

**Bridgend County Borough
Council**

Local Area Energy Strategy

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Cyngor Bwrdeistref Sirol



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Executive Summary

The Vision

Bridgend County Borough Council has a vision to transition from the current national centralised energy system to a future low carbon decentralised energy system that works for its people, communities and businesses¹. This could realise many benefits in enabling investment, economic growth and employment opportunities for the local area. This transition will require major change to Bridgend's energy networks, moving away from using fossil fuels to provide heating, increasing decentralised low carbon and renewable energy generation, taking forward planned and targeted energy efficiency programmes and utilising advanced home, building and network energy management systems; working with a wide range of technologies at different scales.

The Approach

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

This Strategy recognises that both Wales and the UK have made major carbon emission reduction commitments and provides a means for Bridgend County Borough Council to lead its own low carbon transition. Its initial focus is on decarbonising domestic heating, which is a major contributor to the borough's carbon emissions. This recognises that different homes in different locations have several possible future energy network and low carbon heating options which need to be considered and there is no one size fits all solution.

This Strategy focuses on planning for the long-term, with major energy system change anticipated to roll out from 2030. This Strategy should be revisited when substantial changes in energy technology, policy or market warrant, as well as when the approaches for decarbonising heat in all of Bridgend's non-domestic buildings, along with emissions from transportation and land use, are developed.

Informed by Evidence

The development of this Strategy has been informed by modelling the local energy system using EnergyPath Networks, a local whole energy system design and planning analysis framework, used to investigate potential decarbonisation pathways for energy supply and demand and compare the cost-effectiveness of different routes to reduce the borough's carbon emissions by 2050².

Future Local Energy Scenarios

The EnergyPath Networks analysis involved the investigation of many possible future local energy scenarios. Of these, three main scenarios have been selected by the stakeholder group to demonstrate potential pathways for the decarbonisation of Bridgend's energy system. These scenarios are intended to

¹ Bridgend County Borough Council, Smart Systems and Heat, June 2014 Submission in response to Request for Proposal to participate in Local Area Energy Planning pilot study

² A detailed and comprehensive supporting Evidence Base document summarises this EnergyPath Networks analysis.

provide three alternative visions of Bridgend's future energy system to 2050, dependent on what actions are taken to reduce carbon emissions.

- **Business-as-Usual.** This scenario assumes national electricity generation will decarbonise but there is no coordinated focus to decarbonise heat. This results in a **58%** reduction in carbon emissions³ from a 1990 baseline. The total discounted energy and system cost to 2050 is **£6.6 billion**⁴.
- **A World Without Green Gas.** This scenario assumes there is a local focus on decarbonising heat; reducing local carbon emissions by 95% from a 1990 baseline. This considers various options to decarbonise including the use of electricity, biofuel and heat supplied through heat networks to provide heat. It assumes the gas network will not decarbonise significantly by 2050. High proportions of heat pump based heating systems (78%) are used to provide heat to homes, with circa 15% of homes served by heat networks; replacing the use of gas fired boilers. This scenario costs **£0.8 billion more** than business as usual.
- **A World with Green Gas.** This scenario also assumes there is a local focus on decarbonising heat, however it considers the availability of green gas that can be blended with natural gas, again reducing local carbon emissions by 95% from a 1990 baseline. This scenario has a higher proportion of homes using hybrid heating systems (+3.5%) and connected to heat networks (+3.5%) than the World Without Green Gas scenario and a lower proportion of high temperature electric air source heat pumps (-7.5%). This scenario is estimated to cost **£0.7b billion more** than business as usual.

The Role of this Strategy in Supporting a Smart Low Carbon Energy System

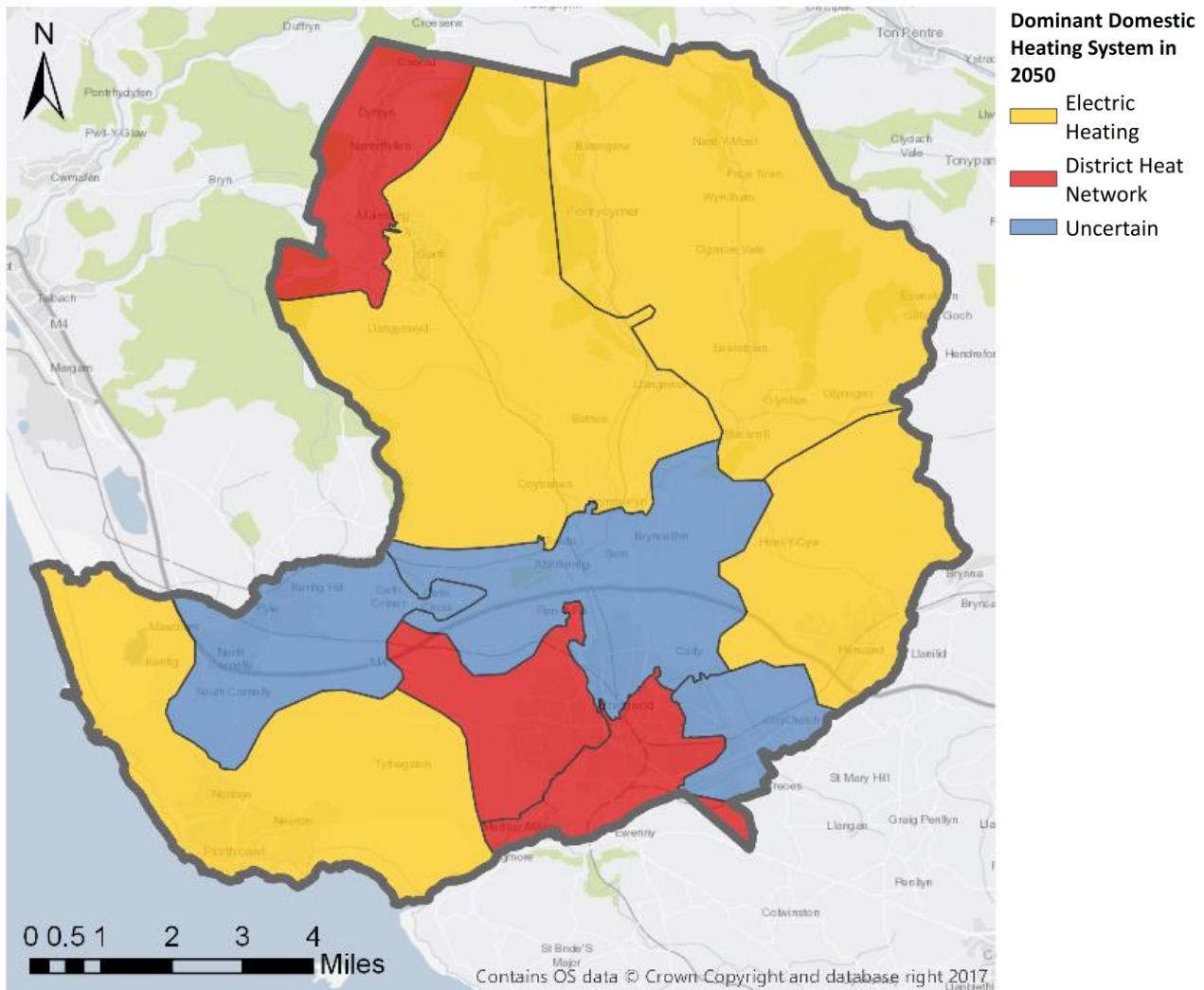
In addition to developing these scenarios, the options and choices for future energy networks in specific areas of Bridgend have been investigated (as illustrated in the Figure 1-1). To cost effectively deliver Bridgend's vision this is likely to involve a combination of electrification of heating through heat pump systems and connection of existing homes to heat networks. This is informed by assessing trends for decarbonising homes from many possible decarbonisation pathways using EnergyPath Networks.

This approach provides the basis of this Strategy, through identifying recurring low carbon transition themes to be explored and tested further. This Strategy recognises that there are various uncertainties associated with the decarbonisation options. Technical, commercial, policy and regulatory barriers are identified which need to be overcome before confident local energy system decisions and long-term network choices are made. A key aspect of this Strategy is to test and demonstrate how the transition of Bridgend's energy system can be delivered, acknowledging that there is a window of opportunity for Bridgend to plan for transition of the local energy system.

³CO₂ Emissions associated with providing all electricity, gas & other fuels to domestic, industrial and commercial buildings and large industrial installations; including electricity emissions associated with domestic electric vehicles.

⁴ The total systems costs presented (and discussed throughout this Strategy) include network reinforcement, energy network/infrastructure new build and operation, changes to individual homes (including heating system changes and fabric retrofit) and the cost of the energy consumed.

Figure 1-1 Dominant heating system transitions to 2050



Moving this Strategy Forward

To take this Strategy forward, three key areas of focus are defined, outlining areas for the council to concentrate on as it progresses this Local Area Energy Strategy, these are:

- **An on-going whole system approach to Local Area Energy Planning**

The following activities provide initial recommendations to take forward over the next few years, to continue the local area energy planning approach that has been initiated. Recognising that further activity will be required as the process of local area energy planning evolves.

- Set a local carbon emissions target.
- Establish on-going whole system planning dialogue with energy network operators.
- Work with Welsh Government to ensure that national policy aligns to local policy.
- Work with Welsh Government to determine an on-going whole system local area energy planning process.
- Support low carbon product and service developers to innovate in Bridgend.
- Develop a suitable governance framework.

- **A focus on innovation to unlock the barriers to decarbonisation of heat.**

This can be achieved through developing decarbonisation options into more mature solutions. This is important as many aspects of enabling the decarbonisation of the borough's buildings are outside of the council's direct control. However, the council can directly influence this aspect through facilitating the Development & Demonstration of the decarbonisation options discussed in this Strategy. This is significant, so that the council can focus its resources on the activity that will provide the most benefit.

▪ **Implementation of the Near-Term Delivery Plan**

This strategy has identified five key activities to progress in the near term. These have been developed in response to the recurring transition themes identified through the whole system analysis; in support of Bridgend's vision and consultation with key stakeholders. The council will need to determine how, when and by whom these activities are taken forward, whether as council led initiatives, public/private partnerships or through innovators and industry.

- Better targeted retrofit.
- Developing and testing compelling customer propositions for hybrid heat pumps.
- Overcoming barriers to transitioning existing homes from gas to heat networks.
- Reducing costs of heat networks in urban centres and expanding to connect existing homes.
- Developing and testing compelling customer propositions for electric heating (heat pumps) including targeting able to pay/early adopters through council services.

Realising the benefits of low carbon transition

Decarbonisation will require the majority of households in Bridgend to decide to replace gas boilers with a low carbon heating system. Breaking the established boiler replacement cycle is unlikely unless new heating systems and products, new energy service business models and compelling customer propositions for the mass market are developed; a major transformation of the energy market is needed which may require policy and regulatory intervention. This means that there is a window of opportunity to effectively plan for major network choices and to develop, test and demonstrate integrated low carbon solutions for mass market adoption, providing confidence to investors and Bridgend's residents and businesses to develop and adopt them.

The council is already making progress, for example, as part of the Smart Systems and Heat Phase 2 programme Bridgend is working with the Energy Systems Catapult in trialling the type of advanced home energy management control that could become prevalent in homes over the next decade, supporting the design of more appealing low carbon heating solutions for consumers. It is also working on the development of the Caerau Heat Scheme⁵ which aims to use local renewable resources to support transitioning existing homes from gas boilers to a low carbon heat network. However, many more benefits are available from implementing this Strategy, including:

- **Jobs and economic growth** – Delivering the transition will create jobs and economic growth. There is also an opportunity to develop the high value jobs that will be needed to enable the transition.

⁵ <http://www.bridgend.gov.uk/media-centre/2018/january-2018/19-01-2018-65m-awarded-for-uk-s-first-large-scale-mine-water-energy-project.aspx>

- **Transition** to a decentralised low carbon energy system will deliver social and economic benefits including reductions in energy consumption and carbon emissions, and wider benefits such as improvements in health (where homes are made warmer) as well as contributing to national targets to address climate change (refer Socio-Economic Report⁶).
- **Innovation and Collaboration** - Decarbonisation provides significant opportunity for Bridgend and any partnering organisations to develop the systems, technologies, services, business models, governance and funding solutions that will be needed. If Bridgend makes itself a more attractive location for start-ups and large company R&D, new solutions can then be exported throughout Wales, the UK and internationally.
- **Infrastructure Investment.** A clear strategy that sets out Bridgend's approach to decarbonising the area's energy system can provide confidence to investors to invest in the area.
- **Empower Residents and Businesses.** Through providing guidance that can help individuals make informed decisions on the types of energy systems and products they choose, acknowledging that some assets (e.g. a new vehicle or heating system) are significant investments.
- **Fuel poverty.** A new approach provides an opportunity to consider how a future energy system can lead to safeguarding the most vulnerable.
- **Leadership** – The council, collaborating with other key stakeholders such as the Welsh Government and Western Power Distribution and Wales and West Utilities, can act as leading examples and help to influence future strategy and policy at both local and national level.

Implementation Roadmap

This strategy sets out an implementation roadmap to focus resource and help plan for the major change needed to the local energy system if Bridgend is to achieve its ambition of transitioning to a future low carbon decentralised energy system. This includes the role of establishing near-term delivery plans, to test and demonstrate the proposed future energy system through delivery plan activity, to enable energy network and technology choices to be made with more confidence.

⁶ Energy Transition Plan: Policy and Commercial Insights for Energy System Transformation, Feb 2018

Bridgend's Local Area Energy Strategy Roadmap - Present Day to 2032

Prepare now by planning, testing and demonstrating ways to enable energy system change and carrying out low regret activities **Major energy system change rolls out in the medium term and beyond**

Implement Near-term delivery plan	Future delivery plan 1	Future Delivery Plan 2	Future Delivery Plan 3
Better targeted retrofit	Ongoing Data Gathering & Systems Analysis activity - Refining the analysis to make better local decisions		
Developing and testing compelling customer propositions for hybrid heat pumps			
Overcoming barriers to moving homes from gas to district heating	Ongoing Deployment activity - Deploying low carbon solutions where there is the confidence that they are the right choices for the local area		
Reducing costs of heat networks in urban centres and overcoming barriers to connecting existing homes to heat networks			
Developing and testing compelling customer propositions for electric heating targeting able to pay/early adopters through council services	Ongoing Development & Demonstration - Developing the maturity of low carbon options where there is little clarity on how to realise them at scale in the current consumer, commercial and policy/regulatory environment		
Progress Other Activities discussed in Section 5.4			
Progress activities associated with the Ongoing Role of Local Area Energy Planning discussed in section 5.1	Ongoing Research activity - Assessing potential options that might be attractive in the long term if certain technical, commercial and /or policy barriers can be overcome		
2018 to 2022	2023 to 2027	2028 to 2032	2032 +

Key

- Recommended key activities to progress over the next 5 years
- Other activity to progress over the next few years
- Further activity expected to be needed and delivered through future delivery plans until there is greater certainty to make network choices

Continuous evaluation of this Strategy. Assessing potential impacts. Maintaining or amending this Strategy as necessary. Working with key stakeholders to collaboratively plan future activities to help shape Bridgend's future energy system

1 Introduction

1.1 Purpose of the Local Area Energy Strategy

This Local Area Energy Strategy provides an approach to support Bridgend County Borough Council transition from the current national centralised energy system to a future decentralised and low carbon energy system. This Strategy sets out the vision, objectives and roadmap to enable the transition.

This Strategy has been developed through investigating:

- **The potential pathways, using EnergyPath Network analysis, to decarbonise Bridgend's buildings cost effectively.**
- **The changes needed to Bridgend's buildings and energy networks based on the pathways.**
- **The innovation opportunities available to the local area through decarbonising heat.**

It sits alongside the local area's other spatial planning activities, and those of the Welsh Government and other agencies and authorities. It aims to inform the decisions needed to achieve the ambition of transitioning to a decentralised low carbon energy system.

The production of this Strategy has drawn upon close collaboration with a stakeholder group consisting of Bridgend County Borough Council, the Welsh Government, Western Power Distribution and Wales and the West Utilities and the Energy Systems Catapult.

This Strategy recognises that it will be necessary to largely eliminate heat related carbon emissions by 2050⁷ and there has been little progress made to date in a static market with just 4% of homes in the UK having low carbon heating⁸, whereas the decarbonisation of the electricity used in buildings is well underway⁹. It sets out a vision to decarbonise Bridgend's buildings by 95% from a 1990 baseline by 2050. Studies have shown the elimination of carbon emissions from buildings is more cost effective than deeper cuts in other energy sectors such as goods transport and international travel¹⁰. In time the approach to local energy planning can evolve to consider emissions from other energy uses such as industry and transportation.

Who is it for?

This Strategy has been developed primarily for the council, to support the transition to a low-carbon future, based on the council's priorities of economic growth, job creation and reduced fuel poverty. It acknowledges that the council alone could not realise this ambition: action by several key stakeholders including network operators is also needed. Therefore, it focuses on the areas that the council can influence.

Recognising that the transition requires action by various stakeholders, the Strategy aims to aid their planning and decision-making processes. A sector-wide transformation of market structure is needed to

⁷ October 2016, Next Steps for UK heat policy, Committee on Climate Change

⁸ ETI 2015 Consumer Insight

⁹ <https://www.gov.uk/government/publications/decc-single-departmental-plan-2015-to-2020/single-departmental-plan-2015-to-2020>

¹⁰ <http://www.eti.co.uk/insights/heat-insight-decarbonising-heat-for-uk-homes/>

consider and then enable the regulatory, policy and planning changes required to facilitate a low carbon future. This Strategy assumes that major physical work to energy networks and systems will take place in the medium to long-term, starting approximately from 2030. Therefore, these key stakeholders will need to work on this challenge over the next decade, to provide the guidance and governance mechanisms to deliver the transition. National Government plans to determine its position regarding the long-term future of heat¹¹ in the period 2020 to 2025 and this will drive future decision making.

This Strategy acknowledges that the council cannot deliver the transition by itself, but it can take a lead role. It is best placed to guide the transition so that it considers and benefits Bridgend's residents and businesses, just as local government does in other areas such as spatial and transport planning.

What does it provide?

This Strategy is released with the intention that the council takes it forward in their preferred format. It is underpinned by a technical Evidence Base, which is published separately and presents the results of an EnergyPath Networks modelling study. It is also supported by a Socio-economic and Policy Evaluation for Energy System Transformation report, which offers suggestions on interventions that the council and the Welsh Government could implement to enable the transition.

The EnergyPath Network analysis investigated least-cost decarbonisation pathways, considering a range of possible options for decarbonising heat which are appropriate and technically feasible in Bridgend (refer to Evidence Base). This process identified several cost-optimal decarbonisation technologies, based on the use of fabric retrofit, heat pumps (and hybrid gas/electric heating solutions) and district heat networks. Heat pumps and district heat networks are the most commonly identified options.

The EnergyPath Network analysis was also used to develop three core decarbonisation scenarios, based on investigation of many different future local energy scenarios and associated sensitivity analyses, and input from the council and other key stakeholders. These core scenarios illustrate credible pathways for Bridgend's future local energy system. They illustrate the scale and cost of potential change, along with the technologies that could be part of the local energy system.

Central to this Strategy is a map of Bridgend's proposed future energy system, illustrating potential network choices to decarbonise the local energy system, based on the identification of recurring transition themes in different parts of Bridgend.

Consumer, commercial and policy factors are then considered. This Strategy recognises that current market conditions make it hard to move away from today's energy system because, for example, there is currently no clear commercial route to market for heat networks and heat pumps in owner-occupied homes. It is therefore considered too early to make definitive network choices. However, this Strategy highlights opportunities for the council and other organisations to develop and test the solutions needed to overcome these barriers. Specific activities are identified to test the future energy system before any network choices are made. The activities are also designed to support the council's priorities of economic growth, job creation and reduced fuel poverty. The council can seek new partnerships and funding opportunities to facilitate this.

A roadmap is provided to help manage delivery of the Strategy, along with the activities, and recommendations to review and evolve it over time. The Strategy aims to focus local effort and resources on testing and demonstrating solutions to enable the proposed future energy system, as well as carrying

¹¹ HM Government, Government Response to the CCC, 2017 Report to Parliament - Meeting Carbon Budgets

out low regret activities where relevant. This testing and demonstration phase is expected to last until there is enough certainty to make firm network choices. Other stakeholders will also be working on these challenges, so it is difficult to forecast how long this will take, however, this Strategy assumes that there is a ten to fifteen-year window of opportunity before choices must be made. As such, the Strategy's roadmap illustrates a lifetime to 2032, based on taking forward activity defined in near-term delivery plans that have a 5-year timeframe.

1.2 Context

Addressing Climate Change

The case for addressing climate change is overwhelming, and one of the defining issues of our time¹². The UK has responded through committing to a legally binding obligation to cut greenhouse gas emissions by 80% by 2050 (against 1990 levels)¹³. The UK is the first country to set legally binding carbon budgets to support achieving the obligation. These place a restriction on the total amount of greenhouse gases the UK can emit over a 5-year period. The current (third) carbon budget applies for the period 2018 to 2022. In its latest annual report to parliament (published in March 2018), a 41% reduction in emissions from the 1990 base year were reported¹⁴.

Climate Change - Welsh Government Approach

The Welsh Government approach for tackling the causes and effects of climate change is set out in their Climate Change Strategy for Wales¹⁵. The Bridgend Local Area Energy Strategy will need to consider and align with relevant and evolving Welsh Government guidance regarding climate change and energy such as:

- **The Environment (Wales) Act 2016** This sets out the approach to help Wales reduce its carbon emissions and sets a minimum of 80% emission reduction by 2050. This will be achieved through the setting of interim targets for 2020, 2030 and 2040 and five yearly carbon budgets. The Welsh Government will be laying regulations around their interim targets and first two carbon budgets by the end of 2018 and shortly afterwards by publishing a Low Carbon Delivery Plan.
- **Planning Policy Wales** – This has been under consultation until May 2018 and the conclusion of this process should be evaluated. For instance, it states that “Planning authorities should develop an evidence base to inform the development of renewable and low carbon energy policies. Planning authorities should consider the contribution that can be made by their local area towards carbon emission reduction and renewable and low carbon energy production, they are asked to assess the potential for renewable energy in their area and to set local targets in their local development plans”.
- **Renewable Energy Targets** - Welsh Government has set renewable energy targets of generating 70 per cent of Wales' electricity consumption from renewables by 2030, that 1 GW of renewable electricity capacity in Wales to be locally owned by 2030 and Renewable energy projects to have at least an element of local ownership by 2020

¹² <http://en.unesco.org/themes/addressing-climate-change>

¹³ <https://www.legislation.gov.uk/ukpga/2008/27>

¹⁴ <https://www.gov.uk/government/publications/annual-statement-of-emissions-for-2016>

¹⁵ <http://gov.wales/topics/environmentcountryside/climatechange/emissions/climate-change-strategy-for-wales/?lang=en>

The Decarbonisation of Heat

Energy use in buildings is a significant contributor to carbon emissions. Heating accounts for over 40%¹⁶ of the UK's total demand for energy. Decarbonising heat, and, domestic heat, is critical to achieve a decentralised low carbon energy system. 96% of Bridgend's domestic heating in homes is by natural gas, with little incentive for consumers to change. Previous emissions reductions have been achieved through relatively simple and cheap measures with clear benefits to households (e.g. cavity and loft insulation and boiler replacement). This challenge provides the context for this Local Area Energy Strategy, recognising that a new, whole system approach to planning and delivering local energy systems is vital, to create a resilient, low carbon energy system for the future. Further information can be gained by referring to ETI Insight Papers: Options, Choices and Actions¹⁷, Housing Retrofits, A New Start¹⁸, Decarbonising Heat for UK Homes¹⁹, How Can People Get the Heat They Want at Home Without the Carbon²⁰.

The Low Carbon Transition

Delivering a cost effective and socially accepted low carbon transition will require change to existing energy infrastructure and the types of energy that are supplied to buildings; as well as how, and when, they are used. The transition will involve switching from using fossil fuels and natural gas fired boilers to other forms of energy and heating systems, this could involve many possible components such as greater uptake of heat networks; the electrification of heating; upgraded electricity networks; repurposed or decommissioned gas grids; improving the efficiency of buildings; and systems to manage and control how energy is used in buildings.

A Whole Energy System Perspective

This Strategy will need to consider any potential change to one part of the energy system as a component of a whole energy system, as a decision on any one element could have an impact across the whole system. For example, this Strategy includes an assumption that a proportion of Bridgend's residents (primarily those with off-road parking) will switch to electric vehicles by 2050²¹. If this significantly changes then the impact on the electricity network and options for decarbonising heat using electrically based systems may need to be reconsidered. Section 5.2 provides an approach for reviewing potential change. Options for decarbonising all of the local area's transportation and industry will need to be considered in conjunction with the decarbonisation of heat.

Barriers to Decarbonisation

Achieving a desirable and effective transition will require an integrated energy system, reflecting local priorities and constraints. Policy or regulatory barriers which impede Bridgend's transition will need to be overcome. Funding will need to be drawn from public and private sources who will expect a return on their investment over a specified payback period. Consideration will be needed to work out how to work

¹⁶ October 2016, Next Steps for UK heat policy, Committee on Climate Change

¹⁷ <http://www.eti.co.uk/insights/options-choices-actions-uk-scenarios-for-a-low-carbon-energy-system/>

¹⁸ <http://www.eti.co.uk/insights/housing-retrofits-a-new-start>

¹⁹ <http://www.eti.co.uk/insights/heat-insight-decarbonising-heat-for-uk-homes>

²⁰ <http://www.eti.co.uk/insights/how-can-people-get-the-heat-they-want-without-the-carbon>

²¹ Electric vehicle charging profiles are based upon assumed take-up rates for electric vehicles and are based on car journeys extracted from the Department for Transport's National Travel Survey. This means that distances travelled (level of charge required) and times of arrival (time of charging) reflect the diversity of real world use. This scenario assumes that electrification continues as the main form of decarbonisation in vehicles, although it is acknowledged that this is only an assumption and that the actual situation can differ, dependent on factors such as the development and uptake of hydrogen vehicles.

with and influence the actions the key stakeholders described in Section 2.3.4, as their choices and actions will impact Bridgend's future energy system. Refer Douglas J, 2015, Decarbonising Heat for UK Homes, ETI Insight Paper²².

1.3 Key Influences

The following four sections discuss some of the key aspects that have influenced the development of this Strategy.

1.3.1 This Strategy's Vision

To transition Bridgend from the current national centralised energy system to a future low carbon decentralised energy system that works for its people, communities and businesses. Enabling investment, economic growth and employment opportunities for the region.

1.3.2 Objectives

The following objectives have been developed to support this Strategy's Vision and to enable the council to oversee and guide the important energy network related decisions and interventions that are required to decarbonise Bridgend's buildings.

- **Future Energy Approach** - To provide a whole energy system based strategy and roadmap, based on exploring many possible future pathways and defining possible future local energy scenarios, that indicate what actions are needed to move the area from its current centralised energy system to a future low carbon decentralised energy system. Supported with a Near-term delivery plan to take forward over the next five years and a structure to develop and adapt the Strategy to circa 2032²³.
- **Economic Growth** – To provide opportunities that can create local and regional jobs and economic growth.
- **Emission Reduction** - To support the council in meeting future carbon budget targets, particularly where the Welsh Government determines its approach to carbon emissions reduction.
- **Investment** - To guide and facilitate investment in the areas energy networks and systems and better connect energy network decisions; recognising that current practice means that energy network decisions are made independently, without considering the whole energy system.
- **Activity Prioritisation** - To identify and prioritise activities that can help the council achieve its decarbonisation aspirations. To also demonstrate innovation in the areas of reducing carbon emissions, improving energy security, providing affordable energy and reducing fuel poverty.

²² <http://www.eti.co.uk/insights/heat-insight-decarbonising-heat-for-uk-homes>

²³ The Strategy is based on progressing delivery plans that have a 5-year timeframe. Delivery plans will be needed until there is certainty to adapt the areas energy system. The 2032 timeframe is based on the provision of three 5-year delivery plans

- **Local area energy planning approach** – To support an objective, evidence based and data driven local area energy planning approach that can be scaled up throughout Wales and better connected with other local planning functions.

1.3.3 Opportunities & Challenges

This section discusses the opportunities available from implementing this Strategy and the challenges surrounding decarbonisation and local area energy planning. Delivering a cost effective and socially desirable low carbon transition will require significant change to the way energy is currently generated, stored, distributed and consumed.

Opportunities

There is a significant opportunity to shape Bridgend's future energy system, providing an opportunity to cost effectively design the local energy system and inform energy network choices, thus avoiding the potential of investing in energy system stranded assets. This has the benefit of managing uncertainty, creating jobs and investing in low carbon infrastructure, and importantly creating a better, healthier and cleaner environment for citizens and future generations.

- **Jobs and economic growth** – Delivering the transition will create jobs and economic growth. There is also an opportunity to develop the high value jobs that will be needed to enable the transition.
- **Innovation and Collaboration** - Decarbonisation provides significant opportunity for Bridgend and any partnering organisations to develop the systems, technologies, services, business models, governance and funding solutions that will be needed. If Bridgend makes itself a more attractive location for start-ups and large company R&D activities, new solutions can then be exported throughout, Wales, the UK and internationally.
- **Infrastructure Investment** - A clear strategy setting out Bridgend's approach to decarbonising the local areas energy system can provide confidence to investors to invest in the area.
- **Empower Residents and Businesses** - Through providing guidance that can help individuals make informed decisions on the types of energy systems and products they choose, acknowledging that some assets (e.g. a new vehicle or heating system) are significant investments.
- **Fuel poverty** - A new approach will create an opportunity to consider how a future energy system can lead to safeguarding the most vulnerable.
- **Leadership** - The council can demonstrate leadership, working with other key stakeholders such as the Welsh Government and Western Power Distribution and Wales and West Utilities, can demonstrate leadership and influence the necessary direction of future strategy and policy at both local and national level.

Innovation is important, it can support economic growth in Bridgend by attracting investment in new and low carbon energy infrastructure and systems, providing new skills and employment opportunities.

Challenges

- Considering the cost to society, recognising that there will be a cost to decarbonise over the cost of maintaining the current system (referred to as Business-As-Usual (BAU) throughout this Strategy).
- Changes to the way energy is provided and used today. Such as the electrification of transport and moving away from the dominance of fossil fuels to new ways to heat buildings.
- Significant change to existing energy infrastructure and building heating systems, along with advances in technology, connectivity and digitisation.
- The role of the council in influencing the transition recognising the council's current responsibilities and resources.
- Removing barriers and reducing the risk associated with new low carbon systems; to allow more confident decisions to be made regarding changing energy networks and systems.
- The need to develop mechanisms, skills and supply chains to deliver new systems rapidly, at scale.

1.3.4 Key Stakeholders

This Strategy has been developed for Bridgend County Borough Council. Taking this Strategy forward will require collaboration with and consideration of many key stakeholders including the Welsh Government, UK Government, the energy industry (including the electricity and gas network operators), energy retailers, product developers, innovators, property investors and Bridgend's residents and businesses. This section explains the roles and relationships between the various key stakeholders, summarised in Table 1-1, that will influence the successful delivery of this Strategy.

Local ambition cannot be achieved without the national energy system adapting (such as the decarbonisation of the electricity system) and the council is aware of the influence of national decisions (including policy and regulation) and their effect on the local energy landscape. Organisations will need to develop low carbon products and solutions with mass market appeal; recognising that there has been little uptake of low carbon heating system to date. Decarbonisation will be reliant on building owners and individuals changing from business-as-usual (e.g. using fossil fuels for heating) to adopting new low carbon products or solutions. This will need a market transformation which is much more likely to be successful under a supportive carbon policy environment. Market transformations are not uncommon if the market can provide the right solutions, such as the uptake of broadband in the telecoms sector, where consumers were willing to pay more for a better experience (replacing dial-up internet).

Table 1-1 Key Stakeholders

Stakeholder	Relationship with the Strategy
National Government (including Regulators)	Establish UK level energy system policy, decisions and regulation that can influence and affect Bridgend's current and future energy system.
Welsh Government	Establish Welsh Government energy, climate change and emission reduction related policy, decisions and regulation that can influence and affect Bridgend's current and future energy system.
Bridgend County Borough Council and other Local Government	Bridgend County Borough Council can support the transition by providing local leadership and guidance. It can also use its current planning remit to make decisions on energy related aspects e.g. land allocation for new energy generation systems and infrastructure. Bridgend County Borough Council should also work with other regional Local Government organisations, such as the Cardiff Capital Region to ensure a coordinated approach for the region.
Western Power Distribution & Wales and West Utilities (Network operators)	Own and operate Bridgend's current energy networks. Consideration will be needed to plan what changes will be needed to energy networks (including potential new and adapted networks) to enable Bridgend's low carbon future.
Energy sector organisations such as energy generators & suppliers and energy service & product / technology providers	These organisations make decisions on how energy is supplied to and used by Bridgend's residents and businesses. Decarbonisation will require new and improved ways of providing Bridgend's energy along with new low carbon products and services.
Bridgend's residents, businesses, industry and building owners	Decarbonisation will mean that these key stakeholders will use energy differently (such as charging electric vehicles) and will need to use new types of products and services to provide heat.

This Strategy has been developed with these key stakeholders in mind, to provide a framework and evidence base to support their decision-making process. A low carbon future can only be achieved through acknowledging that coordination is essential as these key stakeholders will make many interdependent choices and decisions that can impact the whole energy system. In addition, it is important to highlight that local area energy planning cannot be viewed in isolation from the wider national energy system as "decisions taken in one locality can affect the interests of consumers in another"²⁴.

This Local Area Energy Strategy has been developed to support the key stakeholders through providing vital insight into potential future energy infrastructure changes and investment needs from a whole system perspective.

²⁴ https://www.ofgem.gov.uk/system/files/docs/2017/01/ofgem_future_insights_series_3_local_energy_final_300117.pdf

2 Bridgend's Local Energy System

This Strategy focuses on developing an approach to meet the area's current and future energy demand whilst ensuring security of supply and affordability for the people and businesses of Bridgend. Consideration is also needed to ensure that Bridgend's future energy system can meet changing expectations of consumers for comfort and smart control, but within the constraint of a carbon target that falls to near-zero by 2050.

2.1 Current & Future Energy Demands

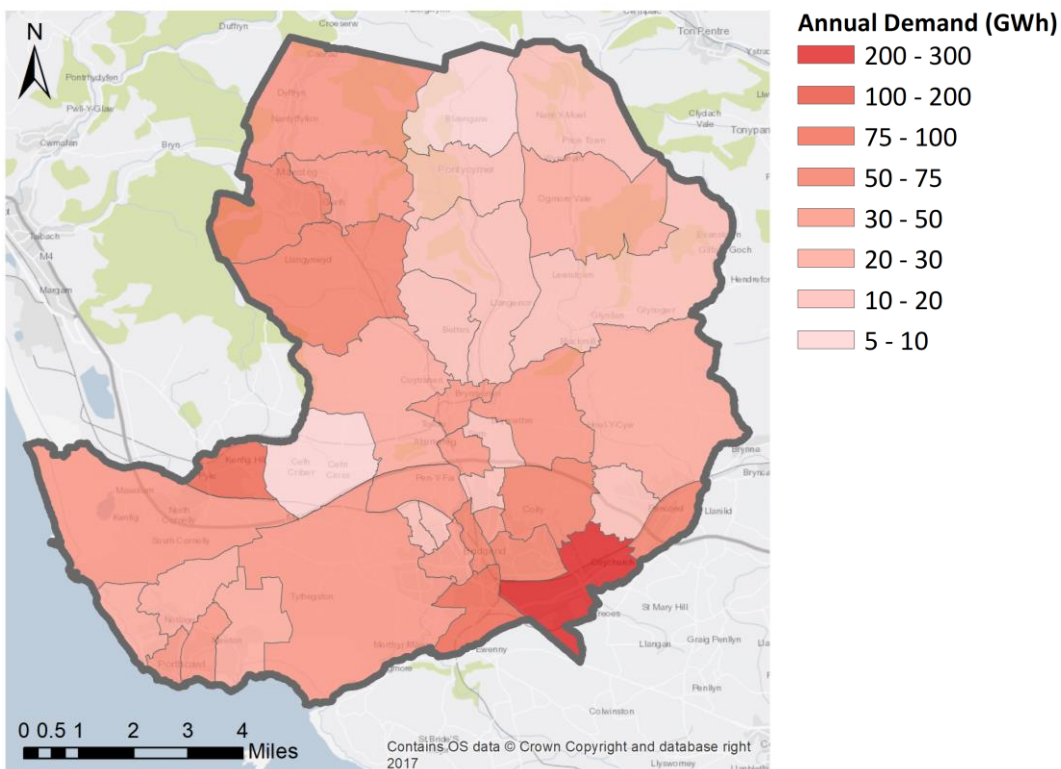
2.1.1 The Local Area

The Bridgend County Borough covers 255 km² and has a population of approximately 142,000. There are around 62,000 domestic buildings, of which 3% (2,060) are not connected to the gas network, and 5,600 non-domestic buildings.

The modelled local electricity network consists of 10 high voltage and 759 low voltage sub stations. The local electricity network is made up of a network length of approx. 3,340 km.

The annual gas and electricity demands in 2016 for Bridgend were 1,259 GWh and 616 GWh respectively shown by ward in Figure 2-1.

Figure 2-1 Energy Used for Heat in Bridgend's Buildings²⁵



²⁵ Domestic and non-domestic buildings (non-domestic includes gas used for process use)

Bridgend uses 3,416 GWh/year of energy

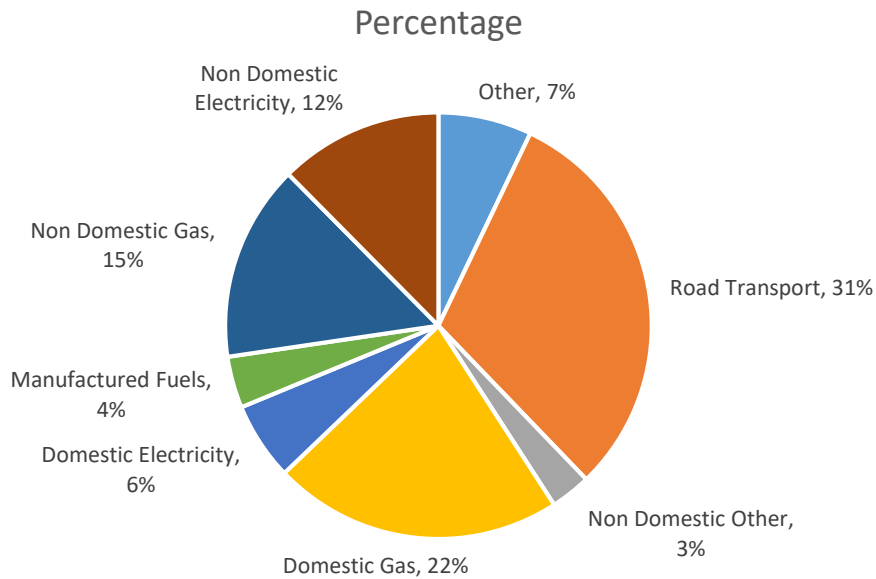


Figure 2-2 Breakdown of Bridgend's Energy Use²⁶

A breakdown of Bridgend’s energy use is shown in Figure 2-2.

- **28%** of Bridgend’s energy use is attributed to the domestic sector. 37% is used by the non-domestic sector and the majority of the remainder is used by the road transport sector (31%).
- Gas is the primary heating fuel for homes in Bridgend (**22% of all energy**), with domestic electricity consumption accounting for 6%.

Bridgend has a wide range of housing types of different ages which influences energy consumption.

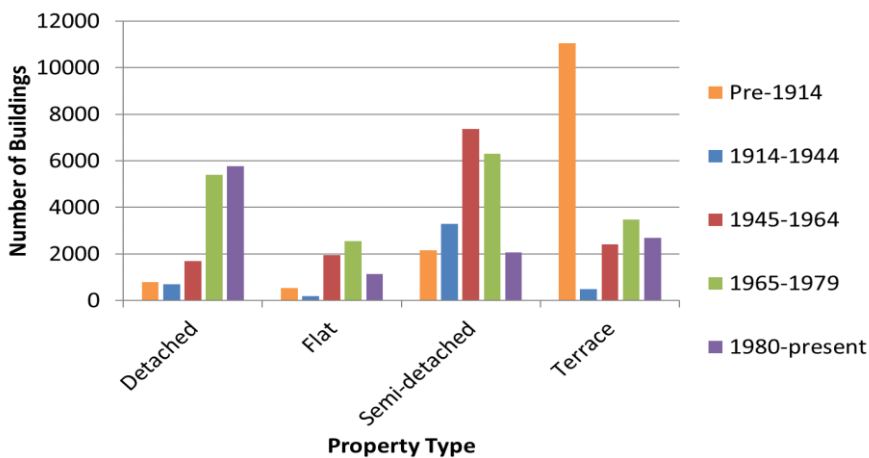


Figure 2-3 Breakdown of Bridgend's Housing Types and Age Including Planned New Homes

²⁶ BEIS, Sub-national total final energy consumption data, 29TH September 2016. Road transport represents the energy used (tonnes of oil equivalent) by all road using vehicles, based on fuel consumed (i.e. petrol and diesel), within the borough in a year.

A breakdown of Bridgend's housing types and age is shown in Figure 2-3.

- The greatest proportion of Bridgend's housing stock was built between **1965-1979**, with approximately **21%** being **pre-1914** and over **20%** built **between World War 1 and 2**. The pre-1914 and some of the world war 1 to 2 stock are generally more difficult to treat from an energy efficiency perspective²⁷.
- **23% of Bridgend households** are estimated to be in **fuel poverty**²⁸ with the greatest areas of fuel poverty concentrated in Nant-y-moel, Pontycymmer, Caerau and Bleangarw.
- **76% of homes are owner occupied and 10% are private rented versus a 14% of social housing stock**²⁹. Therefore, the council has little influence over **86%** of the housing stock. Consumer/commercial solutions will need to be found for decarbonising the owner-occupier and private rented homes. This has traditionally not been a priority for the council and will require a new way of thinking.
- Most of **the existing homes in Bridgend are likely to be still in use by 2050**. Identifying cost effective pathways for the domestic retrofit of energy efficiency and low carbon heating systems to these homes is essential to support Bridgend's long-term decarbonisation targets.

Bridgend also has a wide range of non-domestic buildings

There are a broad range of building types in Bridgend that make up the 5,600 non-domestic buildings. The total floor area for the top nine combined archetypes is illustrated in Figure 2-4. The greatest proportion of floor area is classed as factory type. This sector also generally has a higher average energy use per square metre than other types, particularly in the industrial and manufacturing sectors.

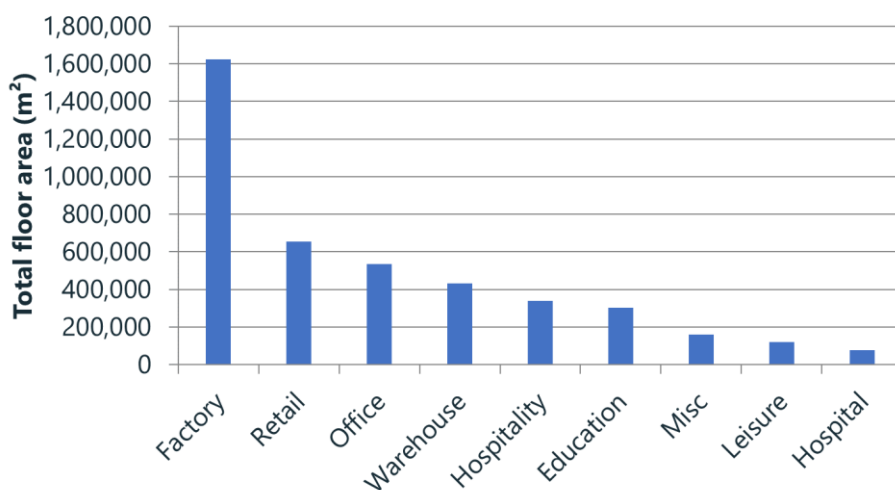


Figure 2-4 Non-Domestic Building Archetypes by Floor Area (top nine categories)

The council should increase its understanding of Bridgend's non-domestic buildings (as recommended in Section 5.4.1), so that it can further develop this Strategy. This will involve understanding how and where energy is used, recognising that there are many aspects to consider. For example, energy use in sectors

²⁷ These homes are generally more expensive to insulate than home built with cavity walls suitable for retrofit cavity wall insulation

²⁸ <http://lle.gov.wales/map/fuelpoverty#b=europa&l=209h,0.8;396h,0.7;398hi,0.7;220,0.5;223h,0.5;263h;&m=-3.37408,51.90948,8>

²⁹ Bridgend County Borough Council, CASH Local Action Plan

such as industry and manufacturing can be diverse and is dependent on a site's activities and processes. Therefore, a robust data set is required for the non-domestic sector in the first instance, so that decarbonisation options can be developed further for Bridgend's non-domestic buildings in the future.

2.1.2 The Modelling Approach

The modelling approach is summarised here and described in detail in the accompanying Evidence Base.

EnergyPath Networks

This Strategy has been supported by EnergyPath Networks. The Energy Technologies Institute (ETI) developed EnergyPath Networks, as part of the Smart Systems and Heat programme³⁰, to support an evidence based whole system approach to local area energy planning. This aims to engage relevant stakeholders to investigate possible cost effective future local energy scenarios and systems designs and better inform future network planning and choices.

Whole System Optimisation

EnergyPath Networks is a whole energy system optimisation analysis framework that provides a robust, technology neutral techno-economic evidence base. It considers the technical aspects of the whole energy system and is built on a detailed local area representation of the energy system. It has been designed in partnership with local authorities to develop cost-effective local energy system options for the UK.

Multi Scenario and Limitations

Using EnergyPath Networks, many possible scenarios have been generated to inform this Strategy. These look across a range of assumptions and constraints to identify lowest-cost decarbonisation pathways for the Bridgend's energy system. It is important to highlight that EnergyPath Networks has its limitations, as will any model of the future. Hence the outcomes that have informed this Strategy cannot provide a conclusive indication of the future. Further information regarding the EnergyPath Networks Modelling Approach is explained in the supporting Evidence Base document.

Consumer, Commercial and Policy/Regulatory Aspects

This Strategy has been informed by the Bridgend Local Area Energy Planning Evidence Base alongside a consideration of related consumer, commercial and policy/regulatory aspects. This is a critical component of effective Local Area Energy Planning. Considering these factors is crucial if informed investment based decisions are to be made in the future.

Future Updates

Future consideration will be needed:

- As the practice of local area energy planning incorporating whole energy system analysis develops.
- To also encompass industry and transportation decarbonisation analysis.
- Considering the relationship between the local system (which this Strategy has focused upon) and the wider regional and national energy systems.

³⁰ <http://www.eti.co.uk/programmes/smart-systems-heat>

2.1.3 Analysis Areas

The EnergyPath Network modelling approach is based on the consideration of ten analysis areas as illustrated in Figure 2-5. This figure shows the relationship between analysis areas and ward boundaries. The analysis areas are based on High Voltage (HV) substations and all buildings and electrical network infrastructure served by them. Due to the number of buildings and the complexity of the energy networks within Bridgend this Strategy takes an area based approach for considering future network choices. Rationale behind this methodology is discussed in the supporting Evidence Base.

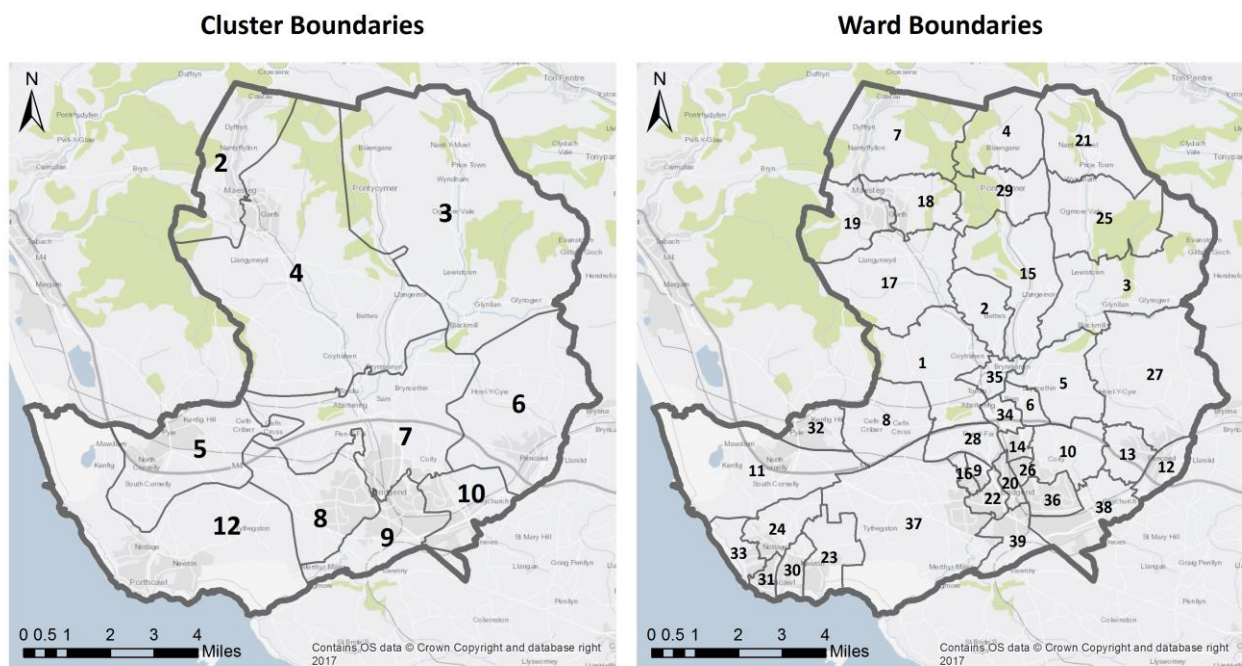


Figure 2-5 Bridgend's Ward Boundaries & Relationship with EnergyPath Networks Analysis Areas

2.1.4 Planned Growth

This Strategy has considered the impact of planned growth from over 5,900 new homes and 1,200 non-domestic buildings in the region³¹ (Figure 2-6). New build homes are assumed to be constructed in accordance with Welsh Government sustainable building standards. Increased energy demand from space heating and hot water demand is estimated at less than 40 GWh/yr. This is around 6% of total heat related energy demand used for buildings in Bridgend. The new gas demand from new homes under business as usual could increase carbon emission by ~7,000 tCO₂/year (equating to circa 1% of assumed 2020 emissions).

³¹ Building types allocated based on the Joint Housing Land Availability Study (JHLAS)

<https://democratic.bridgend.gov.uk/documents/s10059/290916%20-%20JHLAS%202016%20INCLUDING%20APPENDIX.pdf?LLL=0> where details available. Otherwise, breakdown suggested by BCBC planning department was used.

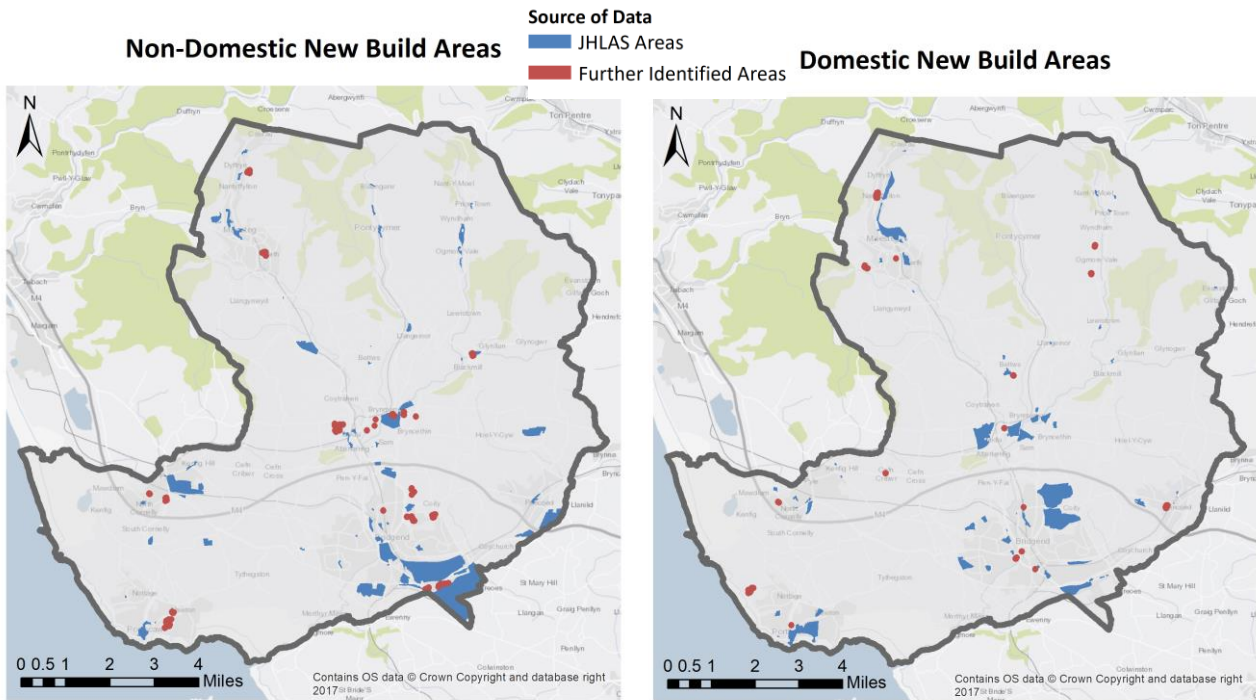


Figure 2-6 Bridgend’s Planned Domestic and Non-Domestic Growth Areas

2.2 Local Carbon Emissions

Reducing carbon emissions from buildings and the local energy system is essential to achieve a low carbon decentralised energy system that works for the borough’s people, communities and businesses. This Strategy has explored cost-effective pathways to decarbonise Bridgend’s buildings.

2.2.1 Scope of Emissions

In scope CO₂ emissions include those associated with providing all electricity, gas & other fuels to domestic, industrial and commercial buildings and large industrial installations. Carbon emissions out of scope relate to those associated with agriculture, land use change and transportation (apart from the electricity associated with the assumed electric vehicle take-up rate discussed in section 1.2 which are in scope).

2.2.2 Local Carbon Target

This Strategy considers a future where carbon emissions associated with providing energy to all buildings are reduced by 95% compared to a 1990 baseline. Figure 2-7 and Table 2-1 illustrate the outcome if this future vision were followed. The 95% local carbon target was agreed with the project stakeholder group. The remaining 5% of emissions are predominantly associated with heat used in the non-domestic sector (such as in manufacturing processes).

Table 2-1 Modelled Emission Reduction in Bridgend Through Delivering the Strategy

Year	Emissions (ktCO ₂ /yr.) ^{32 33}	% Reduction from 1990
1990	1086	
2020	556	49
2030	330	70
2040	154	86
2050	58	95

The table and figure depicts the carbon emissions associated with providing energy to all the borough's buildings (domestic and non-domestic). They show that around a 50% reduction is assumed to have been achieved (by 2020) from 1990 levels predominantly due to a reduction in industrial related carbon emissions. Followed with a further expected reduction to be achieved by 2030 through the assumed decarbonisation of the UK's electricity system. This, of course, is based on electricity decarbonising in-line with the scenario illustrated in Figure 2-8 and any deviation from this would need to be assessed.

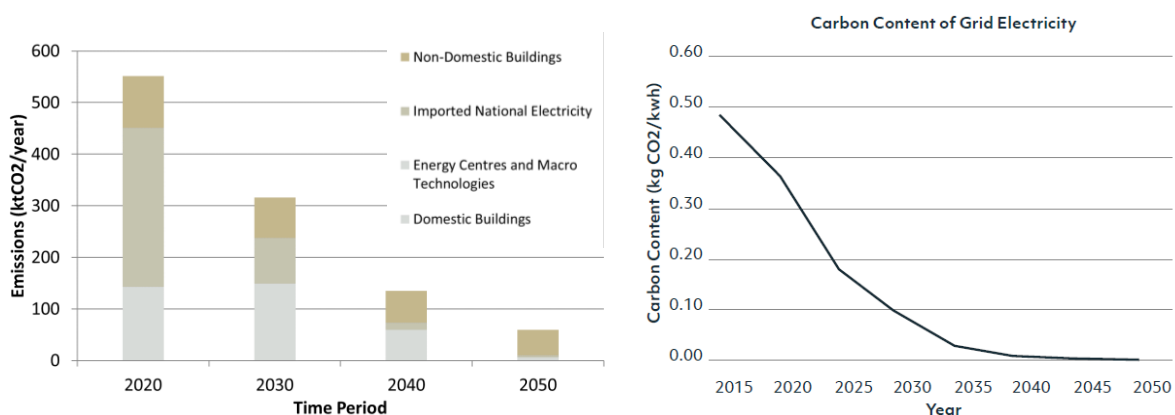


Figure 2-7 Illustrative Carbon Emissions Projection to Decarbonise Bridgend's Buildings by 95% and Figure 2-8 Assumed Grid Decarbonisation³⁴

Figure 2-7 highlights that most carbon emissions associated with domestic buildings are assumed to be eliminated by 2050. The remaining carbon emissions in the 2050 period are predominantly associated with energy use in Bridgend's non-domestic buildings; where future consideration will be needed to determine an approach for reducing these emissions. It is appreciated that it can be more difficult to decarbonise non-domestic carbon emissions, as acknowledged by the Committee on Climate Change³⁵. This Strategy recommends that on-going discussion and consideration of all building and site owners is essential as it is vital to plan for a clean future that provides advantages to the region's businesses and industries.

³² Presented carbon emissions are calculated by EnergyPath Networks. These are derived from a 1990 baseline.

³³ In scope carbon emissions include those associated with: Domestic, Industrial and Commercial electricity, gas & other fuels and large industrial installations. Out of scope relate to carbon emissions associated with: Agriculture, Land Use Change and Transportation.

³⁴ Based on future projections of UK grid carbon sourced from the ETIs ESME model; Patchwork Scenario.

³⁵ <https://www.theccc.org.uk/2015/03/27/industrial-decarbonisation-and-energy-efficiency-roadmaps-to-2050/>

3 Future Local Energy Scenarios

There are many possible energy system pathways to decarbonise Bridgend's energy system and it is not practical to represent every possible scenario. Insights were drawn from over 100 scenarios assessed in the EPN modelling analysis, from which the three most feasible future local energy scenarios were selected for inclusion in the Strategy.

These scenarios have been developed in collaboration with the project stakeholder group using EnergyPath Networks. This process involved incorporating feedback from the stakeholder group to consider factors outside the modelling framework, with the emphasis on ensuring outputs represent cost-effective scenarios for the borough's future energy systems, reflected in a credible and detailed local evidence base, with due regard to local priorities and constraints.

The three scenarios are not intended to predict the future (which would not be possible), but they suggest credible pathways for Bridgend's future local energy system. The scenarios illustrate the technologies and energy systems that are likely to be part of the local energy system dependent on what action is taken. A key objective of presenting these scenarios is to stimulate debate and facilitate an on-going process of local area energy planning.

3.1 Business-as-Usual Scenario

It is important to consider the assumed Business-as-Usual (BAU) scenario. This has been generated for Bridgend using the EnergyPath Networks model of the local area's existing energy system with no local carbon emissions reduction target being set.

The assumption is made that imported national electricity generation will decarbonise driven by national policy initiatives regardless of any local action in Bridgend. This scenario assumes that there will be limited coordination between the key stakeholders to collaboratively adapt the whole energy system and few consumers pro-actively adopting low carbon technologies, with the retention of gas boilers in most homes by 2050.

There is some assumed modest growth of district heating around the town centre, predominantly associated with expansion of the planned town heat network, between now and 2050 under business-as-usual, but no other significant change to heating infrastructure. Natural gas remains the predominant form of heating for most homes and new homes continue to be fitted with gas boilers. Where district heat networks are built, gas fuelled energy centres are utilised in preference to low carbon alternatives. Some retrofit and improvement in the thermal efficiency of Bridgend's existing homes is undertaken, predominantly through low cost measures such as fitting cavity wall, loft insulation and double glazing where this is cost-effective or part of typical refurbishment cycles.

The total energy system cost to 2050 under business-as-usual is estimated at **£6.6b**³⁶. All costs illustrated in this Strategy are discounted³⁷ to 2015 values and represent the total energy cost to society. In general, the business-as-usual scenario represents a continuation of today's market arrangements, with consumers continuing to use and be charged for gas and electricity as they do today (with some change due to expected electric vehicle and district heating uptake), adjusted to account for future cost variation. The modelled reduction in carbon emissions achieved under Business as Usual is illustrated in Figure 3-1 below.

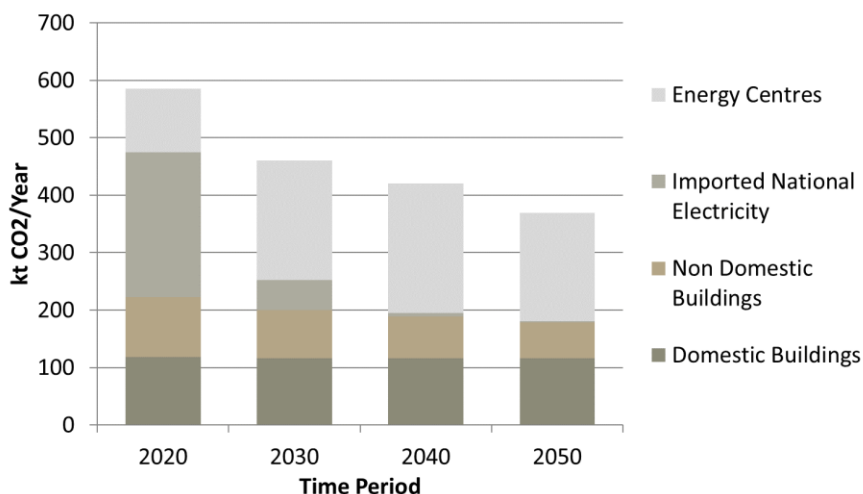


Figure 3-1 Illustrative Carbon Emissions Projection Under BAU

The assumed 2020 CO₂ emissions from energy used in buildings is 586ktCO₂/yr. In the BAU scenario, comparing 2050 CO₂ levels without the implementation of the local decarbonisation target, CO₂ emissions are expected to reduce to 369 ktCO₂/yr. as illustrated in Table 3-1. This reduction is based on the emissions already reduced from 1990 levels and the assumed decarbonisation of the UK's electricity system, expected building retrofit and heating systems changes (predominantly more efficient boilers), along with the increase of Heat Networks³⁸. This scenario equates to a 58% reduction from a 1990 baseline; highlighting that without co-ordinated action to decarbonise heat used in Bridgend's buildings, there is a significant shortfall in achieving the 95% CO₂ emissions reduction target.

Table 3-1 Projected Variation in Carbon Emissions Between BAU and 95% Reduction

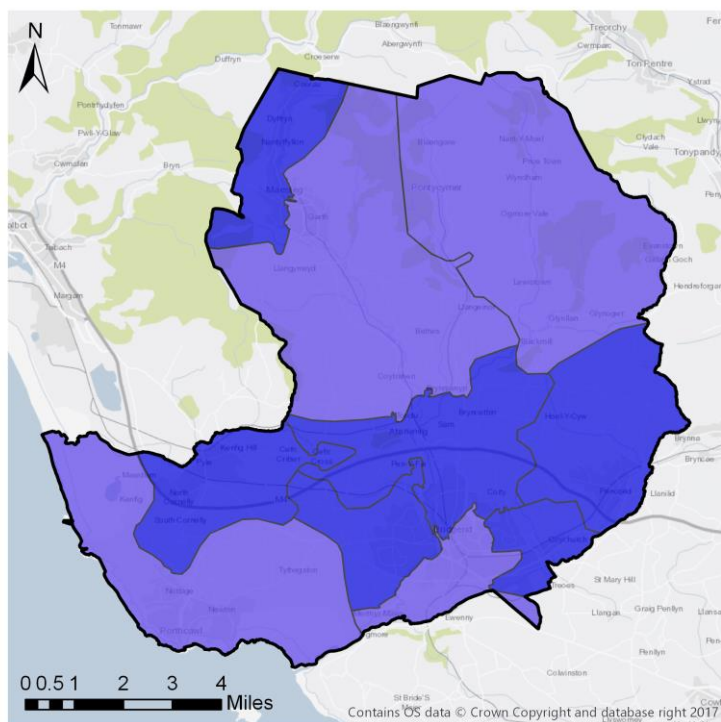
Year	BAU Emissions (ktCO ₂ /yr.)	95% Reduction Emissions (ktCO ₂ /yr.)
1990	1086	1086
2020	586	556
2030	461	330
2040	421	154
2050	369	58

³⁶ The total systems costs presented (and discussed throughout this Strategy) include network reinforcement, energy network/infrastructure new build and operation, changes to individual homes (including heating system changes and fabric retrofit) and the cost of the energy consumed

³⁷ Discounting is a process that accounts for costs and benefits with different time spans to be compared on a present value basis. This is considered as the value of money will vary over time, where due to factors such as inflation, a £ today is worth more than it would be in a years' time.

³⁸ The business-as-usual scenario assumes a small level of heat networks development under current market conditions.

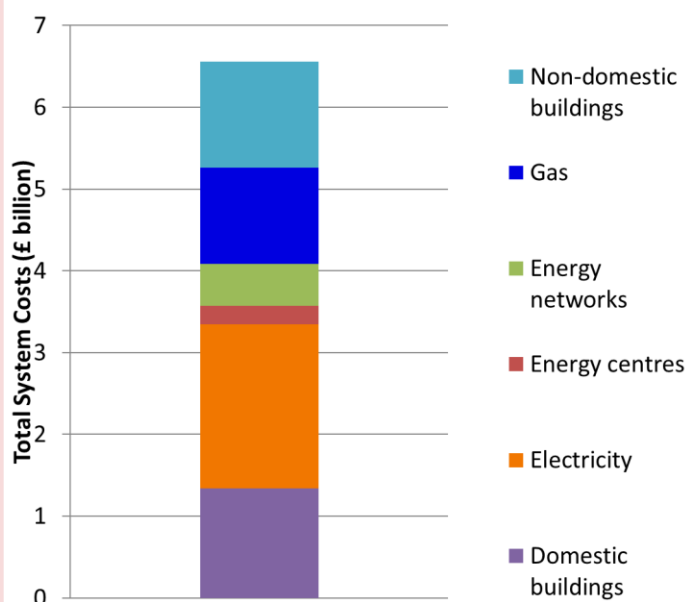
2050 Dominant Heating System Business as Usual



Proportion of Homes with Gas Boiler

- 95% - 100%
- 90% - 95%

Total discounted energy system cost to 2050



Business as Usual

Under BAU no local heat decarbonisation target is set. The scenario assumes national policy will drive decarbonisation but there is no local co-ordinated focus on decarbonising heat.

- By 2050 over 95% of properties remain on gas boilers, less than 2% are connected to a heat network.
- Only 255 non-domestic buildings are connected to a heat network.
- The total discounted energy system cost to 2050 is estimated to be £6.6 billion, attributed to:
 - £2.0b and £1.2b to electricity and gas imports.
 - £1.3b spent on changes to individual homes, this includes heating system changes (replacement of gas boilers) and fabric retrofit. The same amount is spent for non-domestic buildings.
 - £0.23b on building energy centres.
 - £0.5b spent on reinforcing, operating and maintaining gas, electricity and heat networks.
- A small number of energy centres are built for local heat generation, they are powered by gas technologies.
- Gas peak network demand varies from 485 MW (2020) to 451 MW (2050).
- Electricity peak network (at 11kV) demand varies from 205 MW (2020) to 221 MW (2050).
- Heat network peak heat demand increases from 0 MW (2020) to 12 MW (2050).

3.2 Bridgend's Low Carbon Future

Two main low carbon future local energy scenarios have been developed as alternatives to Business-as-Usual and illustrate how Bridgend might cost effectively decarbonise its local energy system.

- **Scenario 1 - A World without Green Gas.** A least cost decarbonisation pathway that considers various options to decarbonise including the use of electricity, biofuel and heat supplied through heat networks to provide heat. It does not assume that the national gas grid will decarbonise, although the use of natural gas is considered where needed.
- **Scenario 2 - A World with Green Gas.** This provides another decarbonisation pathway, based on assessing the potential availability of Green Gas³⁹. This scenario assumes the availability of low carbon gas which is blended with natural gas, assessing what role this could play in contributing to the cost-effective reduction of carbon emissions when considered alongside other options.

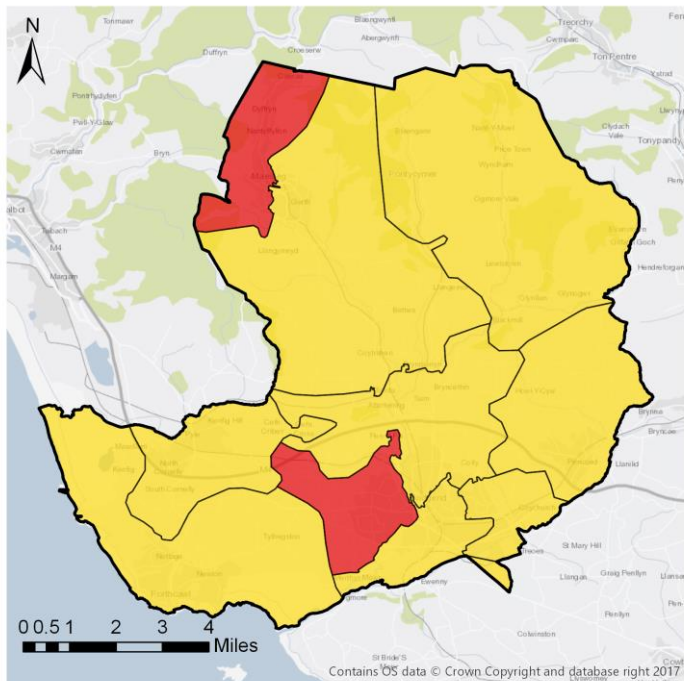
Both these future local energy scenarios are based on transitioning from using fossil fuels to alternative forms of low carbon heating along with a projection of the associated transition cost. They have been developed based on EnergyPath Networks cost-optimisation modelling analysis and outputs. This analysis has been combined with assessment of the practical limitations to network and technology choices that were not considered by the modelling, based on feedback from the project stakeholders group.

The scenarios represent a vision of Bridgend's low carbon future energy system informed by the energy system modelling and analysis using EnergyPath Networks. Whilst the scenarios are a modelled vision of the future, they provide a good indication of the scale of change that will be needed to transition to a decarbonised energy system.

Importantly, the costs discussed are entirely dependent on transitioning to a modelled, low carbon future. This means that the modelled scenarios assume a well-managed low carbon transition. In reality, it is appreciated that the transition will not follow an orderly modelled view of the future. This will of course impact the actual cost of decarbonisation.

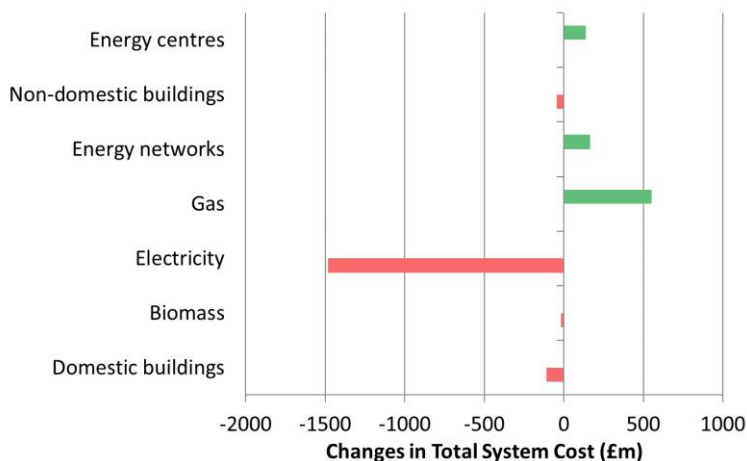
³⁹ Green Gas derived from biomethane and bio-Synthetic Natural Gas (SNG). The methodology for assessing and determining the availability of Green Gas is discussed in the supporting Evidence Base.

2050 Dominant Heating System Without Green Gas



Heating System

- District Heating
- Electric Heat Pump



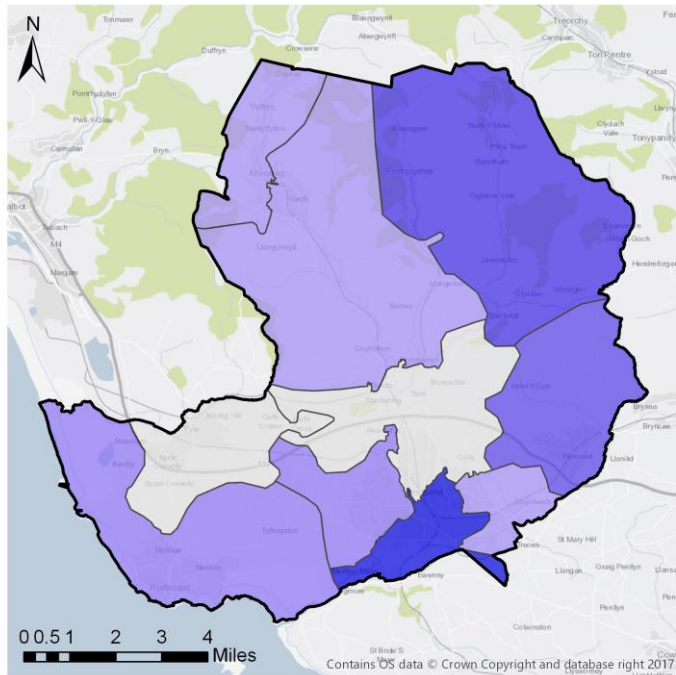
The figure above illustrates where there has been a change in total energy system cost compared to BAU. Green bars indicate where more money is spent under BAU compared to this World Without Green Gas scenario. For example, under BAU more money is spent on using gas because consumers continue to use fossil fuels to heat their homes. Red bars indicate where less money is spent under BAU. For example, under BAU far fewer buildings use electricity based heating systems, therefore less money is spent on using electricity.

A World Without Green Gas

A 2050 low carbon transition scenario where electric heat pump based systems provide nearly 80% of heat.

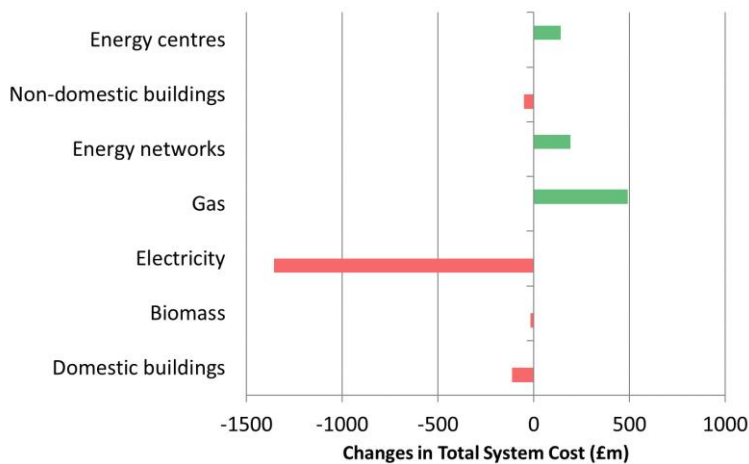
- Consisting of 47% high temperature Air Source Heat Pumps, 24% Ground Source Heat Pumps & 7% hybrid heat pumps. This leads to almost 650MW of electricity network reinforcement.
- By 2050 10,500 homes (circa 15% of total) are connected to a heat network.
- The total discounted energy system cost to 2050 is £7.4 billion, attributed to;
 - £3.5b and £0.6b on electricity and gas imports
 - £1.4b spent on changes to individual homes, this includes heating system changes and fabric retrofit. Non-domestic spend is estimated at £1.3b.
 - £89m on building energy centres.
 - £350m spent on reinforcing, operating and maintaining gas, electricity and heat networks.
- Gas peak network demand varies from 451 MW (2020) to 87 MW (2050)
- Electricity peak network (at 11kV) demand varies from 205 MW (2020) to 285 MW (2050)
- Heat network peak demand increases from 0 MW (2020) to 53 MW (2050)

Extra gas used under the carbon target with Green Gas available



2050 Increase in Annual Gas Usage (MWh)

Dark Blue	25,000 - 35,000	Light Blue	2,500 - 7,500
Medium Blue	10,000 - 25,000	Very Light Blue	0 - 2,500
Lightest Blue	7,500 - 10,000	White	0



The figure above illustrates where there has been a change in total energy system cost compared to BAU. Green bars indicate where more money is spent under BAU compared to this World with Green Gas scenario. For example, under BAU more money is spent on using gas because consumers continue to use fossil fuels to heat their homes. Red bars indicate where less money is spent under BAU. For example, under BAU far fewer buildings use electricity based heating systems, therefore less money is spent on using electricity. Availability of green gas has made some changes to the transition of heating system type but does not significantly impact the cost of transition.

A World with Green Gas

A 2050 low carbon transition scenario based on the availability of Green Gas.

- Domestic heating systems are predominantly electrically heated with an increase in hybrid heat pumps (additional 2,500) due to the lower carbon content of gas. Fabric retrofit is less critical to decarbonise and effectively prioritised and target at those where it delivers best value
- There are more properties connected to heat networks (13,000) in this scenario. This is because the lower carbon content of gas allows higher gas consumption in energy centres. Heat networks are assumed to be supported at a national level and planned effectively at a local level enabling development at scale in the local area.
- Annual electricity demand in 2050 is 32,000 MWh/y less than the world without green gas scenario.
- The total discounted energy system cost to 2050 is £7.3 billion, attributed to;
 - £3.3b and £0.68b on electricity and gas imports
 - £1.4b spent on changes to individual homes, this includes heating system changes and fabric retrofit. For non-domestics this was £1.3b.
 - £88m on building energy centres.
 - £320m spent on reinforcing, operating and maintaining gas, electricity and heat networks.
- Gas peak network demand varies from 450 MW (2020) to 109 MW (2050)
- Electricity peak network (at 11kV)

4 Network Choices

In addition to developing the future local energy scenarios for Bridgend discussed in Section 3, this Strategy has explored the most prevalent forms of decarbonisation options that are repeatedly identified in the modelling for specific areas of Bridgend. This is based on assessing trends across the many scenario and sensitivity analyses considered, including the World With and Without Green Gas scenarios.

This multi scenario approach identifies the recurring transition themes that should be explored and tested further. This has involved analysing different system choices and adjusting cost and performance characteristics to understand the impact on Bridgend's future energy system. This provides an understanding of the most valuable combinations of technologies under different conditions, and which combination of network choices occur consistently across a wide range of input assumptions. The different scenarios that have been considered in this analysis are discussed in the supporting Evidence Base document.

This approach is based on looking for consistent transition themes. For example, if under multiple cost and input assumptions, EnergyPath Networks consistently identifies transition to a heat network or electric heat pump based solutions in a particular area as the most cost effective in decarbonising the local energy system, then this provides evidence to inform future network choices and local energy system designs for the area.

4.1 Prevalent Future Heating System and Network Changes

Figure 4-1 illustrates the most prevalent transitions identified across all scenarios, where the objective is to achieve the lowest cost transition. These relate to replacing fossil fuel based heating systems (primarily the use of gas) with electric heating using heat pump based systems, with heat networks selected in areas of denser development. This identifies the areas⁴⁰ of Bridgend where heat network and electric heat pump transition occurs under a wide variety of circumstances. **These outputs illustrate the most prevalent heating system network options identified across multiple scenarios, based on current information.**

Figure 4-1 also shows that there are areas where there is no prevalent form of future network option, illustrated as the "Uncertain" areas, these generally follow the route of the M4 motorway through the region, where homes are decarbonised through a combination of solutions.

⁴⁰ Based on the analysis areas explained in Section 2.1.3

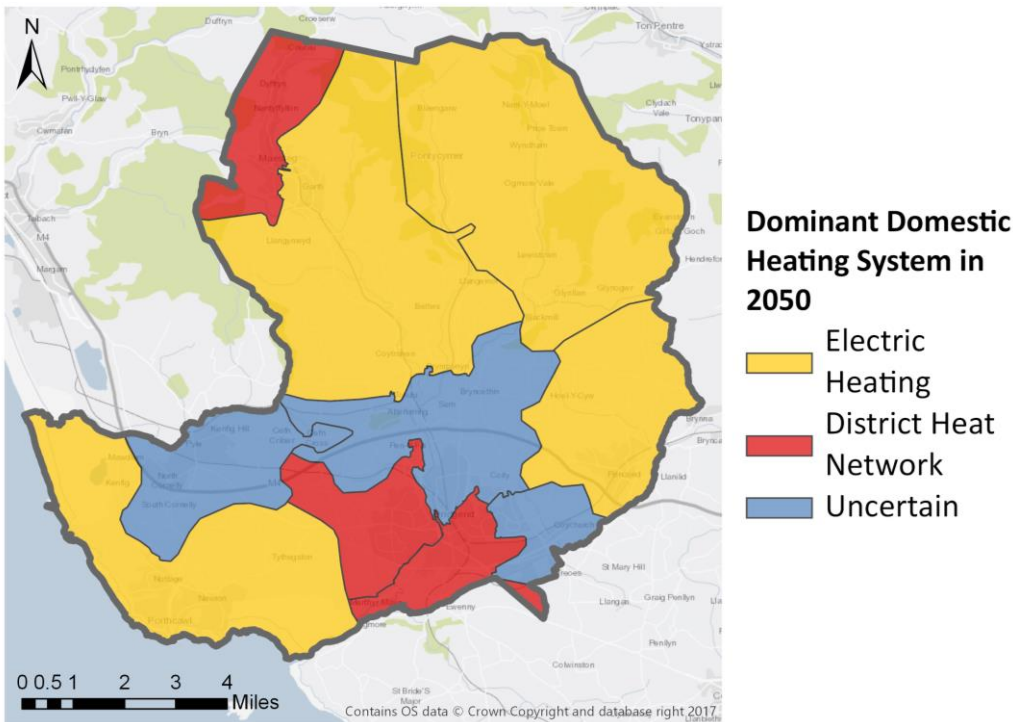


Figure 4-1 Dominant Energy Networks and Systems by Area

4.2 Network Choice Considerations

4.2.1 Factors that need to be considered in relation to network choices

There are many factors that will influence whether this represents a realistic vision of the future. Therefore, a key focus of the Strategy is based on planning, testing and demonstrating how these changes to the energy system could be progressed before any network choices should be made; where barriers to transition need to be overcome and opportunities to enable are required.

This strategy is not suggesting that all buildings in the analysis areas illustrated in Figure 4-1 would transition to one type of energy network. Even in areas where a dominant network choice is illustrated, other options will still be needed as there are many different aspects to consider regarding suitability of system and technology to building type. Importantly, such a widescale transformation of the local energy system would be highly disruptive to the energy sector and market and consideration relating to consumer, commercial and policy/regulatory factors is needed.

Decisions will need to be made regarding Bridgend's existing electricity and gas networks, along with the development of new energy infrastructure. For this Strategy to deliver its vision it must enable the key stakeholders to work together in planning and developing the low carbon networks of the future.

4.2.2 Area by Area Influences on Network Choices

There are many factors that contribute to whether a particular heating system is a suitable option for a specific building. For example, where areas contain buildings of similar construction, area based trends can

occur. EnergyPath Networks is a sophisticated model that trades off domestic & non-domestic building level options, network options and energy centre & macro level technology options. Therefore, it is impossible to conclude that a particular energy system option is completely dependent on one or two inputs. However, it is useful to consider potential contributing metrics as it can help to consider solutions and approaches for planning future energy system transition. The supporting Evidence Base document discusses key metrics that have influenced network choices; examples include:

- The district heat dominated areas have higher levels of semi-detached and terrace buildings than detached buildings. Analysis areas 3, 4 and 6 (refer to Figure 2.5 for area locations) also have higher levels of semi-detached and terrace buildings, although these areas are much larger and the building density is sparser.
- Building age and condition does have a significant impact on heating system, however, building age can impact what type of electric solution is chosen. For example, low temperature ASHPs may not be able to meet the heat demand of inefficient properties that are very costly to retrofit (e.g. large pre-1914 buildings with uninsulated solid walls). Instead, a high temperature system or a hybrid system may be necessary.

4.3 Network Impact

The modelled impact on peak gas, electricity and heat network demand (for the three scenarios discussed in Section 3) is illustrated in figure 4-2 below. This illustrates the likely scale of change over time to the local area's energy networks in each scenario.

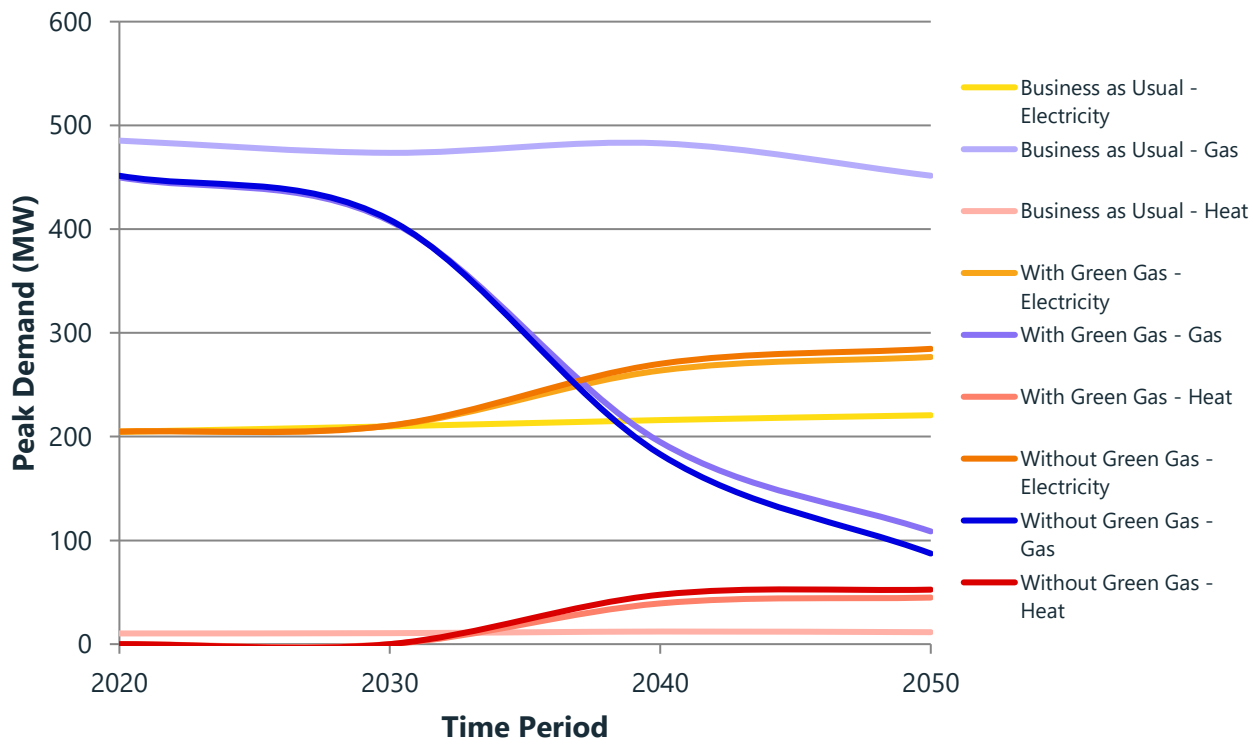


Figure 4-2 Change in Peak Network Demand for Gas, Electricity and Heat for the 3 Scenarios

Under BAU, Bridgend continues to be reliant on imported gas, with a minor increase in electricity network peak demand and no significant change in heat network peak demand.

Under the modelled future low carbon scenarios there is a major decline in peak demand for gas, a significant increase in electricity peak demand and minor increase in heat network peak demand. The variation in network demand scenarios highlights why it is essential to plan for an evolving energy system.

Wales & West Utilities Statement

“Whilst the project has demonstrated that changes to the energy system may be required, there are some further opportunities which haven’t necessarily been considered in detail which could be a cheaper and less disruptive way of meeting the challenge of decarbonisation. We suggest that the opportunity offered by additional vectors such as hybrid appliances, needs to be fully evaluated. This may provide for a more integrated approach across different energy networks and potentially a more optimal solution.

Work undertaken in piloting EnergyPath Networks and a whole system approach to local area energy planning and informing this strategy along with WWU’s project Freedom all highlight that more flexible networks and systems will be required to make best use of intermittent renewable energy that may be available in the future if we want to maintain the levels of reliability we are used to.

It is key that network operators can invest in networks that can be operated in a way that delivers flexibility across a range of demand supply scenarios. Interactions between networks need to be identified and planned for, including some less well recognised impacts such as a requirement to transport more gas to feed gas fired power stations where these are required to support the additional power requirement resulting from the increased use of Electric Vehicles. We would also anticipate that integrated System Operation across power and gas, and transmission and distribution, will be key in order to allow the best use of the networks, based on their design.

We see central Government as the key influencer of local policies which will encourage both networks and our customers (homes and businesses) to invest in the most appropriate way to minimise their CO₂ emissions. This assumes they implement appropriate levers to either ban or penalise use of less appropriate solutions and / or provide subsidies for those that are more optimal to our total (gas and electric) energy system. When considering how appropriate a solution is we would anticipate consideration being given to its impact on the total energy system.

Energy networks are currently unable to invest in speculative infrastructure and only build new capacity once the need for it has been confirmed either via general load growth or a specific enquiry. Our arrangements are also currently focussed on meeting the highest demand we would anticipate in 20 years. New arrangements or incentives to allow returns for investment based on total system (gas and electric, transmission and distribution) efficiency or reduction in UK CO₂ emissions would be required in order to enable us to invest in and support the development of plans for future energy systems such as those demonstrated by this project.”

Western Power Distribution Statement

“The development of Bridgend’s local area energy strategy has highlighted the major changes to electricity supply and demand that we can expect in the future. WPD has prepared for the changes in supply and demand by using innovation projects to learn about the potential technical and commercial solutions to meet the challenges of the proliferation of low carbon technology. This has resulted in solutions, such as alternative connections and active network management, that enable the connection of renewable generation faster and at lower cost. We have recently set out our strategy for transition to a distribution system operator, which outlines how we will respond to the requirements to operate more flexible networks and to plan using a whole system approach.

Distribution Network Operators can support the local authority planning process by providing the information to assess the potential impacts and costs of various options. In the case of the project in Bridgend, we were able to provide network data for third party analysis and we are continuing to investigate how we can provide stakeholders with similar information via our project on the Common Information Model. It is important for the various parties involved in long term planning to share their information and assumptions. We have built on the National Grid scenarios for our analysis of the regional impact of the changes in load and demand and have publicised the local impacts in our set of sub-transmission reports.”

4.3.1 Potential Future Role of Hybrid Heating Solutions

This Strategy has considered the use of hybrid solutions recognising that they could have an important role in decarbonising heat, just as they have in the transport sector. For example, hybrid heating solutions could help overcome issues associated with practical constraints to deployment of electric heat pump technologies and the impact of moving peak heat demand onto Bridgend's local electricity distribution network. The supporting Evidence Base illustrates the average proportion of buildings within each analysis area that were found to be cost-effective to transition to hybrid heat heating across all the scenarios analysed. However, hybrid heat pumps could have a greater role if they are proven to provide greater benefits than the alternative options.

The development of hybrid heating technologies provides a good example of how technology development may result in the need to reconsider this Strategy, particularly when combined with the use of low carbon gas, either hydrogen or green gas. Continued collaboration with Wales and West Utilities to assess any low carbon gas and hybrid technology developments is recommended.

Recognising the potential role of hybrid heating solutions, the Near-term Delivery Plan Activity in section 5.4.1 provides a project concept to improve the understanding of the potential role of hybrid heating.

4.3.2 Potential Future Role of Hydrogen

Significantly, this Strategy has not assessed the option for repurposing the gas grid to a hydrogen-based system, lacking (at the time of the study) sufficient, robust data to include in the analysis. It is recognised that work is ongoing across the UK assessing the potential of using hydrogen to provide heat in the residential, commercial and industrial sectors. Whilst hydrogen supplied fuel cells or gas engines could also provide potential future options for local electricity generation. This Strategy will be updated to consider hydrogen’s use (along with any other form of low carbon gas) when valid and robust data is available and if

a cost-effective and sufficient supply of low carbon hydrogen is planned for the region. This is a key requirement of this Strategy, so that it evolves and considers any significant change to the energy sector and system. This potential scenario, along with other examples of possible areas of significant change, are discussed in Section 5.2.

4.4 The Role of the Strategy in Supporting Network Choices

Section 4.1 illustrated what the prevalent future heating system and network changes might look like in Bridgend's future energy system. Section 4.2 Network Choice Consideration, 4.3.1 Potential Future Role of Hybrid Heat Pumps and 4.3.2 Potential Future Role of Hydrogen, highlighted that there are many aspects that need to be addressed before it is possible to consider formalising any network choices.

This Strategy's focus is over the short to medium term (over the next five to ten years) exploring how heat can be provided at scale through district heating and the electrification of heat using heat pumps. The outcomes from this activity is expected to coincide with greater certainty on the potential of using hydrogen as a replacement for natural gas. The combined evidence will provide greater confidence in local area energy planning and decision making, discussed further in Section 5 Moving this Strategy Forward.

4.4.1 The Role of Testing and Demonstration to Overcome Uncertainty

A key challenge and opportunity for this Strategy is to work out what scale of transition using district heating and the electrification of heat using heat pumps could evolve when all factors are considered. Importantly, there is not enough certainty, or the right conditions (e.g. from a market and policy perspective), to make major decisions on infrastructure choices now. Therefore, significant innovation, test and demonstration is needed over the next decade to inform network choices and de-risk the decarbonisation of heat in Bridgend. Section 5.3 The Role of Innovation provides a recommended approach for taking this theme forward.

4.5 Building fabric retrofit

In the majority of homes, analysis has shown that widescale and extensive energy efficiency improvement is not a cost-effective option for decarbonisation. It does not significantly affect network choices, particularly where retrofit measures become more difficult and costly to implement e.g. solid wall insulation. As the level of emission reduction target increases, retrofit alone cannot meet the level of reduction required⁴¹. Therefore, a low carbon heating system is also required and once the capital investment of installing the new heating system is made, it becomes more cost-effective to fit a higher power heating system than to fit a lower power system combined with improvements to building thermal performance. This is also influenced by the cost of whole house retrofit which is very expensive and is

⁴¹ Whole house retrofit, which can involve more extensive energy efficiency measures such as solid wall insulation, floor insulation and mechanical ventilation with heat recovery system, can achieve high levels of emission reduction. However, renewable systems, such as photo-voltaic panels and solar thermal hot water systems are typically required to reduce carbon emissions more than 80%.

unlikely to deliver cost-effective carbon savings to justify the work at current energy prices (especially without a carbon price on gas used for heating).

It's important to recognise that fabric retrofit can deliver wider social benefits such as reducing fuel poverty and improved comfort. Therefore, consideration is needed to determine where fabric retrofit can be used to manage the cost of decarbonisation to Bridgend's residents. However, extra insulation aimed at reducing fuel poverty and/or increasing comfort may reduce running costs for the targeted residents, but will increase total systems costs, and so should be considered holistically.

In addition, analysis has shown that some level of basic retrofit of thermal efficiency measures is cost-effective and better suited to some housing types and areas of Bridgend than others. Lower cost items such as topping up loft insulation, filling the last 'easy-to-fill' cavity walls and fitting double glazing where properties still have single glazing should be prioritised. The supporting Evidence Base document describes the average percentage of homes where an insulation package (of cavity wall and loft insulation) is selected by EnergyPath Networks. The Near-term Delivery Plan Activity in section 5.4.1 provides a project theme to improve the building fabric of targeted homes across Bridgend.

5 Moving the Strategy Forward

This section provides activities, tools and processes to both progress and deliver this Strategy and manage, review and evolve it over time.

5.1 Ongoing Role of Local Area Energy Planning

To ensure this Strategy's success, this Strategy will need to continually evolve and develop over time, aligning with relevant Welsh and National Government policy and guidance and developing supporting initiatives and projects accordingly. In the first instance, there are several activities to proactively consider before progressing the Near-term Delivery Plan Activity described in section 5.4.1. These activities provide initial recommendations to take forward, to continue the local area energy planning approach that has developed through this project, recognising that further activity will be required as the process of local area energy planning evolves:

- **1. Set a local carbon emissions target.** A local carbon emissions target should be set combined with developing supporting policy with ambitious but achievable interim targets. Setting local carbon targets aligned to the evolving Welsh Government approach referenced in Section 2.2 could be an effective means of incentivising local low carbon transition. This should include a mechanism for monitoring progress of domestic sector emission reduction alongside emissions for other sectors.
- **2. Establish on-going whole system planning dialogue with energy network operators.** The Strategy has already been developed through consultation with Western Power Distribution, and Wales and West Utilities. To support the delivery of this Strategy, continued collaboration is needed with these organisations along with considering how local and Welsh Government engages with the regulator (Ofgem). Joint local area energy planning decisions will need to be made, seeking consensus where possible, to ensure that Bridgend plans for and delivers the lowest-cost transition, recognising that considerable investment⁴² is needed to achieve decarbonisation.
- **3. Work with Welsh Government to ensure that national policy aligns to local policy.** It is expected that Welsh Government will be working with central government departments such as BEIS, in conjunction with ongoing collaboration between network operators, to support and or influence the development of policy with respect to:
 - Decarbonisation of the National electricity generation in a way that provides affordable, secure and reliable supplies for Bridgend County Borough.
 - National policies that support development and expansion of new energy networks and low carbon and energy efficient solutions in areas such as addressing market structures, liquidity and pricing issues; supporting new technologies with effective financial and regulatory measures and regulation of District Heat Network operation in a similar framework to that used for other energy network operators.

⁴² For example, this Strategy has illustrated that the additional cost of transition to a low carbon energy system between 2016 and 2050 is estimated to be between £0.7 billion and £0.8 billion to achieve a 95% emission reduction

The council should work with Welsh Government to ensure any developments in these areas reflect and consider the needs of Bridgend's residents and businesses.

- **4. Work with Welsh Government to determine an on-going whole system local area energy planning process.** The council should work with the Welsh Government to consider an ongoing approach for local area energy planning. This recognises that decisions on network choices will also need to consider interaction with other local areas served by the existing energy system. The council should also consider how this Strategy aligns and interacts with relevant and evolving Welsh Government policy and guidance.
- **5. Support low carbon product and service developers to innovate in Bridgend.** The council should consider initiatives to support product and service developers to introduce low carbon offerings that building owners and occupiers want to use. Initiatives such as development & demonstration projects can be used as potential mechanisms as these also facilitate research and innovation. The decarbonisation themes that would benefit from such initiatives are discussed in Section 5.4.1 (Near-term Delivery Plan Activity).
- **6. Develop a governance framework.** The council should develop and implement a suitable governance framework. This will also ensure that this Strategy is regularly reviewed and updated, and therefore relevant over time. The Governance Framework should set out the roles, responsibilities and procedures to manage the delivery of this Strategy, recognising that this Strategy will require the resource and capability within the Council to deliver.

In addition, the council could develop and implement a low carbon heat transition consumer charter. Acknowledging that it will be the council that will be directing the transition. A charter should be developed to ensure that any decisions benefit, protect and improve the quality of the energy services to its residents and businesses over other market influences. The charter will also be used to influence the products and services brought forward by any third-party organisation so that they benefit and protect consumers, meeting agreed standards of service in a just, affordable, sensitive and inclusive manner. These products and services should be based on consumers' needs.

The Charter should consider any conclusion from the Fair Futures initiative⁴³ which is being developed to better understand the issues faced by a range of vulnerable energy consumer groups and identify the areas where commercial, governmental, community and householder needs and motivations could be aligned to provide more and effective innovative policies, products and services.

⁴³ The ESC is partnering with organisations from various sectors to develop the Fair Futures programme

5.2 Reviewing & Monitoring Delivery

This Strategy will need to be flexible throughout its lifetime and will involve numerous iterations. Recognising that the Strategy is based on planning for the future, so that important, informed and tested, energy network related decisions can be made to support the vision.

Reviewing Delivery

Where the Dominant Energy Networks and Systems by Area map in Figure 4-1 has indicated the prevalence of certain energy networks by area, it is critical to reiterate that these are based on modelling analysis, using present day assumptions. Significant work is required to ascertain applicability in the consumer, commercial and policy/regulatory environment.

For example, if no credible route evolves to enable the provision of wide scale heat network development in low rise residential areas (which is a UK wide risk), then this Strategy would need to be updated to reflect this reality.

Whilst not an exhaustive list, this example along with other types of potential change that may affect this Strategy and would need to be assessed by the review process, are described below. Any potential impact can be discussed with key stakeholders as further evidence and decarbonisation options become available, new information may need to be assessed through further research, assessment and modelling.

Potential Changes

- Policy & Regulation
- Political Change
- Market Forces & Consumer Behaviours
- Technology Developments
- Evolving Carbon Emissions Targets
- Decarbonisation Option Maturity⁴⁴
- Development of Local Area Energy Planning and Whole Energy System Analysis

Dependent on the nature of the change, there is expected to be instances where an updated whole system model is generated. Example scenarios include:

- If new or repurposed gas grids using a low carbon form of gas, such as hydrogen, become a feasible, alternative decarbonisation option, then the new solution would need to be assessed to determine if it should be part of Bridgend's future energy system.

⁴⁴ 'Maturity' refers to when a decarbonisation option is classed as being ready for deployment. Readiness is dependent on the option being mature across four components (1. Consumer, 2. Commercial, 3. Technical & 4. Policy/Regulation)

- Evolving this Strategy to further consider the approach for decarbonising heat in Bridgend's non-domestic buildings, along with carbon emissions from other sectors such as industry and transportation

Defining an ongoing analytical process to support future updates will be essential for maintaining the validity of this Strategy.

5.3 The Role of Innovation

Managing Uncertainty

The predominant decarbonisation options (based on either using electric heat pump based systems or heat networks) that are discussed throughout this Strategy are not proven at scale in the UK. It is therefore difficult to make major energy network and system choices today.

At a high level, this Strategy is based on considering the use of new or adapted energy network choices to provide heat. This will result in replacing products and solutions that individuals are familiar with and like using (e.g. natural gas boilers) with new solutions. However, market conditions currently prevent such a major transformation. For example, when individuals need to replace their existing heating system, currently they are likely to buy a like for like replacement, rather than replace it with a low or zero carbon alternative.

Therefore, to have confidence in the proposed energy system changes, and before making area-based energy network choices, confidence is needed that the proposed energy system transition is achievable. This means that the uncertainties associated with the proposed energy system and network transition needs to be managed. For example, the electrification of heat could play a significant role in the future provision of decarbonised heat. However, there are many areas that need to be addressed before this can become a reality.

Necessary Market Conditions

The right market conditions should be in place before network choice decisions are made.

When making network decisions, confidence is needed that the right market conditions will emerge to support them. Products or services develop towards market readiness across the four components described in Table 5-1 below. A product/service could be technically mature, but not commercially as there is no route to market. Therefore, ideally all four components should be at or nearing maturity.

Confidence may also be possible before maturity is reached, particularly when there is significant momentum developing. For example, there is substantial impetus building regarding the electrification of vehicles. This is developing before all components are mature; technical componentry is still evolving (e.g. charging infrastructure) and the policy/regulatory environment hasn't been fully established. However, major decisions are being based on its use. The market is in part driving this change based on key influences such as consumer demand.

Table 5-1 Components of a Mature Solution

Component	Description
Consumer	A product/service should be accepted and wanted by consumers. Confidence is needed to a point where it is regarded as either normal to use, or something that a consumer aspires to want as they believe in the benefit it will provide.
Commercial	A product/service needs a viable business model and route to market to succeed. If the product/service is not provided in an appealing way to consumers, then they will not want to buy or use the solution.
Technical	Technologies need to be at a point where mainstream use has started to take off, past the point of being an emerging or improving technology, where all prototyping and testing is complete and all relevant technical componentry is effectively integrated.
Policy / Regulation	Solutions require a supportive policy and regulatory environment, along with a suitable legal framework to succeed. Organisations will want this to initially support the uptake of products and then to sell in an established market. Likewise, many consumers will want to know they are protected and supported when buying and using solutions.

Developing Mature Solutions

Developing market-ready solutions is important to provide confidence that an option is deployable before significant investment decisions are made.

Figure 5-1 illustrates the perceived maturity levels of electric heating (heat pumps) and heat networks. Neither is currently considered sufficiently mature across all aspects (consumer, commercial, technical, policy and regulation) for mass market uptake by existing homes in support of decarbonising heat⁴⁵. These solutions need to be sufficiently mature across all aspects to be confident in mass market appeal and inform network choices.

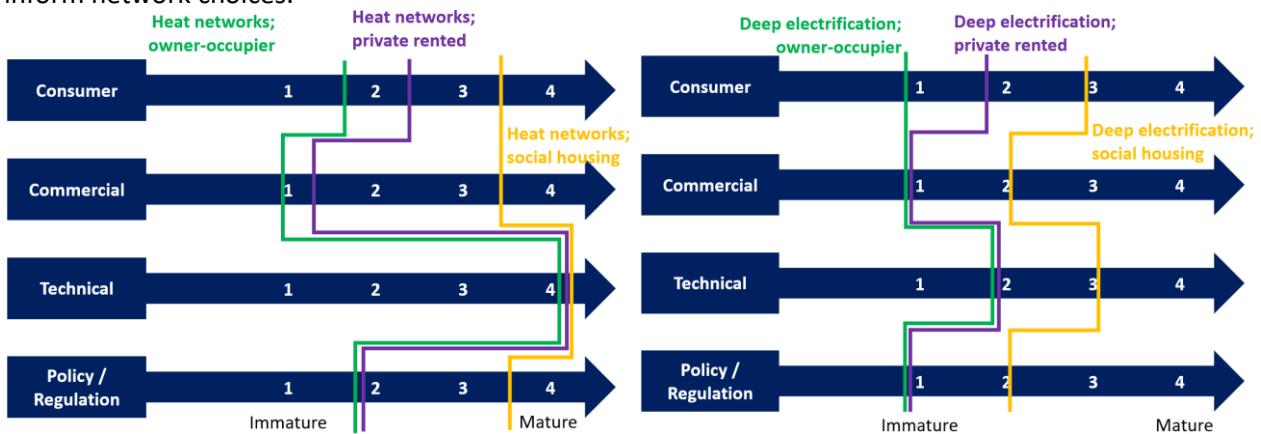


Figure 5-1 Indicative Market Readiness of the Electrification of Heat using Heat Pumps & Heat Networks

⁴⁵ For example, access to consumers for the electrification of heating is considered more mature for social housing owing to the role of social landlords as integrators to many consumers, and a policy environment supporting improving energy efficiency of rented properties. In the UK, retrofitting heat networks to existing social housing is much more mature both commercially and from a consumer perspective (with a number of heat networks serving social housing) than for the private renters and owner occupiers.

The purpose of highlighting these technology specific challenges is to:

- Provide focus for all future Strategy activity.
- So that resource can be targeted in developing SMART project objectives.
- Enabling solution development and demonstration that is Specific, Measurable, Achievable, Relevant and Time-bound.

The council should use this understanding when considering any future variation to this Strategy. For example, if hydrogen were to be considered as a decarbonisation option for Bridgend, then confidence is needed that it is a deliverable solution before this Strategy could plan on its use.

Development & Demonstration

Development & Demonstration is a key component of this Strategy and should be used to build the maturity of heat network and heat pump based systems. Many aspects of enabling the decarbonisation of Bridgend's buildings are outside of the council's direct control. However, the council can directly influence this aspect through facilitating the Development & Demonstration of the options.

Heat networks and heat pumps will need significant Development & Demonstration over the short to medium term. Some aspects of the following Section 5.4.1 (Near Term Delivery Plan) detail the Development & Demonstration activity to take forward over the next five years, based on the activity discussed and agreed with the project stakeholder group.

This Strategy recognises that ongoing Development & Demonstration will be needed, accepting that all the uncertainties will not be solved in one Development & Demonstration project, where it is likely that a project will identify new questions that need to be assessed. These challenges, as they develop, will need to be explored through future delivery plans, as illustrated in this Strategy's Roadmap (see section 5.5).

A programme of projects is needed to build capability through practical demonstration and experience. Local Authority leadership will help facilitate the establishment of industrial scale capability and stimulate private sector participation, innovation and investment.

Coordinating Future Activity to Benefit Bridgend and Align with Welsh Government Strategy

Not all aspects of decarbonising heat in buildings need to be addressed specifically in Bridgend, where it is recognised that similar challenges are relevant throughout Wales, the UK and internationally. Therefore, decisions will need to be made on whether Bridgend directly leads on the subject, supports, contributes to or monitors progress on other national projects. The H21 project led by Northern Gas Networks is a good example. This project investigated decarbonising the UK's gas distribution network from a technical and economic perspective through converting the existing gas network in Leeds to 100% hydrogen. The project looked in detail at the Leeds area but also considered the implications and options for a wider roll out across the UK.

The scale of innovation and solution development required to be able to decarbonise heat is significant.

Therefore, focusing resource towards solving specific challenges is recommended. The council should ascertain what activity to focus on, based on progressing the aspects that would provide the most benefit to Bridgend and align with relevant and evolving Welsh and UK Government Strategy, such as the UK Clean Growth and Industrial Strategies.

Consideration should be given to aspects such as existing local capability (in industry and academia), regional collaboration and local ambition for green growth, whilst also having an ongoing understanding of other regional and UK (and any relevant International) development & demonstration type projects to assess any lessons learnt and implications for Bridgend's future energy systems. This is particularly relevant as there will be many organisations considering the same challenges. **Working to this strategic approach should facilitate partnering, funding and innovation opportunities that can then lead onto more focused green growth activity.**

Participating in this solution development space is also important so that the council has confidence in the solutions being recommended, whilst also providing opportunities to forge new partnerships with energy system innovators.

Solution development is essential if Bridgend wants to benefit from embracing the transition, through developing the systems, technologies, services, business models, governance and funding solutions that will enable a low carbon future.

Consideration will be needed to determine how the council considers the actions of the various key stakeholders, so that relevant low carbon products and services are brought to the market that building owners and occupants want to use. Recognising that the council has limited influence over the type of heating system individuals choose to use and when they will replace their existing system.

The council should use this appreciation, that there is a need to manage uncertainty associated with technologies, services and solutions, to help inform the development of the Strategy; using this understanding to set the scope and objectives for testing and developing the future projects and activities that will be needed to achieve the low carbon transition.

5.4 Near Term Delivery Plan

This section describes the near-term delivery plan that has been developed to take forward Bridgend's Local Area Energy Strategy over the next five years. Figure 5-2 shows the near-term delivery plan alongside other illustrative future delivery plans. This highlights that these (future delivery plans) will need to be developed around every 5 years as and when further evidence is available, until there is certainty around making major area based decisions. This approach recognises that the Strategy is based on planning for the medium to long term. The council will need to develop the detail of each future Delivery Plan with relevant stakeholders, developing specific objectives and aligning focus to a rapidly evolving energy sector.

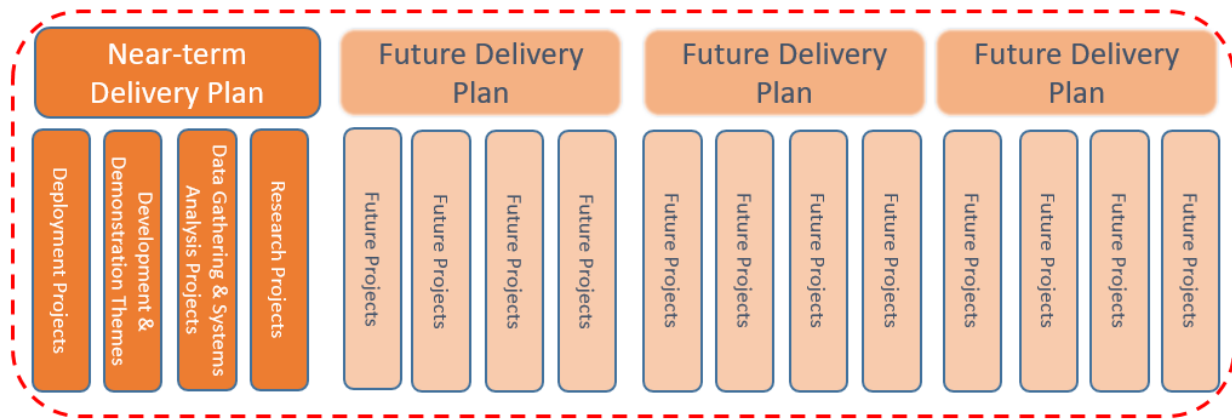


Figure 5-2 Near-term Delivery Plan and the Requirement to Develop Future Delivery Plans

The Near-Term Delivery Plan provides the focus for targeting resources and explores how the proposed energy system changes illustrated in Figure 5-1 could be progressed.

5.4.1 Near-term Delivery Plan Activity

The near-term delivery plan activity provides recommended activity to both continue and prepare for Bridgend’s decarbonisation, describing the themes and activities that should be progressed in the near term. This consists of the following five activities:

- Better targeted retrofit.
- Developing and testing compelling customer propositions for hybrid heat pumps.
- Overcoming barriers to moving homes from gas to district heating.
- Reducing costs of heat networks in urban centres and overcoming barriers to connecting existing homes to heat networks.
- Developing and testing compelling customer propositions for electric heating targeting able to pay/early adopters through council services.

The Delivery Plan Activity has been developed through collaboration with the project stakeholder group. This process involved considering the proposed energy system change illustrated in Figure 5-1, alongside other evidence resulting from the EnergyPath Networks analysis.

Acknowledging that there are many potential activities needed to enable the transformation of Bridgend’s energy system, focus has been given to five activities based on:

- Subjects that considered the drivers and priorities of the project stakeholder group.
- Prioritising activities that are objective and informed by the EnergyPath Networks evidence base.
- Addressing the challenge of decarbonising heat.

- A combination of innovation and deployment⁴⁶ projects, but with a focus on innovation to unlock the barriers to transforming the borough's energy system.

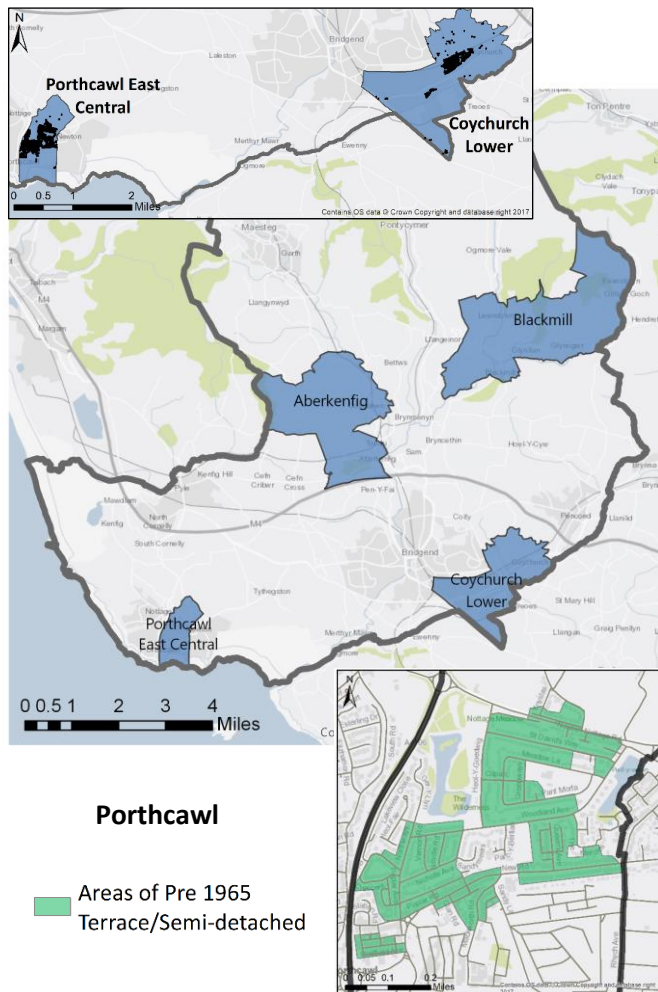
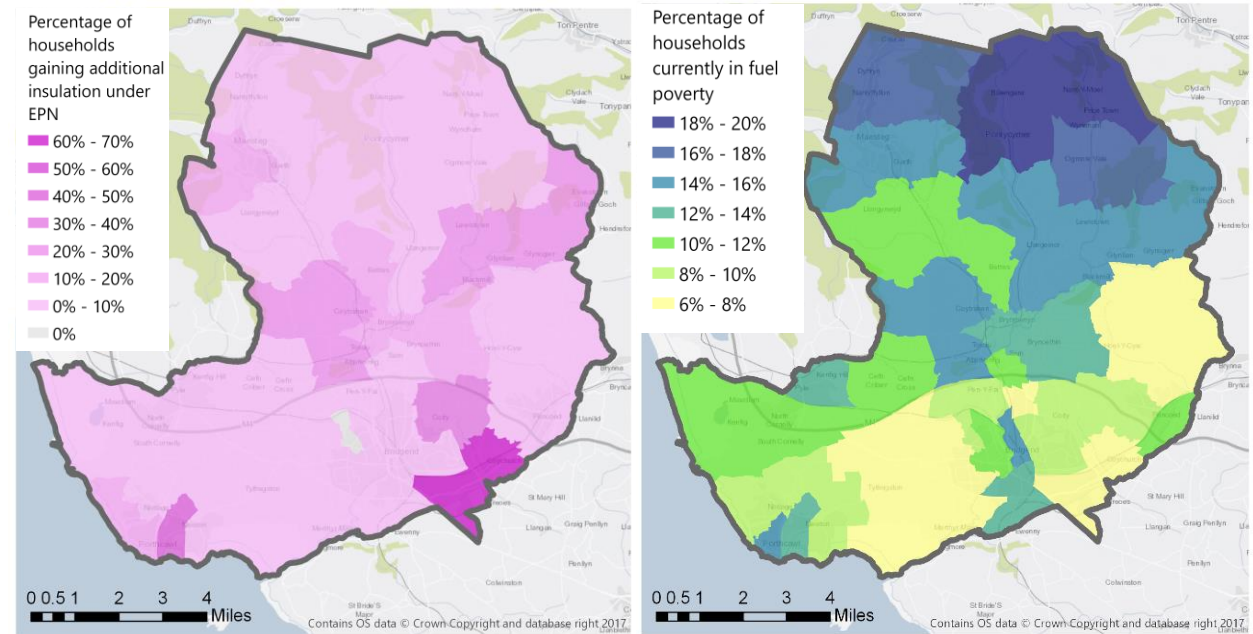
These activities are summarised below followed by **Other Activity** to consider progressing as identified and discussed during the development of this Strategy.

⁴⁶ Deployment Projects are considered to be low regret, short-term opportunities where there is certainty that they are the right solution and there is clarity on how to realise them in the current consumer, commercial and policy/regulatory environment.

Activity No.1 Description	Deployment of Better Targeted retrofit. Refer EPN Supporting maps/data below.
Activity Context	<p>Improving the energy efficiency of buildings is a key opportunity to reduce carbon emissions.</p> <p>This activity focuses on fabric retrofit which means improving the thermal performance of the building so it uses less energy to heat. This has the added benefit of reducing energy costs regardless of the type of system that is used, both currently (e.g. a gas boiler) and in the future.</p>
Activity Objectives	<ul style="list-style-type: none"> ▪ Build on available data and past projects to better target homes in need of fabric retrofit, prioritising areas of fuel poverty. ▪ Identify new business models that can self-finance wide scale deployment; this could involve providing integrated solutions incorporating other measures alongside retrofit. Reducing dependency on public grants. ▪ Work with Welsh Government to identify any mechanisms and available funding to initiate. ▪ Consider procurement options and service delivery partners. ▪ Develop new forms of service provision as different approaches will be needed for different areas and consumer segments. ▪ Focus on: developing and delivering new retrofit service offers and business models that also improve quality of homes/comfort; defining target areas and consumer segments; and adopting a means of performance contracting to ensure outcomes rather than measures are achieved
Supporting Evidence	<p>EnergyPath Networks selects fabric retrofit for over 4,700 homes (average number across all scenarios) across Bridgend. The illustrations below highlight the areas EnergyPath Networks selects where it is cost-effective to do so (from a least cost decarbonisation perspective), showing a relationship with areas of fuel poverty. This is based on typically installing cavity wall and loft insulation. The data is derived from assessing EPCs and the council's building stock data where available. Installing these measures could save over 1,200 tonnes of CO₂ at an average cost of £1,900 per dwelling. As EnergyPath Networks works on the basis of achieving a least cost emission reduction target, additional opportunities to improve energy efficiency will be available where the objective is to reduce energy use and cost.</p>

Activity No. 1 - EnergyPath Networks Supporting maps/data

The figure below highlights the proportion of properties by ward identified for basic fabric retrofit measures under the business as usual scenario, meaning that it is cost effective to progress even without working to a carbon target. This is shown alongside the average percentage of homes assumed to be in fuel poverty, where providing initial focus in areas of perceived fuel poverty would be beneficial.



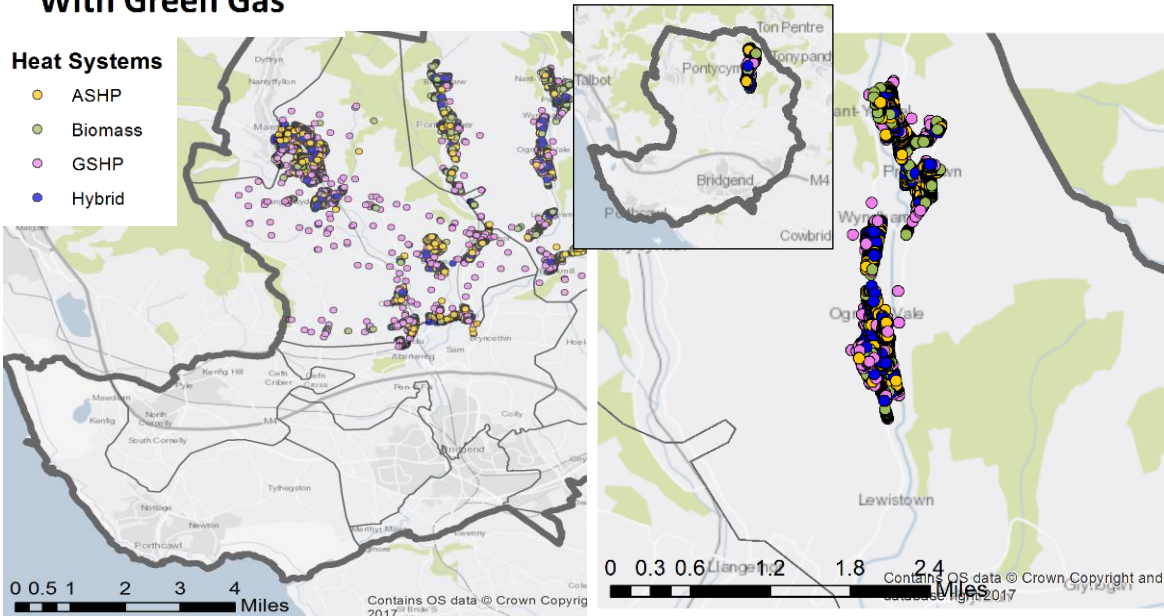
Considering the areas with the highest perceived levels of fuel poverty and greatest proportion of properties that could benefit from basic fabric retrofit measures results in the four areas illustrated below, in the wards of Aberkenfig, Blackmill, Porthcawl East Central and Coychurch Lower. These provide potential focus areas to consider for this activity. Coychurch Lower, whilst not flagged as a fuel poverty area, contains 594 homes, of which nearly 70% are detached/semi-detached built since 1980, concentrated in two major housing estates. Porthcawl East contains nearly 3 times as many homes with 1,520, with more of a variety of types and ages. Semi-detached and terraced properties built prior to 1965 make up 57% of all homes in this area, which are likely to have a high energy demand and poorer thermal efficiency than the more modern homes of Coychurch Lower. The data suggests that they are also much more likely to be lived in by fuel-poor residents which makes them an ideal priority target for retrofitting insulation measures.

Activity No.2 Description	Innovation - Developing and testing compelling customer propositions for hybrid heat pumps. Refer EPN Supporting maps/data below.
Activity Context	Hybrid heat pumps combine an electric heat pump with a gas boiler. They provide the benefit of switching between both system types, dependent on the optimum time to use each system. Lower carbon forms of gas can also be used if supplies develop as suggested by the Freedom project. They can be perceived as being less disruptive and more appealing for residents.
Activity Objectives	<ul style="list-style-type: none"> ▪ Understand value of hybrids – is it transition technology or a long term 2050 solution. ▪ Develop and test compelling customer propositions that are attractive to customers so they buy-in to the transition. ▪ Build on Freedom Project. For example, consider interaction with private rented/owner occupiers as the pilot worked with the social housing sector. ▪ Assess value of looking at more clustered deployment; understanding potential benefits to electricity and gas networks. ▪ Consider benefits of hybrid v electrification, potentially alongside fabric improvement. ▪ Provide further evidence on potential role of hybrid solutions before making energy network decisions
Supporting Evidence	EnergyPath Networks selects the greatest average number of hybrid heat pumps in analysis areas 3 and 4 comprising the Ogmore and Garw valleys. However, electric heat pumps and biomass boilers are also selected in nearby dwellings. Further consideration is needed to understand the potential role of hybrids in these and other comparable areas. If hybrid solutions were to be used in specific areas, then further thought is needed to assess the impact of increasing/reducing uptake e.g. utilising hybrid solutions instead of all electric heat pumps or biomass systems. For example, the project stakeholder group raised concerns over the use of biomass systems. These are often the least cost option in dwellings where it is not practical or is too expensive to use an electric heat pump, hence hybrid solutions could provide an alternative option.

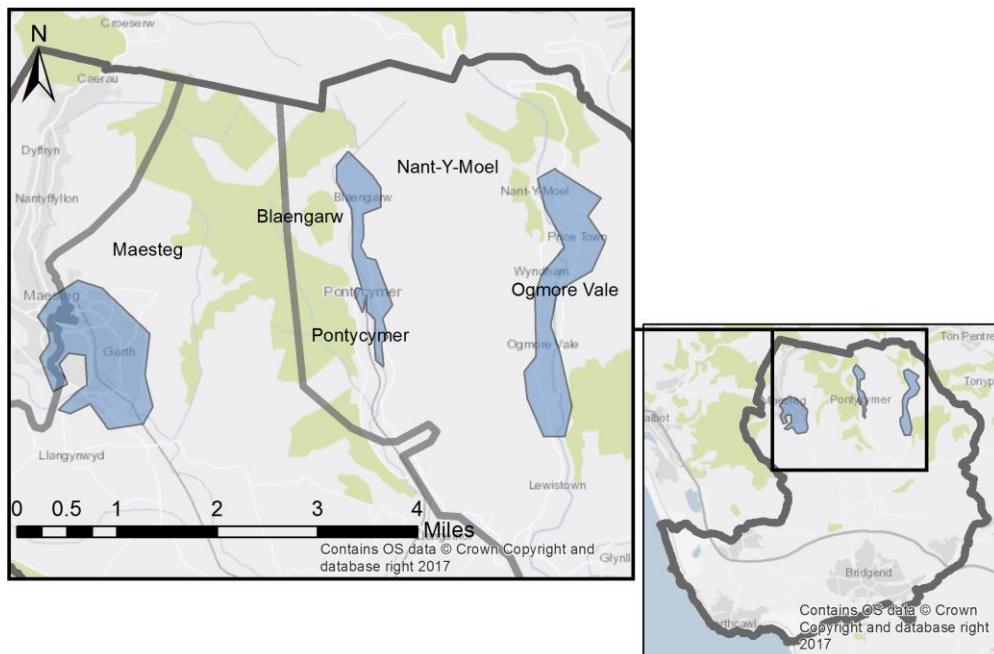
Activity No. 2 - EnergyPath Networks Supporting maps/data

The figure below illustrates the variation in heating systems selected as the least cost decarbonisation option for one of the scenarios assessed in analysis areas 3 and 4. Highlighting a mixture of Air and Ground Source Heat Pumps, Hybrid Heat Pumps and Biomass systems.

With Green Gas



Identified Zones to Develop and Test Compelling Customer Propositions for Hybrid Heat Pumps

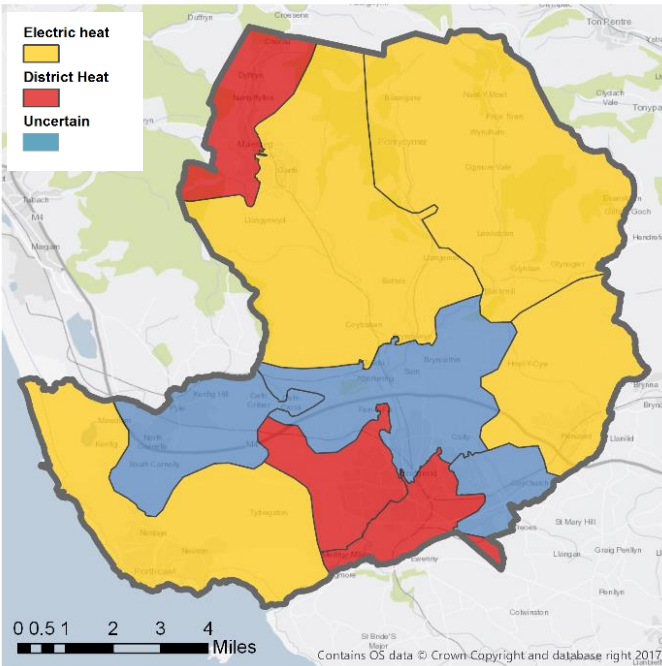


This activity could be focused on the three zones illustrated below. These comprise the largest clusters of homes modelled to transition to a form of heat pump, based around east Maesteg/Garth, Blaengarw/ Pontycymer &

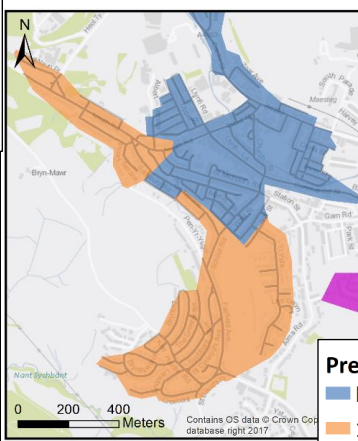
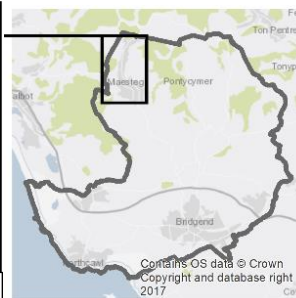
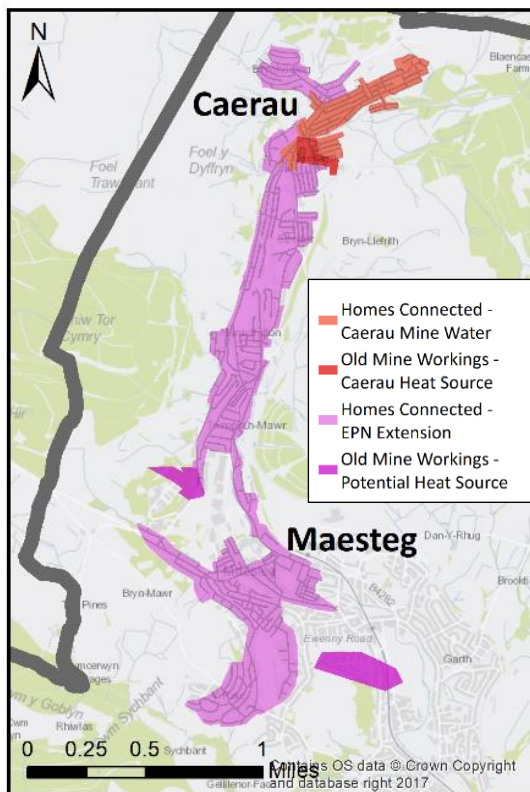
Nant-Y-Moel/ Price Town/ Ogmore Vale. For example, there are over 2000 buildings in the Ogmore Vale valley to consider. The majority of are terraced (62.82%) homes, whilst there are 18% semi-detached homes, 10% flats and 8% detached homes. In the Green Gas scenario, over 55% of homes transition to air source heat pumps, 20% to hybrid heat pumps, 17% to biomass and 8% to GSHPs illustrating that further thought is needed before network choices for this and similar areas can be made.

Activity No.3 Description	Innovation – Overcoming barriers to moving homes from gas to district heating. Refer EPN Supporting maps/data below.
Activity Context	District heating has been consistently highlighted, across multiple scenarios, as providing the optimised decarbonisation option for many homes in and around Caerau. However, there are many barriers to overcome before the planned network could be expanded. Learning from this activity is essential if other heat network schemes, serving existing residential areas, are to be developed en-masse.
Activity Objectives	<ul style="list-style-type: none"> ▪ Understand insights from Caerau Heat Network scheme to identify barriers and opportunities to extend the scheme in the areas illustrated below. ▪ Provide key learning to inform other potential residential retrofit schemes to similar groups of housing. ▪ Focus on understanding aspects such as: <ul style="list-style-type: none"> ▪ Successful consumer engagement methods. Considering aspects such as the social demographic. ▪ Commercial considerations. Key actual cost and economic data can be assessed to understand the financial implications of retrofitting heat networks to existing low rise residential areas. ▪ Consumer’s experience – what are the key aspects to focus on to encourage further uptake?
Supporting Evidence	EnergyPath Networks has identified an average of over 70% of homes transitioning to heat networks in analysis area 2 which comprises Caerau and Maesteg, equating to over 3,800 homes. District heating has been identified as a cost-effective transition option, for reasons such as the density and type of dwellings in this area. For example, electric heat pumps are likely to be inadequate to heat the pre-1914 dwellings which make up a large proportion of dwellings in this area (accounting for 64% of all dwellings).

Activity No. 3 - EnergyPath Networks Supporting maps/data



The figure opposite re-illustrates that district heating has been identified as the dominant least cost network option for the analysis area surrounding Caerau (top left area), where the planned Caerau mine water heat network scheme would be built. Numerous barriers need to be overcome before the planned network, or other heat networks could be built/expanded.



The figure opposite illustrates the proposed Caerau Mine Water Heat Network Scheme in relation to other homes, extending south from Caerau to Maesteg, where district heating has been modelled as the least cost option. This also shows the location of the proposed mine water heat source in relation to other mine water heat sources.

In Maesteg, pre-1914 terraced properties dominate the north of the town while the south comprises mainly semi-detached homes built between 1914-1964, where district heating was modelled as the least cost option for circa 160 of these homes.

Activity No.4 Description	Innovation - Reducing costs of heat networks in urban centres and overcoming barriers to connecting existing homes to heat networks. Refer EPN Supporting maps/data below.
Activity Context	Market conditions combined with the cost of developing heat networks currently restrict heat network development throughout the UK. Innovation could be used to reduce the capital cost of schemes to facilitate increased uptake. Similarly, extending urban centre heat networks schemes to connect nearby existing residential areas faces many technical, commercial and consumer barriers. The effective planning for development and expansion of heat networks along with development of compelling customer propositions for people to connect to networks in the future could help to overcome such barriers.
Activity Objectives	<ul style="list-style-type: none"> ▪ Assess options of reducing cost of heat networks; focusing on proposed Bridgend Town Centre scheme. Utilising resources such as ETI Heat Infrastructure Development project: Reducing the capital cost of district heat network⁴⁷. ▪ Provide insights relevant to other potential comparable urban centre schemes. ▪ Consider aspects relevant to extending from urban centres to existing residential areas. ▪ Determine if compelling residential value propositions can be developed to support expansion from town centre non-domestic heat networks. ▪ Develop new forms of service provision as different approaches will be needed for different areas and consumer segments. ▪ Focus on overcoming barriers to connecting existing homes to heat networks
Supporting Evidence	EnergyPath Networks has identified an average of nearly 70% and over 90% of homes (in one scenario) transitioning to heat networks in analysis areas 8 and 9 respectively, consisting of areas around Bridgend's town centre. This would equate to circa 10,000 homes transitioning to a heat network that are currently served by gas boilers. These homes are shown below, highlighting their proximity to the location of the proposed town centre scheme. Should the town centre scheme develop, it provides an opportunity to consider expansion to these nearby homes, acknowledging that barriers to connecting existing homes to heat networks need to be overcome beforehand.

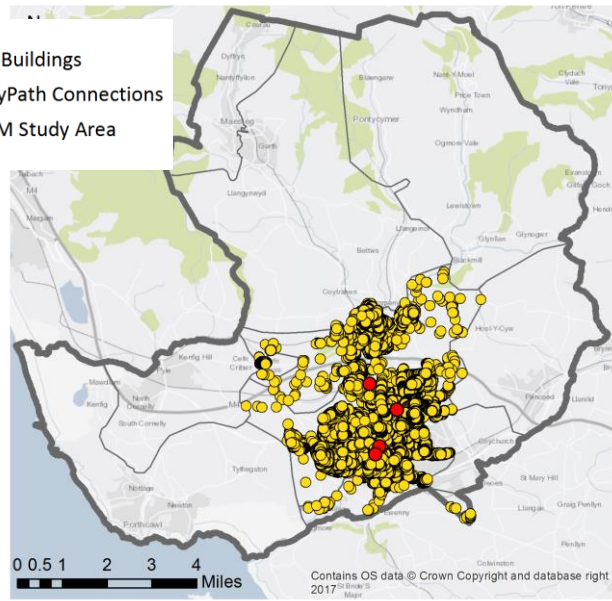
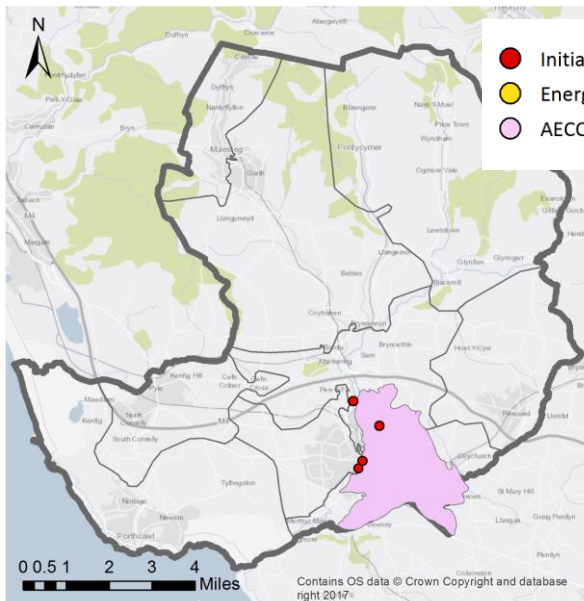
⁴⁷ <http://www.eti.co.uk/programmes/energy-storage-distribution/heat-infrastructure-development>

Activity No. 4 - EnergyPath Networks Supporting maps/data

The figure below shows the non-domestic buildings already proposed to connect to potential Bridgend Town Centre heat network scheme (red dots), alongside the other domestic and non-domestic buildings in the vicinity where district heating is selected as the least cost decarbonisation option (yellow dots). An existing heat network study covering the shaded polygon area is available for supporting information.

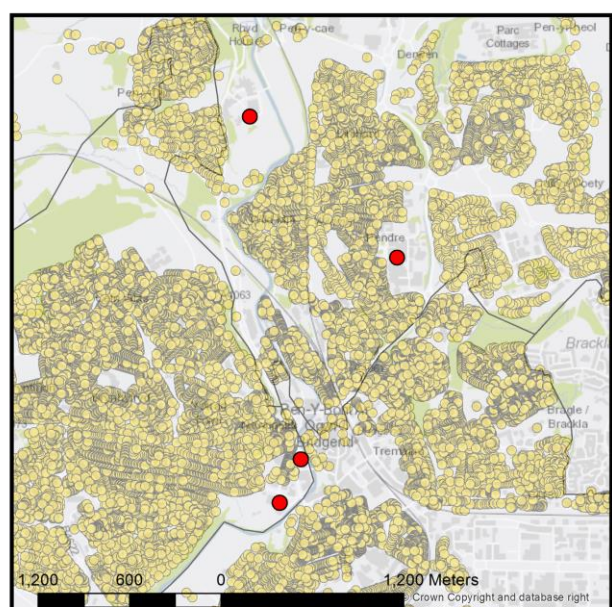
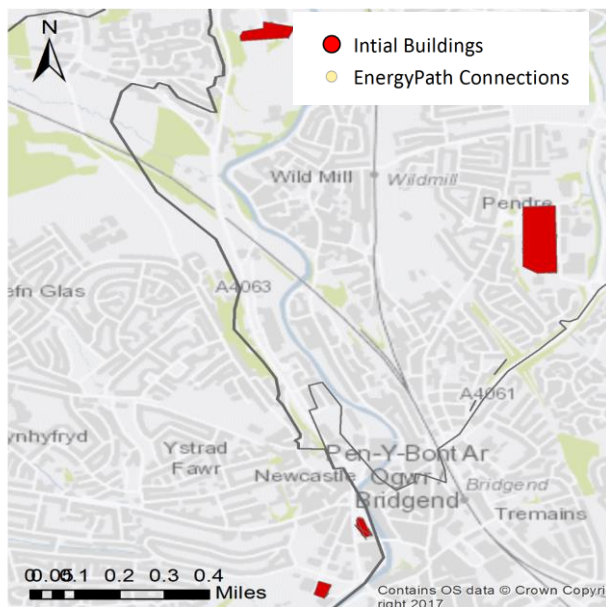
Aecom Study Area

Energy Path Networks Average Connections



Aecom Study Area

Energy Path Networks Average Connections

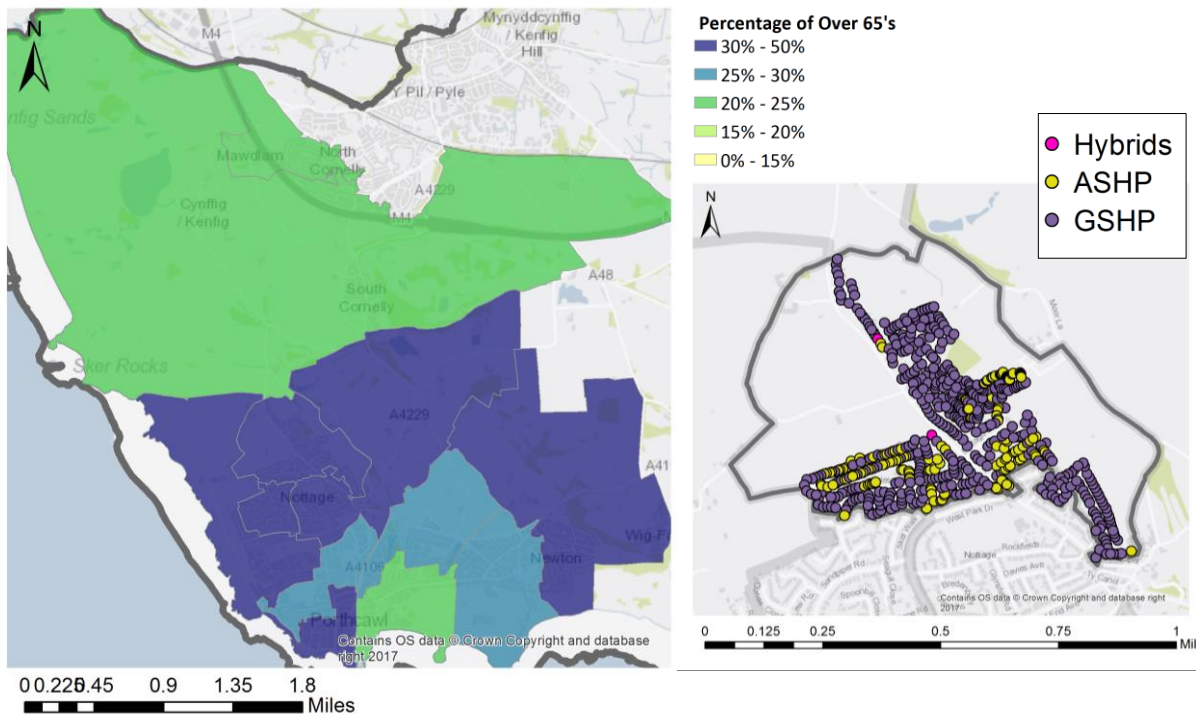


Activity No.5	Innovation - Developing and testing compelling customer propositions for electric heating targeting potential early adopters through council services. Refer EPN Supporting maps/data below.
Activity Description	
Activity Context	EnergyPath Networks selects the use of electric heat pump systems under multiple scenarios as the optimal decarbonisation solution for a significant proportion of Bridgend's housing stock. Whilst there are many barriers that prevent such a transition, having a compelling product and finding successful ways to engage with end users is critical to support the transition to new types of heating systems. Social care and other council services have been identified as a potential engagement route. This approach has been used in the UK as a means of providing energy efficiency measures. Testing the concept in the coastal areas of Bridgend has been suggested (e.g. Porthcawl) due to the location of perceived technology early adopters, due to socio demographic factors.
Activity Objectives	<ul style="list-style-type: none"> ▪ Develop and test compelling customer propositions that are attractive to customers so they buy-in to the transition. ▪ Develop new forms of service provision as different approaches will be needed for different areas and consumer segments. ▪ Establish partners and test approaches through council services such as social care. ▪ Consider targeting perceived early adopters in coastal areas. ▪ Consider integration with fabric retrofit - creation of integrated service offer and new business models.
Supporting Evidence	EnergyPath Networks selects heat pumps as the least cost transition option in over 70% of homes in analysis area 12, comprising Porthcawl and surrounding areas. However, the technology type is not critical; the main challenge is to offer consumers a compelling electric heat product to switch to in the first place. The figure below highlights potential focus areas to test propositions based on areas with a high level of over 65s who may be utilising council services such as social care.

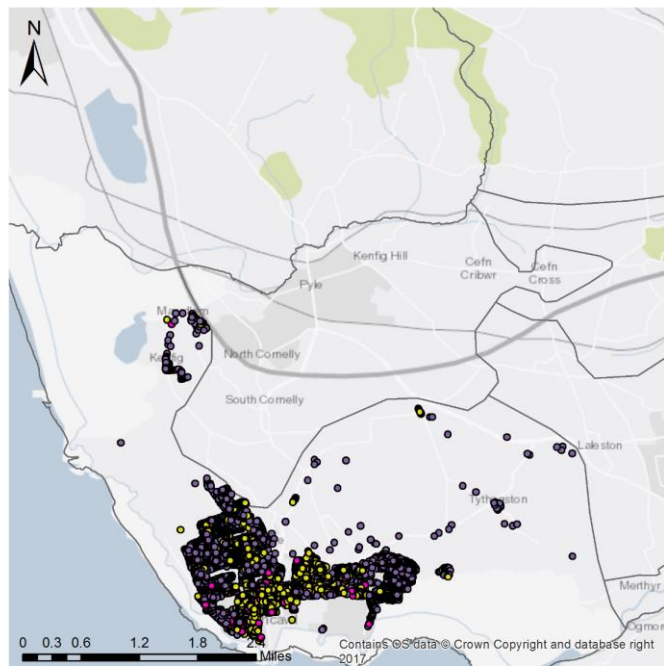
Activity No. 5 - EnergyPath Networks Supporting maps/data

The figure below highlights the areas surrounding Porthcawl with the greatest proportion of over 65s.

Map of Proportion of Over 65s by LSOA in Cluster 12



With Green Gas (Analysis Area 12)



Heat Systems

- ASHP
- GSHP
- Hybrids

The figure opposite highlights the dwellings in the vicinity where electric heat pump based systems are selected as the least cost decarbonisation option for a representative scenario. This shows clusters of Air and Ground Source Heat Pumps, generally selected due to the type of dwelling.

The figure illustrates the modelled least cost option for the northern parts of Nottage which could be an area to consider for this activity due to the high proportion of over 65s.

Other Activity

Table 5-2 Other Activity Identified During the Project

Context	Description
A detailed and robust data set for of non-domestic buildings is required to update the whole system analysis, assess impact on this Strategy and evolve where relevant.	Develop understanding of: <ol style="list-style-type: none"> 1) Actual sector classification and use of buildings 2) The construction method and thermal performance of buildings. 3) Heating Ventilation & Air Conditioning system in use 4) Current energy use 5) Breakdown of energy end uses
If district heating is going to be used at scale, suitable sources of low and zero carbon heat will be needed to decarbonise the heat supplied to heat networks.	A research activity could be progressed to gain a better understanding of the locations, magnitude and feasibility of potential low and zero carbon heat sources that can be used or upgraded. For example, identifying sources and feasibility of ground, water, mine water and industrial waste heat.
EnergyPath Networks consistently identifies heat pumps as the least cost heating system across a wide range of building types including terraced homes and converted flats.	Current planning policy may make installation problematic. Particularly in dwellings where planning guidance restricts the positioning/location of heat pumps in proximity to the dwelling. Consideration of relevant planning policy is recommended.

5.5 Implementation Roadmap

Successful delivery of the energy system transition will rely on effective evidence-based planning, proactive stakeholder engagement and a programme of activities to implement this Strategy. An indicative high level ‘road map’ has been developed to illustrate this Strategy’s implementation and ongoing delivery. This shows:

- The near-term delivery plan to take forward between 2018 to 2022.
- Development of future delivery plans (approximately every 5 years).
- Use of whole system analysis to support the identification of activity.

Leading to certainty around making major area based decisions.

The Implementation Roadmap highlights that the Strategy’s aim is to focus resource and to plan for the medium to long-term, when the major decisions regarding energy network and technology choices must be made.

The roadmap illustrates that the main transition to low carbon building heating systems is expected to take place around 2030 onwards, by which time some network based decisions and deployments may have occurred. Timescales and focus will change, keeping pace with an evolving energy sector.

The near-term delivery plan (for the period 2018 to 2022) provides a guide to take forward the Strategy over the next 5 years. The period post 2023 (to 2032) continues with the ongoing identification of focusing resource, recognising that options will need to be assessed to determine the lowest cost transition, identifying what energy network and system choices are recommended by area; whilst considering conclusions from the projects tested during the near-term plans. The future delivery plans will need to be developed over the Strategy's lifetime, as further priority projects / activities are identified.

This ongoing process should prioritise activity that both benefits the local area and progresses the vision of Bridgend's future energy network and system.

Near-term Implementation Period (2018 to 2022) Key Points

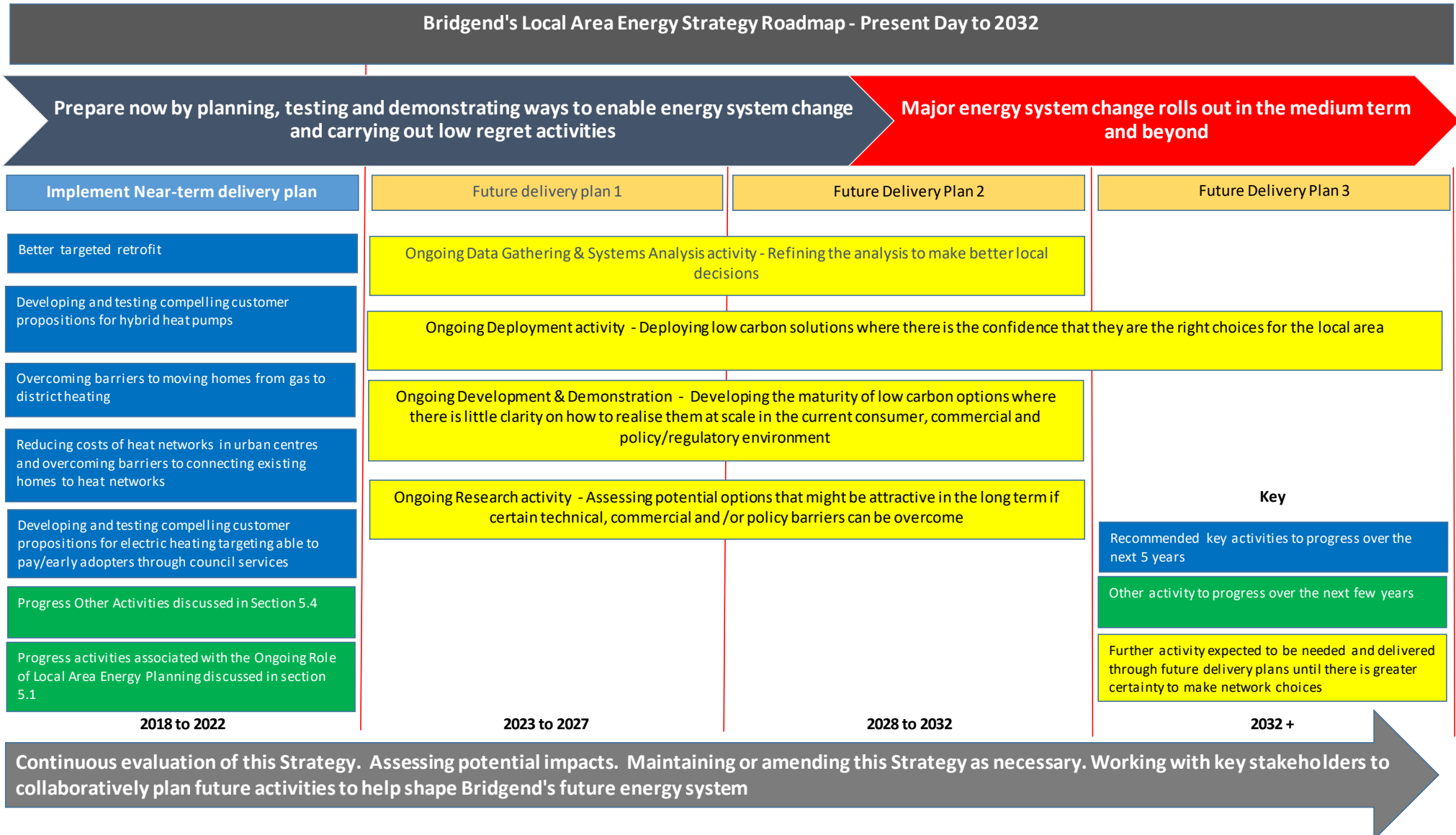
- This illustrates progressing the near-term delivery plan activity over the next 5 years.
- This contains the five activities discussed in Section 5.4 to take forward, informed by the whole system analysis. One of the core objectives of these activities is to inform the ongoing development of the Strategy.
- Innovation activities are expected to be progressed through multiple projects, recognising that there is significant uncertainty to overcome before major network and system choice decisions can be made. Some of these themes may move onto deployment projects in the medium to long term.
- The council will need to review the activities and develop compelling projects to take forward. This process will be supported by SSH Phase 2⁴⁸ and the appointment of a SSH Phase 2 Local Development Officer.

Period Post 2023 Key Points

- There is a requirement for ongoing development & demonstration, data gathering & systems analysis and research activities before this Strategy can prioritise and plan on the use of the specific energy networks and systems that are proposed by area. The actual activities will need to be determined.
- A continuous process of evaluation is needed as this Strategy will need to be regularly updated.
- Future deployment activity, such as the widescale use of low/zero carbon district heating and electric heating systems to domestic homes, can be progressed where these are proven to be the correct solution. These significant transitions (where a new system takes over from Business-as-Usual) are expected to be market-led, in parallel with other large-scale transitions⁴⁹.
- It is assumed that most of the major energy system change will occur in the later stages of this Strategy (post 2030). **This provides Bridgend with a window of opportunity to plan for the major change that will be needed, as the pathway to decarbonisation becomes clearer.**

⁴⁸ The Energy Systems Catapult has been awarded a £9.8m grant from the Department of Business, Energy and Industrial Strategy (BEIS) to deliver Phase Two of the Smart Systems and Heat (SSH) project

⁴⁹ Such as the widespread adoption of electric vehicles (EV), the reinforcement of the electricity grid to support increased demand, the decarbonisation of the electricity grid from fossil fuel produced electricity to renewable and nuclear sources; and the potential repurposing of the gas grid to a low carbon form of gas (such as hydrogen or Bio-SNG).



6 Conclusions

This Strategy has been developed to help Bridgend County Borough Council in collaboration with key stakeholder's plan for the transformation of Bridgend's local energy system and to benefit its people, communities and businesses.

Benefits

Bridgend has been the first Welsh region pilot a new whole system approach to local area energy planning. During the development of this Strategy, the Welsh Government noted that the Bridgend County Borough, with its mix of urban, rural, valley and coastal areas, provides a representation of the whole of Wales. This provides the council with an exciting opportunity to pioneer its low carbon transition and to realise the benefits from innovation and green growth and solutions developed in the local area can be exported throughout Wales and the UK. This should lead to the council establishing new partnerships with the many organisations that will be needed to provide a new low carbon future.

The benefits and advantages of implementing this Strategy are summarised as:

Jobs and economic growth – Enabling and delivering the transition will create jobs and economic growth. An estimated 120 full-time jobs could be created in the time period 2035 – 2050 for just physically delivering the transition.

Innovation and Collaboration - Providing opportunities for the council and any partnering organisations to develop the systems, technologies, services, business models, governance and funding solutions that will be needed. This provides opportunities for further job creation through enabling the transition.

Infrastructure Investment - A clear strategy setting out Bridgend's approach to decarbonising the local area's energy system can provide confidence to investors to invest in the area.

Energy Savings - Progressing the transition in line with the scenarios of Bridgend's Low Carbon Future discussed in this Strategy, could deliver net positive energy savings of c. 25TWh/year compared to the business-as-usual reference case.

Carbon Savings – providing emissions savings of c. 10.5 million tonnes of CO₂.

Empower Residents and Businesses - Through providing guidance that can help individuals make informed decisions on the future energy systems and products they choose.

Fuel poverty - A new approach will create an opportunity to consider how a future energy system can lead to safeguarding the most vulnerable.

Comfort and Health – Changing the way energy is delivered to homes provides an opportunity to improve the comfort of Bridgend's homes. This could result in a wider benefit from better health of c. £5 million (through having warmer homes).

Energy System Change

The Challenge

- Wales and the UK have committed to reducing greenhouse gas emissions by 80% by 2050 (against 1990 levels). This is a significant opportunity to fundamentally change the way energy is provided which is likely to be highly disruptive to the entire energy industry, and will require all major stakeholders to adapt from a business-as-usual position. The transition will directly impact the energy networks which will need to be adapted by reducing capacity in some places and increasing it in others.
- The lifespan of domestic heating systems, which predominantly use natural gas fired boilers, means that most homes in the borough are unlikely to have their boilers replaced more than twice between now and 2050. Natural gas boilers are expected to remain the predominant form of heating for many homes in the borough throughout the 2020s. This results in a window of opportunity, over at least the next 10 years or so, to effectively plan for major network infrastructure choices and to develop, test and demonstrate integrated low carbon solutions for wide-scale adoption.
- There are only a limited number of technology-based options currently available to decarbonise heat and there isn't a 'one size fits all' solution. A whole system analysis has identified that the electrification of heat and the use of heat networks are the predominant, currently available, technology choices to decarbonise Bridgend's buildings. However, significant work is required demonstrate that these solutions can be turned into attractive consumer propositions which can be delivered commercially at scale. In addition, some areas are more expensive to decarbonise than others and consideration will be needed to address this challenge. Other emerging solutions, for example the use of hydrogen, may also need to be considered for future iterations of this Strategy.

What Needs to Happen?

- This Strategy has provided various examples, highlighting that a successful low carbon transition is dependent on the ability to consider and manage multiple interdependencies including: consumer, commercial, technology and engineering based challenges; national and local influences; policy & regulation; economics and social impacts and benefits.
- Co-ordinated planning and action to decarbonise the national electricity supply is needed which falls outside of the council's control and influence. However, as this Strategy is taken forward, there will be opportunities for the local area and Welsh Government to consider how local changes and energy generation can reduce reliance on centralised power generation.
- Business-as-Usual without any local carbon target will not drive the change needed to buildings and local energy infrastructure. An ongoing whole system approach is needed to determine what future energy systems are used, requiring collaboration between the various responsible stakeholders who own, manage and regulate the borough's energy infrastructure. For example, if the electrification of heat is proven as a significant decarbonisation component, then coordination is required to determine if, and how, the additional electricity can be generated and distributed. Depending on building level choices, coordination will be required between decarbonising the electricity supply, building upgraded networks, changing the appliances at the customer premises and, potentially, implementing new digital solutions for matching supply-demand.

- Energy system change in Bridgend County Borough will also depend on the support and engagement of its local people and communities. Over 85% of homes in the borough are owner-occupied or privately rented properties. This means that new low carbon technologies and services that consumers want will be needed, providing significant opportunities for the council to work with organisations who can step up to the challenge.
- Greater clarity is needed on the potential role of hybrid heating solutions and low carbon gas (e.g. hydrogen), along with the development of heat networks and heat pumps so that they are market ready, before network decisions can be made.

Cost

- The total modelled cost of the borough's energy system from present day to 2050 under Business-as-Usual is estimated at £6.6 billion. The additional modelled cost of transition to a low carbon energy system (based on reducing in scope carbon emissions by 95% from 1990 levels) is estimated to be between £0.7 billion and £0.8 billion⁵⁰. This increase in cost highlights the need for society to think about how the cost of decarbonisation is managed.
- There are many factors that are outside of the council's control that can impact on costs and hence local energy system and network choices. For example, changes to national energy policy can influence the most cost effective local solution. Hence why this Strategy recommends monitoring and reviewing major change.
- This increased cost is offset by a direct benefit of c. £414 million from a reduction of c.10.5 million tonnes of CO₂ emissions saved when a value is placed on CO₂, plus a wider benefit from better health of c. £5 million. The supporting Socio-economic and Policy Evaluation report discusses these points and the value of carbon further, along with identifying potential related policy initiatives which could help overcome some of the barriers to decarbonisation.
- These figures are based on a modelled, low carbon future, where the modelled scenarios assume a perfectly managed low carbon transition. However, the actual transition will be different to a modelled view of the world. In addition, changes intended to save cost in one part of the energy system typically transfers the cost to another part of the system. These factors highlight the importance of adopting a whole system perspective to plan and manage the cost of decarbonisation.
- A key focus of this Strategy is based on benefiting economically from the innovation and collaboration needed to enable the transition. Between 2000 and 2008, innovation accounted for 51% of UK productivity growth⁵¹, and Innovate UK's schemes (for example) return an average of £6 Gross Value Added to the economy for every £1 invested. The Governments Clean Growth Strategy highlights that more than 430,000 UK jobs in low carbon businesses and their supply chains have already been created and "the UK low carbon economy could grow by an estimated 11 per cent per year between 2015 and 2030 – four times faster than the rest of the economy –and could deliver between £60 billion and £170 billion of export sales of goods and services by 2030"⁵²

⁵⁰ These costs reflect all energy related costs within Bridgend (e.g. energy system and network related), as well all the energy consumed in Bridgend. Within the current energy system, a large proportion of energy costs are recuperated via consumers energy bills.

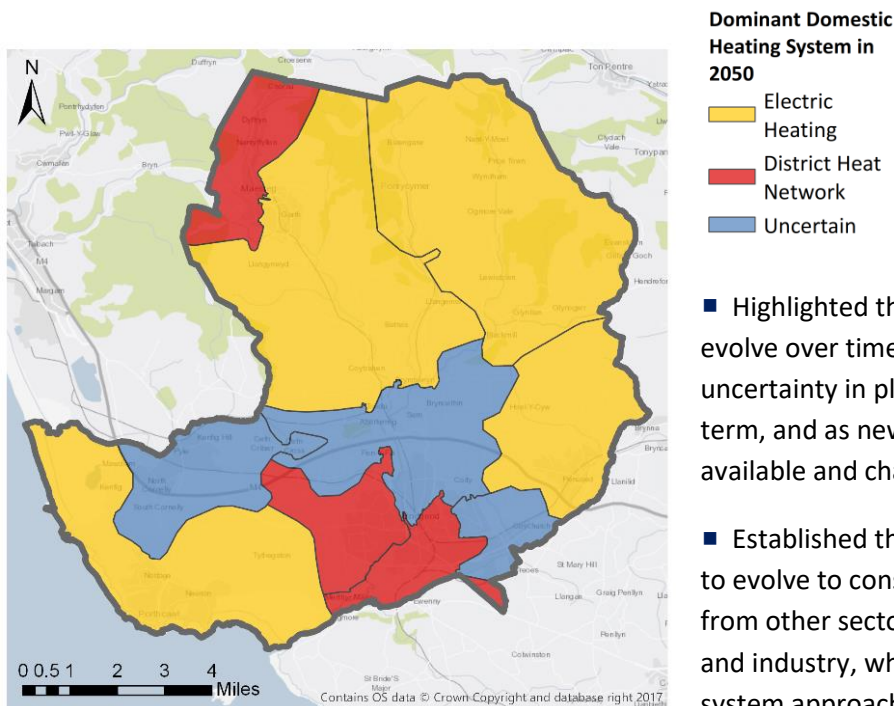
⁵¹ Royal Academy of Engineering Report, 2015

⁵² <https://www.gov.uk/government/publications/clean-growth-strategy>

Bridgend's Future Energy System

Good progress has been made in beginning to address the challenge of climate change. Examples include the Council's key involvement in the SSH programme, activity in developing heat networks in Caerau and Bridgend Town Centre, and Bridgend's success in attracting an industry first project, the Freedom project, led by Western Power Distribution Wales & West Utilities. Moving forward, this Strategy provides a vision to transition the borough from the current national centralised energy system to a future low carbon decentralised energy system that works for its people, communities and businesses. This will help enable new investment, economic growth and employment opportunities for the region. The Strategy:

- Provides an evidence base and roadmap, to help prioritise and plan energy networks and systems for specific areas of the borough, to enable decarbonisation. It has identified, through a whole system analysis, a range of potential future pathways for the transition of the borough's local energy system.
- Provided a summary of the most prevalent decarbonisation themes within the local area, shown in the map below, and provides a vision of the borough's future low carbon energy system based on present day assumptions.



- Highlighted that the actual pathway will evolve over time given the inherent uncertainty in planning for the longer term, and as new information becomes available and challenges are addressed.
- Established that this Strategy will need to evolve to consider carbon emissions from other sectors such as transportation and industry, where a whole energy system approach will be needed.
- Clarified that it is not possible to make major area based energy network choice decisions today. A key focus of the Strategy is to test and evaluate - through innovation, development and demonstration - if and how the identified decarbonisation of heat themes can be rolled out at scale, and provide evidence to reduce uncertainty and increase confidence for planners, investors and businesses.

What Next?

Section 5 identified a series of activities associated with the ongoing role of Local Area Energy Planning for the Council and the Welsh Government to consider how to progress. These activities are initial recommendations to be taken forward over the next few years, and to be re-evaluated as part of a continuous evolving process of local area energy planning.

A Near-Term Delivery Plan is proposed which recommends the following key activities for the council to progress over the next five years. The activities focus on testing and progressing the recurring transition themes identified in the Strategy and its Evidence Base and will help target and prioritise effort and resources to enable Bridgend to realise its vision of a future low carbon decentralised energy system.

- Better targeted retrofit informed by whole system analysis and data to help prioritise what should be done, where and when.
- Developing and testing compelling customer propositions for hybrid heating solutions.
- Overcoming barriers to moving existing homes from gas to heat networks.
- Reducing costs of heat networks in urban centres and overcoming barriers to expansion and connecting existing homes.
- Developing and testing compelling customer propositions for electric heating targeting able to pay/early adopters through council services.

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Revision History

Date	Version	Comments
09/11/2017	0.1	First draft
23/01/2018	0.2	Second draft
05/03/2018	0.3	Draft incorporating GT review comments
23/04/2018	0.4	Draft incorporating RH review comments
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10/05/2018	0.6	Draft for ESC approval
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06/08/2018	2.1	Graphics amendments for ETI comments
12/02/2019	2.2	Additional copyright/footnote information added
01/02/2019	2.3	Updated to Bridgend County Borough Council branding

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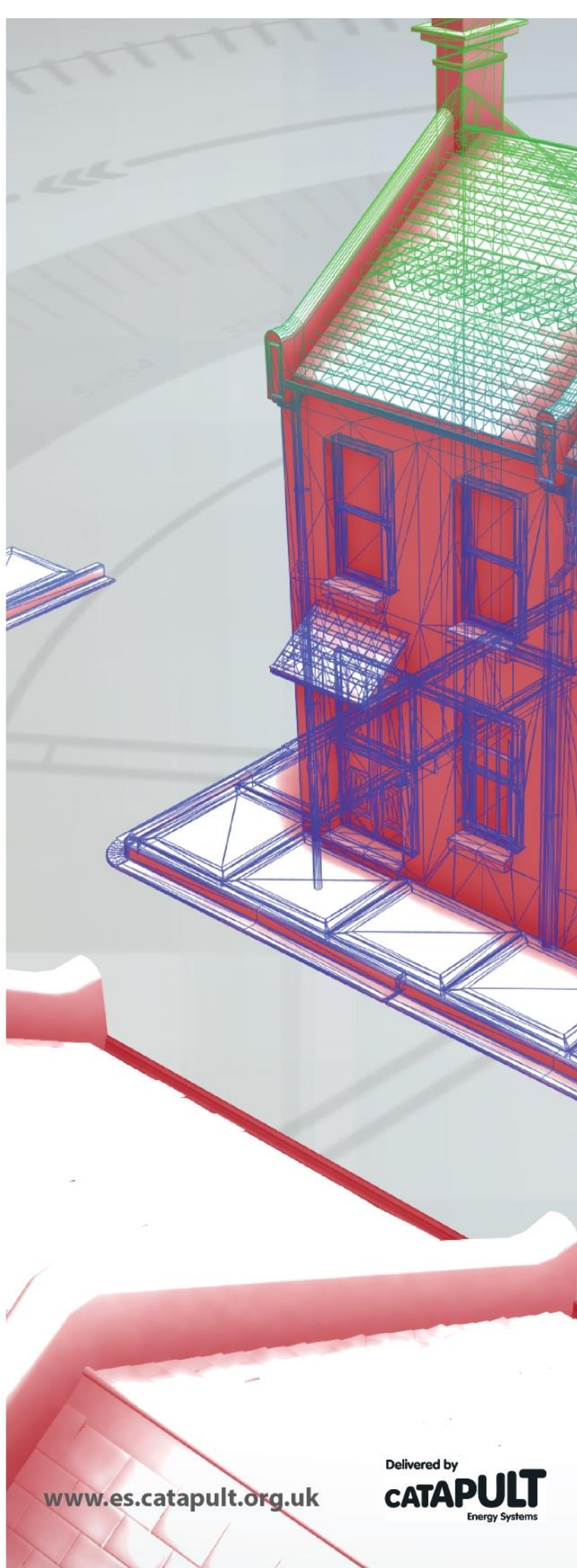
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