Programme Area: Smart Systems and Heat

Project: WP2 Bridgend Area Energy Strategy

Title: Bridgend Local Area Energy Strategy – Review of Near Term Transformation Projects – Nondomestic

Abstract:

Arup have been appointed to carry out a desktop review of the Energy Systems Catapult's EnergyPath Network (EPN) tool in regards to decentralised energy and district heating deployment in Bridgend. This report assesses the viability of connecting 13 non-domestic buildings, specified by EPN, to a heat network and their potential to act as anchor loads. This assessment takes the form of a review of the available heat offtake and location of the buildings in comparison to surrounding buildings. A view on the effect each building could have on the commercial and technical viability of any heat network developed in the area is provided.

Context:

Bridgend County Borough Council has been working with a group of stakeholders consisting of Welsh Government, Western Power Distribution, Wales and West Utilities and the Energy Systems Catapult, to pilot an advanced whole system approach to local area energy planning. Bridgend is one of three areas including Newcastle and Bury in Greater Manchester participating in the pilot project as part of the Energy Technologies Institute (ETI) Smart Systems and Heat (SSH) Programme.

Energy Systems Catapult

Support for EnergyPath Networks

Task 016: Review of Near Term Transformation Projects

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Ove Arup & Partners Ltd
6th Floor 3 Piccadilly Place
Manchester M1 3BN
United Kingdom
www.arup.com

ARUP

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1 Introduction

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This report assesses the viability of connecting 13 non-domestic buildings, specified by EPN, to a heat network and their potential to act as anchor loads. This assessment takes the form of a review of the available heat offtake and location of the buildings in comparison to surrounding buildings. A view on the effect each building could have on the commercial and technical viability of any heat network developed in the area is provided.

2 Heat Demand Assessment

2.1 Non-domestic connections

Connection viability can be broadly assessed based on annual consumption and peak demand. This provides a strong indication of the heat offtake and therefore the benefit of connecting the building to a heat network. This is both in terms of useful heat capacity which can be installed in the energy centre and on the return on investment of the infrastructure required for connection. Building 'loads' are used as the metric to determine connection viability.

The annual heat consumption and corresponding peak demand for the buildings was provided by EPN. Table 1 displays this information.

Table 1: Non-domestic connections, heat demand, supplied by EPN.

	Cluster	Floor area (m2)	Annual heat consumption (kWh/annum)	Peak heat demand (kW)
Penybont Primary School	9	2,450	288,000	62
Archbishop McGrath RC Comprehensive School	9	16,400	1,933,000	418
Brackla Primary School	9	1,450	168,000	36
Ysgol Gymraeg Bro Ogwr	9	1,650	197,000	43
Oldcastle Primary School	9	4,050	476,000	103
Brynteg Comprehensive Upper School	9	3,000	351,000	76
Brynteg Comprehensive Lower School	9	1,450	174,000	38
Pen Y Bont Court	9	2,050	615,000	133
Bryn-y-Cae Nursing Home	9	1,750	519,000	112
Co-op + other stores Brackla	9	1,150	175,000	38
Wilko, Nolton House	9	5,650	863,000	187
Rhiw Shopping Centre	9	3,500	532,000	115
Wyndham House	9	1,150	174,000	38
TOTAL (rounded)		**45,700 m2**	**6,465 MWh**	**1.4 MW**

2.1.1 Schools

It is expected that schools in the area would be heated using wet heating systems, most likely from a gas fuelled boiler. In this case, connection to a heat network would require only minimal conversion of the existing system. This increases the probability of the connection being technically viable, and also expands the lower bound (of the annual consumption and peak heat demand) at which the connection is likely to be commercially viable. From a heat offtake viewpoint all the

connections provided by EPN are considered to be technically and commercially viable.

Archbishop McGrath RC Comprehensive School is a preferred connection due to the size of the heat demand and would provide a key anchor from which to catalyse a heat network. Oldcastle Primary School also represents a preferred connection and would also be a key anchor load.

As Bynteg Comprehensive Upper School and Lower School are assumed to be two parts of a singular school, their combined heat demand alongside a reduced stakeholder engagement requirement (due to assumed joint ownership) makes them another key anchor.

The other schools should be connected to any heat networks in the area as they would provide commercially and technically viable connections and contribute to the success of a heat network. Alone they are not considered large enough to catalyse a network and are unlikely to be considered a key anchor load.

2.1.2 Nursing homes

Both nursing homes are considered key heat anchors as they provide a high heat offtake. It is highly probable that they have wet heating systems which would make conversion and connection to the heat network easy.

2.1.3 Retail

As the heating system of retail units varies based on the size and type of shop, it is more difficult to make assumptions on the technical viability of conversion and connection. A review of online information (Display Energy Certificates and Energy Performance Certificates) provided some insight into the buildings, see Table 2. Rhiw Shopping Centre and Wyndham House did not have enough data. This is assumed to be due to the number of business within. So they have been assumed to be electrically heated.

Table 2: Secondary side heating systems, retail buildings

	Heating system
Co-op & other stores Brackla	Some stores electrically heated, some stores wet heating using natural gas
Wilko, Nolton House	Electrically heated
Rhiw Shopping Centre	Electrically heated (assumed)
Wyndham House	Electrically heated (assumed)

This means that all the retail units would require some form of conversion to a heat network compatible secondary side system. This reduces the probability of the buildings being technically viable for connection.

Of the four retail buildings, Wilko is the only one considered commercially and technically viable at this stage. This is due to the large heat load, and single ownership of the building which makes conversion and compatibility more achievable.

As the other buildings are made up of multiple small units they are not considered commercially viable. Conversion of these buildings is likely to be technically difficult and coordination of the works, contracts and leases provides too many barriers to connection. Should a large refurbishment programme be planned in any one of the buildings, this should be used to initiate conversion to a heat network compatible system if a heat network is present in the area.

2.1.4 Data quality

A review of the annual consumption and peak demand compared to the floor area (in kWh/m^2 and W/m^2) shows that the data has no variation within each building category, see Table 3. This is due to the consumption being based on energy benchmarks (CIBSE benchmarks and UCL Carb2 databases). As the consumption is not based on metered data, this is an added uncertainty and reduces confidence in the heat offtake available and therefore the benefit to connection.

Table 3: Heat demand per unit floor area.

	Annual heat consumption (kWh/m^2/annum)	Peak demand (W/m^2)
Penybont Primary School	118	25
Archbishop McGrath RC Comprehensive School	118	25
Brackla Primary School	118	25
Ysgol Gymraeg Bro Ogwr	118	25
Oldcastle Primary School	118	25
Brynteg Comprehensive Upper School	118	25
Brynteg Comprehensive Lower School	118	25
Pen Y Bont Court	298	64
Bryn-y-Cae Nursing Home	298	64
Co-op & other stores Brackla	153	33
Wilko, Nolton House	153	33
Rhiw Shopping Centre	153	33
Wyndham House	153	33

2.2 Heat demand profile

2.2.1 Daily variation

The buildings considered by this analysis fall under three categories; schools, general retail and sheltered housing. The heat demand profiles for schools and retail buildings are similar. They both have high heat use in the morning with the heat use tailing off throughout the afternoon. In contrast the sheltered housing uses heat both in the morning and throughout the evening into the night. This suggests that combining sheltered housing and either retail or school loads would be beneficial to a heat network by raising the base load seen by the energy centre.

2.2.2 Annual variation

Heat demand varies throughout the year. This variation is due to weather temperatures, occupation and domestic hot water use. All three building categories will have lower heat demands in the summer due to increased outside temperatures.

The sheltered housing has a relatively high domestic hot water demand compared to its space heating demand. The domestic hot water demand is relatively constant throughout the year as it is not weather dependent and the nursing homes are continuously occupied. Therefore the nursing homes will have lower annual variations in heat demand which is beneficial to the heat network. This makes nursing homes commercially desirable connections.

Schools regularly have low occupancy periods, during the summer and other times during the year (Christmas, Easter, half terms and weekends). This significantly reduces the domestic hot water demand at these times. The heat demand from schools varies throughout the year as a result.

Retail units have proportionally low domestic hot water demand. This means that despite continuous occupation and usage, the total heat demand varies significantly over the year due to the weather. This is not beneficial to a heat network.

As such, connecting schools and retail units to a heat network is likely to exacerbate the problem of high peak demands in parts of the winter and low daily demand through the summer. This may not be a problem depending on the prime mover in the energy centre. However it may lead to smaller capacity low carbon plant being installed, and as a result more dependency during the winter months on backup plant to meet peak demand.

3 Location

The locations of the buildings can be seen in Figure 1. The location and its effect on viability to network connection depends heavily on the location of the network itself. Connection to a network spine which runs immediately adjacent to the building is evidently going to be more viable than to a network on the opposite side of a river.

However, some high level judgements can be made based on the location of the buildings in relation to each other and other areas which may provide viable connections.

Figure 1: Location of specified non-domestic buildings

As a metric, a linear heat density of 2 MWh/m is expected to provide a commercially viable heat network. This means that if a single building can provide a high proportion of this, then a network is more likely to be viable in that area. Note that the building does not have to provide the entire heat offtake. In most cases smaller non-anchor loads would be connected in the immediate area. This increasing the linear heat density of the pipe route. The following subsections provide a viewpoint on viability of connection.

3.1 Groups

The following groups of connections can be seen in Figure 1:

1. **Group 1**: (east of railway tracks) Archbishop McGrath RC Comprehensive, Co-op + other stores Brackla, Bryn-y-Cae nursing homes and Brackla Primary school.
2. **Group 2**: (west side) Wyndham House, Rhiw Shopping centre and Wilko, Nolton House.

The proximity of the buildings within the groups provides an aggregated demand which improves the commercial viability of installing the required infrastructure to connect the area as a whole. This would positively impact the viability of individual buildings in the area. In particular, Co-op & other stores Brackla whilst likely to be unviable for a number of reasons as a standalone building, provides an additional demand in a location which is supported by other viable buildings. This makes it a possible connection as the viability of the building can be based purely around technical complexity of conversion, rather than also taking into account the viability of the pipe route and related infrastructure costs.

Brynteg Comprehensive Upper and Lower schools are very close to one another and in an area of residential housing. Their aggregated heat demand in conjunction with single ownership makes them a commercially attractive connection option.

3.1.1 Adjacent demand

Connection to the specified buildings may be commercially preferable if the connection acts as a catalyst to heat delivery to buildings in the adjacent area. As such a high level review into the type of building in the local area has been undertaken. This finds that the retail units in central Bridgend have the highest potential to connect to adjacent demands due to the built up nature of the location with expected high heat users in the immediate vicinity. The other specified buildings do not have the same potential to connect to high density loads (other than those specified by EPN for this analysis) as they are located in areas of mid-density residential housing.

Pen-Y-Bont Court is an exception to this as there are other non-domestic buildings in the immediate area including a hotel and Bridgend science park. These buildings would also benefit a local heat network and so Pen-Y-Bont Court may be more commercially viable as a connection based on the areas other buildings.

3.1.2 Outliers

Pen-Y-Bont Court is notably remote (to the south) from the other specified buildings. It is bordered on one side by the railway, and is in a much less densely populated area. Connection to the other specified buildings would require crossing of the A48, a major traffic carrier. There are some low density office buildings in the area. However in general it is thought that the building is poorly located for

connection to a heat network in Bridgend. This said, it does not affect the viability of connection to a local heat network.

Ysgol Gymraeg Bro Ogwr is also remote (to the north) from the other specified buildings. However it is in an area of residential housing, and could be connected to Brackla Primary school via a comparatively inexpensive soft-dig trench route. This does not adversely affect its viability of connection to a local heat network.

While close to the town centre, Penybont Primary school is not close to other specified non-domestic buildings and is on the opposite side of the railway to the town centre buildings. This may make the connection less viable as the network route may need to cross the railway adding additional cost to the initial infrastructure investment. However there is an area of domestic housing nearby which would increases the heat density of the area.

3.2 Local land suitability

The land surrounding the buildings can have an impact on the viability of connection as soft-dig areas are quicker and cheaper to install heat network pipes throughout in comparison to hard-dig areas. Similarly, low density suburban areas have generally less expensive installation costs compared to high density urban areas. This is a result of the other utilities being supplied along similar routes as the heat network which can mean a more complex heat supply pipe route is needed.

The retail loads in the centre of Bridgend: Wilko, Norlton House; Rhiw Shopping Centre; and Wyndham House are in an area in which is expected to be heavily congested with utilities. The area also will require hard-dig installation throughout. This will increase installation costs, may incur programme delays as a result of diversions around utilities and hence reduce the technical and commercial viability of buildings in the area.

All the other specified buildings are in residential areas and installation of infrastructure will encounter residential level utilities. However installation around these and local road closures are expected to be less disruptive than in central Bridgend. Outlying buildings such as Pen-Y-Bont Court and Ysgol Gymraeg Bro Ogwr have areas of possible soft-dig installation, as do many of the schools when considering routes to school buildings across playing fields. This increases the commercial viability of connecting these loads.

Where the schools have multiple buildings on one site, it cannot be assumed that these are currently connected to a single existing heating system served by one boiler plant. However as the areas in between the buildings are owned by the schools themselves installation through them is not considered a barrier to connection.

4 Conclusion

Table 4: Table of recommendations

	Recommendation
Penybont Primary School	Viable
Archbishop McGrath RC Comprehensive School	Key anchor
Brackla Primary School	Viable
Ysgol Gymraeg Bro Ogwr	Viable
Oldcastle Primary School	Key anchor
Brynteg Comprehensive Upper School	Key anchor
Brynteg Comprehensive Lower School	Key anchor
Pen Y Bont Court	Key anchor
Bryn-y-Cae Nursing Home	Key anchor
Co-op + other stores Brackla	Viable
Wilko, Nolton House	Viable
Rhiw Shopping Centre	Viable
Wyndham House	Viable

This report has determined the commercial and technical viability of connecting specific non-domestic buildings to any heat network in the area. The report has found that in general due to the ease of conversion of the secondary side systems and heat offtake available, the schools and nursing homes provide viable connections. The larger the heat offtake the more preferential the connection.

In contrast, the uncertainty regarding secondary side conversion complexity makes the retail units less viable. Wilko provides a viable connection due to the size and singular ownership of the building. Co-op & other stores may be viable but only due to their proximity to other non-domestic buildings. Rhiw Shopping Centre and Wyndham House are electrically heated and in highly congested areas. They are not recommended as anchor loads but could be viable if they are converted to a wet heating system.

The shops in central Bridgend have more potential to be part of a network which connects to other high heat dense buildings locally due to their location. However this area is likely to be more technically difficult to install the infrastructure.

Pen-Y-Bont Court, while remote from the other loads specified here, is adjacent to other buildings which may help to create a localised network, or provide a stronger commercial case for extending a network out past the A48.