Programme Area: Smart Systems and Heat

Project: WP2 Manchester Local Area Energy Strategy

Title: Non-Domestic Decentralised Energy and District Heating Deployment, Bury

Abstract:

This study provides a desktop review of the EnergyPath Networks (EPN) Decentralised Energy and District Heating deployment in Bury, considering the connection of non-domestic buildings to heat networks. The EPN model develops heat network deployment across cluster area, with connections to both domestic and non-domestic buildings. This report provides general recommendations on nondomestic building connection to a heat network based on their use type and size. The aim of this report is to define metrics on which the connection policy applied by the model can be tested and refined.

Context:

The Spatial Energy Plan for Greater Manchester Combined Authority project was commissioned as part of the Energy Technologies Institute (ETI) Smart Systems and Heat Programme and undertaken through collaboration between the Greater Manchester Combined Authority and the Energy Systems Catapult. The study has consolidated the significant data and existing evidence relating to the local energy system to provide a platform for future energy planning in the region and the development of suitable policies within the emerging spatial planning framework for Greater Manchester.

Energy Systems Catapult

Decentralised Energy and District Heating Deployment, Bury

Task 015

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

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		Name	Evagelos Korais	Gavin Poyntz	Mark Anderson
		Signature			
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			Prepared by	Checked by	Approved by
		Name	Evagelos Korais	Gavin Poyntz	Mark Anderson
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1 Executive Summary

This study provides a desktop review of the EnergyPath Networks (EPN) Decentralised Energy and District Heating deployment in Bury, considering the connection of non-domestic buildings to heat networks.

The EPN model develops heat network deployment across cluster area, with connections to both domestic and non-domestic buildings. This report provides general recommendations on non-domestic building connection to a heat network based on their use type and size.

The aim of this report is to define metrics on which the connection policy applied by the model can be tested and refined. To achieve this, connection viability has been analysed from three viewpoints:

1. Individual building viability, based on constraints from the design of existing heating systems of each non-domestic building type and related issues network connection. This includes assessment of the most common heating system type by building category, connection feasibility, conversion costs and expected heat demand.

2. Multiple building viability, based on daily heat demand profiles for typical building types/usages and assessing beneficial combinations expected to provide idealised demand profiles when connected to the network. An idealised profile is one which maximises heat consumption from the prime mover by minimising modulations in the heat profile.

3. Network viability, based on linear heat densities which would be expected to result in viable networks.

An overall risk of connecting each building category to heat networks has been provided to define what building uses and scales are more likely to benefit a heat network or on contrary are likely to be an obstacle to its viability.

The highest proportion of connections should be derived from buildings within the sheltered housing, restaurant and leisure categories, with the lowest proportion derived from general non-residential and retail buildings.

A key outcome of this assessment is the identification of 2 MWh/m as the approximate linear heat demand metric for commercial viability. This number varies between 1 MWh/m and 10 MWh/m (mode 3.3 MWh/m).

2 Introduction

This study provides a desktop review of the EnergyPath Networks (EPN) Decentralised Energy and District Heating deployment in Bury, considering the connection of non-domestic buildings to heat networks.

The EPN model develops heat network deployment across cluster areas, with connections to both domestic and non-domestic buildings. The aim of this report is to review and inform the connection policy applied by the model, providing evidence on the applicability and viability of non-domestic building connection to a heat network.

This includes a review of:

- The use types and scales of non-domestic buildings selected within EPN for connection to a heat network;
- The use types and scales of non-domestic buildings not selected within EPN for connection to a heat network;
- The use types and scales of non-domestic buildings excluded from EPN for connection to a heat network.

The review determines if the buildings can be practically converted to be fed by a heat network, and if the building would be technically suitable for a heat network.

The methodology used to assess this is as follows:

1. Classification of building use types to form overarching building categories;
2. Determine typical heating systems found in each building category, based on the typical floor area scales at which different systems are found. Types of heating fuels used with each heating system have also been considered;
3. Technical viability to convert the building use type for compatibility with a district heat network. (Cost of conversion is considered only from a practical point of view, not financial feasibility.)
4. This report recommends the minimum floor area at which a building type is valid for connection and, if applicable, the subset sizes of the building type viable.
5. The report develops a pass/fail process for a heat network connection based on building use type given the non-domestic floor area.

Subsequently, the main barriers associated with risk level and benefits to convert each building category to connect to a heat network have been assessed. A level of risk (low/medium/high) to connect each building category to a heat network has been determined.

The report then analyses combinations of buildings and determines the most beneficial combinations which would maximise heat output of the prime mover by creating a consistent heat offtake demand profile. This analysis is extended to a metric which states an idealised proportion of building categories. To establish if an area is likely to sustain a heat network, the report assesses the typical linear heat density for which a network is expected to be viable.

Where the model has previously excluded the building, the report recommends if this assumption is valid, or if the building type should in fact be considered for connection.

The report does not assess the financial viability of the proposed building connections.

3 Heating System by Building Category and Connection Viability

The provided connected and non-connected building use types have been classified into general building categories. These have been subcategorised based on typical floor areas for different scales (small, medium and large) of building in each category. This assists recommendations as the type of heating system varies across building use types based on the building scale. This is further related to the magnitude of the energy demand that can be expected.

Table 1 presents the heating system type, associated heat emitter and fuel source typically used in each building category.

It should be noted that these generalisations may not be applicable for all buildings as actual heating system design is based on not only building use and size, but also building utilisation and layout, occupancy, level of comfort, energy efficiency and local energy supply. Further to this, large multi-use buildings may have several heating systems operating within.

Given the heating system type typically used in each building category, technical compatibility for connection to a heat network has been assessed. The general suitability of each building category for district heat has also been assessed based on typical building use.

The first step to determine building connection suitability is based on heating system type. Building scales not suitable for connection include floor areas for which the most common heating system type is non-compatible with a heat network connection and would require complex retrofitting (e.g. cases in which the building does not have space to absorb the required retrofitted heat distribution pipework).

The conversion and connection costs of the domestic hot water system in most circumstances is considered inconsequential in comparison to the heating system. This is due the majority of buildings having an installed domestic hot water distribution system which can be connected to the district heat network in a straightforward manner. In some cases the domestic hot water service is provided by electric heating at the point of use. Taking heat from the heat network for the domestic hot water service in these buildings is likely to be technically unviable, and hence would not incur conversion/connection costs.

Connection to a district heat network in most cases will not involve the removal of the gas supply to the building as some buildings may have a separate gas requirement such as for cooking or industrial processes. This report therefore has not taken account of any changes to the gas supply infrastructure.

Table 1 Heating system type by building category. Note: All air refers to heating via the air handling unit

Building category	Size	Floor area (m^2)	Fuel source	Heat emitters	Building environment	Compatible with district heat
Workshop	S	< 1,000	Electricity	Convectors	Heating & natural ventilation	N – no wet heating system (electric system not viable)
	M	1,000 to 10,000	Gas fired boiler	Unit heater	Heating & mechanical ventilation	Y
	L	> 10,000	Gas fired radiant panels	Radiant panels	Heating & mechanical ventilation	N – no wet heating system (internal gas distribution only)
General retail	S	< 150	Electricity	Refrigerant fan cooler	Air conditioning	N – no wet heating system (electric system not viable)
	M	150 to 3,000	Electricity	Refrigerant fan cooler	Air conditioning	N – no wet heating system (electric system not viable)
	L	> 3,000	Gas fired boiler	Hot water fan heater	Air conditioning	Y
Non-food retail shop	S	< 150	Gas fired boiler	Radiators	Air conditioning	Y
	M	150 to 3,000	Gas fired boiler	Radiant panels	Air conditioning	Y
	L	> 3,000	Gas fired radiant panels	Radiant panels	Air conditioning	N – no wet heating system (internal gas distribution only)
Food retail shop	S	< 750	Electricity	Refrigerant fan cooler	Air conditioning	N – no wet heating system (electric system not viable)
	M	750 to 2,500	Gas fired boiler	All air	Air conditioning	Y
	L	> 2,500	Gas fired boiler	All air	Air conditioning	Y
Storage facility	S	< 1,000	Gas fired boiler	Radiant panels	Space specific	Y
	M	1,000 to 3,000	Gas fired radiant panels	Radiant panels	Space specific	N – no wet heating system (internal gas distribution only)
	L	> 3,000	Gas fired radiant panels	Radiant panels	Space specific	N – no wet heating system (internal gas distribution only)

Building category	Size	Floor area (m^2)	Fuel source	Heat emitters	Building environment	Compatible with district heat
Office	S	< 1,000	Gas fired boiler	Radiators	Heating & natural ventilation	Y
	M	1,000 to 5,000	Gas fired boiler	Hot water fan heater	Air conditioning	Y
	L	> 5,000	Gas fired boiler	Hot water fan heater	Air conditioning	Y
Restaurant	S	< 150	Gas fired boiler	Radiators	Heating & natural ventilation	Y
	M	150 to 500	Electricity	Refrigerant fan cooler	Heating & mechanical ventilation	N – no wet heating system (electric system not viable)
	L	> 500	Gas fired boiler	All air	Heating & mechanical ventilation	Y
General accommodation	S	< 500	Gas fired boiler	Radiators	Heating & natural ventilation	Y
	M	500 to 5,000	Gas fired boiler	Radiators	Heating & natural ventilation	Y
	L	> 5,000	Gas fired boiler	Radiators	Heating & mechanical ventilation	Y
Bar/pubs	S	< 200	Gas fired boiler	Radiators	Heating & natural ventilation	Y
	M	200 to 1,000	Gas fired boiler	Radiators	Heating & natural ventilation	Y
	L	> 1,000	Electricity	Refrigerant fan cooler	Heating & mechanical ventilation	N – no wet heating system (electric system not viable)
Clinic	S	< 500	Gas fired boiler	Radiators	Heating & mechanical ventilation	Y
	M	500 to 5,000	Gas fired boiler	All air	Heating & mechanical ventilation	Y
	L	> 5,000	Gas fired boiler	All air	Heating & mechanical ventilation	Y
Hospital	S	< 500	Gas fired boiler	All air	Heating & natural ventilation	Y
	M	500 to 10,000	Gas fired boiler	All air	Heating & mechanical ventilation	Y
	L	> 10,000	Gas fired boiler	All air	Heating & mechanical ventilation	Y

Building category	Size	Floor area (m^2)	Fuel source	Heat emitters	Building environment	Compatible with district heat
School	S	< 1,000	Gas fired boiler	Radiators	Heating & natural ventilation	Y
	M	1,000 to 5,000	Gas fired boiler	Radiators	Heating & natural ventilation	Y
	L	> 5000	Gas fired boiler	Radiators	Air conditioning	Y
Cultural	S	< 800	Gas fired boiler	Radiators	Heating & natural ventilation	Y
	M	800 to 3000	Gas fired boiler	Radiators	Heating & natural ventilation	Y
	L	> 3000	Gas fired boiler	Radiators	Heating & natural ventilation	Y
Leisure centre	S	< 700	Electricity	Refrigerant fan cooler	Heating & mechanical ventilation	N – no wet heating system (electric system not viable)
	M	700 to 3000	Gas fired boiler	All air	Air conditioning	Y
	L	> 3000	Gas fired boiler	All air	Air conditioning	Y
Leisure centre with a pool	S	< 700	Gas fired boiler	All air	Heating & mechanical ventilation	Y
	M	700 to 3000	Gas fired boiler	All air	Air conditioning	Y
	L	> 3000	Gas fired boiler	All air	Heating & mechanical ventilation	Y
Swimming pool centre	S	< 1000	Gas fired boiler	All air	Air conditioning	Y
	M	1000 to 10000	Gas fired boiler	All air	Air conditioning	Y
	L	> 10000	Gas fired boiler	All air	Air conditioning	Y
Dry sports facility	S	< 700	Gas fired boiler	Radiators	Heating & mechanical ventilation	Y
	M	700 to 3000	Gas fired boiler	Radiators	Heating & mechanical ventilation	Y
	L	> 3000	Gas fired boiler	All air	Heating & mechanical ventilation	Y

Building category	Size	Floor area (m^2)	Fuel source	Heat emitters	Building environment	Compatible with district heat
Emergency services	S	< 600	Gas fired boiler	Radiators	Heating & natural ventilation	Y
	M	600 to 5000	Gas fired boiler	Radiators	Heating & natural ventilation	Y
	L	> 5000	Gas fired boiler	Radiators	Heating & natural ventilation	Y
Cold storage	S	< 1000	Electricity	Resistive element	Frost protection	N – no wet heating system (electric system not viable)
	M	1000 to 10000	Electricity	Resistive element	Frost protection	N – no wet heating system (electric system not viable)
	L	> 10000	Electricity	Resistive element	Frost protection	N – no wet heating system (electric system not viable)
Public building	S	< 700	Gas fired boiler	Radiators	Heating & natural ventilation	Y
	M	700 to 3000	Gas fired boiler	Radiators	Heating & natural ventilation	Y
	L	> 3000	Gas fired boiler	Radiators	Heating & natural ventilation	Y
Public waiting/ circulation area	S	< 1000	Electricity	Convectors	Heating & natural ventilation	N – no wet heating system (electric system not viable)
	M	1000 to 5000	Electricity	Convectors	Heating & natural ventilation	N – no wet heating system (electric system not viable)
	L	> 5000	Gas fired boiler	Convectors	Heating & natural ventilation	Y
Entertainment hall	S	< 1000	Gas fired boiler	All air	Heating & natural ventilation	Y
	M	1000 to 3000	Gas fired boiler	All air	Heating & natural ventilation	Y
	L	> 3000	Gas fired boiler	All air	Heating & natural ventilation	Y
Hotel	S	< 1000	Electricity	Refrigerant fan cooler	Air conditioning	N – no wet heating system (electric system not viable)
	M	1000 to 7000	Electricity	Refrigerant fan cooler	Air conditioning	N – no wet heating system (electric system not viable)
	L	> 7000	Gas fired boiler	Hot water fan heater	Air conditioning	Y

4 Connection Risk

The overall risk attributed to each building use and size has been determined based on an assessment of connection viability, heat demand magnitude and consistency. Where these are considered more manageable, predictable and the connection is likely to be beneficial for the heat network in terms of heat offtake, the risk to the project is considered lower, and vice versa.

Table 2 presents the risk levels associated to a heat network connection along with their description. Table 3 shows the risk level attributed to each building.

Table 2 Heat network connection risk assessment.

Risk	Description
L	Minimal conversion works are required for a heat network connection and/or heat demand is likely to be sufficient to significantly benefit the network.
M	Medium conversion works are expected to be required and/or heat demand is expected to be medium and connection might benefit the heat network.
H	Major conversion works are expected to be required and likely to be prohibitive, and the heat demand expected is unlikely to benefit the network.

Table 3: Heat network connection suitability by building category.

Building type	Building floor area not suitable for connection (m^2)	Risk (L/M/H)	Comments
Workshop	< 1,000 and > 10,000	M	Over scales suitable for connection, workshops are expected to have a central heat demand limited to working hours in weekdays. This demand profile is unlikely to help smooth the overall network demand minimising the effective benefit of connecting the building. Although the heating system would be compatible with a heat network connection which reduces conversion complexity.
General retail	< 3,000	M	Large general retail shops are expected to have a central heat demand, mainly in weekdays and part of weekends, and a heating system compatible with a heat network connection which minimises conversion complexity. Connection to small retail shops is not recommended due to non-compatibility of heating system and lack of space to accommodate the required equipment for a heat network connection. For instance, there may be insufficient space to house heat interface units (HIU).
Non-food retail shop	< 150 and > 3,000	M	Medium non-food retail shops are expected to have a central heat demand throughout the week and a heating system compatible with a heat network connection, minimising conversion complexity. Connection to small retail shops is not recommended due to non-compatibility of heating system and lack of space to accommodate the required equipment for a heat network connection.
Food retail shop	< 750	L	Medium and large food retail shops are expected to have a central heat demand, typically throughout the week, and a compatible heating system with a heat network connection which minimises conversion complexity. Connection to small food retail shops is not recommended due to non-compatibility of heating system and lack of space to accommodate the required equipment for a heat network connection.

Storage facility	> 1,000	H	Medium and large storage facilities are not expected to have a compatible heating system with a heat network connection. However, storage requirements are highly dependent on the goods being stored and the energy required and heating systems (if applicable) vary significantly from one facility to another increasing the risk of connection.
Office	None	L	Medium and large offices are expected to have a central to high heat demand, in weekdays from early morning to early evening, with a heating system compatible with a heat network connection. In general offices follow similar operating times and so will not smooth the overall demand profile of the network when aggregated. This reduces the benefit to the network placing more demand on peak rather than baseload plant.
Restaurant	From 150 to 500	M	Small and large restaurants are expected to already have a heating system compatible with a heat network connection which reduces conversion complexity. There is a wide variety of operational schedules on which heat demand will depend, although over an aggregated number of premises this is likely to help smooth overall demand profile and benefit the heat network.
General accommodation	None	L	Medium and large scale accommodation are expected to have significant heat demand, non-continuous occupancy, often only used in evenings, and a heating system compatible with heat network connection which minimises conversion complexity.
Bar/pubs	> 1,000	M	Small and medium bar/pubs have a low heat demand and connection is recommended only on an aggregate level. Pubs with restaurant and/or guest rooms are likely to have a higher heat demand. At higher sizes, non-suitable heating systems significantly increase conversion complexity and district heating connection is not recommended.
Clinic	None	L	Medium and large clinics are expected to have significant heat demand, typically in days and evenings, and a heating system compatible with heat network connection which minimises conversion complexity.
Hospital	None	L	Medium and large hospitals are expected to have significant heat demand with a 24 hour use, and a heating system compatible with heat network connection which minimises conversion complexity. The continuous operation and heat demand are expected to be highly beneficial to a heat network.

School	None	L	Medium and large schools are expected to have significant heat demand, weekday use for part of the year, and a heating system compatible with heat network connection which minimises conversion complexity. Seasonal variations in heat demand should be considered as this is likely to affect the baseload seen by the network throughout the summer. This may be exacerbated through connection of a high number of schools on an aggregated basis.
Cultural	None	L	Medium and large cultural buildings are expected to have a heating system compatible with a heat network connection as well as significant heat demand, daytime use, similar to office hours, but more likely to be open weekends.
Leisure centre	< 700	L	Medium and large leisure centres are expected to have a heating system compatible with a heat network connection as well as significant heat demand, typically daily and evening use, making them beneficial for smoothing demand as well as increasing the baseload.
Leisure centre with a pool	None	L	Leisure centres with a pool are expected to have heating systems compatible with a heat network connection. Due to the floor area required to host a pool and associated facilities, and due to high heating requirements for pool water, any leisure centre is expected to have a significant heat demand, typically daily and evening use.
Swimming pool centre	None	L	Swimming pool centres are expected to have a heating system compatible with a heat network connection. Pool water heating, space heating, ventilation and air dehumidification required. Due to the floor area required to host a pool and associated facilities, and due to high heating requirements for pool water, any pool centre is expected to have a significant heat demand.
Dry sports facility	None	L	Dry sports facilities are expected to have a heating system compatible with a heat network connection. Medium and large dry sports facilities are expected to have a central heat demand, ranging from occasional use to daily and evening use.
Emergency services	None	L	Emergency Services are expected to have a heating system compatible with a heat network connection. Medium and large emergency services are expected to have a central heat demand, normally continuous, some stations closed in the evenings and weekends.
Cold storage	All	H	Heating system not compatible with a heat network connection over any scale. Cold Storage facilities require refrigeration and usually use electricity for this purpose generating waste heat rather than a heat demand, so district heating is not a suitable option. Technology options could be considered to capture the waste heat to act as a heat supplier to the network, however due to the low grade heat available this is unlikely to be viable in most instances.

Public building	None	L	Wet heating system is likely to already be in place and heat emitters are compatible with a heat network connection. Medium and large public buildings are expected to have a sufficient heat demand.
Public waiting/ circulation area	> 5,000	M	Large public waiting/circulation areas are expected to have a compatible heating system with a heat network connection. Conversion complexity is likely to be high as the building arrangement is likely to be complex and around a difficult road layout.
Entertainment hall	All	L	Entertainment halls are expected to have a heating system compatible with a heat network connection. Medium and large entertainment halls are expected to have a central heat demand, mainly evening use.
Hotel	< 7,000	L	Large hotels, usually luxury hotels, are likely to have a heating system compatible with a heat network connection. Small and medium hotels are expected to use electricity for heating and so not to have a heating system compatible with a heat network connection, however over an aggregate scale, conversion and connection may be viable.

5 Demand Profile Integration

Different building types exhibit characteristic heat demand profiles with various peaks and troughs distributed throughout a twenty-four hour period. Connection of these different building types can produce an aggregate demand, which is more linear and therefore able to maximise production of the prime mover. Aggregating heat demand is a key benefit of a heat network, enabling continuous operation, with enhanced process control and a reduced requirement for more carbon intensive peak demand elements, such as gas boilers. Energy centres operating to satisfy aggregated demands can also benefit from economies of scale on the installed capacity. Consequently, demand aggregation can improve the viability of the heat network.

The suitability of connecting each building type as part of an aggregate demand has been assessed on a case by case basis by integrating demand profiles for different matched building scenarios. The analysis presented here estimates the most suitable scenario by assessing which achieves closest to the idealised profile. The idealised profile is one which is as flat linear as possible and minimises the operational variation of the prime mover, maximising the heat consumption of the energy centre.

Table 4 presents the profile categories for the building typologies described in earlier sections and used as part of the integrated profile assessment. The building types included in the study have been classified under different profile categories, which represent general building archetypes with standard heat demand profiles. In each case the building types have been grouped into the most suitable profile category.

Table 4: Profile classification for building typologies

Profile category	Building types included in category
General non-residential	Workshop; Public building.
Retail	General retail; Food retail shop; Non-food retail shop.
Storage	Storage facility.
Office	Office.
Restaurant	Restaurant; Bar/pubs.
Sheltered housing	General accommodation.
Hospital	Hospital; Clinic; Emergency services.
School	School.
Cultural	Cultural.
Leisure	Leisure centre; Leisure centre with pool; Swimming pool.
Assembly & leisure	Public waiting/circulation area; Entertainment hall; Dry sports facility; Sports centre.
Hotel	Hotel.

Table 5 presents indicative heat demand profiles for each building typology used in the integrated profile assessment. Each demand profile is co-efficient led and indicates the extent of heat demand for the relevant building typology over a twenty-four hour period compared to that building's maximum demand. Each demand profile is informed by previous project data and in-house experience.

Table 5: Heat demand profiles per category

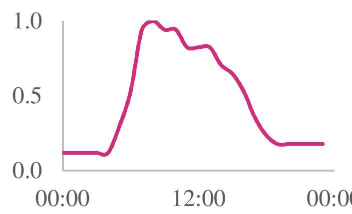
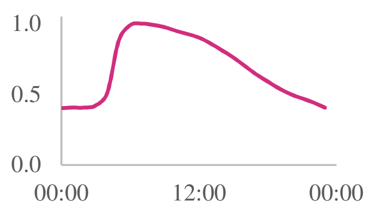
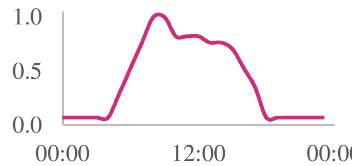
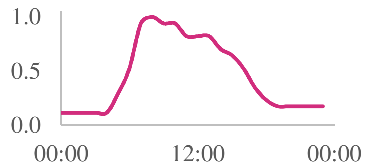
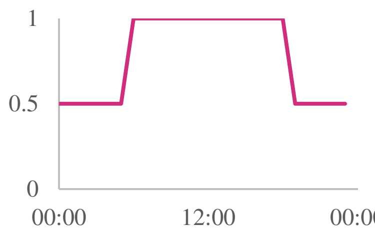
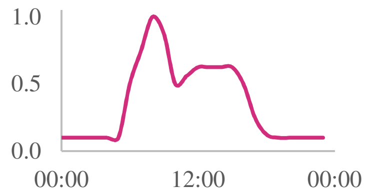
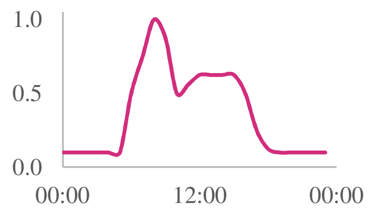
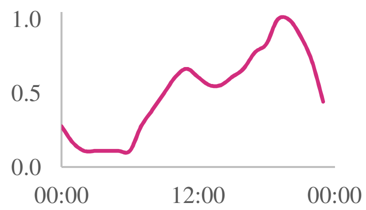
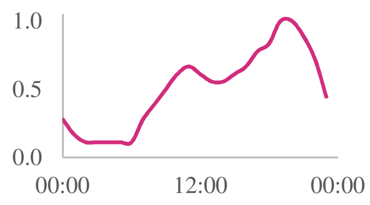
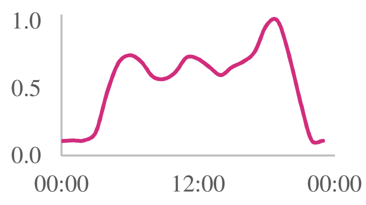
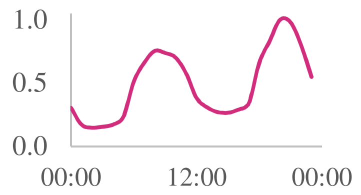
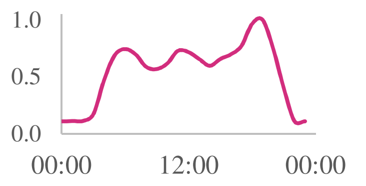
Profile category	Heat demand profile	Profile category	Heat demand profile
General non-residential		Hospital	
Retail		School	
Storage		Cultural	
Office		Leisure	
Restaurant		Assembly& leisure	
Sheltered housing		Hotel	

Table 6 indicates the general suitability of connecting building types to produce an aggregate load. This is displayed using a colour scheme profile with more suitable connections shown in green and less suitable connections in red. The values within the matrix are indicative of the extent of non-linearity of the resulting integrated demand profiles between two building types. Thus lower percentage values indicate less deviation over the 24 hours from the idealised and hence a more suitable connection.

The matrix indicates that the building matches which produce the most linear integrated profiles include:

- general accommodation and storage;
- hospital and office;
- hospital and restaurant;
- hospital and leisure.

The most unsuitable building matches include:

- general non-residential and retail;
- school and retail;
- office and retail;
- cultural and retail.

Table 6: Network connection decision matrix

	General non-residential	Retail	Storage	Office	Restaurant	General accommodation	Hospital	School	Cultural	Leisure	Assembly & leisure	Hotel
General non-residential		32%	26%	29%	20%	18%	25%	30%	29%	20%	23%	22%
Retail	32%		28%	30%	20%	18%	26%	32%	30%	20%	24%	23%
Storage	26%	28%		24%	18%	15%	21%	26%	24%	18%	21%	21%
Office	29%	30%	24%		18%	20%	15%	20%	18%	18%	20%	20%
Restaurant	20%	20%	18%	18%		20%	15%	20%	18%	24%	20%	20%
General accommodation	18%	18%	15%	20%	20%		16%	18%	16%	20%	18%	20%
Hospital	25%	26%	21%	15%	15%	16%		25%	23%	15%	20%	20%
School	30%	32%	26%	20%	20%	18%	25%		29%	20%	23%	22%
Cultural	29%	30%	24%	18%	18%	16%	23%	29%		18%	21%	21%
Leisure	20%	20%	18%	18%	24%	20%	15%	20%	18%		20%	20%
Assembly & leisure	23%	24%	21%	20%	20%	18%	20%	23%	21%	20%		22%
Hotel	22%	23%	21%	20%	20%	20%	20%	22%	21%	20%	22%	

Table 7 has been developed on the basis of an analysis of the network connection decision matrix with results given for each profile category. The results of the analysis indicate the proportion of connections to the heat network to achieve an ideal aggregated demand profile.

Table 7: Proportion of connections to heat network to achieve ideal demand profile

Profile category	Proportion of connections to heat network to achieve ideal demand profile
General non-residential	0%
Retail	0%
Storage	6%
Office	10%
Restaurant	12%
Sheltered housing	14%
Hospital	10%
School	3%
Cultural	6%
Leisure	12%
Assembly & leisure	9%
Hotel	9%

The idealised profile is mostly made up of offices, restaurants, sheltered housing, hospitals, leisure buildings, assembly buildings and hotels. Storage facilities and cultural add to this and a bit of school completes the categories of buildings. The aggregated profile balances the early morning dominated office profile with the evening dominated leisure profile to produce a flatter total profile.

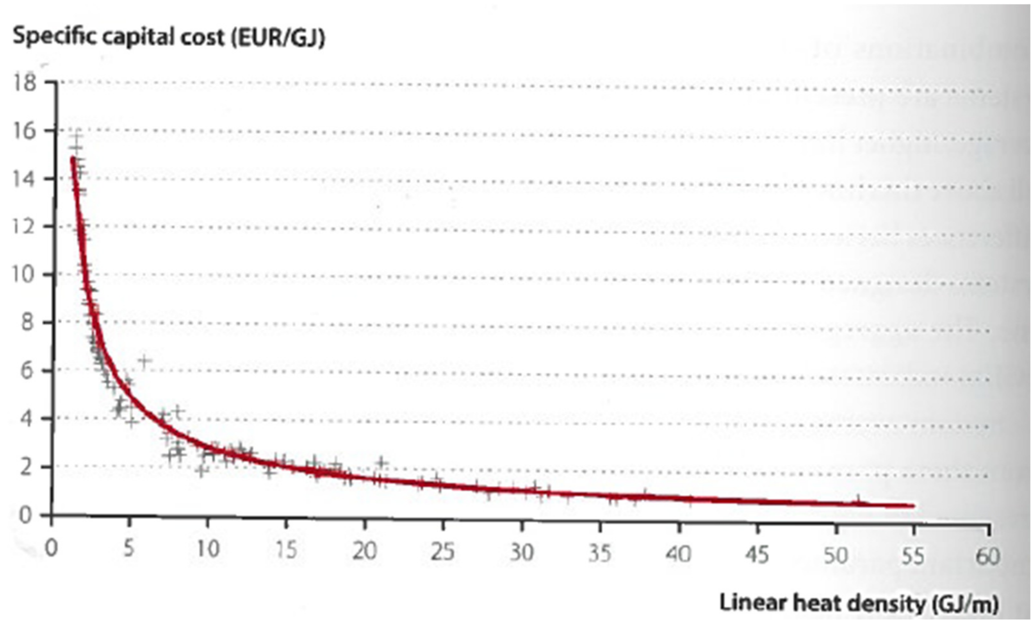
Due to the nature of building in a cluster it is highly unlikely that the cluster will have the idealised make up. It is then likely the profile would tend towards the idealised, but add in building groups in line with Table 6 pairings. An interpretation piece that uses floor areas of each building type, in the cluster, the idealised profile, and building pairing will be needed for each heat network. This should give a feeling for a unique, cluster specific, idealised profile.

6 Network Viability

During the planning stage of district heating a method of determining high level feasibility is to use the linear heat density of the area. This compares the length of pipe required to serve an area to the heat demand available in that area. A network is more viable in areas where the linear heat density (MWh/m) is higher. A high heat demand requiring a comparatively small length of pipe. This is more viable due to the benefits associated with having a more compact network (e.g. smaller pumping requirement, lower heat losses, smaller initial capex) while achieving the benefits of supplying a high heat demand (e.g. greater revenues, unlocking larger capacity plant).

The required linear heat density for a network to be expected to be technically and commercially viable is approximately 2 MWh/m. This is the industry rule of thumb for commercial viability. This is the lower end of linear heat densities found in Swedish district heat networks, varying between 1 MWh/m and 10 MWh/m (mode 3.3 MWh/m)[1]. Below 2 MWh/m the network is indicative of a low density suburb and typically the investment costs of the network become dominant.

Figure 1: Specific capital cost for district heat distribution



[1] Kulvertkostnadskatalog, Tuve Nordensen, Svensk Fjarrvarme AB (2007)

7 Suitability of the Model

The suitability of building connection to a heat network by building use type has been discussed. According to this study, the suitability of the model to determine connected and non-connected buildings can be tested. This section discusses where the model has previously excluded the building, if this assumption is valid, or if the building type should in fact be considered for connection.

After a high level review of the model output provided, it appears that some large fitness centres with a pool have been excluded while they have significant heat demand. It is recommended that they be connected as connection would be technically feasible.

Some small workshops with very low heat demand have been selected for a heat network connection. Connection of these buildings may not be recommended due to the complexity of conversion and connection compared to the expected heat offtake. However, conversion and connection is expected to be technically feasible.

Some medium general accommodations with a central heat demand have also been excluded while a connection is likely to benefit a local heat network and be technically feasible.

Most small food retail shops have been excluded for a heat network connection which is aligned with the recommendations. Cold stores and public waiting/circulations areas have also been excluded as recommended. Most small schools have been excluded. This assumption may be appropriate depending on the total number of schools connected, however medium schools like state schools which have also been discounted should be considered, as the heat offtake and conversion complexity are expected to make these viable connections. In general, the selections of hospitals and clinics for a heat network connection meet the recommendations for these building categories. The same observation is valid for pubs and restaurants.

8 Conclusion

A listing of the different categories of non-domestic buildings has been conducted followed by an assessment to determine the types of heating system that would typically be expected in the different building use types.

The risk of connecting each building type to a heat network has also been assessed based on the connection feasibility, conversion complexity and the heat demand magnitude and consistency. This analysis informed the conclusion that the general storage, cold storage and public waiting/circulation building types represent the highest risk connections to the heat network. The remaining building types were determined to be low risk connections, save the workshop, restaurant, bar/pub and retail categories, which represent medium risk connections.

For each building use and size, building scales at which a heat network connection is assumed to be suitable have been determined, along with preferred building connection scenarios and target linear heat densities of network development areas. A key outcome of this assessment is the identification of 2 MWh/m as the approximate linear heat demand metric for commercial viability. This number varies between 1 MWh/m and 10 MWh/m (mode 3.3 MWh/m). This assessment also outlines where exceptions should be made to the model outputs, such as the inclusion of connections to large swimming pools due to their high heat demand.

The suitability of connecting various building types as part of an aggregate demand has been assessed. The aggregated demand assessment enabled the development of a metric indicating proportions of connections to produce an ideal heat demand profile. The metric indicates that the highest proportion of connections should be derived from buildings within the sheltered housing, restaurant and leisure categories, with the lowest proportion derived from general non-residential and retail buildings.

In summary this report provides a desktop review of EnergyPath Networks (EPN) Decentralised Energy and District Heating deployment in Bury. The review encompasses various assessments and analyses to inform recommendations on the connection of non-domestic building types to heat networks.