Local Area Energy Plan

Bridgend County Borough Council

August 2021

Contents

1. The Vision

This refresh to the Local Area Energy Plan (LAEP) aims to support Bridgend to transition to an affordable and decarbonised energy system and to support both the UK's commitment to net zero by 2050 and local commitments to reach this level by 2040.

Decarbonising Bridgend's local energy system by this date is achievable and expected to require capital investment of up to £2.8bn. Total energy costs including capital investments, operations and energy consumed is around £4.5bn to 2038*. The column chart (right) shows the source of emissions in each time period for the primary scenario. The emissions reduce over time as the economy is decarbonised with a residual 23.9ktCO_2 in 2038. The line chart (below right) shows the cumulative emissions** over the period 2021-2038. In both the primary and secondary scenarios, cumulative emissions are around 620-640ktCO_2.

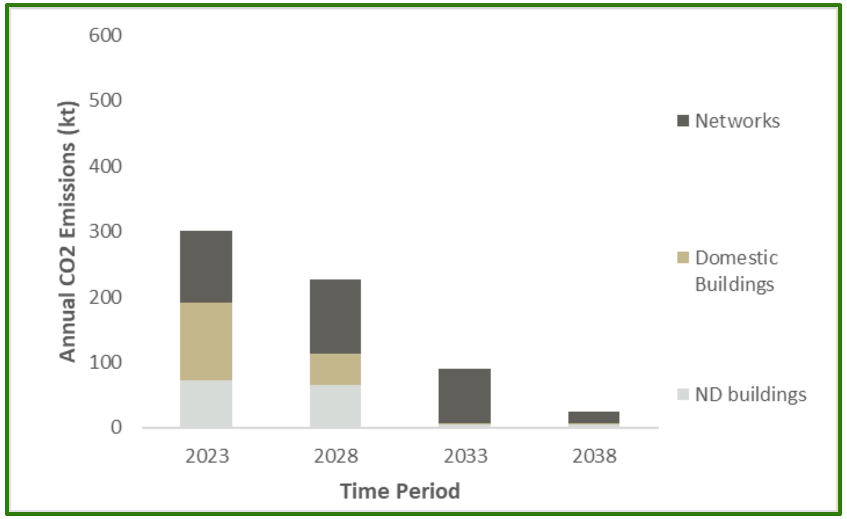
How to Interpret this Vision

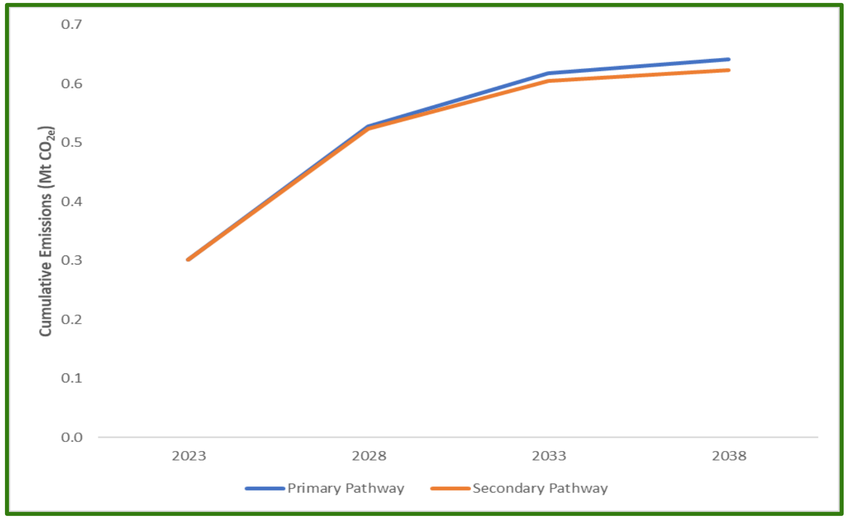
This document must be considered alongside the original Local Area Energy Plan produced by Energy Systems Catapult in 2018. This Refresh serves only to update the modelling to capture significant changes in that original plan including, but not limited to:

- The UK Government Net Zero target of 2050
- The phasing out of fossil fuel vehicle sales by 2030
- Projects scoped within Bridgend where details have been provided by BCBC.

The transition will involve whole-scale infrastructure change across Bridgend over the next two decades. Key sections of this LAEP Refresh illustrate the scale of change and investment needed, based on a primary scenario. An alternative scenario focusing on hydrogen for heat is discussed alongside where appropriate or where there are significant differences to the scenario. Given the importance of backing one view of the future (or scenario) now, this document promotes a demonstration and scale-up approach over the coming short-term, before moving to full-scale implementation. Therefore, this document highlights several 'priority areas' in which to work with citizens and stakeholders to build capacity and test approaches to delivery.

Bridgend CO_2 emissions over time





Fabric Retrofit

Many of Bridgend's dwellings receive insulation retrofit in the plan: 33,800 in the primary scenario and 30,600-33,200 in the hydrogen focused alternative scenario depending upon the cost and availability of hydrogen and level of use. This is an increase compared to the previous LAEP due to the wider use of low temperature heat pumps compared to high temperature.

Heat Decarbonisation

Three heating options are explored to decarbonise buildings: electric heating (primarily heat pumps), hydrogen to replace natural gas, and district heat networks.

In the primary scenario, planned heat networks further encourage district heat network connections in all of Bridgend Town and Maesteg with the remainder of the county moving towards electrification. Hybrid heat pumps rarely feature due to the net zero target. In the secondary scenario, Maesteg and Bridgend Town North & South remain on district heat, Ogmore Vale and Coastal Area remain electrified, however the remainder of the county either looks to transition to hydrogen or is uncertain.

Energy Generation

To reduce emissions local energy generation needs to increase significantly. Current domestic PV deployment is around 20,500m^2 however across the domestic and non-domestic stock around 1.8million m^2 will be required (circa 290MW_p). This means that most suitable, south-facing roofs will have PV installed. This could account for as much as 30% of Bridgend's electricity demand by 2033.

EV Infrastructure

The transition to electric vehicles (EVs) is expected to take place rapidly with all new vehicle sales being plug-in by 2030 and full electric by 2035. Uptake is expected to increase to around 70,000 EVs in 2040 requiring around 49,000 domestic chargepoints supported by multiple public charging stations (or hubs).

* Overall total costs are discounted using standard treasury green book assumptions. Annual costs are undiscounted.
** In-scope emissions are those resulting from domestic, industrial and commercial consumption of electricity, gas & other fuels, electric vehicle charging and process emissions from large industrial installations. Out-of-scope are emissions from agriculture and existing liquid fuels for transportation.

2. Introduction

Context

Bridgend County Borough Council (BCBC) is committed to net zero carbon emissions across the borough by 2040 and becoming a Net Zero Council by 2030. Recognising the climate emergency declared by the Welsh Government in 2019, national Net Zero* commitments and the need to translate the strategic vision to an implementable plan of action, BCBC is refreshing its Local Area Energy Plan.

Energy Systems Catapult developed the concept of Local Area Energy Planning (LAEP) as a mechanism of applying a whole system approach to the planning and design of Net Zero Local Energy Systems. BCBC was one of the first Local Authorities in the country to pilot a data-driven whole system approach to energy planning, working with Energy Systems Catapult, Welsh Government, Western Power Distribution and Wales and West Utilities. Since this initial pilot, BCBC has developed a Smart Energy Plan (2019) and has committed to achieving carbon neutrality of its own activities by 2030.

Alongside this, there have been significant updates to ESC's supporting whole system modelling approach, including updating technology attributes and costs, building data and network data, changes in EV uptake projections and more detail in options for decarbonising non-domestic buildings. The most significant update has been the addition of options to repurpose the gas network for hydrogen, as an option that in certain scenarios can be used to decarbonise heat demand in domestic and non-domestic buildings. This is key as achieving the net zero target will require the transition of Bridgend's heating systems from natural gas fired boilers to a variety of heating systems including electrified heating systems and district heating networks or converting the gas network to hydrogen.

Modelling Approach

We have used the ESC-developed EnergyPath Networks tool to produce a series of future local energy scenarios for Bridgend. This tool seeks to develop a number of decarbonisation options for the local area and then uses an optimisation approach to identify the combination that best meets the carbon ambitions in a cost-effective way across the whole system. For the impact of the energy system outside the boundaries of Bridgend on the local system, the national Energy System Modelling Environment (ESME) – an internationally peer-reviewed national whole energy system model – has been used to identify the lowest-cost decarbonisation pathways for the UK energy system to then feed into the local modelling.

These scenarios have been used to inform the development of a primary pathway that illustrates a potential cost-effective vision for carbon neutrality in Bridgend. This pathway explores the actions and investments needed in different areas of Bridgend between now and 2040 to reduce its emissions in line with its net zero ambitions. The scope of emissions in this plan covers those resulting from domestic, industrial and commercial consumption of electricity, gas & other fuels, electric vehicle charging, and some process emissions from large industrial installations (emissions from the Rockwool plant have not been included). Out-of-scope are emissions from agriculture and existing liquid fuels for transportation.

It should be noted that techno-economic optimisations (i.e. the scenarios that have been considered and modelled) are imperfect. Many low carbon solutions have benefits and drawbacks that cannot be easily represented in modelling approaches. This appreciation has been used to shape this refreshed LAEP; however, as the LAEP is implemented, it is likely that further updates will be required to reflect changing situations and new insights.

Scenarios for achieving net zero in Bridgend

These scenarios explore uncertainties, considering implications of different choices and behaviours by policy makers, businesses and individuals, the development and take up of technologies and the balance between different options where they exist. Within the scenarios, the key technologies that are likely to be important in cost effective local system designs have been considered, as well as some that are more expensive but may have popular support. Technologies that consistently appear across a broad range of scenarios and are resilient to sensitivity analysis warrant prioritisation in preparing for transition; this approach has led to the identification of the priority and pioneer areas within this LAEP.

Two scenarios have been created for the purpose of this LAEP Refresh: a primary (cost-effective) scenario and a secondary (hydrogen) scenario.

The primary scenario makes assumptions around changes to behaviour and advances in technology and innovation whilst recognising uncertainty in key areas such as the potential use of hydrogen for transport and heating in homes and buildings, as well as advances in energy storage and controls. While it is not a prescriptive plan to be followed exactly, it does provide a detailed spatial evidence base and supporting data that can be used to inform the planning and coordination of activity in Bridgend over the coming years. Even if hydrogen for building heating does become available, it is expected that all the components within the primary pathway (heat pumps, district heating, solar PV, EV charging, building fabric retrofit and flexibility and storage systems) will still be needed to decarbonise Bridgend; any uncertainty is generally around the scale of deployment. Therefore, it is deemed low risk to demonstrate how to deploy these components and prepare for significant scale-up.

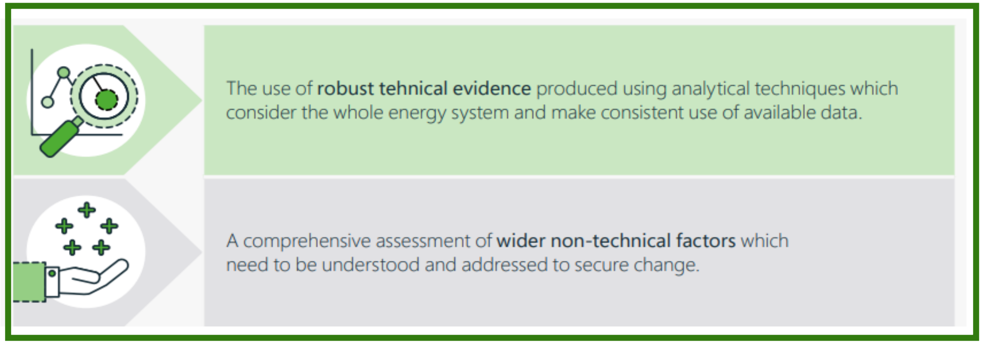
The secondary scenario introduces hydrogen to see the effect of this vector being available while accounting for the uncertainty around the likely cost and availability of 'green' (zero carbon) hydrogen.

These scenarios seek to identify the costs, benefits, uncertainties, opportunities and risks to decarbonisation by 2040. This LAEP Refresh has also considered strategically important projects which were highlighted to us prior to the start of the modelling.

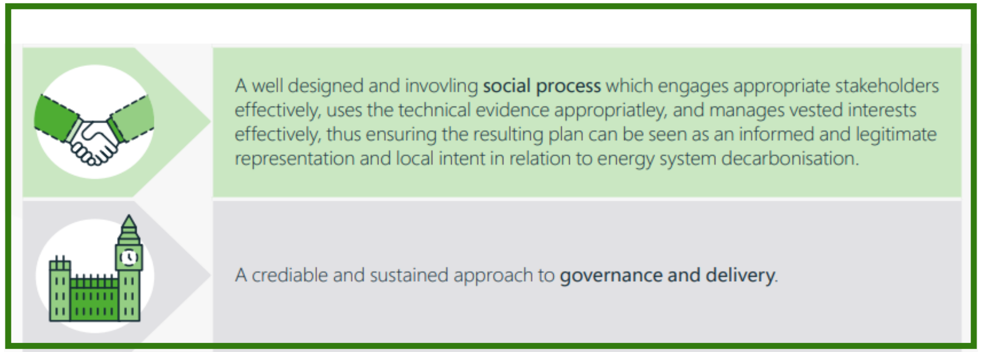
* Climate Change Act 2008 (2050 Target Amendment) Order 2019

2. Introduction

In accordance with the Ofgem LAEP Method*, which provides guidance and a framework for LAEP 'done well' - this plan has been developed through the use of robust technical evidence which considers the whole energy system for Bridgend and consistent use of available data and assumptions. It has also sought to consider wider non-technical factors that influence the deliverability, pace and scale of change required for decarbonisation.



The next steps of the development of the plan are expected to comprise wider stakeholder and public consultation on the plan to inform its further development and its ongoing governance and delivery.



Report Structure

The report is set out in the following structure, it summarises the key aspects of the plan that have changed significantly compared to the original LAEP.

Section 1: Set out the vision and some of the key findings from the primary (cost-effective) pathway to net zero for Bridgend.

Section 2: High-level introduction to the report, the context and the approach taken to modelling, and developing the scenarios.

Section 3: Sets out the some of the key aspects of the primary scenario with regards to the low carbon heating systems, how these compare to the previous LAEP and the secondary (hydrogen) scenario.

Section 4: Sets out the some of the key aspects of the primary scenario with regards to the retrofitting of domestic dwellings and where 'basic' and 'deep' retrofits are required in order to reduce demand.

Section 5: Highlights the priority area for the decarbonisation of non-domestic buildings and the low carbon technologies that could be deployed.

Section 6: Sets out the assumptions for the transition from internal combustion vehicles to EVs and the number of domestic chargepoints that will be required to sustain the growth.

Section 7: Shows the results of the modelling of the electricity and gas networks over time and the potential constraints and demand changes due to the transition towards electricfication of heat and transport, and in a hydrogen scenario.

Section 8: Sets out the estimated system costs and investment needed for implementation of the primary plan. This includes definition of the total system costs across each zone of Bridgend.

Section 9: Summarises the key findings and recommended actions to support implementation.

* From LAEP: The method https://es.catapult.org.uk/reports/local-area-energy-planning-the-method/

4. Heating System Zones

Vision to 2040

Building characteristics inform the low carbon heating system best suited to each building, and this causes patterns to emerge between the zones across Bridgend. Also of considerations is the density or buildings, both domestic and non-domestic. Heat networks are a more viable solution in zones with a higher density of buildings, such as towns and cities, and individual building solutions are more suitable in rural areas.

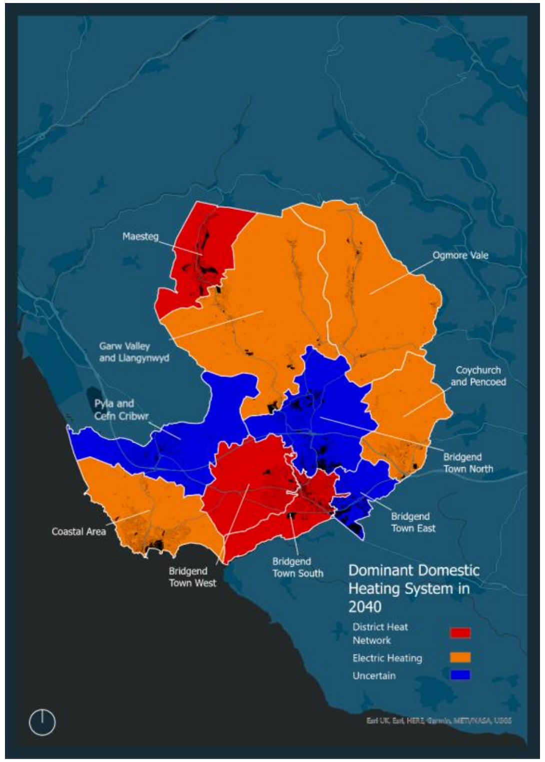
In the original LAEP, electric heating (four orange zones) and district heat networks (three red zones) were the most prevalent technologies, with the three remaining zones not having a prevalent heating technology (coloured blue), instead having a combination of approaches to decarbonisation.

In the refreshed LAEP, the primary pathway is forecast twice, once with and once without hydrogen as a fuel for boilers (due to the uncertainty of the future cost and availability of hydrogen). In the scenario without hydrogen, five zones have electric heating as the prevalent heating technology, with the remaining five on district heat networks. The heat networks developed first may initially be powered with gas boilers, but at the end of their life the expectation is that they will be replaced with large scale heat pumps. The three areas that were previously shown as being uncertain and adopting a combination of technologies, all now have a single prevalent heating technology identified.

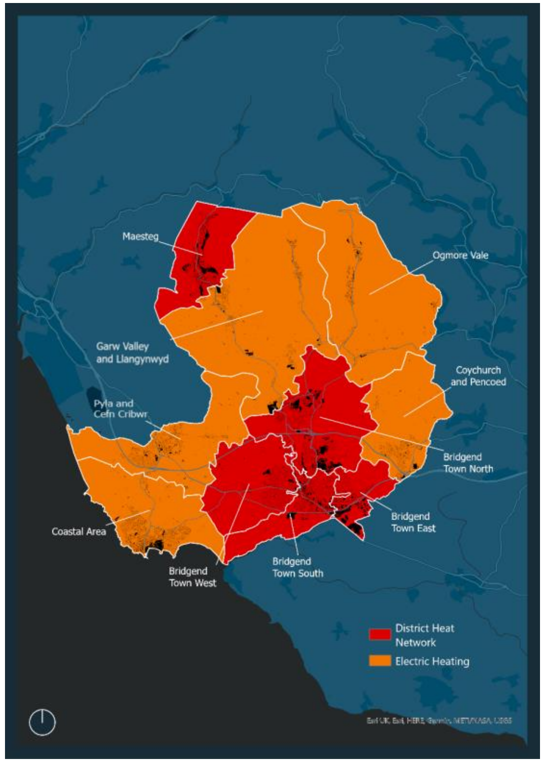
In the scenario with hydrogen, the picture is much more varied. In six zones, individual building heating solutions are prevalent, with electric heating technologies prevalent in two zones (orange), hydrogen boilers prevalent in three zones (purple), and a zone where both technologies will be prevalent (blue). Three of the remaining zones are heat networks (red); the remaining zone being a combination of heat networks and individual hydrogen boilers (pink). The availability and price of hydrogen will determine the number of properties that connect to the heat network in the pink zone, and the fuel used for district heating systems in the red zones. In the red zones, the expectation is that initially the district heating systems will be powered by large scale heat pumps; as these come to the end of their life, and hydrogen is more readily available, they may then switch to hydrogen boilers.

Across the scenarios and zones, the type of heat pump deployed in the heat networks will need further and more detailed analysis. It could be that in specific instances water source (using the River Ogmore, or mine water), air source, or ground source heat pumps could be the most suitable

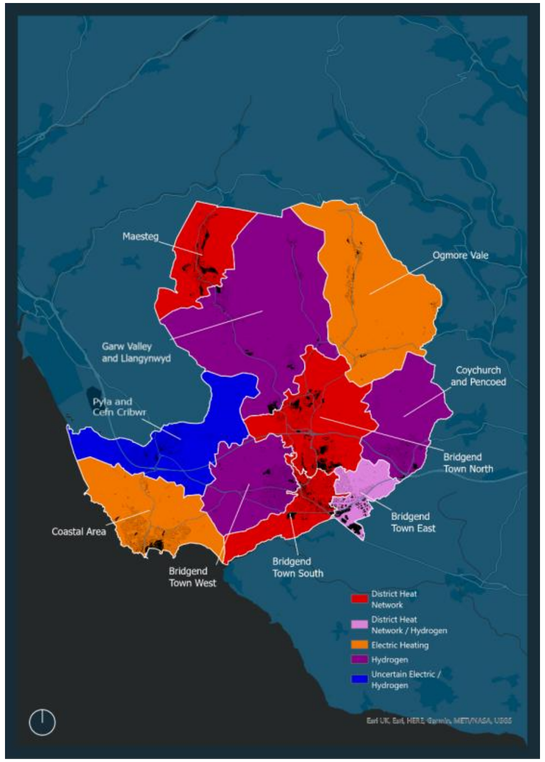
Heating zones in original LAEP



Heating zones in LAEP refresh Primary pathway – without hydrogen



Heating zones in LAEP refresh Primary pathway – with hydrogen



Air source heat pumps are typically more viable options than ground source as they have lower installation costs, and are easier installed with less of a regulatory or technical burden than river or mine water heat pumps.

Given the uncertainty surrounding hydrogen, least-regret effort in the near term is focussed on fabric retrofit, priority electrification areas, and monitoring the development of hydrogen (at national and regional levels). The installation of hydrogen-ready boilers could provide optionality given the uncertainty, at minimal additional cost.

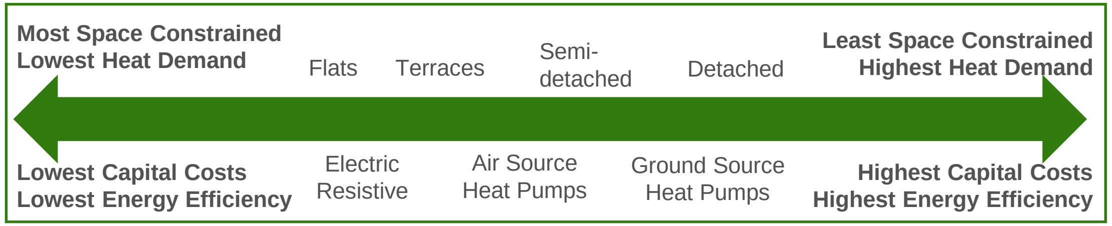
These forecasts are not definitive and represent a view of the future for each zone, to illustrate the scale of change required, it is expected that alternative solutions will be specified when exploring at a more detailed level, for example, there may be opportunities for communal / shared heating systems over the use of individual heat pumps.

4. Heating System Zones

Heating System Selection

The diagram on the right shows how heating systems are selected for different domestic building types, considering characteristics such as space availability, heat demand, costs and energy efficiency.

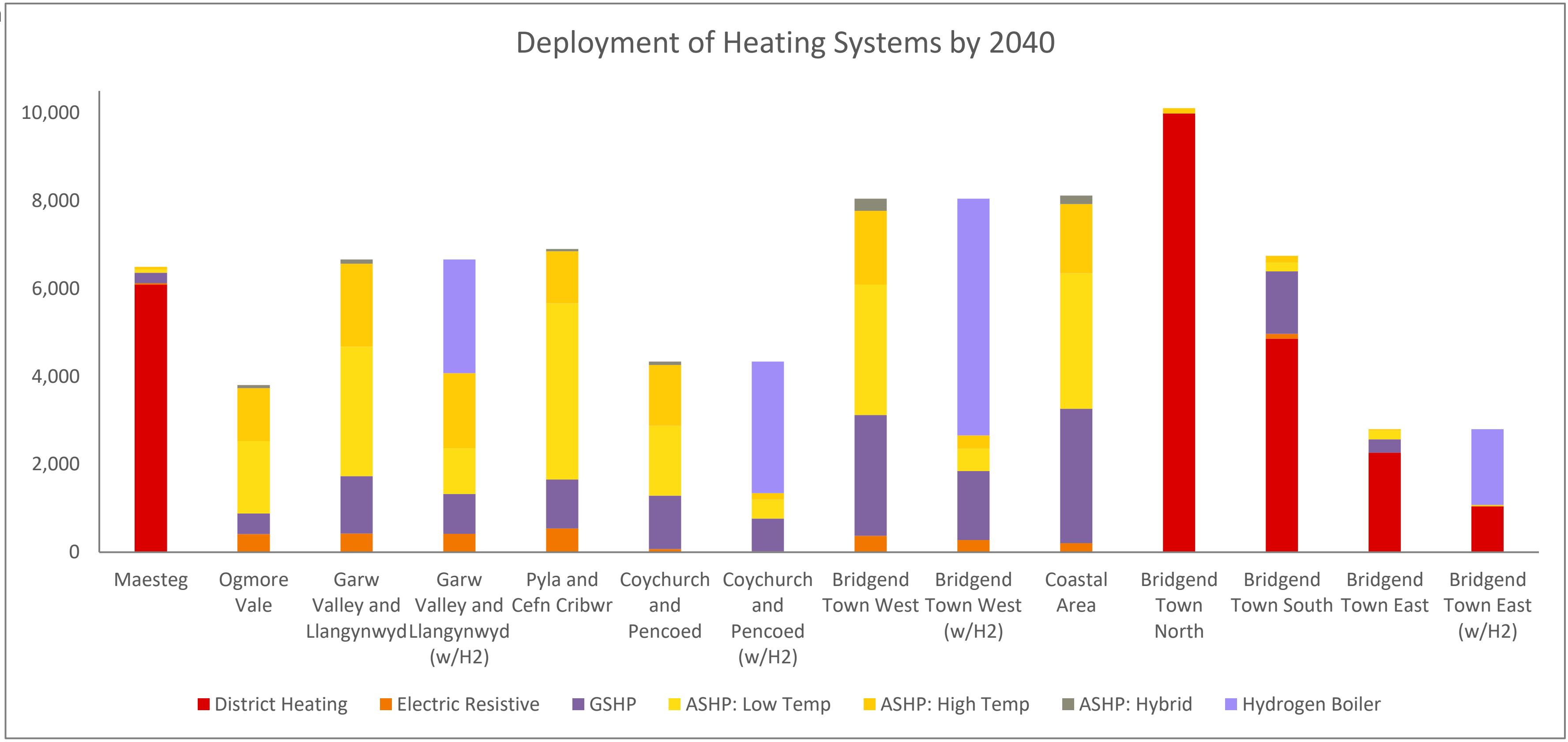
The chart below right shows the breakdown of heating technologies in each of the zones on a building-by-building basis, providing additional detail from the maps that showed prevalence on the previous slide. Four zones are included twice, one to show the breakdown without hydrogen boilers, and again to show the breakdown with hydrogen boilers.



Air source heat pumps are the most widely suited technology, though a proportion of buildings in most areas was found to be suitable for ground source heat pumps, where greater outdoor space permits the installation of a ground collector, and larger properties can justify the higher upfront cost with greater savings in running costs. These properties could also be suitable for air source if preferred. Electric resistive (conventional heaters) can be used in space-constrained buildings with low heat loads, such as modern flats.

Heat pumps are a proven and mature renewable heating technology, capable of delivering deep emissions reductions today. They can be rolled out to individual households gradually, without the requirement for large scale area transitions and buy-in from multiple households that district heating and hydrogen require. Some disruption within the home is typically required for radiator replacements and the installation of a hot water cylinder in homes which do not have one already. These indoor space requirements, together with the need to manage disruption to the household and site an outdoor unit where it will not cause noise issues for neighbouring properties, must be considered in the design, and can make heat pumps unsuitable for some properties.

Heat pumps perform best in homes with good levels of insulation; so, building fabric retrofit should be considered alongside heat pump installations. This would minimise disruption to dwelling occupants and potentially reduce overall cost due to a reduced heat demand and therefore capacity of required heat pumps and reduced need to increase radiator sizing.



4. Heating System Zones

First Steps: Priority Areas

Certain zones within Bridgend have been highlighted as having a large number of buildings well-suited to a particular heating technology, independent of pathways. Early progress can be made in deploying systems in these zones, with low risk of regret even before the UK's heat strategy becomes more certain. Prioritising these zones for early deployment as existing heating systems approach end-of-life (while avoiding the distress replacement of a failed system, which can constrain options) can help establish supply chains, delivery approach and capacity. This strikes a balance between flexibility and early progress, leaving the plan open to developments around the future of the gas network, conversion to hydrogen and UK heat strategy, ahead of a mass programme of transition in places where the best option is currently less clear.

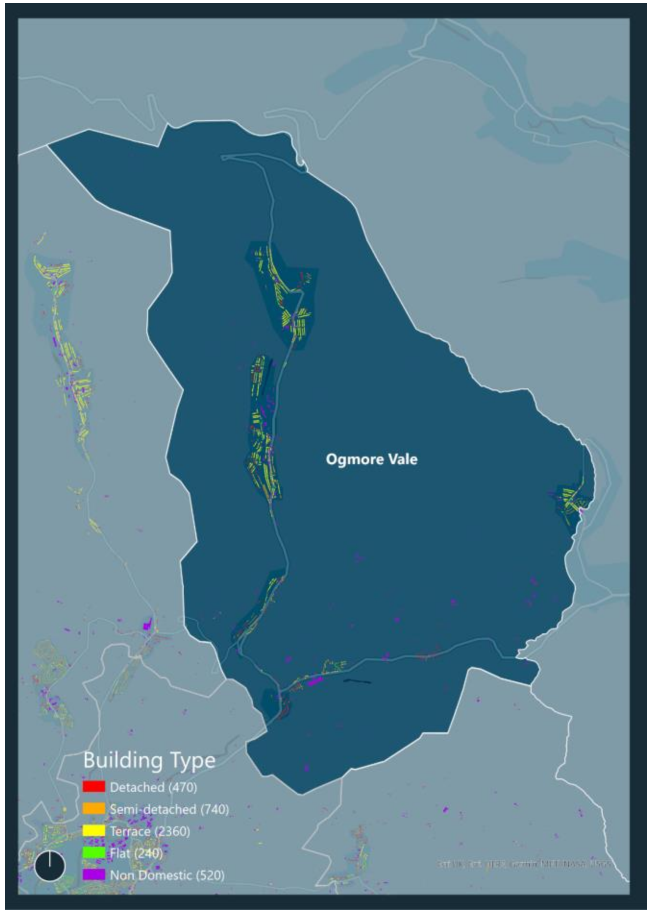
The maps here and on the following pages illustrate suggested priority areas for demonstration and scale-up activity. Consideration will be needed to develop a programme of works that aligns with other interventions to maximise delivery efficiency and minimise disruption to residents.

Heat Pumps

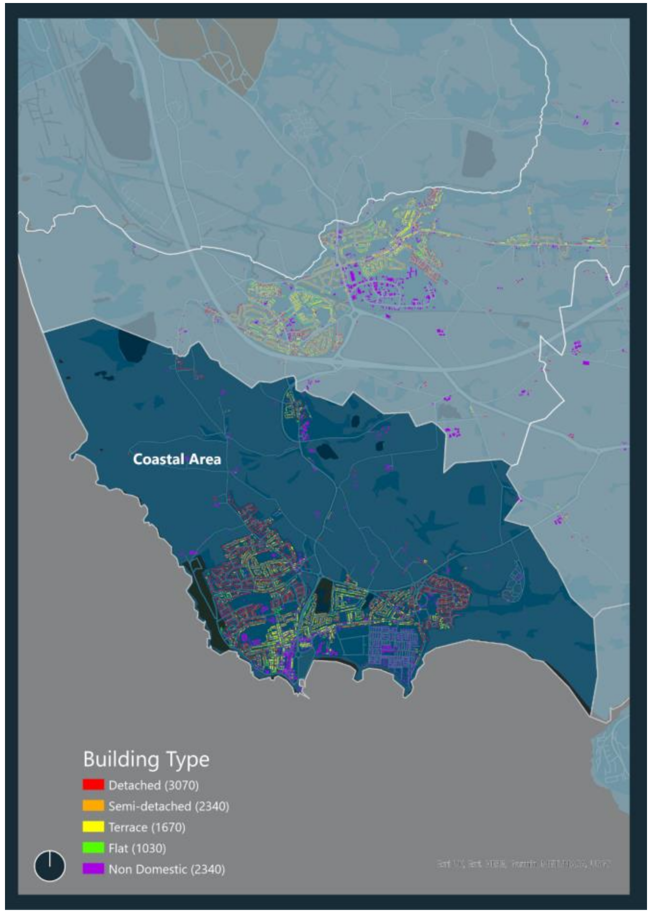
Heating Zones – Ogmore Vale and Coastal Area

In these two zones, being more rural with more dispersed housing, a mix of individual electric heating technologies is proposed in all scenarios. In Ogmore Vale, nearly all domestic buildings are best suited to either low or high temperature air source heat pumps, with a small proportion suitable for a ground source heat pump. In the Coastal Area, a much greater proportion of dwellings are suited to ground source heat pumps, with the remainder again split between low or high temperature air source heat pumps.

Heating Zone – Ogmore Vale



Heating Zone – Coastal Area



4. Heating System Zones

District Heat Networks

Heat supplied through underground pipes from a centralised energy centre tends to be most suitable for denser urban areas, particularly where there are large numbers of dwellings where it is either too expensive or to make suitable for heat pumps impractical (e.g. due to space limitations).

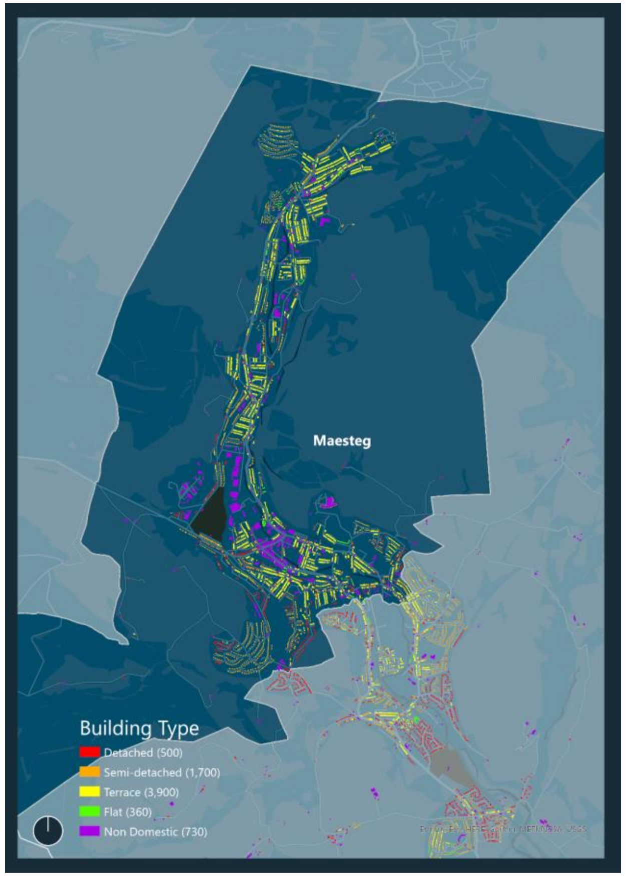
Heat networks can have the advantage of causing less disruption in dwellings during installation compared to some other options, though there are wider considerations such as disruption to roads during pipe laying.

Three zones of lowest regret* for district heating have been identified for Bridgend. These are all additions to existing plans for heat networks in these areas.

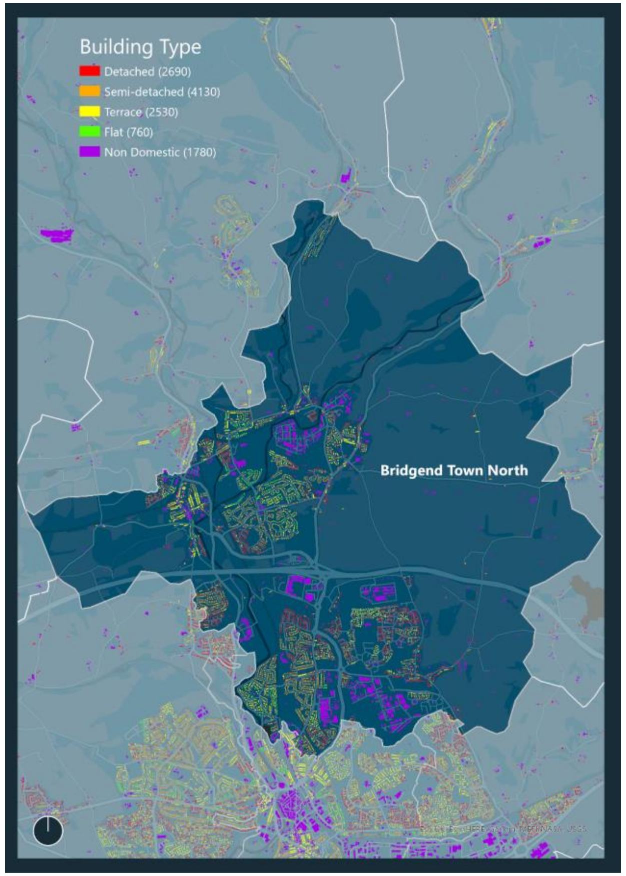
Heating Zones – Maesteg, Bridgend Town North and South.

Planned heat networks in Maesteg and Bridgend mean that a high proportion of domestic dwellings in three zones - Maesteg, Bridgend Town North and South - are best suited to connecting to these heat networks in both scenarios in this refresh. In Maesteg and Bridgend Town North, the proportion suitable is very high, whereas in Bridgend Town South the proportion is lower, with the remaining dwellings best suited to heat pump solutions.

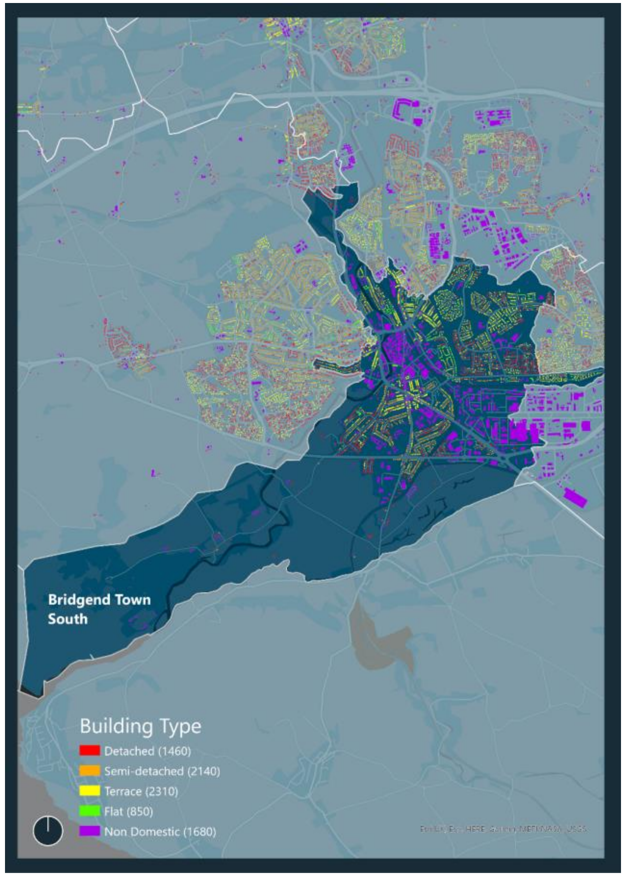
Heating Zone – Maesteg



Heating Zone – Bridgend Town North



Heating Zone – Bridgend Town South



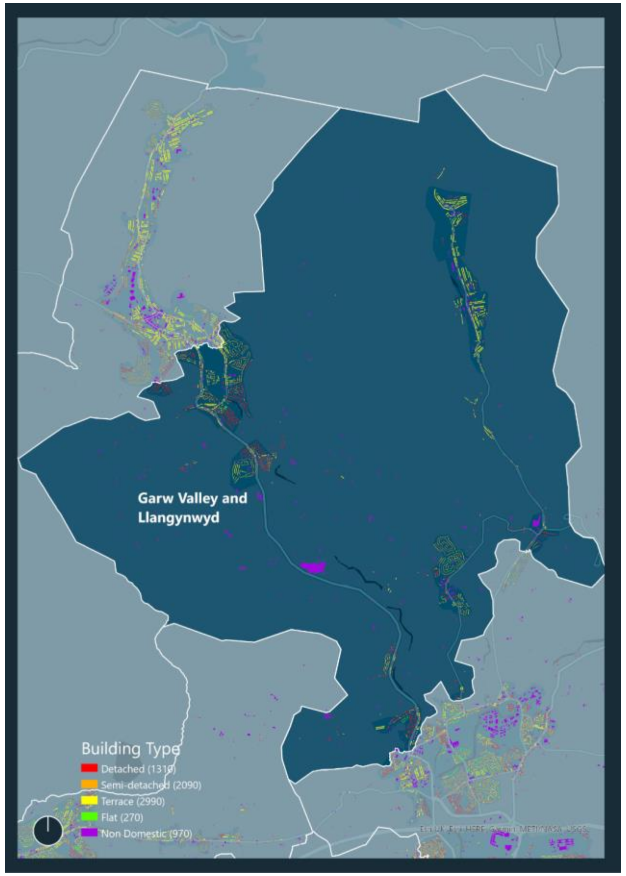
* These ‘low regret’ areas highlight where it has been identified that district heating could provide the most cost-effective dwelling heat decarbonisation system. They should be regarded as initial opportunity areas for further consideration, where more detailed feasibility assessment would be required, as would be the case with any heat decarbonisation option

4. Heating System Zones

Hydrogen for Heating

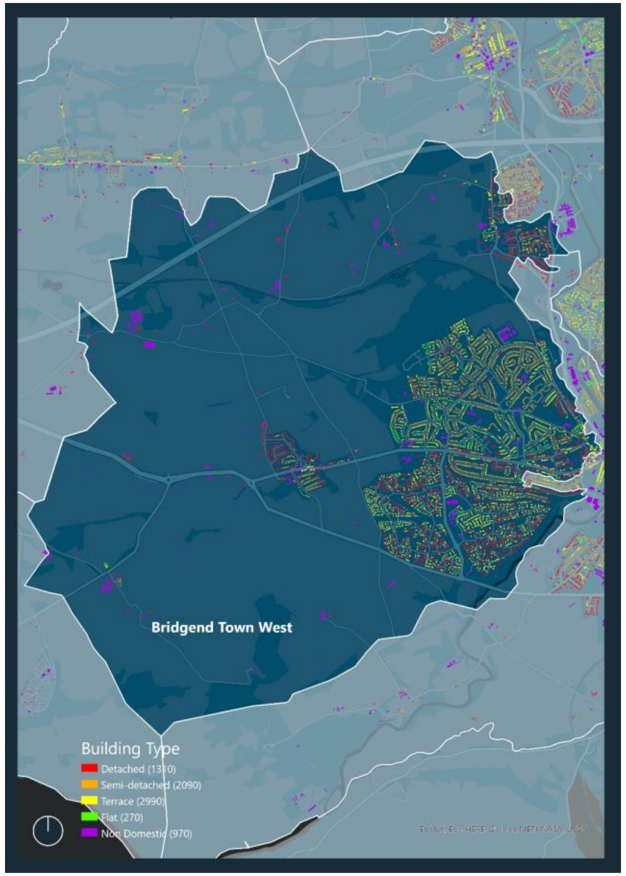
The second scenario proposed in this refresh considers re-purposing of the gas grid for hydrogen. In this scenario, three zones have hydrogen boilers as their most prevalent heating technology type. A fourth zone, Bridgend Town East may have hydrogen boilers, depending on the future cost and availability of hydrogen.

Heating Zone – Garw Valley and Llangynwyd



Heating Zone – Coychurch and Pencoed

Heating Zone – Bridgend Town West

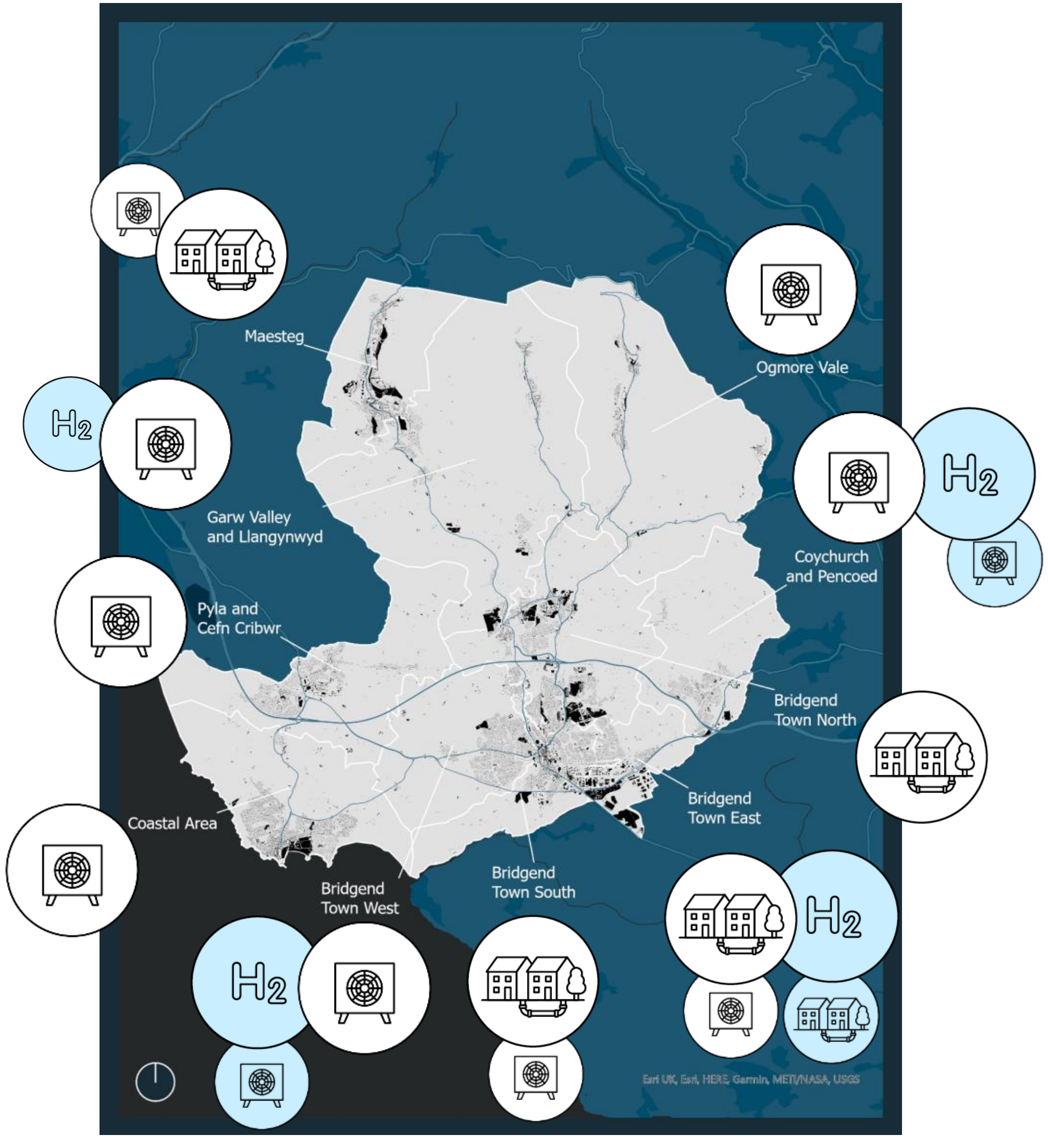


4. Heating System Zones - Summary

Zone	District Heat	Electric Heat	Hydrogen
Maesteg	Majority	Secondary	None
Ogmore Vale	None	Majority	None
Garw Valley and Llangynwyd	None	Majority	N/A
Garw Valley and Llangynwyd (w/H_2)	None	Majority	Secondary
Pyla and Cefn Cribwr	None	Majority	None
Coychurch and Pencoed	None	Majority	N/A
Coychurch and Pencoed (w/H_2)	None	Secondary	Majority
Bridgend Town West	None	Majority	N/A
Bridgend Town West (w/H_2)	None	Secondary	Majority
Coastal Area	None	Majority	None
Bridgend Town North	Majority	None	None
Bridgend Town South	Majority	Secondary	None
Bridgend Town East	Majority	Secondary	N/A
Bridgend Town East (w/H_2)	Secondary	None	Majority

Heat Pump Primary Scenario
District Heat Network Primary Scenario
Heat Pump Secondary Scenario
District Heat Network Secondary Scenario
H_2 Hydrogen Network Secondary Scenario

Summary of Heat Zone Focus Areas



3. Fabric Retrofit Zones

High-Level Overview

A high level of fabric retrofit will be needed across existing dwellings in Bridgend, with over half (53%; 33,700) requiring some level of retrofit. This is true even in areas where there is less certainty on the choice of future low carbon heating systems. Early focus and investment in fabric retrofit would be a low regret step in these areas.

Dwellings consistently identified as requiring a basic level of retrofit were the larger buildings: detached and semi-detached. Indeed, 73% (11,500) of detached dwellings will require a basic level of retrofit (e.g. cavity wall insulation and/or loft insulation) and 53% (11,900) of semi-detached. Around 8,900 of the semi-detached dwellings currently are without cavity wall insulation, and 5,200 of those also require a top-up of loft insulation (i.e. currently have <200mm).

Terraced dwellings are less likely to require a basic level of retrofit (24%; 5,100) but are the most likely to need a deep level of retrofit. 21% (1,400) of end-terrace and 10% (1,500) of mid-terrace dwellings will need investment in deep retrofit. This compares to around 8.5% (1,900) of semi-detached dwellings. Of the dwellings requiring deep retrofit, 4,200 of them currently have uninsulated solid walls.

Age of the dwelling is a reasonable indicator to both the percentage of that stock requiring retrofit and the level to which it needs to be undertaken. 65-70% of dwellings built in the last 100 years will require basic retrofit. However, 20% of those built prior to 1914 require deep retrofit compared to 0-3% of those built post-1914.

Fabric Retrofit Approach

Retrofit measures should be tailored for the individual dwelling, taking account of its type, age, construction, existing insulation and likely future heating system. For example, cavity wall insulation will only be applicable to dwellings that have suitable cavities (usually post-1920 properties) that are not already filled. Narrow cavities, common in interwar houses, are likely to be unfilled, having been considered "hard to treat" during previous rounds of cavity treatment.

The retrofit zones identified on the following pages are designed to allow the coordinated targeting of interventions across Bridgend in such a way that supports and aligns with the wider local energy system transformation.

There is uncertainty in the specific measures needed and most suitable for individual homes as exact details of the existing fabric efficiency of any given dwelling are not known. Survey work will be needed before any works are undertaken.

The proposed approach centres on ensuring basic fabric retrofit measures are implemented in the vast majority of suitable homes in Bridgend, which is found to be the most cost-effective approach for the whole system. The deployment of more advanced measures is much more limited due to the additional cost and disruption to install but may prove more cost-effective on an individual house basis as part of a package of wider measures.

Typical measures included in the modelling approach used for this LAEP 'basic' and ‘deep' retrofit packages are shown in the graphic.

Supporting Low Carbon Heat

The improvement of building insulation supports the roll out of low carbon heat in several ways. By reducing the heat demand, less powerful heating systems can be installed, reducing capital costs. The reduced demand for heat will also compensate for a shift to a more expensive energy source (gas to electricity). Finally, reduced heat losses enable heat pumps and district heat networks to run at lower temperatures, improving their efficiency and running costs, and may also reduce the need for radiator upgrades in homes. It therefore makes sense to carry out retrofit either before or at the same time as heating system replacements to capture these benefits. Carrying out both activities at the same time would minimise the number of disruptions experienced by households, while insulating earlier would provide further emissions reductions compared to the modelled pathway.

Basic

- Cavity wall insulation
- Loft insulation

Deep

- Basic +
- External/internal wall insulation
- Triple glazing

3. Fabric Retrofit Zones

Deployment

The distribution of the dwellings in Bridgend expected to need ’deep’ retrofit measures by dwelling type is shown below. Combined with those requiring ‘basic’ retrofit, around half of the 64,000 dwellings in Bridgend will require measures to be installed by 2040.

Rapid deployment of retrofit measures could be a relatively easy intervention in the near term. The rate of deployment that is possible will depend on the development of a supply chain and business models; developing this in the next few years could allow for higher deployment rates in the medium-term to support progress with decarbonisation where there may not yet be clarity on heating systems across all parts of Bridgend. However, deployment of measures should not be considered in isolation: integration with other components (such as heating system changes and PV installation) can help minimise disruption and offer cost savings, and so opportunities to develop cost-effective whole-house approaches will need to be considered during the development of any activity.

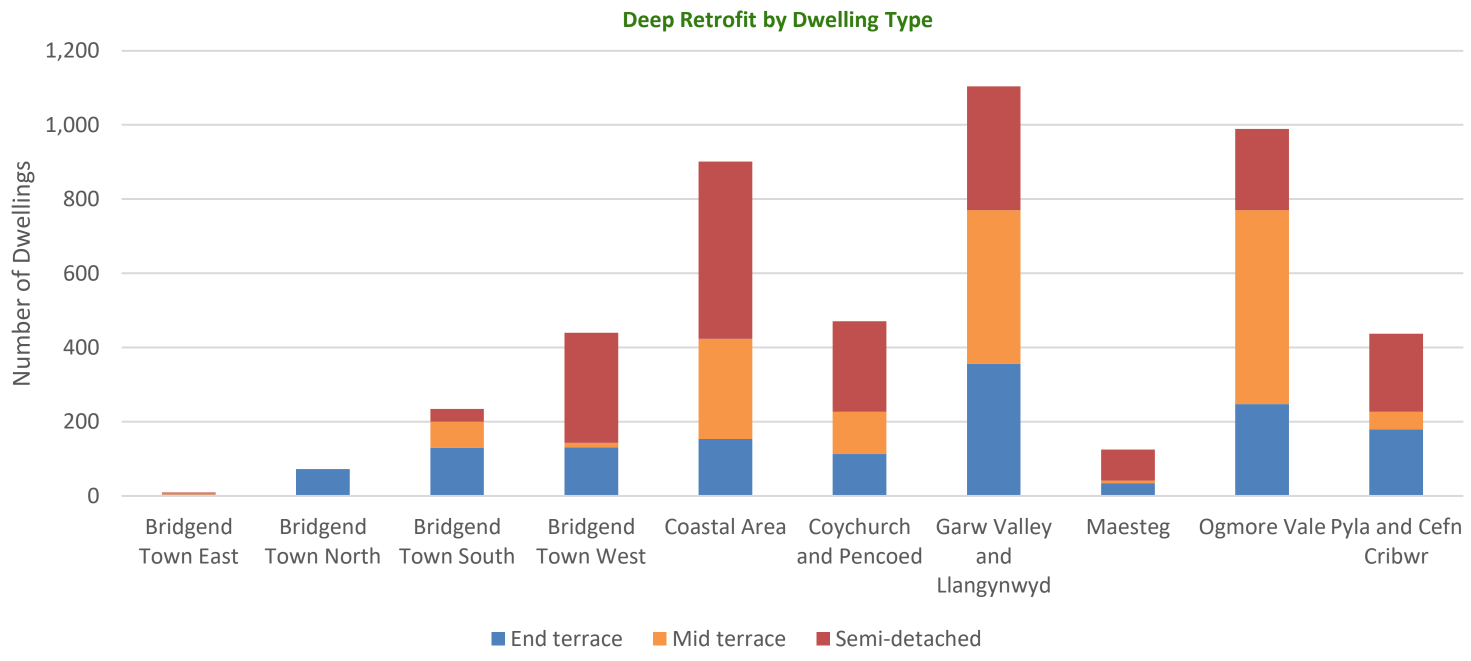
Deeper Retrofit

The approach described is based on finding the most cost-effective route for decarbonising Bridgend overall.

However, there may be strong reasons for additional retrofit work and so deeper and more extensive retrofit for individual dwellings is expected, with the potential to bring a number of benefits:

- Increased comfort and reduced running costs for individual households. This could also be important for some households to reduce fuel poverty and improve health and general quality of life
- Potential to reduce energy consumption and associated carbon emissions across Bridgend more quickly.

Carrying out basic measures in earlier years would not preclude deeper measures being installed in dwellings in later years, and so basic measures such as loft and cavity wall insulation are low regret across all scenarios and heating system selections.



3. Fabric Retrofit Zones

Priority Areas

Whilst large numbers of dwellings will need to be retrofitted, to improve energy efficiency, across all areas of Bridgend, a number of potential fabric retrofit zones have been identified. These have been selected as high levels of energy efficiency improvements are very likely to be required.

The purpose of providing these priority zones is to highlight areas where demonstration and scale-up could be prioritised over the near-term (<5 years)*.

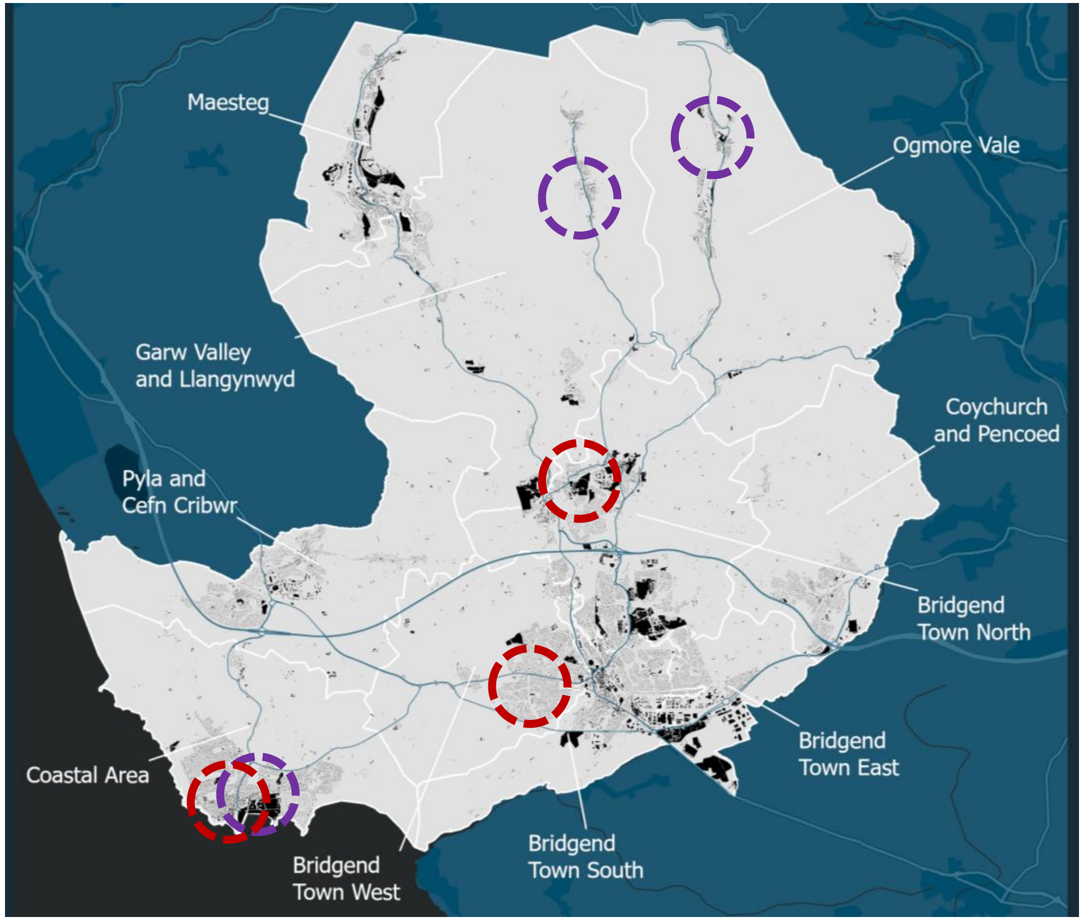
These have been split to provide 3 priority retrofit areas where 'basic' retrofit is required (i.e. loft and cavity wall insulation) and 3 priority retrofit areas where 'deep' retrofit is required (i.e. internal or external wall insulation and triple glazing in addition to the basic retrofit measures).

On the map (right) the 'basic' retrofit priority areas have been circled in red and are within the following zones:

- **Basic Retrofit Zone 1 – Bridgend Town West**
- **Basic Retrofit Zone 2 – Coastal Area**
- **Basic Retrofit Zone 3 – Bridgend Town North**

The detached and semi-detached dwellings in these three areas alone account for 38% of all basic retrofits that need to be undertaken in Bridgend.

Priority Retrofit Zones in Bridgend



A further three priority retrofit areas where 'deep' retrofit is required (i.e. external/internal wall insulation and triple glazing in addition to the basic measures) have been defined:

- **Deep Retrofit Zone 1 – Garw Valley & Llangynwyd**
- **Deep Retrofit Zone 2 – Ogmore Vale**
- **Deep Retrofit Zone 3 – Coastal Area**

These areas are circled in purple in the map (left).

The dwellings that were constructed prior to 1914 in these three areas alone account for two-thirds of all deep retrofits that need to be undertaken in Bridgend.

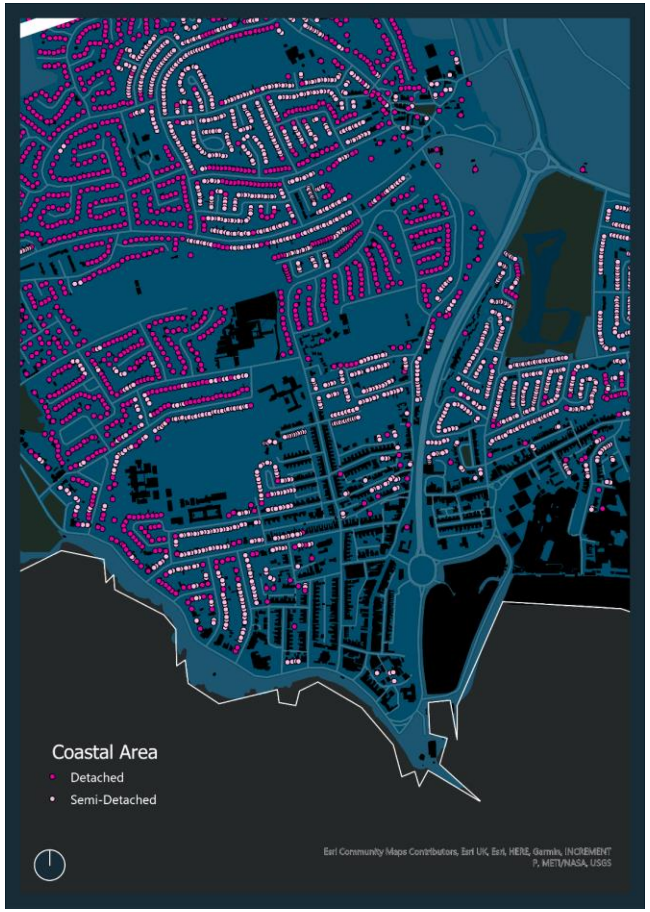
Conversely, Bridgend Town East and Bridgend Town North are less likely to be an immediate focus for retrofit, as they have the lowest overall levels of deep retrofit required, both having under 1% of the stock requiring this level of treatment. Equally, Ogmore Vale has the lowest proportion of the housing stock requiring basic retrofit at under 19%.

Whether or not a priority area based retrofit approach is pursued, it is essential that any delivery programme considers how to best integrate implementation with other dwelling related components e.g. heating system change.

NB: Fabric retrofit measures have been identified following a whole energy system approach, considering the cost-effectiveness of fabric retrofit measures alongside other options to achieve carbon neutrality in Bridgend. This does not mean that individual dwellings or buildings would not benefit from additional retrofit measures when considered on a case by case basis, particularly as part of a package of wider measures that could include heating system change and PV installation. During the development of any activity or plans to progress this LAEP, consideration will be needed to determine the optimum approach for deployment, when appraised alongside the approach for taking forward any of the other components of this LAEP.

3. Fabric Retrofit Zones

Basic Retrofit Zone 1 – Bridgend Town West
A total of 4,400 dwellings requiring basic retrofit including 1,800 semi-detached and 2,000 detached. Almost all of these were constructed between 1945 and present.
The image above shows dwellings in the Bryntirion, Cefn Glas and Newcastle areas many of which are likely to require a basic retrofit.



Basic Retrofit Zone 2 – Coastal Area
A total of 4,100 dwellings requiring basic retrofit including 1,200 semi-detached and 2,400 detached. The majority of these were constructed between 1945 and 1979.
The image above shows dwellings in the Porthcawl and Nottage areas which are likely to require a basic retrofit.

Basic Retrofit Zone 3 – Bridgend Town North
A total of 4,300 dwellings requiring basic retrofit including 1,800 semi-detached and 1,700 detached. The majority of these were constructed between 1945 and 1979.
The image above shows dwellings in the Sarn, Byrncoch and Bryncethin areas which could require a basic retrofit.

Note: Numbers may not sum correctly due to rounding and omissions of small number of dwellings in different categories.
Building surveys will be required in these areas to identify exactly which buildings already have basic retrofit measures installed and which still require them.

3. Fabric Retrofit Zones

Deep Retrofit Zone 1 – Garw Valley & Llangynwyd

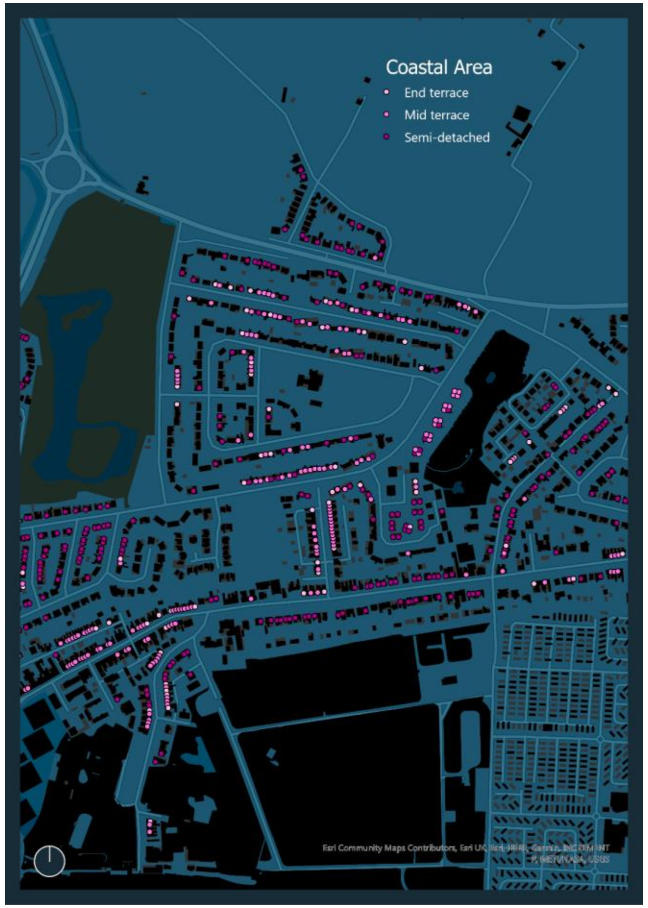
A total of 1,100 dwellings requiring deep retrofit fairly evenly split between end-terrace (400), mid-terrace (350), and semi-detached (325) dwellings.

The image above shows dwellings in the Pontycymer area which are likely to require a deep retrofit.

Deep Retrofit Zone 2 – Ogmore Vale

A total of 1,000 dwellings requiring deep retrofit weighted heavily towards mid-terrace (520), with the remainder being end-terrace (250) and semi-detached (220).

The image above shows dwellings in the Price Town and Nant-y-moel areas which are likely to require a deep retrofit.



Deep Retrofit Zone 3 – Coastal Area

A total of 910 dwellings requiring deep retrofit weighted heavily towards semi-detached (480), with the remainder being mid-terrace (270) and end-terrace (150).

The image above shows dwellings in the Trecco Bay area which are likely to require a deep retrofit.

Note: Numbers may not sum correctly due to rounding and omissions of small number of dwellings in different categories.
Building surveys will be required in these areas to identify exactly which buildings already have basic retrofit measures installed and which still require them.

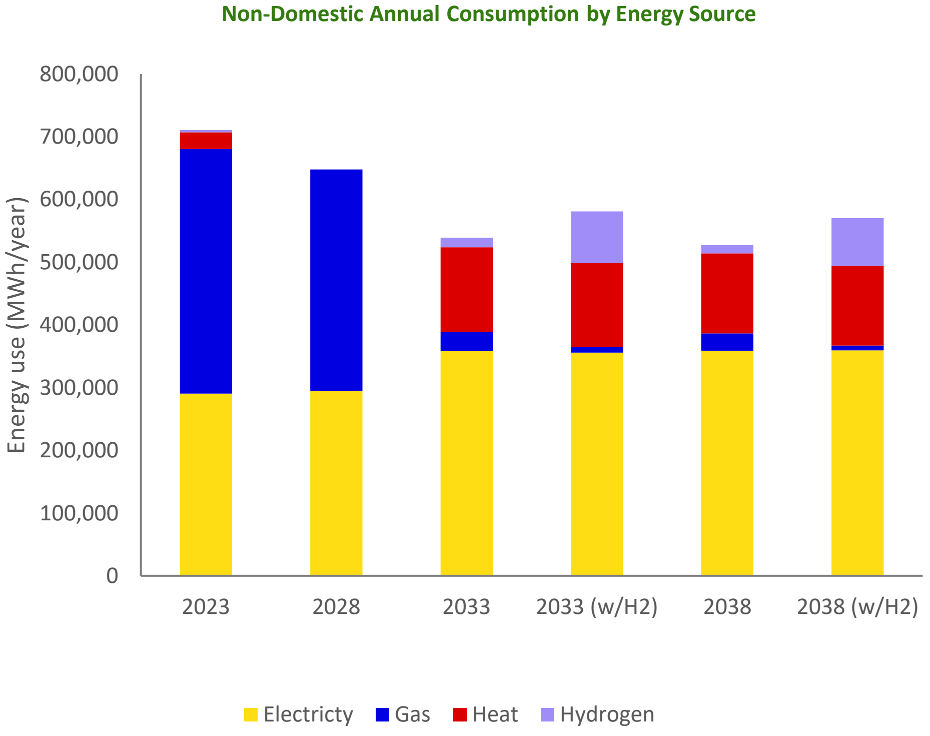
4. Non-Domestic Buildings - Summary

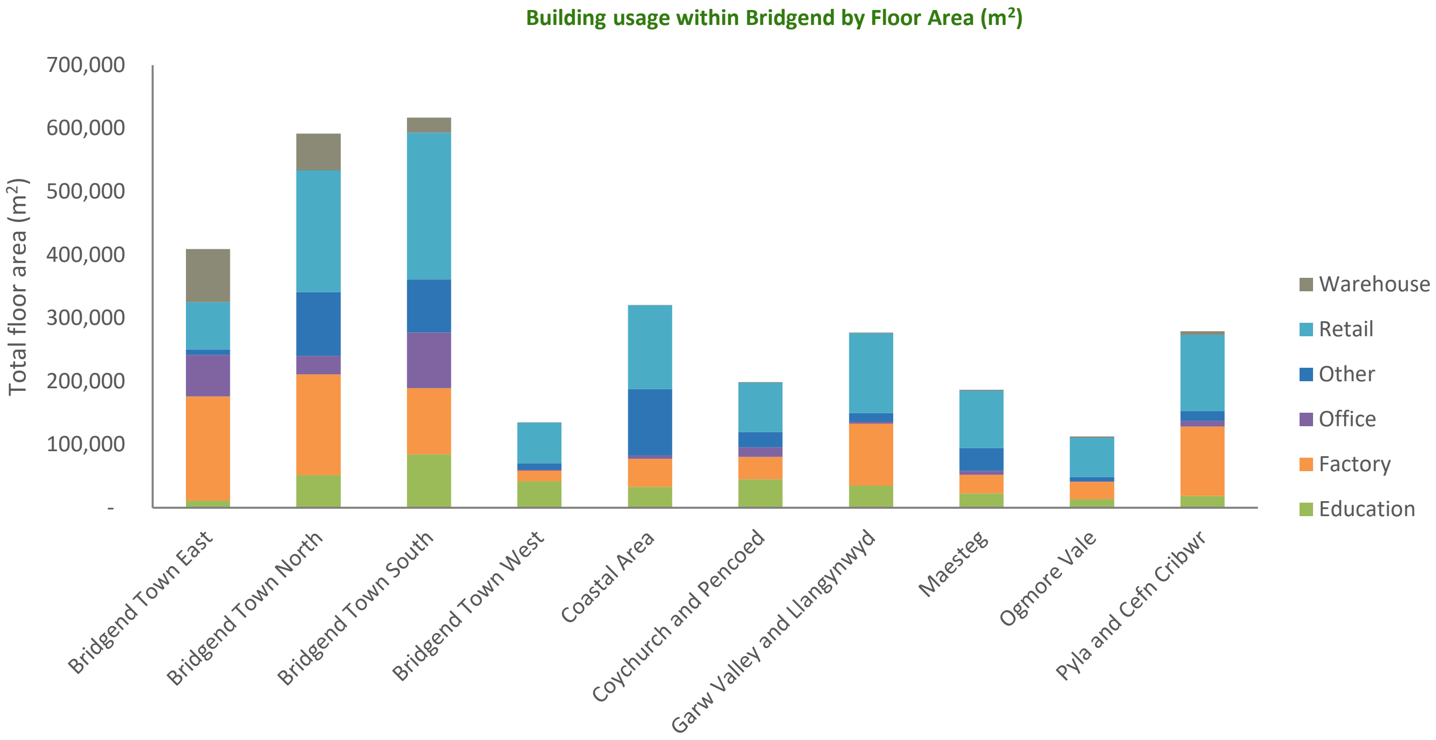
The mix of energy required for non-domestic buildings to 2038 is shown in the chart below left, in five year steps. Both 2033 and 2038 are shown twice, to show scenarios with and without hydrogen.

By 2038, the move to heat networks and the contribution of hydrogen has all but eliminated the need for gas in non-domestic buildings in Bridgend. Heat networks provide approximately 25% of total demand by 2038 in both scenarios (with and without hydrogen). To 2038, the demand for electricity grows by approximately 20%; electricity use for heating is expected to primarily be served by air source heat pumps as they are cheaper to install than alternative heat pump options (such as ground source). In larger non-domestic buildings with large outside spaces, ground source heat pumps may be suitable. Fabric retrofit contributes to a reduction in total energy demand by approximately 20% and is likely to be required in many buildings to allow a switch to heat pumps.

In the future scenario with hydrogen, the following zones switch to individual hydrogen boilers in the non-domestic stock: Garw Valley and Llangynwyd, Pyla and Cefn Cribwr, Coychurch and Pencoed, Bridgend Town West and Bridgend Town East. Hydrogen is also used in these areas to provide industrial heat demands (non-heating) in place of using gas. If hydrogen isn't available, then a solution for industrial heat will be required.

The chart bottom right shows the usage of the non-domestic buildings, in each of the ten zones. None of the ten zones have a particular noteworthy concentration of any particular use type, although the four zones that make up Bridgend Town account for over half of the total floor area. Over 90% of warehousing is found in three of the Bridgend Town zones.





4. Non-domestic buildings

Non-domestic buildings priority area selection

Bridgend Town South has been identified as a priority area to demonstrate how to decarbonise Bridgend's non-domestic buildings before considering wider scale-up.

Bridgend Town South has the greatest proportion of non-domestic buildings in Bridgend, containing a large amount of education, retail and office space that mean it has been identified as a potential district heating zone. These characteristics provide a good basis for determining an approach that could later be applied to non-domestic buildings across Bridgend.

Illustrative deployment of heating system in non-domestic buildings in Bridgend Town South, showing the central Town area

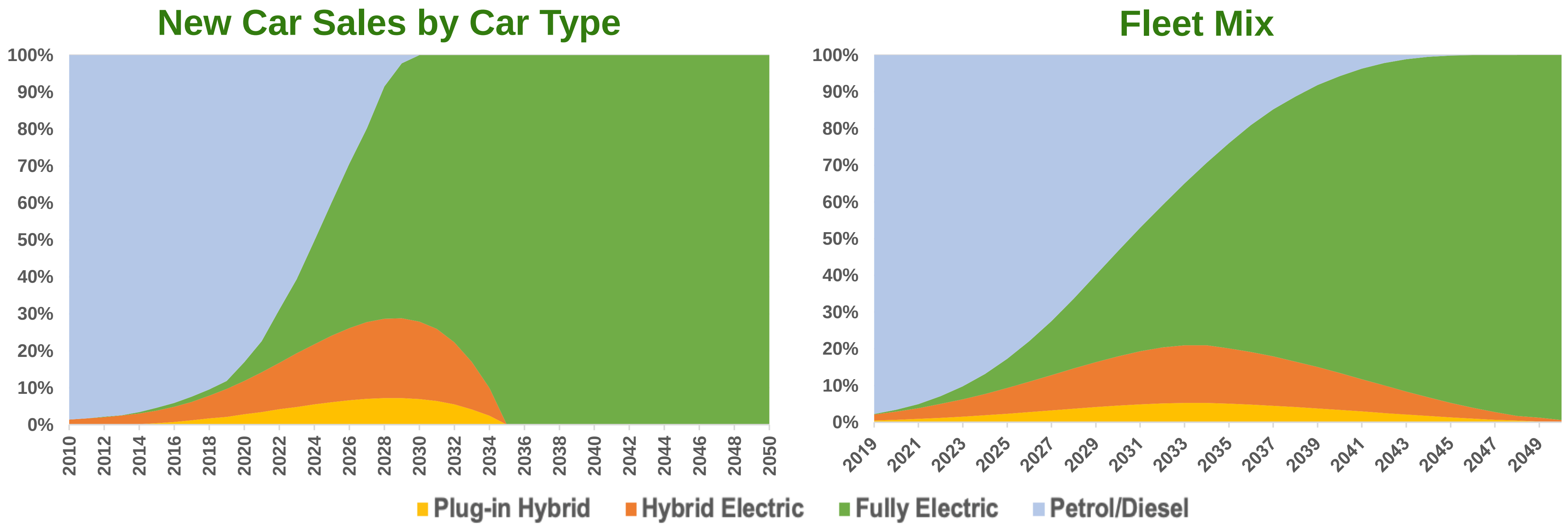
Bridgend Town – Non-domestic decarbonisation priority area

5. EV Charging

Vision to 2040

Electric Vehicle (EV) ownership is expected to grow significantly to support local decarbonisation targets and in alignment with national policy, which will see the phasing out of internal combustion engine vehicle sales by 2030 and hybrids by 2035. Fully electric and plug-in hybrid vehicles (PHEVs) in Bridgend are expected to grow from around 3,000 today to around 70,000 cars by 2040. The transition to electric vehicles requires support from publicly accessible and domestic chargers, and this is a consistent result across all scenarios; therefore all moves to make steps in charger deployment can be considered low regret.

Charging infrastructure will need to be installed to encourage this transition and keep up with this demand, providing confidence that owners will be able to recharge when needed. A mixture of publicly accessible (such as workplaces and shopping centres) and private residential chargers will be required to provide this amenity. At-home charging for dwellings that have off-street parking is a solution which is well developed, but for dwellings without off street parking other solutions will be needed. One solution may be public charging hubs located in residential areas with limited off-street parking. Other alternatives include developing an EV car club offer and expanding levels of workplace and destination charging provision. It is estimated that around 49,000 domestic charge points will be required.



7. Energy Networks

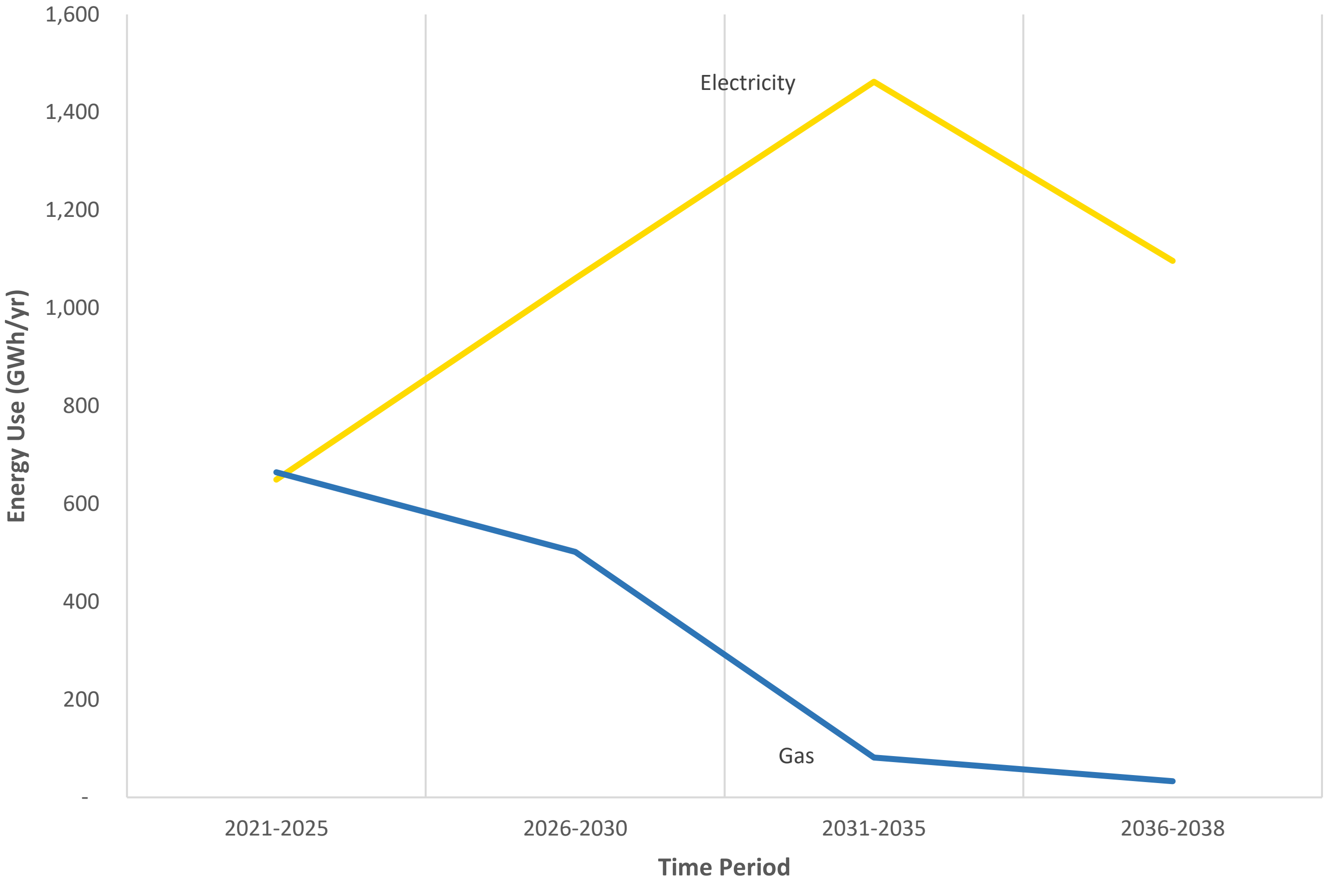
Vision to 2038

Energy networks are the backbone of Bridgend's carbon neutral future; the large scale changes in the way we use energy described in the previous sections will require networks to adapt and evolve in significant ways. Major changes to the existing gas and electricity networks will be required, as well as the development of new networks including district heat and potentially hydrogen networks to meet future demand with significantly reduced carbon emissions.

The electrification of heat and transport is likely to drive a major shift towards greater dependency on the electricity network. Greater demand for electricity will require investment in generation capacity and storage and distribution network infrastructure upgrades.

In the primary scenario, to decarbonise Bridgend by 2038 gas demand is reduced by 95% with its remaining use in some non-domestic and industrial applications which are more difficult to electrify. In the hydrogen scenario, the gas demand reduces by 98.5% due to the ability of hydrogen to decarbonise some of the non-domestic and industrial demands that cannot be electrified. There is uncertainty currently about the role of hydrogen to replace heating, including when and where it may be available, in what quantities, the associated carbon emissions, and the cost compared to other solutions.

This section of the report provides an overview of the impact on each of the energy networks of the primary scenario.



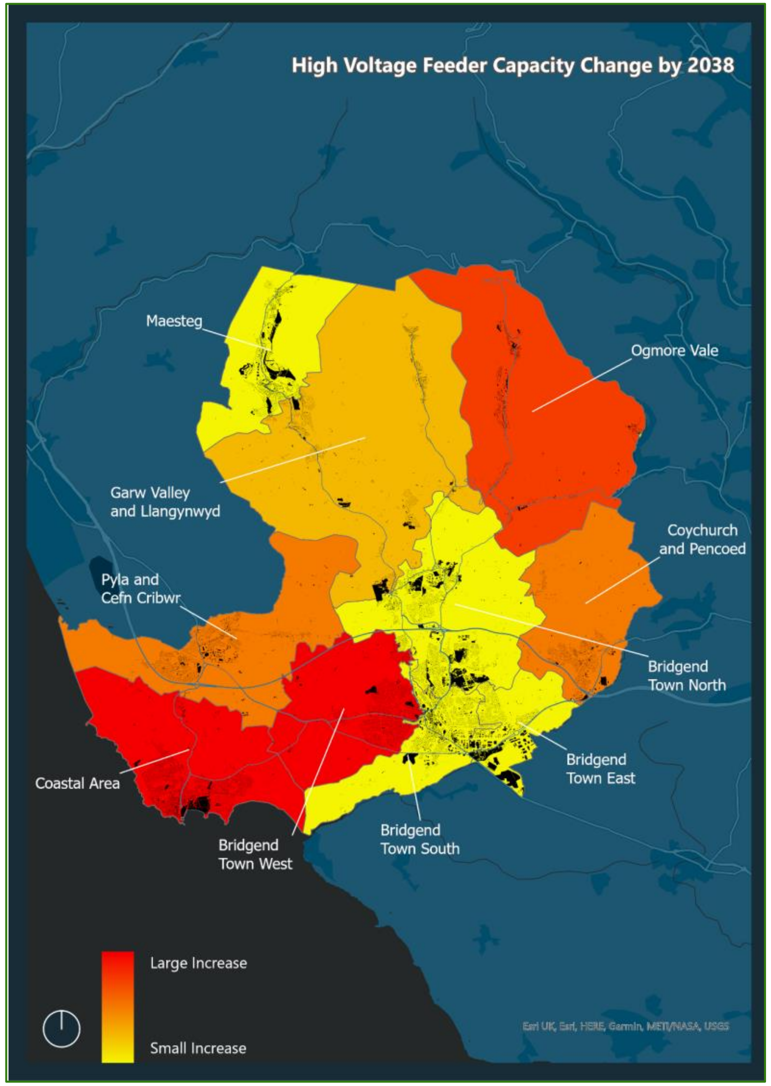
7. Energy Networks - Electricity

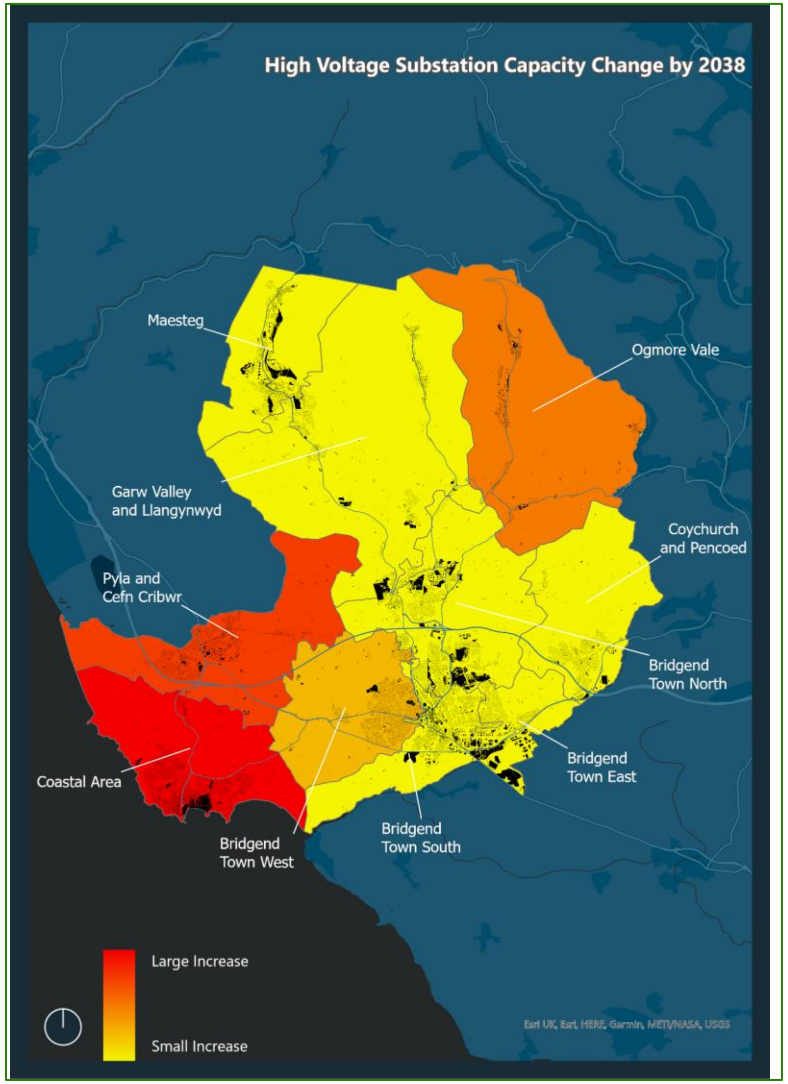
Capacity Requirements for 2038: High Voltage

The local electricity distribution network, operated under license by Western Power Distribution, supplies electricity to the dwellings and industry in Bridgend today. Modelling indicates the capacity required to meet all projected demand growth through conventional investment, but some of this demand could instead be accommodated through alternative investments, such as flexibility and storage. Hence the physical capacity increase required could be less than shown here. Areas with large increases in required capacity present opportunities for innovation and smart technology. Smart EV chargers and smart heat pump controls could make demand flexible, while storage technologies and vehicle-to-grid could help meet peaks in demand locally and provide other grid services.

The modelled capacity requirements at high voltage and low voltage (see next slide) levels are shown in the maps and tables. The distribution of these impacts is determined by a combination of factors, such as electric vehicle ownership, space for off-street parking and existing spare capacity in the current electricity infrastructure. For example, a zone may see a large increase in demand for home EV chargers, but not require large capacity increase because it currently has significant spare capacity.

	High Voltage Feeder Capacity (MW)		High Voltage Substation Capacity (MW)	
Zone	2021	2038	2021	2038
Maesteg	23	23	29	29
Ogmore Vale	13	27	14	26
Garw Valley & Llangynwyd	30	39	43	43
Pyla & Cefn Cribwr	27	50	29	74
Coychurch & Pencoed	20	37	43	43
Bridgend Town West	28	70	29	43
Coastal Area	31	83	29	86
Bridgend Town North	41	41	43	43
Bridgend Town South	44	44	86	86
Bridgend Town East	26	26	43	43



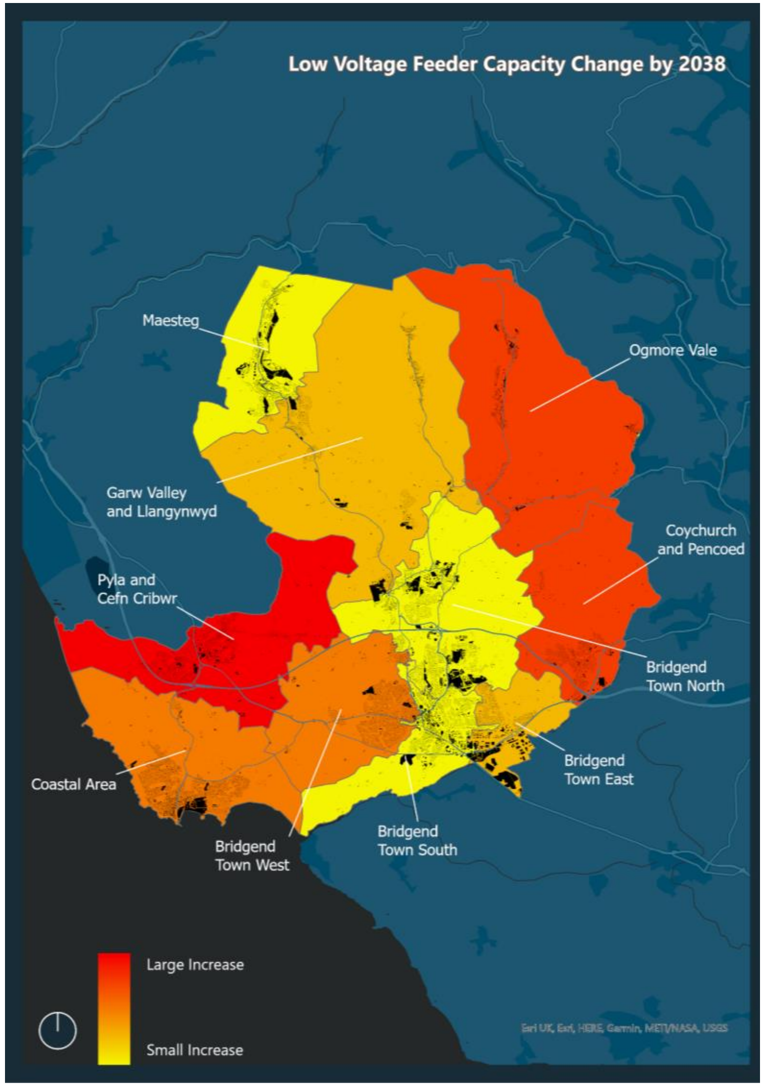


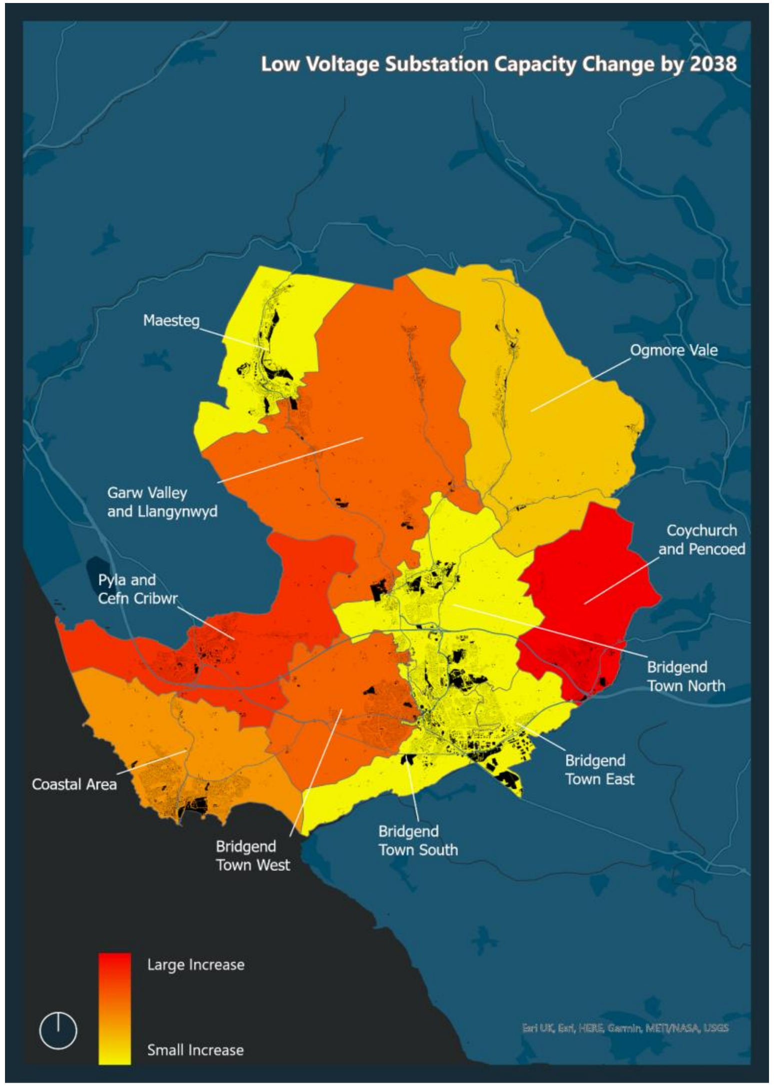
7. Energy Networks - Electricity

Capacity Requirements for 2038: Low Voltage

Low voltage feeders are the cables serving individual buildings, so upgrades to these can involve extensive roadworks and disruption. High voltage feeders, only run to substations which typically serve multiple streets, so are less disruptive to replace. Substations are located on designated plots of land, with exclusive access for the DNO.

	Low Voltage Feeder Capacity (MW)		Low Voltage Substation Capacity (MW)	
Zone	2021	2038	2021	2038
Maesteg	21	21	23	23
Ogmore Vale	12	20	12	22
Garw Valley & Llangynwyd	29	31	24	95
Pyla & Cefn Cribwr	21	58	22	97
Coychurch & Pencoed	16	34	15	91
Bridgend Town West	41	46	22	90
Coastal Area	39	43	23	82
Bridgend Town North	35	35	38	38
Bridgend Town South	36	36	36	36
Bridgend Town East	16	16	16	16





7. Energy Networks - Gas

Gas Network Today

The gas network, operated under license by Wales and West Utilities, supplies gas to the majority of dwellings in Bridgend today, predominantly for heating and hot water but also cooking. It also supports a range of non-domestic and industrial local energy demands. The current total gas consumption across Bridgend is around 660 GWh – comparable to the demand for electricity.

To deliver against BCBC's net zero target, it is expected that nearly all dwellings will no longer use natural gas by the early 2030s . Most non-domestic buildings will also transition away from gas.

Future of Gas and Hydrogen for Heat

The primary plan for Bridgend sees the majority of domestic dwellings converting their heating systems to either be:

- connected to a district heat network or, more commonly,
- converted to electric heating, predominantly in the form of different types of heat pumps depending on different factors such as location, energy efficiency and house type.

This would necessitate phased disconnection of homes from the gas network as they are converted to electric or district heating, which would need coordination.

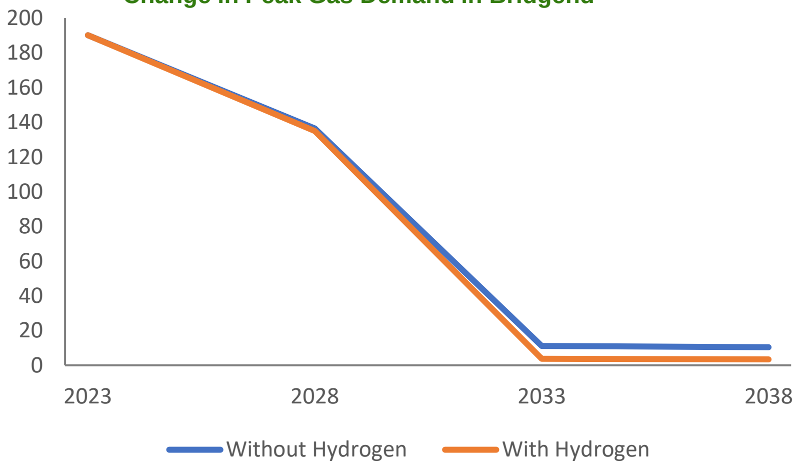
Hybrid heating (air source heat pump/gas boiler hybrid) is an option in certain circumstances – typically in larger pre-1914 semi-detached properties that are hard to heat that may not have space for a ground source heat pump and are not close to a heat network. Around 760 dwellings may be best suited for this technology, but this decreases to around 300 in the scenario with hydrogen.

The gas network may be repurposed to distribute hydrogen. Three zones in particular may look to hydrogen – Coychurch and Pencoed, Bridgend Town West, and Garw Valley and Llangynwyd in the second scenario where hydrogen is available and affordable. Equitable solutions for dealing with the ongoing gas network maintenance costs for remaining customers will need to be explored. The extent of this issue will depend on whether the gas network is re-purposed for hydrogen or not.

Most non-domestic properties will also transition away from gas, again connecting to district heat networks or converting to electric heating options. There are a small number of non-domestic properties that are harder to decarbonise, particularly with industrial uses that require high temperature process heat: these remain on the gas network in the modelling under the primary scenario.

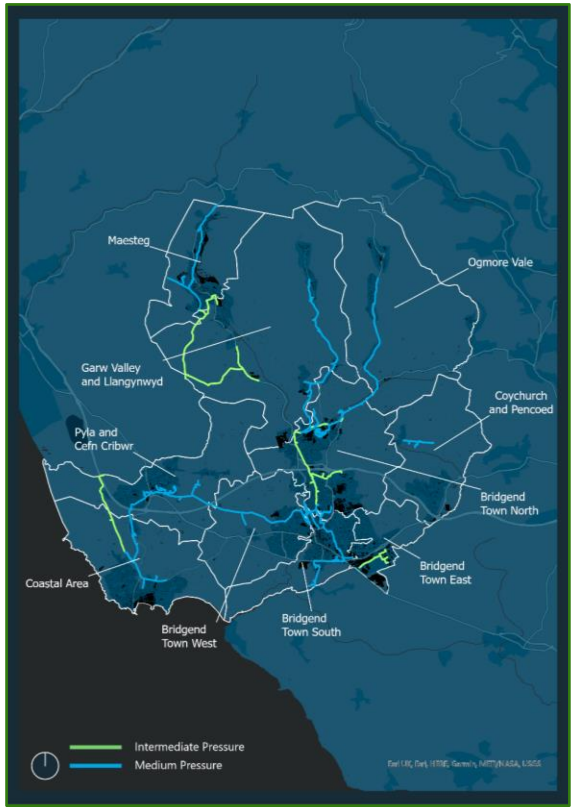
Conversion to hydrogen can be a cheaper alternative to electrification for some domestic and non-domestic properties. The total capital cost saving on buildings was estimated at £11.5 for domestic and £30m for non-domestic compared to the primary scenario.

Change in Peak Gas Demand in Bridgend



The estimated cost to re-purpose the gas network in Bridgend to hydrogen was £60m with savings of around £7m in avoided decommissioning costs.
Using hydrogen for heat also reduces the requirement to reinforce the electricity network. The capital cost saving here was estimated at £15m
An overall potential capital cost saving of around £4m was estimated for the hydrogen scenario compared to the primary scenario (0.5% of total estimated capital investment required).

Current Gas Network in Bridgend

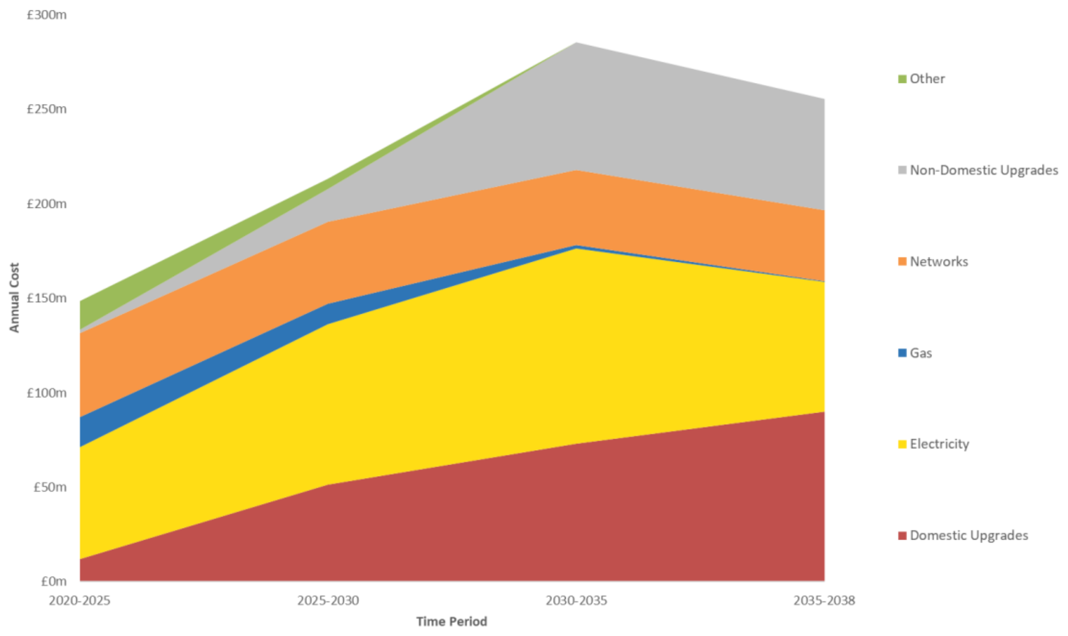


8. Cost and Investment

Total cost

The primary scenario is based on a total energy system spend of £4.5bn. The cost is attributed to investment in domestic and non-domestic upgrades, electricity, gas, networks and other. The chart below illustrates the split between these main components. Notably, a significant proportion of this cost would have been spent without accounting for decarbonisation. Money is spent every day on maintaining existing energy systems, replacing old or failed systems (e.g. gas boilers in dwellings), improving energy efficiency and paying gas and electricity bills. This update in conjunction with the original LAEP sets out an approach for redirecting some of that status quo expenditure, boosted with additional investment, to the areas needed to achieve the carbon neutral target. For example, energy costs are re-directed to electricity use in place of natural gas.

Annual Cost of Energy System in Bridgend



Investment

The tables below and the charts on the following pages illustrate the total investment (£2.8bn) needed in the energy system to deliver the primary scenario and how this is broken down by zone across Bridgend. These figures do not include energy costs.

Investment Categories

- Technologies = roof mounted PV, heat network energy centres and EV chargers
- Non-domestic buildings = heating system & insulation retrofit
- Domestic buildings = heating system & insulation retrofit
- Networks = gas, electricity and district heating network investment

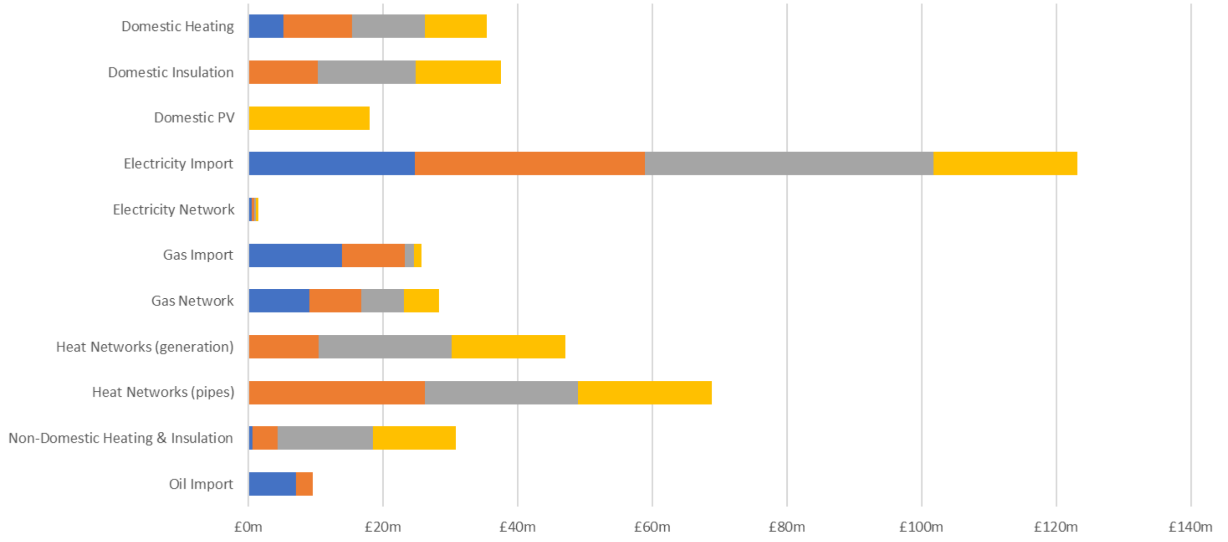
Zone	Total Investment (£m)
Maesteg	267
Ogmore Vale	170
Garw Valley & Llangynwyd	258
Pyla & Cefn Cribwr	251
Coychurch & Pencoed	183
Bridgend Town West	218
Coastal Area	300
Bridgend Town North	424
Bridgend Town South	417
Bridgend Town East	192

Investment type	Total Investment (£m)
Technologies	155
Non-domestic buildings	730
Dwellings	823
Networks	971

8. Cost and Investment

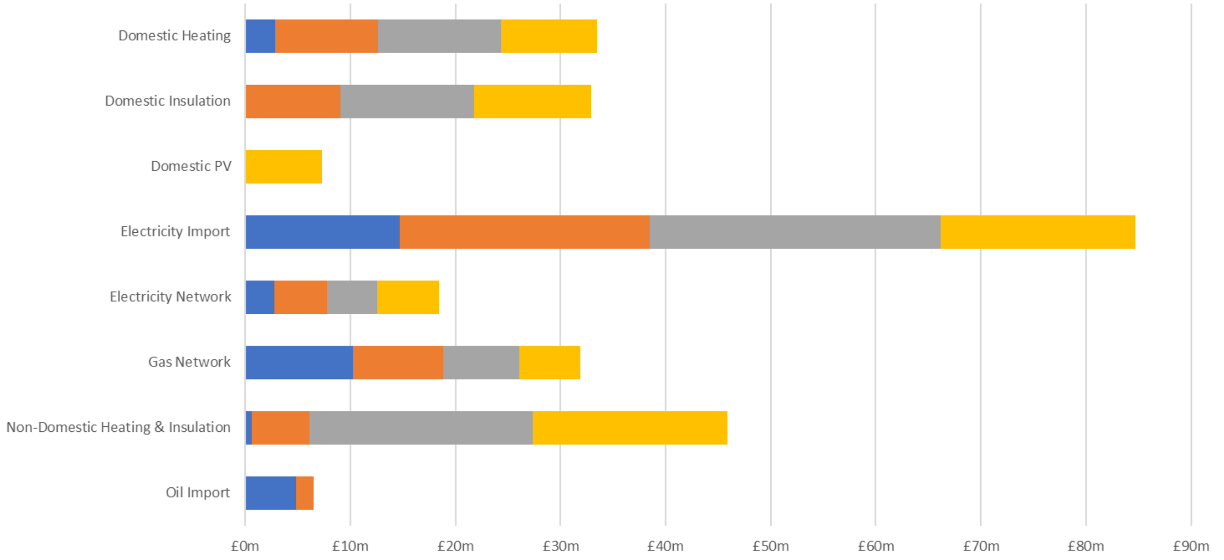
Investment in Bridgend's energy system (£m) by time period across each of Bridgend's zones

Maesteg



	Oil Import	Non-Domestic Heating & Insulation	Heat Networks (pipes)	Heat Networks (generation)	Gas Network	Gas Import	Electricity Network	Electricity Import	Domestic PV	Domestic Insulation	Domestic Heating
2021-2025	£7m	£1m	£0m	£0m	£9m	£14m	£0m	£25m	£0m	£0m	£5m
2026-2030	£2m	£4m	£26m	£10m	£8m	£9m	£0m	£34m	£0m	£10m	£10m
2031-2035	£0m	£14m	£23m	£20m	£6m	£1m	£0m	£43m	£0m	£15m	£11m
2036-2038	£0m	£12m	£20m	£17m	£5m	£1m	£0m	£21m	£18m	£13m	£9m

Ogmore Valley

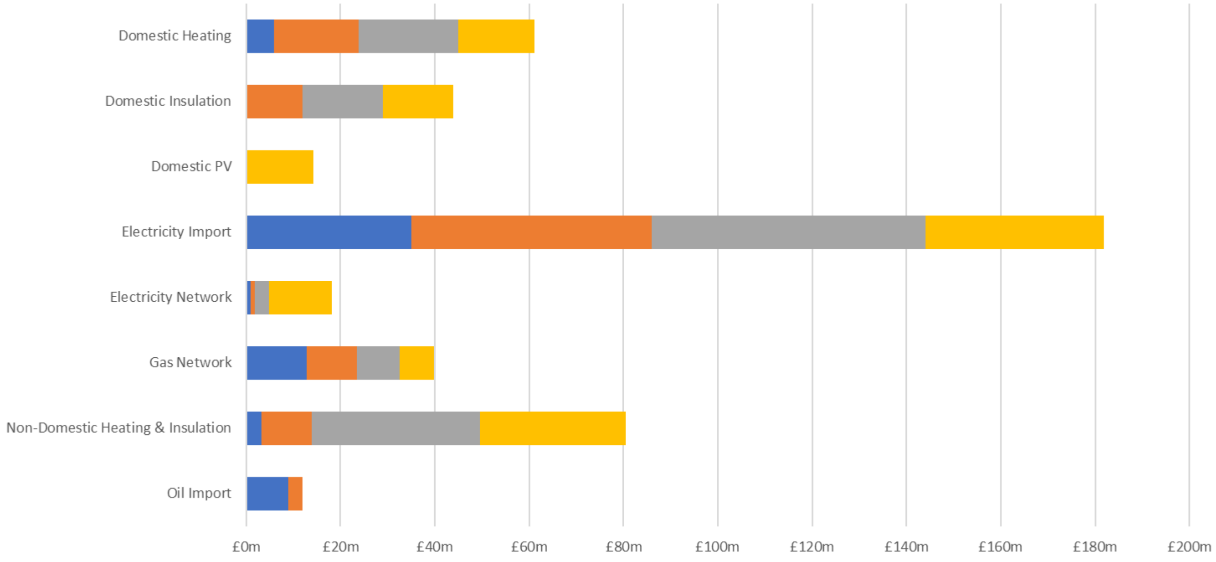


	Oil Import	Non-Domestic Heating & Insulation	Gas Network	Electricity Network	Electricity Import	Domestic PV	Domestic Insulation	Domestic Heating
2021-2025	£5m	£1m	£10m	£3m	£15m	£0m	£0m	£3m
2026-2030	£2m	£5m	£9m	£5m	£24m	£0m	£9m	£10m
2031-2035	£0m	£21m	£7m	£5m	£28m	£0m	£13m	£12m
2036-2038	£0m	£19m	£6m	£6m	£19m	£7m	£11m	£9m

8. Cost and Investment

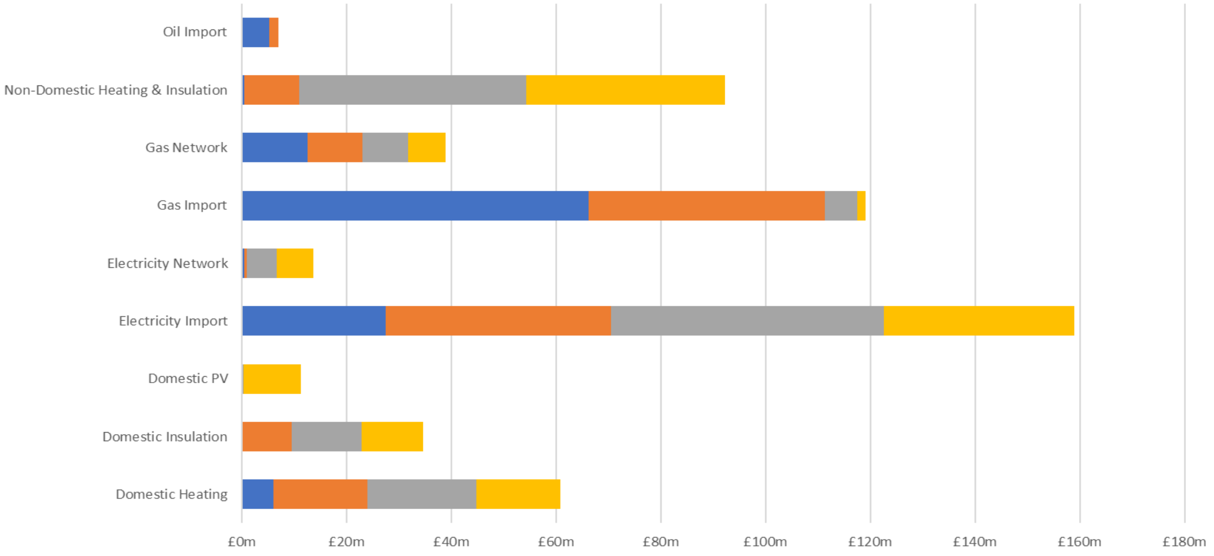
Investment in Bridgend's energy system (£m) by time period across each of Bridgend's zones

Garw Valley and Llangynwyd



	Oil Import	Non-Domestic Heating & Insulation	Gas Network	Electricity Network	Electricity Import	Domestic PV	Domestic Insulation	Domestic Heating
2021-2025	£9m	£3m	£13m	£1m	£35m	£0m	£0m	£6m
2026-2030	£3m	£11m	£11m	£1m	£51m	£0m	£12m	£18m
2031-2035	£0m	£36m	£9m	£3m	£58m	£0m	£17m	£21m
2036-2038	£0m	£31m	£7m	£13m	£38m	£14m	£15m	£16m

Pyla and Cefn Cribwr

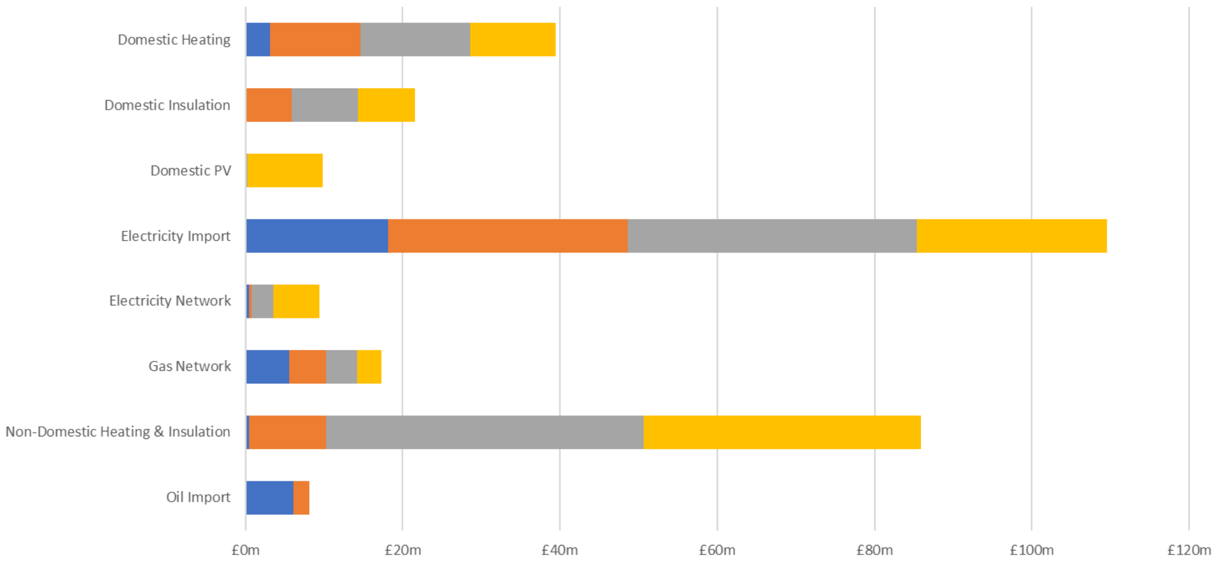


	Domestic Heating	Domestic Insulation	Domestic PV	Electricity Import	Electricity Network	Gas Import	Gas Network	Non-Domestic Heating & Insulation	Oil Import
2021-2025	£6m	£0m	£0m	£27m	£0m	£66m	£12m	£0m	£5m
2026-2030	£18m	£9m	£0m	£43m	£0m	£45m	£10m	£11m	£2m
2031-2035	£21m	£13m	£0m	£52m	£6m	£6m	£9m	£43m	£0m
2036-2038	£16m	£12m	£11m	£36m	£7m	£2m	£7m	£38m	£0m

8. Cost and Investment

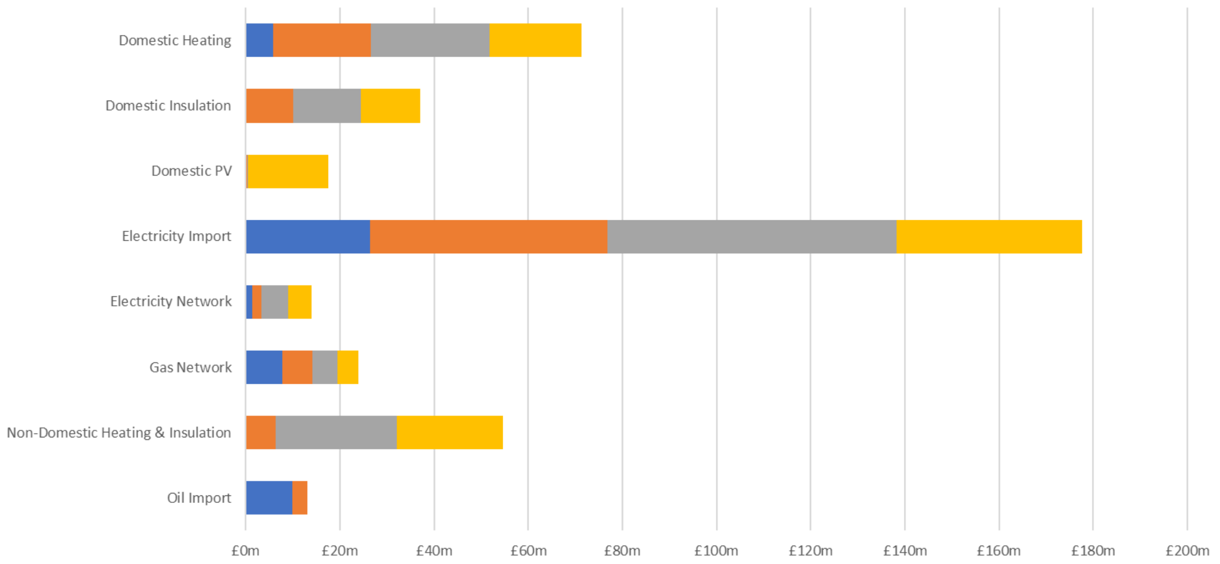
Investment in Bridgend's energy system (£m) by time period across each of Bridgend's zones

Coychurch and Pencoed



	Oil Import	Non-Domestic Heating & Insulation	Gas Network	Electricity Network	Electricity Import	Domestic PV	Domestic Insulation	Domestic Heating
2021-2025	£6m	£0m	£6m	£0m	£18m	£0m	£0m	£3m
2026-2030	£2m	£10m	£5m	£0m	£30m	£0m	£6m	£12m
2031-2035	£0m	£40m	£4m	£3m	£37m	£0m	£8m	£14m
2036-2038	£0m	£35m	£3m	£6m	£24m	£10m	£7m	£11m

Bridgend Town West

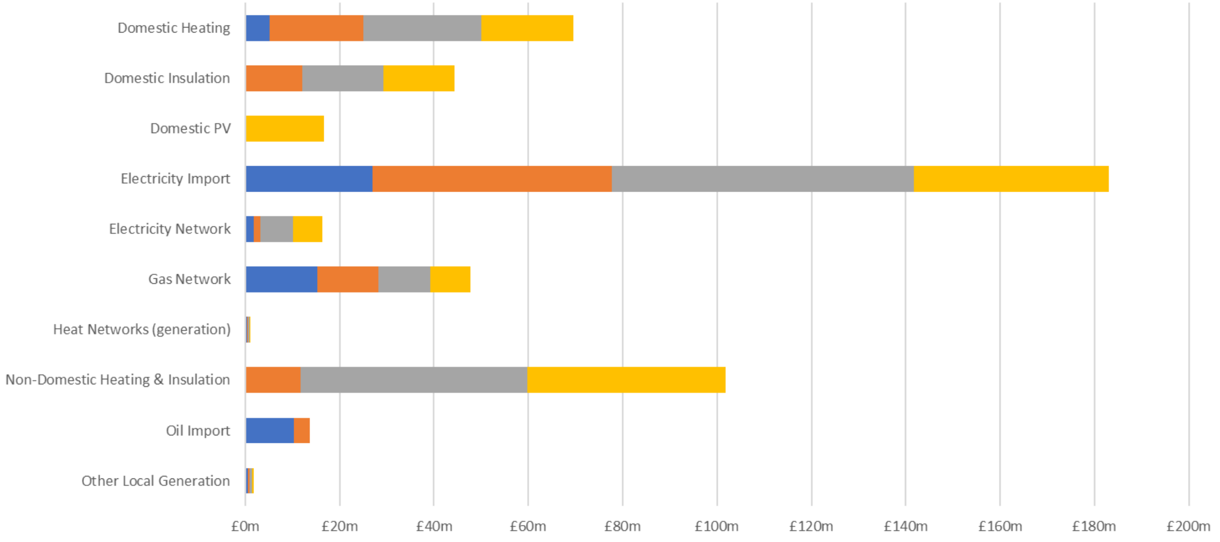


	Oil Import	Non-Domestic Heating & Insulation	Gas Network	Electricity Network	Electricity Import	Domestic PV	Domestic Insulation	Domestic Heating
2021-2025	£10m	£0m	£8m	£1m	£26m	£0m	£0m	£6m
2026-2030	£3m	£6m	£6m	£2m	£50m	£0m	£10m	£21m
2031-2035	£0m	£26m	£5m	£6m	£61m	£0m	£14m	£25m
2036-2038	£0m	£22m	£4m	£5m	£39m	£17m	£13m	£20m

8. Cost and Investment

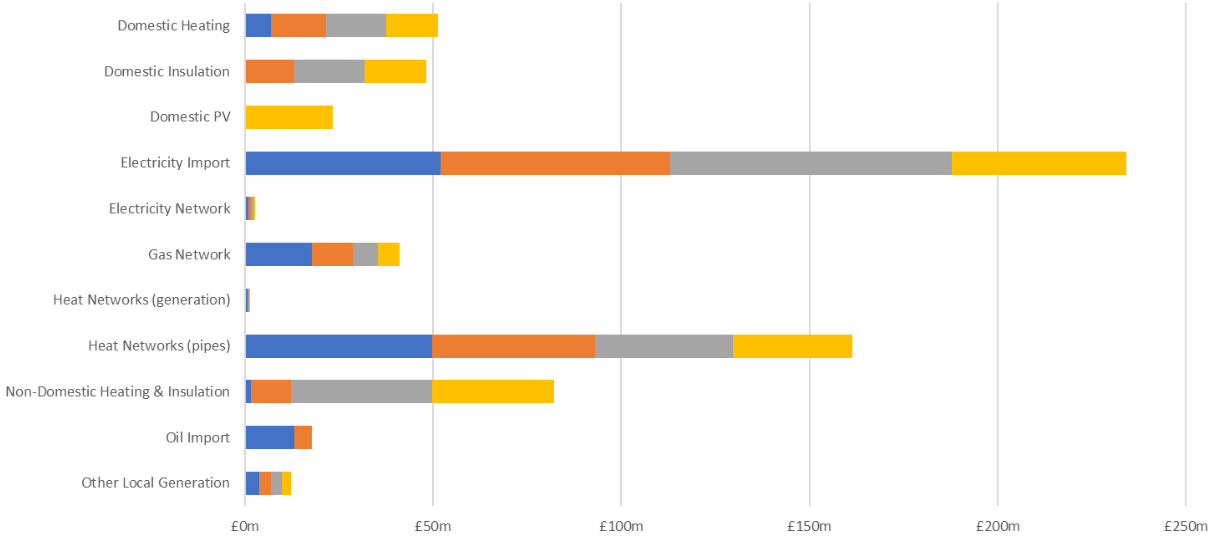
Investment in Bridgend's energy system (£m) by time period across each of Bridgend's zones

Coastal Area



	Other Local Generation	Oil Import	Non-Domestic Heating & Insulation	Heat Networks (generation)	Gas Network	Electricity Network	Electricity Import	Domestic PV	Domestic Insulation	Domestic Heating
2021-2025	£1m	£10m	£0m	£0m	£15m	£2m	£27m	£0m	£0m	£5m
2026-2030	£0m	£3m	£12m	£0m	£13m	£1m	£51m	£0m	£12m	£20m
2031-2035	£0m	£0m	£48m	£0m	£11m	£7m	£64m	£0m	£17m	£25m
2036-2038	£0m	£0m	£42m	£0m	£9m	£6m	£41m	£17m	£15m	£20m

Bridgend Town North

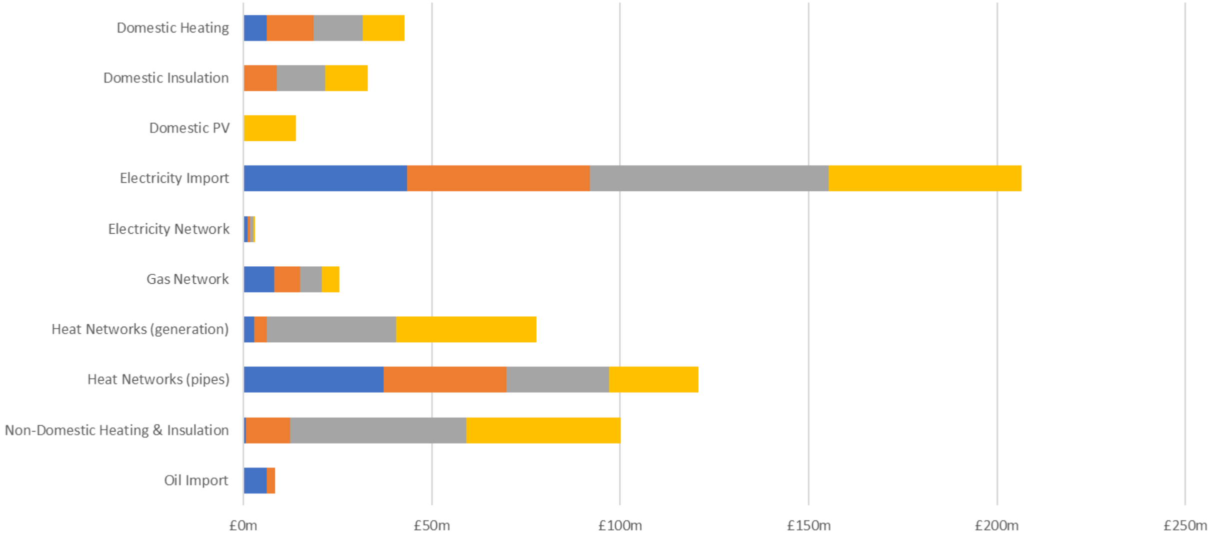


	Other Local Generation	Oil Import	Non-Domestic Heating & Insulation	Heat Networks (pipes)	Heat Networks (generation)	Gas Network	Electricity Network	Electricity Import	Domestic PV	Domestic Insulation	Domestic Heating
2021-2025	£4m	£13m	£2m	£50m	£1m	£18m	£1m	£52m	£0m	£0m	£7m
2026-2030	£3m	£5m	£11m	£43m	£0m	£11m	£1m	£61m	£0m	£13m	£15m
2031-2035	£3m	£0m	£37m	£37m	£0m	£7m	£1m	£75m	£0m	£19m	£16m
2036-2038	£2m	£0m	£33m	£32m	£0m	£6m	£1m	£46m	£23m	£16m	£14m

8. Cost and Investment

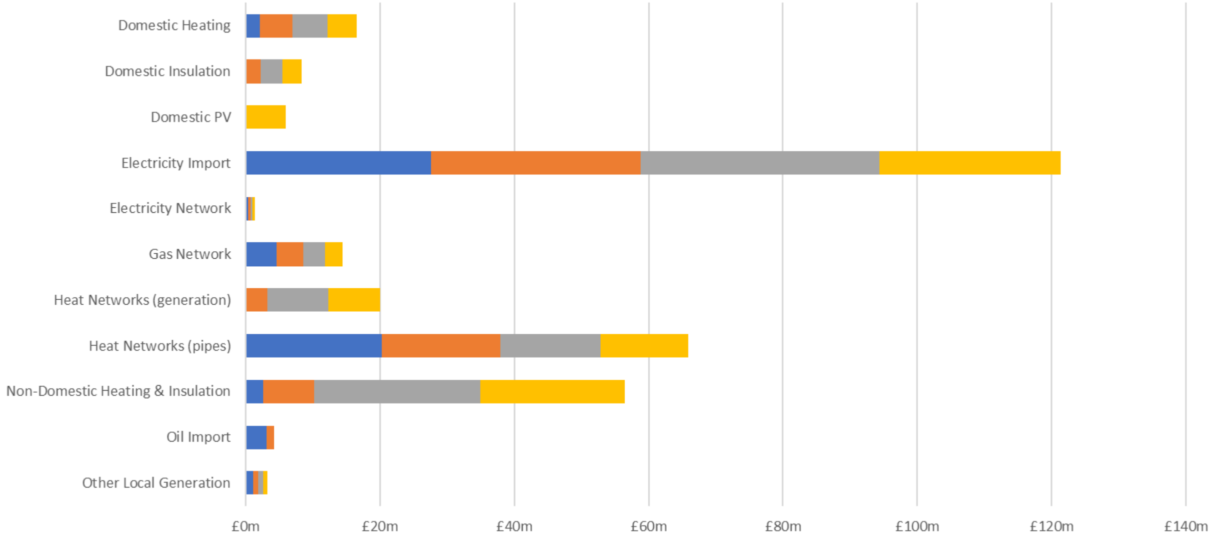
Investment in Bridgend's energy system (£m) by time period across each of Bridgend's zones

Bridgend Town South



	Oil Import	Non-Domestic Heating & Insulation	Heat Networks (pipes)	Heat Networks (generation)	Gas Network	Electricity Network	Electricity Import	Domestic PV	Domestic Insulation	Domestic Heating
2021-2025	£6m	£1m	£37m	£3m	£8m	£1m	£43m	£0m	£0m	£6m
2026-2030	£2m	£12m	£32m	£3m	£7m	£1m	£49m	£0m	£9m	£12m
2031-2035	£0m	£47m	£27m	£34m	£6m	£1m	£64m	£0m	£13m	£13m
2036-2038	£0m	£41m	£24m	£37m	£5m	£1m	£51m	£14m	£11m	£11m

Bridgend Town East



	Other Local Generation	Oil Import	Non-Domestic Heating & Insulation	Heat Networks (pipes)	Heat Networks (generation)	Gas Network	Electricity Network	Electricity Import	Domestic PV	Domestic Insulation	Domestic Heating
2021-2025	£1m	£3m	£3m	£20m	£0m	£5m	£0m	£28m	£0m	£0m	£2m
2026-2030	£1m	£1m	£8m	£18m	£3m	£4m	£0m	£31m	£0m	£2m	£5m
2031-2035	£1m	£0m	£25m	£15m	£9m	£3m	£0m	£36m	£0m	£3m	£5m
2036-2038	£1m	£0m	£21m	£13m	£8m	£3m	£0m	£27m	£6m	£3m	£4m

9. Summary and Conclusions

There are under twenty years until 2038, the date by which Bridgend aims to be carbon neutral, and less than thirty years until 2050, the latest date by which the UK must reach Net Zero emissions*.

Whilst there is some flexibility to meet this target, there is an urgency to prepare to start the transition now and over the next few years, focusing on low regret activities, building capacity and supply chains alongside training in new skills. Key decisions will need to be undertaken in the next 2-4 years in order to realistically meet the target.

The total cost of the primary pathway modelled to reach a net zero energy system within Bridgend by 2040 is £4.5bn, of which £2.8bn is capital investment.

Future Local Energy System in Bridgend

The primary scenario investigated involves strong contributions from core activities and technologies and also identified a number of key opportunities and uncertainties. This have been categorised into four key areas:

1. **Reducing energy demand in Bridgend**
2. **Increasing uptake of low carbon solutions in Bridgend**
3. **Increasing local low carbon electricity production and storage**
4. **The future role of the gas grid in Bridgend**

1. Reduced energy demand in Bridgend: Reducing emissions, energy use and energy costs through making buildings more energy efficient has been shown to play an important role in the scenarios considered.

In the primary pathway this means basic fabric retrofit of nearly 29,000 homes and deep retrofit of a further 5,000 homes requiring £340m of investment. Across both scenarios extensive fabric retrofit of existing homes is prominent in cost-effectively reducing emissions in the near term, and also enabling the future installation of low carbon heating systems. It is important to note that new demands from transport, buildings and industry (moderated by improving energy efficiency) mean that electricity demand is modelled to increase in Bridgend from around 650 GWh of electricity consumed per year to 1,460 GWh in the early 2030s before dropping off slightly back to 1,100 GWh. This drop is caused by the model adding significant amounts of solar PV in this period (see Summary Point #3).

2. Increasing uptake of low-carbon solutions in Bridgend: By the early 2030s all new cars, vans and heating system replacements in homes and businesses must be low carbon. In the primary pathway in the 2020’s the majority of this shift is to battery electric vehicles (BEVs) and electric heat pumps along with development of heat networks, that are primarily served by large scale heat pumps providing the heat generation. EV charging comprises a combination of domestic charge points (c.49,000) and public EV charging hubs, targeted at priority locations. Industry in Bridgend must either adopt technologies that use zero carbon electricity or hydrogen instead of fossil fuels, or install carbon capture and storage technologies

3. Increasing production of local low carbon electricity and its storage in Bridgend: Increasing electricity demand and reducing costs of generation from renewable sources sees an increase in local renewable energy production. Solar PV could play an important and significant part in the future energy system in Bridgend. There is potential to install as much as $290MW_p$ of solar PV capacity which could generate almost 0.5GWh of electricity (around 30% of local demand after the electrification of heating).

In our primary scenario, this capacity is installed towards the end of the decarbonisation period (after 2035) however early installation of solar PV will accelerate the decarbonisation of Bridgend and allow more time for deployment.

It is likely that different types and scales of energy storage will be required. In most houses some level of thermal storage will be required to allow effective operation of a heat pump. Domestic battery storage can also play a part, particularly when linked to solar generation. Larger scale batteries may also provide significant benefits in terms of reducing the need for electricity network reinforcement. Furthermore, thermal storage could be valuable on heat networks to help match supply and demand.

4. The future role of the gas grid in Bridgend: The role of hydrogen for heating is uncertain. Whilst there are many activities underway across the sector to develop a potential hydrogen supply, at a suitable scale, there is currently no guaranteed commitment for this to be considered a reliable means of supporting decarbonisation.

The secondary scenario shows that hydrogen could provide a viable route to decarbonisation in some areas of Bridgend depending upon the final prices and availability of green hydrogen. The cost of repurposing the gas network pathway is estimated at £60m however this cost is borne by the GDO with savings for the DNO (as some reinforcement works would not be required estimated at around £15m) with some property owners also saving money (around £11.5m for domestic and £30m for non-domestic). A hydrogen heat based future could also be more appealing to Bridgend’s citizens due to the lower level of disruption within each dwelling.

The hydrogen scenario also produces a slightly reduced level of projected emissions over the next 20 years due to some of the more difficult to electrify industries being able to transition onto hydrogen.

Geographically, ‘Garw Valley and Llangynwyd’ and ‘Bridgend Town East’ are the main targets for hydrogen given their large industrial loads.

*. On 12 June 2019 the Government laid the draft Climate Change Act 2008 (2050 Target Amendment) Order 2019 to amend the *Climate Change Act 2008* by introducing a target for at least a 100% reduction of greenhouse gas emissions (compared to 1990 levels) in the UK by 2050

Acknowledgements

This report was prepared by Energy Systems Catapult on behalf of Bridgend County Borough Council. Local knowledge, data, direction and guidance were provided by Bridgend County Borough Council.

Information relating to existing energy networks, and wider input to the development of this Plan were provided by the electricity distribution network operator Western Power Distribution and gas distribution network operator Wales and West Utilities.

About Local Area Energy Planning

Energy is a core part of national and local economies and infrastructure. Decarbonisation of the UK will require significant changes to energy systems, yet every local area is unique and the changes needed to decarbonise will be specific to each area. Energy Systems Catapult (ESC) pioneered a new whole system approach to Local Area Energy Planning (LAEP) with pilots in three different local areas of the UK – Newcastle, Bury in Greater Manchester and Bridgend in Wales. ESC has since worked with others to evolve this approach, including with Ofgem and Centre for Sustainable Energy to define a method for LAEP* 'done well'., In this project the ESC's EnergyPath Networks toolkit has been used to perform the local analysis.

About Energy Systems Catapult

ESC was set up to accelerate the transformation of the UK's energy system and ensure UK businesses and consumers capture the opportunities of clean growth. ESC is an independent, not-for-profit centre of excellence that bridges the gap between industry, government, academia and research. We take a whole systems view of the energy sector, helping us to identify and address innovation priorities and market barriers, in order to decarbonise the energy system at the lowest cost. We work with innovators from companies of all sizes to develop, test and scale their ideas. We also collaborate with industry, academia and government to overcome the systemic barriers of the current energy market to help unleash the potential of new products, services and value chains required to achieve the UK's clean growth ambitions as set out in the Industrial Strategy.

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	Name	Position
Authors	Carl Holland	Technical Collaboration Manager
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Approver	Rebecca Stafford	Senior Manager - Local Energy Systems

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Date	Version	Comments
27.07.2021	0.1	Initial draft for client review
03.08.2021	0.2	Assumptions slide added.

* https://es.catapult.org.uk/reports/local-area-energy-planning-the-method/
** https://es.catapult.org.uk/reports/local-area-energy-planning/

Assumptions & Data

This report used many sources of data including national datasets, those provided by stakeholders, and ESCs modelling assumptions which have been developed over time incorporating good quality datasets from previous projects. This slide provides some of the assumptions and data that were used in the Bridgend Local Area Energy Plan Refresh 2021 Project and were requested by stakeholders, but is not exhaustive.

Cost of Energy Efficiency Measures

Source: ETI, 'Optimising thermal efficiency of existing housing project'. Note: This has then been adjusted to reflect other information ESC have received over time.

Measure	Fixed Capex (£/property)	Marginal Capex (£/m^2)
Cavity wall insulation	1500	5
Double glazing	443	285
Energy-efficient doors	0	538
External wall insulation	4800	89
Floor insulation	0	11
Internal wall insulation	1920	58
Loft insulation	126	2
Mechanical ventilation	3843	0
More than triple glazing	443	486
New build upgrade to HLR 2	2069	45
Reduced infiltration 1 (Draught proofing)	0	6
Reduced infiltration 2 (Whole dwelling)	35	6
Single glazing	443	185
Triple glazing	443	386

Cost of Renewable Energy Heating Technologies

Source: BEIS, 'Average reported costs of domestic RHI installations, Great Britain, April 2014 to December 2018'

Technology	Capacity (kW)	Cost (£)			£/kW of Capacity		
		Median	Lower Quartile	Upper Quartile	Median	Lower Quartile	Upper Quartile
ASHP	< 5	7,430	5,730	8,110	1,500	1,270	1,720
	6 – 10	7,930	6,900	10,400	1,040	880	1,310
	11 – 15	11,000	9,000	13,780	880	710	1,100
	16 – 20	12,500	9,800	15,250	780	610	940
	21 – 25	17,840	14,890	22,500	770	620	980
	26 – 30	20,000	15,910	25,450	710	570	910
	31 – 35	20,000	16,000	24,730	630	500	770
	36 – 40	-	-	-	-	-	-
	41 – 45	22,000	10,900	28,810	520	250	690
Biomass	< 5	-	-	-	-	-	-
	6 – 10	13,000	9,000	16,210	1,370	900	1,760
	11 – 15	11,630	9,050	15,850	810	650	1,090
	16 – 20	13,000	9,130	16,930	700	500	900
	21 – 25	15,000	10,210	18,000	620	440	720
	26 – 30	16,550	13,110	20,000	600	480	730
	31 – 35	18,000	17,600	22,400	510	510	670
	36 – 40	19,350	15,000	25,230	500	390	670
	41 – 45	25,000	18,290	33,800	570	410	750
GSHP	< 5	8,590	7,210	10,900	1,800	1,720	2,500
	6 – 10	13,500	10,800	18,000	1,800	1,390	2,330
	11 – 15	18,000	13,600	25,000	1,490	1,130	2,010
	16 – 20	25,000	19,300	32,680	1,400	1,060	1,840
	21 – 25	29,000	22,000	40,000	1,290	980	1,810
	26 – 30	38,600	28,500	53,000	1,330	1,000	1,900
	31 – 35	49,990	36,500	70,000	1,470	1,100	2,150
	36 – 40	44,000	32,670	65,000	1,120	840	1,730
	41 – 45	47,500	33,720	66,190	1,100	770	1,580
Solar Thermal	< 5	4,500	3,380	6,000	1,770	1,260	2,580
	6 – 10	6,000	4,500	8,400	930	680	1,240
	11 – 15	5,740	4,300	8,060	420	330	660

Primary Data Sources (Hydrogen)

- WWU network data received in 2017/18 was used as the source for network materials and pipe sizes.
- Network repurposing costs from H21 Leeds City Gate project and from BEIS 'Hydrogen supply chain: evidence base' *. ESC have access to the underlying data in this document which allowed us to ensure that we captured costs in the way required for EnergyPath (the published data did not allow us to do this all cases).
- Heating system costs from BEIS 'Hydrogen supply chain: evidence base' *
- ESC assumed that all hydrogen used in Bridgend would be zero carbon which implies it is entirely from electrolysis using green electricity (so favourable to hydrogen compared to electricity which still has a low level of emissions associated with generation in 2040 in our default data set).
- ESC tested a range of hydrogen costs but in all cases these were less than the cost of electricity at the same time (again, favourable to hydrogen given that the cost of hydrogen from electrolysis is highly uncertain and if demand is high it cannot be guaranteed that it can be produced with low cost electricity since there will be competition for that electricity supply).

* https://www.gov.uk/government/publications/hydrogen-supply-chain-evidence-base