U-value	0.11		<0.15
Roof-U value	0.11		<0.15
Window U-value	1.3	Triple glazing	0.8
Air permeability	5 m^3 /h/m2 (approx. 0.4 ACH)	3 m^3 /h/m2 (approx. 0.4 ACH)	<0.6 ACH
Waste water heat recovery	No	Yes	Yes

3.4. **Energy Generation**

3.4.1. Renewable technology options both on-site and off-site should be kept under review for this site depending on when the site would be consented and implemented. The following table (figure 6) summarises the credentials of renewable technologies as they relate to this site.

3.4.2. Cost and emissions factors in particular should be kept under review. Some technologies attract payments, for example under the Renewable Heat Incentive (e.g. at present this applies to heat pumps), that can support the viability of implementation. This also should be kept under review as Government policy in relation to subsides and payment evolves in support of decarbonisation of priority sectors.

Figure 6: Renewable technology options appraisal for the site (on-site)

Technology	Application	Advantages	Disadvantages	Option for the Bridgend College site proposals
Biomass	Space heating and domestic water heating	Significant reduction of heating related CO_2 emissions	Requirement for fuel source transportation and storage Particle emissions	Unlikely

		Reduces need for gas supply to the site		
Solar thermal	Domestic water heating and contribution to space heating	Efficiency	Seasonality Maintenance Competes for roof space with solar pv	Potentially
Heat pumps	Space heating and domestic water heating (alongside electricity / gas)	Significant reduction of heating related CO_2 emissions Reduces need for gas supply to the site	Costs higher than gas heating	Likely
Gas CHP	Domestic water heating and contribution to space heating, electricity generation	Known to work well as on-site district heating technology	Worse CO_2 emissions than individual gas boiler scenario, particularly in the context of reducing electricity network emissions	Unlikely
Solar PV	Electricity generation	Good electricity related CO_2 emissions Low maintenance costs	Capital and replacement costs Seasonality	Likely
Wind	Electricity generation	Good electricity related CO_2 emissions	Intermittency Spatial requirements	Unlikely
Anaerobic digestion	Space heating and domestic water heating (from methane generation)	Significant reduction of heating related CO_2 emissions	Requirement for organic waste (fuel) source transportation and storage Spatial requirements Emissions (and regulation)	Unlikely

Figure 7: Renewable technology options appraisal for the site (off-site or co-located)

Technology	Application	Advantages	Disadvantages	Option for the Bridgend College site proposals
Biomass	Space heating and domestic water heating	Significant reduction of heating related CO_2 emissions Reduces need for gas supply to the site	Requirement for fuel source transportation and storage Particle emissions (and regulation)	Unlikely, unless separate project comes forward in proximity to the site, with waste heat connection opportunities to the site
Anaerobic digestion	Space heating and domestic water heating (from methane generation)	Significant reduction of heating related CO_2 emissions	Requirement for organic waste (fuel) source transportation and storage Emissions (and regulation)	Unlikely, unless separate project comes forward in proximity to the site, with waste heat connection opportunities to the site
Gas CHP	Domestic water heating and contribution to space heating (potential electricity generation)	Significant reduction of heating related CO_2 emissions (with waste heat utilisation)	Without carbon capture, CO_2 and other emissions are worse, except in waste heat utilisation scenario	Unlikely, unless separate project comes forward in proximity to the site, with waste heat connection opportunities to the site. Electricity from this type of project would connect to the grid network rather than direct connection.
Solar PV	Electricity generation	Good electricity related CO_2 emissions Low maintenance costs	Capital and replacement costs Should be considered in context of reducing CO_2 emissions of power sector / grid	Potentially, given grid infrastructure capacity, availability of resource, if co-location sites found

Wind	Electricity generation	Good electricity related CO_2 emissions	Capital and replacement costs Should be considered in context of reducing CO_2 emissions of power sector / grid	Potentially, given grid infrastructure capacity, availability of resource, if co-location sites found, though site more likely to be further away than solar pv
Hydrogen	Space heating and domestic water heating (gas network injection)	Significant reduction of heating related CO_2 emissions Reduces the requirement for on-site solutions (noting the high pressure gas main at the site)	Not feasible in the shorter term as it is a longer term network scale solution	Unlikely (if site comes forward in mid 2020s)

3.4.3. The options analysis provided in figures 6 and 7 is in line with the BCBC Renewable Energy Assessment (2020, Carbon Trust), which signposts maximising of onsite electricity generation from roof top solar pv and ground mounted solar, the potential for private wire integration to an off-site offshore wind development (or indeed solar pv array), and installation of heat pump technologies.

3.5. Management systems

3.5.1. Performance of buildings also relies on effective management. A building automation and control system is a term used for a centralised system installed to monitor and control a building's environment and services i.e. its heating, ventilation, air conditioning, lighting and other systems (such as security alarms and lifts). Such systems would typically be installed in large commercial buildings but not usually in dwellings. A building automation and control system could be considered for a larger apartment block, which may not be relevant to the proposals at the Pencoed College site as the proposed apartments are only 3 storey.

4. Feasibility of Options

4.1. Introduction

4.1.1. As noted in section 1 of this report, the proposals at the Pencoed Campus site include up to 770 dwellings across a mixture of different types and tenures of housing. In addition a new primary school is proposed, with the potential to also be used as a community hub (used by the community out of school hours). The proposals also allow for expansion of the existing college campus if additional educational facilities are required.

4.1.2. Given the status of the Pencoed Campus site as a potential strategic allocation site for the DLDP, the Carbon Trust has provided an estimate of energy demand for the site in the BCBC Renewable Energy Assessment. Figure 8 provides an indication of heating demand, and non-heating demand, including heat pump scenarios.

Figure 8: Estimate of energy demand by Carbon Trust / BCBC Renewable Energy Assessment

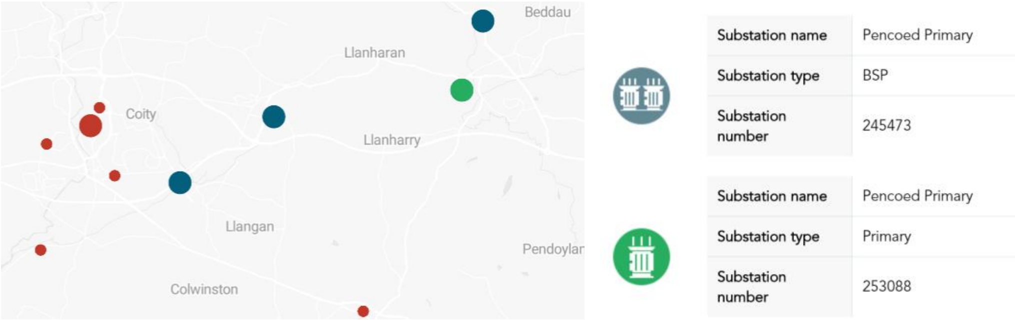
Site name	Indicative capacity (no. of residential units)	Indicative floor area detached dwellings (m²)	Indicative floor area flats (m²)	Indicative floor area semi-detached dwellings (m²)	Indicative floor area terraced dwellings (m²)	Indicative heating demand (MWh p.a.)	Indicative electrical heating demand if met by ASHP with a COP of 3 (MWh p.a.)	Non-heating demand (MWh p.a.)	Total energy demand (MWh p.a.)	Total energy demand (if ASHP used) (MWh p.a.)
Pencoed Campus	800	32,230	7,020	22,848	9,664	13,355	4,452	2,480	15,835	6,932

4.1.3. The assessment of the feasibility of low carbon options at the site considers site wide options and options in relation to building and use type (dwellings and schools), building on the options analysis at figures 6 and 7.

4.2. Infrastructure

4.2.1. The electricity distribution network in Bridgend is operated by Western Power Distribution (WPD). At present there is a demand headroom at the Pencoed Primary (253088) of around 12MVA, therefore unlike other parts of the BCBC, notably Bridgend, indications are that there are no constraints to connecting new development (see figure 9). However this should be kept under review, depending on when the site comes forward for development, with early engagement with WPD recommended.

Figure 9: WPD electricity distribution network connections capacity map

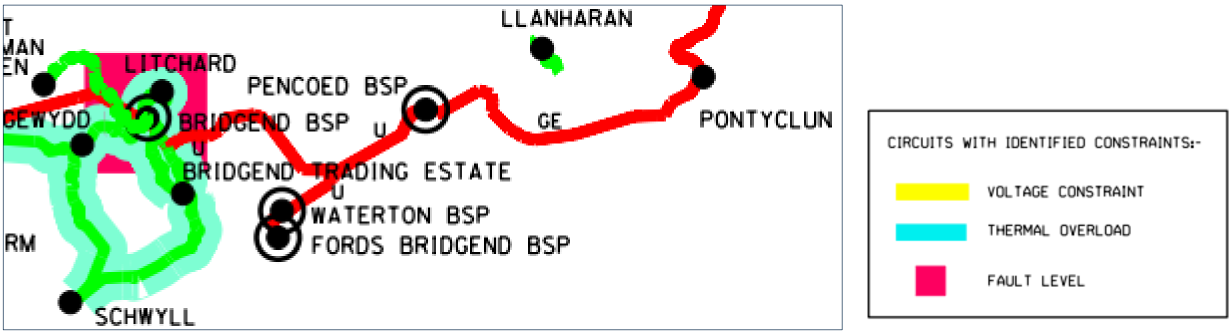


(source: https://www.westernpower.co.uk/our-network/network-capacity-map-application

4.2.2. As noted in the Smart Energy Plan, the distribution network is constrained in south Wales with respect to new energy generation connections. This increases the likelihood of export restrictions or expensive additional generation connections, due to network reinforcement requirements. Increases in electrical loads through electrification of heating and transport may cause constraints and reinforcement requirements with respect to demand connections.

4.2.3. Although there are voltage and thermal constraints for connecting generation in BCBC, the Pencoed area appears to be less constrained (see figure 10). Nevertheless, this status is subject to change as the maps only indicate existing generation connected to the network and generation not yet connected but holding an accepted connection offer from WPD. These constraint maps should be reviewed on a regular basis to inform feasibility of connecting generation in advance of direct engagement with WPD on the connection potential and prior to confirmed status for any connections via formal connection agreements.

Figure 10: WPD electricity distribution network distributed generation constraint map – extract for the Pencoed area (map issue 01/07/2020)



(Source: WPD https://www.westernpower.co.uk/downloads-view/132376)

4.3. **Low Carbon Options - Dwellings**

4.3.1. In relation to fabric efficiency, dwellings should be designed to meet the relevant Part L standards (see figure 5). This is the equivalent of PassivHaus standard or to exceed Passivhaus standard.

4.3.2. The level of insulation and air tightness required by the standards would result in reduced demand for space heating, although there is a seasonal element to consider for winter which can be supported by mechanical ventilation and heat recovery technologies. The degree of insulation and air tightness allows for space heating to be supported by heat pumps either via underfloor heating or radiators. As noted at figure 6 the CO2 emissions from heat pumps are low and are set to reduce further as power emissions decrease further decarbonising the electricity network. Viability of technologies should be kept under review given the scale up of technology take up should drive down costs, as well as payments and subsidy availability (as noted previously at 3.4.2).

4.3.3. Solar PV is the obvious opportunity for micro scale generation, capitalising on roof space, layout and orientation. Increasing deployment of solar pv on roof has established four main deployment options depending on ownership model which are broadly suited to the two main types of homes proposed for this site, houses and apartments.

4.3.4. The BCBC Renewable Energy Assessment notes that the potential roof top solar pv capacity is 2,046kW, capable of generating 1,792MW per annum. This could meet approximately 11% of the electricity demand (or equivalent in offset if dispatched to the grid).

4.3.5. In a scenario where the solar PV on roof is owned by the owner of the dwelling, there are 3 main options:

- Electricity generated by the on roof solar pv is use instantaneously by the dwelling. Excess electricity is fed into the electricity grid (potentially subject to export tariff, which ensures payment for the excess electricity).
- Electricity generated by the on roof solar pv is connected to a domestic battery which stores the energy to maximise the utilisation at source and minimise waste. When battery is fully charged, electricity could feed into the electricity grid (potentially subject to export tariff, which ensures payment for the excess electricity), or disconnects.
- Electricity generated by the on roof solar pv is connected to a decentralised grid at a fixed tariff, and distributed within the site according to demand, thereby maximising utilisation of the renewable resource. This would require arrangements with a management company and implementation of smart metering and trading systems.

4.3.6. Alternatively, an Energy Service Company (ESCo) is set up for the site and owns or leases the on roof solar pv and associated infrastructure. In this scenario, all electricity generated by the on roof solar on the site would be fed into a decentralised grid which in turn distributes electricity within the site according to demand. The ESCo would be responsible for maintenance and replacement of the on roof solar pv installations and all associated infrastructure. This scenario provides a potential option for the proposed apartments.

4.3.7. Detailed consideration of the design of on-site solar pv options will be required as the proposals develop. Emerging technologies should be reviewed, including improvements in solar tiles.

4.3.8. Solar pv solutions on site could also contribute to supplying electric vehicle (EV) charging points, either at / near the relevant dwelling or at central charging points, for example the school, noting is it proposed a community hub.

4.4. **Low Carbon Options – School (and potential future education facilities)**

4.4.1. In relation to fabric efficiency, the school (and potential future education facilities) should be designed to meet the relevant Part L standards. This is the equivalent of PassivHaus standard or to exceed Passivhaus standard. An example of implementation of Passivhaus standard for schools in Wales is the Patrwm 21 approach (https://www.patrwm21.com/), a standardised model for cost effective delivery of Passivhaus.

4.4.2. The level of insulation and air tightness required by the standards would result in reduced demand for space heating, although there is a seasonal element to consider for winter which can be supported by mechanical ventilation and heat recovery technologies. The degree of insulation and air tightness allows for space heating to be supported by heat pumps either via underfloor heating or radiators. As noted at figure 6 the CO2 emissions from heat pumps are low and are set to reduce further as power emissions decrease further decarbonising the electricity network. Viability of technologies should be kept under review given the scale up of technology take up should drive down costs, as well as payments and subsidy availability (as noted previously at 3.4.2).

4.4.3. The scale of the school and therefore the roof provides an attractive opportunity for solar PV installation. Options include roof-integrated or roof-mounted options. Detailed consideration will be required at the design stage, and should consider maintenance practicalities when considering cost and payback. The deployment options are broadly similar to the options set out above (at 4.3.4 and 4.3.5) in relation to dwellings, scaling from independent ownership and on-site consumption, to decentralised site wide grid system facilitated by an ESCo.

4.4.4. Increasing use of canopies at schools (and any future educational facilities) could provide further opportunity for solar pv. Also, the existing educational buildings could be retrofitted, if they have not already, with installation of solar pv to maximise the efficiencies available of implementing at scale.

4.4.5. At previously noted, the potential role of the school as a community hub makes a link between the solar pv and EV charging points an attractive opportunity.

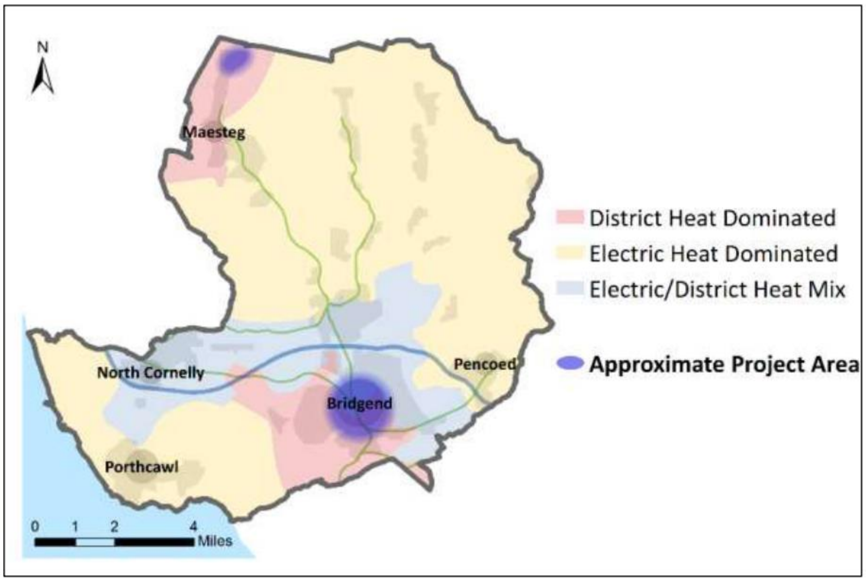
4.5. **Site Wide Options - District Heating**

4.5.1. District Heat Networks are not necessarily low carbon, but the scale allows for efficiencies and lower carbon emissions than individual boilers. A number of different technologies can support a district scale solution, with gas CHP being the most conventional, though clearly does not perform well enough in terms of lowering emissions, unless and until the gas network itself decarbonises. Therefore renewable options are required.

4.5.2. Following numerous studies, in line with the Local Area Energy Strategy and the Smart Energy Plan, deployment of district heat networks is being prioritised in two main areas of BCBC, Caerau and Bridgend. Development activity has been prioritised where the greatest potential exists, relating to the Caerau Mine Water Heat Network Scheme, and Bridgend Town Lower Carbon District Heat Network. A district heat network would require a central energy centre on site, to accommodate heat generators and connections to the district heat network. An energy centre acting as a hub for a district heat network could also serve as a hub for distribution of electricity on site, for example in an integrated rooftop solar pv system (see 4.3.5 and 4.3.6). For sites where an energy centre is required, it should be located to avoid impacts to receptors, noting potential noise and visual impact. Location of an energy centre would also be determined by location of other infrastructure, and with accessibility in terms of maintenance and operations.

4.5.3. The Pencoed area is not considered to be an area for a district heat network solution, instead considered to be an area for future electricity heating (see figure 11), which is also highlighted in the BCBC Renewable Energy Assessment.

Figure 11: Dominant Heating Systems in 2050 by area



(Source: Smart Energy Plan)

4.6. Site Wide Options – Renewable Technologies

4.6.1. The low carbon options for the proposed dwellings and the school at the Pencoed College site set out above include options for on roof solar pv deployment that scales up to a site wide solutions. As described above, establishment of an ESCo could facilitate a site wide solution for renewable electricity, which also facilitates site wide EV charging solutions.

4.6.2. Further analysis of the space on site may inform whether there is scope for on-site renewable energy generation, which at best would involve ground mounted solar pv.

4.6.3. The electricity grid context allows for consideration of the potential for renewable energy projects to come forward at or in proximity to the site. The edge of settlement location of the site also provides an opportunity for consideration of co-location solutions. Figure 7 provides an analysis of co-located options. Although opportunities may arise to capitalise on waste heat from projects in the vicinity (e.g. biomass, gas CHP, anaerobic digestion), and should be kept under review, it should not be relied upon and should be considered an opportunistic solution.

4.6.4. Wind is a good resource in BCBC, therefore onshore wind developers will be prospecting for opportunities in the LPA to develop projects, likely of a nationally significant scale (>10MW, consented under the Development of National Significance regime, determined by Welsh Ministers). These projects are likely to be located away from this site given the location of the resource and the spatial requirements associated with locating turbines (amenity and health and safety considerations). However, onshore wind developers are required to consider factors such as local ownership and local benefits, therefore there could be merit in engaging with local wind farm developers to understand whether there could be opportunities for physical and / or commercial arrangements (e.g. private wire, or power purchase agreement) to support a low carbon community.

4.6.5. Ground mounted solar pv nearby is the most likely of co-located technologies to come forward, subject to detailed feasibility. There are environmental constraints that may impact on this potential, notably the river and floodplain, however there is space beyond this. There are a number of options for consideration, including the same options noted above in relation to collaboration with onshore wind developers if solar development opportunities arise nearby, or development of a dedicated ground mounted solar pv site for site wide use facilitate by an ESCo or an alternative management model.

4.7. EV infrastructure

4.7.1. Increased deployment of electricity vehicles is anticipated and should be considered as part of an energy strategy for a strategic site. This has been considered above in relation to the dwellings scale solutions and hub scale, potentially using the school as a hub accessible to the community.

4.7.2. WPD's Electric Vehicle Strategy[1] outlines an aspiration to future proof new properties with regards to deployment of electric vehicles and the demands on infrastructure. WPD has undertaken analysis to help facilitate electric vehicles and the associated infrastructure in order to understand constraints to EV charging capacity, as illustrated by figure 12. No particular constraints are noted for the Pencoed College site, however it would be a new development, as such early engagement with WPD would be recommended.

Figure 12: WPD Electricity capacity map for BCBC and the Pencoed area

(Source: WPD Electric Vehicle map: https://www.westernpower.co.uk/ev-capacity-map-application Accessed 16/07/2020)

[1] WPD Electric Vehicle Strategy https://www.westernpower.co.uk/downloads-view/114340

4.8. Implementation Considerations

4.8.1. The assessment above references the potential role of an ESCo, however there are several models for management of site-wide options as it relates to a district heat network and a solar pv electricity network. An ESCo could be a private entity or a public entity, for example BCBC.

4.8.2. The role of the ESCo is principally to manage and maintain the infrastructure (including replacements which are inevitable during the lifetime of a dwelling for example). If a site wide ESCo was established, dwelling owners would be part of a community scheme, and contracted to buy heat and electricity from the ESCo. Therefore a scheme would need to be competitively priced, compared to the energy market options.

4.8.3. Although there are a number of different models, an alternative approach could involve more active involvement of the community. A residents committee could be responsible for the on-site networks, and contracting day to day management or technical aspects to a third party. It is more likely that an ESCo type model would suit for a mixed use and mixed tenure site like the Pencoed College site should an on-site network be developed.

5. Conclusions

5.1.1. The Pencoed Campus site being promoted by Bridgend College as a strategic allocation in the BCBC LDP is capable of being a low carbon community in line with BCBC and Welsh Government policy objectives on decarbonisation and place-making.

5.1.2. A district heat network is not recommended at the site, in line with the BCBC Renewable Energy Assessment. However, if an opportunity arises to capitalise on nearby waste heat (at present there are no indications that such an opportunity could arise), a district heat network could be reconsidered.

5.1.3. This energy strategy report has identified a number of options at both building and site wide scale that can be implemented in support of an 'electricity' dominated strategy at the site. At this stage in development of the proposals, it is clear that the site can meet future requirements on energy and decarbonisation.

5.1.4. This strategy should be used to inform further development of the proposals. The following recommendations are intended to help provide a focus and prioritisation of effort in support of realising this site as a low carbon community.

5.2. Recommendations

- All buildings should be designed to meet the equivalent of PassivHaus standard or to exceed Passivhaus standard.
- The technology options should be kept under review, particularly with regards cost, emissions reduction performance, and potential for subsidy or payments.
- Roof-mounted solar pv should be maximised on all buildings, either for direct consumption by the building or to support a distributed network.
- Further consideration of a distributed electricity network, including early consideration of potential supply and management arrangements.
- Feasibility of ground-mounted solar pv on or in proximity to the site should be investigated further;
- Engagement with local onshore wind and solar developers should be undertaken to establish whether there are opportunities for such developments to be linked in a way that supports cost effective development of low carbon communities (e.g. private wire, power purchase agreements).
- Engagement with WPD as it relates to the network capacity constraints for connections, both offtake and generation, and engagement on EV charging infrastructure opportunities and initiatives.