Programme Area: Smart Systems and Heat

Project: WP2 Bridgend Area Energy Strategy

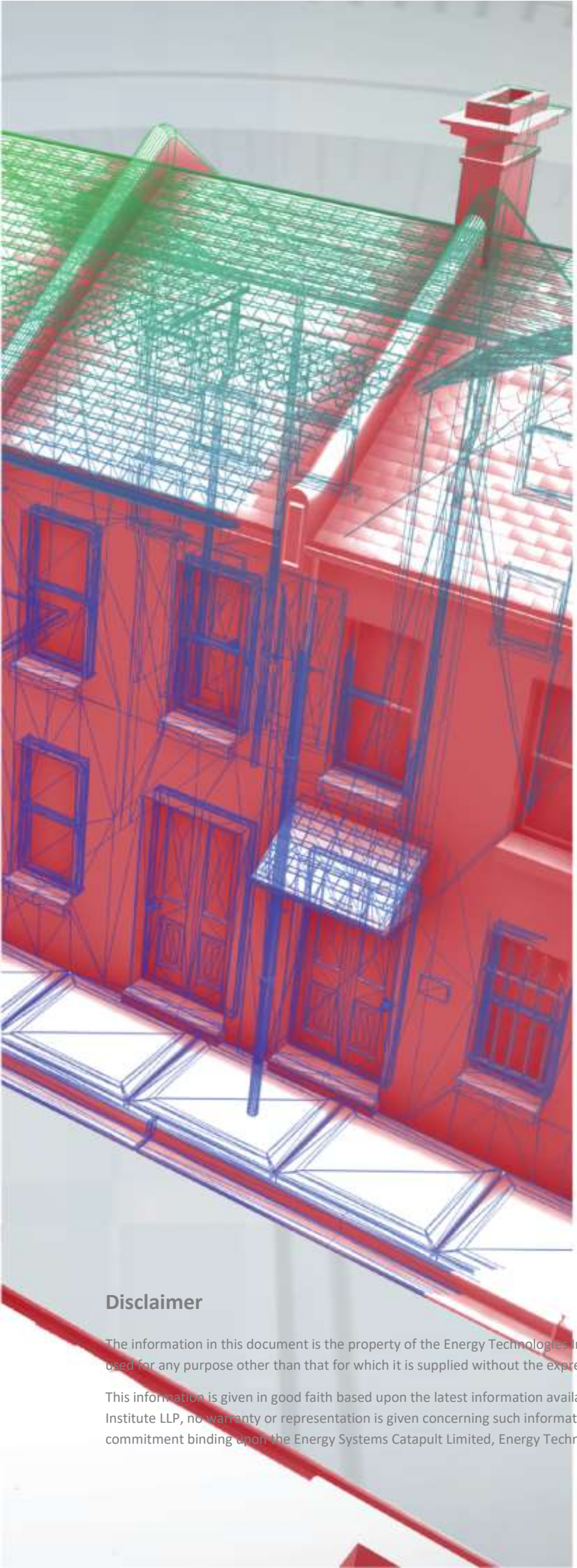
Title: Bridgend Policy and Socio Economic Impact Report

Abstract:

This report describes the policy, economic and commercial perspective as it relates to the EnergyPath Transition Plan for Bridgend County Borough Council. It includes a national policy and regulatory perspective, which considers the current environment for low-carbon and energy efficient interventions and describes the opportunities for deployment and barriers which may hinder their adoption. A socio-economic impact considers a cost-benefit analysis of the transition plan for Bridgend identifying and quantifying tangible and intangible benefits selected scenarios including commercial opportunities and risks.

Context:

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



Energy Transition Plan:

Policy and Commercial Insights for Energy System Transformation:

Bridgend

ESC Project Number **ESC00048**

ETI Project Number **SS9006**

Contents

Executive Summary

A significant reduction of the carbon intensity of heat is central to helping the UK reduce its greenhouse gas emissions, whilst using heat more efficiently will help to reduce fuel poverty and provide commercial opportunities. To do this will require a move away from natural gas-fired boilers towards low-carbon forms of heating such as heat pumps, district heat networks and biogas- or hydrogen-fuelled heating systems.

There are multiple options to make heat generation more energy efficient or to decarbonise heating systems completely. In urban areas, district heating can provide the infrastructure for flexible heating supply, based on a number of sources including biomass, waste heat and heat pumps. The electrification of heat generation, provided the electricity is sourced from renewable sources, offers another route to decarbonisation - this is particularly efficient when heat pumps are used. Direct renewable heat options use solar thermal, biomass or biogas boiler, biomass or biogas CHP systems and biogas injection into gas grid.

The Bridgend Local Area Energy Planning project has produced a draft Strategy for decarbonising heat in the Bridgend Council area and a roadmap for its implementation. It is based on evidence from an *EnergyPath Networks*[1] modelling study with inputs from a number of key stakeholders including local authorities, Welsh Government and the electricity and gas network operators. This analysis compares the results of the EPN scenario *'A world without Green Gas'* and '*Business As Usual' (BAU).* Both scenarios include the national cost of decarbonisation however BAU does not have a local carbon target in Bridgend.

On average, the *'A world without Green Gas'* scenario delivers net positive energy savings of c. 25TWh over the period 2020-2050 compared to BAU, which when monetised results in an increased total cost[2] of c. £800 million because gas is being displaced by more expensive fuels. This increased cost is offset over the period 2015-2050 by a direct benefit of c. £414 million from a reduction of c.10.5 million tonnes of CO_2 emissions saved as a result of implementing the Strategy plus a wider benefit from better health of c. £5 million.

An important challenge for achieving a sustainable heat pump market in the UK is ensuring good technical performance and improving consumer awareness and acceptance arising from this. Without these factors, levels of uptake of heat pumps are likely to be low.

A number of low-regret policies such as standard contractual structures, consumer protection and building skills and capabilities to support district heat could be introduced at little cost. The extended use of Local Development Orders for the installation of heat networks (including pipes,

[1] http://www.eti.co.uk/programmes/smart-systems-heat/energypath
[2] Total cost including capital equipment/measures and energy spend

heat exchange equipment, street furniture, informational signage and ancillary engineering works) should be supported in Bridgend.

In addition to the direct monetary benefits from the transition, it's estimated that 120 full-time equivalent jobs could be created in the time period 2035 – 2050, over and above those for the BAU scenario, when most of the buildings are expected to start transitioning to low carbon heating systems. These are additional jobs associated with retrofitting domestic buildings and the installation of new energy networks.

The results from the EPN study indicate that policy initiatives should be focused in three areas: Energy Efficiency; Electrification/Heat Pumps; District Heating.

The Strategy for Bridgend CBC is likely to be implemented in two stages:

Stage 1: 2020 – 2029 – where there will be some fabric retrofit in identified properties (with a focus on those households in fuel poverty) and some switch away from gas boilers to heat pumps and district heating.

Stage 2: 2030 – 2050 – when the main low carbon transition will occur as electrification of heating gathers pace as the electricity grid is decarbonised, and more households are connected to low carbon-fuelled district heating schemes. New innovative business models will be developed and new value propositions will be offered to the consumer. The structure of the gas and electricity markets will be transformed to facilitate these new ways of producing, distributing, trading and selling energy.

Different local and national policies may be required to facilitate each stage of the transition. During Stage 1, policies to encourage more efficient gas heating and retrofit of energy efficient and low carbon interventions such as insulation and smart appliances may be promoted. The transition to low carbon heating solutions gathers pace from around 2030 when the electricity grid is planned to be decarbonised. Any new policies and business models to encourage greater uptake of heat pumps and connection to district heat networks will need to be developed and implemented before 2030 to prepare for the transition.

One option promoted in the Strategy is targeted retrofit. In general, designing retrofit policy around home improvement practices offers a more effective solution than merely supporting energy efficiency schemes such as the Green Deal. This is because householders are far more likely to consider funding energy retrofit within their broader home improvement plans rather than as a standalone initiative.

The economics of the switch to heat pumps could be improved in the short-term by applying subsidies for low carbon/renewable heat i.e. a continuation of the Renewable Heat Incentive (RHI) or Feed-in Tariff (FIT) that pays a top-up for every kWh of renewable heat produced. A better alternative to subsidies might be an upfront capital contribution to offset the relatively high costs of purchasing a heat pump in the first instance. However, in the longer term, policies that incentivise energy providers to reduce the carbon intensity of their energy supply portfolio should obviate the need for subsidies/capital payments (see below).

The introduction of a carbon price applied to gas and other fossil fuels to reflect the environmental costs of burning such fuels would address the carbon externality and help to level the playing field

for low carbon forms of heating such as heat pumps and district heating (from low carbon heat sources). However, a carbon price applied to heating can be a blunt instrument and may worsen fuel poverty if safeguarding measures for vulnerable customers are not put in place.

An alternative approach to applying a carbon price on fossil fuels is the setting of a Carbon Intensity Standard (CIS) for Energy Providers – this option is currently being explored by the Energy Systems Catapult. A CIS could be set for an EP on a portfolio basis and would require carbon reductions via a number of measures, including low-carbon retrofits and possibly through carbon trading.

Consumer research by the Energy Technologies Institute (ETI) as part of the Smart Systems and Heat programme has shown that, if households bought energy services, they would be indifferent to how they were delivered as long as they achieved the desired outcome. This creates a channel to market for low carbon energy systems without forcing government to subsidise components. The ESC has considered a number of business models to meet people's needs and a key result is the concept of buying *Heat as a Service (HaaS)*[3]. A service model would enable EPs to deliver heat outcomes and be encouraged to improve efficiency in delivering them.

[3] www.eti.co.uk/insights/domestic-energy-services

1 Introduction

1.1 The Smart Systems and Heat Programme

Heating accounts for almost one third of total UK carbon emissions. To achieve the 2050 target of an 80% reduction in carbon emissions compared with a 1990 baseline, the UK will need to decarbonise the domestic heating market at the rate of 20,000 homes a week by 2025 – the current rate is less than 20,000 homes a year.

The Smart Systems and Heat (SSH) Programme was initiated and funded by the Energy Technologies Institute (ETI) and is being delivered by the Energy Systems Catapult (ESC) together with several Local Authorities and other stakeholders. SSH is seeking to determine the most effective means of decarbonising the UK's 26 million homes and contributing to the target of an 80% reduction in the UK's Greenhouse Gas emissions by 2050.

SSH is designed to help innovators address this market failure and unlock the commercial opportunity of low carbon heating, by:

- Addressing the technical, regulatory, economic and social barriers that block new low carbon heat products, services and business models getting to market,
- Establishing a range of platforms, insights and modelling tools to help innovators discover new low carbon heating solutions that consumers value,
- Bringing innovators, businesses, local authorities, networks, policy-makers, regulators and consumers together to create new markets that deliver low carbon heating solutions at scale.

1.2 This Study

1.2.1 Background

This document has been produced by ESC as part of Work Package 2 within the SSH Phase 1 Programme and to support production of an evidence base and local area energy strategy for Bridgend Council. ESC supports innovators in unlocking opportunities which are generated by Transition to develop a clean, intelligent energy system. ESC is one a network of innovation centres set up by the government to transform the UK's capability for innovation in specific sectors and to help drive future economic growth.

The study analyses the economic impact results generated by the *EnergyPath Networks* modelling framework developed by the Energy Technologies Institute. EPN applies a multi-vector approach to select the most appropriate energy technology options in a local area, for a given set of technical and economic criteria, at least social cost. Options include energy efficiency interventions for the homes in that area.

ESC is working with Bridgend County Borough Council (BCBC) to develop a Local Area Energy Strategy that seeks to reduce carbon emissions from buildings by 90% by 2050. It's also working with Newcastle City Council and the Greater Manchester Authority (specifically Bury Council) to develop similar local area energy plans.

1.2.2 Structure of this report

This document describes the policy, economic and commercial perspective as it relates to the creation of a Local area Energy Strategy for Bridgend Council. **Section 2** describes an evaluation of the policy and socio-economic considerations for the transition to a Low Carbon Future for Bridgend, including an overview of the current UK and Welsh Government energy policy, and the barriers that prevent uptake of low carbon and energy efficient interventions.

Section 2 includes evaluation of the socio-economic costs and benefits from the implementation of the '*World without Green Gas' scenario* in Bridgend – these include direct benefits such as reductions in energy consumption and carbon emissions, and wider benefits such as improvements in health and increased employment. Possible future policies which might facilitate the implementation of the Strategy are then considered and some conclusions and recommendations made.

Section 6 is an Appendix containing supporting information ion the methodology and assumptions for the calculation of the socio-economic benefits

2 Evaluation of Policy and Socio-economic Considerations for Transition

2.1 The Current UK Energy Policy and Regulatory Environment

2.1.1 Overview

Heating buildings accounts for around 450 TWh/year of energy demand in Great Britain[4], around half of the total demand. Most of the energy demand is for domestic space heating and is satisfied with natural gas boilers in homes throughout the country.

Space heating resulted in the emission of approximately 100 megatonnes of carbon dioxide equivalent ($MtCO_2e$) into the atmosphere in 2008, 18% of the total carbon emissions including industry, power stations and transport. Total heat demand, including industry, contributed 182 $MtCO_2e$, bringing the total to 32%.

Decarbonising heat is essential if the UK is going to meet its 2050 target of reducing Greenhouse Gases (GHG) by 80% below 1990 levels. Improving energy efficiency helps increase the sustainability, resilience and affordability of the energy system and can help bring down carbon emissions and reduce fuel poverty. However, despite the legislative efforts of the *Climate Change Act (2008)* and the *Energy Act (2013)*, the UK has a relatively low installation rate of retrofit energy efficiency measures.

Retrofit energy efficiency in buildings is an important part of many low carbon, low fuel poverty pathways and it is an essential part of the UK's future heat and electrical infrastructure mix. Some progress has been made in recent years with energy saving in retrofits, such as developments in the skills of the UK energy efficiency workforce, the drafting of the Private Rented Sector Regulations and mortgage providers beginning to take a greater interest in energy efficiency.

There remain challenges, however: there have been two major setbacks for energy efficiency of UK buildings, the first being the announcement of the ending of the Green Deal; and secondly the removal of the Zero Carbon Homes Standard.

Another factor in achieving a lower-carbon energy system is the re-purposing of the gas transmission network. Replacing natural gas with alternative gases such as Syngas and hydrogen could help the UK achieve its carbon reduction targets, as part of a multi-option energy solution. However, the economic case for using alternative gases is yet to be made, and the technical and safety considerations still

[4] "Policy for Heat: Transforming the System: Future Heat Series, Part 2" – A report by Carbon Connect (October 2015)

need to be addressed. It is clear that to re-purpose the gas network would involve considerable investment in the long term.

2.1.2 Energy Policy in Wales

Wales' housing stock currently has a relatively poor energy performance. There are a large number of solid wall homes and many rural properties are dependent on oil or liquefied petroleum gas (LPG) for central heating. Tackling this backlog of hard-to-heat homes will create jobs, encourage skills, improve local areas and help to reduce fuel poverty.

The power to take action on energy efficiency is not fully devolved to Wales. The role of the Welsh Government is limited to the promotion of energy efficiency while the regulation of energy efficiency rests with the UK Government.

The Welsh Government has laid out the strategic direction for energy efficiency in: ***Energy Efficiency in Wales: A strategy for the next 10 years 2016-26***. This document describes the strategy that the Welsh Government will adopt to reduce Greenhouse Gas Emissions, improve energy efficiency, increase related employment and reduce fuel poverty. The strategy builds on existing work such as the ***Warm Homes Programme***[5] and ***Resource Efficient Wales***[6].

There are also new supply initiatives such as *One Wales Energy*[7] – these propose to offer better value, community energy supply, which benefits accruing to customers and to businesses in Wales.

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 Wales. This Strategy will need to consider and align with relevant and evolving Welsh Government guidance regarding climate change and energy. The points below highlight three key examples:

- **The Environment (Wales) Act 2016 - 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 5 yearly carbon budgets. The Welsh Government will be laying regulations around their interim targets and first 2 carbon budgets by the end of 2018 and shortly afterwards by publishing a Low Carbon Delivery Plan, setting out the actions to meet the first carbon budget.**
- **Renewable Energy Targets - Welsh Government has set the following renewable energy targets:**
    - **Generating 70 per cent of Wales' electricity consumption from renewables by 2030**

[5] http://gov.wales/topics/environmentcountryside/energy/efficiency/warm-homes
[6] http://resourceefficient.gov.wales
[7] http://html.dw1.co.uk/one-wales-energy/

- **1 GW of renewable electricity capacity in Wales to be locally owned by 2030**
- **Renewable energy projects to have at least an element of local ownership by 2020**

2.1.3 Energy Efficiency in Wales

The ***Welsh Government Warm Homes Programme (WHP)***[8] includes the Arbed and Nest schemes. It provides funding for energy efficiency improvements to low income households and those living in deprived communities across Wales.

Both the Arbed and Nest schemes adopt a whole house approach to home energy efficiency improvements. This helps to tackle harder to treat homes where the impact of fuel poverty tends to be most severe. Since 2012, the Welsh Government has invested over £150 million and improved over 27,000 homes as part of the WHP.

The Welsh Government Warm Homes Arbed Programme provides grants to Local Authorities for area-based energy efficiency schemes. It is the Local Authority which procures and appoints contractors.

2.1.4 Fuel Poverty in Wales

The Welsh Government ***Fuel Poverty Strategy***[9] defines a household as being in fuel poverty[10] if "*it would be required to spend more than 10 per cent of its income (including Housing Benefit, Income Support for Mortgage Interest or council tax benefits) on all household fuel use, in order to maintain a satisfactory heating regime*". Households that are required to spend more than 20 per cent are considered to be in severe fuel poverty.

Three main factors influence whether a household will be in fuel poverty: these are **household income, energy prices and the energy efficiency of the home.** The Welsh Government has limited powers to tackle low income and energy prices, however, where it can make a significant difference is in improving the energy efficiency of homes in Wales. This is the most sustainable way to reduce energy bills in the long-term.

Statistics for fuel poverty in Wales have been produced by the *Building Research Establishment (BRE)*. The BRE report[11] provides modelled estimates of fuel poverty and severe fuel poverty in all households, fuel poverty in vulnerable households and fuel poverty in social housing from 2012 to 2016. The research also estimates the impact of energy efficiency improvements on levels of fuel poverty.

[8] http://gov.wales/topics/environmentcountryside/energy/efficiency/arbed/?lang=en
[9] The Welsh Government: "Fuel Poverty Strategy for Wales" (2010)
[10] A different definition of fuel poverty is used in England – this is the Low Income High Costs (LIHC) definition which states that a household is considered to be fuel poor if its fuel costs are above average and, if it were to spend that amount, it would be left with residual income below the official poverty line.
[11] BRE: "The Production of Estimated Levels of Fuel Poverty in Wales: 2012-2016" (July 2016).

The BRE research shows that the estimated number of Wales' households in fuel poverty has reduced from c.30% (386,000) in 2012 to c.23% in 2016.

The BRE research highlights the positive impact of home energy efficiency improvements on levels of fuel poverty. This indicates that an all-Wales scheme supporting low income households with such provisions, alongside a comprehensive package of advice and other support, continues to be a highly effective way to further reduce levels of fuel poverty.

2.1.5 Planning Policy in Wales

The ***Planning and Energy Act, 2008***[12] ***('The Act')***, enables local planning authorities in Wales to set reasonable requirements in the Local Development Plan (LDP) for the generation of energy from local renewable sources and low carbon energy and for energy efficiency. Policies in the Planning Policy Wales complement the *The Act* and provide a legal basis for the implementation of LDP policies against the national framework.

The Welsh Government is required to make a contribution to the International, EU and UK targets for greenhouse gas emission reduction. The **Climate Change Act 2008** provides the statutory framework for the reduction of greenhouse gas emissions in the UK.

Planning Policy Wales – Edition 10 **is currently under consultation and the conclusions from this process need to 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 take into account 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".***

Bridgend Local Development Plan (LDP)

The Bridgend LDP was adopted on the 18th September 2013. Policy SP2 of the LDP represents the starting point for the assessment of all planning applications within Bridgend Council. The policy requires a high quality of design in all development proposals. For most applications, Design and Access Statements/Planning Statements will be required as part of the Development Control process to ensure the policy is implemented effectively.

Policy ENV17: Renewable Energy and Low/Zero Carbon Technology

BCBC encourages major development proposals to incorporate schemes which generate energy from renewable and low/zero carbon technologies. These technologies include onshore wind, landfill gas,

[12] *www.legislation.gov.uk/ukpga/2008/21/pdfs/ukpga_20080021_en.pdf*

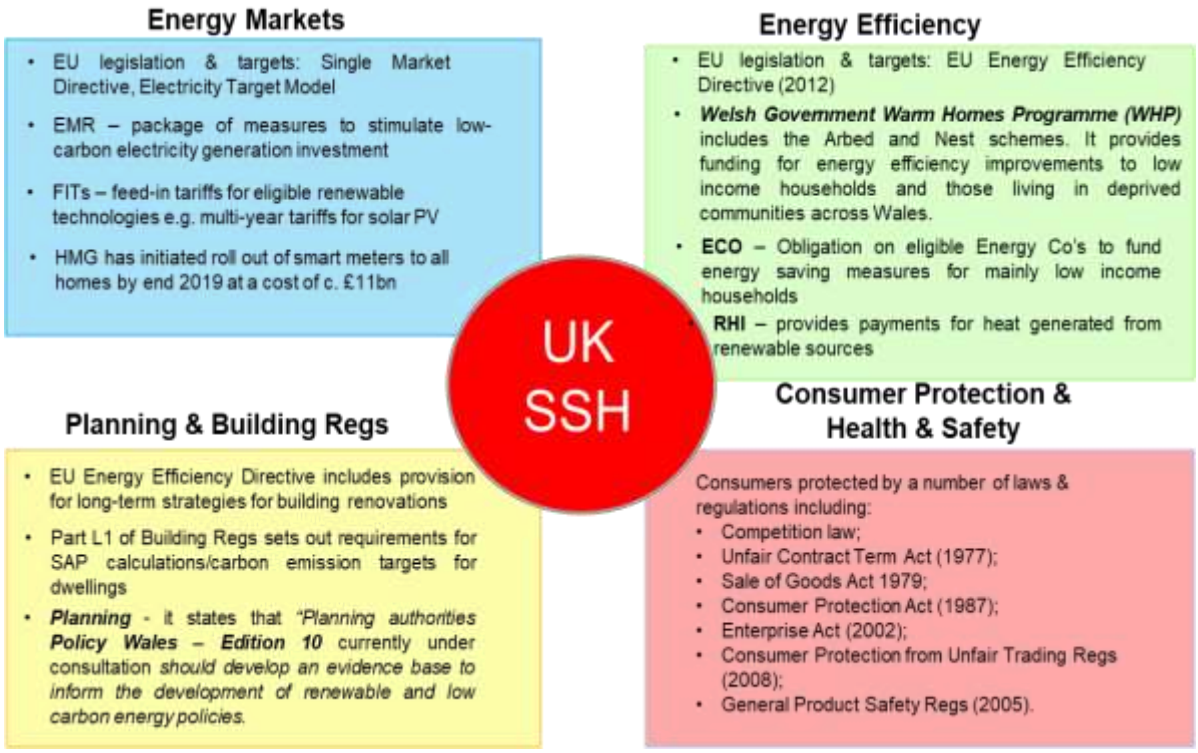
energy crops, energy from waste, anaerobic digestion, sewage gas, hydropower, biomass, combined heat and power and buildings with integrated renewable sources. To achieve this, all development proposals of ten or more residential dwellings or with a total floor space of 1,000 m^2 or more should, where viable, be able to connect to district supply networks of heat and energy.

2.1.6 Current UK Energy Policy

A report by Carbon Connect[13] on the future of heat policy in the UK, states that currently there is no visibility of specific policies driving low carbon heat supply and energy efficiency retrofit beyond the next 1-2 years, even though there are long-term targets in place for carbon and fuel poverty reduction.

An overview of the current policies that have a bearing on the SSH Programme is shown in Figure 3.1.

Figure 3.1: An Overview of Some of the Key UK/Wales Policy & Regulations for the SSH Programme



The vote for the UK to leave the EU has created a great deal of uncertainty. This uncertainty manifests itself in the development of the future energy policy framework: how many of the current EU-based energy regulations will be kept? It must be pointed out though that the basis for the agreed climate change obligations and targets in the UK is the 2008 Climate Change Act which is enshrined in UK legislation.

The other major uncertainty that may affect the implementation of the Bridgend CBC low carbon transition surrounds the ability to obtain finance. It is not yet clear how these uncertainties will be

[13] A report by Carbon Connect (October 2015): Policy for Heat: Transforming the System: Future Heat Series, Part 2"

resolved. There are also a number of existing policy barriers that need to be addressed in order to meet the 2050 climate change targets – these are discussed in *Section 3.1.7* below.

2.1.7 Policy Barriers

There are many issues that need to be considered when looking at future policy to promote low carbon and renewable heating and power supply. These include the role of local authorities; the need to improve energy efficiency; the implications of smart meters; and the role of regulation. These will all have a big impact on the nature of any support schemes the Government introduces (and/or discontinues), and the potential impact of private sector incentives.

The *Department of Energy and Climate Change (DECC – now the Department of Business Enterprise and Industrial* Strategy - BEIS) and others identified a number of barriers to the uptake of low carbon and energy efficient interventions. The DECC research[14] found nine main barriers (in five categories) to uptake across all sectors. These are:

Awareness and attention – Lack of information or awareness, Lack of focus;

- Financial and non-financial costs – Transaction barriers, does not meet hurdle rate or payback period;
- Capturing benefits – Split Incentives (i.e. between landlords and tenants), Risk and Uncertainty;
- Financing – Capital costs;
- Execution – Product availability, Installation and use.

Transaction Barriers and Capital Constraints were found to be most important barriers in the residential sector. Frontier Economics[15] in conjunction with the ETI as part of the SSH Programme, has carried out a review of the DECC barriers and has found other factors such as Policy Complexity and Uncertainty, Lack of Trust (e.g. due to branding), and Product Aesthetics to be important.

[14] DECC (2013) – "The Future of Heating: Meeting the challenge"

[15] Frontier Economics (January 2015) – "Overcoming barriers to smarter heat solutions in UK homes: A Report Prepared for The Energy Technologies Institute"

This study also considered insights from behavioural economics[16]. Behavioural economics provides a framework and tools which help to explain actual decision making - this needs to be taken into account when considering take-up of new technologies or the impact of new policies - and provides insights on barriers in five key areas:

- Time inconsistency – where individuals have high discount rates for future cost savings but a small discount rate for large initial investment outlay, or where individuals may want to invest in energy efficiency but are delaying.
- Endowment effect – where households are attached to existing appliances which are known to work and are unwilling to take the risk of replacing them even when it is efficient to do so – research shows that this effect has nothing to do with wealth or transaction costs.
- Salience – where individuals display a lack of focus and place too much weight on observable factors which may result in placing too much emphasis on initial investment costs and under-investment in energy efficiency.
- Errors in behavioural finance – where consumers can show limited attention (lack of focus) and over-confidence when making a decision or where loss aversion may mean consumers put more weight on potential losses than potential gains.

A potential policy landscape, mapped against these barriers is shown below in Figure 3.11 with a range of new Enabling, Incentivising and Mandating policies.

2.2 Socio-economic Evaluation of the Local Area Energy Strategy for Bridgend

2.2.1 Background

The EnergyPath™ Networks (EPN) modelling tool has been used to develop a ***Local Area Energy Strategy (LAES)*** for Bridgend CBC. The Strategy covers the period 2020-2050, although most of the interventions will not be made until around 2035 onwards after the national electricity grid has decarbonised.

EPN has been used to generate a least-cost pathway for the Bridgend CBC area. The focus of this pathway is making interventions to domestic buildings, energy efficiency measures and low-carbon heating systems, and changes required to the gas, electricity and heat networks to facilitate these.

A *"Business-As-Usual" (BAU)*[17] EPN output run has been produced. This BAU run consists of running the tool with exactly the same dataset but with no carbon target set for the local area (of course, decarbonisation of the national energy supply still occurs in this scenario).

[16] Behavioural economics considers psychological, social, cognitive and emotional effects when consumers make a real-world decision, as well as the economic rationality for that decision.
[17] The BAU scenario has been compared against multiple low carbon pathways - the economic impacts are an indication of possible pathways to decarbonise.

2.2.2 Methodology

The costs of the interventions made as part of the energy transition in Bridgend CBC will be offset by a number of socio-economic benefits. These benefits include:

- **Direct Benefits**
    - Reductions in carbon emissions
    - Improved energy efficiency/energy usage reduction
    - Improved comfort
- **Wider Benefits**
    - Improvements in health
    - Employment benefits

A methodology has been developed to assess these economic costs and benefits. This methodology takes output data directly from EnergyPath™ Networks (EPN) and calculates indicative costs and benefits using *HM Treasury (HMT) Green Book and Inter-departmental Analysts Group (IAG)* guidance where appropriate[18,19].

Note: Costs and benefits are derived from the difference between a target run i.e. a "low carbon future local energy scenario" *and a reference run (the BAU). The target run chosen is 'A world without Green Gas' as this is a result of the decisions and considerations made by the key stakeholders along the modelling process (council, local government, distribution networks) and is one of the primary scenarios considered in the Strategy and Evidence Base. Metrics that show a range for results with error bars have been calculated using 9 of the 'sensitivity' runs to give an indication of how these figures may vary.*

A detailed overview of the approach used, including the calculation methodology and the key assumptions made is included in Annex 5.1.

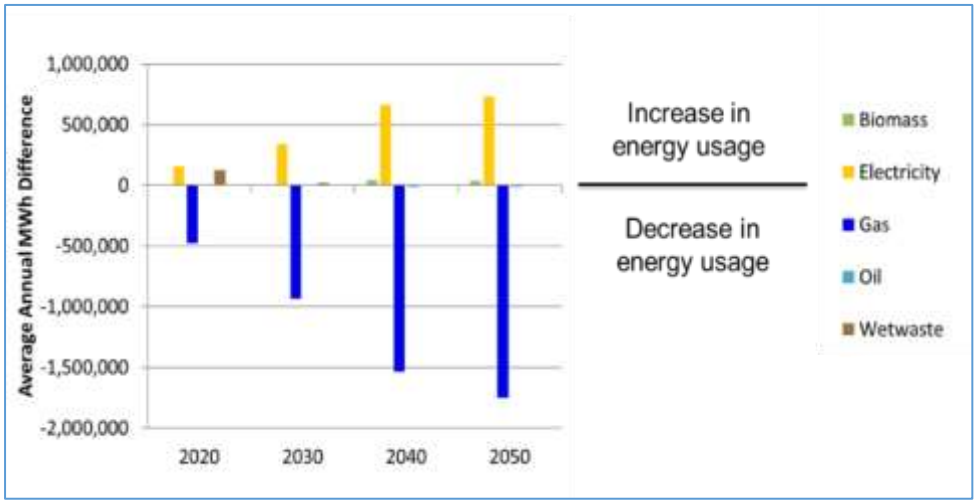
[18] HMT Green Book guidance: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/220541/green_book_complete.pdf
[19] IAG guidance: https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

2.2.3 Socio-economic Benefits

Direct Benefits

The **Average Energy Savings** (MWh) as a result of the modelled future local energy relative to the respective Business-As-Usual run for each time period and broken down by energy type are shown in Figure 3.2.

Figure 3.2: Average Energy Savings (MWh/year) for the EPN scenario relative to the BAU reference case

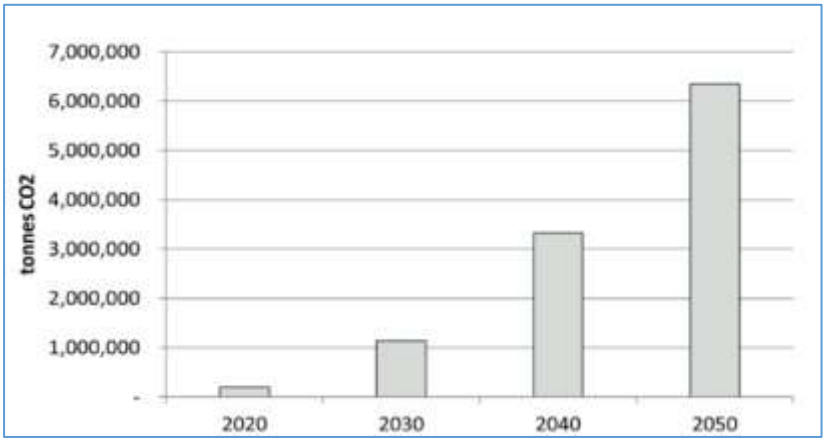


Note: The calculated metrics from the Target run are subtracted from the BAU run: therefore, positive results are increases and negative values are savings.

On average, the LAES will see a net energy saving of c.25TWh over the period 2020-2050 due to a reduction in gas usage of c.45TWh offset by an increase in electricity usage of c.18TWh plus a small increase in wet waste and biomass

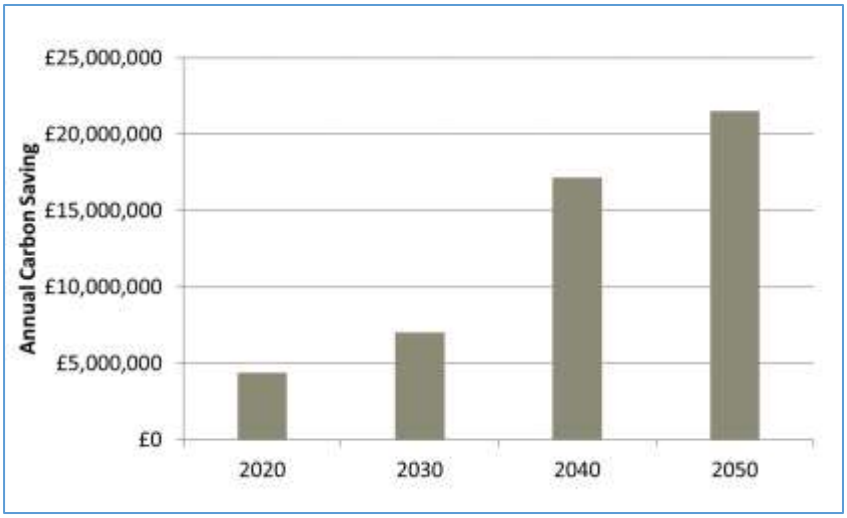
The **Average Carbon Savings** (tCO_2) as a result of the modelled future local energy scenario for each time period and broken down by energy type are shown in Figure 3.3.

Figure 3.3: Cumulative Tonnes of CO_2 saved (compared to 'Business as Usual')



On average, the LAES will see a net saving of c.6 million tonnes of CO_2 over the period 2020-2050 due mainly to a reduction in gas usage

Figure 3.4: Annual CO_2 Cost Saving of 'A world without Green Gas' Scenario vs 'Business as Usual'

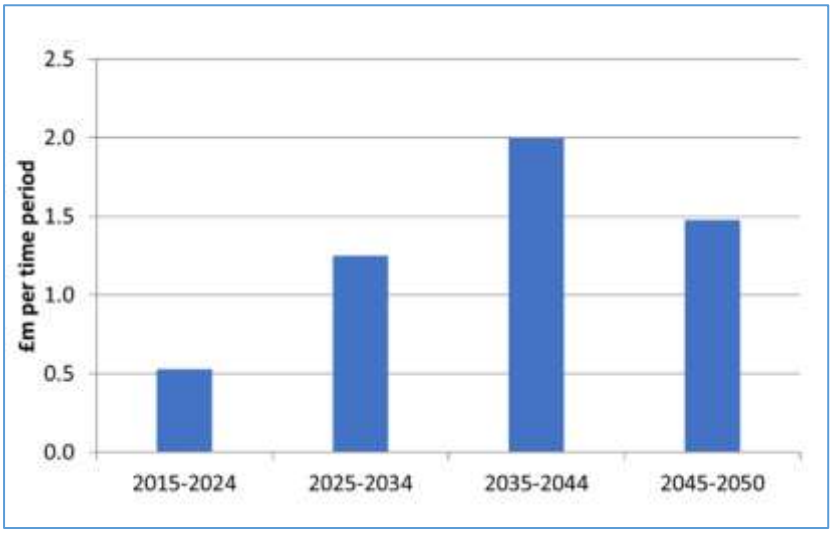


- **Prices based on IAG projections of future EU ETS Carbon Prices**
- **Total saving from reduced CO_2 emissions by 2050 of c. £415 m**

Wider Benefits

The **Average, Discounted, Annual Health Benefits** from implementation of the Strategy have been evaluated by converting energy savings to *Quality Adjusted Life Years (*QALY) with a value of £30,000/QALY. These are shown in Figure 3.5.

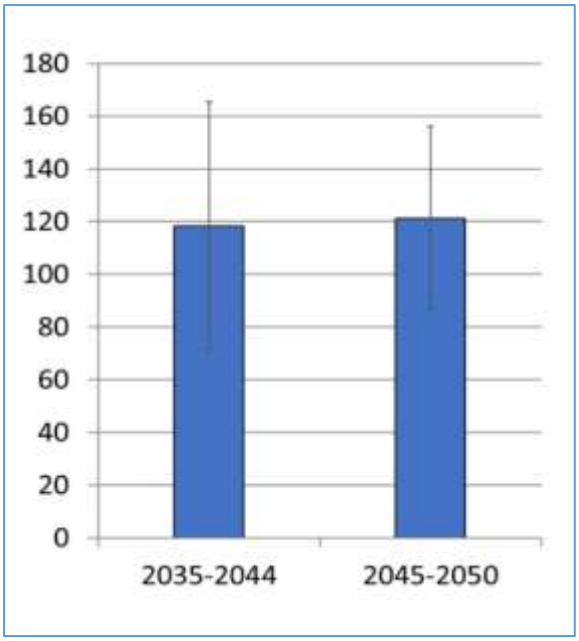
Figure 3.5: Average, Discounted, Annual Health Benefits from EPN Scenario



- **Health benefits of at least £5m between now and 2050**
- **QALY: Quality Adjusted Life Years: 1 QALY ≈ 1,500 to 6,000 MWh**
- **1 QALY = £30,000**

The **Employment Impact** created from implementation of the Strategy (over and above those for the BAU reference case) is shown in Figure 3.6.

Figure 3.6: Average Full Time Equivalent (FTE) jobs created for Bridgend Council residents by the Strategy



Assumptions:

- **18 jobs per £m per year spend in certain sectors**
- **17.3% 'leakage' accounted for (jobs created outside local authority)**

Analysis of results:

- **Gas CHP energy-centre generation under BaU affects 2015-34 figures.**
- **Insulation in homes between 2015-34 (~13,000 houses) will be a big generator of jobs**
- **In 2035-50, higher number of upgrades to domestic buildings (insulation and heating system installation) and networks, leading to creation of jobs**

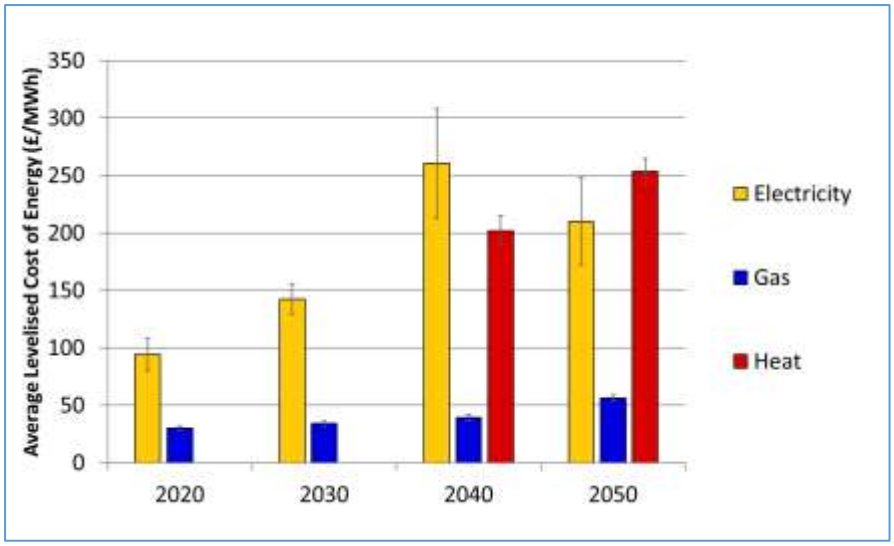
Note: The number of FTE roles is over and above those that would happen under the BAU scenario and should would be considerably higher in absolute terms.

2.2.4 Energy Costs

Levelised Unit Costs of Fuel

The average calculated levelised unit costs of fuel (£/MWh) as a result of the EPN analysis are shown below in Figure 3.6.

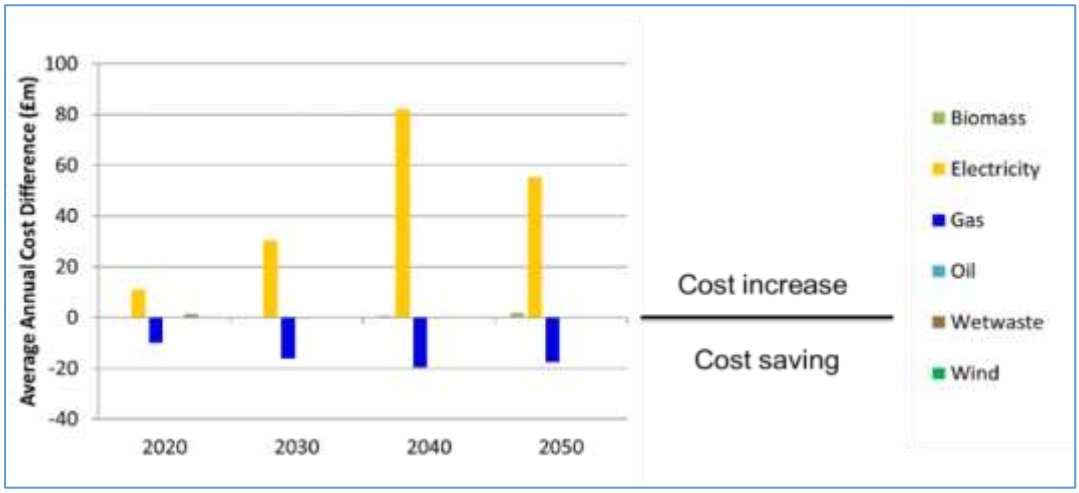
Figure 3.6: Levelised Unit Costs of Fuel



- **This graph shows that electricity remains significantly more expensive (around 4 times so in 2045-50) than gas – this makes the economic case for the changeover from gas to electricity more difficult (the carbon price externality has not been priced into the cost of gas).**

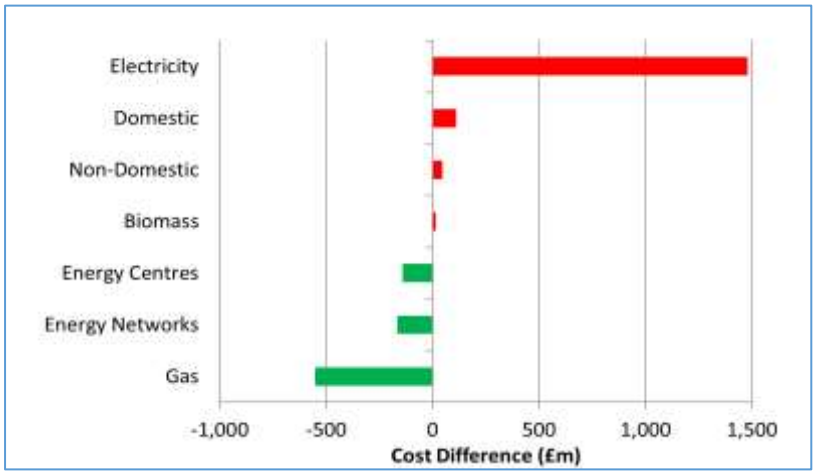
The **Changes in Energy Costs** (£m) as a result of the EPN Scenario respective to its BAU run, monetised using the levelised unit costs of fuel, are shown in Figure 3.7.

Figure 3.7: Changes in Energy Costs



A breakdown of the differences in total costs between the *EPN scenario* and BAU are shown in Figure 3.8.

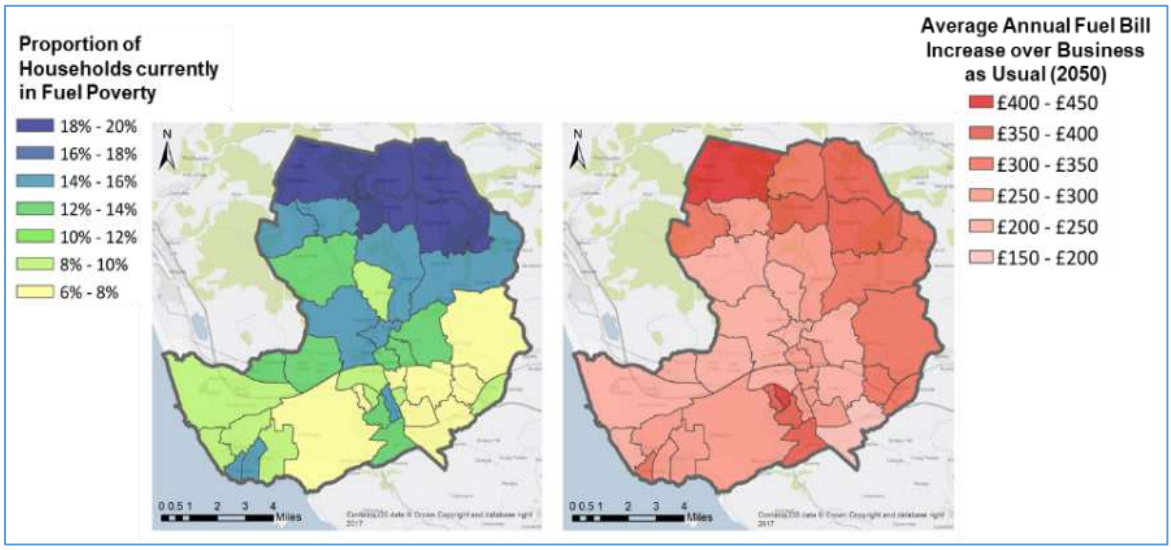
Figure 3.8: Total cost of 'A world without Green Gas' scenario minus BAU



- **On average, the *EPN* scenario delivers net positive energy savings of c. 25TWh compared to the Business-As-Usual reference case - however, when these are monetised this results in an increased cost of c. £800 million (as gas is being displaced by more expensive fuels)**
- **This increased cost is offset by a direct benefit of c. £415 million from a reduction of c.10.5 million tonnes of CO_2 emissions saved as a result of the LAES plus a wider benefit from better health of c. £5 million**

The change in fuel bills across Bridgend Council area is shown below in Figure 3.9.

Figure 3.9: Changes in Fuel Bills across Bridgend Council as a Result of the Strategy



- **Average annual fuel bill increase of £160/yr per home between now and 2050**
- **More needs to be done to reduce impact of increased energy costs in fuel poor areas e.g. the Welsh valley towns**

The average cost of delivering energy to heat a home is predicted to increase out to 2050, even without intervention, however this increase is expected to be greater as a result of the LAES. On average, the cost of delivering the energy required to heat a home in 2050 as a result of the LAES will be approximately twice as expensive as the BAU equivalent scenario (equating to an increase of approximately £160 after discounting to 2015 values).

This increase in cost reflects the fact that the majority of households will be moving from gas-fired heating to a more expensive fuel, electricity or heat, and the additional network reinforcements necessary to accommodate this. The estimated costs do not include any tax or profit margins from the energy suppliers or any subsidies which may be necessary to make this a viable solution for all homes.

Measures may be required to offset the increase in fuel costs – these could of course include increases in household income through increased employment or higher benefits, and/or schemes such as the Warm Home Discount which subsidise energy costs. **Subsidies of between £150 to £400 per home per year may be required (based on 2015 prices).**

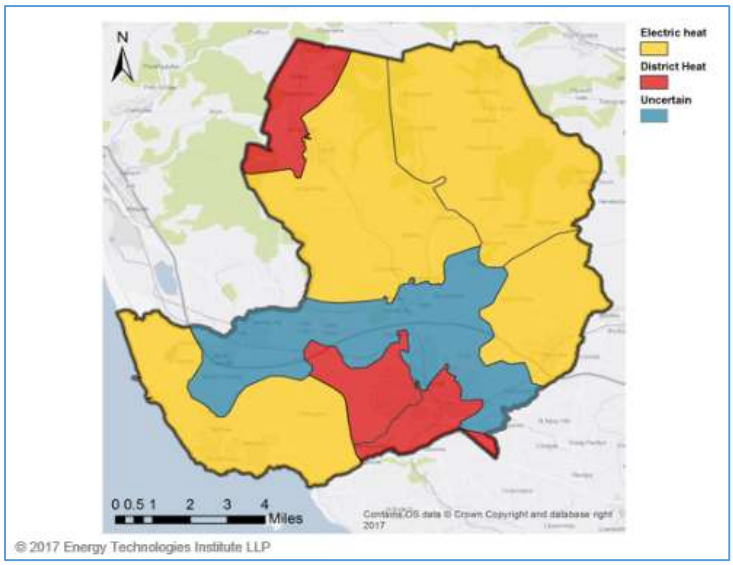
2.2.5 Key Findings from the Bridgend Council Local Area Energy Plan

Outputs from the EnergyPath modelling framework offer potential to identify local energy systems projects that could help Bridgend Council achieve its decarbonisation aspirations and demonstrate innovation in the areas of reducing carbon emissions, improving energy security, providing affordable energy, and reducing fuel poverty. The LAES will also help Bridgend Council prioritise local energy

projects that likely to have the greatest impact in achieving these objectives and which are technically and financially viable over the planning period.

The main results from the LAES are discussed below.

Figure 3.10: Dominant Energy Networks and Systems by Area



As part of the SSH programme, Bridgend Council has been looking at developing a test and demonstration project to transition homes from gas to district heat using local mine water and electric heat pumps in the former mining town of Caerau, and development of a more conventional gas-fired CHP heat network in the Town Centre.

Whereas the map above illustrates that the Council and local area energy strategy also needs to think about the entire region, particularly the areas that could electrify.

Some types of interventions were present in all the EPN scenarios:

- Some level of fabric retrofit.
- Domestic connection to heat networks.
- Non-domestic connection to heat networks (not always traditional large loads).
- Biomass boilers in hard-to-heat off-gas grid properties.
- Electric heat pump-based solutions.
- Hybrid heat pumps in certain areas.

The results from the EPN analysis indicate that policy initiatives should be focused in three areas:

- Energy Efficiency.
- Electrification/Heat Pumps.
- District Heating.

Energy Efficiency/Fabric Retrofit

Types and locations of buildings can be identified from the study where there are opportunities for low-cost fabric retrofit such as loft and cavity wall insulation. Ideally, fabric retrofit should be linked to areas of fuel poverty, but many of these buildings may not be fuel poor households. The results from the EPN analysis can also be used to inform the development of new business models by Energy Providers to meet customers' needs.

There should be focus on identifying how to fund retrofit outside of the current Welsh Government Arbed scheme.

Electrification/Heat Pumps

As discussed above in Section 3.1.7, a number of barriers have been identified that prevent consumers adopting new technologies. In terms of a switch from gas-fired (or oil-fired) heating to heat pumps, the *Endowment Effect*, where households are attached to existing appliances which are known to work and are unwilling to take the risk of replacing them even when it is efficient to do so, is important. Hybrid heat pumps could be a transitional solution that could help consumers move away from their existing heating solutions and become familiar with low carbon technology.

For hybrid heat pumps, there are challenges around maintaining and paying for the gas network for a reduced number of properties in areas where hybrids could be used. The re-purposing of the gas network using biogas and/or hydrogen needs to be investigated.

An important barrier may also be the increased capital and operating costs associated with heat pumps. The economics of the switch to heat pumps could be improved in the short-term by applying subsidies for low carbon/renewable heat i.e. a continuation of the Renewable Heat Incentive or Feed-in Tariff that pays a top-up for every kWh of renewable heat produced. A better alternative to subsidies, may be an upfront capital contribution to offset the relatively high costs of purchasing a heat pump in the first instance. However, in the longer term, policies that incentivise Energy Providers to reduce the carbon intensity of their energy supply portfolio should obviate the need for subsidies/capital payments.

District Heat Networks

Heat networks/energy centres will need to move away from gas-fired CHP to low-carbon sources – it may be possible to use some local resources. Consumer engagement will be important: the barriers to the uptake of district heating will need to be understood. Some of these barriers may be preventing developers building and operating heat networks such as lack of access to funding, lack of standard contractual structures and issues such as business rates being charged to DH schemes. The Caerau mine water district heating scheme is proposing to convert homes from using gas for heating to being connected to a heat network. This will require a number of policy initiatives, considered in Section 3.3, and new business models such as Heat as a Service (HaaS). As with heat pumps, a carbon tax applied to gas and oil used for heating may be required to incentivise the switch to district heat networks using renewable fuels. An important issue is the policy for new development, particularly with large or significant heat networks. Local policy would need Welsh Government support to enable enforcement.

Summary of Key Findings from the Socio-economic Evaluation[20]

- Some types of interventions were present in all LAES scenarios:
  - Some level of fabric retrofit.
  - Domestic connection to heat networks.
  - Non-domestic connection to heat networks (not always traditional large loads).
  - Biomass boilers in hard-to-heat off-gas grid properties.
  - Electric heat pump-based solutions.
  - Hybrid heat pumps in certain areas.
- BCBC's recent and current focus has been based on the two heat network schemes in Caerau and the Town Centre. The LAES indicates that more attention should be given to the areas that could electrify.
- On average, the LAES delivers net positive energy savings of c. 25TWh over the period 2020-2050 compared to the Business-As-Usual reference case, - however, when these are monetised this results in an increased cost of c. £800 million (as gas is being displaced by more expensive fuels).
- This increased cost is offset by a direct benefit of c. £414 million from a reduction of c.10.5 million tonnes of CO_2 emissions saved as a result of the LAES plus a wider benefit from better health of c. £5 million.
- The average cost of delivering energy to heat a home is predicted to increase out to 2050, even without intervention, however this increase is expected to be greater as a result of the LAES. On average, the cost of delivering the energy required to heat a home in 2050 as a result of the LAES will be approximately twice as expensive as the BAU equivalent scenario (equating to an increase of approximately £160 after discounting to 2015 values).
- This increase in cost reflects the fact that the majority of households will be moving from gas-fired heating to a more expensive fuel (electricity or heat), and the additional network reinforcements necessary to accommodate this. The estimated costs do not include any tax or profit margins from the energy suppliers or any subsidies which may be necessary to make this a viable solution for all homes.
- Measures may be required to offset the increase in fuel costs – these could of course include increases in household income through increased employment or higher benefits, and/or schemes such as the Warm Home Discount which subsidise energy costs. Subsidies of between £150 to £400 per home per year may be required (based on 2015 prices).
- An important consideration is the possible future role of hydrogen in decarbonising heat – this has not been fully considered in this analysis due to the current uncertainty of its application and lack of representative data.

2.3 Possible Future Policies

2.3.1 Overview

There are multiple amended and new policy measures that could be introduced to address the barriers to take up already discussed in Section 3.1.7. These include new Incentivising Measures where the consumer/other actor is incentivised, either financially or through some other mechanism, to take up a policy measure. Examples include reductions in Stamp Duty and/or Council Tax, where householders get a rebate if they install energy efficient interventions and meet a defined energy efficiency standard.

Enabling Measures, where the take-up of a policy measure is facilitated by enabling legislation or regulation, could include the provision of standardised information for district heating developers and the adoption of new regulations to support the installation, supply and trading of heat.

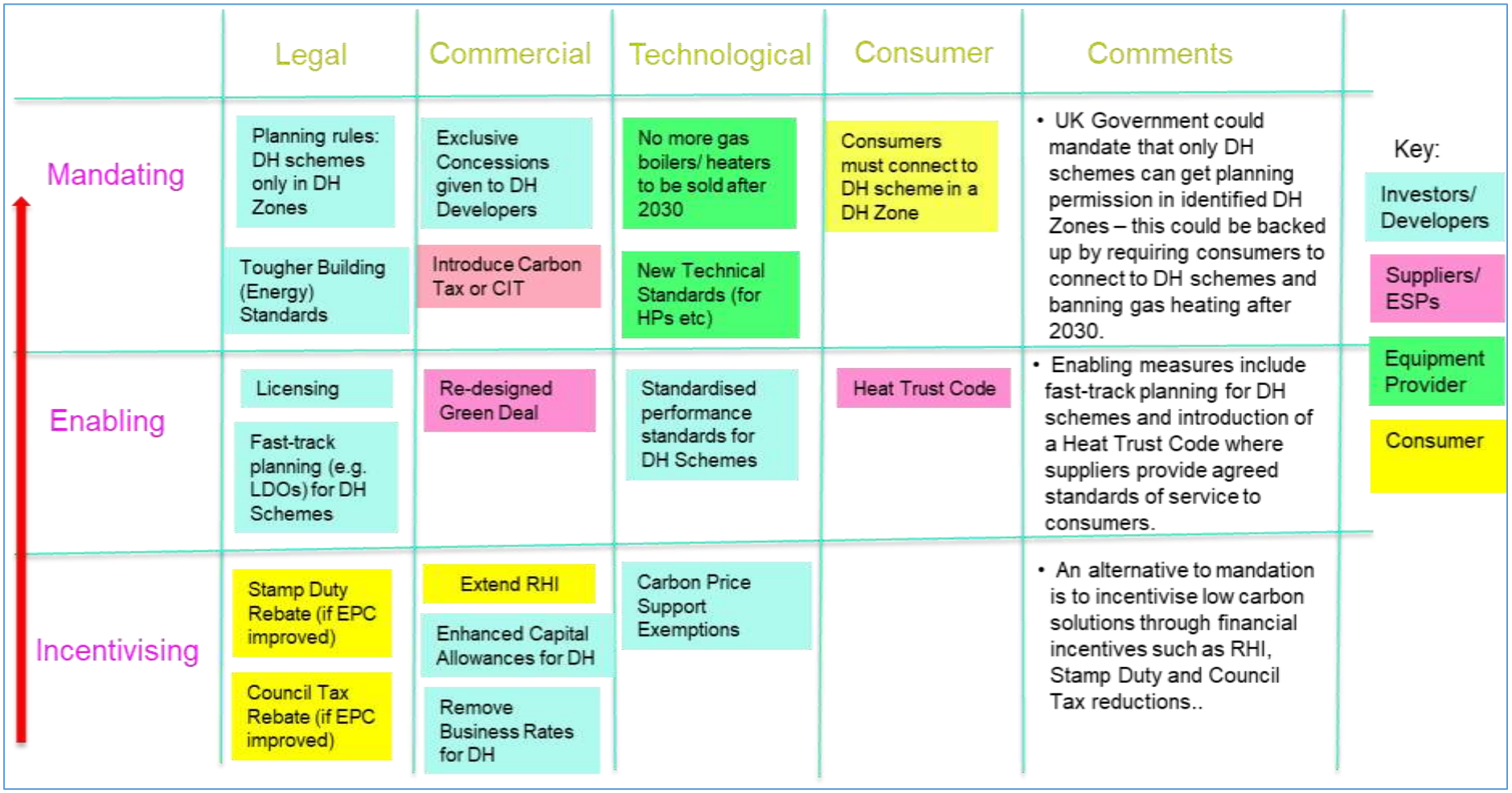
Mandating Measures (where the consumer/other actor is obliged to take up a policy measure) could include the introduction of tougher building standards for new and retrofitted properties.
The policies in these three categories are applied across four areas: Legal; Commercial; Technological and Consumer. For instance, Planning Rules could be mandated such that Investors and Developers (blue box) can only offer a district heating solution in a designated DH Zone, whereas consumers (yellow box) must connect to a DH scheme in a DH Zone.

The most optimal approach may be to introduce a mix of Mandating policies such as amending planning regulation to only allow DH schemes in an identified DH Zone, enabling policies such as standardised performance standards for DH schemes and Incentivisation through extending the Renewable Heat Incentive and introducing Stamp Duty and/or Council Tax Rebates where the EPC ratings for properties are improved to an agreed standard.

These Enabling, Incentivising and Mandating policies are summarised in Figure 3.11.

[20] It is important to note that the LAES is not based on a fixed pathway and there is a level of uncertainty in the range of results that needs to be considered.

Figure 3.11: Possible Future Policy Measures to Facilitate the Low Carbon Transition

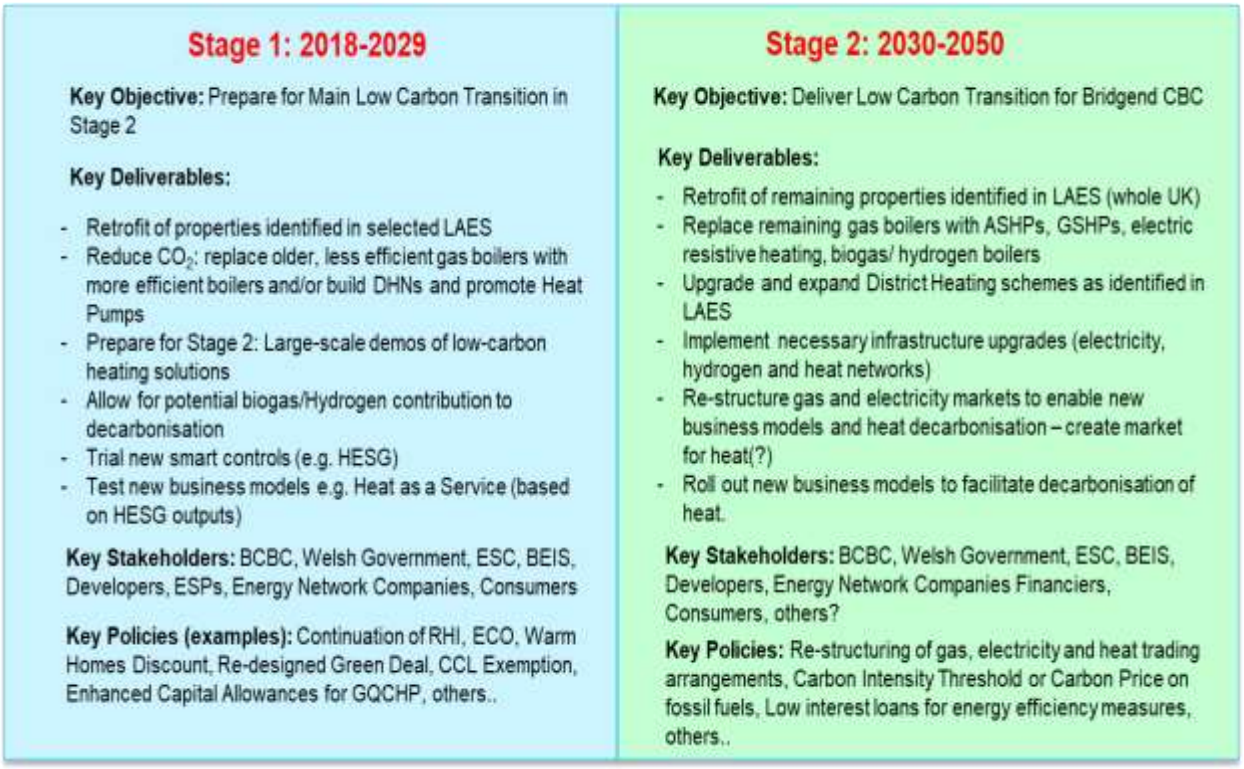


2.3.2 Policy Framework to Facilitate the Bridgend Council Local Area Energy Strategy (LAES)

The Local Area Energy Strategy for Bridgend is likely to proceed in two distinct stages:

- Stage 1: 2020 – 2029 – where there will be some fabric retrofit in identified properties (with a focus on those households in fuel poverty) and some switch away from gas boilers to heat pumps and district heating.
- Stage 2: 2030 – 2050 – when the main low carbon transition will occur as electrification of heating gathers pace as the electricity grid is decarbonised, and more households are connected to low carbon-fuelled district heating schemes. New innovative business models will be developed and new value propositions will be offered to the consumer. The structure of the gas and electricity markets will be transformed to facilitate these new ways of producing, distributing, trading and selling energy.

Figure 3.12: Delivering the Low Carbon Transition



Different policies may be required to facilitate each stage of the transition. During Stage 1, policies to encourage more efficient gas heating and retrofit of energy efficient and low carbon interventions such as insulation and smart appliances may be promoted. The transition to low carbon heating solutions gathers pace from around 2030 when the electricity grid is planned to be decarbonised. Any new policies and business models to encourage greater uptake of heat pumps and connection to district heat networks will need to start before 2030 to prepare for the transition.

2.4 Evaluation

An assessment of the type of policies that could support the Bridgend Local Area Energy Strategy is shown in Tables 3.1 and 3.2.

Table 3.1: Resolving Barriers and Policy Gaps for District Heating Networks

Policy/Issue	Problem/Barrier	Possible Solutions	Comments
Reduce/offset high DH Development Costs	The costs of heat networks are high in the UK and payback periods are long	• Introduce an economy-wide carbon price (either through applying fuel duty to fossil fuels, including gas for heating, or applying the Carbon Price Floor to the whole UK economy) to encourage widespread uptake of DH. • Increase support through the RHI and RO where heat supply is eligible; through the ECO and through continued exemption from the Climate Change Levy (CCL) for electricity generation from Good Quality CHP. • Provide tax-breaks to DH Network developers. • Remove business rates on heat networks. • Facilitate increased partnering of developers with local authorities who may have lower finance costs.	• It may be difficult to persuade policy makers to introduce more subsidies which may have to be met through general taxation; and/or extend carbon pricing which would increase consumers' costs[21]. • LAs may not have the financial and/or human resources in current economic climate.

[21] The UK government remains committed to carbon pricing to help decarbonise the power sector. Currently, UK prices are determined by the EU Emissions Trading System and Carbon Price Support. Starting in 2021–22, the government will target a total carbon price and set the specific tax rate at a later date, giving businesses greater clarity on the total price they will pay.

Propose/support a regulatory regime for District Heating	District Heating is not currently regulated but increasing adoption may lead to new regulation being introduced – but it is uncertain what this might be and this may delay/deter investment.	• This can be overcome by clear statements on regulatory intentions by BEIS/Ofgem on DH, and by ensuring regulation recognises long payback periods. • Alternatively, industry stakeholders, LAs and devolved administrations could work with Ofgem/BEIS to draw up proposals for a suitable regulatory regime.	• A regulatory regime would provide protection to consumers who might be locked into a DH Network. It would also facilitate competition in the supply and distribution of heat.
Policy/Issue	Problem/Barrier	Possible Solutions	Comments
Mandate connection to a DH Network in identified DH Zones	Heat Networks need a high number of connections to offset the high capital costs.	• Areas where it could be economic to develop DH Networks can be identified can be identified through local area energy strategies. In these areas, consumers could be obligated to connect to a DH Network as long as there were safeguards in place that prevented these customers being disadvantaged financially and/or through low standards of customer service.	• Any form of mandate may be difficult to "sell" to consumers. Effective consumer protection would need to be in place. A better alternative might be to offer consumers attractive deals. through new business models such as ***Heat as a Service (HaaS)*** which offer agreed levels of comfort for a set monthly fee.
Improve the Planning Approvals process for DH Networks	Difficulties around planning approvals and a lack of LA resources or expertise may act as barriers	• Support fast track planning for DH Networks, • Support provision of standardised guidance and encouragement of information sharing between local authorities on planning issues associated with DHN	• Local Development Orders (LDOs) have been used to grant planning permission for a heat network, including pipes, heat exchange equipment, street furniture,

			informational signage and ancillary engineering works. An example of this is the London Borough of Newham[22]
Facilitate connection for DH schemes to the Distribution Network	Connection to the DN is required and can take a long time and involve high connection costs – this may act as a barrier	• Changes to the Distribution Charging Methodology (DCM) may be required to give lower connection and use of system charges for district heating CHP plant.	• Required changes to DCM may face opposition from other charge payers and may take a long time.

[22] The LDO was part of the streamlined planning process for the Royal Docks Enterprise Zone (March 2013).

Table 3.2: Resolving Barriers and Policy Gaps for Energy Efficient Retrofit and Electrification

Policy/Issue	Problem/Barrier	Possible Solutions	Comments
Improve returns from investment in retrofit	Returns from retrofit investments can be low and there is risk of default of a provider	• Introduce a carbon price on gas and oil used for heating to improve the returns from retrofit investments. • Increase support through the RHI and RO where heat supply is eligible; through the ECO and through continued exemption from the Climate Change Levy (CCL) for electricity generation from Good Quality CHP. • Offer government guarantees to investors in case of the default of a retrofit provider, or adoption of a tax relief scheme which allows investors to offset tax liability while earning interest or dividend on their loans.	• It is likely to be difficult politically to introduce more subsidies which may have to be met through general taxation, • Introducing carbon pricing on fuels used for heating would increase consumers' costs – this could worsen fuel poverty and increased financial support (such as the Warm Homes Discount) may be required. • State Aid legislation may prevent the tax relief from being extended.
Need to stimulate Energy Efficiency	Initiatives such as the Green Deal did not provide sufficient incentives for individual home owners to retrofit energy efficiency measures	• Replace the Green Deal with a ""*Home Improvement Fund*", using the results for local area energy planning to target those consumers whose prime consideration is renovation and not energy efficiency or who live in hard-to-treat homes where paybacks would be very long. • Extend ECO – continue to focus on improving energy efficiency for vulnerable customers – this	• Possible issues around how savings would be calculated and cost to government may be prohibitive and would still need to overcome barriers to consumer take-up e.g. transaction barriers and capital constraints. • May be difficult for government & LAs to calculate Stamp Duty &

		would target more of the hard-to-treat (rural) homes. • Introduce Stamp Duty and/or Council Tax Rebates – householders would receive a rebate if a property is above a given energy efficiency standard, or potentially pay higher rate if performance is poor.	Council Tax levels and provide the level of discount required - all homes would need a valid Energy Performance Certificate which might be onerous and costly.
Policy/Issue	Problem/Barrier	Possible Solutions	Comments
Reduce the impact of any extra energy costs from the transition to low carbon heating	Analysis of the benefits of Transition (Section 3.2) show that energy savings may not be high enough to offset increased costs due to the switch from gas to electricity – this may increase bills for vulnerable customers.	• Extend support schemes for vulnerable customers such as the Warm Homes Discount.	• There may be other routes to achieve the desired reduction in fuel poverty such an increase in income through better employment or an increase in social security payments, and the ability to leverage funds into Arbed and Nest from ECO.
Improve uptake of Heat Pumps	Heat pumps are currently significantly more expensive than gas boilers and consumers are not familiar with their use.	• Introduce a carbon price on gas and oil used for heating to improve the competitiveness of heat pumps versus gas and oil-fired heating, • Offer a "one-off" upfront payment (capital grant) to consumers to offset the capital cost of HPs.	• As uptake increases, the cost per heat pump should decrease, improving competitivity with gas boilers. The introduction of a carbon price should improve this further, although a subsidy payment (a one-off, upfront payment make be more effective

		• Apply a carbon emissions standard on heating system replacement - this is a minimum standard on new heating systems based on CO_2 performance. This would replace the current energy efficiency requirement on boilers with a requirement that the average lifetime carbon intensity of new heating systems is lower than 180g CO_2/kWh. It could be targeted at specific property types.	than a feed-in tariff) may still be required. Alternatively, new, compelling and affordable propositions for electric heating need to be developed to stimulate consumer take-up.

Applying a Carbon Price

There is an important unpriced externality in the market for low-carbon heat: there is no carbon price on domestic gas use. This unpriced externality is a market failure: without a price on carbon, consumers and businesses will not factor carbon emissions into their decisions. In practical terms, this means that some interventions that have net benefits to society will not be taken up. DECC estimated a carbon price that is consistent with the level of marginal abatement costs required to reach the targets that the UK has adopted: the carbon price consistent with meeting targets rises to £67/tonne in 2020 and £78/tonne in 2030 (DECC (2014) - *Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal).*

Frontier Economics has considered **a carbon tax on domestic gas use*** and found that applying a carbon price could increase annual gas bills in 2020 by £200 for medium gas users and £278 for high gas users – this is not equitable. Applying a carbon tax does not address barriers associated with the high upfront costs of the low-carbon heating interventions. This means they will fail to overcome consumers' focus on near term costs and benefits. Additional policy initiatives, such as low interest loans, may be required to incentivise the uptake of low carbon heat alternatives such as heat pumps.

An alternative approach to applying a carbon price on fossil fuels is the setting of a **Carbon Intensity Standard (CIS)** for Energy Suppliers/Service Providers (ESP) – this option is currently being explored by the Energy Systems Catapult. A CIS could be set for an ESP on a portfolio basis and would require carbon reductions via a number of measures, including low-carbon retrofits and possibly through carbon trading.

Note: * Analysis by Frontier Economics/Element Energy (October 2013) - *"Pathways to high penetration of heat pumps"* assessed the effect of applying a carbon price on gas used for domestic heating.

New Business Models: Example – Heat as a Service (HaaS)

With energy, as with other services such as food, travel or entertainment, people care more about their experiences, than how they are delivered. ETI consumer research has shown that, if households bought energy services, they would not care how they were delivered as long as they achieved the desired outcome. This creates a channel to market for low carbon energy systems without forcing government to subsidise components. The ESC has considered a number of business models to meet people's needs and a key result is the concept of buying ***Heat as a Service (HaaS).*** HaaS would allow customers to define the levels of heat that they want, with different temperatures in different parts of the dwelling if required.

Consumers like the idea of buying HaaS, but want more detail of (a) how it would be delivered in practice and (b) what it might cost them. HaaS would move away from the current model of customers buying kWh of energy from suppliers to one where the supplier guarantees a level of heat – changes would be required to energy supply licences to reflect this change and protect customers' rights.

HaaS could be provided from various heat sources such as gas boilers, heat pumps, district heating networks, etc. The type of heat source will determine the performance that can be achieved, for instance, today people turn their room thermostat until it clicks to turn their boiler on/off, but this approach would not allow them to rapidly get comfortable with a lower powered system like a heat pump. It is important that people understand any limitations with the service being provided. It is possible, of course, that the heat source could be changed part-way through the HaaS contract (say from a gas boiler to a heat pump or district heating system) and any change in service would have to be allowed for. The data outputs from a Home Energy Services Gateway (HESG) will be critical in tailoring the service to meet an individual customer's heating requirements.

Key learnings from the Low Carbon Transition in Other Countries

There are a number of lessons that the UK can learn from other countries on an effective low carbon transition. The availability of natural gas from the North Sea has resulted in the development of an infrastructure where a large number of households and industry are connected to the gas grid - around 85% of UK households use gas for heating[5]. The cost of gas heating in the UK is low due to the lack of a carbon tax on gas as well as the comparatively low capital costs of gas boilers when compared to low carbon alternatives such as heat pumps and connection to a district heat network. The UK housing stock is also among the least energy efficient in Europe, which is a barrier to the uptake of some low carbon technologies which provide heat at lower flow temperatures.

There are several lessons for the UK from Germany's heat transition, and some policies and strategies used by Germany are quite relevant to the UK. Germany has introduced a **comprehensive energy strategy, including effective building codes, retrofit policies, and tax credit and loan programmes. Germany's state development bank's building renovation loan programme has been a key consideration in stimulating private investment delivering over €34 billion in 2013**. Access to low rate finance was identified by the Energy Committee on Climate Change as a key measure to improve take-up of the Green Deal. Relaxing the "Golden Rule", to allow a wider range of interventions including more expensive measures such as solid wall insulation, could also have made the scheme more attractive.

An important challenge for achieving a sustainable heat pump market in the UK is ensuring good technical performance and improving consumer awareness and acceptance arising from this. Without these factors, levels of uptake of heat pumps in the UK are likely to be low.

The **implementation of energy and/or carbon taxes have also been important in some countries to drive the transition** away from fossil fuels to the use of renewable energy technologies. Sweden has introduced the highest carbon tax in Europe, and in district heating, this has led to a transition away from heating oil to biomass. **Technical Standards** have also supported the market for heat pumps in both Germany and Sweden, in addition to extensive R&D into improving heat pump performance.

Building regulations that mandate higher energy efficiency levels and lower heating demands in new buildings and require a certain percentage of heat to be supplied from renewables, have encouraged the take-up of low carbon technologies. For instance in Sweden, they have contributed to Sweden having the most energy-efficient housing stock in the EU. In Germany, building codes for new builds have made heat pumps the second most popular heat source after gas.

Evidence from countries with unregulated district heat networks (e.g. Sweden and Germany) shows that competition issues can occur in the absence of ex-ante regulation. This suggests that **regulation may be needed to provide sufficient consumer protection both in terms of price and quality of service**. This is because heat networks are natural monopolies, and consumers have limited alternative heating options after connecting to a heat network. Public price-monitoring could focus on mitigating the risks of misuse of a strong market position under competition law, and thus help to create trust between customers, society and DH companies.

2.5 Summary of Policy Evaluation

A number of policy initiatives can support the implementation of Strategy as can be seen from the socio-economic analysis in Section 3.2, the consideration of the policies that have been adopted successfully in other countries and also discussed in Tables 3.1 & 3.2.

These can be encapsulated in 9 measures, divided into 4 broad categories as follows:

Planning

1. **Support Fast-track Planning Approvals for District Heat Networks** – us Local Development Orders (LDOs) and Permitted Development Rights to facilitate the introduction of district heating network infrastructure.

2. **Amend Existing Planning Legislation to require local authorities to develop an evidence base to inform the development of renewable and low carbon energy policies - Local Area Energy Planning can be used to provide** evidence and data to target retrofit and plan for low carbon solutions such as heat pumps, heat networks (and hydrogen?), bring stakeholders together to create shared views and support local policy and inform national policy.

Subsidy/Financial Support:

3. **Support the replacement of the Green Deal with a "*Home Improvement Fund*" –** this fund would lend money to householders for home improvements that improve energy efficiency at a subsidised rate (similar to the KfW scheme in Germany). The EPC rating would need to be improved by a defined amount and the improvement verified by independent assessors.

4. **Support the introduction of a Stamp Duty Rebate for energy efficiency improvements** – this would be designed to incentivise householders to improve the EPC ratings of their properties when moving home. Once this improvement to the EPC rating had been verified, the householder would obtain a rebate on the stamp duty already paid at the time of the exchange of contracts. The total stamp duty tax take would remain the same as those householders who didn't improve the EPC rating of their property would pay more.

5. **Support the introduction of a Council Tax Rebate for energy efficiency improvements** – this would be designed to incentivise householders to improve the EPC ratings of their properties at any time. Once this improvement to the EPC rating had been verified, the householder would obtain a rebate on the council tax already paid at the beginning of the financial year.

6. **Support an Extension of the Warm Homes Discount** – the level would be set to give the required financial support for vulnerable customers to meet any additional energy costs from switching to low carbon heating (around £160-£250 p.a. for Bridgend residents).

7. **Support a Reduction/Offset of high District Heating Development/ Operational Costs** e.g. remove the requirement for district heating schemes to pay business rates.

Market Structure, Liquidity and Pricing

8. **Support rule changes that promote Demand Reduction/Demand Side Response** to facilitate the aggregation of domestic DSR and allow peer-to-peer trading of electricity, facilitated by the introduction of smart energy platforms such as HESG.

Energy Regulation

9. **Support the Introduction of a Carbon Price applied to gas and oil (and coal) used for heating** – this will price in the carbon externality and level the playing field for low carbon heating solutions such as heat pumps.

10. **Propose/support the Introduction of a Regulatory Regime for District Heating** – this would allow competition in the supply of heat over heat networks and introduce consumer protection safeguards to ensure that consumers are not locked in to uncompetitive contracts with DH providers.

The Policy Measures can also be mapped to different housing categories such as the Social Housing sector or for Homeowners – this is shown below in Table 3.3.

Table 3.3: Mapping of the Prospective Policy Measures to Different Housing Categories

Measure	Social Housing	Rented	Homeowner – Low Income/ Vulnerable	Homeowner – Able to Pay	Pros	Cons	Comments
1. Support Fast-track Planning Approvals for District Heat Networks	✚	✚	✚	✚	• Should improve commerciality of DH Schemes • Relatively easy to achieve	• Energy centres may still need separate planning permission	• BCBC should be able to use existing planning legislation to achive this – if changes are required then Welsh Government (WG) could support.
2. Amend Existing Planning Legislation to require LAs to **develop an evidence base to inform development of renewable and low carbon energy policies**	✚✚	✚	✚✚	✚	• **Can provide** evidence and data to target retrofit and plan for low carbon solutions – can be targeted at vulnerable households	• Any obligation to produce LAES can be onerous for LAs	• A co-ordinated LAES approach should give the most optimal solution to decarbonisation of heat for LAs working with a number of stakeholders.
3. Support replacement of the Green Deal with a "*Home Improvement Fund*"	✚	✚	✚	✚✚	• Should stimulate uptake of insulation and low carbon heating	• May require some subsidy to offer low interest loans to improve scheme attractiveness.	• A targeted fund to allow home-owners to improve their homes and the EPC at the same time may be more attractive than a purely energy efficiency scheme. UK Government (UKG) would need to introduce.

Measure	Social Housing	Rented	Homeowner – Low Income/ Vulnerable	Homeowner – Able to Pay	Pros	Cons	Comments
4. Support introduction of a Stamp Duty Rebate for Energy Efficiency (EE) improvements	✚	✚	✚✚	✚✚	• Reducing stamp duty should be attractive to home-buyers • EE improvements should increase value of property • Enables retrofits at time of house move – might be easier/combined with other home improvements.	• Might be difficult to measure actual EPC improvement • May be some uncertainty about Stamp duty revenues • No benefit for renters.	• UKG would need to authorise changes. Home-buyers would pay stamp duty as normal and claim a rebate when EPC improvements verified. • Only applies to home-buyers and could mean some buyers pay more duty (including less wealthy?)
5. Support introduction of a Council Tax Rebate for energy efficiency improvements	✚	✚	✚✚	✚✚	• Reducing council tax should be attractive to home-owners. • EE improvements should increase value of property	• Might be difficult to measure actual EPC improvement • May be some uncertainty about council tax revenues • Little/no benefit for renters.	• UKG would need to authorise changes but councils should be able to set council tax bands accordingly. • Benefit mainly to home-owners[23] and could mean some council tax payers pay more (including the less wealthy?)

[23] There is an issue here with 'Split Incentives' where the tenant of a property may not benefit financially from any home improvements made which reduce council tax or energy bills.

Measure	Social Housing	Rented	Homeowner – Low Income/ Vulnerable	Homeowner – Able to Pay	Pros	Cons	Comments
6. Support an Extension of the Warm Homes Discount (WHD)	✚✚	✚	✚✚		• An extension of WHD could mitigate any increase due to the low carbon transition.	• This is a subsidy paid for by other energy users – may not be equitable.	• Extending the WHD goes against medium-term UKG policy of reducing/ removing subsidies.
7. Support a Reduction/Offset of high District Heating Development/Operational Costs	✚✚	✚	✚✚	✚	• Removing busness rates (for example) for DH schemes would improve commercial viability.	• Capital and operational cost reductions may not be enough to make DH schemes profitable. • Other business rate payers would have to pay more.	• BCBC may have some scope to vary business rates and/or also partner with DH developers e.g. to provide low-rate finance. This may improve viability of DH schemes including those in areas of social deprivation which may not otherwise be developed.
8. Support rule changes that promote Demand Reduction (DR)/Demand Side Response (DSR)	✚	✚	✚	✚✚	• Promoting DR/ DSR through changes to electric market offers a potential income stream to offset increased costs of low carbon transition.		• The installation of smart technology such as the HESG should facilitate greater particpation in the electricity market, including peer-to-peer trading.

Measure	Social Housing	Rented	Homeowner – Low Income/ Vulnerable	Homeowner – Able to Pay	Pros	Cons	Comments
9. Support the Introduction of a Carbon Price applied to gas and oil (and coal) used for heating	✚✚	✚	✚✚	✚	• Would address the carbon externality that disadvantages low carbon heating compared to gas (and oil).	• May be difficult to pitch a carbon tax at the correct level • Would mean that those unable/unwilling to switch from gas or oil-fired heating would pay (a lot) more.	• Applying a carbon tax to gas and oil used for heating could increase heating bills by c. £200-£300 p.a.[24] (according to usage). Some of these users may be vulnerable and could be tipped into fuel poverty. • An alternative aproach is some form of carbon intensity limit on suppliers.
10. Propose/support the Introduction of a Regulatory Regime for District Heating	✚✚	✚	✚✚	✚✚	• Could allow competition in supply of heat • Consumer protection safeguards to ensure consumers not locked in to uncompetitive DH contracts	• Could actually reduce DH Scheme attractiveness if regulation is too prescriptive.	• Implementing regulation that supports DH Network development and operation could be difficult and should not be too prescriptive.

Key: Some Impact ✚ Large Impact ✚✚

[24] Frontier Economics

3 Conclusions

The conclusions from this report are as follows:

1. Local Area Energy Strategies could be the basis of developing energy efficient plans for local areas, with a number of partners including local authorities, ESPs, the ESC, as well as network companies working together to deliver these plans.

2. On average, the Local Area Energy Strategy (LAES) for Bridgend CBC delivers net positive energy savings of c. 25TWh over the period 2020-2050 compared to the Business-As-Usual reference case, however, when these are monetised this results in an increased cost of c. £800 million (as gas is being displaced by more expensive fuels).

3. This increased cost is offset by a direct benefit of c. £414 million from a reduction of c.10.5 million tonnes of CO_2 emissions saved as a result of implementing the Strategy plus a wider benefit from better health of c. £5 million.

4. In addition to the direct monetary benefits from the Transition, an estimated 120 full-time jobs could be created in the time period 2035-2050. This is when most of the buildings are expected to start transitioning to low carbon heating systems. These are additional jobs from retrofitting domestic buildings and from installation of new energy networks.

5. The results from the EPN analysis indicate that policy initiatives should be focused in three areas:

    - Energy Efficiency
    - Electrification/Heat Pumps
    - District Heating

6. The economics of the switch to heat pumps could be improved by applying subsidies for low carbon/renewable heat i.e. a continuation of the Renewable Heat Incentive or Feed-in Tariff that pays a top-up for every kWh of renewable heat produced. However, a better approach may be an upfront capital contribution to offset the relatively high costs of purchasing a heat pump in the first instance.

7. The introduction of a carbon price applied to gas and other fossil fuels to reflect the environmental costs of burning such fuels would address the carbon externality and help to level the playing field for low carbon forms of heating such as heat pumps and district heating (from low carbon heat sources).

8. An alternative to applying a carbon price is to set carbon targets on energy suppliers. There is currently no *System Integrator* role in the Home Heat Market, and hence no effective co-ordination of CO_2 emissions reductions. One option would be to place an obligation on Energy Suppliers/Energy Service Providers (ESP) to reduce CO_2 emissions in domestic properties (similar to that placed on car manufacturers to reduce CO_2 emissions in cars) - this could be an effective means of incentivising low carbon interventions.

9. Policies that provide a one-off, lump-sum cash payment (Stamp Duty Discount and Grants) could be more effective at incentivising take-up of energy efficient interventions than feed-in-type policies such as the RHI, electricity FiTs or Variable Council Tax.

10. Designing retrofit policy around home improvement practices offers a more effective solution than merely supporting energy efficiency schemes such as the Green Deal. This is because householders are far more likely to consider funding energy retrofit within their broader home improvement plans rather than as a standalone initiative.

11. An alternative to a '*Green Deal*'-type scheme could be a '*Home Improvement Fund*' where loans could be made to consumers to fund home improvement which could include energy efficient measures.

12. *'Split Incentives'*, where the bill payer may not own the premises, can act as a barrier to implementing low-carbon interventions. This can be partly overcome by imposing an obligation on landlords to ensure rental properties meet a minimum EPC rating (i.e. 'C' or above).

13. The use of policies which mandate actions and interventions can be effective in some cases but generally should be avoided as they can lead to sub-optimal outcomes and inefficiencies – an example of this is the introduction of a minimum EPC rating for all properties which would be unpopular and disadvantage those less able to pay.

14. A number of low-regrets policies such as Standard Contractual Structures for District Heat, Consumer Protection for District Heat, and Building Skills/Capabilities to Support District Heat could be introduced at little cost.

15. The extended use of Local Development Orders for the installation of Heat Networks (including pipes, heat exchange equipment, street furniture, informational signage and ancillary engineering works) in BCBC should be supported.

16. The energy market is designed around selling units of gas and electricity - there are no similar arrangements for selling heat. It might be helpful if a heat market were developed with standard contractual terms for heat provision. In terms of selling heat to the consumer, the ESC is developing a number of business models which look to offer a level of comfort to customers rather than selling them energy on a kWh-basis.

17. The most optimal approach may be to introduce a mix of ***Mandating*** policies such as amending planning regulation to only allow DH schemes in an identified DH Zone, ***Enabling*** policies such as standardised performance standards for DH schemes and ***Incentivisation*** through extending the Renewable Heat Incentive.

18. There is currently no credible route to owner-occupier customers switching to heat networks. There is a need for a new type of business that will act as an integrator on behalf of the customer to sort out the complexities of ensuring they get the experience they value. For new build, there is an integrator (the developer); for social housing, there is an integrator (the local authority or housing association); but for owner-occupiers, there is no integrator so the customer is left to navigate the complexities and uncertainties largely on their own.

19. The use of ***Local Development Orders*** for the installation of Heat Networks (including pipes, heat exchange equipment, street furniture, informational signage and ancillary engineering works) should be extended.

4 Glossary

4.1 Definitions

Air Source Heat Pump (ASHP)	This extracts heat from the outside air in the same way that a fridge extracts heat from its inside. This heat can be used to heat radiators, underfloor or warm air heating systems and provide hot water. An ASHP can extract heat from the air even at temperatures as low as -15° C.
Carbon Price Floor (CPF)	The CPF came into effect on 1st April 2013 is made up of the price of CO_2 from the EU Emissions Trading System (EU ETS) plus the Carbon Price Support (CPS) rate per tonne of CO_2
Carbon Price Support (CPS)	This reflects the differential between the future market price of carbon and the floor price determined by the UK Government. It will be capped at a maximum of £18/tonne CO_2 from 2016-17 until 2019-20.
Carbon Price Support exemptions	District heating suppliers using good quality gas-fired CHP are exempt from paying the Carbon Price Floor on the fuel used to generate heat and, from April 2015, also for the electricity they use on site.
Carbon Tax	A tax that is applied to fossil fuels to account for the economic damage due to climate change that these fuels cause.
Climate Change Levy (CCL) exemptions	A tax on fossil fuels used to heat, light and power businesses. Any suppliers with *'Good Quality CHP'* are exempt from paying the levy on all gas and electricity used internally.
District Heating	A system for distributing heat generated in a centralised location for residential and commercial heating requirements such as space heating and water heating.
ENOVA	A technology and data analytics-driven online lending company operating 11 brands in 6 countries and providing analytics services to businesses.
Fuel poverty	A measure of the number of energy consumers who may be struggling to pay for the energy they need. In England, fuel poverty is measured by the Low Income High Costs (LIHC) definition, which considers a household to be fuel poor if: • It has required fuel costs that are above average (the national median level)[25]; and

[25] An adequate standard of warmth is usually defined as 21ºC for the main living area, and 18ºC for other occupied rooms.

	• Were it to spend that amount, the residual equivalised net household income would be below the official poverty line. Fuel poverty in Wales and Scotland is measured using the 10% indicator. This considers a household to be fuel poor if it spends 10% or more of its income on energy costs, where income is inclusive of Housing Benefit, Income Support or Mortgage Interest or council tax benefits on energy costs.
Ground Source Heat Pump (GSHP)	This extracts heat using pipes buried in the ground (usually in the garden). As with an ASHP, this heat can be used to heat radiators, underfloor or warm air heating systems and provide hot water.
Local Development Order (LDO)	An alternative to the submission of a planning application - it enables a Local Planning Authority to grant permission for a particular type of development. LDOs can be seen as an extension of permitted development rights, but are prepared and decided locally in response to local circumstances.
Renewable Energy Investment Fund (REIF)	A Scottish Investment Bank initiative that provides financial assistance to renewable energy sources, including renewable district heating.
Renewables Heat Incentive (RHI)	This provides subsidy payments for homeowners that use eligible renewable sources to heat their homes. The heat supply component of district heating schemes also qualifies for RHI payments providing they have an eligible heat source.

4.2 Acronyms

ASHP	Air Source Heat Pump
CIBSE	Chartered Institute of Building Engineers
CPS	Carbon Price Support
CCL	Climate Change Levy
ADE	Association of Decentralised Energy
ECO	Energy Companies Obligation
ESP	Energy Services Provider
GSHP	Ground Source Heat Pump
LAES	Local Area Energy Plan
LDO	Local Development Order

RHI	Renewable Heat Incentive
SDHA	Swedish District Heating Association

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6 Appendix

6.1 Methodology and assumptions for the calculation of the Socio-economic Benefits

6.1.1 Discounting

The LAES runs out from present day (2015) to 2050, however, as values of costs or benefits in the future are not representative on the actual worth in the present day (due to inflation etc.) all[26] future costs and benefits are discounted to present day values. In accordance with Green Book supplementary guidance[27] the following long-term discount rates are used:

- 0 – 30 years: 3.5%
- 31 – 75 years: 3.0%.

This results in discount factors for the time period being used for each time period to convert values to present values, calculated using formula being used for each time period to convert values to present values, calculated using the following formula:

$$D_t = \frac{\sum_{n=i}^{j} \frac{1}{(1+r)^n}}{j-i}$$

Where
$t =$ time period
$D_t =$ Discount factor for time period t
$i =$ number of years ahead start year of time period (time period start - present day (2015))
$j =$ number of years ahead end year of time period (time period end - present day (2015))
$r =$ Discount rate

For the base assessment, the future value of carbon savings, evaluated with a carbon price, will also be discounted, however, as discounting can dramatically affect results, there is functionality within the methodology to test different discount rates, with functionality built in to test the flat rate of 1.4% as suggested in the Stern report.

6.1.2 Levelised Unit Cost of Fuel

For both the reference case and the target run a set of levelised unit costs of fuel needs to be calculated in-order-to monetise any energy savings for the cost-benefit analysis. As the LAES predicts how the energy networks will change overtime alongside the transitions of the domestic buildings, the costs of delivering this energy will also change. For each time-period, the total costs of delivering each of the fuels (including any

[26] The calculation of economic impact does not discount the costs before applying the employment multipliers due to the nature of the calculation.
[27] Lowe 2008. *Intergenerational wealth transfers and social discounting: Supplementary Green Book guidance.* HM Treasury.

local generation) are summed and divided by the total energy delivered to give levelised costs for gas, electricity and heat. These costs are taken directly from EPN, socialised across the whole LA area and include:

- UK market price of energy[28]
- Annualised network (transmission and distribution) investment costs, including both new-build networks and network reinforcements (this includes a 3.5% cost of capital)
- Network operating and maintenance costs
- Annualised investment costs for local generation (excluding solar PV)
- Local generation operating and maintenance costs.

Any other resource costs (e.g. biomass or oil) are valued at the assumed UK market price, taken from the Energy Technologies Institute's ESME model[28], consistent with EPN input data. The presented costs are exclusive of any tax or profit for the energy suppliers, consistent with EPN, which presents results as, and minimises on, the total cost of the transition to society.

In the cases of energy centres which are producing both electricity and heat the costs of the energy centre and generation fuel need to be apportioned between the two products so-as-to be represented in the calculated costs. The apportioning is done based simply on the electricity to heat generated ratio. If an energy centre is producing waste heat in-order-to access electricity generation, this is counted towards electricity generation not heat.

An additional complication comes in the form of the cost of heat networks for the calculation of the levelised heat cost. When EPN decides to build a heat network it must build it for the entire analysis area in one time-period[29], even if connections are spread out across further time periods. In-order-to avoid this modelling simplification skewing the costs of heat, the cost of building heat networks in each analysis area is redistributed according to the uptake of heat connections in that area. In this way, the heat cost is more reflective of the gradual expansion of the network which is more likely to occur.

6.1.3 Direct Benefits

The key 'direct' benefits that arise from the LAES are listed below.

1. **Energy Savings**

Energy savings are calculated at an analysis area level as a total for each time-period and then aggregated up to the LA level. As EPN considers only domestic heating and subsequent network level interventions to meet the designated carbon target, with non-domestic buildings, appliance and lighting demand and electric vehicle charging demand (collectively known as 'service demands') being exogenous inputs to the modelling tool, the energy considered is the total energy into each analysis area minus any service demands.

[28] UK market prices of energy are inputs to the EPN tool and taken from the Energy Technologies Institute's ESME model. ESME is a National Energy System Planning and Design Tool, which underpins and informs UK Government's future Energy Policies - see www.eti.co.uk/modelling-low-carbon-energy-system-designs-with-the-eti-esme-model

[29] EPN presents its outputs in four different 'time periods' between now and 2050. Rather than assigning a specific year for interventions they are just said to occur within the time period and any costs/change in demand averaged across the time period. Time periods are broken down as follows: 2015 – 2024, 2025 – 2034, 2035 – 2044 and 2045 – 2050 (note how the final time period is shorter than the rest).

In this way, the methodology considers any fuel imported into the area (gas, electricity, oil, biomass, coal) which is used for domestic heating, either directly in domestic buildings or into energy centres to generate either electricity or heat. Generated energy itself is not included as this should be accounted for by the generation fuel and a reduction of imports in terms of electricity, with the same logic applying to both energy centres and solar PV. In this calculation, heat is not included as a vector, although it may theoretically be imported/exported across the analysis area boundaries, since heat is not exported outside of the study area, at a whole LA level, and hence heat generated vs. consumed will balance out.

After calculating the energy savings for each area and for both the target and reference run, a comfort taking percentage is applied to the total energy savings value to reflect the fact that some households will utilise some of the energy saved to increase the level of comfort in their homes. The target run energy savings are then subtracted from the reference case savings to give total energy saved by fuel, analysis area and time-period such that negative values are an increase in energy consumption.

The energy savings figure can be presented both in MWh of energy saved and as a monetised benefit by using the levelised unit costs for each fuel, discounted to 2015 values.

2. Comfort Taking

Comfort taking is the proportion of energy saved which householders retain and utilise in-order-to increase the level of warmth in their homes. Comfort taking is excluded from the energy saved, however, an increased level of comfort and warmth in residents' homes is still a benefit to the local authority as a result of implementing the Strategy and so is calculated as a separate metric.

A value of 15% is used as the percentage of energy savings utilised for increased comfort - this is consistent with the assumption used in UK Government impact assessments of retrofit energy efficiency improvements, e.g. the impact assessment of changes to Part L 2013. This value can then easily be explored as part of the sensitivity analyses as discussed below.

The calculation of the benefit due to comfort taking is performed using the same logic as for the energy savings and can be produced in both MWh or £, but including the carbon taking fraction directly as for the calculation of Energy Savings.

Note: It is assumed that when energy savings result in a cost rather than a benefit, i.e. when gas is displaced with electricity, a much more expensive fuel, that there is no comfort taking benefit – households are not likely to improve the level of comfort in their household if it is much more expensive. Indeed, the likelihood is that in cases when fuel is much more expensive, consumers are more likely in fact to reduce the energy used in homes, for this reason we still apply the 15% reduction to the energy savings calculation.

3. Carbon Savings

Carbon savings for the LA are generated using similar logic to that for the energy savings, but then converted into carbon emissions using emission factors for each fuel. The energy savings for each fuel type, analysis area and time-period, are converted to tCO_2 emitted using the fuel emission contents from EPN. These emission contents are taken from ESME and change over the time-period to reflect changes to the national energy system based on the ESME scenario chosen for the run. The values can then be presented either in tCO_2 saved or monetised for cost-benefit analysis using a discounted carbon price.

Carbon prices are from the latest IAG guidance and either "traded" for electricity to reflect the presence of a carbon market in the form of the EU ETS, or valued using a "non-traded" price for all other fuels. The carbon

price is discounted using a 3.5% discount rate, but again this can be varied in sensitivity analyses, for example to reflect the 1.4% rate advocated in the Stern Report.

4. **Air Quality Improvement**

Additional to the direct benefits of energy savings and carbon savings there are also air quality improvement benefits which result from reductions in energy consumption. The IAG guidance provides £/MWh values for the air quality damage associated with different fuels and for different location types[30] - these are used to quantify the air quality improvements associated with the energy savings made as-a-result of the LAES. Electricity is not valued at this level as the generation of any imported electricity would not directly affect the air quality in the LA and any local generation will be accounted for in the generation fuel.

6.1.4 Cost-Benefit Analysis

A Cost-Benefit analysis can be performed on the LAES using the previously calculated, monetised, 'direct' benefits (energy savings, comfort taking, carbon savings and air quality improvement) and the costs of implementing the transition to give an overall net present value (NPV) of the transition.

The costs of implementing the plan for the target run are once again discounted and compared to the reference case. As the cost of any network reinforcement, network running costs, local generation and energy imports are accounted for in the calculation of the levelised unit costs of fuel, the cost of the transition in this instance is just the cost of installing any domestic interventions, i.e. changes to heating systems or retrofit installations. For assets with an economic life which stretches past 2050, the costs are adjusted to represent only the proportion of the asset's lifetime which is present during the LAES.

All these costs are taken directly from EPN outputs which include any regional adjustments where applicable (e.g. network costs will be specific to the network serving the LA) and any assumptions on future cost projections.

The costs for the target run are subtracted from the reference case run meaning that increases in costs are negative values and decreases in costs are positive values. These values are then summed with the benefits to give an overall NPV of the transition, either at LA level or for each individual analysis area

6.1.5 Wider Benefits

'Wider' Benefits are those that are evaluated separately from the calculated direct benefits and are included in addition to the NPV. These are described below.

1. **Employment Impacts**

The estimated impact of the LAES covers both installation jobs for domestic interventions and new energy networks/reinforcements and additional maintenance jobs generated as-a-result of the interventions. The impacts are calculated using a broad approach of estimating the employment impact based on the amount of money spent. Using data from a range of studies estimating the employment impact of expenditure on

[30] Domestic air quality damage costs are given for the following location types: inner conurbation, urban big, urban medium, urban small and rural.

domestic energy renovations[31], a value of **18 FTE per £m spent** is utilised. Energy efficiency investment has one of the highest coefficients of employment to spend of any area.

Money spent for this calculation is evaluated slightly differently than the overall costs of the transition calculated for the NPV. The money spent is again taken relative to the reference case but unlike the NPV calculations exclude the following:

- Any cost of capital associated with the LAES
- Any fuel/resource imports
- Any discounting.

With the inclusion of the reference case as the "baseline" for this calculation, the effect of "deadweight" (any jobs that would have occurred anyway) is accounted for within the calculation. An adjustment does have to be made, however, for "leakage", i.e. the proportion of generated jobs that would benefit those outside the LA area. A leakage value of 17.3% is used which is the sub-regional mean leakage value for capital projects as estimated by BIS[32].

Employment impacts are evaluated at the whole LA area, as, for this purpose, looking at an analysis area level would prove inaccurate and not meaningful. The job impact can, however, be broken down by category/employment source and either by time-period or transition (results of EPN come out in two "transitions" where interventions occur – as more "business-as-usual" transition towards the beginning of the plan and a "low-carbon" transition out towards 2050).

As part of the sensitivity analysis it will be possible to vary both the employment multiplier and the leakage percentage. If data were available, it would also be possible, with little modification to the source code, to define different employment multipliers for different costs categories, e.g. one for domestic interventions, one for network reinforcements and one for network operating and maintenance etc.

2. Health Benefits

The LAES will lead to a number of improvements to the housing stock within BCBC, such as improved building insulation, more energy efficient and lower carbon heating, and upgraded energy networks. This will lead to an increased level of comfort due to housing that is warmer and less damp, and air quality in the house should also be better as fossil fuels will not be used directly in the home. These factors should help to improve the health of residents who have existing medical conditions such as respiratory, cardio-vascular and circulatory problems, and also help to prevent new cases developing. This will lead to better health of the general population of Bridgend – this can be quantified using domestic energy savings as-a-result of retrofit or heating system interventions[33].

Energy savings are converted to *Quality Adjusted Life Years (QALYs)*, as recommended in the HMT Green Book. For each property type and fuel type, an average MWh/QALY value is derived using QALY per measure estimates from DECC's framework for future action on poverty and the respective energy savings of these measures. The calculated value of a QALY is then applied to the time-period energy savings for each property

[31] The following two studies provide summary statistics of the findings of a range of studies: www.ukace.org/wp-content/uploads/2012/11/ACE-Research-2000-09-Energy-Efficiency-and-Jobs-UK-Issuesand-Case-Studies-Case-Studies.pdf www.neujobs.eu/sites/default/files/publication/2013/01/Energy renovation-D14-2 19th December 2012.pdf

[32] BIS Occasional Paper No. 1: Research to improve the assessment of additionality: www.gov.uk/government/uploads/system/uploads/attachment_data/file/191512/Research_to_improve_the_assessment_of_additionality.pdf

[33] Any energy savings as a result of solar PV installations are not accounted for in this calculation as these will translate to health benefits via comfort taking, not due to increased energy efficiency.

and fuel type and then monetised using a value of £30,000 (the widely accepted monetary value commonly used in the healthcare sector), discounted to 2015 values. As with previous calculations, the benefits for the target run are then subtracted from the reference case to give a monetised health benefit from domestic energy efficiency improvements as-a-result of the LAES.

3. Fuel Poverty

A key driver for BCBC is the impact of the LAES on the fuel poor. A household is considered to be fuel poor if "*it would be required to spend more than 10 per cent of its income (including Housing Benefit, Income Support for Mortgage Interest or council tax benefits) on all household fuel use, in order to maintain a satisfactory heating regime*". Households who need to spend more than 20 per cent are considered to be in severe fuel poverty.

Although EPN can give an indicator of how fuel costs for a household may change over time, the quantification of income levels is outside the scope of the tool. Therefore, it is not possible to accurately quantify the number of households that will leave or enter fuel poverty as-a-result of the LAES. Instead, the analysis focuses on how the cost of delivering energy to households may change.

The methodology considers how the energy demand for heating a household changes across the time-period of the transition and, using the levelised unit cost of fuels, how the cost of delivering this energy to the household may change. As with the rest of the analysis, this calculation excludes any tax or profit which may apply to the price of fuel, due to the uncertainty of these over time.

Calculated energy demand is generated on a per household basis, as-a-result of any retrofit and heating system transitions; in some instances, there are two different, potential "pathways" a group of households may follow, in these cases the households are split, probabilistically, between the pathways. Similarly, solar PV is assigned within EPN as a m^2 value to an entire analysis area. This is broken down to a household level using **an assumption of 15.6 m^2 per household** and probabilistically assigning the panels to suitable housing.

Using assumptions consistent with the Feed-in Tariff (FIT), we assume 50% of this is exported back to the grid and 50% used in house, which is offset from the household demand. The assumption is also made that the households themselves do not benefit from the FIT payments. Any demand resulting from lighting and appliances is not included in this analysis as these are exogenous inputs to EPN and thus consistent across all runs.

Demand is then monetised, using the levelised costs for each fuel, on an individual household basis for both the reference case and target run, these are then subtracted from each other in-order-to quantify how the cost of delivering energy to that household may change over the duration of the LAES. As the analysis is performed at a household basis, properties whose energy delivery costs have changed (either reduced or increased) can then be mapped to see how these properties correlate with the fuel poor.

In instances where the cost of energy delivery has increased, the value of this increase can be used to determine policies for any subsidies (such as the Warm Homes Discount) which may be required to ensure homes do not fall into fuel poverty as-a-result of the transition.

6.1.6 Additional Impacts NOT Included in the Analysis

In addition to the socio-economic impacts discussed in this methodology there are also some potential impacts which are not considered/evaluated by this methodology. These are any incentive payments and balance of payment impacts.

As previously mentioned, EPN, and thus the LAES, considers the total cost to society of the low carbon transition (i.e. exclusive of any tax) and incentive payments. As these are transfer payments between two parties, the benefits of incentive payments are not included. This includes, but is not limited to, any of the following:

- VAT
- FIT tariffs
- RHI tariffs
- ECO funding.

Balance of payments impacts are also not considered when assessing the impact of the LAES as these are not directly relevant at a LA level.

Additionally, no regional or social adjustments are made. EPN accounts for regional adjustments where applicable, for example the housing stock is LA-specific, and costs are region-specific where necessary. Social adjustments cannot be made in the methodology due to lack of data and the granularity (analysis area) of the methodology.

6.1.7 Sensitivity Analysis

Any economic analysis spanning as far out as 2050 is inherently uncertain – this is amplified by the uncertainty within the LAES itself as there are many potential pathways that could be followed, with no one "correct" choice. To try to reflect this in the methodology, the economic analysis has been performed on a range of EPN scenarios for BCBC - all results can then be presented as an average **with a range of +/- one standard deviation across the runs**. In presenting the results in this way, as a range, the analysis will capture the uncertainty in the future energy system

Additionally, part of the functionality of the methodology allows for sensitivity analyses of the economic specific parameters to be easily performed. The methodology allows for certain sensitivities to be performed as standard, alongside the base assessment, these include testing the impact of:

- Carbon price (high and low)
- Stern carbon discount rate of 1.4%
- Employment multiplier.

These sensitivities, however, are likely to vary the results in a much more predicable way than performing the analysis on a range of the EPN sensitivities. For example, in increasing the carbon price used then the carbon savings only will increase or reducing the employment multiplier will result in a direct reduction in the estimated number of jobs created.

On top of these "built-in" sensitivities, the methodology also allows the user to add additional sensitivities for any of the defined parameters discussed in this methodology (e.g. profit proportion for fuel poverty, assumed solar exports, overall discount rate etc.), allowing for a wide range of uncertainty to be estimated. In a similar way, it will also be possible to vary any number of these parameters for a Monte Carlo sensitivity analysis if required.

6.2 Existing Policies and Regulations for District Heating

There is a variety of existing policy and regulations designed to promote and regulate DH. In addition to UK policies above, the EU Emissions Trading Scheme (EU ETS) exacerbates the externalities barrier for district heating. The EU ETS applies to district heat networks with a boiler or CHP plant over a certain size, but does not apply to domestic gas boilers. This further financially disadvantages large CHP plants. Intervention in the UK to protect consumers from district heat monopolies is limited.

These policies and regulations can be broken down into four categories:

- Legal & Regulatory (including planning regulations)
- Commercial & Financial (including policies to incentivise DH uptake)
- Technical & Operational
- Consumer (including consumer protection).

These policies and regulations are described in more detail below.

Existing Legal & Regulatory Policies and Regulations

The key policies that underpin the legal and regulatory framework for DH are listed below:

- **Energy Efficiency Directive –** the *EU Directive on Energy Efficiency* requires Member States to undertake a national comprehensive assessment - this includes an assessment of the potential for high-efficiency CHP and efficient district heating and cooling. Assessments of national heating and cooling demand over the period 2016-2025, heating and cooling maps and maps of existing infrastructure have been submitted to the EU Commission by the UK Government and the Devolved Administrations. Cost-effective potential for heat networks and outline policies that could support deployment have also been submitted.

- **National Planning Policy Framework (NPPF) –** the NPPF encourages Local Authorities (LAs) to consider low-carbon and renewable heat networks. The NPPF requires local planning authorities to identify opportunities for development that can source energy supplies from decentralised, renewable or low-carbon energy systems. It also looks for opportunities for the co-location of potential heat customers and suppliers. It does this through requirements to develop supportive policies and strategies and to have a *'presumption in favour'* of low-carbon developments. This aims to overcome restrictive planning policies.

- **General building regulations -** these require developers to meet certain energy efficiency standards by the most cost-effective means they choose. For example, Part L of the Building Regulations relates to energy efficiency standards for new builds and renovations; covering window replacements, boiler installations and insulation measures. These regulations are likely to increase the viability of DH schemes (because they are usually more energy efficient), but DH schemes' high

fixed costs mean that this policy alone is unlikely to make sufficient difference to the viability of DH schemes, particularly for smaller-scale schemes.

- **The London Plan -** this requires developers to conduct a feasibility study over whether a development can feasibly connect to a DH network. If this is not plausible, then proposals should be developed to evaluate opportunities for site-wide CHP systems and, where CHP systems are appropriate, for extending the system beyond site boundaries. In this case, developers should *'future-proof'* the development to facilitate connection to a district heat network at a later date. Using this approach, the *London Plan* helps increase the number of potential heat network users including the potential *'anchor tenants'*, providing developers with a base load from which they can attempt to connect other users.

- **Scottish District Heat targets -** the *Expert Commission on District Heat in Scotland* has amended planning regulations to help district heat schemes by requiring that developments should consider DH, and providing guidance to planners on how to do this. However, The Commission does not go as far as requiring a *'presumption in favour'* of district heat within planning.

- **EU and Defra Regulations over use of waste** – these apply to both heat and landfill and support DH indirectly by ensuring planning policy supports the use of waste heat. In particular, Defra's *Waste Infrastructure Development* programme supported the creation of capacity to burn waste and create heat.

Existing Commercial and Financial Policies and Regulations

The key policies that support the commercial and financial framework for DH are listed below:

- **Renewables Heat Incentive (RHI) -** this provides subsidy payments for homeowners that use eligible renewable sources to heat their homes. The heat supply component of DH schemes also qualify for RHI payments providing they have an eligible heat source. The RHI has supported a number of biomass CHP district heat schemes, however, gas-fired CHP schemes are not eligible.

- **Energy Company Obligation (ECO) -** the ECO is a government scheme that requires larger suppliers to deliver energy efficiency measures to domestic residences in the UK. ECO's design is not well suited to DH schemes as energy suppliers are required to 'bank' their energy efficiencies within a two-to-three year period. Given the long investment lead times for DH, there is a high risk that efficiencies are not realised within the required time period. As such, suppliers opt for alternatives which deliver energy efficiencies sooner.

- **Climate Change Levy (CCL) exemptions -** the CCL is a tax on fossil fuels used to heat, light and power businesses. Any suppliers with *'Good Quality CHP'* are exempt from paying the levy on all gas and electricity used internally[34]. As this policy is focussed on business use, it is likely to support building-

[34] The Association of Decentralised Energy (ADE) estimates that this policy saves generators almost £2 per MWh for gas and over £5 per MWh for electricity

level gas-fired CHP, rather than suppliers of DH networks that are connected to domestic users. As with the Carbon Price Support (CPS) exemptions (see below), a limitation of the CCL is that it does not incentivise electricity generation for export.

- **Carbon Price Support (CPS) exemptions -** DH suppliers using good quality gas-fired CHP are exempt from paying the Carbon Price Floor on the fuel used to generate heat and, from April 2015, also for the electricity they use on site. The *Association of Decentralised Energy (ADE)* estimates that suppliers will save over £3/MWh p.a. due to the CPS exemption policy. The CPS exemptions do not include exported generation and, in comparison, gas used in central heating boilers is also exempt from the CPS.

- **Enhanced Capital Allowances -** these allow a business to off-set investments in energy saving measures against its tax liability over the period in which the investment was made. So, for example, if a business pays corporation or income tax at 20%, every £10,000 spent on qualifying equipment would reduce its tax bill in the year of purchase by £2,000. The design of this policy means that it is likely to have a very limited impact on DH suppliers because DH schemes have a long pay-back period, and it is unlikely, therefore, that a scheme will earn sufficient profit to have a tax liability within the relevant investment period. The exception might be for companies with other profitable activities against which to offset their DH investment.

- **Scottish District Heat Loan Fund -** this provides low-interest unsecured loans, typically up to £400k per project to be repaid within ten years. A key objective of the fund is to deliver affordable heat to local communities. The fund is available to local authorities, registered social landlords, SMEs and Energy Service Companies (ESCOs) with fewer than 250 employees. According to Scottish Government statistics[35], by 2014, the fund had provided loans totalling £4.4m, helping to connect 173 homes and 16 non-domestic buildings to district heat networks.

- **Renewable Energy Investment Fund (REIF) –** the REIF is a Scottish Investment Bank initiative that provides financial assistance to renewable energy sources, including renewable district heating. The REIF can provide loans, guarantees and equity investments, all on fully commercial terms. To be eligible for funding, a scheme must also be able to demonstrate a benefit to the Scottish economy and have a demonstrable funding gap. The fund aims to complement the Scottish DH loan fund and prioritises applications for funding over £400k.

Existing Technical and Operational Policies and Regulations

- **The 2014 Heat Network (Metering and Billing) Regulations -** these require suppliers to install meters in properties connected to their DH networks and issue bills to customers. This policy aims to give more transparency on bills and improve consumers' ability to better control their heating costs. The introduction of metering in the water industry delivered fairer billing for customers.

[35] Scottish Government www.gov.scot/Topics/Business-Industry/Energy/Energy-sources/19185/Heat

Existing Consumer Policies and Regulations

There are a number of voluntary schemes, such as the **Heat Network Code of Practice**[36] and the **CHP Quality Assurance** scheme[37], that aim to increase the quality of heat networks. These help to improve the technical quality of district heat networks which may help with consumers' perception of quality. In addition to these voluntary measures, a number of other policies and measures are currently used to protect customers connected to a DH network. These are:

- **Heat Trust –** this was introduced in 2015 and is a voluntary scheme to encourage suppliers to sign up to meet certain standards for consumers, ranging from metering and billing to handling consumer complaints. It also established an industry-led ombudsman which provides an independent complaints handling service for consumers who have exhausted the complaints process with their operator.

- **The Independent Complaint Handling Service -** this is operated by the same organisation that operates the Energy Ombudsman. This scheme is designed to address a number of consumer concerns around quality of service. At this stage it is not clear how many suppliers will sign-up or what effective sanctions the ombudsman has at its disposal.

- **Tendering for District Heat licences –** tendering is designed to increase **c**ompetition in the DH sector. Tenders may be released by councils or by individual developers. They can focus on discrete elements such as constructing or operating the network, or can include *'Concession Contracts'* – these award an exclusive licence to design, build, finance and operate the DH network. Tendering is unlikely to be sufficient by itself to maintain competition: it requires the body that is tendering to be able to prioritise consumers' best interests - this may not be possible in practice.

6.3 Potential Future Policy and Regulatory Options

The potential future policies and regulations for district heating can be broken down into four categories:

- Legal & Regulatory (including planning regulations).
- Commercial & Financial (including policies to incentivise DH uptake).
- Technical & Operational.
- Consumer (including consumer protection).

[36] The **Heat Network Code of Practice** is a voluntary industry scheme that aims to improve the quality of heat networks. It sets out objectives and minimum requirements for each stage of the development of a heat network, including feasibility, design, construction and installation commissioning, operation and maintenance, customer expectations and obligations.

Policies and regulations in each of the above categories will now be considered separately and summarised in Table 5.1.

6.3.1 Future Legal & Regulatory Policies

Introduce a District Heat Strategy

Local authorities should be obligated to produce *Local Area Energy Strategies* (LAES) to identify optimum expansion of existing DH schemes and the development of new networks (as demonstrated in the LAES for Newcastle City Council). LAES would identify the optimum areas *('DH Zones'*) for expanding existing or developing new DH schemes. These DH Zones are defined as local areas in which district heat has been assessed as being likely to be cost-effective once the value of carbon has been taken into account. DH Zones are likely to be a useful policy tool for district heat because of the high fixed costs associated with networks, and the resulting economies of scale. These economies of scale mean that concentrating district heating policies on securing uptake in defined zones may be more cost-effective than applying policy incentives at a national level.

District heat targets could be set in each local area with responsibility for meeting them allocated to the local authority. The LA would then be accountable to BEIS and need to explain performance against its targets. This would address a current lack of ownership and coordination within the sector.

Introduce a supportive Planning Policy for District Heat

Potential Solution(s)

Supportive planning policy aims to address policy distortions and overcome policy-created barriers. A ***Local Development Order (LDO)*** is an alternative to the submission of a planning application - it enables a Local Planning Authority to grant permission for a particular type of development. The provision for LDOs was originally introduced in the *Planning and Compulsory Purchase Act 2004* (the 2004 Act). LDOs can be seen as an extension of permitted development rights given under the GPDO, but are prepared and decided locally in response to local circumstances.

LDOs have been used to grant planning permission for a heat network, including pipes, heat exchange equipment, street furniture, informational signage and ancillary engineering works. An example of this is the London Borough of Newham: the Council approved their District Heating Network LDO in March 2013 covering the Royal Docks[38], Beckton and Canning Town. This LDO grants planning permission for minor works associated with implementing the Newham Heat Network.

[38] The LDO was part of the streamlined planning process for the Royal Docks Enterprise Zone

The intention of the LDO was to promote the development of decentralised energy in Newham. The District Heating LDO granted planning permission for **"a heat network including pipes, heat exchange equipment, street furniture, informational signage and ancillary engineering works" along the length of the route**. The LDO did however exclude any thermal energy generating plant or equipment and any development in listed buildings.

The use of Local Development Orders for the installation of Heat Networks (including pipes, heat exchange equipment, street furniture, informational signage and ancillary engineering works) should be extended.

6.3.2 Future Commercial and Financial Policies and Regulations

Improve the Financial Viability of DH Networks

Issue

Connection to DH Networks may be unattractive to consumers and high levels of subsidy are currently required to bring payback periods down to a level which consumers are likely to find acceptable. DECC published a carbon price that represents the estimated marginal cost over time of meeting carbon targets[39]. In theory, applying this carbon price as a subsidy should deliver the take up consistent with meeting the targets. Indeed, applying a subsidy, in line with the carbon price makes these interventions cost-effective for many consumers over the lifetime of the interventions. However, it will not be enough to bring payback periods down to a level which they are likely to find acceptable. For some consumers, the payback on these interventions will be very long, up to 50 years, even with a subsidy in line with the carbon price.

A lack of standard contractual arrangements for DH projects

Issue

A lack of standard contractual arrangements was found to be a key barrier for both private and public sector-led development of district heating networks in the UK[40]. In practice, generation, networks, heat exchangers, meters and retail may be integrated, resulting in the financial flows between a smaller number of parties. Heat and power generators buy fuel and convert this into heat and electricity. Heat is then sold to heat networks while the electricity is exported. Electricity exports could be direct to customers or to the distribution grid. Depending on the contractual arrangements, the benefits from selling surplus power may be shared with a corresponding heat network's customers.

For example, this is the case for the Pimlico District Heating Undertaking (PDHU), where this revenue is reinvested in Westminster housing. The heat networks operate as local monopolies and provide heat to end consumers through a heat exchanger which is usually metered for commercial consumers, and often not metered at the household level for domestic consumers (though meters are standard in new heating

[39] DECC (2014) – "*Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal*"
[40] Pöyry and Faber Maunsell (2009) – "*The potential and costs of district heating networks, A report to the Department of Energy and Climate Change*"

networks). End consumers pay retailers, and this is likely to be under long-term contracts or featuring a demand guarantee given the monopoly nature of the network and the need to recover high capital costs associated with setting up the network.

Potential Solution(s)

The energy market is designed currently around selling units of gas and electricity - there are no similar arrangements for selling heat. It might be helpful if a heat market were developed with standard contractual terms for heat provision. In terms of selling heat to the consumer, the ESC is developing a number of business models which look to offer a level of comfort to customers rather than selling them energy on a kWh-basis.

Reducing the uncertainty for DH Network operators in securing revenues from future heat supply

Issue

Uncertainty over revenues from future heat-sales (particularly in **retrofit** schemes) is challenging for DH business models oriented to financial returns. The public sector has the potential to act as an anchor load to make schemes viable, but procurement rules, existing contracts, and time scales of project development often make this difficult to achieve in practice. Research for DECC found that managing risk was crucial, and in combination with a carbon price signal, could ensure that DH meets between 6-14% of UK heating needs in 2030[41].

Potential Solutions

Identifying DH Zones

As already stated above, the EPN analysis framework can be used to identify the most appropriate low-carbon heating and energy efficient interventions for a local area, as part of a decarbonisation strategy, using a range of data including the location of heat sources from the Heat Map for Scotland. The Local Area Energy Strategy (LAES) for Newcastle, developed by the ESC on behalf of the ETI with Newcastle City Council, identifies areas where heat networks are the most appropriate heating solution and provides a costed decarbonisation programme to meet Newcastle's 2050 targets. It is being used by Newcastle City Council to identify possible district heating zones in the city. The LAES also contains a socio-economic analysis that evaluates the financial benefits from reduced carbon emissions, improved health, a reduction in fuel poverty and increased employment, against the costs of implementing the plan.

[41] Department of Energy and Climate Change (2013): *"Summary evidence on District Heating Networks in the UK".*

Concessions

The economics of installing and operating a heat network will be improved by connecting more customers as fixed costs can be better recovered and development and operational risk reduced. Therefore, it makes sense financially to establish an exclusive *'concession'* for heat network developers. However, this financial advantage is partially offset by concerns about restricting customer choice, however, as stated above, well-designed value propositions and business models and effective regulatory oversight can (partly) mitigate any concerns about customer choice.

DHNs have high capital costs and long payback periods and so the concession periods must be long enough to allow developers the opportunity to make a fair return on their investment. This must be balanced by introducing a range of performance criteria that the concession-holder must meet: consistent failure to do so should involve penalty payments with the ultimate sanction of losing the rights to the concession.

The ESC has no evidence to inform the design of concessions but it seems obvious that concessions will have to be of long enough duration and enable connection of a high proportion of local customers to allow developers to recover high capital costs of installing the network. The issue of oversizing the heat network to meet any future growth in customers would have to be carefully managed in order to prevent stranded assets and potential financial over-recovery. However, district heating is a 'push' technology: once a heat network is installed, demand to use the network should increase.

Exclusive concessions should lower financing costs and heat prices, assuming that there are adequate safeguards in place to prevent abuse of dominant positions. Offering tax-breaks and partnering with LAs should also reduce financing costs/risks.

When the concession period is over, the long-term ownership of heat network assets should be sold off to another concession holder with responsibilities for upgrading and maintaining the network as appropriate. Part of the money from the sale should be kept by the LA to reduce fuel poverty in its local area, potentially through a targeted reduction in council tax.

6.3.3 Future Technical and Operational Polices and Regulations

Technical Standards of Operation

Issue

Inconsistent standards and inefficiencies in performance have negative reputational effects, preventing DH adoption and future growth (problems are highlighted in a report by Which? (2015)).

The Heat Networks Code of Practice, developed by the trade associations CIBSE and ADE[42], provides **voluntary** technical standards for heat network developers. There are no mandated technical standards for DH in the UK, though the London District Heating Manual offers guidance to support scheme compatibility.

[42] CIBSE – Chartered Institute of Building Engineers; ADE – Association of Decentralised Energy

Potential Solution

Regulation could set out consistent technical standards for minimum performance of schemes. All DH schemes should be registered and heat suppliers required to report key info annually including price data. Heat suppliers should be required to assess the efficiency of their network(s) annually and report on this to Government. Complaints handling must also be improved. A single set of national Technical Standards for DH systems, should be developed by the UK Government working with the DH industry and other stakeholders. The Technical Standards could be based on the *Heat Networks Code of Practice* developed by the ADE and CIBSE.

6.3.4 Future Consumer Protection Polices and Regulations

Consumer Protection

Issue

District heat is typically sold under long-term contracts linked to the property which is connected to the heat network. However, consumers still take fuel price risk as prices within these contracts typically vary over time in relation to fuel prices (e.g. according to a price index of the fuel used in the heat plant).

The fixed costs of setting up a network connecting heat production to end users are so high that it is most cost-effective to have one network in a given area. This is similar to the electricity and gas sectors, where distribution networks are natural monopolies. Unlike the electricity and gas sectors, district heat networks are not heavily regulated.

Customers are not protected by formal regulation for the sale of heat and cannot switch supplier in the same way that they may be able to with gas and electricity. In some cases they may also be signed up to long-term contracts. This could leave some customers open to abuse by dominant suppliers.

Mandation versus Customer Choice

Where there is potential conflict between choice and compulsion, we believe that customer choice must be paramount. This can be achieved by offering a range of well-designed value propositions and business models offered to those connecting to heat networks. With DHN, the economics are improved by high levels of uptake and so the benefits should be stressed of connecting to a heat network from a consumer's perspective i.e. a small in-house unit, heat on demand, no safety concerns, and quite likely the cheapest overall cost per kWh.

The LA already has a critical role in the potential development of heat networks through the planning process. The issuing and enforcing of concessions could be seen as a natural extension of this planning authorisation – the ESC believes that it seems logical that LAs could be responsible for issuing and enforcing concessions as long as there are effective appeal procedures in place for developers, ESPs and customers. Ofgem would seem to be the most appropriate body to design and own of any appeals process.

There is an argument that LAs should have the power to compel connection to a DH scheme but this must not impose any detriment to the building occupants in comparison with a standard alternative. There should also be a well-defined appeals procedure, administered by Ofgem or the Energy Ombudsman. The benefits and disbenefits of mandating connection to a DH network should be tested as part of a large-scale demonstration of a heat network.

The creation of a local area energy plan such as the LAES can identify the least cost heating solutions in particular areas. An analysis framework such as EnergyPath™ Networks determines where the most suitable locations are for district heating, or heat pumps or biomass boilers etc. If the LAES has identified a particular location (zone) where district heating is the most appropriate solution then any new industrial buildings in that zone could be targeted to determine any potential anchor load or potentially any usable surplus heat. It could be a condition of obtaining planning consent for new industrial buildings to submit potential heat requirements or any usable surplus heat as part of the planning application.

Mandating consumers to connect to a DH network would guarantee significant uptake. Again, to help ensure cost-effectiveness, this could be applied only within certain defined zones. This policy could distinguish between new build and retrofit connections. New builds would be expected to connect straight away. Allowing a number of years for retrofit customers to connect could lower the resource cost by allowing customers to connect when their existing heating system expired.

All DH consumers should have recourse to a single ombudsman for the sector. Government should ensure all consumers are effectively protected.

Potential Solution(s)

At a minimum, a regulatory framework for licenced developers is required. This could involve a tender for the option to develop a network in a particular area. It could also be built into the planning regime so that Local Authorities could require individual developers to engage with and use potential district heat schemes. Licencing could be introduced alongside a target for take up of district heat by 2020 and/or 2030. A target is already in place in Scotland, and was put forward by the CCC in its 2014 progress report.[43]

The regulatory framework would need to ensure good outcomes for consumers. Evidence from countries with unregulated district heat networks shows that competition issues can occur in the absence of ex-ante regulation. There have been numerous competition investigations in Sweden, and an ongoing investigation in Germany. This suggests that regulation may be needed to provide sufficient consumer protection both in terms of price and quality of service. This is because heat networks are natural monopolies, and consumers have limited alternative heating options after connecting to a heat network.

[43] Committee on Climate Change (CCC) (2014) – "*Meeting Carbon Budgets: 2014 Progress Report to Parliament*".

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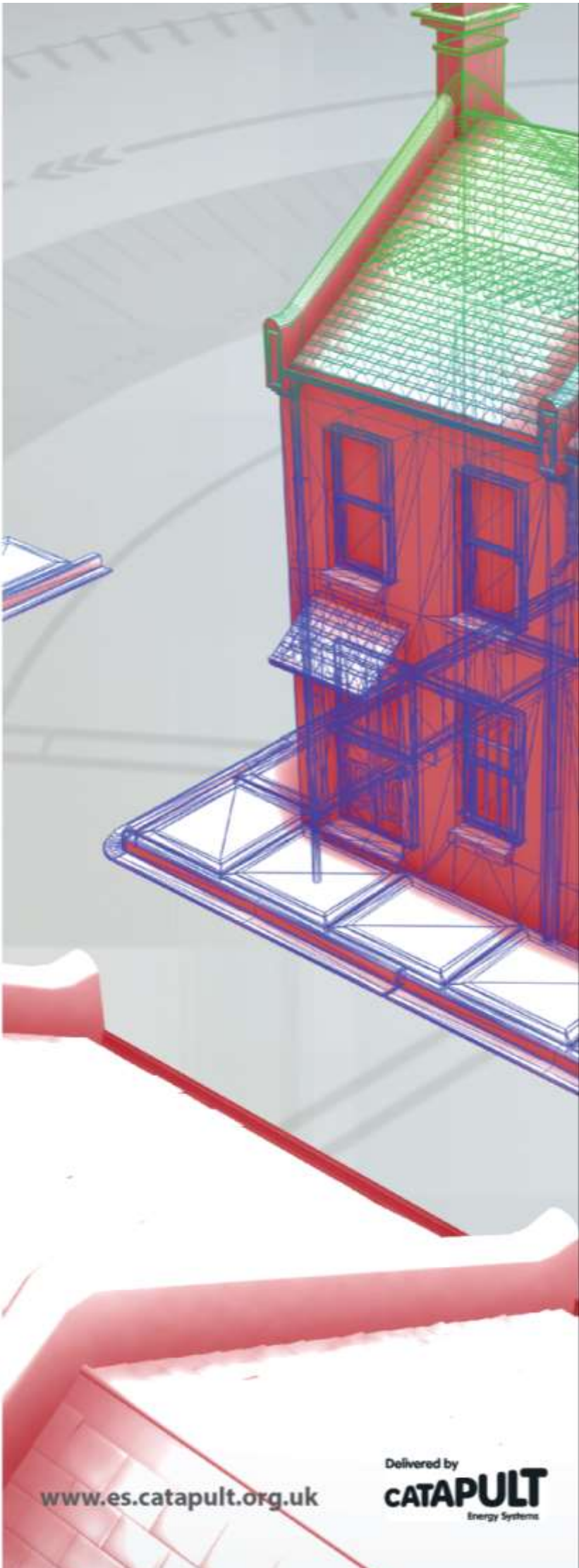

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