The Highland Council WestPlan District Heating Opportunities Assessment

Version 1.1 - incorporating corrections, July 2017

RESOURCE EFFICIENT SCOTLAND

Growth that doesn't cost the earth

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European Union
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European Regional Development Fund
Investing in a Smart, Sustainable and Inclusive Future

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Glossary of Terms:

HNP – Heat Network Partnership
LDP – Local Development Plan
MIR – Main Issues Report
HERO – Heat Energy & Renewables Opportunities
SEEP – Scottish Energy Efficiency Programme
LHEES – Local Heat & Energy Efficiency Strategy
DHOAT – District Heating Opportunity Assessment Tool
CT – Carbon Trust
NPV – Net Present Value
IRR – Internal Rate of Return
BAU – Business as Usual

1 Introduction

The Highland Council are currently developing an energy strategy entitled HERO (Heat Energy & Renewables Opportunities). The strategy will set out the heat network and energy project priorities for the Highlands which aim to help meet Scottish Government targets for 2030 and 2050. A key objective for the strategy is to enable project delivery, partnership working and guide policies such as local planning policy.

The Highland Council are also in the process of preparing a new local development plan (LDP) for the West Highlands and Islands, entitled WestPlan. This plan will earmark sites for a variety of uses including housing, business and mixed use development. A Main Issues Report (MIR) published April 2016 for consultation detailed the Council's initial preference for development sites throughout the area.

To ensure that the policies of the forthcoming Proposed WestPlan align with the forthcoming HERO strategy, The Highland Council require a robust appraisal of the potential for Heat Networks within the settlements in the WestPlan area. The preferred settlement hierarchy for the WestPlan area is set out in table 1 below.

A high level appraisal of district heating economic viability has already been carried out by the Council's Energy & Sustainability Team on a number of settlements using the Scotland Heat Map and Heat Network Partnership (HNP) District Heating Opportunity Assessment Tool. However, the analysis did not consider development sites proposed in the WestPlan or consider a realistic business as usual case appropriate for off gas grid areas in the Highlands.

Table 1 WestPlan Settlement Hierarchy

Tier	Applicable Settlements
Main Settlements	Ullapool, Poolewe, Gairloch, Lochcarron, Kyle of Lochalsh, Staffin, Dunvegan, Portree, Kyleakin, Broadford, Sleat (Teangue, Kilbeg & Armadale), Mallaig, Spean Bridge & Roy Bridge, Fort William, Strontian, Kinlochleven, North Ballachulish & Glenachulish, South Ballachulish & Glencoe
Growing Settlements	Aultbea, Torridon, Plockton, Dornie, Auchtertyre, Balmacara and Reraig, Glenelg, Uig, Edinbane, Inverarish, Carbost, Invergarry, Morar, Arisaig, Acharacle, Kilchoan, Ardgour & Clouvullin, Duror, Lochaline
Community Plan Settlements	Shieldaig, Glendale, Rum, Eigg, Canna, Knoydart, Achnacarry, Bunarkaig and Clunes

District Heating & Planning

To date, few local development plans (LDP's) have included a specific policy for district heating. An area based strategy for district heating can help to highlight investment opportunities and direct future development towards planned infrastructure investment. Through this process, future land use planning site identification can steer development towards planned district heating networks, potentially making proposed networks more viable and acting as a catalyst for their development. Additionally, as will be discussed in greater detail below, the mapping of district heating opportunities can be used as guidance when considering the requirement for installation of networks in new development or regeneration sites.

New developments offer the potential to investigate district heating viability on a site-by-site basis and, where appropriate, include a requirement to install heat networks as part of planning permission provisions. This can ensure that new sites are safeguarded for future network expansion. Property developers and network owners can share the cost of infrastructure on new sites, offsetting the costs typically incurred for conventional gas systems. This provides an opportunity for additional heat sales revenue for network owners with only a fraction of the capital costs for consumer connections, catalysing larger area wide schemes. As such, disregarding opportunities to install heat networks on new sites can undermine the business case for future networks in surrounding areas. Additionally, new developments without district heating may represent a false economy whereby property developers install traditional heating systems that quickly become redundant in the drive towards carbon emission reductions.

Ultimately planners can play a key role to ensure that property developers do not miss opportunities for heat networks and that development takes place with regard to the local district heating strategy.

District Heating Strategy Development

The Highland Council are currently developing an energy strategy entitled HERO (Heat Energy & Renewables Opportunities) and a major part of this strategy will consider low carbon community heating and heat networks.

Currently, local authorities are encouraged, with support from the Heat Network Partnership, on a voluntary basis to develop district heating strategies, or to include a district heating element in wider strategies or plans such as Sustainable Energy Action Plans.

In developing the £0.5 billion Scottish Energy Efficiency Programme (SEEP), the Scottish Government is now considering the introduction of a statutory duty for local authorities to develop Local Heat & Energy Efficiency Strategies (LHEES). These would set a framework and delivery programme for how each local authority would both reduce the energy demand and decarbonise the heat supply of buildings in its area, across the timeframe of the strategy, to ensure progress against the national objectives of SEEP. The requirement for LHEES is currently at a high level policy scoping stage, however the consultation sets out that "an area-based socio-economic assessment would be used to assess the energy efficiency interventions and identify the most appropriate heat technology for an area and to designate district heating zones."[1] Scottish Government approved guidance is expected on this in due course.

This report presents the methodology and results of a heat mapping exercise carried out for the WestPlan area to identify potential district heating "zones" and model the viability of heat networks in both the existing built environment and across preferred sites considered for allocation in WestPlan main issues report.

[1] CONSULTATION ON HEAT & ENERGY. [online] Available at: http://www.gov.scot/Resource/0051/00513244.pdf [Accessed 15 Mar. 2017].

2 Methodology

The methodology presented here uses data from the Scotland heat map to identify the most appropriate locations for heat networks in the WestPlan area. Then, benchmark cost/technical data and heat demand data from the Scotland Heat Map is used to determine financial performance of proposed networks. The outputs are intended to highlight projects that would benefit from a more detailed feasibility study and should not be used for financial decision making.

Process

Figure 1 shows the process that was followed. The subsequent sections outline this methodology in greater detail.

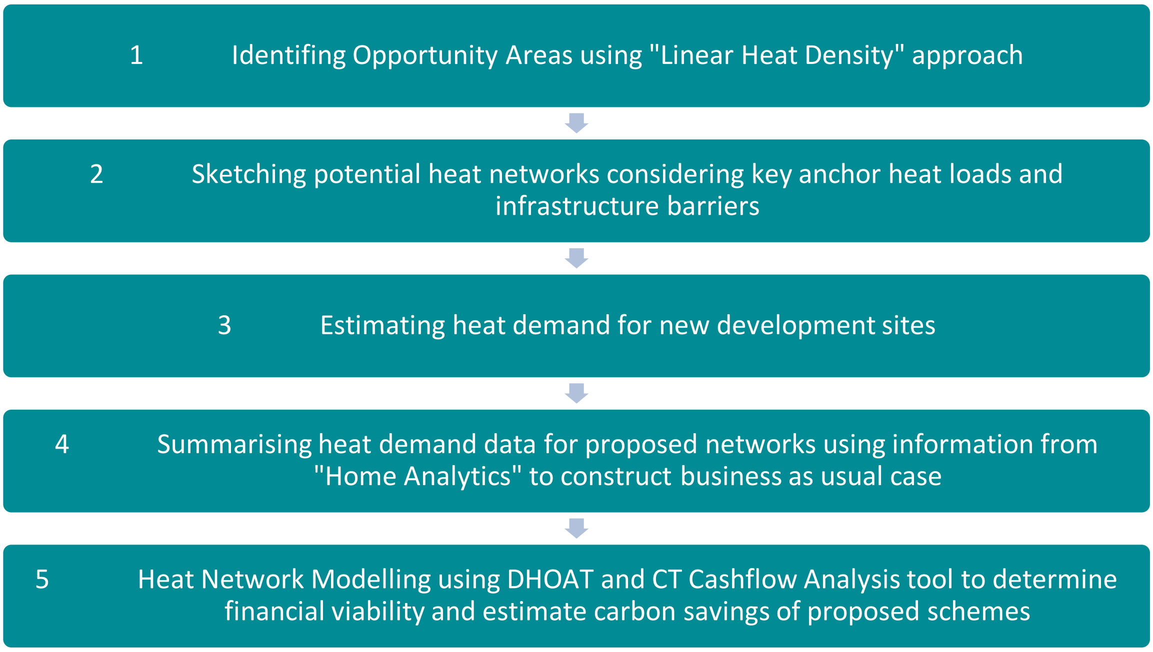
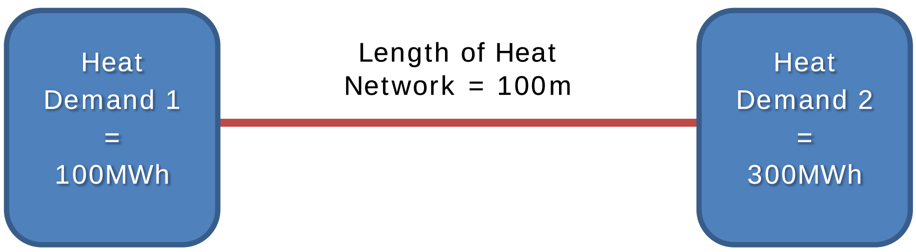


Figure 1 Opportunity Identification and Testing Process

Identifying Opportunity Areas

The principle of "linear heat density" was used to help identify the most appropriate areas for district heating within the WestPlan area. The Linear Heat Density is the total heat demand of a network, divided by the total length of pipe (Figure 2). The resultant Figure serves as a useful marker for financial viability because the high capital costs of heat network infrastructure must be offset by sufficient heat sales through the network over a reasonable period of time. As such, a higher linear heat density generally indicates improved financial viability. Based on our knowledge of successful schemes in the UK and Scandinavia, we have used a benchmark Figure of 4MWh/m/year to help indicate the location of potential schemes.



$$\text{Total Heat Demand} = 400\text{MWh/Year}$$

$$\text{Linear Heat Density} = \frac{\text{Total Heat Demand}}{\text{Length of Network}}$$

$$= \frac{400}{100}$$

$$=4\text{MWh/m/Year}$$

Firstly, the point level heat demand data was mapped for each property in the heat map and divided by 4MWh to provide a maximum length of network that could service each property whilst maintaining a linear heat density of 4MWh/m.

Secondly, the resultant length in meters was used to create a buffer around each heat demand point. Areas where buffers overlapped suggest opportunities for potential heat networks. Opportunity areas which contain more than 15 heat demand points were used to determine heat network opportunity areas. Zones were created based on analysis of the underlying heat demand density data and geographical boundaries such as roads, rivers and

Figure 2 Example Calculation of Linear Heat Density

infrastructure barriers. The process is outlined in Figure 3 below.

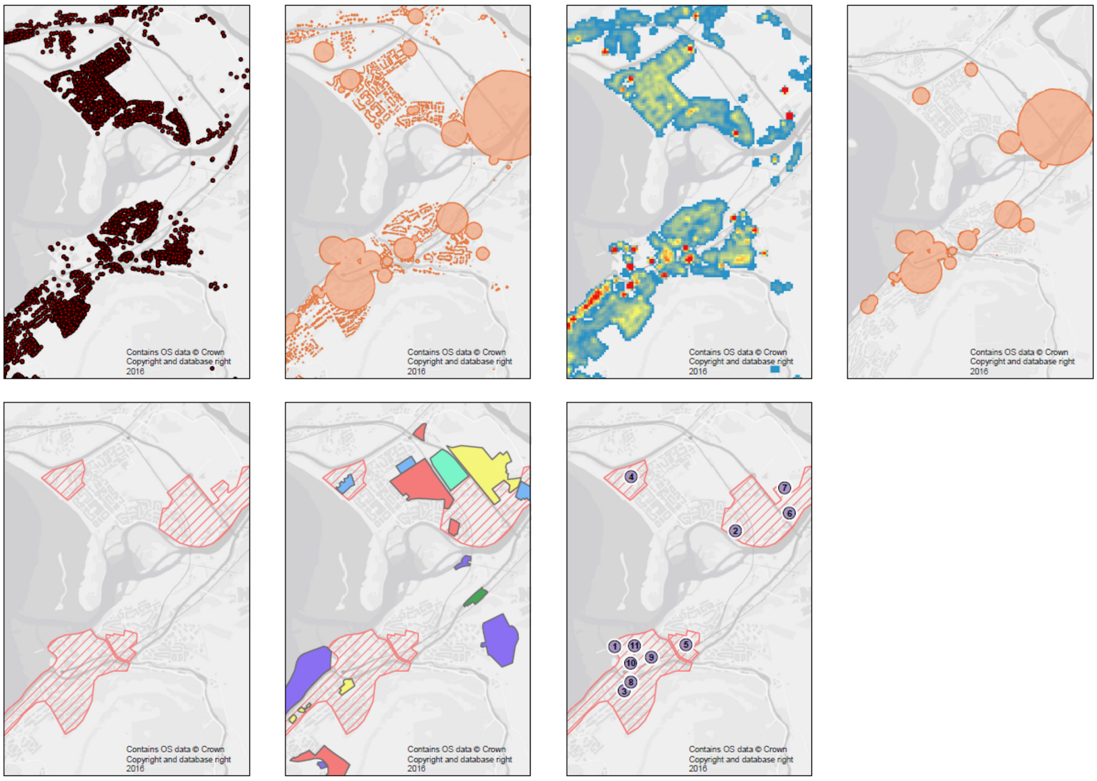


Figure 3 Mapping Heat Network Opportunity Areas

Sketching Potential Heat Networks

Designing the layout of heat network pipe infrastructure is a vital step in the identification and strategic planning of district heating projects. To improve the efficiency of any network and minimise capital costs, the overall length of network should be minimised where possible. In many cases, networks will only be financially viable where the high costs of installing pipework infrastructure can be offset by sufficient heat sales through the network over a reasonable length of time. At the strategic planning stage, it is not practical to consider the detailed design of a network and instead, the proposed route should be sketched using the following basic principles:

- Minimising network length
- Where possible utilise “soft dig” areas
- Where possible avoid costly wayleave agreements by following public rights of way
- Avoid costly infrastructure barriers such as railway lines, major thoroughfare or waterways

For this analysis, the key anchor heat loads were identified by sorting the loads within each opportunity area by annual heat demand. A proposed network was then sketched using the basic principles outlined above.

Estimating Heat Demand for New Development sites

The overarching aim of this work is to help identify the most suitable new development sites to safeguard for future district heating expansion. The most suitable sites will be those which could feasibly connect to planned or existing district heating networks. To understand the feasibility of connecting new development sites, it was necessary to estimate their heat demand.

The Highland Council WestPlan team provided the following information for sites identified in the WestPlan Main Issues Report:

- Indicative Housing Capacity
- Housing Density
- Site Area
- Developable area of the site
- Indication of proposed uses for Mixed Use sites, including information on potential anchor load buildings (e.g. new school, new hospital)

The total indicative heat demand was calculated using a benchmark value of 10306kWh/year/dwelling based on the DECC benchmark values given in annex A. The benchmark value for a semi-detached dwelling built after 2000 was used. A weather correction factor of 12% was then used according to table 3 in annex A. The resulting Figure was then rounded to 11500kWh/year. The true heat demand of the proposed housing will vary according to dwelling type and level of energy efficiency.

The buildings for the proposed mixed use sites were included in the indicative site heat demand based on data from the Scotland Heat Map for similar building in the locality. The true heat demand for such buildings may be less if a higher standard of energy efficiency is achieved for the new building. Alternatively, the heat demand could be higher if the proposed building occupies a greater footprint.

Data was not available for all development sites and as such some sites were removed from the analysis. For some mixed use sites, only the housing heat demand was able to be considered.

The heat demand density for each site was then calculated by dividing the total indicative heat demand for the site by its total developable area. This then provided a visual representation of sites with high heat demand density in relation to district heating opportunity areas. A list of the preferred sites considered for allocation in WestPlan and the calculation of heat demand for each site is shown in annex B.

Summarising Heat Demand Data

Data from the Scotland Heat Map was summarised based on business as usual fuel type.

For non-domestic properties, the BAU fuel types of anchor heat loads were determined or assumed based on visual inspection of buildings on Google Earth & Street View or through web based research. All other non-domestic buildings were included in the "Ancillary Non-domestic" demands category and assumed to use electrical based systems. The BAU scenario for such properties could have a significant bearing on the financial viability of proposed networks and should be the focus of more detailed feasibility studies. For the strategic planning stage however, such assumptions are a necessity.

Domestic properties were summarised based on business as usual fuel type using data from Home Analytics. The quality of the Home Analytics data source is described in further detail below.

Heat Network Modelling

Two models were used in this study to evaluate the financial viability and potential carbon savings from proposed district heating networks. All modelling conducted as part of this study should be considered a high level assessment and would require a more detailed assessment prior to any investment decision making. Firstly, the District Heating Opportunity Assessment model, available on the District Heating Scotland website was used to summarise address level data from the Scotland Heat Map; provide primary plant, back up plant and thermal store sizing; and to provide high level cost estimates for the following components:

- Thermal Store
- Energy Centre
- Consumer Connections

Secondly, the Carbon Trust "District Heating Quality Assurance Cash flow Template" was used to calculate the financial key performance indicators and carbon savings for proposed networks based on specific heat supply technologies (e.g. biomass, WSHP). Further detail on the use of the Carbon Trust model can be found in the webinar.

The approach to using the Carbon Trust model was to consider that costs associated with building level heating system upgrades are borne by the **user**, while all other costs (including connection and infrastructure costs for new developments) are borne by the **network owner**. In reality, for new build developments, it is likely that developers would share some of the costs for connection and infrastructure. Conversely, for existing buildings, it is likely that the network owner would have to cover a portion of the connection costs in order to attract customers to the scheme. In any case, such arrangements should be considered as part of any more detailed feasibility study.

Heat sales tariffs were set to offer a 10% saving on the business as usual tariff, taking into account any fixed costs such as standing charges, maintenance or annualised replacement costs.

Again, the approach to modelling set here can be considered a "first pass" and further analysis should consider how best to maximise financial viability and reduce costs to end users etc. Further analysis should also consider the level of grant funding required to make schemes financially viable, either to a private or public sector investor.

Data Sources

Scotland Heat Map

The Scotland Heat Map was developed to support the activities of local authorities in planning for district heating. The national dataset includes a data point for each property in Scotland, referenced by a Unique Property Reference Number (UPRN). Each data point has an associated annual heat demand Figure, expressed in kWh/year. Data on heat demand has been derived from a number of sources and varies in terms of confidence from 1 (low) to 5 (high) as described in table 2 below.

Table 2 Scotland Heat Map Data Quality

Confidence Level	Definition	Explanation
1	Floor area polygons	The floor areas are based on OS polygons for properties assigned a UPRN. This does not account for number of storeys. A single "average" demand benchmark is used and so there is no variation with building type. There is a risk that UPRNs may be assigned to geographical features with no heat demand.
2	Building data but no age category or floor area	The Assessor and ePIMs data provides information on the building use, age and floor area of properties. In some cases, parts of this information is missing which reduces the confidence.

3	Building data with age category and floor area	The Assessor and ePIMs data provides information on the building use, age and floor area of properties.
4	Building data with additional energy efficiency, heating system or broad energy use data (where public buildings).	Scottish Government hold data on procurement and energy performance certificates of properties which provide an estimate of the building heat demand. This data can be relied upon with good confidence
5	Actual energy billing data	The public sector energy billing data provides accurate building heat demand information.

Data from the Scotland Heat Map was used to identify high density areas of heat demand and also to inform the modelling of district heating financial viability. Further information on the Scotland Heat Map can be found on the Scottish Government Website.

Home Analytics

The Home Analytics dataset is developed by the Energy Saving Trust and provides essential data on the Scottish housing stock. This data is provided down to the address level and is available to the Scottish Government and local authorities in Scotland to assist in developing, targeting and delivering policies, schemes and programmes designed to:

- Improve energy efficiency;
- Install renewable micro-generation technologies;
- Alleviate fuel poverty.

Home Analytics is a combination of two types of data: actual values and modelled values. Actual values are obtained from a variety of sources, such as EPC records, HEED installation records, HEC records, SGN gas meter data, OS AddressBase & MasterMap Topography layer and the Scottish Census. In cases where a property record is not available for a particular variable, models are used to impute (i.e. predict) the value of the variable based on the other building attributes and energy efficiency characteristics of the property. Table 3 shows the proportion of actual and modelled data for each variable in the Home Analytics Dataset.

Table 3. Home Analytics Actual Data Vs Modelled Data

Variable	Actual Data (% of Total)	Modelled Data (% of Total)
Property age	33%	67%
Primary property tenure	48%	52%
Secondary property tenure	41%	59%
Habitable rooms	32%	68%
Primary fuel type	77%	23%
Secondary fuel type	35%	65%
Cylinder insulation type	15%	85%
Cylinder insulation thickness	16%	84%
Meter type	38%	62%
Wall construction	48%	52%
Wall insulation	43%	57%
Loft insulation	41%	59%
Glazing type	28%	72%
Boiler efficiency (A-G)	28%	72%
SAP rating band (A-G)	32%	68%
SAP rating (A-G)	32%	68%
Total floor area	32%	68%
RdSAP fuel bill	32%	68%
RdSAP CO2 emissions	32%	68%
Total energy consumption	5%	95%

Data from the Home Analytics dataset was used to inform the “Business as Usual” primary fuel type for domestic properties considered as a potential connection to district heating network. New housing developments were assumed to have installed electric heating systems for the business as usual case. As the WestPlan area is predominantly off the national gas grid, the business as usual fuel type is an important consideration for a realistic Business as Usual case. Whilst the Home Analytics dataset might introduce uncertainties due to modelled data, particularly in off-gas areas, it is considered the most suitable source of data available.

Models

The assumptions and data sources used to populate the models used in this study are described below. Details are given only for assumptions for the outputs used in this analysis.

District Heating Opportunity Assessment Tool

Table 4 DHOAT Assumptions

Variable	Assumptions
Main Supply Asset Capacity	This value is calculated based on an assumed total operating time of 5000 hours per year for the primary plant
Peaking Plant Capacity	This value is calculated as the sum of peak demands for individual buildings and assuming a diversity factor of 0.75. The peak demands for individual buildings are calculated using assumed equivalent full load hours based on the building use classification.
Thermal Storage Costs	The thermal storage capacity is assumed to be 2.5 x the main supply asset capacity. The cost of thermal storage is assumed to be 40000-60000 £/MW
Energy Centre Costs	The energy centre costs are based on the diversified peak demand and assumed to be 300,000 – 400,000 £/MW
Connection to Customers cost	Is based on the peak demand for the consumer connection. Connections less than 10kW are assumed to cost £3000. Larger connections are costed based on a polynomial equation.
New Development Pipework Length	The length of pipework required for new residential developments is based on an assumed length of pipework per dwelling for a given dwelling density and development type. For the purposes of this analysis, a conservative estimate was used and it was assumed that all new developments were classed as “low density development”. The length per dwelling used is given in table 5.
Service Pipe Length	The length of service pipe per connection was assumed to be 5m

Table 5 New Development Network Length Assumptions

Housing Density	Network Length m/dwelling
Low density housing 5 dw/ha	7.53
Low density housing 10 dw/ha	6.76
Low density housing 15 dw/ha	6.06
Low density housing 20 dw/ha	5.44
Low density housing 25 dw/ha	4.91
Low density housing 30 dw/ha	4.45
Low density housing 35 dw/ha	4.08
Low density housing 40 dw/ha	3.79
Low density housing 45 dw/ha	3.58
Low density housing 50 dw/ha	3.45

Carbon Trust District Heating Quality Assurance Cashflow Template

Table 6 Carbon Trust Model Assumptions

Variable	Assumptions
Time Period	For the purposes of this analysis, the time period has been set to 30 years, however this can be easily altered in the model to consider project financial performance over 25 or 40 years
Energy Price Scenarios	- Price projections are taken from Annex M of the DECC price projections. Last updated Feb 2016. Beyond the 20 year duration of these projections, energy prices are assumed to remain constant. In the model, the gas prices have been replaced by oil price projections to better reflect the off-gas nature of the WestPlan area. The central price projection scenario has been used here, however this can be easily altered in the model to reflect the low, high or fixed price scenarios.
Inflation	Inflation has been set to zero for the purposes of this analysis in line with treasury green book guidance.
% Grant Funding	For the initial analysis, grant funding or funding from cash reserves has been set to zero, however it is recommended that for projects that appear unviable, the level of grant funding required to achieve viability should be investigated by incrementally increasing this variable until a positive NPV and an IRR above the required threshold is achieved.
Discount Rate	The discount rate has been set at 3.5%, reflecting a publically funded project.
Capex contingency	The capital cost contingency has been set to 10%
Network Energy Prices	Network Energy prices can be set according to sector. In this initial analysis, the network prices have been set to offer a 10% saving in

	comparison to a BAU case.
Heat Demand	Heat demand data was obtained from the Scotland Heat Map
% connected	All connections were assumed to be 100% supplied by the proposed network which is standard practice as customers are unlikely to maintain an individual fuel supply whilst connected to the network.
Connection cost	The connection cost for each consumer reflects any cost associated with internal heating system upgrades required to enable connection to the network. The costs for domestic units and small retail customers requiring an upgrade to a wet system was calculated based on the BSRIA rule of thumb of £62.5/m^2. Gross floor areas were obtained from the Scotland Heat Map. Where a non-domestic customer is assumed to require an upgrade to air handling units, a cost of £6000/m^3/s was used and a typical flow requirement of 3 m^3/s was assumed for all such connections.
BAU fuel source	The fuel source of domestic connections was based on the Home Analytics dataset. An effort was made to determine the fuel source of key anchor heat loads using online research or otherwise assumed. References for the source of information used to populate this field is given in the Heat Demand tabs of Annex B. All other Non-Domestic heat loads were assumed to use an electric based system.
BAU fuel price	Fuel prices are taken from Annex M of the DECC price projections. Last updated Feb 2016.
BAU Standing Charge	Standing charges for Electricity are based on the benchmarks provided in the Carbon Trust model. Oil & Biomass are assumed to have no standing charge.
BAU Maintenance costs	Maintenance costs are assumed to be 0.001£/kW based on benchmarks within the carbon trust model
BAU replacement Costs	Replacement costs are assumed to be 0.0025£/kW based on benchmarks within the carbon trust model
Annual distribution losses	Losses were assumed to be 10%
LZC Size (primary heat source size)	Taken from outputs of DHOAT
LZC Heat Generation Per Annum	Assumed to be 60% of total heat generation
LZC Heat Generation Efficiency	Assumed to be 90%
RHI Tariffs	Taken from Ofgem Website.
LZC RHI Accreditation	Assumed to be first year of operation

Year	
Auxiliary Boiler fuel source	Assumed to be oil system reflecting the off-gas grid nature of the WestPlan area. It is recognised that Highland Council may have ambitions to support entirely low carbon heat sources and as such may not support conventional oil or LPG backup systems. This can be modelled within the Carbon trust tool, however would require re-analysis of peaking plant capacity and thermal storage capacity and cost which is beyond the scope of this study.
Auxiliary Boiler efficiency	Assumed to be 90%
Oil price in price base year	Taken from Carbon Trust Benchmarks
Grid electricity price in price base year	Taken from Carbon Trust Benchmarks
Oil CCL price in price base year	Taken from Carbon Trust Benchmarks
Electricity CCL price in price base year	Taken from Carbon Trust Benchmarks
Heat purchase price in price base year	Taken from Carbon Trust Benchmarks
Biomass price in price base year	Taken from Carbon Trust Benchmarks
Low carbon generation technology 1 Capex	Assumed to be £250 per kW based on BISRIA benchmarks
Auxiliary boiler	Oil Boiler Capex assumed to be £100/kW
Energy Centre	Taken from DHOAT outputs
Plant equipment	Not specified – included in energy centre costs
Thermal store	Taken from DHOAT outputs
Network pipe costs	Assumed to be £788/m – taken from Carbon Trust model benchmarks. Price for brownfield sites assumed to better reflect the rural nature of WestPlan settlements
Building connections - heat interface units	Taken from DHOAT
Cost of operation of LZC 1	Assumed to be 3% of the capital costs per year, from Carbon Trust benchmarks
Cost of operation of auxiliary	Assumed to be 3% of the capital costs per year, from Carbon Trust benchmarks

Cost of network operation and maintenance	Assumed to be £0.005/kWh of heat delivered through the network

3 Results

By applying the methodology outlined above, the following 5 settlements contained areas with potential heat network opportunities.

- Fort William
- Gairloch
- Portree
- Ullapool
- Broadford

For each opportunity area, networks were modelled both with and without new development sites except for Gairloch where there was no significant new development sites in the immediate vicinity of the identified opportunity area. The modelling scenarios are described in table 7.

Table 7 Heat Network Opportunities included in this analysis

Network Code	Settlement	Description
FW001	Fort William	Fort William Town Centre Core Network
FW002	Fort William	Fort William Town Centre Core Network (including St Mary's School & Belford Hospital)
FW003	Fort William	Fort William Town Centre Extended Network
FW004	Fort William	Fort William Town Centre Extended Network + New Developments
FW005	Fort William	Lochaber Network
FW006	Fort William	Lochaber Network + New Development
FW007	Fort William	Caol Network
PT001	Portree	Portree West Network
PT002	Portree	Portree East Network

PT003	Portree	Portree West Network + New Development
PT004	Portree	Portree East Network + New Development
BF001	Broadford	Broadford Core Network
BF002	Broadford	Broadford Core Network + New Development
GL001	Gairloch	Gairloch Core Network
UP001	Ullapool	Ullapool Core Network
UP002	Ullapool	Ullapool Core Network + New Development

The above scenarios were tested using Biomass and WSHP as potential heat sources. The following section describes in detail the zoning of heat network opportunity areas in the WestPlan settlements before presenting the results of the high level modelling exercise for potential network scenarios in each zone.

Fort William

Analysis shows that the Fort William area contains 4 distinct heat network opportunity areas (Figure 4). The largest area, (A in Figure 4) is focused on the vicinity of the town centre. The largest heat loads are found immediately North of Fort William railway station where a cluster of buildings would likely constitute the first phase of any development. The railway line and the River Lochy represent key infrastructure barriers for the Northward expansion of this network. Northward expansion of a network in this area could be facilitated by the Caol Link Road. However, future expansion of a network in this area would likely be Southwards, towards existing residential areas and the new housing developments shown in Figure 5.

A small heat network opportunity area (B in Figure 4) was identified centring on Inverlochy Primary School. However, this area is again constrained by the railway line and opportunities for expansion area limited to owner occupied housing. As such this opportunity area has not been taken forward for further analysis.

A further opportunity area (C in Figure 4) is identified to the North of Fort William, in the Lochaber area. This network is centred on anchor heat loads in Lochyside Primary School, Lochaber High School and Fort William Health Centre. Future expansion of this area could be both Northwards towards the housing, industry and mixed use sites shown in Figure 5, or Westwards towards Caol. The final heat network opportunity area (D in Figure 4) is centred on Caol primary school and encompasses a high density area of mixed tenure housing.

A number of preferred sites from the WestPlan MIR are located in close proximity to the heat network opportunity areas described above. Figure 5 shows the use classification of all MIR preferred sites in Fort William in proximity to the heat network opportunity areas. Figure 6 shows the indicative heat demand density of the MIR preferred sites, calculated where data was available.

The Highland Council currently manages seven sites with a collective capacity of over 2MW of low carbon heat (in the form of biomass boilers) in the Fort William area. Many of these sites could be considered as energy centres or energy sources for district heating networks. Utilising existing assets in this way can help to offset costs, balance the heat load (i.e. by using heat for schools during the day, then for homes at night) and increase resilience of a network. The Lochaber Aluminium Smelter may also offer a potential heat source for any network established in the area.

Table 8 Fort William Existing Low Carbon Heat Assets

Site	Capacity (kW)	Within DHO Area	Potential Barriers
Caol Campus	500	✓	-
Fort William Gaelic Primary	199	✗	Distance
Inverlochy Primary School	100	✓	River Nevis
Invernevis House Resource Centre	150	✓	Railway; A82
Lochaber High School	540	✓	-
Lochaber Leisure Centre	400	✓	Railway; A82
Lundavra Primary School	299	✓	-

Figure 4 Fort William District Heating Strategic Plan

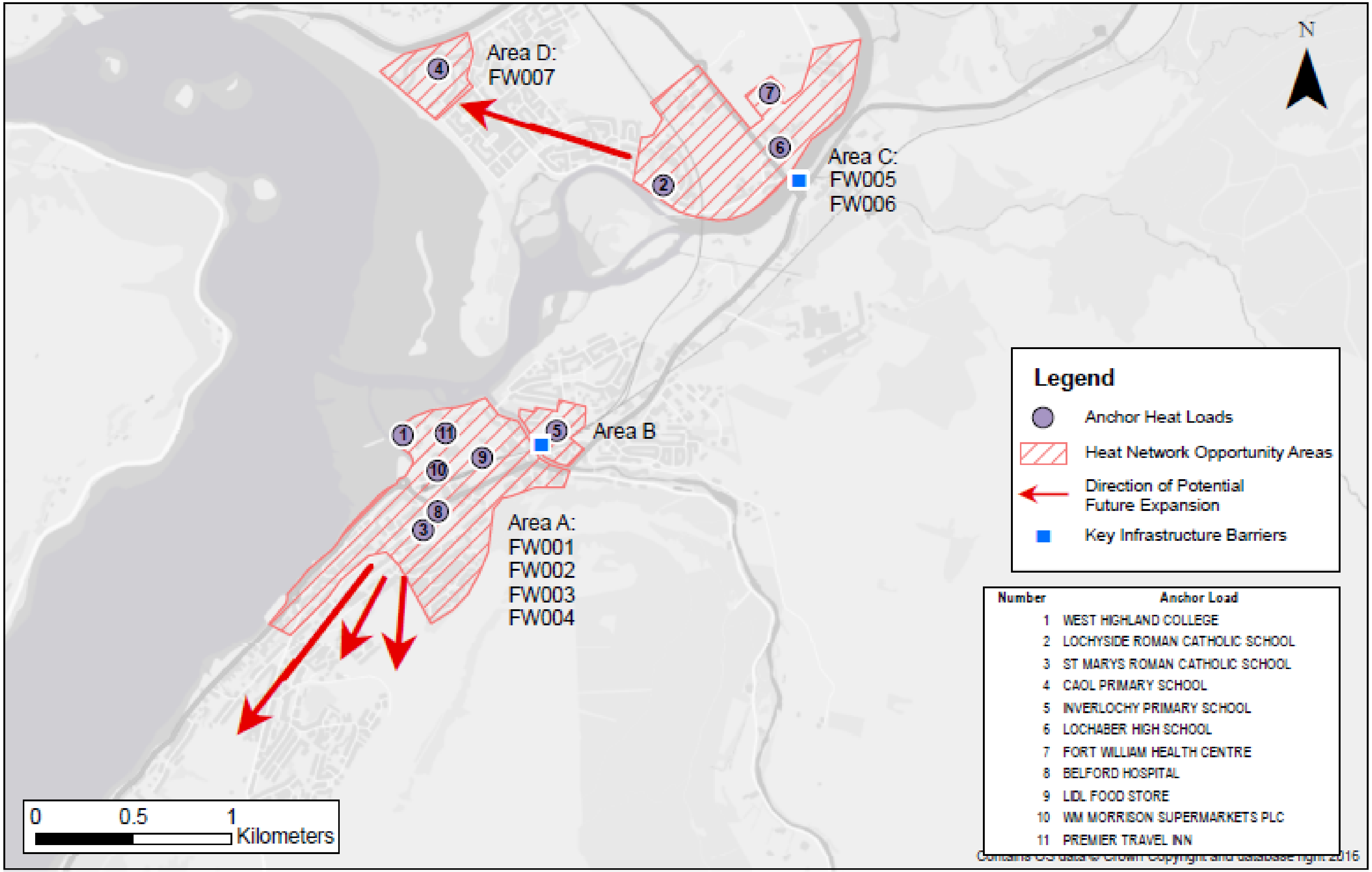


Figure 5 Fort William District Heating Opportunity Areas & MIR Preferred Sites

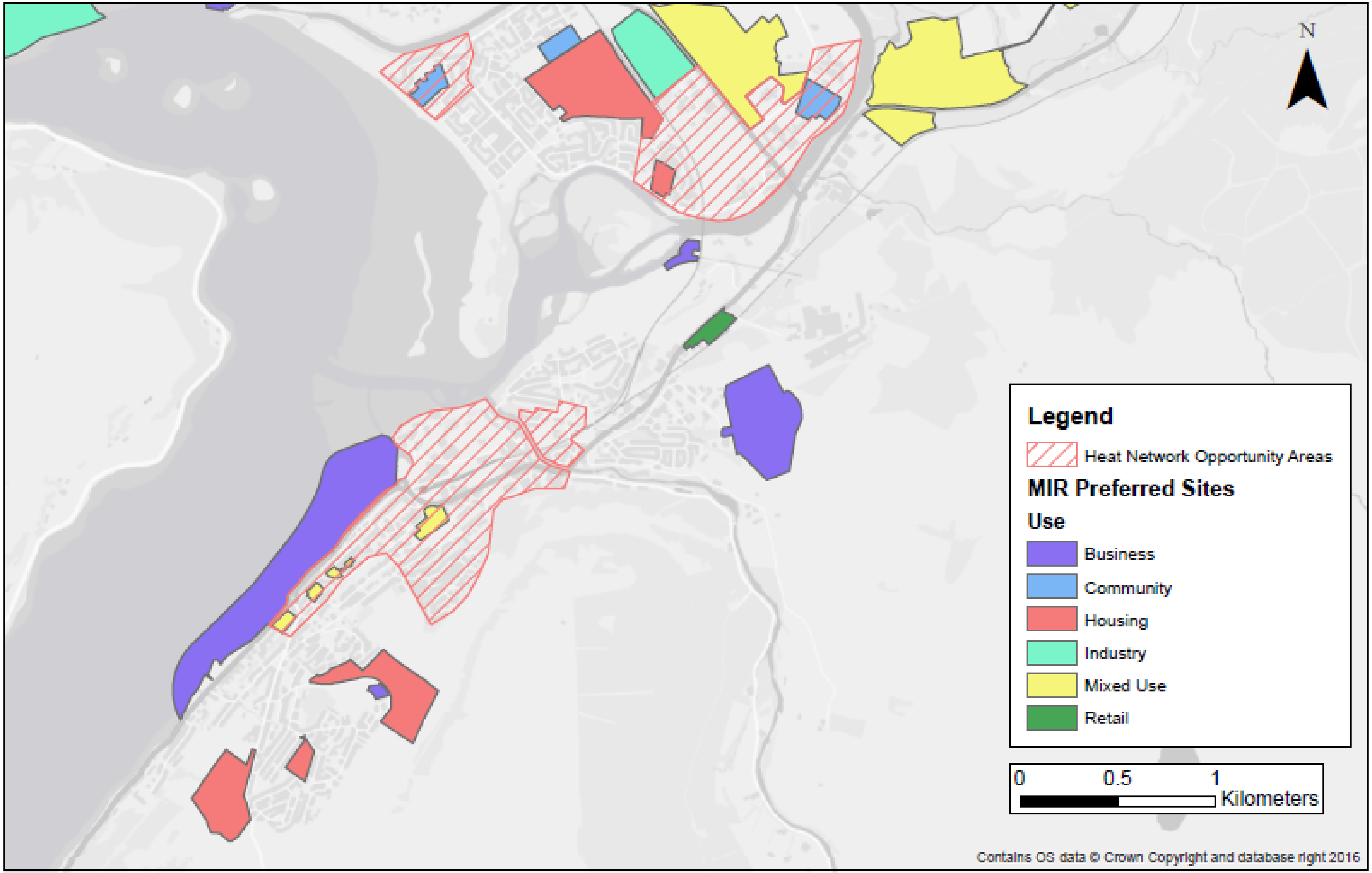
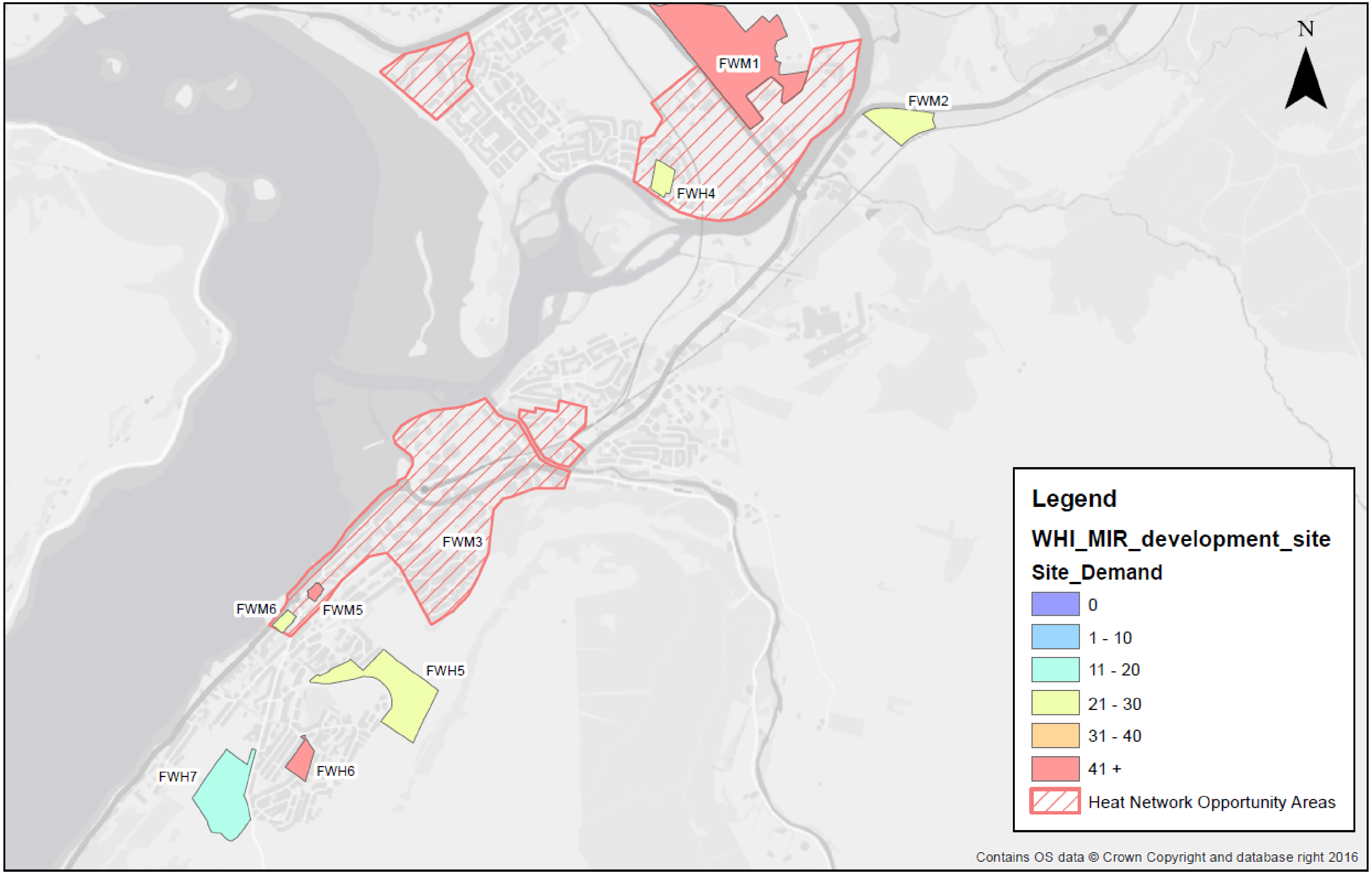


Figure 6 Fort William MIR Sites Heat Demand



Fort William – FW001-3

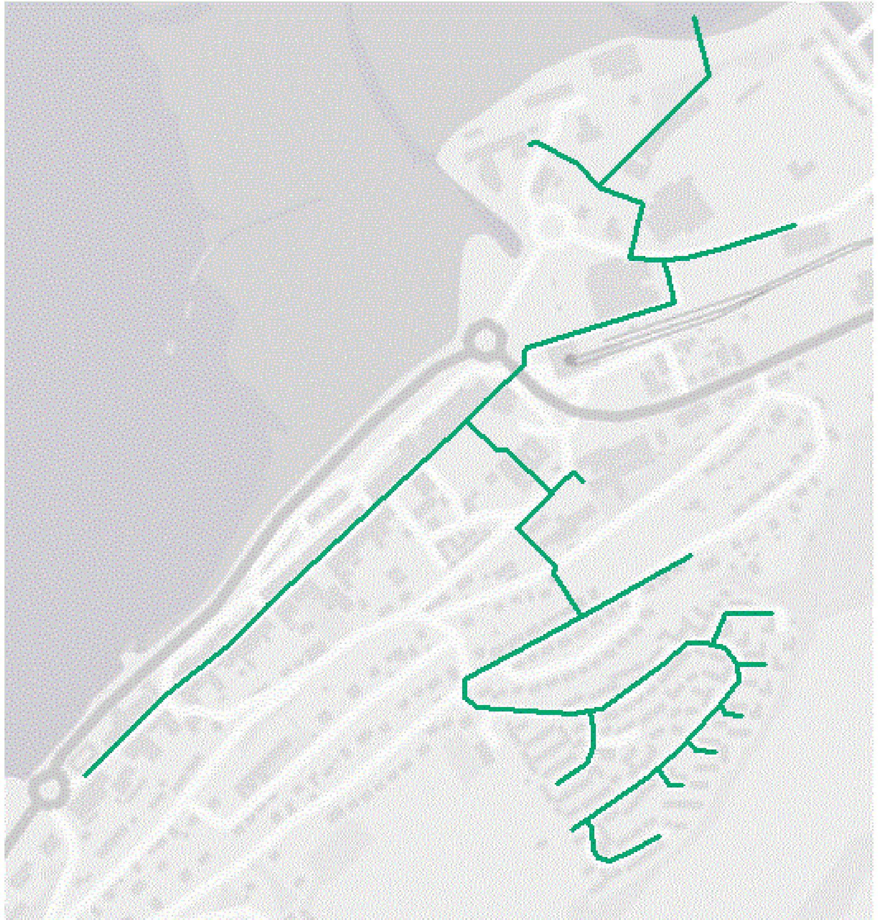


Figure 7 Proposed FW001-3 Heat Network Layout (Biomass option modelled without extension for WSHP)

Networks FW001-3 (Figure 7) show the potential for a phased heat network expansion. The core network, FW001, focuses on a further education campus, hotel and retail properties as anchor heat loads. FW002 extends the network southwards to include St Mary's primary school and Belford hospital. FW003 extends the network further to include non-domestic heat demands along Fort William high street and an area of mixed tenure social housing to the southeast.

The results indicate that the proposed schemes are commercially viable, using either a Biomass system or WSHP as a heat source. The network may be attractive to commercial investors providing that capital grant funding in excess of 50% can be secured. Alternatively, public sector debt finance could likely be secured in the absence of any grant funding where the network readily exceeds the hurdle rate of 3.5% for public sector projects.

The key challenge for future project work will be to de-risk the project through securing heat sales agreements with the diverse customer base. In the current modelling scenario, the scheme has a negative economic impact in terms of financial savings to customers over 25 years. Further investigations should seek to balance the financial benefits between scheme owners and customers.

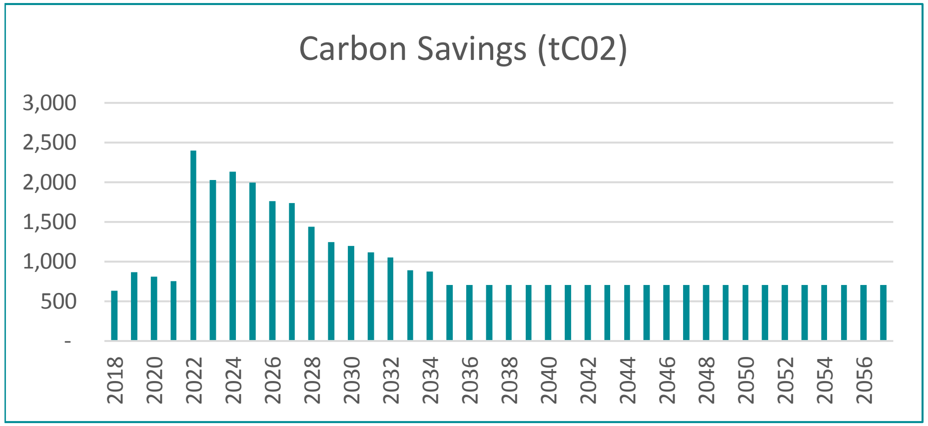
Key Assumptions:

- St Mary's Primary School & Belford Hospital are included in the scheme but are currently vacant or earmarked for closure, the results assume that these sites will be occupied by an alternative heat demand of similar scale.
- Commercial properties along High Street are assumed to have electrical based systems in BAU case

FW001-3 - Biomass

30 years Discounted Cash Flow Model	No Funding	25% Funding	50% Funding
Capital Cost (Total for all phases)	£8.7M	£6.7M	£4.7M
IRR	5.2%	7%	10.8%
NPV (at discount rate of 3.5%)	£2.7M	£4.5M	£6.3M
Discounted payback (years)	**15.6**	**10.6**	**6.5**
Lifetime carbon savings (tCO2)	32,808		
Building Upgrade Costs	£3.2M		

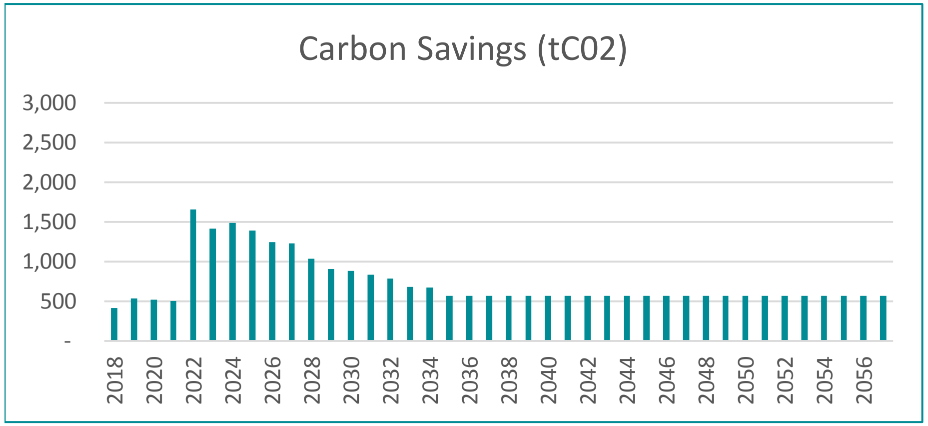
Consumer Savings	25 year financial savings	30 year financial savings	40 year financial savings
Total Consumer Savings	-£141,509	£531,451	£1,877,371



FW001-3 - WSHP

30 years Discounted Cash Flow Model	No Funding	25% Funding	50% Funding
Capital Cost (Total for all phases)	£9.1M	£7M	£5M
IRR	6%	7.9%	12%
NPV (at discount rate of 3.5%)	£4.7M	£6.6M	£8.5M
Discounted payback (years)	**12**	**8.6**	**6**
Lifetime carbon savings (tCO2)	24,079		
Building Upgrade Costs	£3.2M		

Consumer Savings	25 year financial savings	30 year financial savings	40 year financial savings
Total Consumer Savings	-£141,509	£531,451	£1,877,371



Fort William – FW004

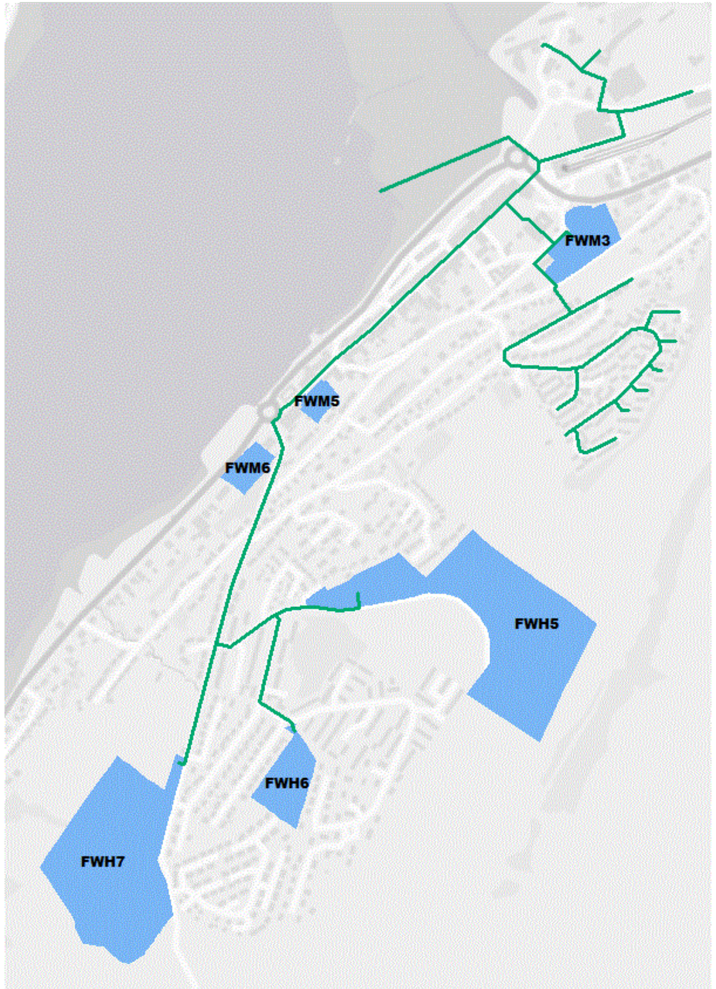


Figure 8 Proposed FW004 Heat Network Layout (Biomass option modelled without extension for WSHP)

Network FW004 (Figure 8) extends network FW003 to consider the following MIR development sites as part of the heat network scenario:

- FWM3, FWM5, FWM6, FWH5, FWH6 & FWH7

The proposed network also includes a number of additional domestic properties on route to the development sites.

The results indicate that the proposed scheme could be financially viable with either biomass or WSHP as a heat source. The WSHP option offers a higher NPV over the 30 year modelling period, however capital costs are higher in comparison to the biomass option. The WSHP option is capable of achieving an IRR greater than 8% with 50% grant funding of capital costs. This may be attractive to commercial investors.

The analysis indicates that an extension of the proposed network to MIR development sites included here may be viable. Further investigation should consider the heat demand and pipework routing on these sites as developers come forward with more detailed plans.

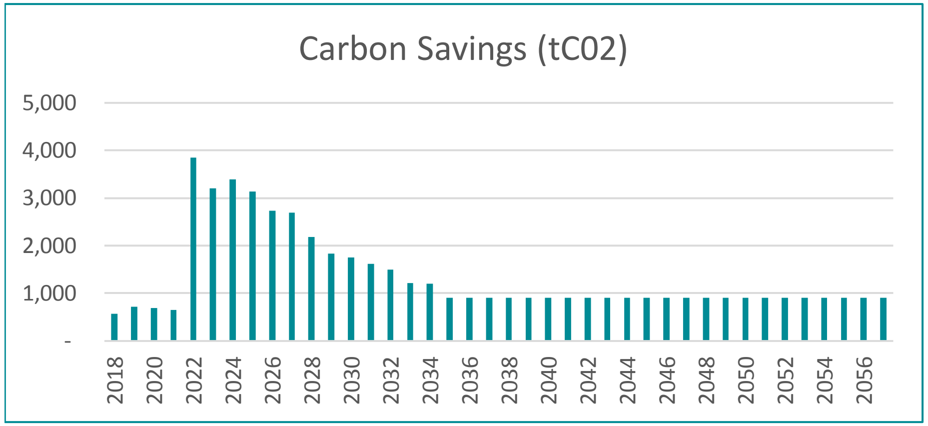
Key Assumptions:

- The entire cost of consumer connection and pipework infrastructure is considered to be borne by the project and no contribution from potential housing developers.
- Estimates have been used to determine the length of pipework infrastructure required for new development sites.

FW004- Biomass

30 years Discounted Cash Flow Model	No Funding	25% Funding	50% Funding
Capital Cost (Total for all phases)	£14M	£10.8M	£7.6M
IRR	3.5%	4.8%	6.9%
NPV (at discount rate of 3.5%)	£65K	£3M	£5.7M
Discounted payback (years)	**30**	**16.6**	**10.6**
Lifetime carbon savings (tCO2)	45,583		
Building Upgrade Costs	£3.1M		

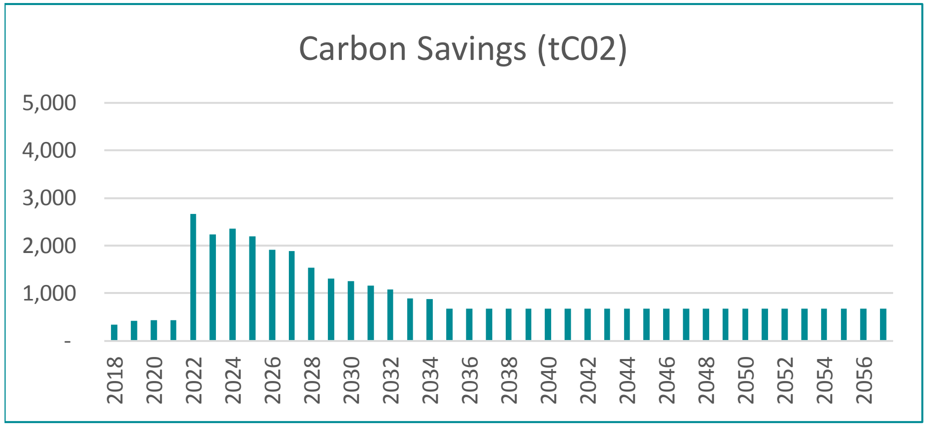
Consumer Savings	25 year financial savings	30 year financial savings	40 year financial savings
Total Consumer Savings	£803,769	£1,671,814	£3,407,902



FW004 - WSHP

30 years Discounted Cash Flow Model	No Funding	25% Funding	50% Funding
Capital Cost (Total for all phases)	£14.6M	£11.3M	£8.5M
IRR	6.9%	5.9%	8.2%
NPV (at discount rate of 3.5%)	£3M	£6M	£9M
Discounted payback (years)	**16.4**	**12.1**	**8.3**
Lifetime carbon savings (tCO2)	32,500		
Building Upgrade Costs	£3.1M		

Consumer Savings	25 year financial savings	30 year financial savings	40 year financial savings
Total Consumer Savings	£803,769	£1,671,814	£3,407,902



Fort William – FW005

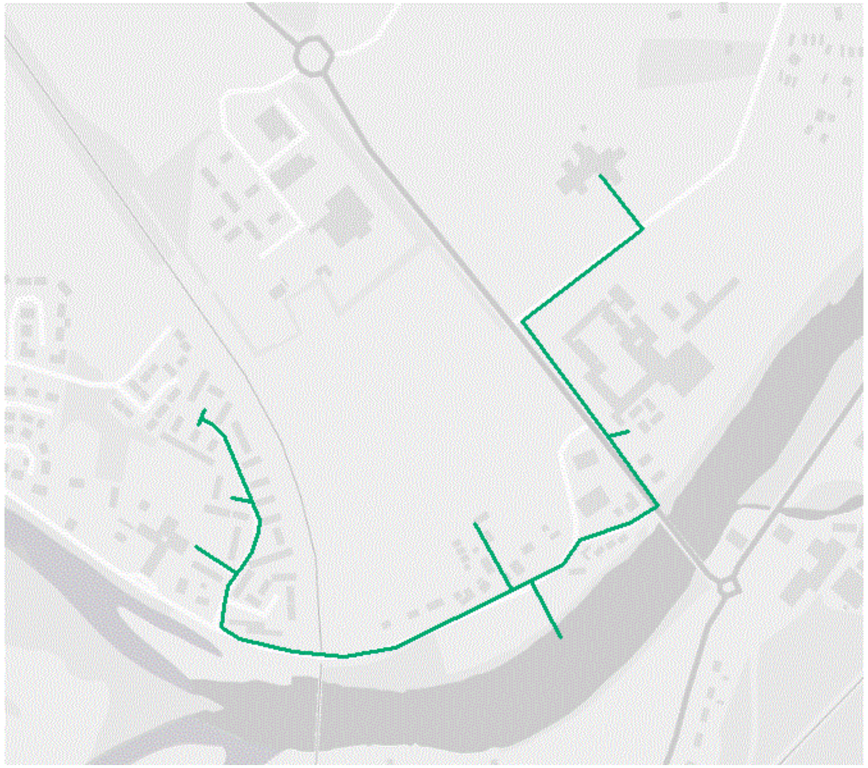


Figure 9 Proposed FW005 Heat Network Layout (Biomass option modelled without extension for WSHP)

Network FW005 (Figure 9) Figure includes Lochyside Primary School, Lochaber High School and Fort William Health Centre. The network also includes a number of mixed tenure domestic properties in the immediate area.

The results indicate that while a biomass based scheme would require at least 50% grant funding of capital costs to be financially viable, a WSHP based network could potentially be publically financed without any grant funding.

Further work should consider the best location for a WSHP and should seek to de-risk the project through securing heat supply agreements with the key anchor loads on the network.

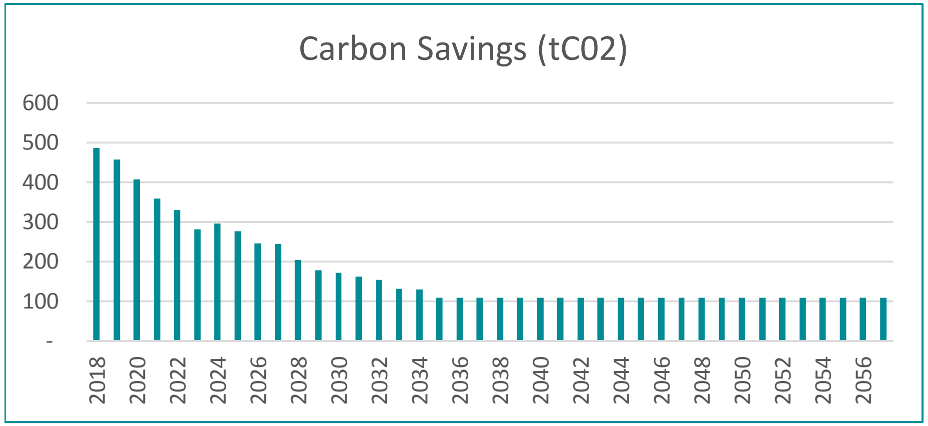
Key Assumptions:

- Lochyside Primary School, Lochaber High School and Fort William Health Centre have all been modelled using biomass only systems in the BAU case although oil is currently used as an auxiliary system. This means carbon savings are likely underestimated.

FW005- Biomass

30 years Discounted Cash Flow Model	No Funding	25% Funding	50% Funding
Capital Cost (Total for all phases)	£3.3	£2.5M	£1.8M
IRR	1.7%	2.9%	4.8%
NPV (at discount rate of 3.5%)	-£1M	-£280k	£467k
Discounted payback (years)	**N/A**	**N/A**	**14.3**
Lifetime carbon savings (tCO2)	6,032		
Building Upgrade Costs	£707k		

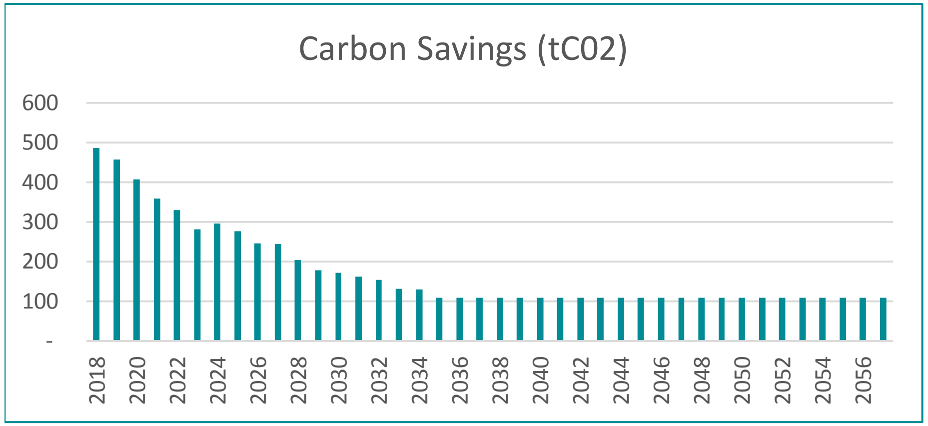
Consumer Savings	25 year financial savings	30 year financial savings	40 year financial savings
Total Consumer Savings	£765,635	£1,078,559	£1,704,407



FW005- WSHP

30 years Discounted Cash Flow Model	No Funding	25% Funding	50% Funding
Capital Cost (Total for all phases)	£3.5M	£2.7M	£6.4M
IRR	3.8%	5.3%	7.4%
NPV (at discount rate of 3.5%)	£250k	£1M	£1.8M
Discounted payback (years)	**18.24**	**12**	**6.6**
Lifetime carbon savings (tCO2)	1,376		
Building Upgrade Costs	£707k		

Consumer Savings	25 year financial savings	30 year financial savings	40 year financial savings
Total Consumer Savings	£765,635	£1,078,559	£1,704,407



Fort William – FW006

Figure 10 Proposed FW006 Heat Network Layout (Biomass option modelled without extension for WSHP)

Network FW006 (Figure 10) extends network FW005 to include the following new development sites.

- FWM1, FWH4

Site FWM1 is a mixed use site which may include a new hospital and commercial facilities as well as housing.

The results indicate that a heat network may be viable using either a biomass or WSHP heat source. The results also indicate that to include the heat demand of the proposed development sites markedly improves the financial performance of the scheme.

The next steps should seek to more accurately define the heat demand of the proposed development sites and seek to determine the most suitable location for an energy centre. The proposed new hospital could be a key anchor heat load for the network and an attempt should be made to engage early with the NHS on this project.

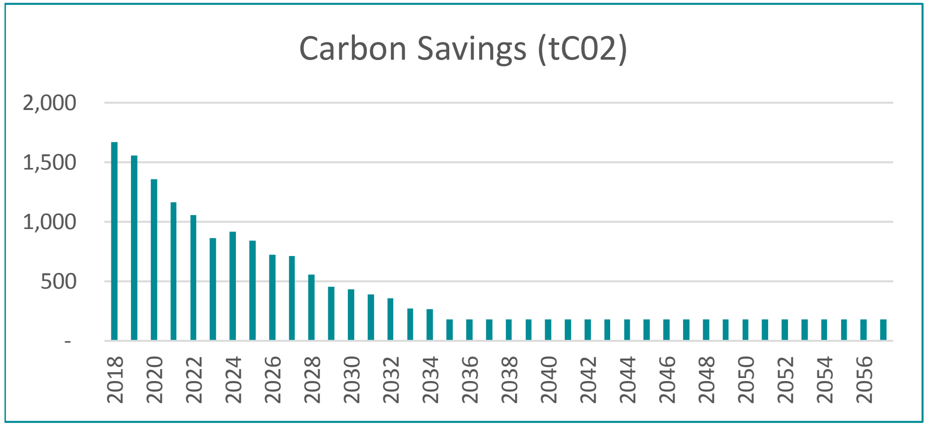
Key Assumptions:

- The entire cost of consumer connection and pipework infrastructure is considered to be borne by the project and no contribution from potential housing developers.
- Estimates have been used to determine the length of pipework infrastructure required for new development sites.

FW006- Biomass

30 years Discounted Cash Flow Model	No Funding	25% Funding	50% Funding
Capital Cost (Total for all phases)	£3.8	£2.9M	£2M
IRR	4.5%	5.7%	7.6%
NPV (at discount rate of 3.5%)	£1M	£1.8M	£2.7M
Discounted payback (years)	**16.96**	**11.6**	**7.3**
Lifetime carbon savings (tCO2)	16,060		
Building Upgrade Costs	£707k		

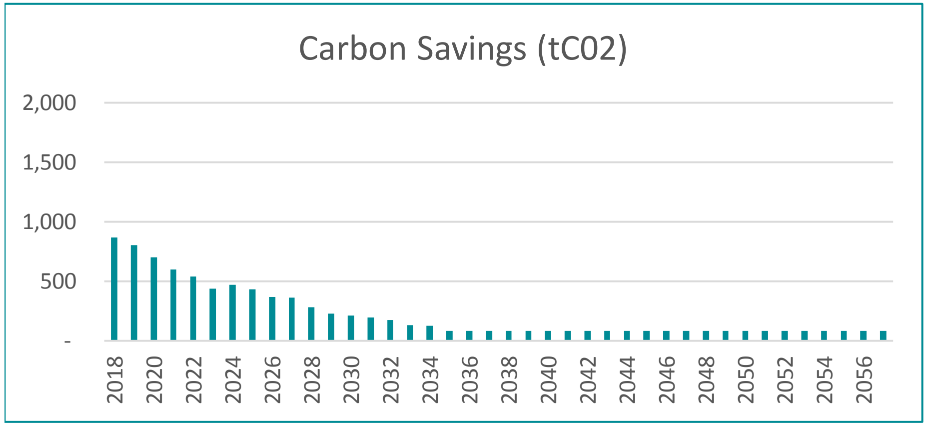
Consumer Savings	25 year financial savings	30 year financial savings	40 year financial savings
Total Consumer Savings	£1,605,971	£2,086,005	£3,046,073



FW006- WSHP

30 years Discounted Cash Flow Model	No Funding	25% Funding	50% Funding
Capital Cost (Total for all phases)	£4.1M	£3.1M	£2.2M
IRR	5.9%	7.2%	9.4%
NPV (at discount rate of 3.5%)	£3M	£3.9M	£4.9M
Discounted payback (years)	**9.78**	**6.86**	**4.11**
Lifetime carbon savings (tCO2)	8,031		
Building Upgrade Costs	£707k		

Consumer Savings	25 year financial savings	30 year financial savings	40 year financial savings
Total Consumer Savings	£1,605,971	£2,086,005	£3,046,073



Fort William – FW007

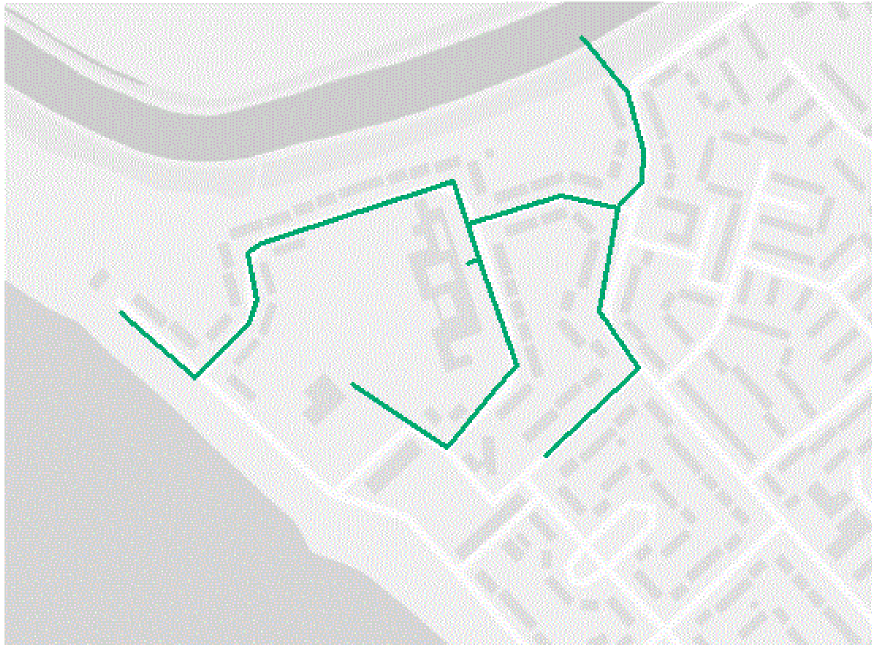


Figure 11 Proposed FW007 Heat Network Layout (Biomass option modelled without extension for WSHP)

Network FW007 (Figure 11) includes Caol Primary School and a number of domestic mixed tenure properties. The area is a possible location for the future expansion for the networks proposed in FW005 & FW006.

The results suggest that a heat network in this area would not be financially viable without some grant funding of capital costs. A WSHP based system improves the financial performance but would still require at least 25% grant funding of the capital costs.

The socio-economic benefit of this scheme has not been defined in this study but could be significant as it targets a number of existing mixed tenure properties. Further work should attempt to quantify the benefit of a scheme in this area on factors such as fuel poverty. Further development work should also consider the willingness of homeowners in this area to connect to any scheme.

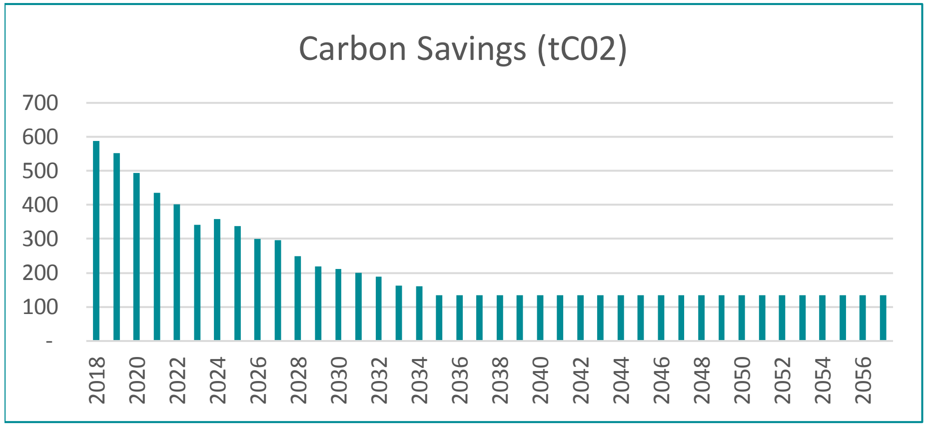
Key Assumptions:

- Existing biomass system in Caol Primary has not been considered as a potential heat supply. Using the existing assets could reduce capital costs and improve financial viability.

FW007- Biomass

30 years Discounted Cash Flow Model	No Funding	25% Funding	50% Funding
Capital Cost (Total for all phases)	£2.7M	£2M	£1.5M
IRR	1.9%	3.2%	5.2%
NPV (at discount rate of 3.5%)	-£736k	-£123k	£488k
Discounted payback (years)	**N/A**	**N/A**	**12.84**
Lifetime carbon savings (tCO2)	7,385		
Building Upgrade Costs	£620k		

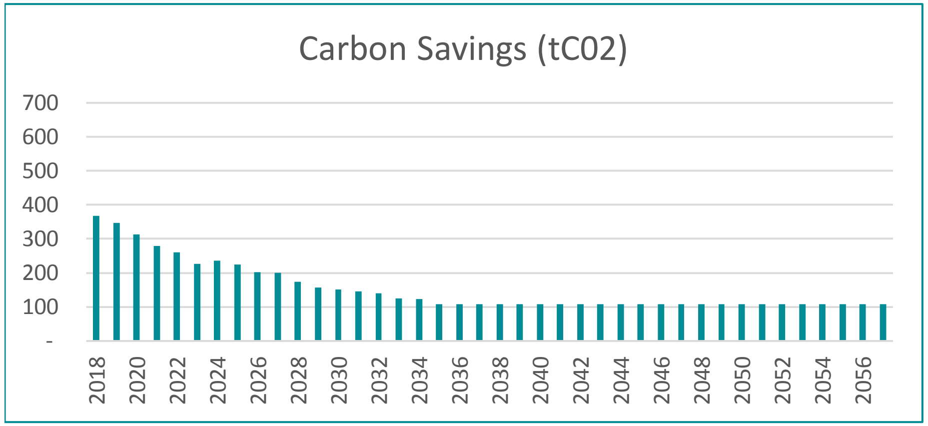
Consumer Savings	25 year financial savings	30 year financial savings	40 year financial savings
Total Consumer Savings	£57,745	£192,247	£461,251



FW007- WSHP

30 years Discounted Cash Flow Model	No Funding	25% Funding	50% Funding
Capital Cost (Total for all phases)	£2.8M	£2.2M	£1.5M
IRR	2.6%	3.9%	5.9%
NPV (at discount rate of 3.5%)	-£477k	£165k	£808k
Discounted payback (years)	**N/A**	**18.74**	**9.65**
Lifetime carbon savings (tCO2)	5,184		
Building Upgrade Costs	£620k		

Consumer Savings	25 year financial savings	30 year financial savings	40 year financial savings
Total Consumer Savings	£57,745	£192,247	£461,251



Gairloch

A single heat network opportunity area is highlighted for Gairloch (Figure 12). The area is focused on the anchor heat loads of Gairloch community centre, high school and primary school. The area is relatively isolated in terms of heat density which may limit future expansion. In the future an established network may extend westwards to pick up further domestic connections.

Figure 13 shows the location of two mixed use development sites in the vicinity of the Gairloch heat network opportunity area. From data supplied by The Highland Council planning, it is clear that the heat loads in these areas are too low to merit inclusion in further analysis. The calculated heat demand density of these sites is shown in Figure 14.

The Highland Council installed an energy centre in 2016 to serve Gairloch High School and Primary School. A significant capacity of 698kW is readily available in the heart of Gairloch and could potentially evolve into an energy centre for the wider community should a district heating scheme be developed. Utilising the asset in this way can help to offset costs, balance the heat load (i.e. by using heat for school during the day, then for homes at night) and increase resilience. The site must be assessed in more detail to establish network design parameters.

Figure 12 Gairloch District Heating Opportunity Area

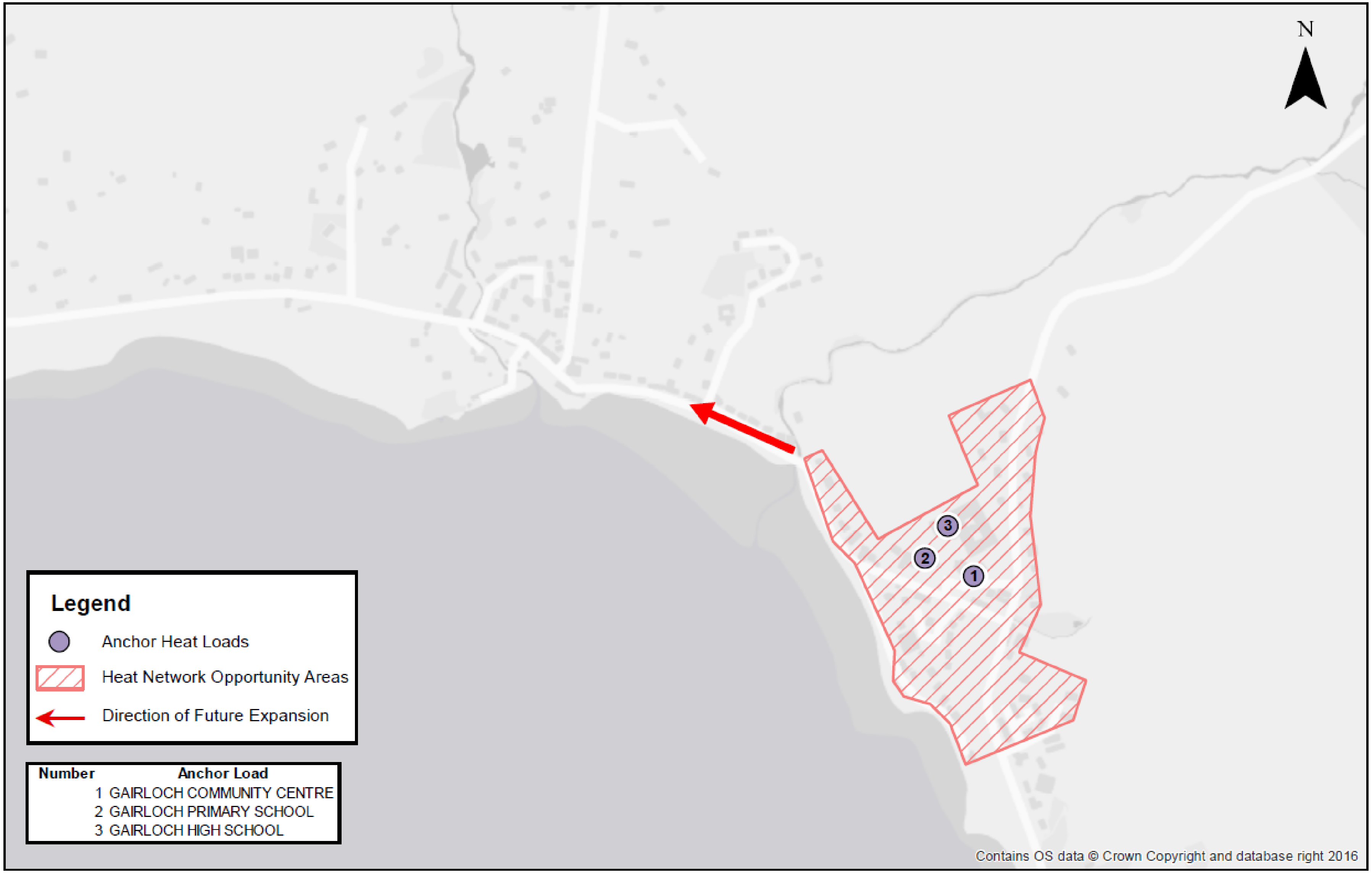


Figure 13 Gairloch District Heating Opportunity Areas and MIR development sites

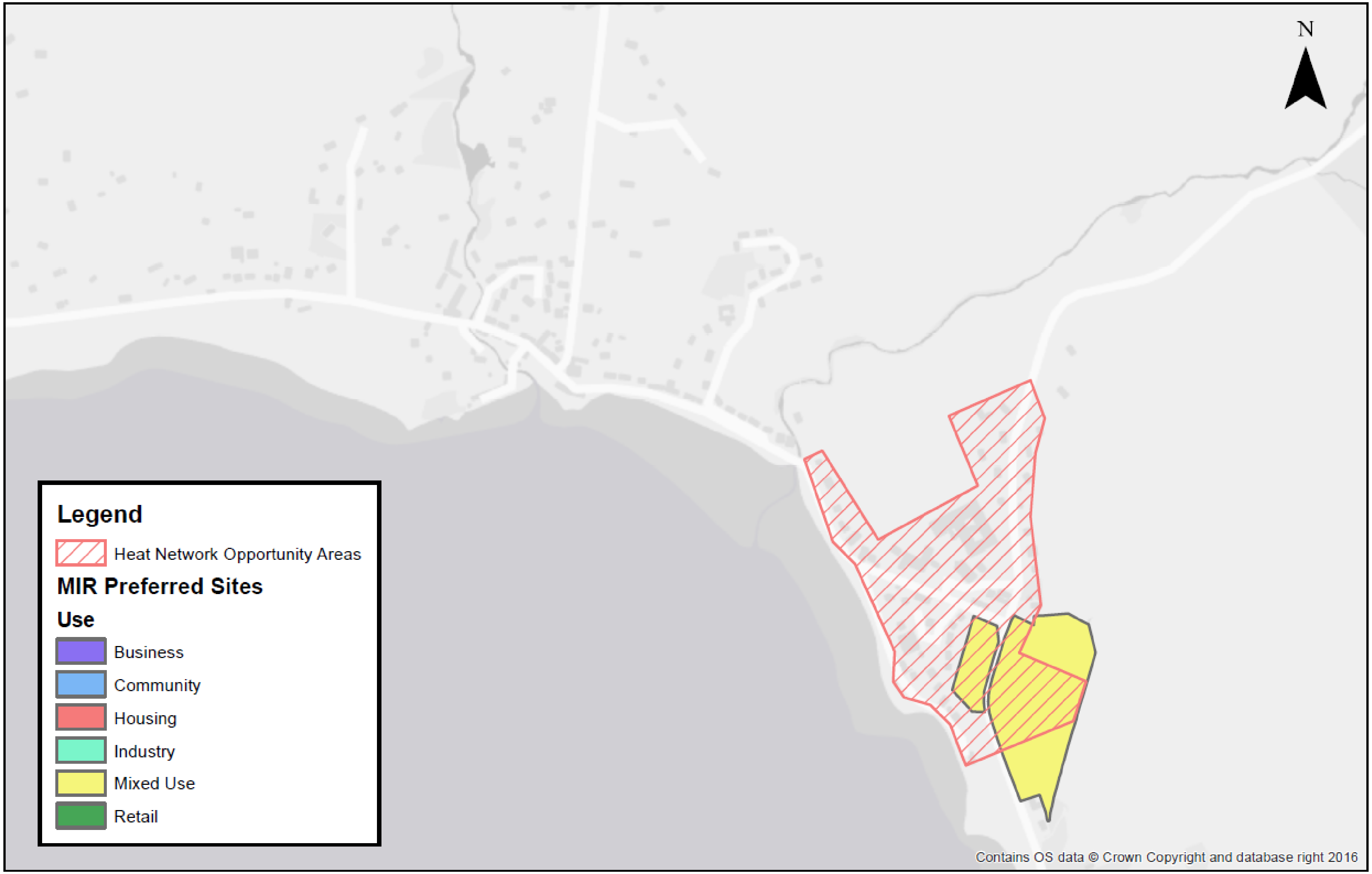
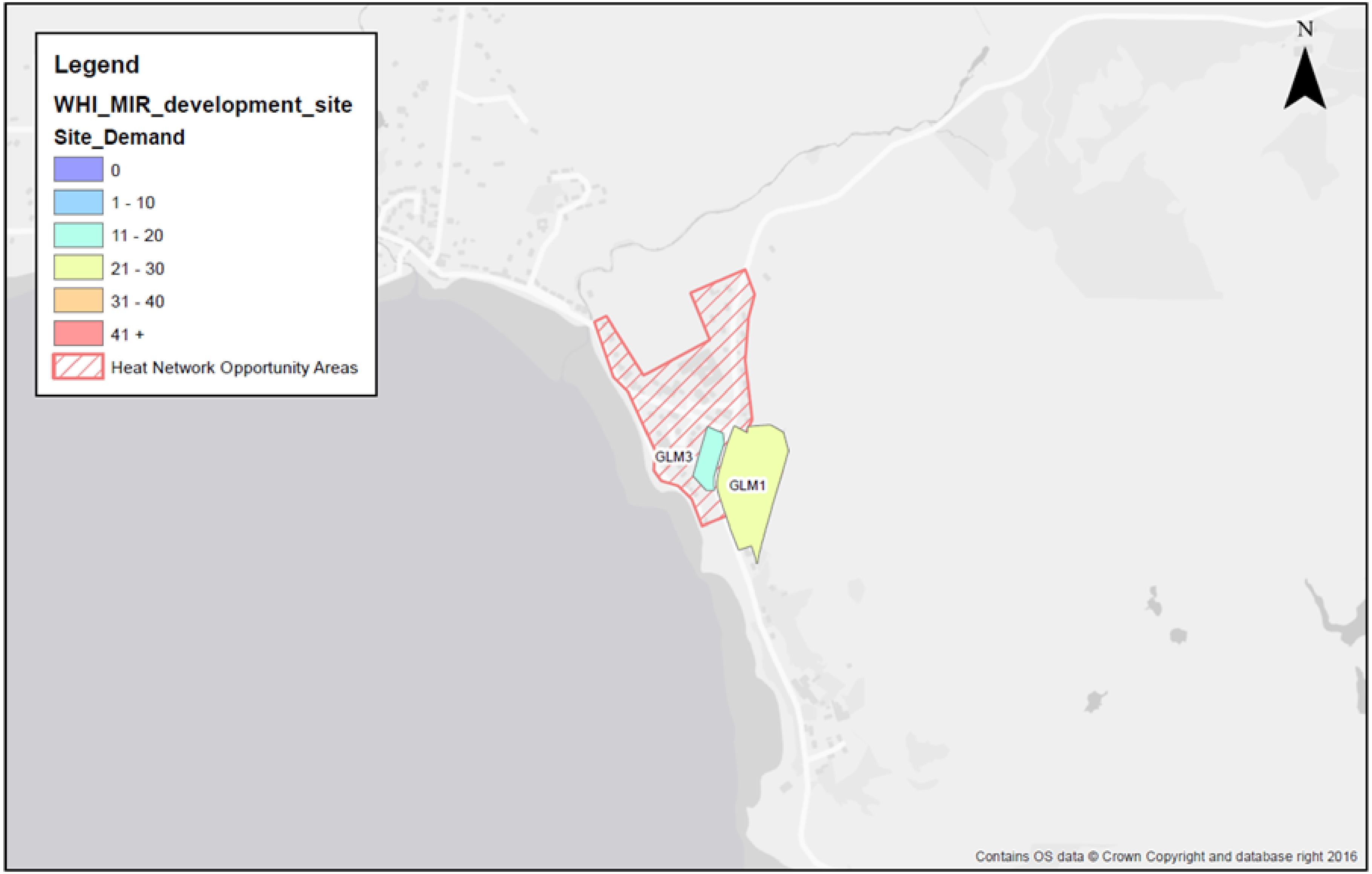


Figure 14 Gairloch MIR Sites Heat Demand



Gairloch – GL001

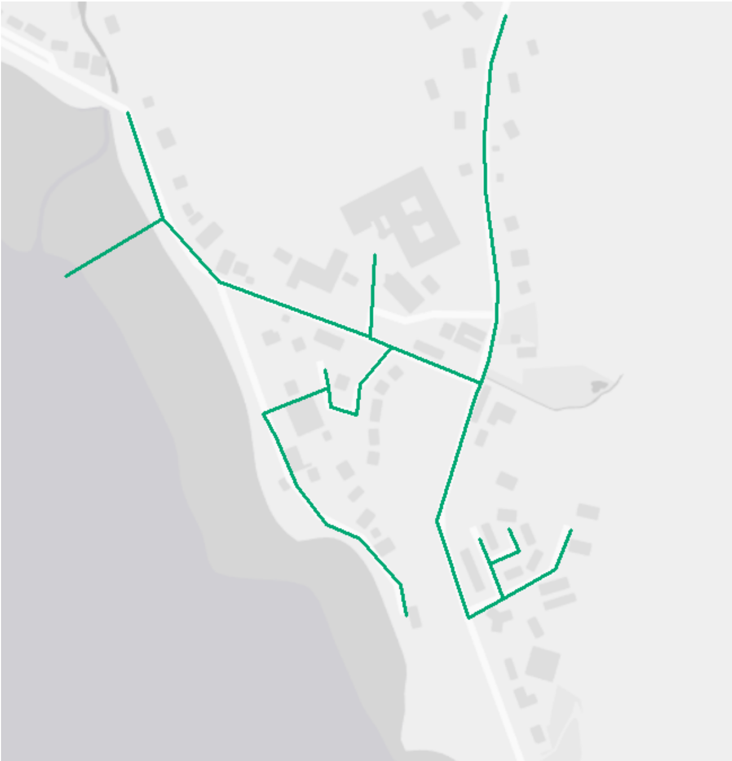


Figure 15 Proposed GL001 Heat Network Layout (Biomass option modelled without extension for WSHP)

Network GL001 (Figure 15) connects Gairloch community centre, high school and primary school with a number of mixed tenure heat loads in the immediate vicinity. The results indicate that the network would not be financially viable without at least 25% grant funding of capital costs. Notably, the network offers minimal carbon savings in comparison to the business as usual case over the course of the scheme lifetime.

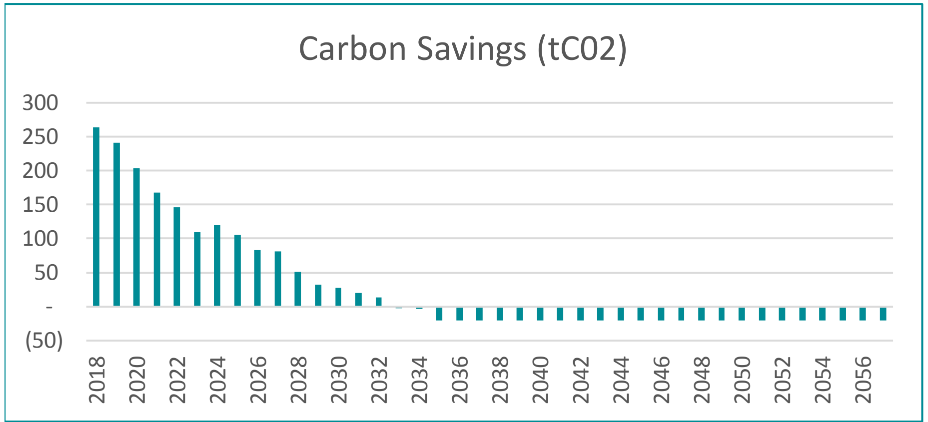
Key Assumptions:

- The analysis has not considered the viability of utilising the pre-existing biomass system in Gairloch as a potential energy centre.

GL001 - Biomass

30 years Discounted Cash Flow Model	No Funding	25% Funding	50% Funding
Capital Cost (Total for all phases)	£2.6M	£2M	£1.4M
IRR	3.3%	4.4%	6.1%
NPV (at discount rate of 3.5%)	-£150k	£449k	£1M
Discounted payback (years)	**39**	**17.8**	**10.8**
Lifetime carbon savings (tCO2)	1,370		
Building Upgrade Costs	£407k		

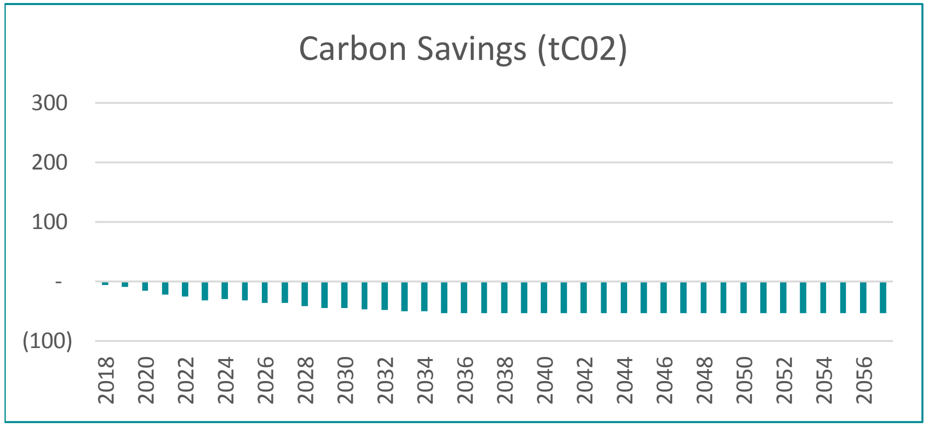
Consumer Savings	25 year financial savings	30 year financial savings	40 year financial savings
Total Consumer Savings	-£73,329	-£24,550	£73,008



GL001 - WSHP

30 years Discounted Cash Flow Model	No Funding	25% Funding	50% Funding
Capital Cost (Total for all phases)	£2.8M	£2.1M	£1.8 M
IRR	4%	4.8%	6.6%
NPV (at discount rate of 3.5%)	£121k	£766k	£1.5M
Discounted payback (years)	**25**	**14**	**8**
Lifetime carbon savings (tCO2)	-1,319		
Building Upgrade Costs	£407k		

Consumer Savings	25 year financial savings	30 year financial savings	40 year financial savings
Total Consumer Savings	-£73,329	-£24,550	£73,008



Portree

The analysis shows two distinct heat network opportunity areas in Portree (Figure 16). Area A is focused on the anchor load of Portree High School. The initial analysis also included Harbro LTD and St Mary's Chapel as anchor loads, however on closer inspection the heat demands on these buildings were considered to be overestimated. Area A extends northward from the anchor loads towards a mixed tenure residential area. Area B, is centred on Portree Primary School and includes an area of mixed tenure housing and could potentially extend northwards to an existing heat network in the "Home Farm" area which provides heat to a 120 homes and care home.

Figure 17 shows the location and use classification of preferred WestPlan MIR development sites in relation to the heat network opportunity areas. A mix of housing, industrial and mixed use sites are within close proximity to the opportunity areas. Figure 18 shows the indicative heat demand MIR preferred sites, calculated where data was available. The following MIR sites were considered to be potential connections and included in the heat network modelling exercise:

- PTM2, PTM3, PTM4, PTM6, PTM7 & PTM8
- PTH2, PTH3 & PTH5

The Highland Council currently owns and manages a significant low carbon heat source in Portree. Portree Primary School is located in the heart of the PT002 network and has an existing 199kW biomass boiler which could act as an energy centre for the scheme. Utilising the asset in this way can help to offset costs, balance the heat load (i.e. by using heat for school during the day, then for homes at night) and increase resilience. The site must be assessed in more detail to establish network design parameters.

Portree District Heating Strategic Plan

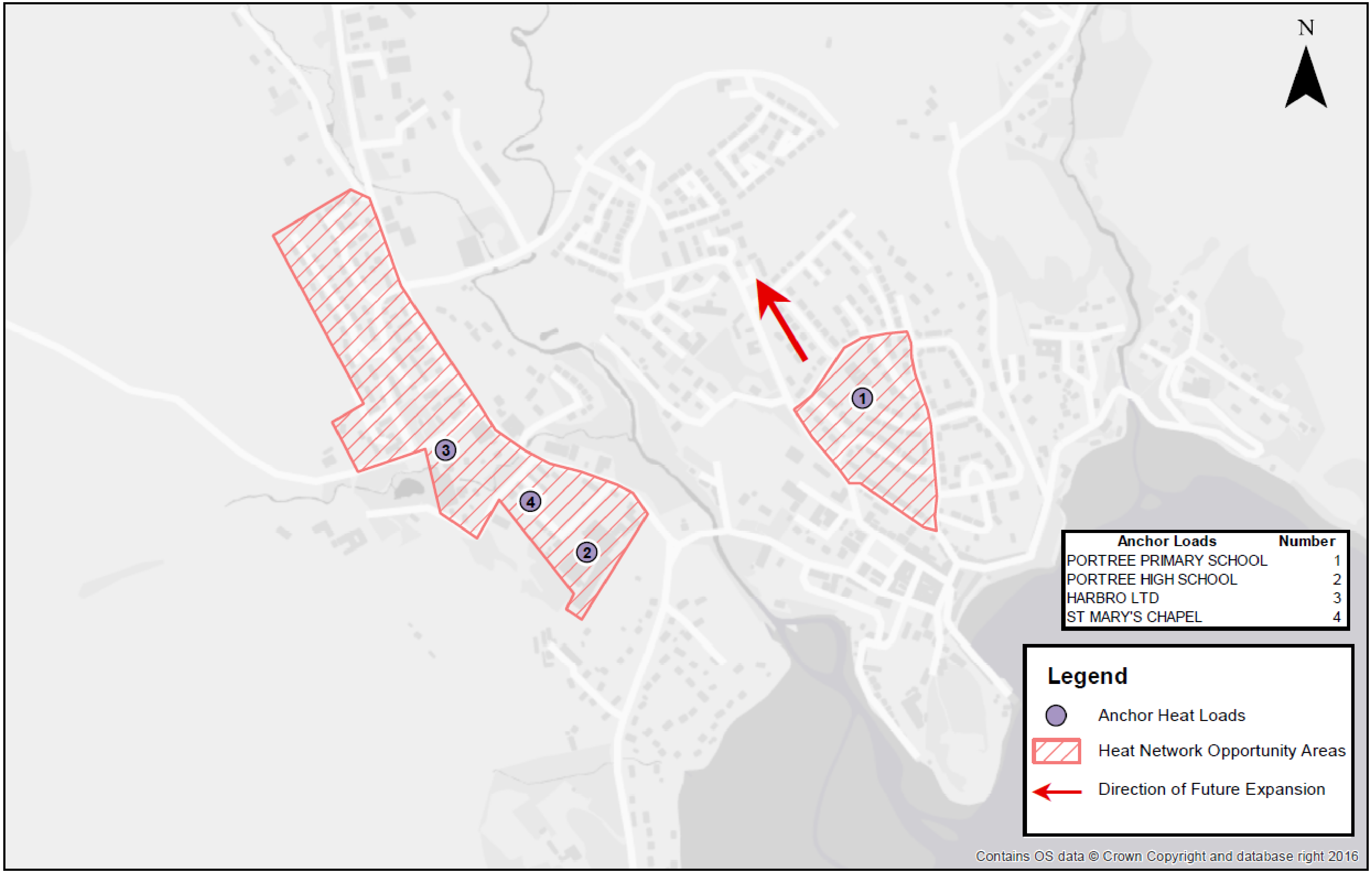


Figure 17 Portree District Heating Opportunity Areas & MIR Preferred Sites

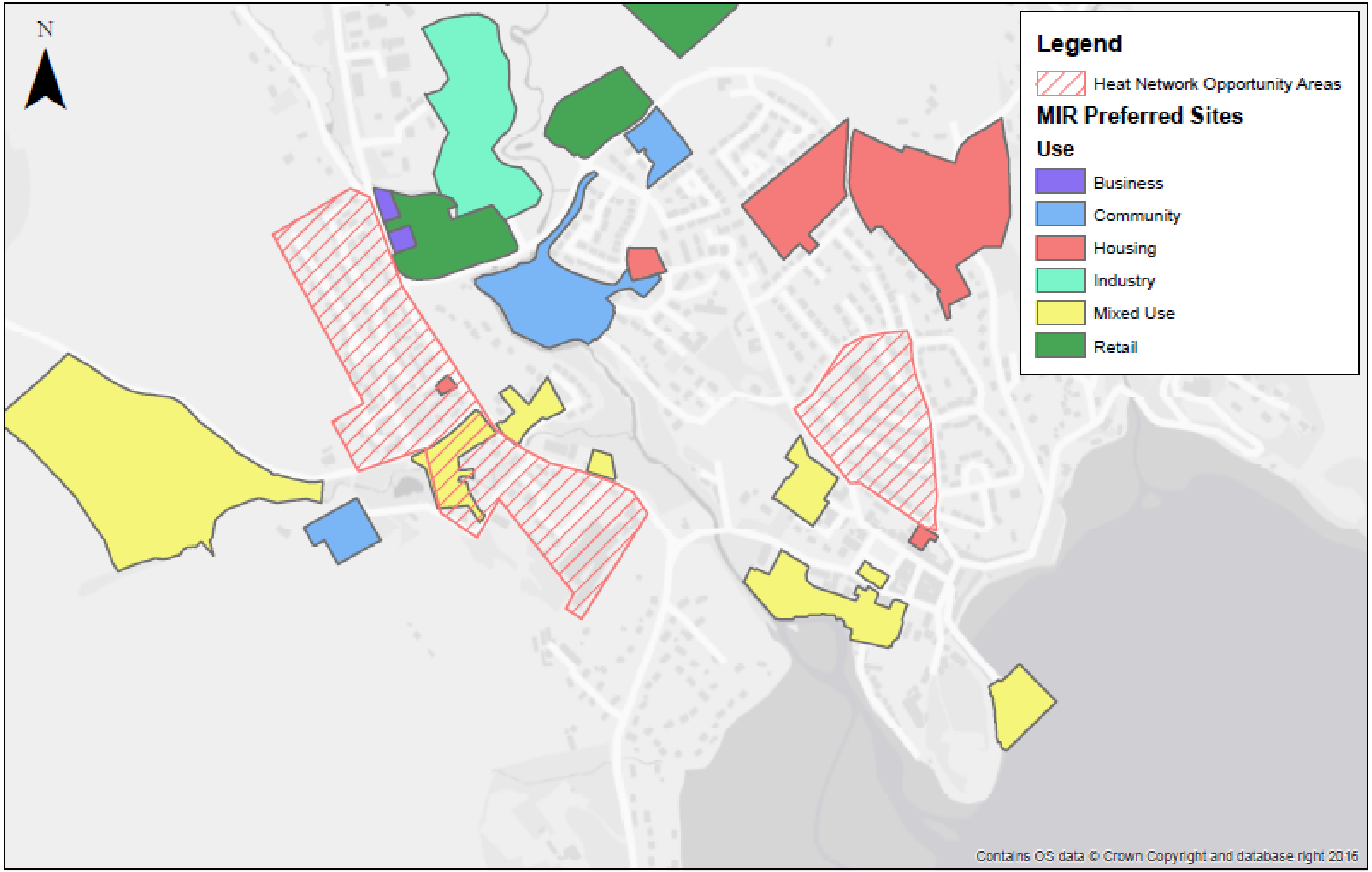
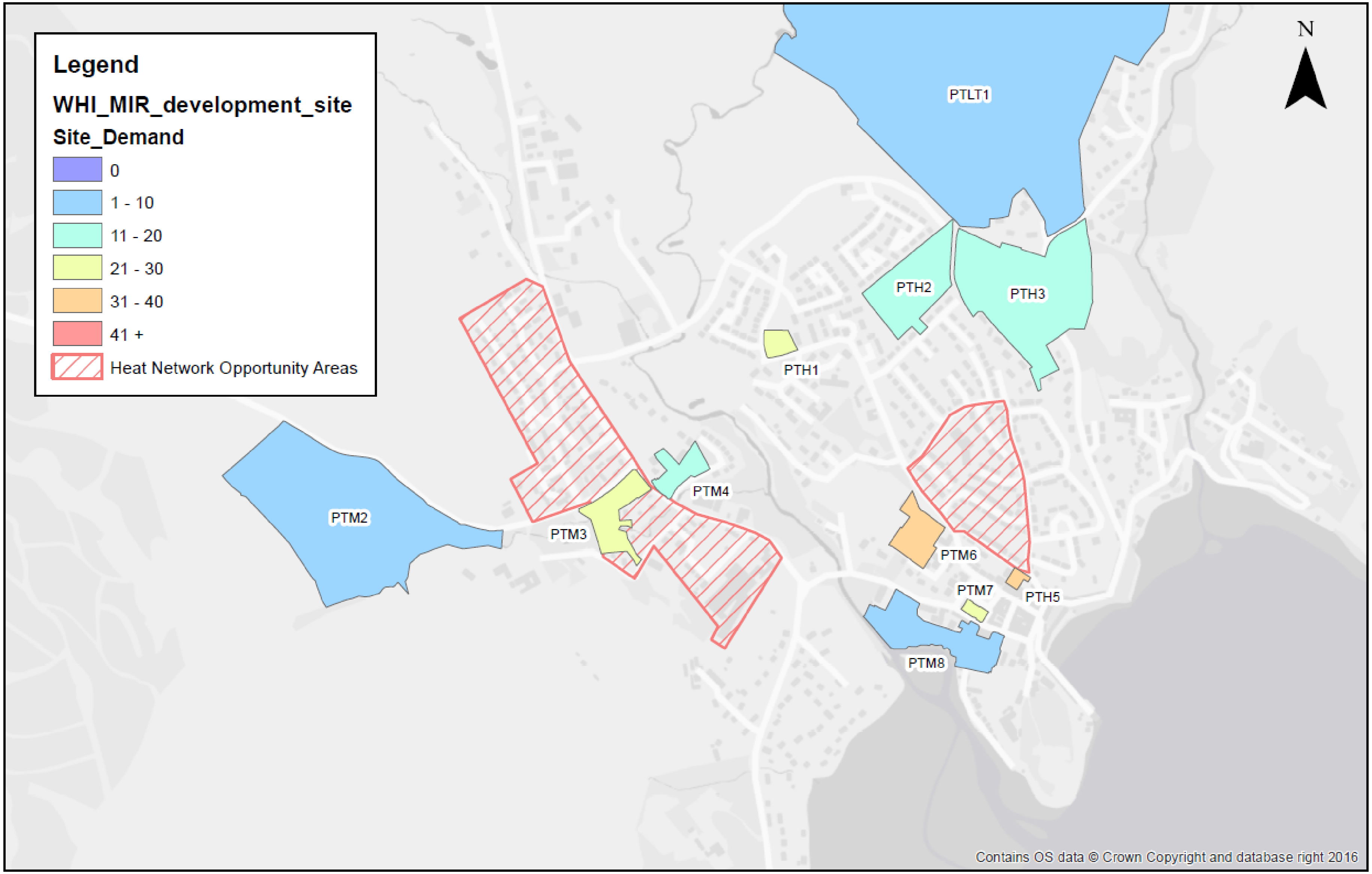


Figure 18 Portree MIR Sites Heat Demand



Portree – PT001

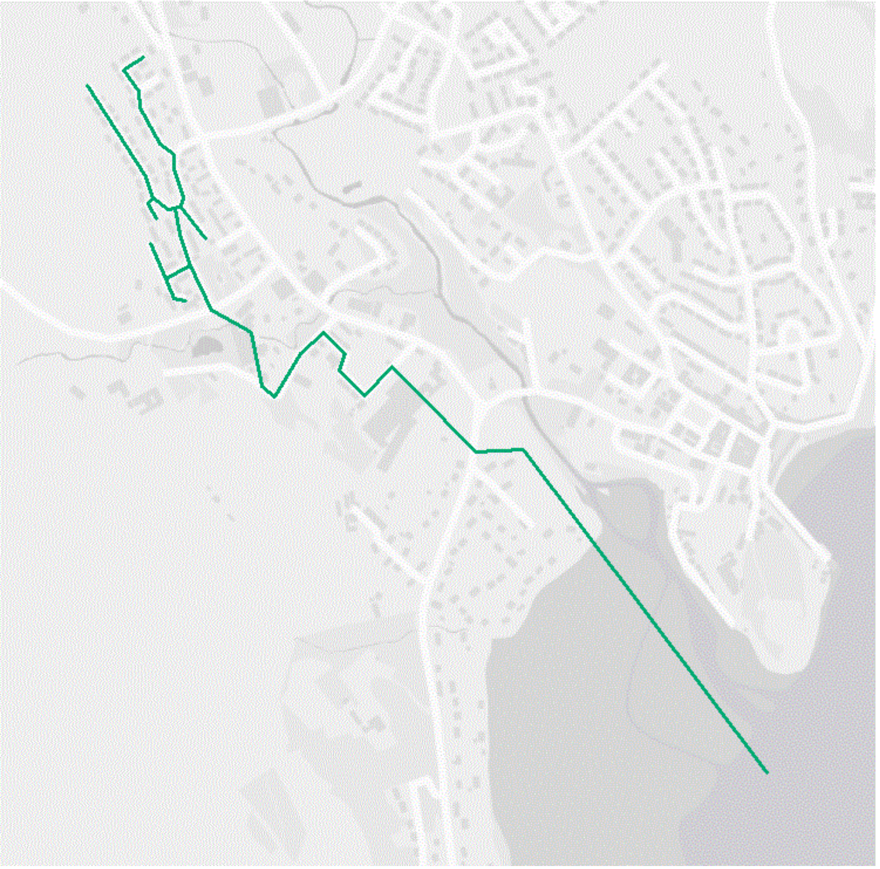


Figure 19 Proposed PT001 Heat Network Layout (Biomass option modelled without extension for WSHP)

Network PT001 (Figure 19) includes Portree High School and a number of residential properties in to the North. Harbro LTD and St Mary's Chapel were removed from the analysis because the heat demand data was deemed unreliable however these properties might be considered in future analysis.

The results suggest that a biomass based scheme here would likely have to attract 25% grant funding to be commercially viable whereas a WSHP may be capable of attracting public sector finance with no grant funding required. The consumer savings in this analysis are skewed by the large anchor load of Portree High School and indicates that the network would cost more to customers in the long term. More detailed feasibility work would have to be undertaken to accurately calculate how connection to the proposed scheme compares to the counterfactual case for Portree High School. In any case it is likely that the economic modelling presented here would have to be re-balanced to offer a better saving to potential customers.

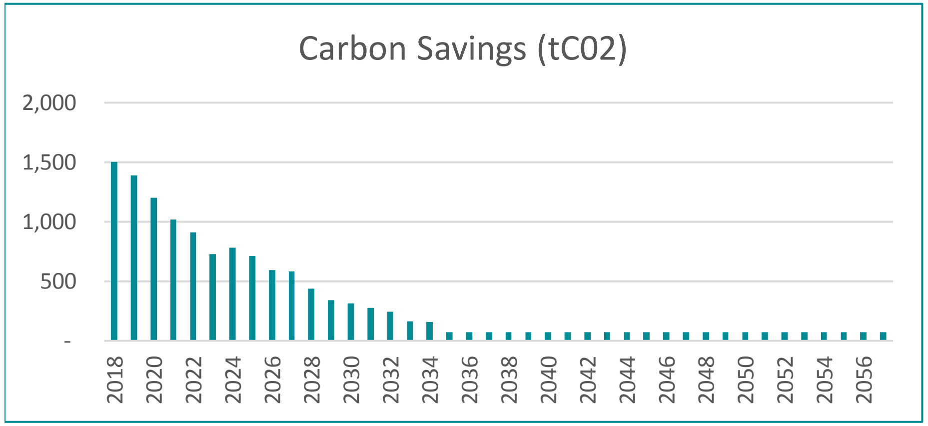
Key Assumptions:

- Portree High School has a heat pump system with LPG back up installed. For simplicity in the BAU case modelled here, the system has been modelled assuming a heat pump only system with a COP of 2.5. This likely underestimates the total consumer savings and lifetime carbon savings presented here and should be clarified in future feasibility work.

PT001- Biomass

30 years Discounted Cash Flow Model	No Funding	25% Funding	50% Funding
Capital Cost (Total for all phases)	£4.3M	£3.3M	£2.3M
IRR	3.3%	4.4%	6.2%
NPV (at discount rate of 3.5%)	£-224k	£758k	£1.7M
Discounted payback (years)	**36.7**	**18.47**	**11.2**
Lifetime carbon savings (tCO2)	12,387		
Building Upgrade Costs	£753k		

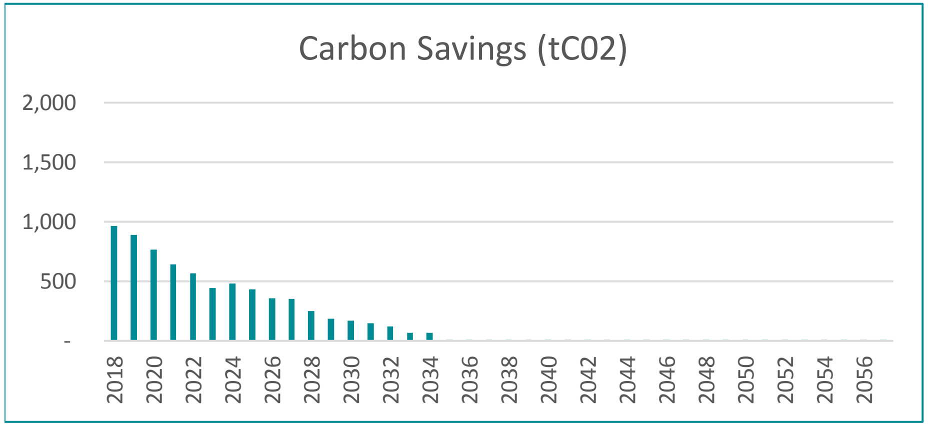
Consumer Savings	25 year financial savings	30 year financial savings	40 year financial savings
Total Consumer Savings	-£2,975,078	-£3,476,236	-£4,478,551



PT001 - WSHP

30 years Discounted Cash Flow Model	No Funding	25% Funding	50% Funding
Capital Cost (Total for all phases)	£5.3M	£4.1M	£2.9M
IRR	3.8%	4.9%	6.7%
NPV (at discount rate of 3.5%)	£397k	£1.6M	£2.8M
Discounted payback (years)	**22.2**	**14**	**8.6**
Lifetime carbon savings (tCO2)	6,997		
Building Upgrade Costs	£753k		

Consumer Savings	25 year financial savings	30 year financial savings	40 year financial savings
Total Consumer Savings	-£2,975,078	-£3,476,236	-£4,478,551



Portree – PT002

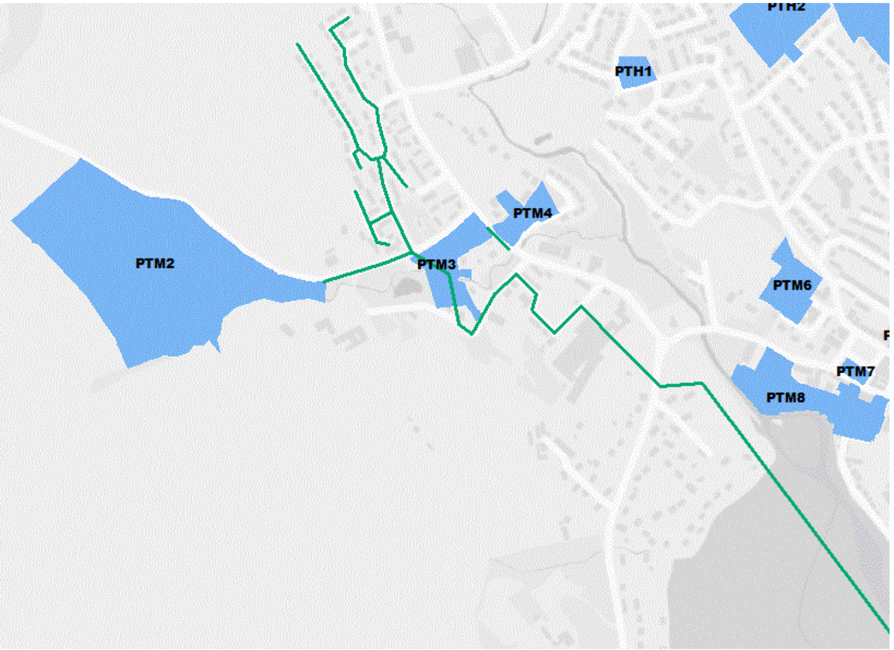


Figure 20 Proposed PT002 Heat Network Layout (Biomass option modelled without extension for WSHP)

Network PT002 (Figure 20) extends network PT001 to include the following new development sites:

- PTM4, PTM3, PTM2

The results suggest that a biomass based system would have to attract at least 50% grant funding to be viable, whereas a WSHP system could be viable with a grant of only 25%. The results indicate that while the inclusion of new development sites may financially viable, it does not improve the business case for a heat network in this area.

Future work should seek to establish the most appropriate location for a WSHP energy centre and gather more detail on the heat demand of any development on the MIR sites.

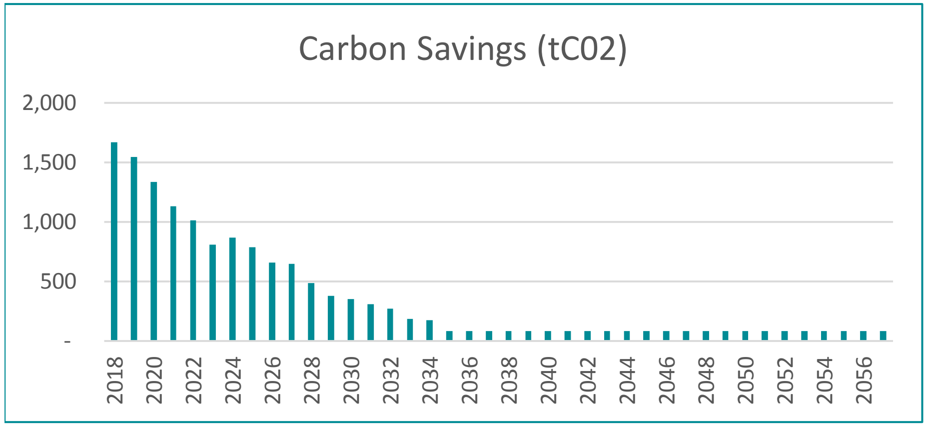
Key Assumptions:

- The entire cost of consumer connection and pipework infrastructure is considered to be borne by the project and no contribution from potential housing developers.
- Estimates have been used to determine the length of pipework infrastructure required for new development sites.
- As with PT001, Portree High School is assumed to operate with a heat pump only system in the BAU case

PT002 - Biomass

30 years Discounted Cash Flow Model	No Funding	25% Funding	50% Funding
Capital Cost (Total for all phases)	£4.8M	£3.8M	£2.6M
IRR	1.2%	2.2%	3.9%
NPV (at discount rate of 3.5%)	-£2M	-£909k	£198k
Discounted payback (years)	**N/A**	**N/A**	**21.15**
Lifetime carbon savings (tCO2)	13,773		
Building Upgrade Costs	£753k		

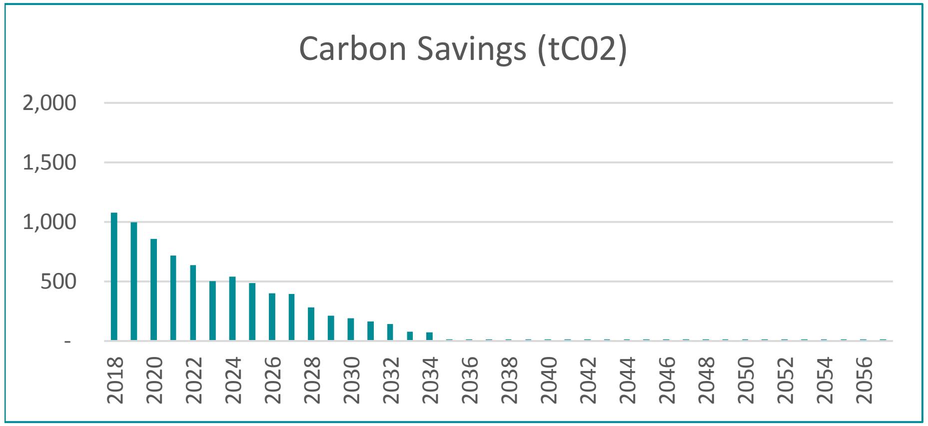
Consumer Savings	25 year financial savings	30 year financial savings	40 year financial savings
Total Consumer Savings	-£778,307	-£841,101	-£966,689



PT002 - WSHP

30 years Discounted Cash Flow Model	No Funding	25% Funding	50% Funding
Capital Cost (Total for all phases)	£5.6M	£3.9M	£2.8M
IRR	3.2%	4.3%	6.1%
NPV (at discount rate of 3.5%)	-£341k	£810k	£1.9M
Discounted payback (years)	**N/A**	**15.7**	**9.3**
Lifetime carbon savings (tCO2)	7,916		
Building Upgrade Costs	£753k		

Consumer Savings	25 year financial savings	30 year financial savings	40 year financial savings
Total Consumer Savings	-£778,307	-£841,101	-£966,689



Portree – PT003

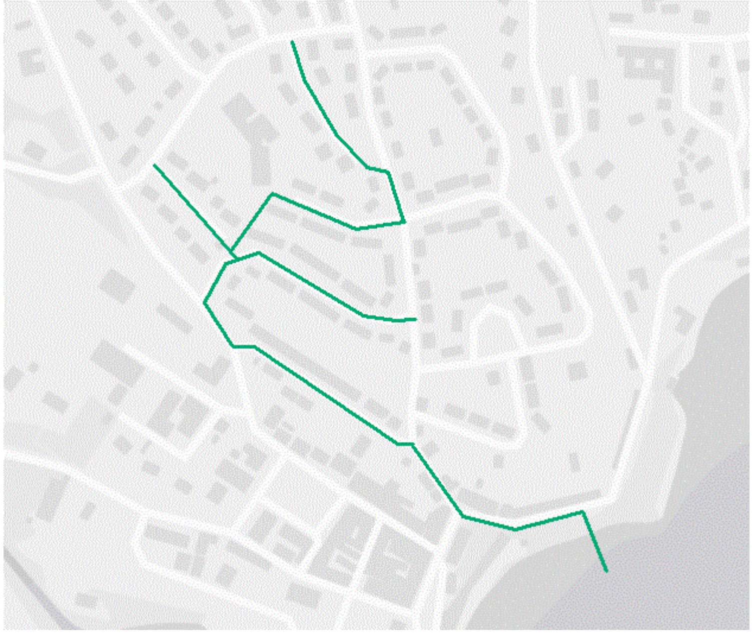


Figure 21 Proposed PT003 Heat Network Layout (Biomass option modelled without extension for WSHP)

Network PT003 (Figure 21) is centred on Portree Primary School and includes a number of surrounding mixed tenure properties.

The network may expand in the future towards “Home Farm” which provides heat to a further 120 homes and care home.

The results suggest that the proposed scheme would not be financially viable without at least 50% funding of capital costs, in both the WSHP and Biomass heat supply scenarios.

The modelling approach presented here results in a net cost to consumers over the modelling period. This is partly due to the high capital costs to customers for internal upgrades necessary. Any future work should seek to re-balance the project economics to ensure that sufficient savings to consumers are achieved in the long term.

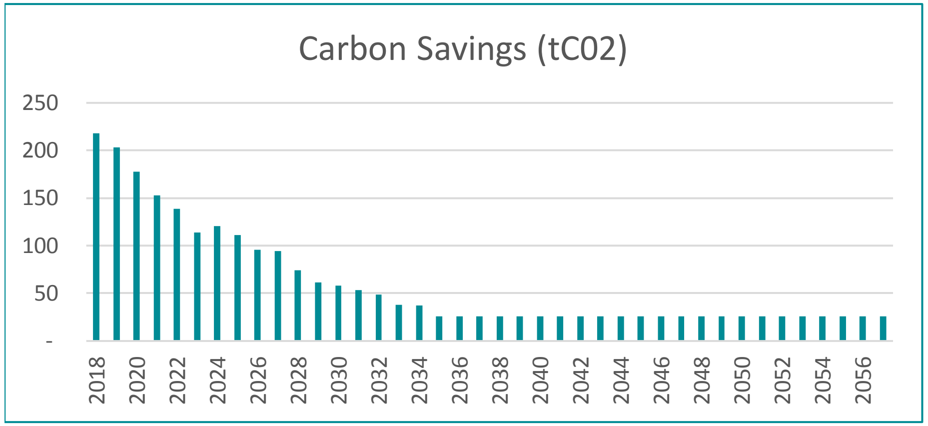
Key Assumptions:

- The location for a WSHP energy centre has been approximated. The most suitable location may lie further from the demand and necessitate more pipework.
- Portree Primary School has recently been equipped with a biomass boiler system. This study has not considered the benefit of including this as a heat source for the proposed network.

PT003- Biomass

30 years Discounted Cash Flow Model	No Funding	25% Funding	50% Funding
Capital Cost (Total for all phases)	£2M	£1.6M	£1.1M
IRR	2.3%	3.5%	5.2%
NPV (at discount rate of 3.5%)	-£475k	-£9k	£456k
Discounted payback (years)	**N/A**	**31.7**	**13.82**
Lifetime carbon savings (tCO2)	2,157		
Building Upgrade Costs	£342k		

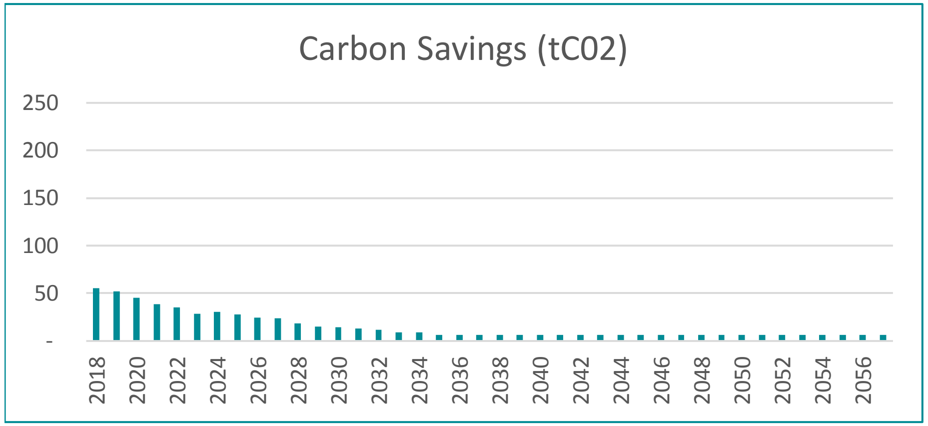
Consumer Savings	25 year financial savings	30 year financial savings	40 year financial savings
Total Consumer Savings	-£263,564	-£259,192	-£250,447



PT003- WSHP

30 years Discounted Cash Flow Model	No Funding	25% Funding	50% Funding
Capital Cost (Total for all phases)	£2.5M	£1.9M	£1.3M
IRR	2.2%	3.3%	4.9%
NPV (at discount rate of 3.5%)	-£667k	£92k	£481k
Discounted payback (years)	**N/A**	**N/A**	**14**
Lifetime carbon savings (tCO2)	536		
Building Upgrade Costs	£342k		

Consumer Savings	25 year financial savings	30 year financial savings	40 year financial savings
Total Consumer Savings	-£263,564	-£259,192	-£250,447



Portree – PT004

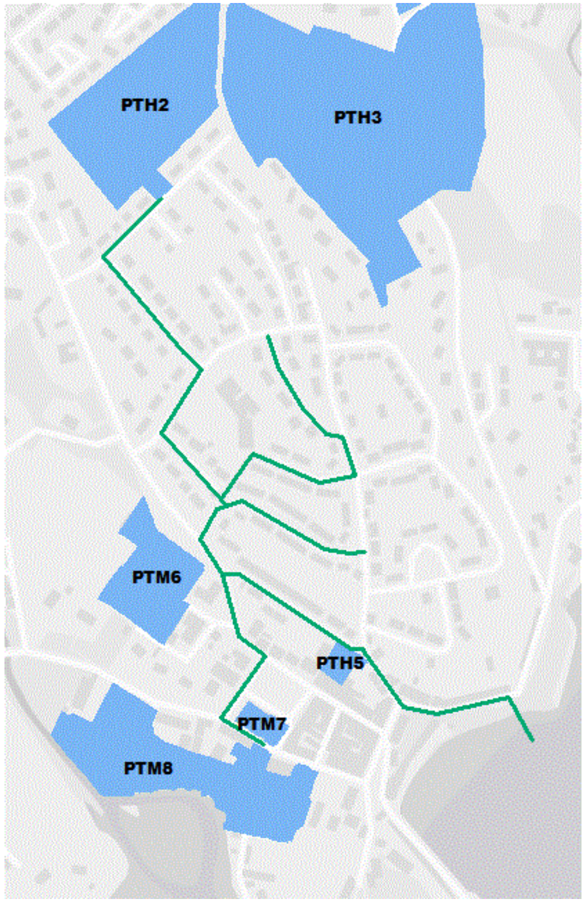


Figure 22 Proposed PT004 Heat Network Layout (Biomass option modelled without extension for WSHP)

Network PT004 (Figure 22) extends the network presented in PT003 to connect the following MIR development sites:

- PTH2, PTH3, PTH5, PTM6, PTM7, PTM8

This network also has the potential to extend northwards and connect to an existing heat network at “Home Farm” which provides heat to a further 120 homes and care home.

The results suggest that a biomass or WSHP based scheme in this area could be viable, providing that at least 25% grant funding of the capital costs can be secured.

The results suggest that the extension of PT003 to the MIR sites may be beneficial to the business case of the project.

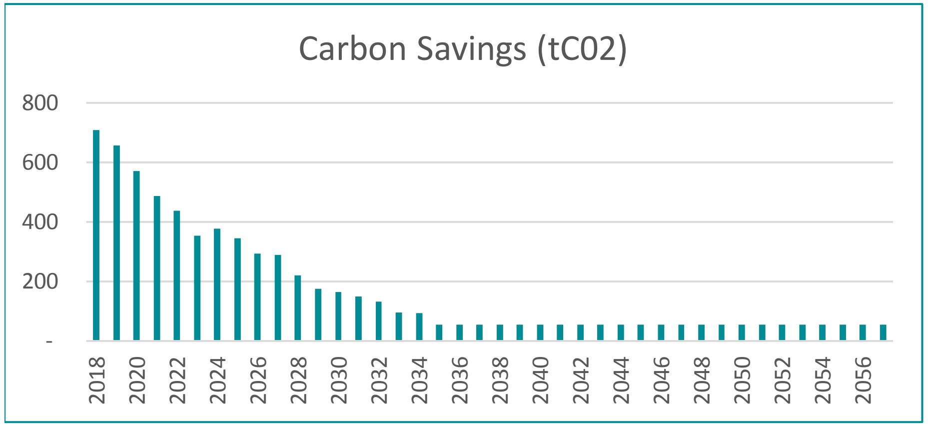
Key Assumptions:

- The entire cost of consumer connection and pipework infrastructure is considered to be borne by the project and no contribution from potential housing developers.
- Estimates have been used to determine the length of pipework infrastructure required for new development sites.

PT004- Biomass

30 years Discounted Cash Flow Model	No Funding	25% Funding	50% Funding
Capital Cost (Total for all phases)	£3.7M	£2.8M	£2M
IRR	2.7%	3.8%	5.3%
NPV (at discount rate of 3.5%)	-£650k	£190k	£1M
Discounted payback (years)	**N/A**	**25.5**	**13.9**
Lifetime carbon savings (tCO2)	6,312		
Building Upgrade Costs	£342k		

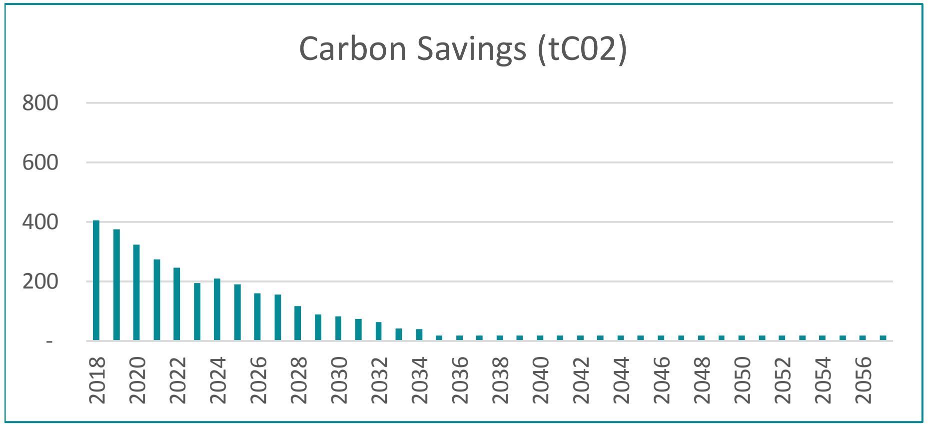
Consumer Savings	25 year financial savings	30 year financial savings	40 year financial savings
Total Consumer Savings	-£438,464	-£492,004	-£599,085



PT004 - WSHP

30 years Discounted Cash Flow Model	No Funding	25% Funding	50% Funding
Capital Cost (Total for all phases)	£4M	£3.4M	£2.2M
IRR	2.3%	4.1%	5.6%
NPV (at discount rate of 3.5%)	-£455k	£455k	£1.3M
Discounted payback (years)	**N/A**	**19**	**12**
Lifetime carbon savings (tCO2)	3,294		
Building Upgrade Costs	£342k		

Consumer Savings	25 year financial savings	30 year financial savings	40 year financial savings
Total Consumer Savings	-£438,464	-£492,004	-£599,085



Ullapool

The analysis shows that a single heat network opportunity area exists in Ullapool (Figure 23), centred on Ullapool Primary School, Lochbroom Leisure Centre and a number of retail units in the Latheron Centre.

Figure 24 shows the location and land use classification of preferred development sites, as outlined in the WestPlan MIR, in relation to the Ullapool district heating opportunity area. Of these sites, the heat demand could be calculated for the following sites, shown in Figure 25:

- UPM1
- UPH2

The Highland Council manage and own two low carbon heat sources in Ullapool as outlined in the table below. Ullapool High School is located within the UP001 network and has an energy centre which includes a biomass boiler capacity of 302kW. The second asset, Lochbroom House, is within 50m of the UP002 network so also offers a potential connection opportunity. Utilising the assets in this way can help to offset costs, balance the heat load (i.e. by using heat for school during the day, then for homes and the care home at night) and increase resilience. The sites must be assessed in more detail to establish network design parameters.

Site	Capacity (kW)	Within Scoped DHO Area	Potential Barriers to Connection
Ullapool High School	302	✓	-
Lochbroom House	100	✗	Distance

Figure 23 Ullapool District Heating Opportunity Area

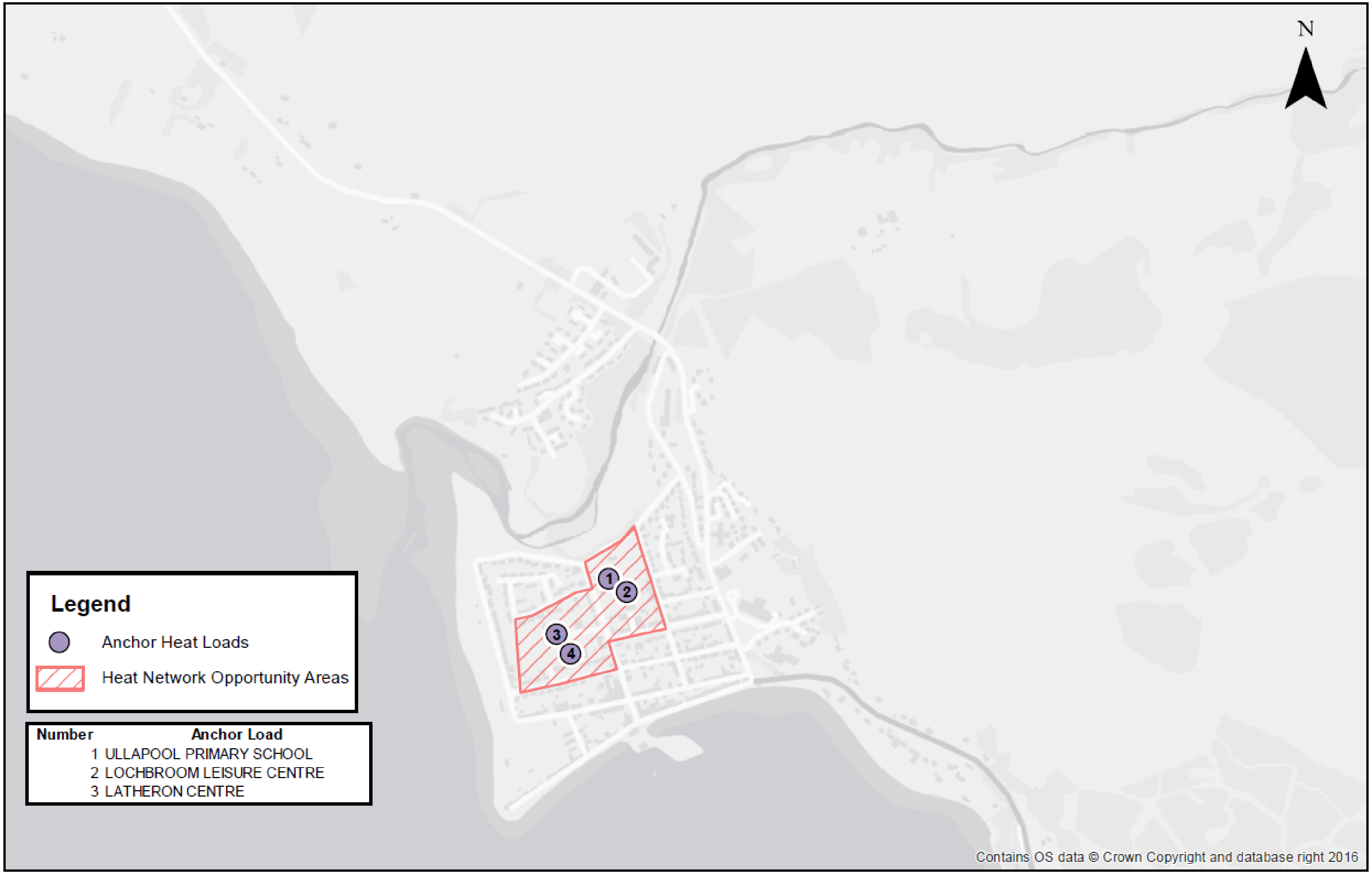


Figure 24 Ullapool Heat Network Areas & Preferred MIR Sites

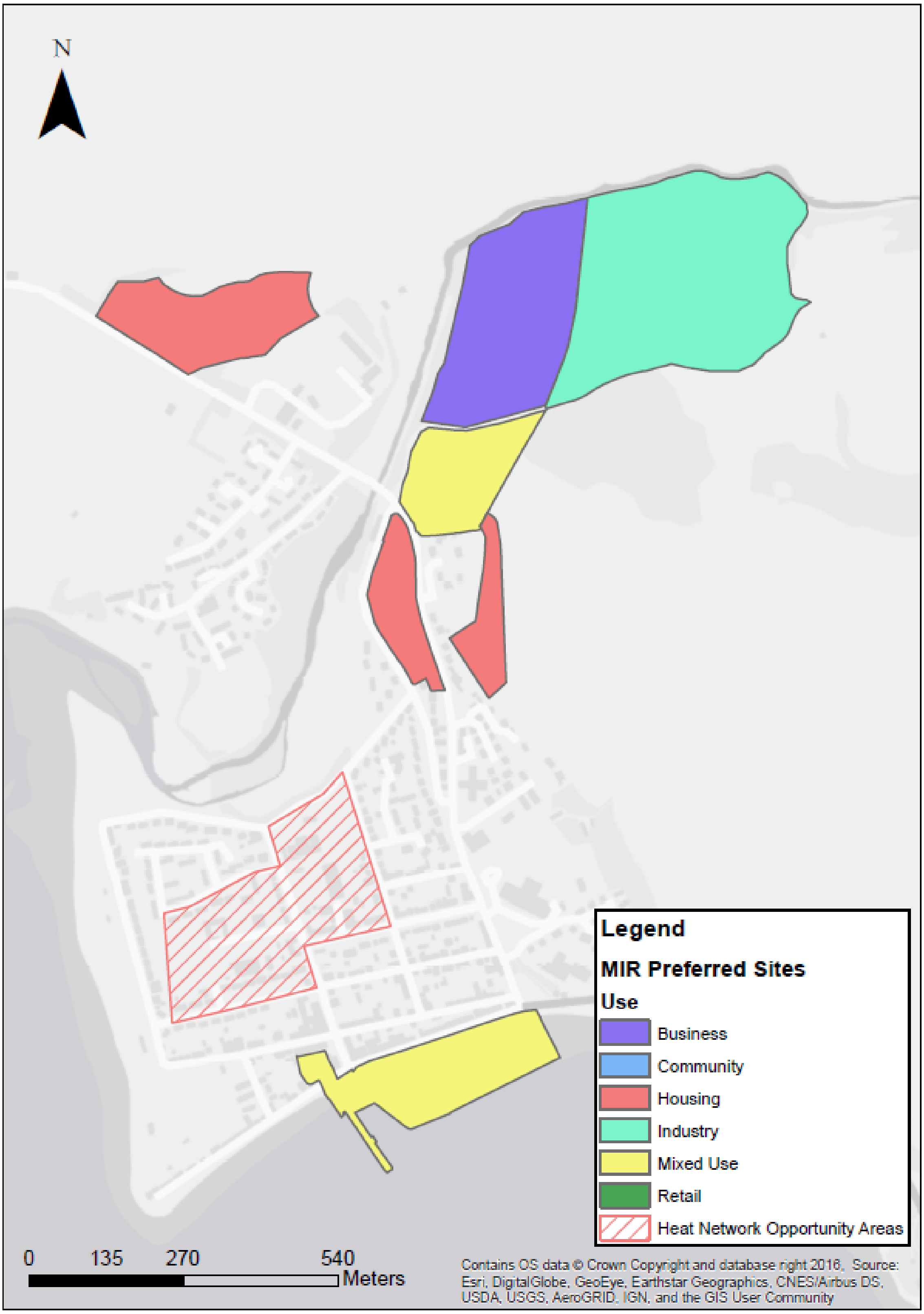
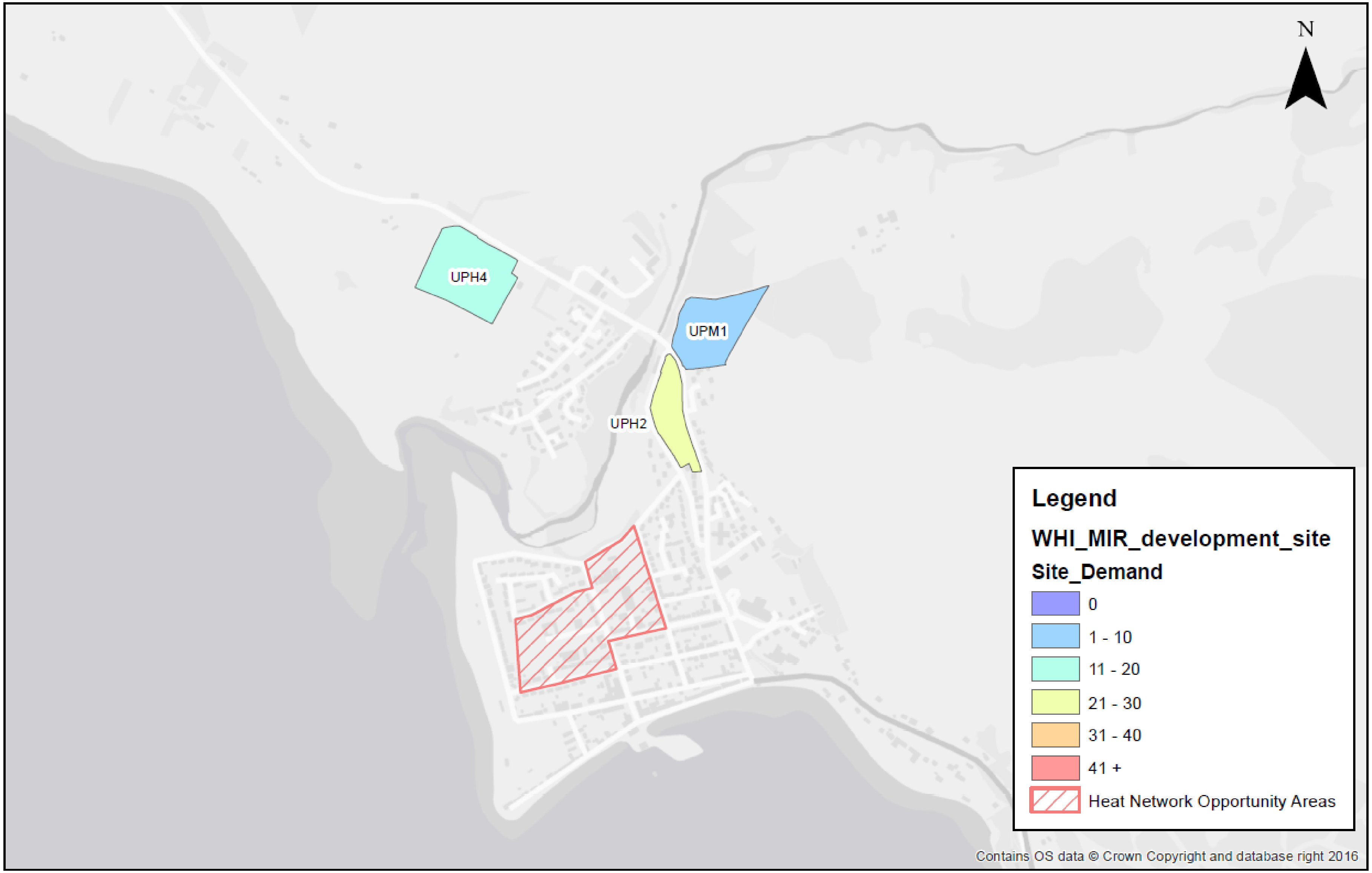


Figure 25 Ullapool MIR Sites Heat Demand



Ullapool – UP001

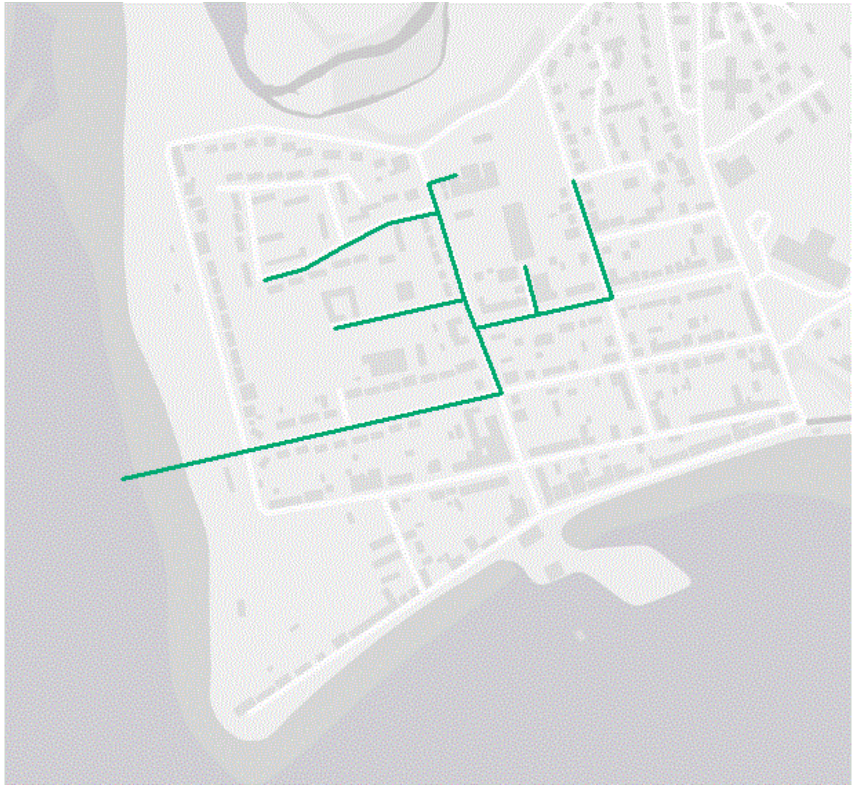


Figure 26 Proposed UP001 Heat Network Layout (Biomass option modelled without extension for WSHP)

Network UP001 (Figure 26) includes connection to small retail units in the Latheron Centre, as well as Lochbroom Leisure Centre, Tesco and Ullapool primary school. A number of mixed tenure domestic properties are also included in the scheme.

The results, suggest that both biomass and WSHP options would require grant funding of the capital costs in the region of 25% in order to be commercially viable. The current modelling approach results in a net cost to consumers over the project lifetime and further analysis should seek to re-balance the project economics to offer savings for any scheme to be viable.

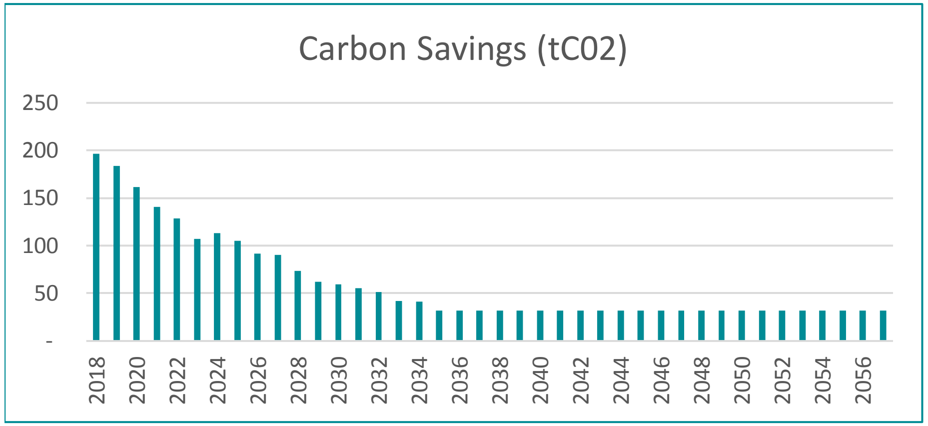
Key Assumptions:

- The analysis likely underestimates the lifetime carbon savings of the system as a number of key anchor loads are assumed to be biomass only systems.

UP001 - Biomass

30 years Discounted Cash Flow Model	No Funding	25% Funding	50% Funding
Capital Cost (Total for all phases)	£2M	£1.6M	£1.14M
IRR	2.5%	3.6%	5.3%
NPV (at discount rate of 3.5%)	-£443k	£33k	£509k
Discounted payback (years)	**N/A**	**28.5**	**13.2**
Lifetime carbon savings (tCO2)	2,148		
Building Upgrade Costs	£355k		

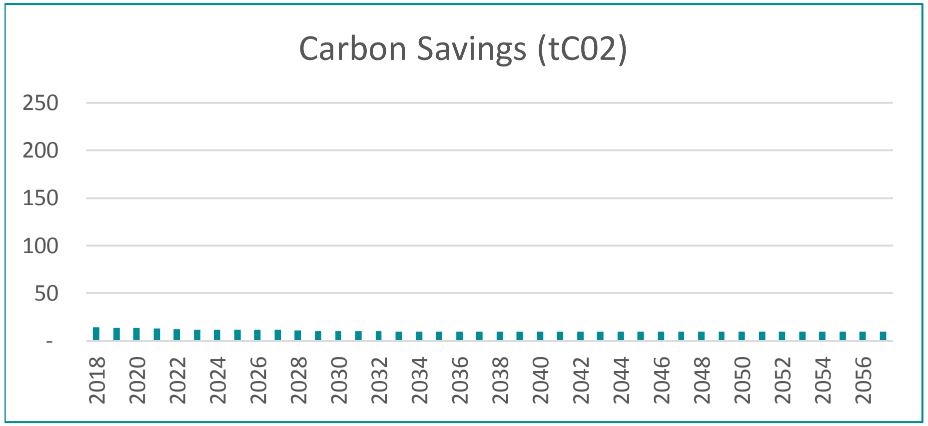
Consumer Savings	25 year financial savings	30 year financial savings	40 year financial savings
Total Consumer Savings	-£238,582	-£225,799	-£200,232



UP001 - WSHP

30 years Discounted Cash Flow Model	No Funding	25% Funding	50% Funding
Capital Cost (Total for all phases)	£2.3M	£1.7M	£1.2M
IRR	2.8%	3.9%	5.6%
NPV (at discount rate of 3.5%)	-£365k	£161k	£688k
Discounted payback (years)	**N/A**	**19**	**11**
Lifetime carbon savings (tCO2)	331		
Building Upgrade Costs	£355k		

Consumer Savings	25 year financial savings	30 year financial savings	40 year financial savings
Total Consumer Savings	-£238,582	-£225,799	-£200,232



Ullapool – UP002

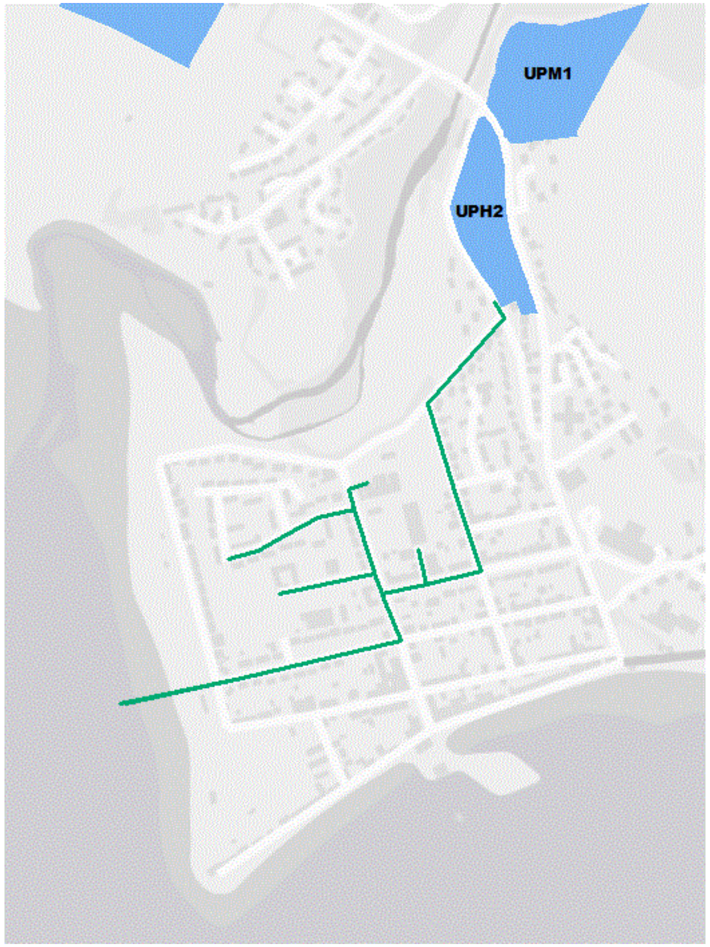


Figure 27 Proposed UP002 Heat Network Layout (Biomass option modelled without extension for WSHP)

Network UP002 (Figure 27) extends network UP001 to include development sites UPH2 and UPM1.

The results suggest that a heat network in this area would only be financially viable if 50% of the capital costs can be grant funded. The analysis suggests that the inclusion of the two MIR development sites do not significantly improve the business case for a heat network in this area.

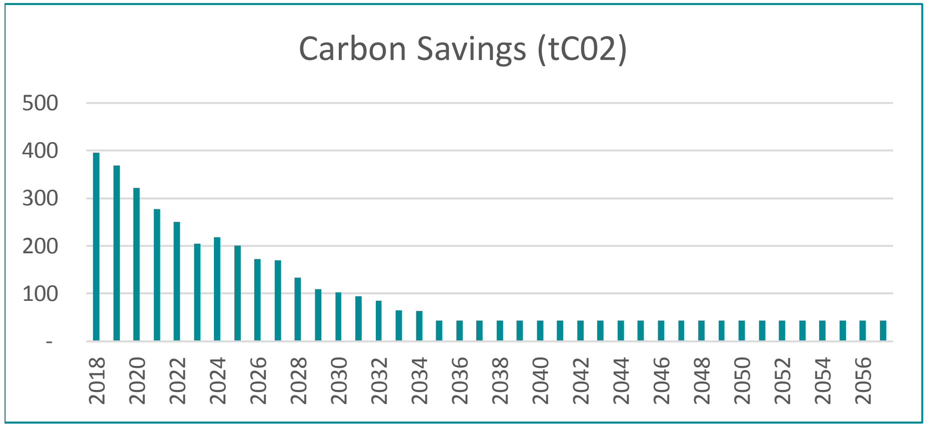
Key Assumptions:

- The analysis likely underestimates the lifetime carbon savings of the system as a number of key anchor loads are assumed to be biomass only systems.
- The entire cost of consumer connection and pipework infrastructure is considered to be borne by the project and no contribution from potential housing developers.
- Estimates have been used to determine the length of pipework infrastructure required for new development sites.

UP002 - Biomass

30 years Discounted Cash Flow Model	No Funding	25% Funding	50% Funding
Capital Cost (Total for all phases)	£3.2M	£2.5M	£1.7M
IRR	0%	3.0%	4.5%
NPV (at discount rate of 3.5%)	N/A	-£303k	£433k
Discounted payback (years)	**N/A**	**N/A**	**17.2**
Lifetime carbon savings (tCO2)	3,841		
Building Upgrade Costs	£355k		

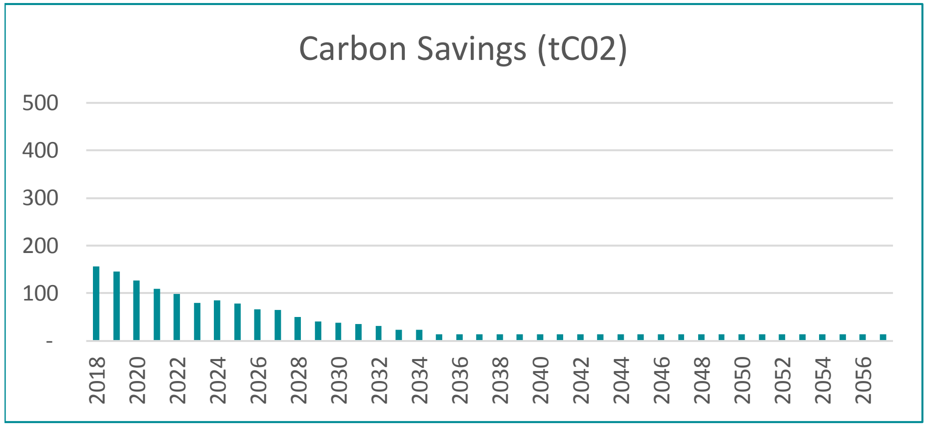
Consumer Savings	25 year financial savings	30 year financial savings	40 year financial savings
Total Consumer Savings	-£226,399	-£220,280	-£208,042



UP002 - WSHP

30 years Discounted Cash Flow Model	No Funding	25% Funding	50% Funding
Capital Cost (Total for all phases)	£3.3M	£2.7M	£1.9M
IRR	2.5%	3.2%	4.9%
NPV (at discount rate of 3.5%)	-£710k	-£81k	£711k
Discounted payback (years)	**N/A**	**36**	**14**
Lifetime carbon savings (tCO2)	1,455		
Building Upgrade Costs	£355k		

Consumer Savings	25 year financial savings	30 year financial savings	40 year financial savings
Total Consumer Savings	-£226,399	-£220,280	-£208,042



Broadford

The results show that a single heat network opportunity area exists in Broadford (Figure 28). The area is centred on the Dunollie Hotel, Cooperative Retail Store and Broadford Primary School. The opportunity area also includes a mixed tenure residential neighbourhood to the South East of the primary school.

Figure 29 shows the location and land use classification of preferred development sites, as outlined in the WestPlan MIR for Broadford. Several mixed use and housing development sites share a boundary with the heat network opportunity area, while a number of sites are located further to the North West, beyond the immediate hinterland of the zone designated as a district heating opportunity.

From the sites shown in Figure 29, the heat demand could be estimated for the following sites as shown in Figure 30:

- BFH1
- BFH2
- BFM6
- BFM7
- BFM8

Broadford Primary School, which The Highland Council own and manage, is located on the outskirts of both the BF001 and the BF002 networks. A 150kW biomass boiler is currently in operation here and could be integrated into a district heating scheme by either acting as a focal energy centre or supplying heat to the wider network. Utilising the asset in this way can help to offset costs, balance the heat load (i.e. by using heat for school during the day, then for homes at night) and increase resilience. The site must be assessed in more detail to establish network design parameters.

Although out with the scoped district heating opportunity areas, an additional asset, An Acarsaid Centre, is located within the BFM4 development site and could potentially link to a district heating network in the future.

Site	Capacity (kW)	Within Scoped DHO Area	Potential Barriers to Connection
An Acarsaid Centre	100	✗	Distance
Broadford Primary School	150	✓	-

Figure 28 Broadford Heat Network Strategic Plan

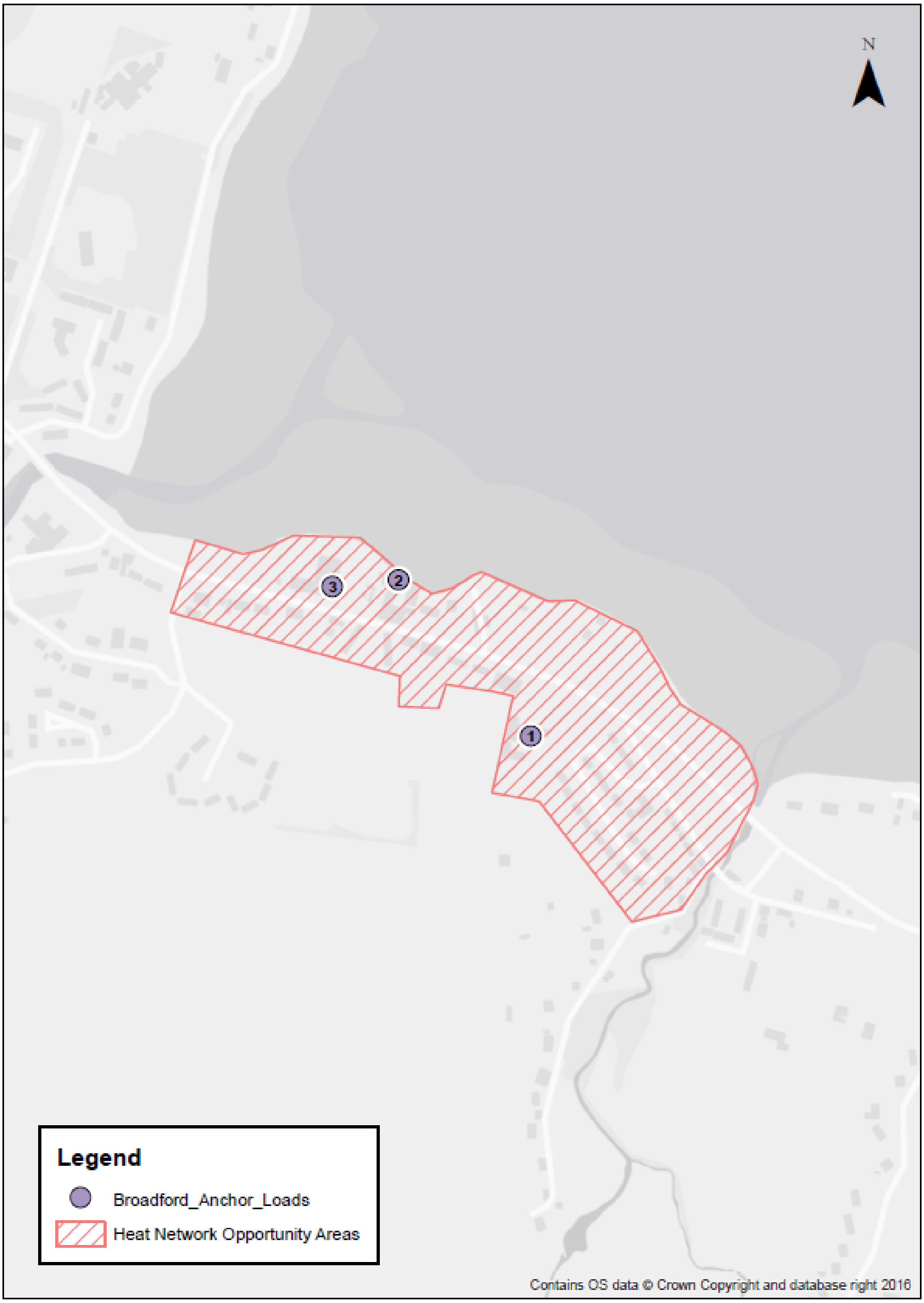


Figure 29 Broadford Heat Network Areas & Preferred MIR Sites

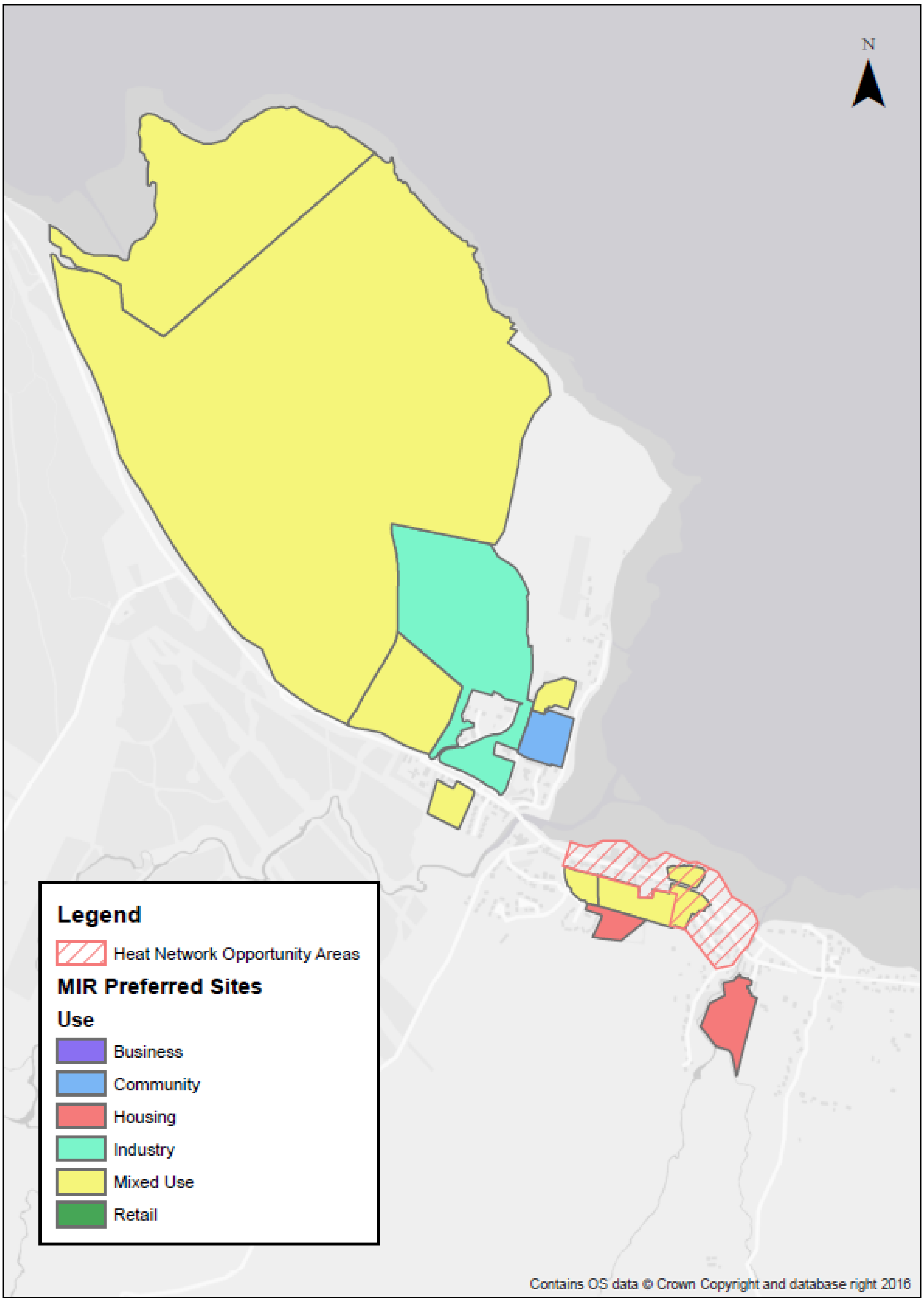
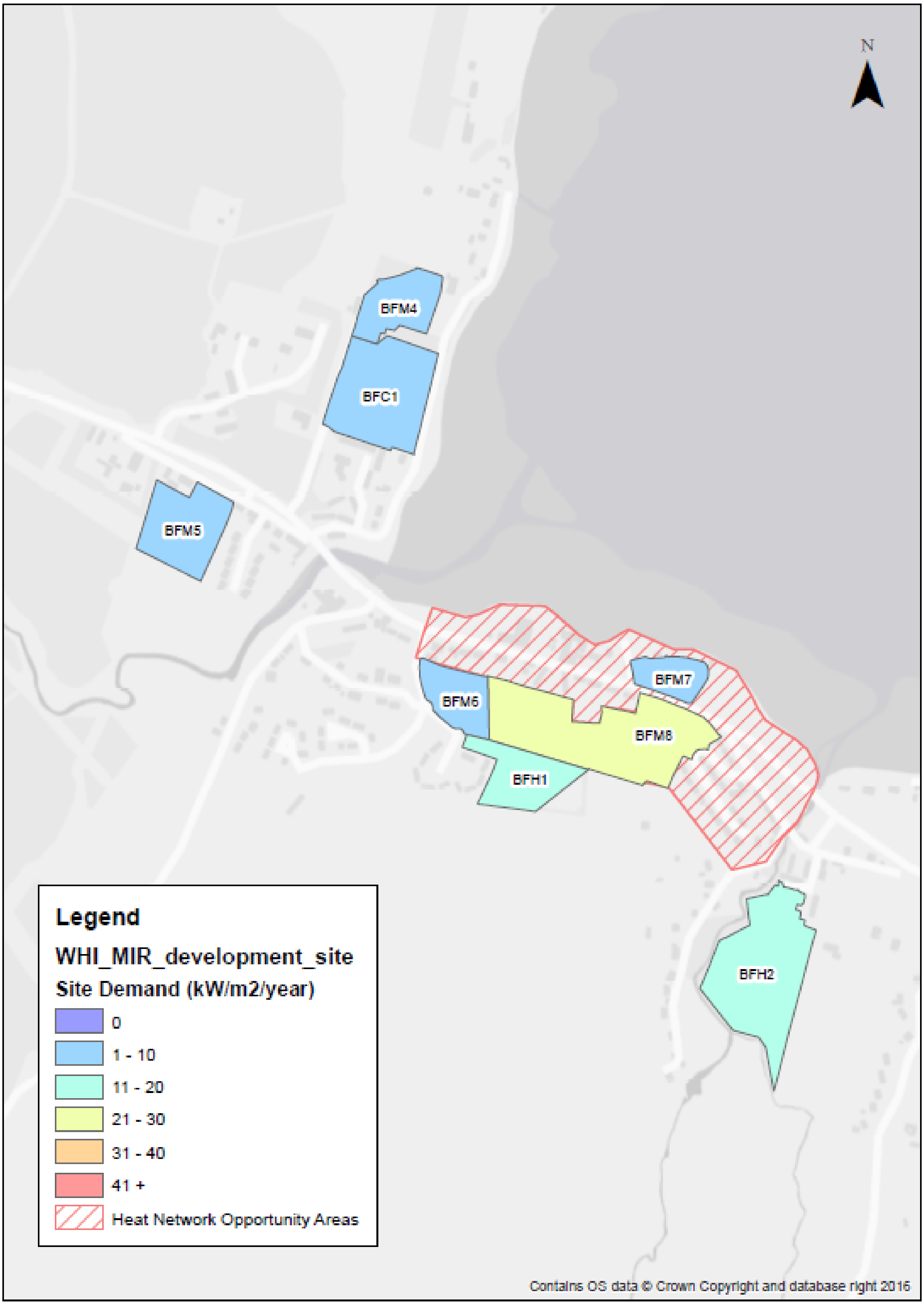


Figure 30 Broadford MIR Sites Heat Demand



Broadford – BF001

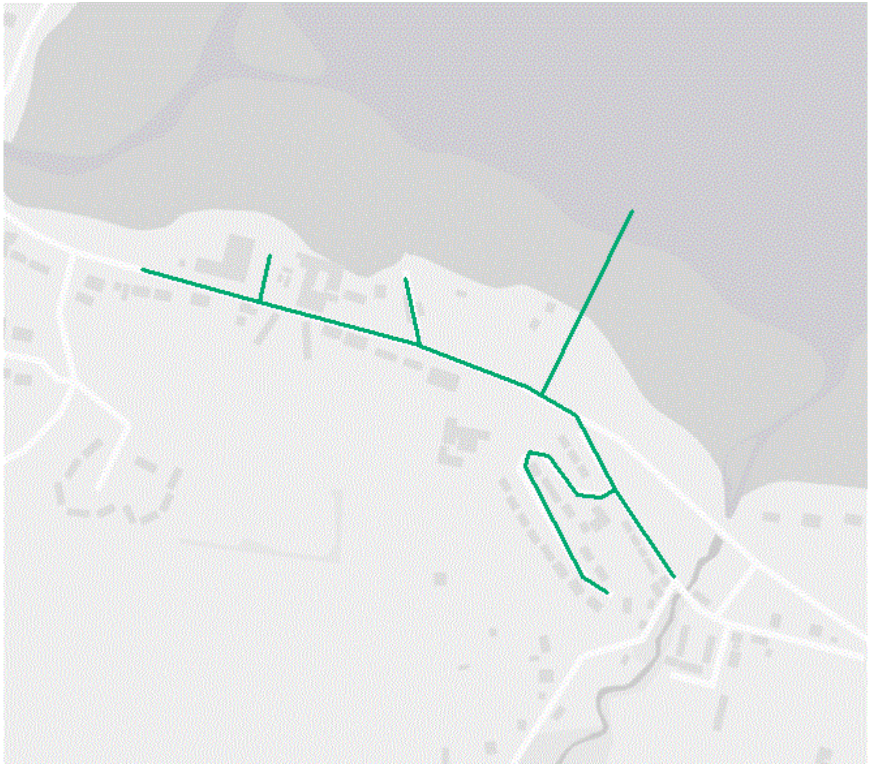


Figure 31 Proposed BF001 Heat Network Layout (Biomass option modelled without extension for WSHP)

Network BF001 (Figure 31) includes Dunollie Hotel, Cooperative Retail Store and Broadford Primary School as anchor heat loads an extends to include a number of domestic connections to the Southeast of the primary school.

The results suggest that a network in this area could be financially viable with either a WSHP or Biomass based heat source. The modelling approach used here shows a net cost to consumers over the project lifetime. Future modelling work should consider how the capital costs for any necessary internal heating system upgrades might be funded to reduce the financial cost to potential customers.

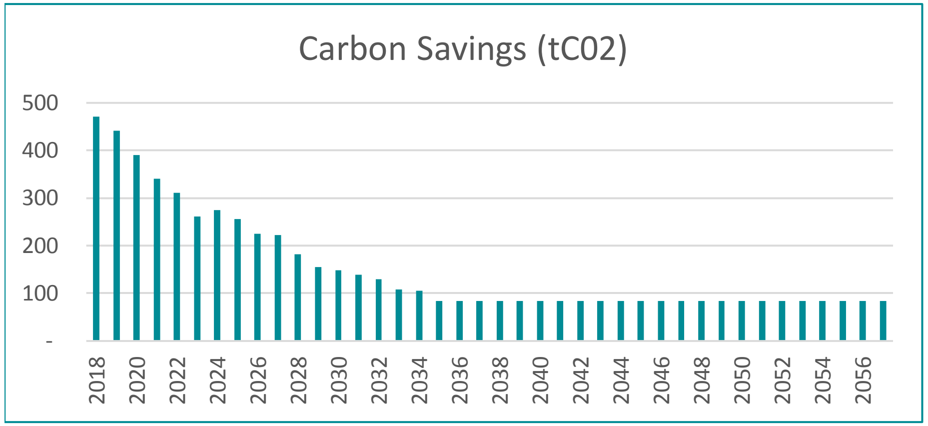
Key Assumptions:

- The analysis assumes that the heating systems of the Dunollie hotel and a number of residential properties would require upgrading. The costs associated with this are based on benchmark data and should be refined in future work.

BF001 - Biomass

30 years Discounted Cash Flow Model	No Funding	25% Funding	50% Funding
Capital Cost (Total for all phases)	£1.9M	£1.5M	£1M
IRR	4.3%	5.6%	7.9%
NPV (at discount rate of 3.5%)	£356k	£792k	£1.2M
Discounted payback (years)	**18**	**12.5**	**7**
Lifetime carbon savings (tCO2)	5,326		
Building Upgrade Costs	£482k		

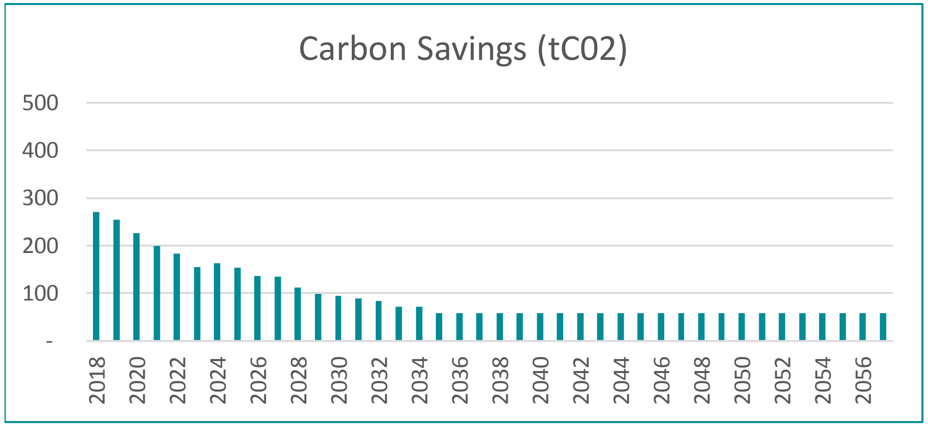
Consumer Savings	25 year financial savings	30 year financial savings	40 year financial savings
Total Consumer Savings	-£422,684	-£428,835	-£441,139



BF001 - WSHP

30 years Discounted Cash Flow Model	No Funding	25% Funding	50% Funding
Capital Cost (Total for all phases)	£2.2M	£1.7M	£1.2 M
IRR	3.7%	4.9%	7%
NPV (at discount rate of 3.5%)	£80k	£572k	£1M
Discounted payback (years)	**27**	**15**	**8.5**
Lifetime carbon savings (tCO2)	3,318		
Building Upgrade Costs	£482k		

Consumer Savings	25 year financial savings	30 year financial savings	40 year financial savings
Total Consumer Savings	-£422,684	-£428,835	-£441,139



Broadford – BF002

Figure 32 Proposed BF002 Heat Network Layout (Biomass option modelled without extension for WSHP)

Network BF002 (Figure 32) extends BF001 to include connection to the following proposed development sites:

- BFH1, BFH2, BFM6, BFM7, BFM8

The results indicate that a biomass based system might be viable without significant grant funding, however with a discounted payback period of 25 years. A WSHP based system would likely require funding in excess of 25% to be commercially viable.

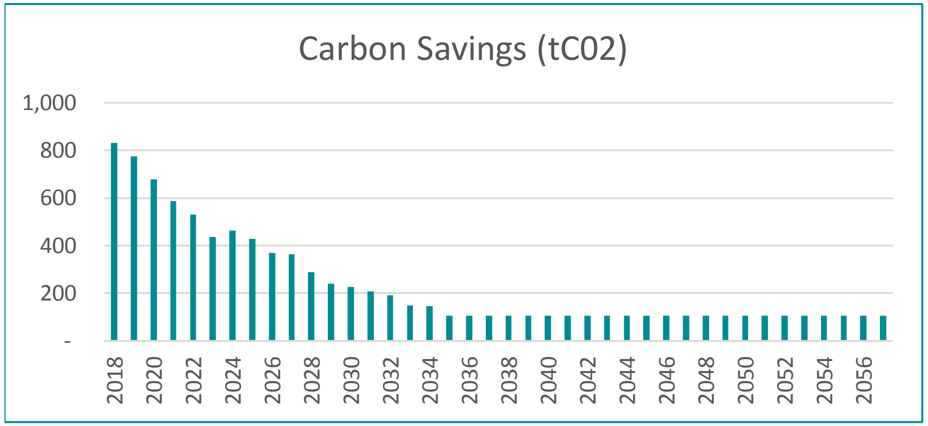
Key Assumptions:

- The analysis assumes that the heating systems of the Dunollie hotel and a number of residential properties would require upgrading. The costs associated with this are based on benchmark data and should be refined in future work.
- The entire cost of consumer connection and pipework infrastructure is considered to be borne by the project and no contribution from potential housing developers.
- Estimates have been used to determine the length of pipework infrastructure required for new development sites.

BF002 - Biomass

30 years Discounted Cash Flow Model	No Funding	25% Funding	50% Funding
Capital Cost (Total for all phases)	£3.2M	£2.5M	£1.7M
IRR	3.8%	4.9%	6.7%
NPV (at discount rate of 3.5%)	£213k	£927k	£1.6M
Discounted payback (years)	**25**	**15**	**9.6**
Lifetime carbon savings (tCO2)	8381		
Building Upgrade Costs	£482k		

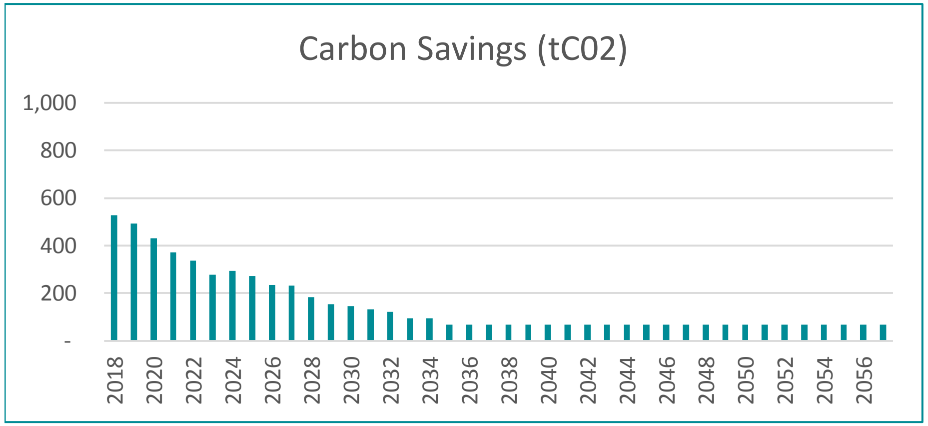
Consumer Savings	25 year financial savings	30 year financial savings	40 year financial savings
Total Consumer Savings	-£551,098	-£599,796	-£697,192



BF002 - WSHP

30 years Discounted Cash Flow Model	No Funding	25% Funding	50% Funding
Capital Cost (Total for all phases)	£3.9M	£3M	£2.1 M
IRR	3.4%	4.6%	6.2%
NPV (at discount rate of 3.5%)	-£47k	£841k	£1.7M
Discounted payback (years)	**32.5**	**16**	**10**
Lifetime carbon savings (tCO2)	5346		
Building Upgrade Costs	£482k		

Consumer Savings	25 year financial savings	30 year financial savings	40 year financial savings
Total Consumer Savings	-£551,098	-£599,796	-£697,192



4 Summary

The scenarios analysed here provide a high level indication of heat network viability within the existing built environment in the WestPlan area and highlight the key development plan sites to consider safeguarding for future heat network infrastructure. This “First Pass” modelling approach suggests that most networks, with the exception of FW001, 2 & 3, would not be financially viable without some level of grant funding of capital costs. However, a number of the networks modelled here may be viable with minor adjustments to end user heat sales tariffs or by offsetting some capital costs with developer contributions for networks that include new developments. Also, further modelling with alternative heat supply technologies such as heat pumps, may improve the viability of some networks where the high capital costs are offset by higher rates of Renewable Heat Incentive subsidy.

The requirement for grant funding of networks considered here will likely mean that projects will have to be prioritised based on socio-economic factors such as fuel poverty alleviation, carbon savings and practicality. Figure 32 summarises the distribution of tenureship for each network. Ultimately, connection to socially tenured domestic properties reduces the risk associated with schemes as heat supply agreements can be more easily put in place with social landlords responsible for a large number of properties rather than individual homeowners. Figure 33 shows, for each of those potential network areas, the average percentage probability that households will currently be in fuel poverty. This data is taken from the Home Analytics dataset and could be used to help prioritise projects that seek to target fuel poverty alleviation.

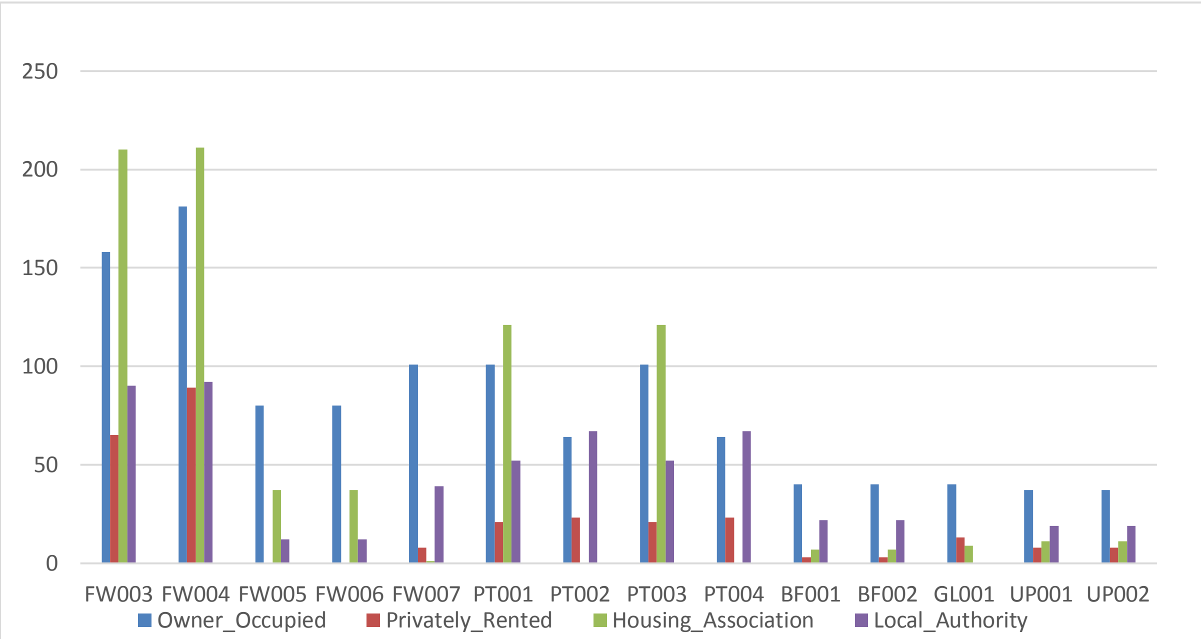


Figure 33 Distribution of tenureship by network

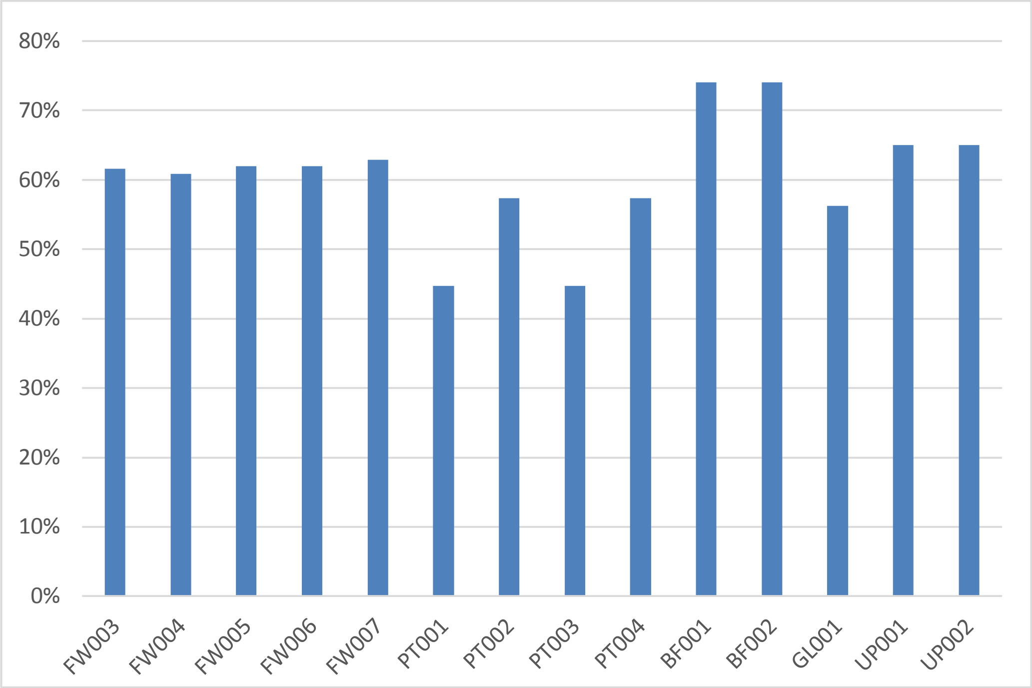


Figure 34 Mean fuel poverty by network scenario

The outputs presented here are the results of a high level analysis using benchmark data and a number of assumptions as described in the methodology section above. Ultimately, considerable development of the projects proposed here would be required before any financial decision making. However, it is hoped that this analysis goes some way towards highlighting the key WestPlan sites that may be important for future district heating infrastructure provision. Ultimately, the prioritisation and development of projects is a matter for The Highland Council.

The Highland Council WestPlan District Heating Opportunities Assessment

Annex A

Department of Energy & Climate Change

Assessing the cost effectiveness of individual metering: Energy demand benchmarks

14 November 2014

URN: 14D/435

Any enquiries regarding this publication should be sent to us at heatstrategy@decc.gsi.gov.uk

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4. Annex 8

1. Calculation of benchmark heat demands for unmetered domestic properties

The following benchmark heat demands for unmetered domestic properties include both space heating and hot water demand. The benchmarks are for use with the assessment criteria set out in Schedule 1 (Determination of cost effectiveness and technical feasibility) of 'The Heat Network (Metering and Billing) Regulations 2014'.

Final benchmark heat demands for each property type and age band must be adjusted by the regional weather correction factors presented in Table 3.

Table 1: Annual domestic energy demand (kWh/year) for heating and hot water by property type and age.

Age band	Flat	Terrace	Semi-detached	Detached
Pre 1917	10,581	16,042	20,476	30,714
1918 – 1938	9,755	14,640	18,652	27,977
1939 – 1959	8,994	13,182	16,688	25,033
1960 – 1975	8,653	12,710	16,065	24,098
1976 – 1982	8,101	11,740	14,749	22,123
1983 – 1989	8,331	11,989	15,072	22,608
1990 – 1999	6,828	9,479	11,728	17,592
Post 2000	6,218	8,371	10,306	15,459

Source: DECC Impact Assessment on the metering requirements for heating, cooling and hot water networks
https://www.gov.uk/government/consultations/implementing-the-energy-efficiency-directive-metering-and-billing-of-heating-and-cooling

2. Calculation of benchmark heat demands for unmetered non-domestic properties

The following benchmark heat demands for unmetered non-domestic properties include both space heating and hot water demand. The benchmarks are for use with the assessment criteria set out in Schedule 1 (Determination of cost effectiveness and technical feasibility) of 'The of The Heat Network (Metering and Billing) Regulations 2014'.

Final benchmark heat demands for each category of use must be adjusted by the regional weather correction factors in Table 3. This correction factor should be applied to only the proportion of the benchmark related to degree days.

Table 2: Non-domestic heat demand (kWh/m^2/year) for heating and hot water by category of use

Category of non-domestic use*	Fossil-thermal typical benchmark (kWh/m2)	% fossil-thermal pro-rated to degree days
General office	120	55
High street agency	120	55
General retail	170	55
Large non-food shop	170	55
Small food store	170	55
Large food store	105	55
Restaurant	370	30
Bar, pub or licensed club	350	40
Hotel	330	45
Cultural activities, Clinics and Terminals	200	55

Entertainment halls	420	55
Swimming pool centre	1130	55
Fitness and health centre	440	40
Dry sports and leisure facility	330	55
Public buildings with light usage	105	55
Schools and seasonal public buildings	150	55
University campus	240	55
Clinic	200	55
Hospital (clinical and research)	420	55
Long term residential	420	55
General accommodation	300	55
Emergency services	390	55
Laboratory or operating theatre	160	55
Public waiting or circulation	120	55
Terminal	200	55
Workshop	180	55

Source: CIBSE TM46 2008 http://www.cibse.org/knowledge/cibse-tm/tm46-energy-benchmarks

*See Annex for further detail on the definition of non-domestic categories

3. Weather correction factors for benchmark heat demands

The following weather correction factors should be applied to the domestic and non-domestic benchmark heat demands to achieve final benchmark figures, as set out in Table 1 and Table 2 above.

Table 3: Weather correction factors by region

Region	Difference (%)
Thames	-15
South East England	0
Southern England	-5
South West England	-18
Severn	-12
Midlands	3
West Pennines	1
NW England / SW Scotland	13
Borders	12
North East England	11
East Pennines	2
East Anglia	4
West Scotland	12
East Scotland	12
North East Scotland	12
Wales	-3
Northern Ireland	7
North West Scotland	12

Source: CIBSE TM46 2008 http://www.cibse.org/knowledge/cibse-tm/tm46-energy-benchmarks Appendix A1

A) Benchmark categories for non-domestic building use with further category details

Name and description			Allocation guides			Further category details		
Name	*Description*	*Space usage*	*Operational schedule*	*Distinguishing features*	*Services include*	*May be part of mixed use with areas below*	*Summary of allowable energy uses*	*Representative buildings*
General office	General office and commercial working areas	Mainly by employees, for sedentary desk based activities. Includes meeting and conference facilities	Weekdays and early evenings	Relative uniformity of occupancy, density, conditions, schedule and appliances	Heating, lighting, cooling, employee appliances, standard IT, basic tearoom	Covered car park, staff restaurant	Regional server, trading floor	General office benchmark category for all offices, whether air conditioned or not, Town Halls, architects, various business services that do not include retail functions
High street agency	High street agency	By employees mainly for desk-based activities and off street visitors - public area and back office	Weekdays and early evenings, commonly part of all of weekend	Office type of activities, with retail street frontage and consequent infiltration and glazing losses	Heating, lighting, cooling, employee appliances, standard IT, basic tearoom			Bank branches, estate agents, travel agents, legal, insurance and advertising services, off-street professional services, Post Offices, betting shops
General retail	General street retail and services	Mainly by clients, customers and visitors for a service activity – some facilities required for employees	Weekdays and early evenings, commonly part or all of weekend	Basic heating, lighting, cooling for off street premises that may contain a wide variety of activities besides sale of goods	Heating, lighting, cooling, appliances for small number of employees			High street store of local store. Corner shops, amusement arcades, takeaways, hairdressers, laundries, laundrettes, dry cleaners, hire premises, indoor markets
Large non-food shop	Retail warehouse or other large non-food store	Mainly for customers for purchasing goods – some facilities required for emloyees	Typically week and weekend days	Large, and tends to be solely used for retailing	Heating, lighting, cooling, appliances for small number of employees			Retail warehouses or shed, department stores, hypermarket, large showrooms
Small food store	Small food store	Mainly by customers for purchasing goods – some facilities required for employees	Typically week and weekend days	Greater needs for refrigeration of goods than other shops	Heating, lighting, display cabinets, food storage, employee appliances			Food stores, green grocers, fish shops, butchers, delicatessens
Large food store	Supermarket or other large food store	Mainly by customers for purchasing goods – some facilities required for employees	Typically week and weekend days, may be used in evenings, some are 24/7 operations	Greater needs for refrigeration of goods, and larger, than other shops	Heating, lighting, display cabinets, food storage, employee appliances	Covered car park	Bakery oven	Supermarkets and freezer centres
Restaurant	Restaurant	Storage and preparation of food which is then cooked and served to users, seating space for eating is provided	There is a wide variety of operational schedules, from selected portions of weekdays to	Assumes minimal reheat of food	Heating, lighting, cooling, food storage, heating of pre-prepared food		Cooking equipment in a catering kitchen	Cafes, restaurants, canteens, refectories, mess, halls

			24/7 operation					
Bar, pub or licensed club	Bar, pub or club	Serving drinks and snacks, with standing and sitting areas for customers	Open to public or members, day or evening	Major activity is the bar and associated areas	Heating, lighting, cooling, some office appliances, snack provision			Pub, licensed clubs, members clubs, wine bars.
Hotel	Hotel or boarding house	Primarily the provision of short-term accommodation and hygiene facilities	Primarily used in evenings	Provision for paid short-term accommodation	Heating, lighting, cooling, some office appliances snack provisions	Swimming pool, fitness and health centre, restaurant, general office (the conference facility)		All hotel types, guest houses, motels
Cultural activities	Museum, art gallery or other public building with normal occupancy	Spaces for displaying and viewing object, with associated office and storage facilities	Daytime use, similar to office hours but more likely to be open in weekends	Activity is office like in its requirements but with some additional conditioning requirements for display and storage of artefacts	Heating, lighting, cooling, humidity control			Municipal museums, libraries and galleries, higher education arts buildings
Entertainment halls	Entertainment halls	Large assembly and seating area, with associated ticketing and snack services, for performance events and films	Mainly in evenings, some daytime use. All days of week	Tend to be large halls, mainly use in evenings	Heating, lighting, cooling of main entertainment spaces, and circulation ticketing and snacks provision			Cinemas, theatres, concert halls. Bingo halls
Swimming pool centre	Swimming pool hall, changing and ancillaries	Swimming pool with associated facilities	Ranges from occasional use to daily and evening	Pool hall is the dominant space use – may have small café and fitness room	Heating, lighting, cooling of all spaces. Office appliances, showers, snack provision and bar			Swimming pool centre without sports facilities
Fitness and health centre	Fitness centre	Fitness, aerobics, dance and solarium/sauna facilities	Typically daily and evenings	Provision of sports and entertainment equipment with generally high energy usage and internal gains	Heating, lighting, cooling of all spaces. Office appliances, showers, snack provision and bar			Fitness centre, health centre
Dry sports and leisure activity	Dry sports and leisure activity	Dry sports and club house buildings – for a combined leisure centre include pool, etc	Ranges from occasional use to daily and evening	Provision of sports to support separated sporting and entertainment activities often lightly serviced	Heating, lighting, and basic office equipment	Swimming pool, fitness and health centre	Sports flood lighting	Dry sports hall, sports grounds with changing rooms, tennis courts with office, speedway tracks, stadiums, pavilions
Public buildings with light usage	Light use public and institutional buildings	Variety of facilities and services provided with generally public access when in use	Intermittent usage	Lightly serviced or lightly used	Heating and lighting			Churches, club houses, village halls
Schools and seasonal public buildings	Public buildings nominally used for part of the year	Teaching and community activities	Weekday usage for part of the year	Public buildings with part annual occupancy	Heating, lighting, and basic office equipment, teaching equipment	Restaurant (dining hall), swimming pool		Primary and secondary schools, nurseries, crèches, youth centres and community centres
University campus	University campus	Lecture theatres, offices, workshops, eating places, laboratories and	Week days and evenings	Large floor space and variety of activities	Heating, lighting, cooling, office and teaching equipment	Laboratory, restaurant	Furnace or forming plant	Typical campus mix for further and higher education universities and colleges

		other activities						
Clinic	Health centres, clinics and surgeries	Provision of primary health care	Usually week days and early evenings	Daytime use, essentially office hours, but needs to provide for high public use, generally by appointment	Heating, lighting, cooling, hot water services			Doctors surgeries, health clinics, veterinary surgeries, dentist
Hospital, clinical and research	Clinical and research hospital	Mainly space for medical care with 24-hour accommodation for patients, with associated operating theatres, laboratories, offices and workshops	Continuous for the majority of the facility	24-hour accommodation with stringent environmental conditions, ventilation control, quarantine, and high occupant servicing needs	All services	Laboratory or operating theatre, restaurant	Furnace or forming plant	Acute hospital, specialist hospital, teaching hospital and maternity hospital
Long-term residential	Long-term residential accommodation	Full accommodation, including sleeping space, day time space, all domestic facilities, some office facilities	Continuous	24-hour fully conditioned and serviced accommodation	Heating, lighting, cooling, appliances, food and hot water services, entertainment, laundry	Restaurant (dining hall)		Residential home, homeless unit, cottage hospital and long-stay hospital, detention centre and prisons
General accommodation	General accommodation	Space for sleeping, showers, basic domestic services	Non-continuous occupancy, often used in the evenings	Slow turnover of occupants requires fewer facilities and less laundry than for example a hotel	Heating, lighting, cooling, laundry, and drying rooms			Boarding houses, university and school hostels, homeless units, nursing homes
Emergency services	Emergency services	Offices, accommodation, food services, cells, garaging and other activities as required	Normally continuous, some stations closed in the evenings and weekends	Provision of a variety of services that wold be in separate category in other parts of non-domestic stock (eg accommodation, offices and vehicle garaging)	Heating, lighting, cooling, food services, office and training equipment			Police, fire and ambulance stations
Laboratory or operating theatre	Laboratory or operating theatre	Special equipment and conditions in at least 30% of floor areas	Either weekday or 24-hour multi-shift	Spaces requiring controlled ventilation and conditions	Heating, lighting, ventilation		Furnace or forming plant	Research chemical laboratory, hospital operating theatre
Public waiting or circulation	Bus or train station, shopping centre mall	Public circulation or waiting facilities	Variable – intermittent to continuous	Waiting and circulation areas, booking desks, boarding facilities	Heating, lighting, cooling, snack services	Retail		Bus stations, local train stations, shopping centre malls
Terminal	Regional transport terminal with concourse	Waiting and boarding facilities for air, ship or regional/international train travel	Daytime and evenings each day to near continuous	Concourse areas, booking areas, identification, customs, security and baggage handling	Heating, lighting, cooling, baggage handling	Retail, restaurant, covered car park		Large train stations, airport terminals
Workshop	Workshop or open working area (not office)	Facilities for light mechanical work	Generally working week but can be multi-shift	Goods access, mechanical tools and facilities	Industrial heating and lighting standards		Furnace or forming plant	Workshops, vehicle repair
Storage facility	Storage warehouse or depot	Storage and goods handling areas	Continuous storage with weekday or multi-	Lightly serviced long-term storage areas	Low-level lighting and heating in storage areas			Distribution warehouse without public areas, and local authority depot

			shift goods handling					
Cold storage	Refrigerated warehouse	Refrigerated storage and goods handling areas	Continuous storage with weekday or multi-shift goods handling	Refrigerated long-term storage areas	Refrigeration, lighting and heating of handling areas		Blast chilling or freezing plant	Refrigerated warehouse without public areas

Source: CIBSE TM46 2008 http://www.cibse.org/knowledge/cibse-tm/tm46-energy-benchmarks

Department of Energy & Climate Change
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www.gov.uk/decc
URN 14D/435

The Highland Council WestPlan District Heating Opportunities Assessment

Annex B

MIR_Ref	Site Area (Ha)	MIR Use	MIR Pref	SDA	PP Use	Site Name	Developable area (% of site)	Density (Houses per Ha)	Indicative Housing Capacity	Indicative Housing Heat Demand	10%	-10%	Additional Demand	Notes
PTH1	0.3	Housing	Preferred	Portree	Housing	North End of Home Farm Road	100%		11.0	126500	139150	113850		
PTH2	2.5	Housing	Preferred	Portree	Housing	North of Storr Road	90%	20	45.0	518014.0808	569815.489	466212.673		
PTH3	6.2	Housing	Preferred	Portree	Housing	Kiltaraglen	30%	15	27.9	321209.8846	353330.873	289088.896		
PTH5	0.1	Housing	Preferred	Portree	Housing	York Drive (East)	100%	35	4.5	51450.65111	56595.7162	46305.586		
PTM2	10.9	Mixed Use	Preferred	Portree	Mixed Use (Housing, Community, Business, Tourism)	West of College, Struan Road	25%	7	19.1	220081.1187	242089.231	198073.007		
PTM3	1.3	Mixed Use	Preferred	Portree	Mixed Use (Housing, Community, Business, Tourism, Retail)	Woollen Mill and Adjoining Ground	30%	25	9.7	111274.2043	122401.625	100146.784		
PTM4	0.7	Mixed Use	Preferred	Portree	Mixed Use (Housing, Community, Business, Tourism)	MacRae's Garage and Adjoining Ground	90%	20	12.8	147063.1977	161769.518	132356.878		
PTM6	1.0	Mixed Use	Preferred	Portree	Mixed Use (Housing, Community, Business, Tourism)	Community Centre and Adjoining Ground	75%	40	28.9	332134.6563	365348.122	298921.191		
PTM7	0.1	Mixed Use	Preferred	Portree	Mixed Use (Housing, Community, Business, Tourism)	Court House and Police Station	100%		4.0	46000	50600	41400		
PTM8	2.2	Mixed Use	Preferred	Portree	Mixed Use (Housing, Community, Business, Tourism)	Bayfield	100%		20.0	230000	253000	207000		
PTLT1	31.0	Long Term Development	Preferred	Portree	Housing		40%	10	124.0	1426000	1568600	1283400		
BFH1	1.4	Housing	Preferred	Broadford	Housing	East of Boreraig Place	100%		24.0	276000	303600	248400		
BFH2	3.4	Housing	Preferred	Broadford	Housing (likely to be some higher density affordable housing here)	South of Caberfeidh	90%	15	45.9	527440.086	580184.095	474696.077		
BFM4	1.2	Mixed Use	Preferred	Broadford	Mixed Use (Community, Housing)(existing hospital which is likely to become surplus if new hospital built on BFC1)	Existing Hospital Site	80%	10	9.8	112839.1838	124123.102	101555.265		
BFM5	1.7	Mixed Use	Preferred	Broadford	Mixed Use (Business, Tourism, Community, Retail, Housing)	South of Library	10%	10	1.7	19987.79426	21986.5737	17989.0148		
BFM6	1.1	Mixed Use	Preferred	Broadford	Mixed Use (Business, Tourism, Community, Housing)	Glen Road (North)	50%	10	5.3	61054.68493	67160.1534	54949.2164		
BFM7	0.7	Mixed Use	Preferred	Broadford	Mixed Use (Business, Housing, Retail, Tourism) (potential for live/work units)	North of Village Hall	25%	10	1.9	21390.73215	23529.8054	19251.6589		
BFM8	4.0	Mixed Use	Preferred	Broadford	Mixed Use (Community School, Housing, Business, Tourism) (Intention for new school on this site which would include community facilities)	Glen Road West of School	50%	10	20.0	229701.8056	252671.986	206731.625	254383	New School (254384) based on existing broadford primary
FWH1	14.3	Housing	Preferred	Fort William	Housing	Annat Farm	70%	25 & 10	130.0	1495000	1644500	1345500		
FWH2	1.4	Housing	Preferred	Fort William	Housing	South of Caravan Site	40%	25	15.0	172500	189750	155250		
FWH4	1.5	Housing	Preferred	Fort William	Housing	Former Lochyside RC Primary School	90%	30	40.0	460000	506000	414000		
FWH7	8.7	Housing	Preferred	Fort William	Housing	Lundavra Road	90%	25 & 10	125.0	1437500	1581250	1293750		
FWM1	22.1	Mixed Use	Preferred	Fort William	Mixed Use (housing + new hospital, collage, retail supermarket (consented), retail non-food,gym & community playing fields.) Amended masterplan required.	Blar Mor	25%	25	140.0	1610000	1771000	1449000	2128098	New Hospital (1077196) + College based on west highland college (601833) +Supermarket based on AN AIRD ROAD (449069)
FWM2	4.2	Mixed Use	Preferred	Fort William	Mixed Use (housing or business / hotel)	Carr's Corner	40%	25	40.0	460000	506000	414000		
FWM3	1.4	Mixed Use	Preferred	Fort William	Mixed Use (primary use likely to be housing, possible ground floor retail, office or tourism)	Belford Hospital / RC Primary School	80%	100 & 75	95.0	1092500	1201750	983250		
FWM5	0.5	Mixed Use	Preferred	Fort William	Mixed Use (footfall generating uses at ground floor, office, hotel or housing uses above)	BT Depot / Police Station	80%	75	30.0	345000	379500	310500		
FWM6	0.7	Mixed Use	Preferred	Fort William	Mixed Use (small scale with site including a listed building)	Fort William Primary School	50%	25	10.0	115000	126500	103500		
FWH5	23.2	Housing	Preferred	Fort William	Mixed Use (primary use is housing with potential small scale neighbourhood centre)	Upper Achintore (North)	50%	25	260.0	2990000	3289000	2691000		
FWH6	1.6	Housing	Preferred	Fort William	Mixed Use (housing site on former school site with astro pitch - expensive site to develop)	Former Upper Achintore Primary School	50%	50	40.0	460000	506000	414000		
GLH1	7.1	Housing	Preferred	Gairloch	Housing	North Fasaich	50%	5	17.7	203617.8139	223980	183256		
GLH2	2.3	Housing	Preferred	Gairloch	Housing	East Fasaich	75%	7	12.3	141343.5686	155478	127209		
GLM1	3.773611251	Mixed Use	Preferred	Gairloch	Mixed Use (Housing, Community, and Retail)	Achtercairn	2%	25	1.9	21698.2647	23868	19528		
GLM2	25.1	Mixed Use	Preferred	Gairloch	Mixed Use (Housing, Community, Business/Tourism, Industry, and Retail)	Gairloch Harbour	4%	15	15.1	173244.9595	190569	155920		
GLM3	0.697852333	Mixed Use	Preferred	Gairloch	Mixed Use (Community, Business/Tourism, Retail)	Achtercairn West	6%	20	0.8	9630.362198	10593	8667		
UPH2	2.0	Housing	Preferred	Ullapool	Housing	Former Glenfield Hotel	95%	25	46.7	536569.2636	590226	482912		
UPM1	3.2	Mixed Use	Preferred	Ullapool	Mixed Use (Housing and Business/Tourism)	Woodland Area by Quarry Access	50%	10	16.1	185652.3246	204218	167087		