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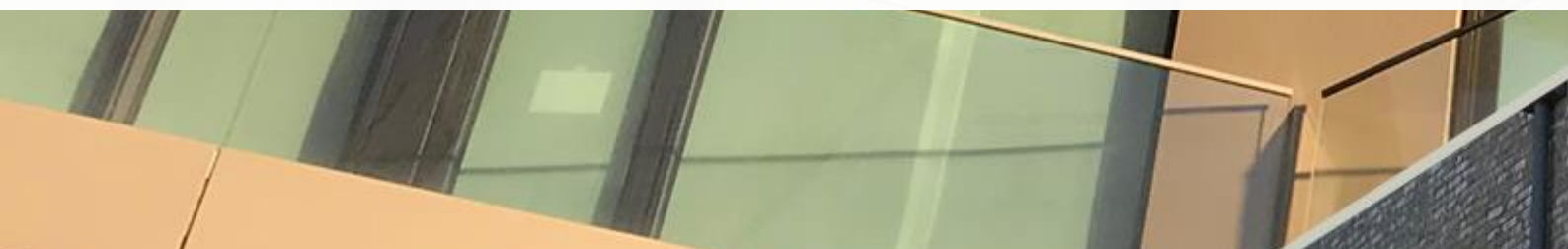
Island Farm
Energy Strategy Report
IF(S)-TBA-XX-XX-RP-ME-800002

June 2020



PROJECT
Island Farm

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Contents

1. Introduction

Bridgend Council Borough Council (BCBC) are current renewing their 2018 – 2033 Local Development Plan (LDP).

The plan aims to sets out, in land-use terms, the priorities and objectives of BCBC's Corporate Plan along with the wellbeing objectives and priorities of the Bridgend Public Services Board's Wellbeing Plan.

A key part of preparing the renewed LDP is identifying suitable sites for new housing, employment, community, recreation and other uses. The land at Island Farm is identified in the LDP Preferred Strategy as a possible Strategic Site for mixed use development.

Having passed a Stage 1 assessment, the Island Farm Development is progressing towards a Stage 2 assessment. A requirement for which is the preparation and submission of a renewable energy strategy.

As such, this report sets out the energy and renewable energy options for the Island Farm Development site in fulfilment of the above.

2. Policy context

2.1 Wales policies

Draft National Development Framework (NDF) 2020 - 2040

The National Development Framework (NDF) is a new spatial development plan for addressing key national priorities (including decarbonisation) through the planning system (Welsh Government, 2019a). One of the 11 outcomes of the NDF is to develop "a Wales where people live […] in places which are decarbonised." (Welsh Government, 2019a, p.17). The draft NDF identifies priority areas for large-scale (over 10MW) solar and wind energy developments and district heat networks.

The draft NDF suggests that, as a minimum, developments of at least 100 or more dwellings should consider the potential for heat networks (Welsh Government, 2019a), with the following draft spatial policy suggested to enforce this:

> "**Policy 15 – Master planning for District Heat Networks**
>
> Large-scale mixed-use development should, where feasible, have a District Heat Network. Planning applications for such development should prepare an Energy Masterplan to establish whether a District Heat Network is the most effective energy supply option and, for feasible projects, a plan for its implementation"

Planning Policy Wales (PPW) Edition 10

PPW 10 sets out the requirements for clean growth and the decarbonisation of energy, which relates to wider legal obligations, needs and policies at an International, UK, Wales, and Local level.

Environment (Wales) Act (2016)

Under the Environment (Wales) Act (2016), Wales is required to reduce net greenhouse gas emissions by at least 80% by 2050 (against a baseline set in legislation) with interim targets and carbon budgets established to ensure this target is met.

In March 2019, Welsh Government published a plan, Prosperity for All: A Low Carbon Wales within which Local Authorities are identified as having a significant role to play.

In addition to requirements set out in the Environment (Wales) Act (2016), Welsh Government has introduced the following targets specifically related to local energy generation and ownership, to be achieved by 2030:

- 70% of Wales' electricity consumption to be generated from renewable sources
- 1GW of locally owned renewable electricity capacity in Wales
- Renewable energy projects in Wales to include an element of local ownership.

To achieve the targets above, local authority planning departments will need to work with renewable energy developers and ensure that renewable energy generation within their authorities is maximised.

2.2 Bridgend County Borough Council (BCBC) policies

Bridgend Local Area Energy Strategy (2018)

The Bridgend Local Area Energy Strategy (2018) requires reduction of carbon emissions from buildings by 95% by 2050.

The Evidence Base for the Local Area Energy Strategy identifies biomass boilers as the most cost-effective decarbonisation heating system for domestic properties in off-gas, rural areas, particularly in the Ogmore and Garw Valley. It was also identified as a potential heat source for district heat networks in the county borough.

The Local Area Energy Strategy identifies predominant heating types in each of the ten analysis areas, as shown in Appendix 1. District heating was identified as the dominant heating type in the more densely populated areas of Bridgend. Where a mixture of options emerged, with no one heating type dominant, the area is identified as Electricity / District heat mix. The electric areas are in general areas where heat pumps dominate the electric heating system mix in 2050.

Smart Energy Plan (2018)

The Smart Energy Plan (2018) aims to deliver the first phase of the strategy, which looks to test innovations that may help to accelerate decarbonisation of heating through a pipeline of projects. It has the following objectives:

- 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

Renewable Energy Assessment Report (2020)

The Renewable Energy Assessment Report by the Carbon Trust identified wind and solar as the county's main resources and recommended maximisation of their deployment. It also recommended a target of 30% of domestic properties in the county borough to be heated by low carbon heat sources by 2030. Table 27 of the report (reproduced in Appendix 1) identifies Island Farm as an area with district heating as the dominant heating mode.

2.3 New Editions of Part L (Wales) Conservation of Fuel and Power

A new edition of the Approved document L1A Conservation of fuel and power in dwellings is currently out for consultation[1] and expected to come into force in the second half of 2020.

Part L 2020 is expected to require a 37% or 56% reduction of CO_2 emissions over the national build mix. The savings will come mainly from fabric performance, but retain gas boilers as the baseline heat generator.

A further revision of Part L is envisaged for 2025, which will retain the fabric efficiency requirements of Part L 2020, except for an additional requirement for triple glazing, but will be premised on low carbon heat generator such as heat pumps and heat networks. It is expected that Part L 2025 will reduce CO_2 emissions from dwellings by 75-80% over Part L 2014. Part L 2025 also advocates heat networks for residential developments because of the ease of replacing technology centrally rather than in each dwelling and the potential to access larger scale low carbon heat sources.

2.4 Carbon accounting

The current Part L 2014 uses an electricity carbon factor (CF) of 0.519 $kgCO_2/kWh$ which is now clearly out of date and penalise the electrification of heating. In the absence of more up to date official electricity carbon factor, the draft SAP10 CF of 0.224 $kgCO_2/kWh$ is often used to approximate the actual carbon impact of a technology.

[1] https://gov.wales/sites/default/files/consultations/2019-12/consultation-document-building-regulations-part-l-review.pdf

In reality, even the SAP10 CF is no longer representative of grid carbon intensity, which has now dropped below the carbon intensity of gas[2].

The net effect of this drop in electricity CF 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. Heat pumps would only emit a third of the CO_2 of a gas boiler.

On the other hand, renewable electricity generators now have a lower impact on reducing CO_2 emissions because of the lower electricity CF.

[2] See for example https://carbonintensity.org.uk/ for average regional and national carbon intensity

3. Energy efficiency / renewables options

3.1 Fabric efficiency

It is expected that the new development will be built under the new Part L 2020 or possibly even under Part L 2025.

Table 1 summarises the fabric efficiency measures under each of the proposed Part L editions[3] and compares it to the PassivHaus standard. It is clear that the energy efficiency requirements mandated by the proposed Part Ls are equivalent to or exceed the PassivHaus Standard.

Item	Part L 2020[4]	Part L 2025	PassivHaus
Regulated CO_2 reduction[5]	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. 0.15 ACH)	<0.6 ACH
Waste water heat recovery	no	yes	yes

Table 1 Fabric Efficiency measures under proposed future editions of Part L and PassivHaus

3.2 Renewables options

The advantages and disadvantages of renewable technologies are summarised in Table 2.

Technology	Application	Advantages	Disadvantages	Suitability for the Island Farm development
Heat pumps	Space heating DHW (generally pre-heat with electric or gas boiler top-up)	Drastically reduces CO_2 emissions associated with space heating Removes need for gas supply to site.	Space heating cost one third higher than gas[6]	Yes

[3] As it applies to dwellings (Part L1A), but is taken as a proxy here for non-dwellings as well (Part L2A).

[4] Information from Appendix A of Part L 2020 consultation document

[5] % improvements are relative to Part L 2014

[6] Based on a gas price of £0.03, electricity price of £0.12 and a heat pump COP of 3

		Low heat losses in district heating systems		
Biomass	Space heating DHW	Drastically reduces CO_2 emissions associated with space heating Removes need for gas supply to site.	Frequent supplies to site Storage Particle emissions (requires high flue for dispersal)	No
Solar thermal	DHW Contribution to space heating via inter-seasonal store	Good efficiency	Competes with PV for roof space Maintenance	No
Anaerobic digestions	Generates methane for combustion in gas boilers for space heating and DHW	Drastically reduces CO_2 emissions associated with space heating	Requires steady supply of large quantities of organic waste	No
Hydrogen	Injection into gas network for combustion in gas boilers for space heating and DHW	Reduces CO_2 emissions associated with space heating Uses excess electricity generated on site	Hydrolysis plant expensive and unproven Safety considerations for hydrogen stores	No
Gas CHP	DHW Contribution to space heating Electricity generator	On-site generation of heat and electricity Works well with district heating	CO_2 emissions worse than gas boiler because of low carbon factor of electricity	No, unless electrical power capacity on site needs to be boosted.
PV	Electricity generator	Low maintenance Good CO_2 reduction potential	Capital and replacement cost	Yes
Wind	Electricity generator	Very good CO_2 reduction potential	High capital cost Maintenance Siting wind speed	Yes, subject to local wind speed analysis

Table 2 Summary of renewable options

3.3 An overview of viable low carbon options for the dwellings

The development proposes 700 to 750 new build dwellings on the main Island Farm site. The new dwellings will comprise 2, 3 and 4 bedroom houses on an assumed 30 / 40 / 30 ratio.

The average size of the units being:

- 2 - bed: 710 to 770ft^2
- 3 - bed: 875 to 1,180ft^2
- 4 - bed: 1200 to 1,650ft^2

Fabric efficiency

The dwellings should be built to PassivHaus standard, or to the applicable edition of Part L where its requirements exceed the PassivHaus standard.

Space Heating

Dwellings with the anticipated level of insulation and air tightness will require minimal amounts of space heating, especially if dwellings are equipped with MVHR for heat recovery in winter. This makes them suitable for heating with low grade heat from heat pumps either via underfloor heating or via radiators. CO_2 emissions from heat pumps are already low and are set to decrease further as the electricity grid continues to decarbonise. At the time of writing heat pumps still attract Renewable Heat Incentive (RHI) payments. It is likely that this will continue in one form or another to promote the uptake of heat pump technology.

PV

Roofs with suitable orientations on all dwellings should be covered with roof-integrated or roof-mounted PV panels. There are four utilisation options:

1. PV on roof is owned by dwelling. Instantaneous use of generated electricity by the dwelling. Excess electricity is fed into the electric grid (possibly attracting a SMART export tariff)
2. PV on roof is owned by dwelling. PV is connected to domestic battery store to maximise utilisation. When battery is fully charged, PV array could disconnect or excess is fed into the electric grid. Battery storage is still an expensive technology with long paybacks.
3. PV on roof is owned by dwelling. Excess generation is fed into a private grid at a fixed tariff (lower than average utility tariff) and distributed around the site according to demand. This would maximise the use of PV generated electricity on site. Smart metering and energy trading software would be used by a management company to account for usage by individual dwellings and schools.
4. An ESCO owns/leases dwelling roof PV and inverters. Electricity generated by all dwellings is fed into a private grid which distributes the electricity around the site according to demand at a tariff lower than the utility average. The ESCO would be responsible for maintaining and replacing PV installations.

The PV area could be increased 25-30% by extending installation to car ports. PV generated electricity could also contribute to supplying EV charging points, either directly at the dwelling/car port or at a central charging point, for example the community hub. Further, detailed consideration of PV options will be required at future detailed design stages.

3.4 An overview of viable low carbon options for schools

The proposed development will comprise two new school buildings on the main Island Farm site:

A new build one form entry (1FE) primary school with a proposed floor area of c.1,318m^2 (GIFA, excluding car park and external games facilities). It is understood that a Special Educational Needs (SEN) facility may be added in future. We have assumed this expansion would equate to less than 50% of the GIFA identified above.

A new build school to replace the existing Heronsbridge School, a Special Educational Needs (SEN) facility with an approximate floor area of 1,800m^2 (excluding car park and external games facilities). It is understood that a future development may incorporate increased educational

facilities and residential units. We have assumed this expansion would equate to less than 75% of the GIFA identified above.

Fabric efficiency
The schools should be built to PassivHaus standard, or to the applicable edition of Part L where its requirements exceed the PassivHaus standard.

Space Heating
Schools with the anticipated level of insulation and air tightness will require minimal amounts of space heating, especially if they are equipped with central or local mechanical ventilation with heat recovery in winter. This makes them suitable for heating with low grade heat from heat pumps either via underfloor heating or via radiators. CO^2 emissions from heat pumps are already low and are set to decrease further as the electricity grid continues to decarbonise. At the time of writing heat pumps still attract Renewable Heat Incentive (RHI) payments. It is likely that this will continue in one form or another to promote the uptake of heat pump technology.

PV
Roofs with suitable orientations on the schools should be covered with roof-integrated or roof-mounted PV panels. The same four utilisation options apply as for dwellings described above.

A proportion of the school car parks could be fitted with PV covered car ports and EV charging points for use by staff.

3.5 Viable low carbon options for community hub
A new community hub will be included on the Island Farm site and serving the Island Farm community. The hub will be accommodate a café of approx. $50m^2$ and a small retail outlet.

Fabric efficiency
The community hub should be built to PassivHaus standard, or to the applicable edition of Part L where its requirements exceed the PassivHaus standard.

Space Heating
Principally, the community hub should follow the same heating strategy as dwellings and schools, if feasible, with a view to integration into a district heating network. However, the heat output from heat pumps may not be compatible with premises in which doors are opened frequently. In that case, electric heating is recommended. DX units could supplement heat output and also provide comfort cooling in summer.

PV
Roofs with suitable orientations should be covered with roof-integrated or roof-mounted PV panels. The same four utilisation options apply as for dwellings described above.

3.6 Site-wide renewables
As well as solar PV, the Carbon Trust Renewables Energy Assessment identified wind as a major resource in the vicinity of Island Farm.

Wind turbines would only be economically viable if the electricity could be used on site via a private renewable electricity network as set out in Section 3.3. In such a network it would provide a good complement to the PV and could provide a relatively steady renewable energy supply to all buildings on site.

With the proposal being for a mainly residential site, the scope for erecting wind turbines is limited due to noise pollution and visual impact. However, the site should be investigated further for suitable wind speeds at low heights (15-30m) and distance from dwellings and school as part of the detailed design process.

4. Feasibility of implementing a district heating strategy

4.1 General

As discussed in Section 2, an increase in district heating networks (DHN) in the more urban areas of Bridgend County is a priority and the Island Farm site was designated for district heating in the Carbon Trust's Renewable Energy Assessment.

DHNs are not intrinsically low carbon, but provide an opportunity to tap into tested or more unconventional or large scale local low carbon heat sources to the benefit of all buildings connected to it.

4.2 Technical considerations

Installing district heating on a previously undeveloped site is cost effective.

A heat generator in a central energy centre feeds a hot water flow and return circuit which serves each dwelling or school via heat exchangers. District heating networks traditionally operate on a flow temperature of 70 or 80^{o}C which causes considerable distribution heat losses. Heat pumps operate at temperatures <55^{o}C which could reduce distribution heat losses. However, realistically, they could still require a flow temperature of 60^{o}C to enable adequate heat transfer at the heat exchangers and provide a design flow temperature of 40-50^{o}C in the dwellings. Therefore, a second heat source may be required to boost the network flow temperature without affecting the heat pump COP. This could be a second heat pump operating at a higher temperature or electric boilers. This would completely eliminate the need for a gas supply on the site but increase the cost of the heat. Alternatively, the flow temperature could be uplifted by gas boilers.

The dwelling-side flow temperature of 40-50^{o}C would not be sufficient to heat DHW by itself. However, it can serve as a pre-heat in a storage cylinder which is topped up by an electric immersion.

Principally, there are two types of heat pump suitable for the development.

1. Air Source Heat Pumps (ASHPs) which extract heat from ambient air. There is no limit to capacity on site, as long as the footprints of the ASHPs themselves can be accommodated
2. Ground Source Heat Pumps (GSHPs) extract heat from the ground. The amount of heat which can be extracted depends on the size of the area which can be used for extraction purposes, as well as the geology, ground water levels etc. Further studies will be required to ascertain if the site can satisfy anticipated heat requirements from the ground

4.3 Site constraints

The Island Farm Development site is near a second development site at Craig Y Parcau which is being submitted separately for Stage 2 assessment as an LDP Strategic Site. The sites are physically separated by a parcel of land and a river at the Craig Y Parcau eastern boundary (see Appendix 1). To our knowledge, there is no right of access over the parcel of land separating the two sites. Designing a joint district heating system serving both sites must therefore be ruled out at this stage.

It would be technically feasible to set up separate district heating systems for the Island Farm site. The anticipated heat demand of the dwellings and other buildings on the Island Farm site is likely to provide the economies of scale to make the DHN and energy centre viable.

4.4 Energy Centre

A district heating network will require a central energy centre on site, which accommodates the heat generators and connections to district heating network. It could also accommodate the hub for the distribution of PV-generated electricity discussed in Section 3.3. The energy centre should be located peripheral to occupied buildings to avoid noise and visual disturbances. It should be easily accessible and ideally located closely to the incoming services. With that in mind, we propose to locate it in the vicinity of the southern tip of the development (Fig. 1) with potential access from New Inn Road.

Fig. 1 Proposed general location of the energy centre on the Island Farm site shown in red (indicative and subject to future detailed analysis).

4.5 Future management of communal installations

There are several business model options for the management of a DHN and potentially a site-wide PV electricity network.

1. Both installations could be run by a private ESCO or BCBC ESCO. The ESCO would look after all aspects of management, including maintenance and replacement. The ESCO or another intermediary would be responsible for billing. The ESCO would set the price of heat and renewable electricity and dwelling owners would be obliged to buy heat exclusively from the ESCO. ESCO services would need to be competitively priced to convince prospective buyers to be tied into a communal heating scheme
2. Both installations could be managed by a residents committee with technical aspects outsourced to third party. This would give residents more control over pricing but requires active involvement

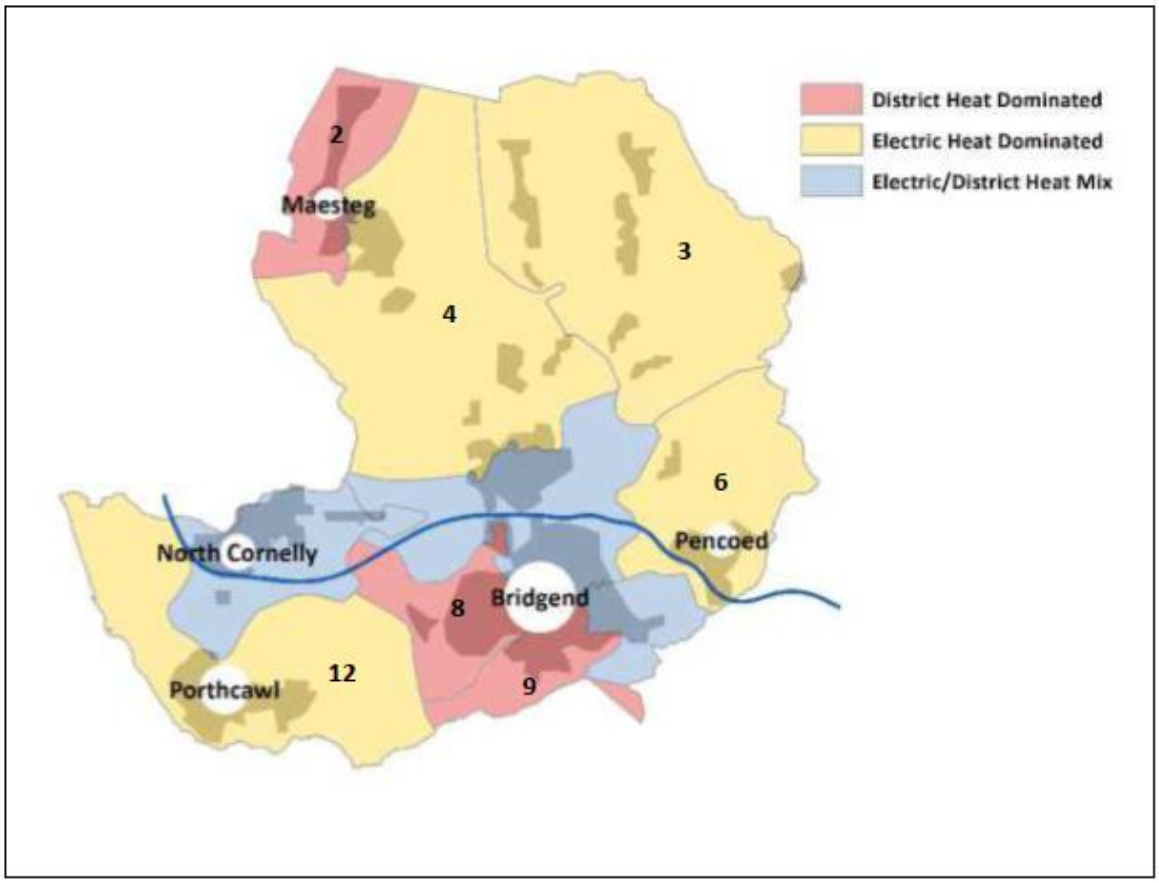
5. Recommendations

1. All buildings on the Island Farm site should aim to be built to PassivHaus standard or the edition of Part L in force at the time if that requires higher standards
2. Install a district heating network (DHN) to serve all buildings (including schools) on the Island Farm site. The DHN operates from an energy centre located near the end of the access road into the development. The DHN will use heat pumps as main heat generator topped up by electric or gas boilers to achieve a flow temperature of 60^{o}C. DHW provision should be pre-heat of domestic hot water storage cylinder from DHN with top up from immersion
3. Roof-mounted PV should be maximised on all buildings, either for direct consumption by the building or to feed private LV networks which distribute the renewable electricity around each site
4. If the concept of private LV networks is taken forward, the feasibility of installation of small scale wind turbines should be investigated further. They could complement the electricity output of the PV and increase the share of low carbon and low cost electricity on site

Appendix 1 Location of the development site

Fig. Appendix 1.1 Island Farm

Appendix 2 Projected dominant heating systems in BCBC area by 2050



Residential site number	Residential site name	Predominant heating type area from Local Area Energy Strategy (ETI, 2018b)
1	Pencoed Campus	Electricity
2	Land East of Pyle	Electricity/District Heating
3	Waun Bant Rd & Pen Y Castell Farm	Electricity/District Heating
4	Porthcawl Regeneration Site	Electricity
5	Island Farm, Bridgend	District Heating
6	Parc Afon Ewenni	On the boundary of District Heating area and a District Heating/Electricity mixed area
7	Land West of Bridgend	On the boundary of District Heating area and a District Heating/Electricity mixed area
8	Pont Rhyd-y-Cyff	Electricity
9	Zig Zag Lane, Porthcawl	Electricity

Table 27: Predominant heating types identified in the Local Area Energy Strategy for each of the candidate residential sites

Source: Carbon Trust Renewable Energy Assessment 2020

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