Programme Area: Smart Systems and Heat

Project: WP2 Manchester Local Area Energy Strategy

Title: Policy and Commercial Insights for Energy System Transformation

Abstract:

This document describes the policy, economic and commercial perspective of the creation of a Local Section 2 includes evaluation of the socio-economic costs and benefits from the implementation of the 2040 and 2050 Carbon Target scenarios in Bury. These include direct benefits such as:

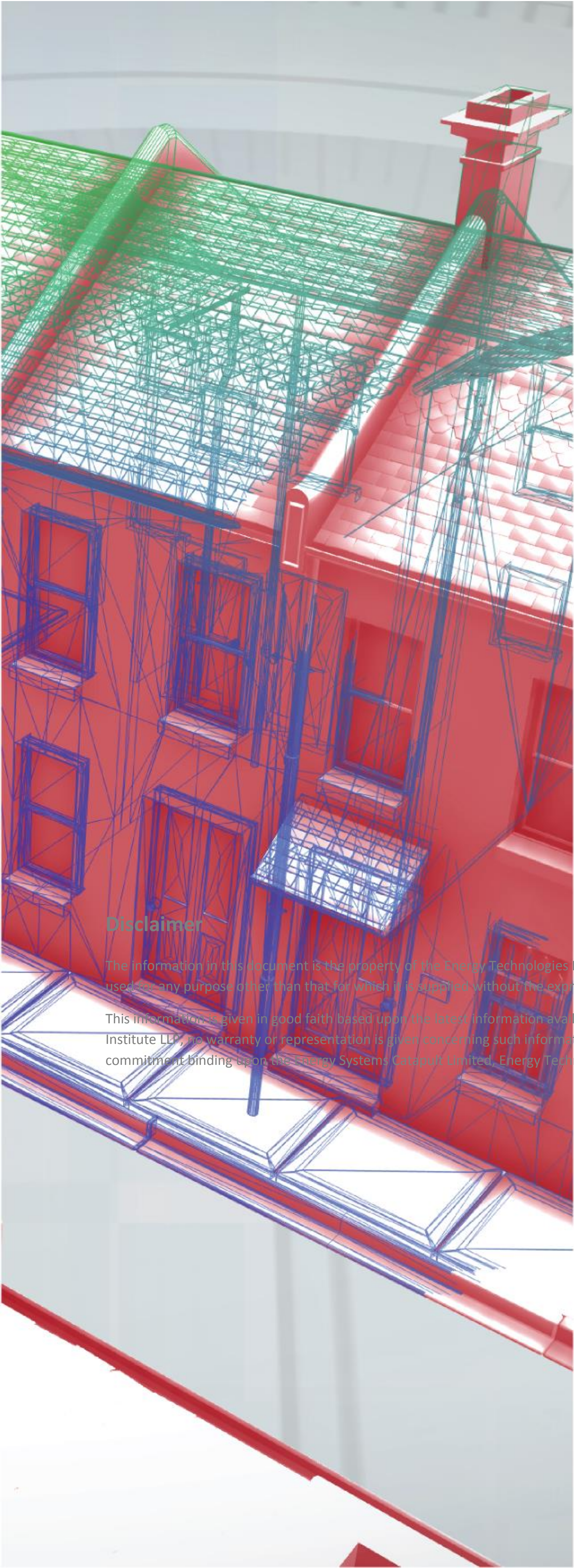
• Reductions in energy consumption and carbon emissions, and

• Wider benefits such as improvements in health and increased employment.

Possible future policies which might facilitate the implementation of the strategy are then considered. Section 3 contains the conclusions from the evaluation in Section 2. Section 4 contains a Glossary. Section 5 is an Appendix containing supporting information on the methodology and assumptions for the calculation of the socio-economic benefits.

Context:

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



Local Area Energy Planning:

Policy and Commercial Insights for Energy System Transformation:

Bury Council

Delivered by Catapult Energy Systems

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 large-scale 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 boilers, biomass or biogas CHP systems and biogas injection into the gas grid.

The Bury Local Area Energy Planning project has produced a draft Strategy for decarbonising heat in the Bury Council area and a roadmap for its implementation. It is based on evidence from analysis using EnergyPath™ Networks[1] (EPN) and inputs from a number of key stakeholders including Bury Council, Greater Manchester Combined Authority (GMCA), the electricity network operator, Electricity North West, and gas network operator, Cadent.

In consultation with the key stakeholders and informed by the assessment of many different possible decarbonisation pathways using EnergyPath™ Networks, three future local energy scenarios for bury have been developed

- The ***'No local carbon target'*** scenario – this represents no coordinated attempt by Bury to reduce carbon emissions (though some reduction is achieved as a result of the assumed decarbonisation of the national electricity supply) – this run acts as a point of comparison.
- The ***'2050 carbon target'*** scenario aims to achieve the maximum possible modelled reduction of in-scope emissions, which equates to a 98% reduction from 1990 levels.
- The ***'2040 carbon target'*** scenario aims to reach the same 98% reduction in emissions by 2050, but in addition, the *2040 carbon target* reduces carbon emissions more quickly, giving a reduction of **96% of in-scope carbon emissions by 2040**.

A comparison of the costs and benefits of the 2040 Carbon Target scenario versus the 2050 Carbon Target scenario is shown below in Table 1.

[1] http://www.eti.co.uk/programmes/smart-systems-heat/energypath. EnergyPath is a registered trademark of Energy Technologies Institute LLP

Without a local carbon target, Bury's energy system is expected to cost **£7.11bn**[2] between now and 2050 – this includes total infrastructure, energy and device costs (see Section 2.2 for more details). Aiming for the 2050 Carbon Target, the transition is expected to cost **£1.1bn** more, an increase of **16%.** The 2040 Carbon Target is modelled to cost a further **£1bn** more than the 2050 Carbon Target, an **86%** higher spend on carbon reduction, but over the study period this transition saves much more carbon (around 2.2 million tonnes). Because the 2040 Carbon Target scenario leads to earlier decarbonisation, it may still be of interest even though it costs more than the 2050 Carbon Target scenario.

Table 1 – Comparison of the Costs and Benefits for the 2040 Carbon Target run versus the 2050 Carbon Target run (figures are relative to the No Local Carbon Target run) – from 2015-2050

	2040 Carbon Target	2050 Carbon Target
Carbon Emissions Reductions (mt CO2)	7.2	5.0
Carbon Savings Benefits (£m)	212	130
Net Energy Savings (TWh)	25	16
Net Air Quality Benefits (£m)	16	9
Net Health Benefits (£m)	2.4	1.1
Net Full-time Equivalent Jobs Created	490 (from 2035-2050) plus 330 from 2025-2034	430 (from 2035-2050)
Total Additional Cost (£bn)	2.1	1.1

In order to minimise carbon emissions in the 2040 Carbon Target scenario, half of the domestic buildings in Bury move away from gas heating in the first transition (to 2035) to district heating, Air Source Heat Pumps (ASHPs) and Ground Source Heat Pumps (GSHPs). For the 2050 Carbon Target run, domestic buildings are modelled to be cost optimal to stay on gas until transition two (post 2035). By 2050, the heating systems are virtually identical for the 2040 and 2050 carbon target runs.

Different local and national policies may be required to facilitate each stage of the transition. For the 2050 Carbon Target run, 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 up to around 2030. The transition to low carbon heating solutions gathers pace from around 2030 when

[2] This includes the total cost of development, operation, maintenance and upgrade of existing and new infrastructure, cost of fuel/energy, cost of maintenance and replacements of heating systems.

the electricity supply is expected to be decarbonised. Any new policies and new business models to encourage greater uptake of heat pumps and connection to district heat networks will need to be developed and implemented before 2035 to prepare for the transition. **For the 2040 Carbon Target run, these policies and business models would need to be introduced by the mid-2020s.**

One intervention expected to play an important role in decarbonisation 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[3].

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. These need to be aligned with improved energy efficiency and better heating controls. Without these factors, levels of uptake of heat pumps are likely to be low.

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. An alternative 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 could obviate the need for subsidies/capital payments (see below).

For heat networks, 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 by energy providers and district heating developers and operators at little cost. 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) could be supported in Bury.

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[45] 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[6] (EP) – this option is currently being explored by the

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[3] Wilson, C., Chryssochoidis, G., and Pettifor, H. (2013) Understanding Homeowners' Renovation Decisions: Findings of the VERD Project – this research showed that when renovating their properties, fewer than 10% of people are driven primarily by energy savings versus other considerations.

[4] An externality is a positive or negative consequence (of an economic activity) experienced by unrelated third parties. The carbon externality takes account of the additional costs of burning fossil fuels such as the damage costs caused by climactic changes.

[5] 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*

[6] An Energy Provider is a supplier of energy and related services to customers.

Energy Systems Catapult as part of the Smart Systems and Heat Programme (SSH) Programme – Part 2. 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 may be indifferent to how they were delivered as long as they achieved the desired outcome. This creates a potential channel to market for low carbon energy systems without requiring government subsidies for individual components. The ESC has considered a number of business models to meet people's needs and a potential approach is the concept of buying *Heat as a Service (HaaS)*[7]. A service model would enable EPs to deliver heat outcomes and be encouraged to improve efficiency in delivering them.

[7] https://es.catapult.org.uk/wp-content/uploads/2018/02/FINAL-How-can-people-get-the-heat-they-want-at-home-without-the-carbon.pdf

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

The ESC supports innovators in unlocking opportunities which are generated by transition to develop a clean, intelligent energy system. ESC is one of 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. This document has been produced by the 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 Plan for Bury Council in Greater Manchester.

The ESC is working with Bury Council (in partnership with Greater Manchester Combined Authority) to develop a draft strategy for decarbonising heat that seeks to reduce carbon emissions from buildings as far as possible by 2050. It is also working with Newcastle City Council and Bridgend Council to develop similar Strategies.

This study analyses the economic impact results generated by the EnergyPath Networks (EPN) modelling framework developed by the Energy Technologies Institute. EPN applies a multi-vector approach to select the most appropriate cost-effective energy technology options in a local area, for a given set of technical and economic criteria. It uses these results to describe the policy, economic and commercial perspectives of the strategy to decarbonise heating in Bury.

1.2.2 Structure of this report

This document describes the policy, economic and commercial perspective of the creation of a Local Area Energy Strategy for Bury Council.

Section 2 includes evaluation of the socio-economic costs and benefits from the implementation of the *2040 and 2050 Carbon Target scenarios* in Bury. 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.

Section 3 contains the conclusions from the evaluation in Section 2. Section 4 contains a Glossary. Section 5 is an Appendix containing supporting information on 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[8], 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.

In 2016, residential emissions[9] were approximately 70 megatonnes of carbon dioxide equivalent ($MtCO_2e$) (around 14% of the total carbon emissions including industry, power stations and transport. Total heat demand, including industry, contributed 175 $MtCO_2e$, bringing the total to 30%.

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 and 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 closure 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 and distribution networks. Replacing natural gas with alternative gases such as Syngas[10] and hydrogen could help the UK achieve its carbon reduction targets, as part of a multi-option energy solution. However, the technical and economic considerations for using alternative gases are at a very early stage. However, early indications are that to re-purpose the gas network would

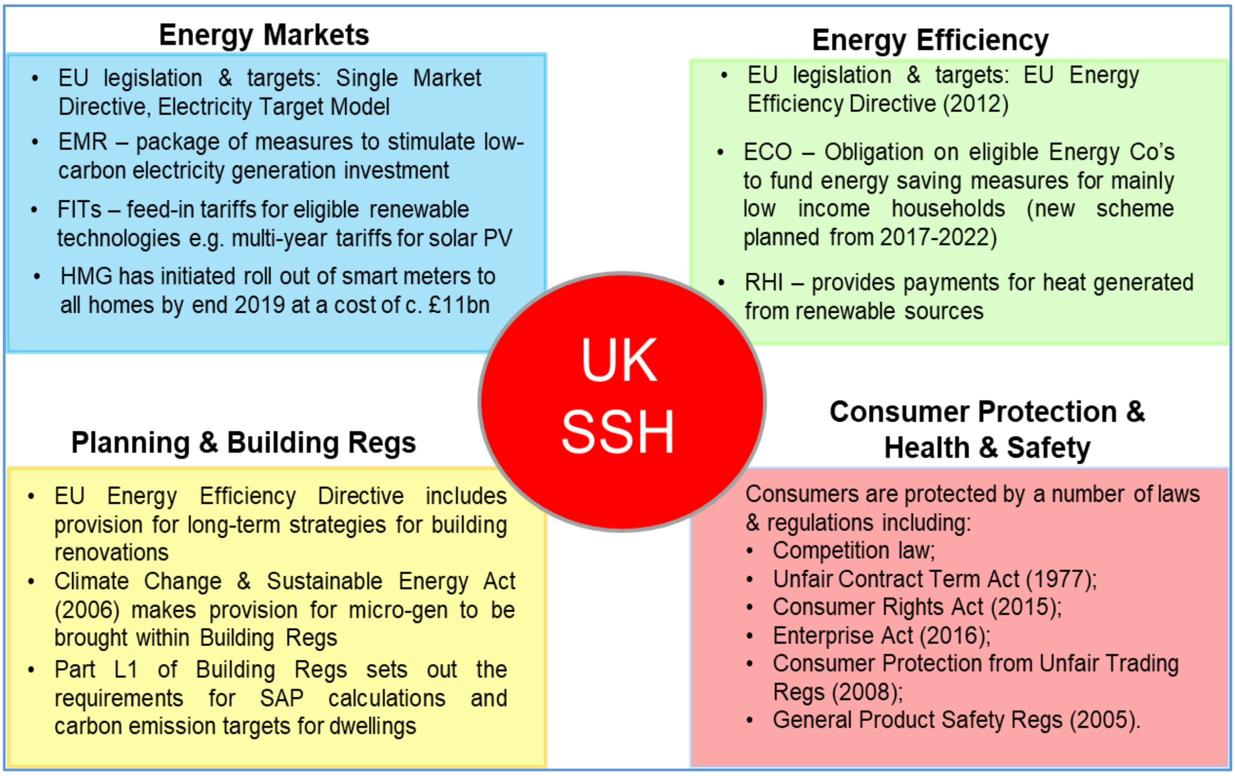
8 "Policy for Heat: Transforming the System: Future Heat Series, Part 2" – A report by Carbon Connect (October 2015)
9 https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2016
10 Syngas, or synthesis gas, is a fuel gas mixture consisting primarily of hydrogen, carbon monoxide, and very often some carbon dioxide. Syngas can be used as an intermediate in creating synthetic natural gas and for producing ammonia or methanol.

involve considerable investment in the long term. The possible re-purposing of the gas network has not been considered in this study.

2.1.2 Current UK Energy Policy

Carbon Connect's report on the future of heat policy in the UK[11], 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 2.1.

Figure 2.1: An Overview of Some of the Key UK 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? However, it should be noted 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 low carbon transition for Bury surrounds the ability to finance the transition. Large-scale, initial investment will be required by private companies and banks. Some of these initial costs will need to be provided by government

[11] Carbon Connect: Policy for Heat: Transforming the System report (Oct. 2015)

bodies and consumers. It is not yet clear how these uncertainties will be 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 2.1.6* below.

2.1.3. Energy Statistics for the Bury and Greater Manchester Energy System

Greater Manchester (GM) has a population of 2.7 million people and approximately 1.1 million homes[12]. A Spatial Energy Plan for Greater Manchester was developed as part of the Energy Technologies Institute (ETI) Smart Systems and Heat (SSH) Programme and undertaken through collaboration between the Greater Manchester Combined Authority[13] and the Energy Systems Catapult. GM currently uses c. 52 TWh/year of energy[14]. This is around 3% of total UK energy use.

Key statistics for Bury include:

- **38%** of Bury's energy use is attributed to domestic use. **24%** is used by the non-domestic sector and the majority of the remainder is used by the road transport sector (**39%).** Space Heating and Hot Water are estimated to account **for 75% of domestic energy demand.**
- **Gas is the primary heating fuel for homes in Bury (96%)**, with electricity accounting for around 2%. Coal and oil (1%) still form part of the energy mix in some areas.
- **Around 390 postcodes have never had a gas connection** and can be considered off-grid. This is around 8% of the postcodes in Bury. This is equivalent to around 2,292 domestic properties or 3% of homes. Note: many of these properties are blocks of flats that do not have gas by design but are actually near the gas grid. So, it's not necessarily just areas that are too far from the grid to be connected.
- The greatest proportion of Bury's housing stock (c. 45%) was built between 1945-1964, with approximately 21% being pre-1914 and over 22% built between World War 1 and 2 stock. The pre-1914 and World War 1 to 2 stock are generally more difficult to treat from an energy efficiency perspective.
- **Around 9,000 Bury households** are thought to be in **fuel poverty** with the greatest areas of fuel poverty concentrated in the **Bury town centre and Radcliffe area.**
- The vast majority of the existing homes in Bury and (GMCA as a whole) are likely to be in existence by 2050.

Identifying cost effective pathways for the domestic retrofit of energy efficiency and low carbon heating systems as part of a coherent whole systems approach is essential to support GM's long-term decarbonisation targets.

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12 https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/bulletins/subnationalpopulationprojectionsforengland/2014basedprojections/relateddata

13 GMCA is made up of the ten Greater Manchester councils and Mayor, who work with other local services to improve the city-region. The ten councils are: Bolton, Bury, Manchester, Oldham, Rochdale, Salford, Stockport, Tameside, Trafford and Wigan).

14 "Greater Manchester Spatial Energy Plan: Evidence Base Study" – ETI/ESC Report (2017)

The **Climate Change Act 2008** provides the statutory framework for the reduction of greenhouse gas emissions in the UK. Bury Council has signed up to the UK100 target of 100% clean energy by 2050. Following its Green Summit on 21st March 2018, GMCA is anticipated to announce an accelerated Mayoral ambition for decarbonisation of the city region ahead of the national 2050 target.

In order to meet 2050 carbon targets, near-full decarbonisation of both buildings and surface transport by 2050 is likely to be required[15]. The Committee on Climate Change (CCC) suggest *'there may be a small amount of room for residual emissions in buildings and/or surface transport'*. Where emissions remain will depend on how different low-carbon technologies develop. It is therefore sensible to plan now to keep open the possibility of near-full decarbonisation of both buildings and surface transport by 2050. If GMCA commits to an accelerated target, then this planning will be even more imperative.

2.1.3 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 government; 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[16] 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[17] in conjunction with the ETI carried out a review of the DECC barriers and found other factors such as policy complexity and uncertainty, lack of trust (e.g. due to branding), and product aesthetics to be important.

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[15] https://documents.theccc.org.uk/wp-content/uploads/2015/11/Fifth-Carbon-Budget_Ch3_The-Cost-effective-path.pdf
[16] DECC (2013) – "The Future of Heating: Meeting the challenge"
[17] Frontier Economics (January 2015) – "Overcoming barriers to smarter heat solutions in UK homes: A Report Prepared for The Energy Technologies Institute"

The Frontier study also considered insights from behavioural economics[18]. 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*[19] – where individuals may want to invest in energy efficiency but are delaying, or where individuals have high discount rates for future cost savings but a small discount rate for large initial investment outlay (meaning that the incentive to invest upfront is reduced).
- *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 2.14 with a range of new *Enabling*, *Incentivising* and *Mandating* policies.

2.2 Socio-economic Evaluation of Future Local Energy Scenarios for Bury

2.2.1 Background

EnergyPath™ Networks (EPN) has been used to analyse potential future local energy scenarios and system designs for Bury. This has considered the changes needed to the local energy system over the period 2020-2050.

This has been based on the identification of the most cost-effective pathways to decarbonise. The focus of these pathways is making interventions to domestic and non-domestic buildings, energy efficiency measures and low-carbon heating systems, and changes required to the gas, electricity and heat networks to facilitate these.

Three EPN scenarios have been carried out to model the most cost effective and low carbon future energy system for Bury. These are:

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[18] 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.

[19] Time inconsistency is a situation in which a decision-maker's preferences change over time in such a way that a preference can become inconsistent at another point in time.

- The ***'No local carbon target'*** scenario – this represents no coordinated attempt by Bury to reduce carbon emissions (though some reduction is achieved as a result of the assumed decarbonisation of the national electricity supply) – this run acts as a point of comparison.
- The ***'2050 carbon target'*** scenario aims to meet a **98%** reduction of in-scope emissions (i.e. **an annual reduction of 27 ktCO_2/yr)** from 1990 levels.
- The ***'2040 carbon target'*** scenario aims to reach the same 98% reduction in emissions by 2050, but in addition, the *2040 carbon target* reduces carbon emissions more quickly, giving a reduction of **96% of in-scope carbon emissions by 2040**.

It is worth noting that even without any local efforts to reduce carbon, Bury's emissions are expected to reduce from c. 620 ktCO_2/yr to c. 400 ktCO_2/yr by 2050 due to reductions in the carbon intensity of grid electricity. Obviously, meeting either the 2040 or 2050 emissions reduction target will require co-ordinated efforts as per the draft LAES.

2.2.2 The Costs of the Transition

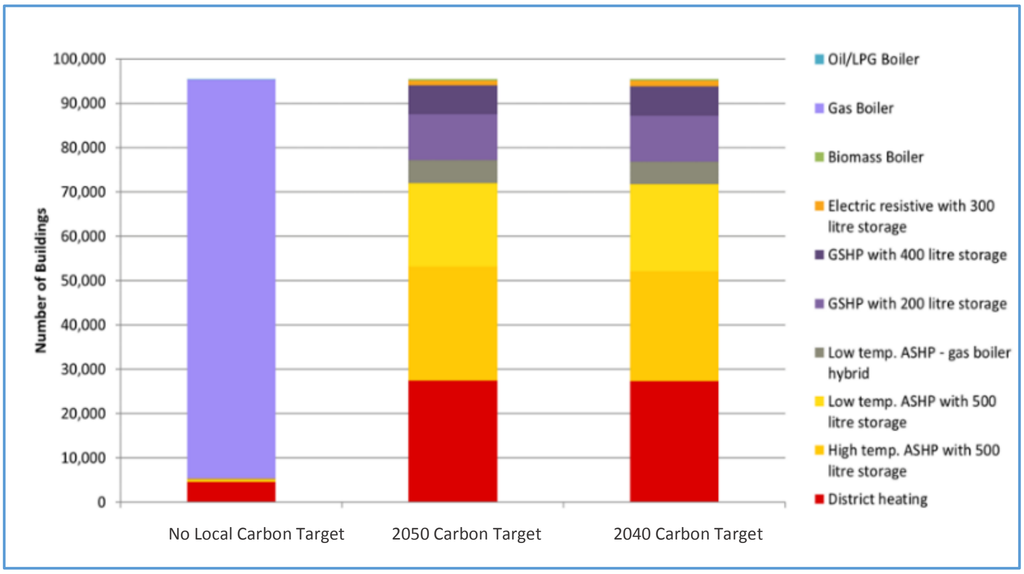
The transition to a low carbon future will require investment in alternative heating technologies such as district heat networks, heat pumps and heat storage, as well as better insulation of buildings and upgrades of electricity distribution networks. **The more ambitious the carbon target, the greater the cost of Bury's energy system to 2050. The *2040 Carbon Target* represents a more ambitious commitment and policy for Bury than the *2050 Carbon Target* as it leads to carbon emissions being reduced sooner, although the overall level of emissions at 2050 is the same for both scenarios.**

Without a local carbon target, the EPN model suggests that Bury's energy system will cost **£7.11bn** between now and 2050 - this includes the total cost of development, operation, maintenance and upgrade of existing and new infrastructure, cost of fuel/energy, cost of maintenance and replacements of heating systems. Aiming for the 2050 carbon target is modelled to cost **an additional £1.1bn**, an increase of **c. 16%.** Therefore**,** delivering a low carbon energy system is possible for a less than 20% increase in costs – if well planned.

The 2040 target is modelled to cost a further **£1.0bn** more than the 2050 target (£2.1bn more than the No Local Target run), but over the study period saves much more carbon, over ninety years of the 2050 emission level.

A breakdown of the domestic heating systems for each of the three future local energy scenarios is shown in Figure 2.2. The 2050 breakdown of heating systems is the same under both carbon target trajectories.

Figure 2.2: Domestic Heating Systems Present in 2050



- **For both carbon target scenarios, no domestic gas boilers remain in Bury by 2050. Instead, approximately a third of homes are connected to a district heat network and the other two thirds use an electric solution.**

As well as an increase in costs, the move to a lower carbon future will result in a number of socio-economic benefits. These are now considered.

2.2.3 Assessing the Socio-economic Benefits of a Low-carbon Transition

The costs of the interventions made as part of the energy transition in Bury will be partly 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
    - Improved air quality
- 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^{TM} Networks (EPN) and calculates indicative costs and benefits using HM Treasury (HMT) Green Book and Inter-departmental Analysts Group (IAG) guidance where appropriate[20,21]. The methodology and outputs have been shared with both the GMCA's cost-benefit analysis team and Bury Council to check for consistency and accuracy.

Note: Costs and benefits are derived from the difference between both the 2040 and 2050 carbon target scenarios (as shown below) and a reference scenario (the No Local Carbon Target scenario), to give an indication of the range of costs and benefits possible i.e. not one definitive answer.

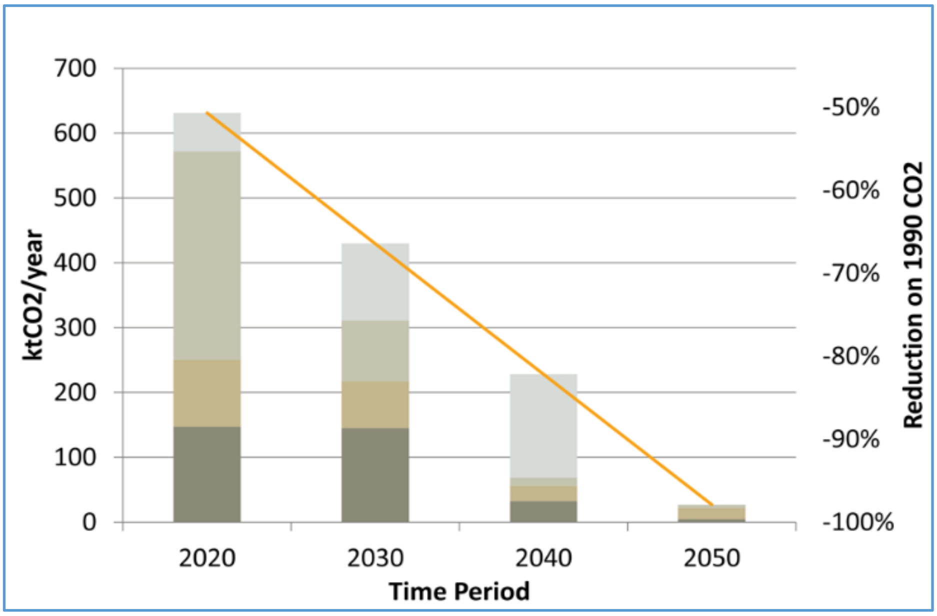
A detailed overview of the approach used, including the calculation methodology and the key assumptions made is included in the Appendix.

2.2.4 Socio-economic Benefits for Bury

Direct Benefits

The **Average Carbon Savings** (tCO_2) as a result of the transition pathway to a 2050 carbon target for each time period, broken down by energy type, are shown in Figure 2.3.

Figure 2.3: 2050 Carbon Target - Linear Reduction in Carbon to 2050



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

Figure 2.4: 2040 Carbon Target - Same 2050 limit with earlier decarbonisation.

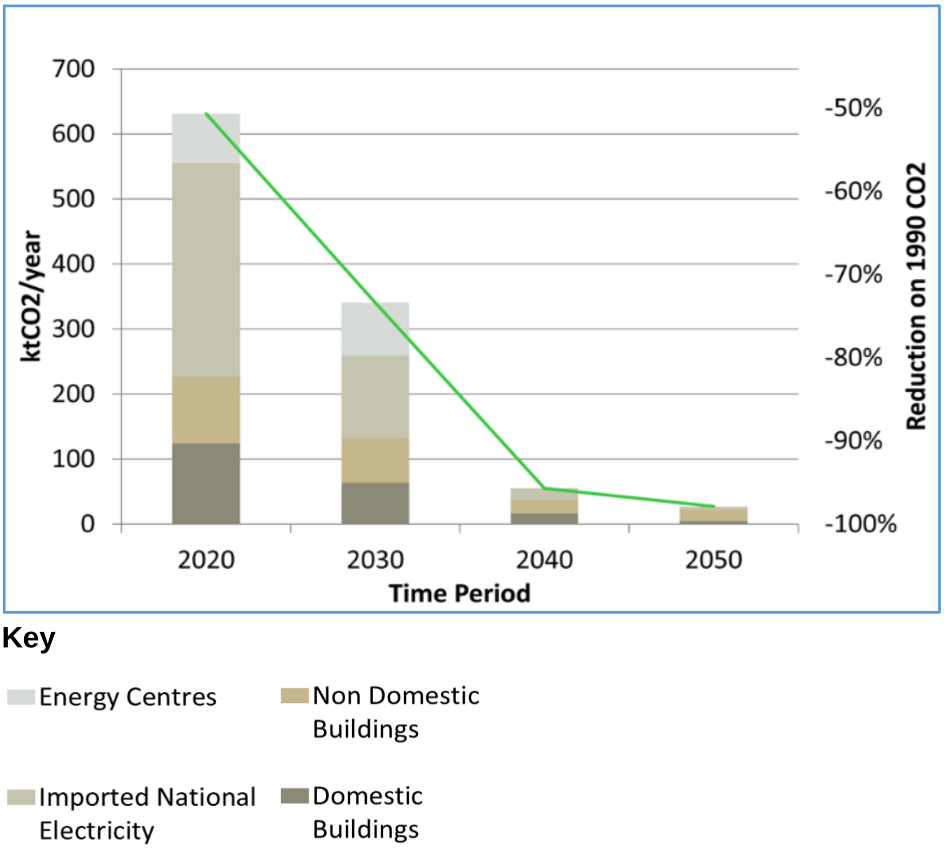
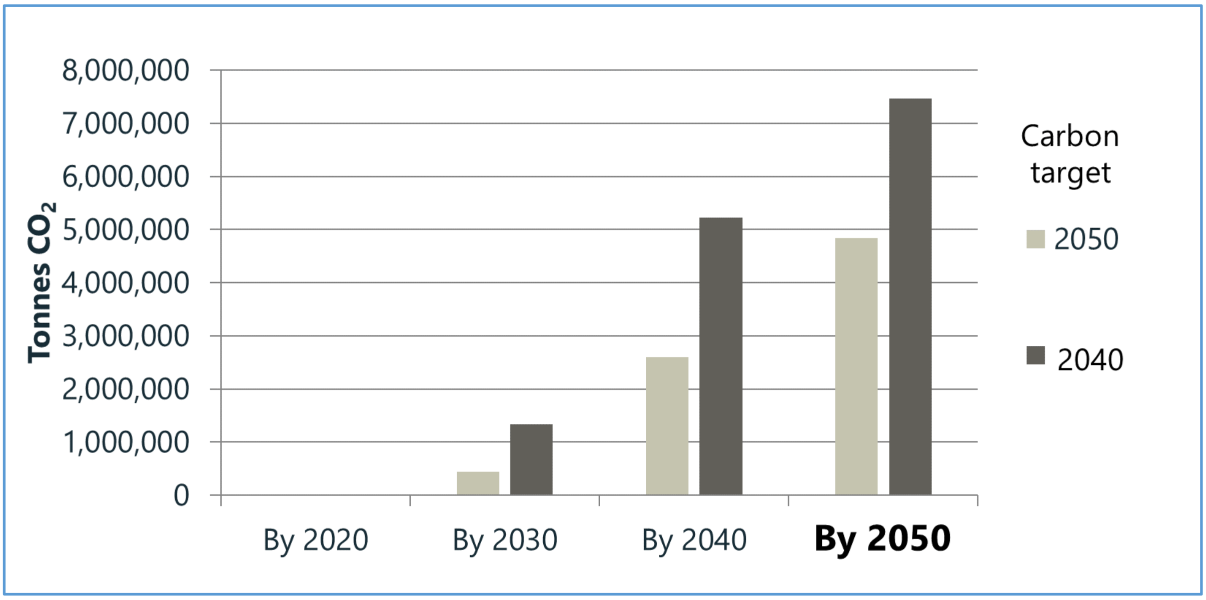


Figure 2.5: Cumulative Tonnes of CO_2 saved since 2015 (compared to No Local Target Scenario)



- Total CO_2 savings to 2050:
    - 2050 Carbon Target scenario: c. 5 million tonnes
    - 2040 Carbon Target scenario: c. 7.2 million tonnes
- Savings due mainly to a reduction in gas usage
- A low level of carbon emissions (c. 25kt) will remain in 2050 mainly due to residual non-domestic emissions, with smaller contributions from electricity grid and domestic sources.

Reductions in carbon emissions are calculated by using the energy savings from not burning fossil fuels (mainly gas). These energy savings are converted into carbon emissions using emission factors for each fuel. These emission contents are taken from ESME[22] and change over time to reflect changes to the national energy. The values can then be presented either in tCO_2 saved[23] or monetised for cost-benefit analysis using discounted carbon prices.

These carbon prices try to put an economic value on the CO_2 emissions i.e. they are priced equal to the monetary value of the damage caused by the emissions. This should result in the economically optimal (efficient) amount of CO_2 emissions.

Carbon prices used are from the latest IAG[24] guidance and either "traded" for electricity to reflect the presence of a carbon market in the form of the EU Emissions Trading Scheme (ETS), or valued using a "non-traded" price for all other fuels. The carbon price is discounted using a 3.5% discount rate.

The layering of policies over time has led to a substantial variation in carbon prices across users and fuel types. Gas has a much lower carbon price relative to electricity and residential consumers pay lower carbon prices than business. Among businesses, big energy-intensive firms face a lower price than smaller, less energy-intensive ones.

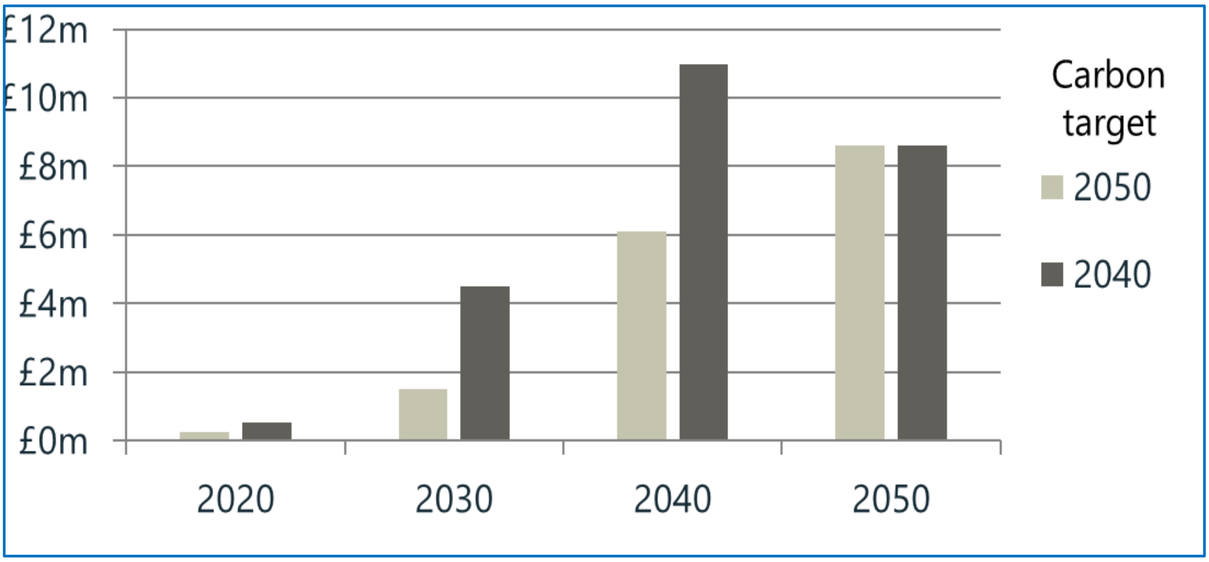
The carbon savings quoted below, accrue to society in general, and cannot be claimed directly by Bury Council. However, they would occur as a direct result of the transition pathways to the carbon target.

[22] Energy System Modelling Environment – a model developed by the Energy Technologies Institute to model the whole energy system environment

[23] http://www.eti.co.uk/modelling-low-carbon-energy-system-designs-with-the-eti-esme-model/

[24] Interdepartmental Advisory Group – an internal group set up to advise the UK Government on energy-related matters.

Figure 2.6: Annual CO_2 Cost Saving of the two Carbon Target Runs vs No Local Carbon Target

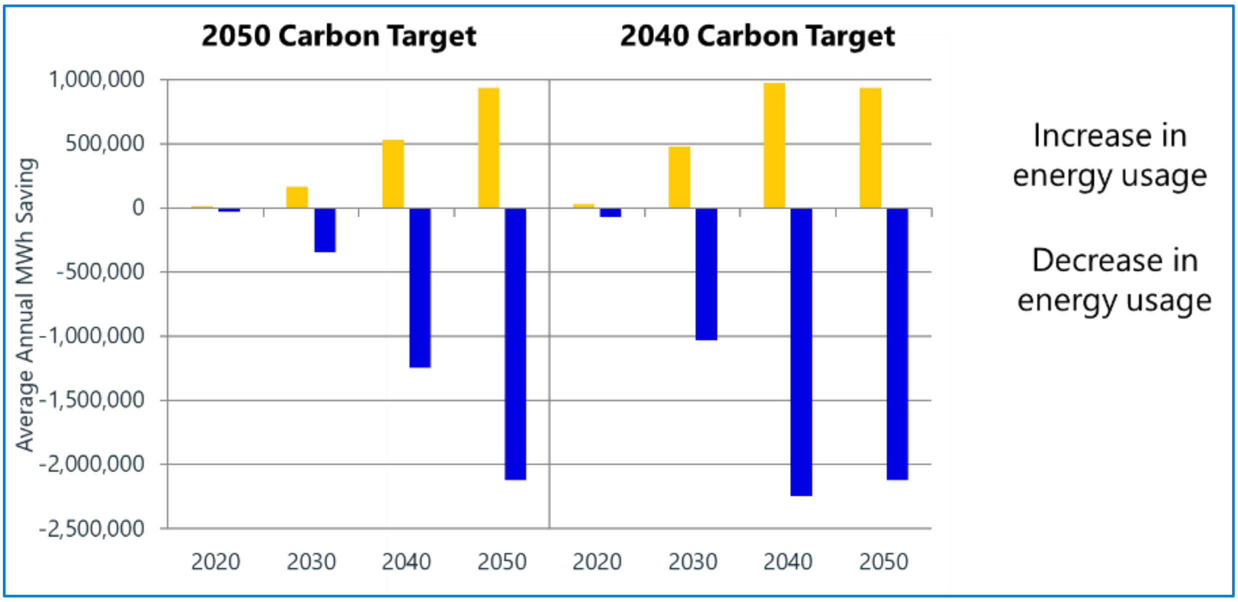


- Total saving to 2050:
    - 2050 Carbon Target scenario: £130m
    - 2040 Carbon Target scenario: £212m
- Carbon emissions savings benefit offsets c.10% of extra cost of decarbonisation

Based on IAG projections for the EU ETS price of carbon between 2015 and 2050

The **Average Energy Savings** (MWh) as a result of the transition pathways to the carbon target (both 2040 and 2050 runs, relative to the No Local Carbon Target scenario) for each time period, and broken down by energy type, are shown in Figure 2.7.

Figure 2.7: Average Energy Savings (MWh/year) for Carbon Target Runs vs No Local Carbon Target



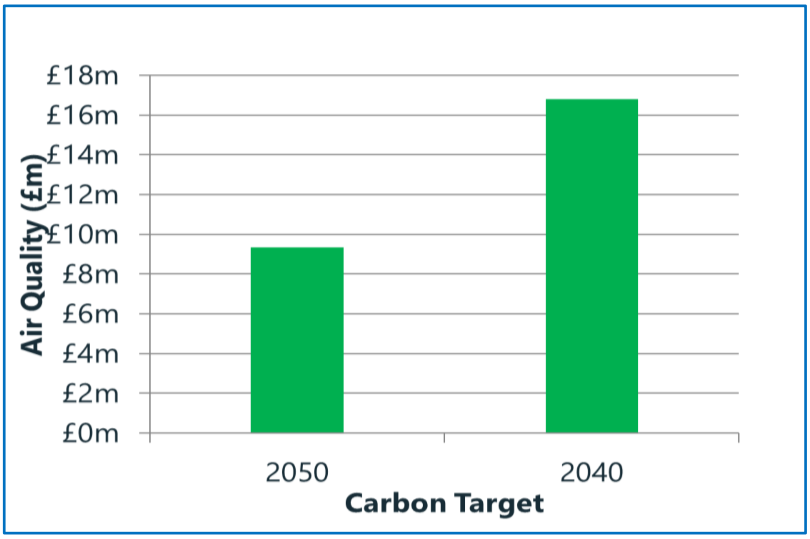
Note: The calculated metrics from the Target runs are subtracted from the No Carbon Target run: therefore, positive results are savings and negative values are increases

- The transition pathways will see net energy savings of:
    - 2050 Carbon Target scenario: over 16 TWh (16 billion kWh)
    - 2040 Carbon Target scenario: over 25 TWh (25 billion kWh)

The improvement in **Air Quality** from the low carbon transition[25] is shown below in Figure 2.8. These benefits are due to burning less gas. Air quality damage figures for gas boilers are relatively low (30 times less than for biomass boilers), but when cutting emissions from burning gas across all of Bury, then tangible improvements are observed.

[25] IAG guidance provides £/MWh values for the air quality damage associated with different fuels and for different location types: https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal.

Figure 2.8: Air Quality Benefits Due to Reduction in Gas Usage

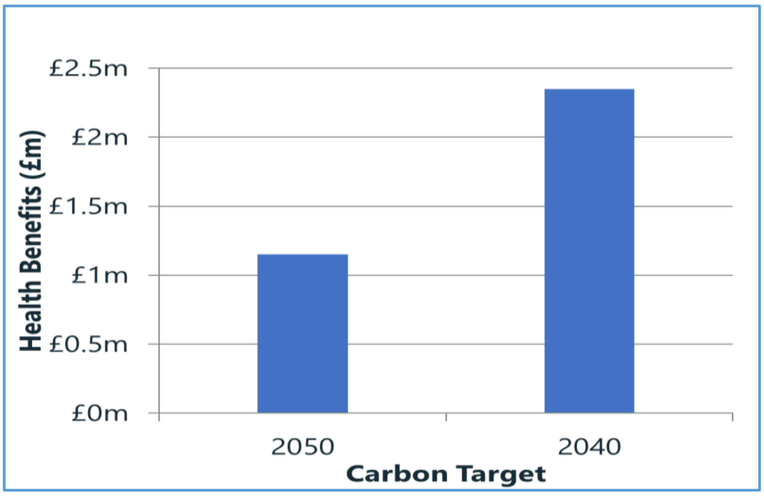


- **The transition pathways will see net Air Quality benefits to 2050 of:**
    - **2050 Carbon Target scenario: over £9 million**
    - **2040 Carbon Target scenario: over £16 million**

Wider Benefits

The **total discounted, annual health benefits** from the transition pathways in the Carbon Target runs have been evaluated by converting energy savings to Quality Adjusted Life Years (QALY's[26]) with a value of £30,000/QALY. These are shown in Figure 2.9.

Figure 2.9: Health Benefits from the two Carbon Target Runs

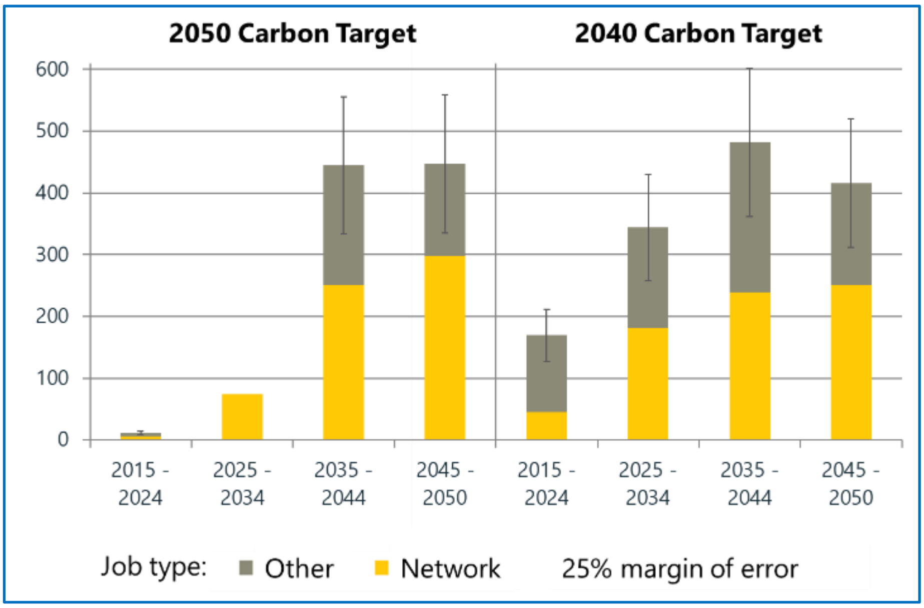


[26] A Quality Adjusted Life Year attempts to put a value on a year of good health. A value of £30,000 per QALY has been used as per the UK Treasury Green Book: www.hmtreasury/greenbook

- The transition pathways will see net health benefits to 2050 of:
    - 2050 Carbon Target scenario: c. £1.1 million
    - 2040 Carbon Target scenario: c. £2.4 million
- Values health based on Quality Adjusted Life Years
- Applies figures of QALY per energy measure as set out in BEIS's Fuel Poverty: A *Framework for Future Action*
- 1 QALY = £30,000

The **employment impact** created from the transition pathways towards the two Carbon Target runs versus the No Local Carbon Target run are shown in Figure 2.10.

Figure 2.10: Number of Full Time Jobs[27] Within Time Period for both the 2040 and 2050 Carbon Target Runs over No Local Carbon Target run



Assumptions:

- 18 jobs per £m per year spend.
- 17.3% 'leakage' accounted for (jobs created outside local authority).
- Figures show extra jobs over *No Local Carbon Target* run, which also has investment such as gas CHP generation – meaning numbers will be higher than shown.
- 'Other' consists mostly of domestic work (insulation, heating system replacement) and energy centre construction and maintenance.

- The transformation pathways will see net Full Time Equivalent jobs to 2050 of:
    - 2050 Carbon Target run: c. 430 from 2040-2050
    - 2040 Carbon Target run: c. 490 from 2040-2050 plus c. 330 FTEs from 2025-2034 due to the earlier decarbonisation under this scenario.

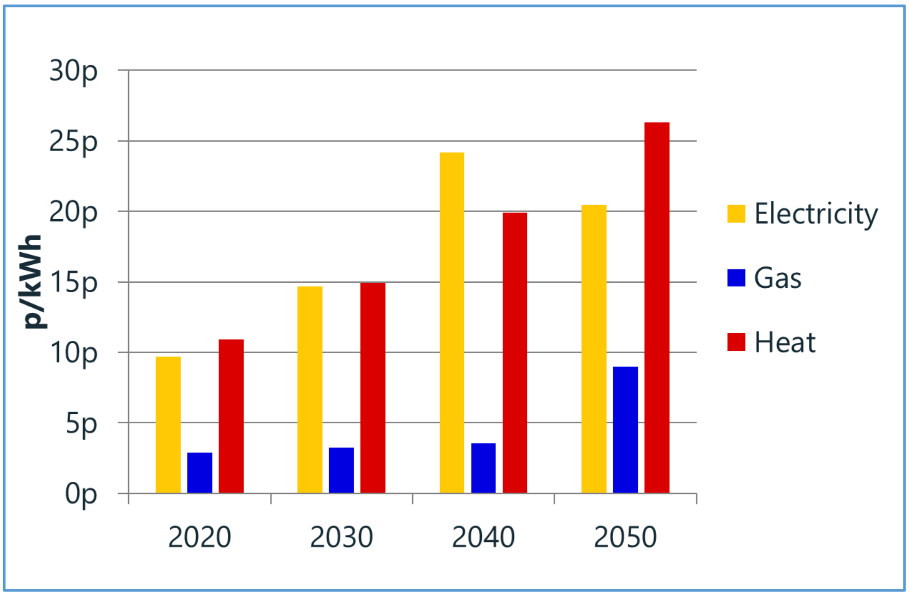
[27] BIS Occasional Paper No. 1: Research to improve the assessment of additionality: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/191512/Research_to_improve_the_assessment_of_additionality.pdf

2.2.5 Energy Costs

Levelised Unit Costs of Fuel

The average calculated levelised unit costs of fuel[28] (£/MWh) as a result of the transition pathways to meet the 2040 and 2050 Carbon Target Runs are shown below in Figure 2.11. This indicates what the breakdown of a fuel bill might be for an end user. The costs include the raw energy cost, network upgrade/maintenance cost, and for district heat the investment/running cost. The costs exclude any taxes and supplier/network operator profit plus all other energy-related costs (e.g. in-home boiler and insulation costs).

Figure 2.11: Levelised Unit Costs of Fuel (as delivered to the customer) for both the 2040 and 2050 Carbon Target Runs

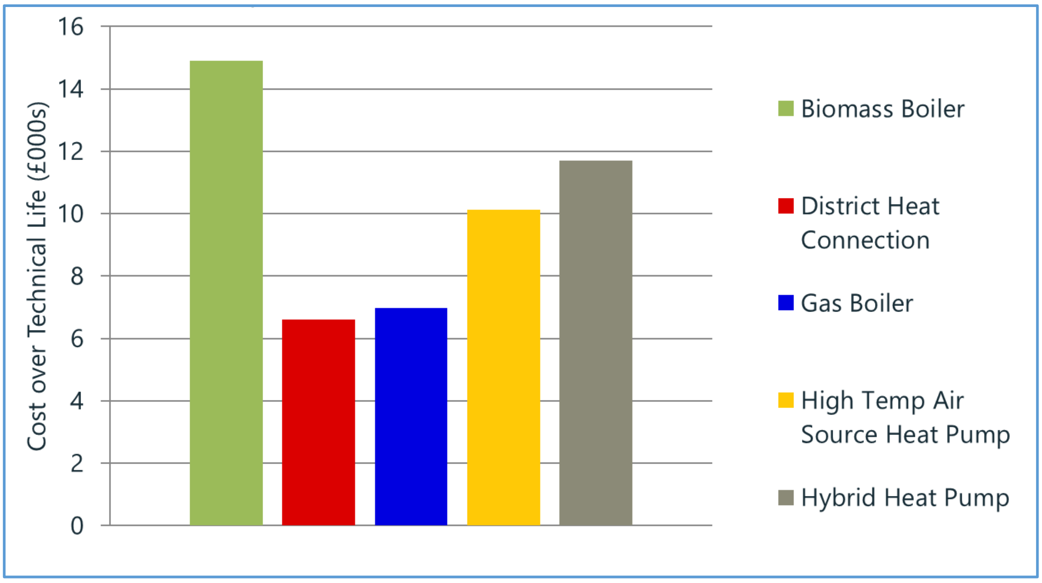


This graph shows that electricity remains significantly more expensive (averaging around 4 times higher across the time period) than gas – this makes the economic case for the changeover from gas to electricity more difficult as the carbon price externality has not been priced into the cost of gas. Applying an appropriate amount for the costs of carbon emissions to the gas price would bring the gas and electricity costs closer together.

A comparison of the total lifetime costs for different heating solutions is shown in Figure 2.12 (including maintenance costs as well as initial cost of the equipment). The district heat areas have higher monthly bills, but significantly lower in-home installation and maintenance costs (money spent on building the heat network is added to the monthly bill).

[28] Levelised costs are calculated by summing all the costs incurred during the lifetime. of the generating technology divided by the units of energy produced during the lifetime of the project.

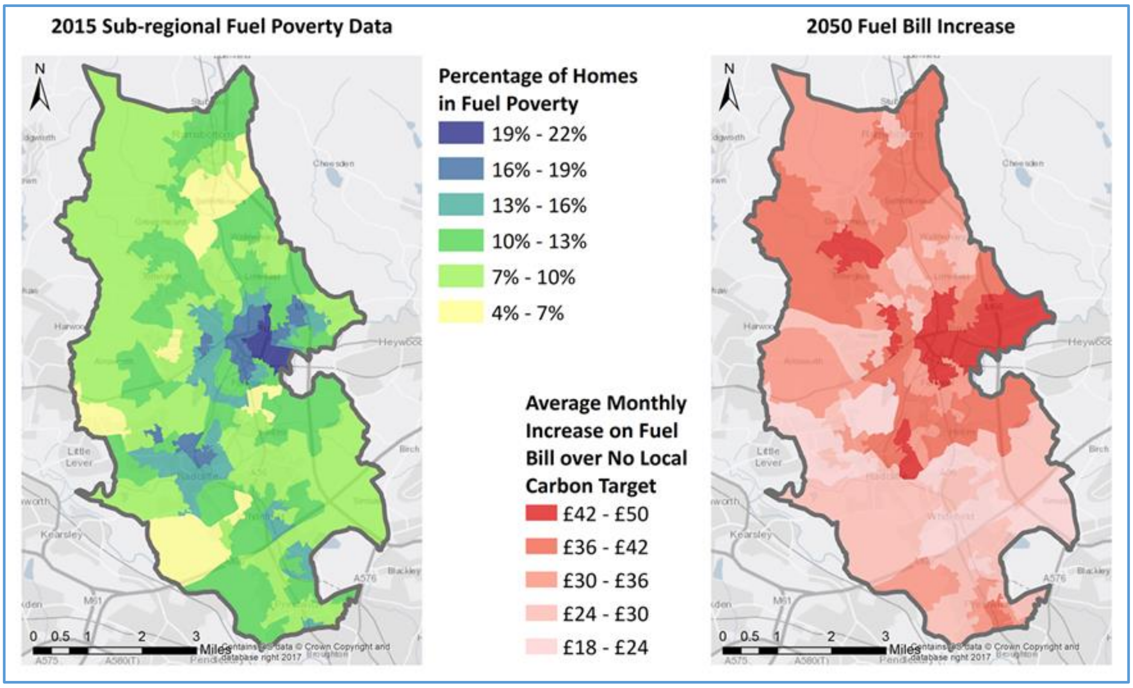
Figure 2.12: Fuel Bills – Summary of Cost over Heating System Life of Equipment for both the 2040 and 2050 Carbon Target Runs



Fuel Poverty/Impact on Fuel Bills

The low-carbon transition can lead to increased energy costs for some consumers: some of these may be vulnerable customers. It will be important to ensure that measures are put in place to protect fuel poor customers – this may require changes in policy (such as the introduction of targets on energy providers to reduce the carbon intensity of their supply portfolios (see Section 2.3). The change in fuel bills across the Bury area is shown below in Figure 2.13.

Figure 2.13: Changes in Fuel Bills across Bury as a result of the transition pathways to meet the 2040 and 2050 Carbon Target Runs



- Average annual fuel bill increase of c. £200/yr - £500/yr per home due to decarbonisation
- Action will be needed to reduce impact of increased energy costs in areas of deprivation.

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 transition pathways in the Local Carbon Target scenarios. On average, the cost of delivering the energy required to heat a home in 2050 under both the 2040 and 2050 Carbon Target scenarios could be approximately twice as expensive as the No Local Target equivalent scenario, equating to an increase of approximately £200-£500 per year 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 or construction necessary to accommodate this. The estimated costs do not include any tax or profit margins from the energy suppliers or any incentive payments that may be necessary to make this a viable solution for all homes.

2.2.6 Key Findings from a Whole System Approach to Local Area Energy Planning in Bury

Outputs from the EnergyPath Networks modelling offer potential to identify local energy systems projects that could help Bury 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. Local area energy planning will also help Bury Council prioritise local energy projects that are 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 modelling are discussed below.

Some types of interventions were present in all modelled scenarios:

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

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

- Energy efficiency.
- Electrification/heat pumps and hybrid heating systems.
- District heating.

Note: the modelling carried out does not include the possible future re-purposing of the gas network using hydrogen. The possible future plans for using hydrogen are not yet defined and insufficient data were available at the time of modelling to allow this scenario to be modelled effectively.

Energy Efficiency/Fabric Retrofit

Types and locations of buildings should be identified where there are opportunities for low-cost fabric retrofit such as loft and cavity wall insulation. There may be limited numbers of households where energy efficiency measures may be required or where these are cost-effective. Ideally, fabric retrofit should be linked to areas of fuel poverty, but many of these buildings may not be fuel poor households.

Electrification/Heat Pumps

As discussed above in Section 2.1.4, 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. An alternative to ongoing 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 would obviate the need for subsidies/capital payments.

District Heat Networks

Heat networks are supplied by energy centres, which to decarbonise will need to move away from gas-fired CHP, which is dominant initially, to lower-carbon energy sources. It may be possible to use some local resources such as waste heat from industrial facilities. Consumer engagement will be important: the barriers to the uptake of district heating, particularly in privately-owned homes, will need to be understood so that the potential of heat networks to supply existing homes can be realised. These barriers could include lack of access to funding, lack of standard contractual structures and issues such as business rates being charged to DH schemes. The modelled potential for district heating in Bury suggests moving a significant proposition of existing homes off gas and on to a heat network. **This will require a number of policy initiatives, considered in Section 2.3, and could be supported by new business models such as Heat as a Service (HaaS)**[29].

As with heat pumps and other forms of low-carbon heating, 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 GMCA and Bury Council support to enable enforcement.

[29] ETI Insights Report (2017): "Domestic Energy Services"

Summary of Key Findings from the Socio-economic Evaluation

- Some types of interventions were present in all scenarios:
    - Some level of fabric retrofit.
    - Domestic connection to heat networks.
    - Non-domestic connection to heat networks (not always traditional large loads).
    - Electric heat pump-based (both ASHP and GSHP) solutions.
    - Hybrid heat pumps in certain areas.
- On average, the LAES delivers net positive energy savings of c. 16TWh for the 2050 Carbon Target run and 25TWh for the 2040 Carbon Target run compared to the No Local Carbon Target run.
- Without a local carbon target, Bury's energy system is expected to cost **£7.1bn** between now and 2050. Aiming for the 2050 Carbon Target, the transition is expected to cost **£1.1bn** more, an increase of **16%.** The 2040 Carbon Target is modelled to cost a further **£1bn** more than the 2050 Carbon Target.
- This increased cost is offset by a direct benefit of c. £130 million from a reduction of c.5 million tonnes of CO_2 emissions saved as a result of the LAES for the 2050 Carbon Target run. The corresponding figures for the 2040 run are c. £212 million and 7.2 million tonnes.
- Other benefits include improvements in air quality of c. £9 million and £16 million for the 2050 and 2040 Carbon Target Runs respectively, and the creation of up to 490 FTE jobs to deliver the low carbon transition.
- 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 transition pathway towards the Local Carbon Target. On average, the cost of delivering the energy required to heat a home in 2050 as a result of the target will be approximately twice as expensive as the equivalent No Local Carbon Target scenario (equating to an increase of c. £200 - £500 (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 networked heat), and the additional network reinforcements or construction 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 include increases in household income through increased employment or higher benefits, and/or schemes

2.3 Possible Future Policies

There are multiple amended and new policy measures that could be introduced to address the barriers to take up already discussed in Section 2.1.4. These include:

- *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. This 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. This 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 optimal approach may be to introduce a mix of:

- *Mandating policies* such as amending planning regulation to allow only DH schemes in a designated DH Zone.
- *Enabling policies* such as standardised performance standards for DH schemes.
- *Incentivising policies* such as 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.

The majority of these policies would need to be developed and implemented at a UK Government level e.g. *Incentivising* policies such as the Renewable Heating Incentive and a re-designed Green Deal or mandating that consumers must connect to a district heating (DH) scheme in an area designated as a DH zone. However, the use of *Enabling* measures such as fast-track planning for DH schemes or incentivising these schemes by removing business rates could be applied locally.

These Enabling, Incentivising and Mandating policies are summarised in Figure 2.14.

Figure 2.14: Possible Future Policy Measures to Facilitate the Low Carbon Transition

	Legal	Commercial	Technological	Consumer	Comments
Mandating	Planning rules: DH schemes only in DH Zones Tougher Building (Energy) Standards	Exclusive Concessions given to DH Developers Introduce Carbon Tax or CIT	No more gas boilers/ heaters to be sold after 2030 New Technical Standards (for HPs etc)	Consumers must connect to DH scheme in a DH Zone	• UK Government could mandate that only DH schemes can get planning permission in identified DH Zones – this could be backed up by requiring consumers to connect to DH schemes and banning gas heating after 2030.
Enabling	Licensing Fast-track planning (e.g. LDOs) for DH Schemes	Re-designed Green Deal	Standardised performance standards for DH Schemes	Heat Trust Code	• Enabling measures include fast-track planning for DH schemes and introduction of a Heat Trust Code where suppliers provide agreed standards of service to consumers.
Incentivising	Stamp Duty Rebate (if EPC improved) Council Tax Rebate (if EPC improved)	Extend RHI Enhanced Capital Allowances for DH Remove Business Rates for DH	Carbon Price Support Exemptions		• An alternative to mandation is to incentivise low carbon solutions through financial incentives such as RHI, Stamp Duty and Council Tax reductions..

Key:
- Investors/ Developers
- Suppliers/ ESPs
- Equipment Provider
- Consumer

Source: Energy Systems Catapult

2.3.1 Policy Framework to Facilitate the Bury Local Area Energy Strategy

Three EPN scenarios have been carried out to model the most cost effective and low carbon future energy system for Bury. These are:

- The ***'No local carbon target'*** run – this represents no coordinated attempt by Bury to reduce carbon emissions – this run acts as a point of comparison.
- The ***'2050 carbon target'*** run aims to meet a 98% reduction of in-scope emissions from 1990 levels.
- The ***'2040 carbon target'*** run aims to reach the same 98% reduction in emissions by 2050, but in addition, the 2040 carbon target reduces carbon emissions more quickly, giving a reduction of **96% of in-scope carbon emissions by 2035**.

A comparison of the costs and benefits of the 2040 Carbon Target run versus the 2050 Carbon Target Run is shown below in Table 2.1.

Without a local carbon target, Bury's energy system is expected to cost **£7.11bn** between now and 2050. Aiming for the 2050 Carbon Target, the transition is expected to cost **£1.1bn** more, an increase of **16%.** The 2040 Carbon Target is modelled to cost a further **£1bn** more than the 2050 Carbon Target, an **86%** higher spend on carbon reduction, but over the study period this transition saves much more carbon (around 2.2 million tonnes).

Table 2.1 – Comparison of Costs and Benefits for the 2040 Carbon Target run versus 2050 Carbon Target run (figures relative to the No Local Carbon Target run) – from 2015-2050

	2040 Carbon Target	2050 Carbon Target
Carbon Emissions Reductions (mt CO2)	7.2	5.0
Carbon Savings Benefits (£m)	212	130
Net Energy Savings (TWh)	25	16
Net Air Quality Benefits (£m)	16	9
Net Health Benefits (£m)	2.4	1.1
Net Full-time Equivalent Jobs Created	490 (from 2035-2050) plus 330 from 2025-2034	430 (from 2035-2050)
Total Additional Cost (£bn)	2.1bn	1.1bn

In order to minimise carbon emissions in the 2040 Carbon Target run, half of the domestic buildings in Bury move away from gas heating by around 2035 to district heating, Air Source Heat Pumps (ASHPs) and Ground Source Heat Pumps (GSHPs). For the 2050 Carbon Target run, domestic buildings are modelled to be cost optimal to stay on gas until after around 2035). By 2050, the heating systems are virtually identical for the 2035 and 2050 carbon target runs.

The results from the EPN studies indicate that policy initiatives should be focused in three areas: **Energy Efficiency (to support the introduction of heat pumps); Electrification/Heat Pumps; District Heating**.

Different local and national policies may be required to facilitate each stage of the transition. For the 2050 Carbon Target run, policies to encourage more efficient gas heating and retrofit of energy efficient and low carbon interventions such as insulation and smart appliances may be useful up to around 2030. 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 new business models to encourage greater uptake of heat pumps and connection to district heat networks will need to be developed and implemented before 2035 to prepare for the transition. For the 2040 Carbon Target run, these policies and business models will need to be introduced by the mid-2020s.

One option towards decarbonisation is targeted retrofit. In general, designing retrofit policy around home improvement practices offers a more effective solution than pure energy efficiency schemes such as the Green Deal. Research by Wilson, Chryssochoidis, and Pettifor[30], showed that when renovating their properties, fewer than 10% of people are driven primarily by energy savings versus other considerations. Householders are far more likely to consider funding energy retrofit within their broader home improvement plans rather than as a standalone initiative.

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. These need to be aligned with improved energy efficiency and better heating controls. 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, heat exchange equipment, street furniture, informational signage and ancillary engineering works) could be supported in Bury.

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. An 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

[30] Wilson, C., Chryssochoidis, G., and Pettifor, H. (2013) Understanding Homeowners' Renovation Decisions: Findings of the VERD Project – this research showed that when renovating their properties, fewer than 10% of people are driven primarily by energy savings versus other considerations

providers to reduce the carbon intensity of their energy supply portfolio would obviate the need for subsidies/capital payments.

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)[31] as part of the Smart Systems and Heat programme has shown that, if households bought energy services, they would be indifferent to how the service was delivered as long as it 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).* A service model would enable EPs to deliver heat outcomes and be encouraged to improve efficiency in delivering them.

[31] Energy Technologies Institute: Smart Systems and Heat – Consumer Challenges for low carbon heat (May 2015)

2.4 Evaluation

An assessment of the type of policies that could support the Bury LAES is shown in Tables 2.2 and 2.3.

Table 2.2: 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 Renewables Obligation 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[32]. • LAs may not have the financial and/or human resources in current economic climate.

[32] 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. However, there are currently no plans to apply a carbon price (tax) to fuels used for heating.

Policy/Issue	Problem/Barrier	Possible Solutions	Comments
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.
Mandate connection to a DH network in identified DH zones	DH 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 through Local Area Energy Plans. 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 mandation 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 e.g. 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, possibly as part of a requirement on local authorities to produce a Local Area Energy Plan. • Support provision of standardised guidance and encouragement of information sharing between	• Local Development Orders (LDOs) have been used to grant planning permission for heat networks, including pipes, heat exchange equipment, street furniture,

Policy/Issue	Problem/Barrier	Possible Solutions	Comments
		local authorities on planning issues associated with DHN	signage and ancillary engineering works. An example of this is the London Borough of Newham[33]
Facilitate connection for DH schemes to the Electricity 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.

Table 2.3: 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 Renewable Obligation 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	• 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

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

Policy/Issue	Problem/Barrier	Possible Solutions	Comments
		scheme which allows investors to offset tax liability while earning interest or dividend on their loans.	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" 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 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.	• Possible issues around how savings would be calculated. 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 & Council Tax levels (to give the required amounts) and all homes would need a valid Energy Performance Certificate.

Policy/Issue	Problem/Barrier	Possible Solutions	Comments
Reduce the impact on vulnerable customers of any extra energy costs from the transition to low carbon heating	Analysis of the benefits of transition (Section 2.2) 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 as an increase in income through better employment or an increase in social security payments, and the ability to leverage funds from ECO.
Improve uptake of heat pumps	Heat pumps are 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. • Apply a carbon emissions standard on heating system replacement - this is a minimum standard on new heating systems based on CO2 performance. This would replace the current energy efficiency requirement on boilers. It could be targeted at specific properties.	• As uptake increases, the cost per heat pump should decrease, improving competitiveness with gas boilers. The introduction of a carbon price could improve this further, although a subsidy payment (a one-off, upfront payment may be more effective than a feed-in tariff) could still be required.

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 would be £67/tonne in 2020 rising to £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 Providers (EPs) – 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. It is reasonable to assume that if carbon reduction is to be achieved by applying a CIS, there would be additional costs, and these would have to be recovered somehow. Assuming that they would not be paid for through general taxation, then ultimately, they would have to be paid for by consumers in some way. The mechanism for recovery and the potential impact of these costs is being evaluated.

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 the service was delivered as long as it achieved the desired outcome. This creates a potential channel to market for low carbon energy systems without requiring 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. Data on home energy use and building/energy system performance would 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. 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 that 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, the KfW, has initiated a building renovation loan programme that has been a key consideration in stimulating private investment, delivering over €34 billion in 2013**. The scheme works by offering long term fixed-rate, low interest loans to support energy efficiency work during general refurbishment of existing buildings, and to encourage energy efficiency standards in new build that are higher than the legally required minimum. The loans are supported by subsidies linked to the achievement of higher energy efficiency levels, together with general promotional activity. The current schemes were launched in 2008, but these built on similar programmes that had operated since 1996. To date, over 3 million German homes have improved energy efficiency as a result of the scheme.

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 e.g. solid wall insulation, could 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 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 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 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.

2.5 Summary of Policy Evaluation and Recommendations

A number of policy initiatives can support the implementation of a local area energy plan in Bury, as can be seen from the socio-economic analysis in Section 2.2, the consideration of the policies that have been adopted successfully in other countries and also the policy options discussed in Tables 2.2 & 2.3. Many of these measures would have to be initiated and progressed by the UK Government. However, through working with the GMCA in a structured process of local area energy planning, bringing together network operators and local stakeholders, Bury Council can realise its low carbon objectives.

Bury Council, with support from the GMCA, could help to inform policy decisions, especially around planning rules.

There are 8 possible future policy measures that should be considered: these can be divided into 4 broad categories as follows:

Planning

1 **Bury Council should consider introducing fast-track planning approvals for district heat networks** – use Local Development Orders (LDOs) and Permitted Development Rights to facilitate the introduction of district heating network infrastructure. Bury Council should be able to do this under current legislation, but this would be facilitated if local area energy planning were introduced.

2 **Bury Council should consider supporting the amendment of existing planning legislation to require local authorities to develop an evidence base to inform the development of renewable and low carbon energy policies -** GMCA and Bury Council could support a requirement on local authorities to introduce local area energy planning as part of the National Planning and Policy Framework. Working with stakeholders, such as network companies, energy providers, community groups and others, this would identify measures that would support the low carbon transition in a local area. This would make it a legal requirement for local authorities to introduce a LAEP. This obligation should provide the impetus to deliver the low carbon transition that may not be there under more voluntary arrangements.

Subsidy/Financial Support:

3 **Bury Council should consider supporting 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 – see page 42). The EPC rating would need to be improved by a defined amount and the improvement verified by independent assessors. This would have to be introduced by the UK Government but could provide the impetus required for householders to improve the energy efficiency of their properties. This would be important to support the introduction of both ASHP and GSHP, as heat pumps work more efficiently in better insulated properties.

4 **Bury Council should consider supporting 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. Once again this would have to be introduced by central government.

5 **Bury Council should consider supporting 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. Although this scheme would have to be introduced by central government, local authorities could decide how the rebates were structured across the various Council Tax bands. Properties in lower tax bands could receive a proportionally higher rebate when their EPC ratings were improved – this could incentivise householders/landlords to make improvements to some of the least energy efficient properties.

6 **Bury Council should consider supporting an extension of the Warm Homes Discount –** level would be set to give required financial support for vulnerable customers to meet additional energy costs from switching to low carbon heating (c.£200-£500 p.a. for Bury residents).

7 **Bury Council should consider introducing a reduction/offset of high district heating development/operational costs** e.g. by removing the requirement for district heating schemes to pay business rates. This could be introduced by Bury Council under proposals for local authorities to keep business rate income: business rates could be structured to allow rebates for district heating schemes

Energy Regulation

8 **Bury Council should consider proposing/supporting the introduction of a regulatory regime for district heating** – this would allow competition in the supply of heat through heat networks and introduce consumer protection safeguards to ensure that consumers are not locked in to uncompetitive contracts with DH providers.

These measures can also be mapped to different housing categories such as the social housing sector or homeowners – this is shown below in Table 2.4.

Table 2.4: 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. **Introduce 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	• Bury Council may be able to use existing planning legislation to achieve this – if changes are required then the GMCA could support
2. **Support amendment of existing planning legislation to require local authorities to develop an evidence base to inform the 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 LAEPs can be onerous for LAs	• A co-ordinated approach should give the most optimal solution to decarbonisation of heat for LAs working with a number of stakeholders. e.g. through the introduction of a requirement to develop a local area energy plan (LAEP).
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 EPC at same time may be more attractive than a purely energy efficiency scheme.

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 – unless landlords pass it on. • Stamp duty rebate unlikely to be high enough to cover energy efficiency improvement cost.	• UK government 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?) • Many inefficient houses are probably already in 'no stamp duty' or lowest stamp duty tax band which would not help.
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.	• UK government would need to authorise changes but councils should be able to set council tax bands accordingly. • Benefit mainly to home-owners[34] and could mean some council tax payers

[34] 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
						• Rebate unlikely to be high enough to cover energy efficiency improvement cost.	pay more (including less wealthy?)
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 UK government policy of reducing/ removing subsidies.
7. **Introduce a reduction/offset of high district heating development/operational costs**	++	+	++	+	• Removing business 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.	• Bury Council may have some scope to vary business rates and/or 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. **Propose/support the Introduction of a regulatory regime for district heating**	++	+	++	++	• Could allow competition in supply of heat	• Could actually reduce DH scheme attractiveness if	• Implementing regulation that supports DH network development and

Measure	Social Housing	Rented	Homeowner: Low Income / Vulnerable	Homeowner: Able to Pay	Pros	Cons	Comments
					• Consumer protection safeguards to ensure consumers not locked in to uncompetitive DH contracts	regulation is too prescriptive.	operation could be difficult and should not be too prescriptive.

Key: **Some Impact** ✚ **Large Impact** ✚ ✚

3 Conclusions

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, the ESC and network operators working together to deliver these plans.
2. Without a local carbon target, Bury's energy system is expected to cost **£7.1bn** between now and 2050. Aiming for the 2050 Carbon Target, the transition is expected to cost **£1.1bn** more, an increase of **16%.** The 2040 Carbon Target is modelled to cost a further **£1bn** more than the 2050 Carbon Target.
3. This increased cost is offset by a direct benefit of c. £130 million from a reduction of c.5 million tonnes of CO_2 emissions saved as a result of the transformation pathway for the 2050 Carbon Target run. The corresponding figures for the 2040 run are c. £212 million and 7.2 million tonnes.
4. The transition pathways modelled deliver net positive energy savings of c. 16TWh for the 2050 Carbon Target run and 25TWh for the 2040 Carbon Target run compared to the No Carbon Target run.
5. Other benefits include improvements in air quality of c. £9 million and £16 million for the 2050 and 2040 Carbon Target Runs respectively, and the creation of up to 490 FTE jobs to deliver the low carbon transition.
6. The results from the modelling indicate that policy initiatives should be focused in three areas:
   - Energy Efficiency/retrofit – this would be required to support the introduction of low carbon heating options such as heat pumps.
   - Electrification/Heat Pumps.
   - District Heating.
7. **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. These need to be aligned with improved energy efficiency and better heating controls. Without these factors, levels of uptake of heat pumps are likely to be low.
8. 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). But issues remain about how a carbon price should be applied to gas used for heating and the effect on those in fuel poverty.
9. Policies that provide a one-off, lump-sum cash payment (Stamp Duty or Council Tax rebate) could be more effective at incentivising take-up of energy efficient interventions than feed-in-type policies such as the RHI and electricity FiTs.
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 improvements which could include energy efficiency measures.
12. A number of low-regret 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.
13. 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) in Bury should be supported.

4 Glossary

4.1 Definitions

Item	Definition
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 CO2 from the EU Emissions Trading System (EU ETS) plus the Carbon Price Support (CPS) rate per tonne of CO2
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 CO2 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 (DH)	A system for distributing heat generated in a centralised location for residential and commercial heating requirements such as space heating and water heating.
Energy Provider (EP)	An organisation that supplies energy and/or related services to customers. These could include existing market participants, such as energy suppliers, or new entrants offering innovate business models.
Fuel poverty	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)[35]; and

[35] 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.
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.
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
DH	District Heat
ECO	Energy Companies Obligation
EPN	EnergyPath™ Networks
ESME	Energy Systems Modelling Environment
E(S)P	Energy (Services) Provider
EU ETS	European Union Emissions Trading Scheme
FiT	Feed in Tariff
GMCA	Greater Manchester Combined Authority
GSHP	Ground Source Heat Pump
LA	Local Authority
LAEP	Local Area Energy Planning
LAES	Local Area Energy Strategy
LDO	Local Development Order
QALY	Quality Adjusted Life Years
RHI	Renewable Heat Incentive
RO	Renewables Obligation

5 Appendix

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

5.1.1 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[36] future costs and benefits are discounted to present day values. In accordance with Green Book supplementary guidance[37] 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.

5.1.2 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 to monetise any energy savings for the cost-benefit analysis. As the modelling 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 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:

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

- UK market price of energy[38]
- 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[38], 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. Apportionment is based 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 builds a heat network it must build it for the entire analysis area in one time-period[39], even if connections are spread out across further time periods. 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 spreading of the network which would actually occur.

5.1.3 Direct Benefits

The key 'direct' benefits that arise from the modelled transformation pathways 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 and non-domestic heating and subsequent network level interventions to meet the designated carbon target, with 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**.

In this way, the methodology considers any fuel imported into the area (gas, electricity, oil, biomass, coal) which is used for heating, either directly in 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

[38] 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 http://www.eti.co.uk/modelling-low-carbon-energy-system-designs-with-the-eti-esme-model/

[39] EPN presents its outputs in four different 'time periods' between now and 2050. Rather than assigning a specific year for interventions they are 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).

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. 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 tonnes of carbon dioxide (tCO2) emitted using the fuel emission contents from EPN. These emission contents are taken from ESME and change over time to reflect changes to the national energy situation. The values can then be presented either in tCO2 saved or monetised for cost-benefit analysis using a discounted carbon price.

Carbon prices are from the latest IAG guidance[40] and either "traded" for electricity to reflect the presence of a carbon market in the form of the EU Emissions Trading Scheme or valued using a "non-traded" price for all other fuels. The carbon price is discounted using a 3.5% discount rate.

3. Air Quality Improvement

Air quality improvement benefits also 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[41] - these are used to quantify the air quality improvements associated with the energy savings made under the modelled transformation pathways. 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.

5.1.4 Wider Benefits

Wider benefits are those that are evaluated separately from the calculated direct benefits**.** These are described below.

1. Employment Impacts

The estimated impact of the modelled transformation pathways 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

40 https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal.
41 Domestic air quality damage costs are given for the following location types: inner conurbation, urban big, urban medium, urban small and rural.

the employment impact of expenditure on domestic energy renovations[42], 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. The money spent is again taken relative to the reference case but **does not include** the following:

- Any cost of capital associated with the modelled transformation pathway
- 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[43].

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).

2. Health Benefits

The modelled transition pathways will lead to a number of improvements to the housing stock within Bury, 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 Bury – this can be quantified using domestic energy savings as a result of retrofit or heating system interventions[44].

Energy savings are converted to Quality Adjusted Life Years (QALYs), as recommended in the 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 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

42 The following two studies provide summary statistics of the findings of a range of studies: http://www.ukace.org/wp-content/uploads/2012/11/ACE-Research-2000-09-Energy-Efficiency-and-Jobs-UK-Issuesand-Case-Studies-Case-Studies.pdf
http://www.neujobs.eu/sites/default/files/publication/2013/01/Energy%20renovation-D14-2%2019th%20December%202012_.pdf

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

44 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.

benefits for the target runs are then subtracted from the reference case to give a monetised health benefit from domestic improvements as a result of the modelled transition pathways.

5.1.5 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 evaluated by this methodology. These are any incentive payments and balance of payment impacts.

EPN, and thus the draft 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.

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.

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Revision History

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10 April 2018	V0.1	First draft for review
16 April 2018	V0.2	Second draft including amendments in response to first review
23 April 2018	V0.3	Moved to ETI document template
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