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UNCOMFORTABLE HOME TRUTHS:

WHY BRITAIN URGENTLY NEEDS A LOW CARBON HEAT STRATEGY

Future Gas Series: Part 3

October 2019

This report follows a year-long inquiry and was written by Joanna Furtado, Sustainability Research and Policy Manager at Policy Connect.

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> **Switching homes over to low carbon heating is an essential part of reaching net zero emissions in the UK. This report sets out the key actions and recommendations for policy-makers working in this area.**

Dr Alan Whitehead MP
and Alan Brown MP
Inquiry Co-Chairs October 2019

Foreword

In June 2019 the UK announced it would be legislating for a net zero carbon emissions target that will mean the UK will end its domestic contribution to climate change from 2050. This will profoundly impact almost all aspects of society, including the way we heat our homes.

Currently most UK homes use natural gas for heat. In a net zero world, all these households must use alternative, lower carbon sources of heat. Unless radical changes in housing, energy and climate policy are prioritised, the UK will miss its 2050 net zero climate target. Momentum from next year's UN climate change summit, COP26, that will take place in Glasgow, could provide an important catalyst for these transformations.

Switching to low carbon heat represents important technical and infrastructural challenges but also opportunities, as was covered in detail in Part 1 and Part 2 of the Future Gas Series. However, decarbonising heat will also have major social implications, requiring change in almost every home in the country. This final inquiry in the Future Gas Series puts consumers at the heart of a revolution in green heat.

We cannot expect to achieve such a transition without bringing people along with us. Polling has shown that households are open to cleaner, greener ways to heat their homes in the future, but they are still in the dark about the potential of smarter, greener heating solutions and do not access the independent advice that can help them make better decisions for their homes and the planet. There are many potential benefits from low carbon heating - implementing a green heat plan can improve air quality in cities, boost green jobs, help consumers stay warm and slash their energy bills. But these benefits can only be unlocked if the costs of a transition to low carbon heat are shared fairly across society; the public are engaged with why such a transition is taking place; and households have strong protections during the switchover.

We were delighted to have co-chaired Part 3 of Carbon Connect's Future Gas Series, which brought together experts to discuss the challenges and opportunities for households of decarbonising our home heating systems. This inquiry represents the culmination of three years of research underpinning the Future Gas Series, drawing evidence from over 100 different organisations through nearly 20 events in parliament and 70 interviews with experts. We would like to thank everyone who gave their time and expertise, and in particular the steering group for their valuable contributions. We would especially like to thank the three report sponsors, Baxi, IGEM and the Energy and Utilities Alliance for generously sponsoring this inquiry.

In July 2019 our colleague and fellow co-Chair for this inquiry, James Heappey MP, joined the government as the Prime Minister's Parliamentary Private Secretary. As our report makes clear recommendations to government on its energy policy, James' new position prevents him from joining us as report signatories. We would like to thank James for his commitment to this and previous Carbon Connect reports.

Alan Brown MP
Inquiry Co-Chair

Dr Alan Whitehead MP
Inquiry Co-Chair

Executive Summary

Low carbon heat in homes

Decarbonisation of heat is essential to reaching net zero emissions and ending the UK's domestic contribution to climate change, and also provides other environmental and health benefits. Domestic heat accounts for 13% of the UK's annual emissions footprint, comparable to the contribution of all the petrol and diesel cars on the road in the UK. The scale of the decarbonisation of heat should not be underestimated: only 4.5% of the UK's total heat demand in buildings is currently met by low carbon sources. Most homes (84%) are connected to the gas grid and heated primarily by natural gas boilers.

Key policy challenges in decarbonising heat

What are the timelines for heat decarbonisation?

To meet our target of net zero emissions by 2050, low carbon heating must reach mass roll-out in the 2030s. Given the long lead-in times of new infrastructure and technology deployment, decisions have to be made about the future direction of heat by the mid-2020s, with low regrets options and at-scale demonstrator projects rolled out even sooner. This means the next five years are critical both for early deployment of low carbon heat and energy efficiency in key sectors like new build homes, and for building an evidence base for technologies, governance, regulatory structures and incentive design that will enable long-term decision-making and at-scale delivery of low carbon heat from 2025.

Who will lead on coordination and deployment of low carbon heat?

A transition to low carbon heat requires highly coordinated planning and delivery across national, regional and local levels, with policies at each level developed and implemented in the right order and at the right time. At the national level, decisions on energy policy will influence how different low carbon heating options develop - but there is currently no clear long-term heat policy. At the regional level, energy planning is required to identify the mixture of low carbon heating options best suited to each area - but currently energy and heat planning by Local Authorities is undertaken inconsistently across the UK, constrained by a lack of resource and prioritisation.

At a local level, most existing homes will need to have low carbon heating retrofitted. Planning the deployment of low carbon heat in each home has to be coordinated with larger energy infrastructure decisions, including those regarding the future of the gas grid.

How can the deployment of low carbon heating technologies be scaled up?

Currently, deployment of low carbon heat in the UK is very low, and most of the technologies already deployed are not those most likely to be used for long term, widespread decarbonisation, such as biomass boilers. Instead, those options that are considered to have most potential for large-scale decarbonisation of heat, including electric heat pumps, hydrogen boilers, gas hybrid heating systems and district heat networks, are not yet deployed widely, even in new build.

How can the public be engaged with low carbon heat challenge?

Given that the transition to low carbon heat at scale will require change both to people's homes and to their communities, it requires at the very least awareness and acceptance from the public, and ideally involvement and support. However, evidence suggests that the public does not consider heat a priority area in tackling climate change; has not been well informed about alternative low carbon heating technologies; and is not aware of the practical implications of a transition to low carbon heat to their homes and local areas, even if they are generally supportive

of it in principle. For example, polling commissioned for this report showed that only 14% of the public placed decarbonising heating as a top priority for government in tackling climate change, below other areas like greener transport, renewable electricity and reducing waste. Similarly, just 5% of MPs polled placed natural gas boilers in their top three sources of emissions to tackle. Increasing engagement and awareness needs to be a core part of a policy framework for a transition to low carbon heat.

Heat is also an area of climate change policy which may require contentious decisions that involve changes to people's homes. There is not currently a strategy for understanding and integrating public attitudes into policy around low carbon heat to ensure these decisions have public consent.

What rights and protections will households have in a transition to low carbon heat?

In general policymakers should aim to encourage low carbon heating solutions that are attractive and that allow maximum choice for households. However, government will probably have to be closely involved with how heat is decarbonised across the UK. This includes through setting regulations and policy support, but may also include zoning certain technologies in certain areas. There is understandable political unease around forcing a household to change their heating, especially if it involves up-front expense and disruption. There needs to be a balance between offering attractive choices to households -including over cost, disruption and aesthetics- but still allowing government to lead a transition that is efficient and fast enough to meet our climate obligations.

Furthermore, low carbon heat creates new challenges for consumer protections. Poor experiences of low carbon heat - such as poorly installed technology - will create negative publicity and damage public trust, as has been demonstrated in some instances even within the small-scale deployment of low carbon heat so far. It is essential that poor experiences are minimised as the UK moves to larger pilots and a widespread roll-out of low carbon heat. There needs to be new protections for those who are on networks that only have a single supplier, as with current district heat networks, and also consumer protections on installation standards for all the different types of low carbon heating systems that will be installed over the course of the transition.

How will low carbon heat be paid for?

Almost all low carbon heating systems are expected to be more expensive on a whole-system basis than current natural gas heating provided through the grid. The Committee on Climate Change (CCC) estimates the low carbon heat and energy efficiency upgrades needed to cut emissions in the housing sector to 4Mt per year will require an additional £15bn annually on top of current system costs by 2050. This would cut energy demand by 25%, connect 5 million homes to district heat networks, and deploy as many as 19 million heat pumps or 16 million hydrogen boilers, amongst other measures.

The CCC does not recommend passing this cost fully onto households through bills. Energy costs are already a contentious political issue, and higher energy prices are challenging not only for those already in fuel poverty – 2.5 million people in England alone – but also for those who are at risk of fuel poverty. A mismanaged transition to low carbon heat could create as many as 2.6 million additional fuel poor households across Great Britain, if policies are not implemented in a way that protects those who are vulnerable. The public will also only be willing to contribute to the costs of decarbonisation if they perceive that costs are being shared fairly. However, what this might look like from a policy perspective – including what the balance should be between socialisation and individualisation of costs, how costs can be fairly shared between regions and how incentive schemes for low carbon heat should be designed – still needs detailed consideration.

Key messages for policy-makers in decarbonising heat

The next five years are critical in deciding the future of heat in the UK but innovation is already helping to build momentum

To meet even our previous target of an 80% reduction in emissions by 2050 - let alone our new net zero target - it is estimated that existing homes will need to switch to low carbon heating at a rate of 20,000 every week between 2025 and 2050. There is urgent need for action in the 2020s to kick-start the deployment of low carbon heat and energy efficiency at-scale. The next five years are critical for heat decarbonisation.

There is already a lot of valuable evidence to build on. Wales and Scotland are developing their own ambitious heat and energy efficiency plans. There are also on-going and planned trials of low carbon heat around the UK, and pilots of new service models that could make low carbon heat more attractive to households. The UK has also already successfully managed one planned change-over of its heating fuel, during the switchover from town gas to natural gas in the 70s and more recently in areas like the Isle of Man, although this did not involve extensive appliance switchover in the same way that a transition to low carbon heat will likely require.

Furthermore, government targets already exist that will enable longer-term decision-making on heat. The Future Homes Standard announced in the Spring Statement this year should mean that by 2025 all new homes will have low carbon heating; and the Clean Growth Strategy stated the government's aim to phase out high carbon heating in off-gas grid homes in the 2020s. Although these are relatively small numbers of homes overall, they provide good initial opportunities to build up qualified installers for low carbon heating options, encourage visibility and trust in low carbon heat and provide an evidence base for how well these technologies work in off-gas grid and new build homes. This can help to begin to drive change in the more difficult to target, on-gas grid owner-occupier homes. Upcoming consultations on new regulations for private and social landlords also provide an opportunity to encourage changes in the heating and energy efficiency of these housing sectors, whilst supporting the government's work on the Homes Fit for Human Habitation Act. Central and local government's procurement powers will also drive uptake of low carbon heat in public buildings and housing.

The most important immediate step for government is setting out a strategy for the decarbonisation of heat in their 2020 Low Carbon Heat Roadmap. This should include a long-term target and trajectory for reaching net zero emissions in the UK housing sector and strategies for immediate deployment of 'low regrets' options, including for decarbonisation of heat in new build and off-gas grid properties, a nationwide energy efficiency upgrade programme and the roll-out of district heat networks, heat pumps and smart hybrid heat pumps in appropriate buildings. It should also support further at-scale pilots of low carbon heating in the near-term to continue to build an evidence base for how the UK ought to completely decarbonise heat. Finally, the Heat Roadmap should commit to publishing a strategy before 2025 for achieving total heat decarbonisation in buildings in the UK, that includes a target for phasing out installation of carbon emitting boilers that cannot be adapted for low carbon fuels, and a decision on whether 'hydrogen-ready' boilers should be mandated in place of conventional boilers in certain areas.

Households need to be engaged, supported and protected during a transition to low carbon heat

The transition to low carbon heat requires changes to the vast majority of homes in the country, and therefore must be supported by strong public engagement and high-quality protections, standards and advice services.

The first step to ensuring public consent for the transition to low carbon heat is making the public aware of it and the reason it is required, and making a case for how low carbon heat can have wider societal benefits. There must be an extensive awareness raising strategy during the early 2020s, capitalising on momentum built up around the recent net zero legislation and the forthcoming COP26, that is complemented by regional awareness campaigns timed to precede a region's switchover to low carbon heat. Awareness can be raised through conventional public information campaigns such as those used in the analogue to digital television switchover, but policy signals like dates for phasing out high carbon heating systems, high profile pilots of low carbon heat and targeted incentives are also opportunities to raise the profile of this issue. Aside from government, there are important roles for media, politicians, NGOs, businesses and community groups to increase awareness.

Understanding and responding to public attitudes will also be important in helping policymakers design low carbon heat policy that has broad public acceptability and support. Evidence given to this inquiry suggests that minimising cost and disruption to households will be important in ensuring the social acceptability of decarbonising heat. However, there also needs to be a better strategy for mapping and monitoring public preferences, and then integrating them into government policy on heat on an ongoing basis. The Department for Business, Energy and Industrial Strategy (BEIS) could consider using processes like citizens' panels to help to shape national and regional heat planning. This type of engagement has also been important in other areas in supporting people to understand the trade-offs required by certain societal changes, and in helping policy-makers design better policy to support those changes.

As well as engagement and awareness, households need to be supported during the transition. Government must be confident that consumer protections are adequate for the large numbers of households who will be transitioning to new heating systems; that they cover all low carbon heating options; and that they protect different households in different regions, particularly to avoid one region having a low carbon heat switchover that is comparatively more expensive or disruptive than in other areas. Standards and certification systems for retrofit of low carbon heating also need to be strengthened, aligned and widened to cover all low carbon heat systems. There may need to be greater resource for those who deliver, monitor and enforce protections.

Finally, there needs to be a revolution in the availability and visibility of energy advice services across the UK. Local advice centres that offer home visits to impartially assess the potential for low carbon heating and energy efficiency will be of particular importance in helping households evaluate their options and access advice. Energy advice services in Scotland provide a good basis for the rest of the UK to follow. However, those who are disengaged and less likely to access advice services will still rely strongly on heating engineers. This means it is also very important that heating engineers are highly trained to be able to provide good advice to households on options for low carbon heat, and to fit them to a high standard. Developing regionally specific upskilling for heating engineers should therefore be an urgent priority for BEIS.

A central delivery body can coordinate and manage a transition to low carbon heat and enable regional leadership

Regional heat planning could prove a powerful way to drive change across the UK energy system, allowing for area-specific pathways that are developed and delivered by the people who live there. However, it will require support, oversight and coordination from central government, including on decisions about national energy infrastructure, pricing, taxation, regulation and engagement.

We propose that this coordination should be delivered by a new Central Delivery Authority, similar to the previous Olympic Delivery Authority or the body proposed to deliver energy efficiency as an infrastructure priority in Scotland. The Central Delivery Body can coordinate the development and delivery of low carbon heat in different regions and areas, including sharing learning between regions, coordinating pilots and developing upskilling programmes for gas engineers. It can also provide a central point for expertise, data and information for low carbon heat planning and whole-house energy efficiency retrofit; monitor and evaluate the delivery and impact of regulation and policies that sit across departments, like Energy Performance Certificates and building regulations; and coordinate and link together awareness raising and engagement programmes.

Key recommendations for government

1. Urgent at-scale action taken from now, with a full decarbonisation strategy in delivery by 2025

a) BEIS should publish its Low Carbon Heat Roadmap early in 2020 that includes:
   - ✓ An action plan for the immediate deployment of at-scale low regrets low carbon heat retrofit around the UK, including a national energy efficiency retrofit programme and a mandatory target for energy efficiency of new homes.
   - ✓ Funding for pilots of low carbon heat in homes around the UK.
   - ✓ A timeline for delivery before 2025 of a strategy for complete heat decarbonisation.
   - ✓ A long term target for reaching net zero emissions in the building sector.

2. Households must feel properly informed, advised and engaged

a) BEIS should pursue the immediate build-up of trusted, publicly funded advice services with regional centres across the UK that give impartial advice to households on their heating options, similar to those currently operating in Scotland.

b) Regional collaborative bodies like the Local Skills Advisory Panels in England or Regional Skills Assessments in Scotland should be involved in developing upskilling programmes for gas engineers to ensure there are fully informed and qualified low carbon heating installers that households can trust.

c) Government should lead a public engagement programme on low carbon heat, including:
   - ✓ A nationwide information campaign.
   - ✓ Regional awareness strategies and local community-led schemes, potentially including community-owned heat, roadshows or showrooms.
   - ✓ Citizens' juries type arrangements to shape heat strategies at a national or regional level.
   - ✓ Processes to map, monitor and incorporate public engagement initiatives with low carbon heat into policymaking on an on-going basis.

3. Low carbon heat must become attractive and visible to households

a) BEIS should run an innovation competition for low carbon heat to reduce barriers for existing and new entrants to the market and make low carbon heat more attractive or visible to households, for example through 'heat as a service'.

b) BEIS should incentivise at-scale early uptake of low carbon heating, with a new scheme in place by 2021 when the Renewable Heat Incentive comes to an end. This could include consumer support such as grants and VAT incentives, and industry-wide measures such as a low carbon gas obligation.

4. There must be strategic governance and financial structures to drive long-term action

a) Government should establish a new Central Delivery Authority in England to coordinate regional leadership on low carbon heat delivery. Devolved nations should continue their work in delivering low carbon heat in Wales and Scotland.

b) BEIS should review the necessary statutory powers, technical capacities, data access and resources required for strategic planning for low carbon heat and energy efficiency, to decide the role that Local Authorities should play in decarbonising heat.

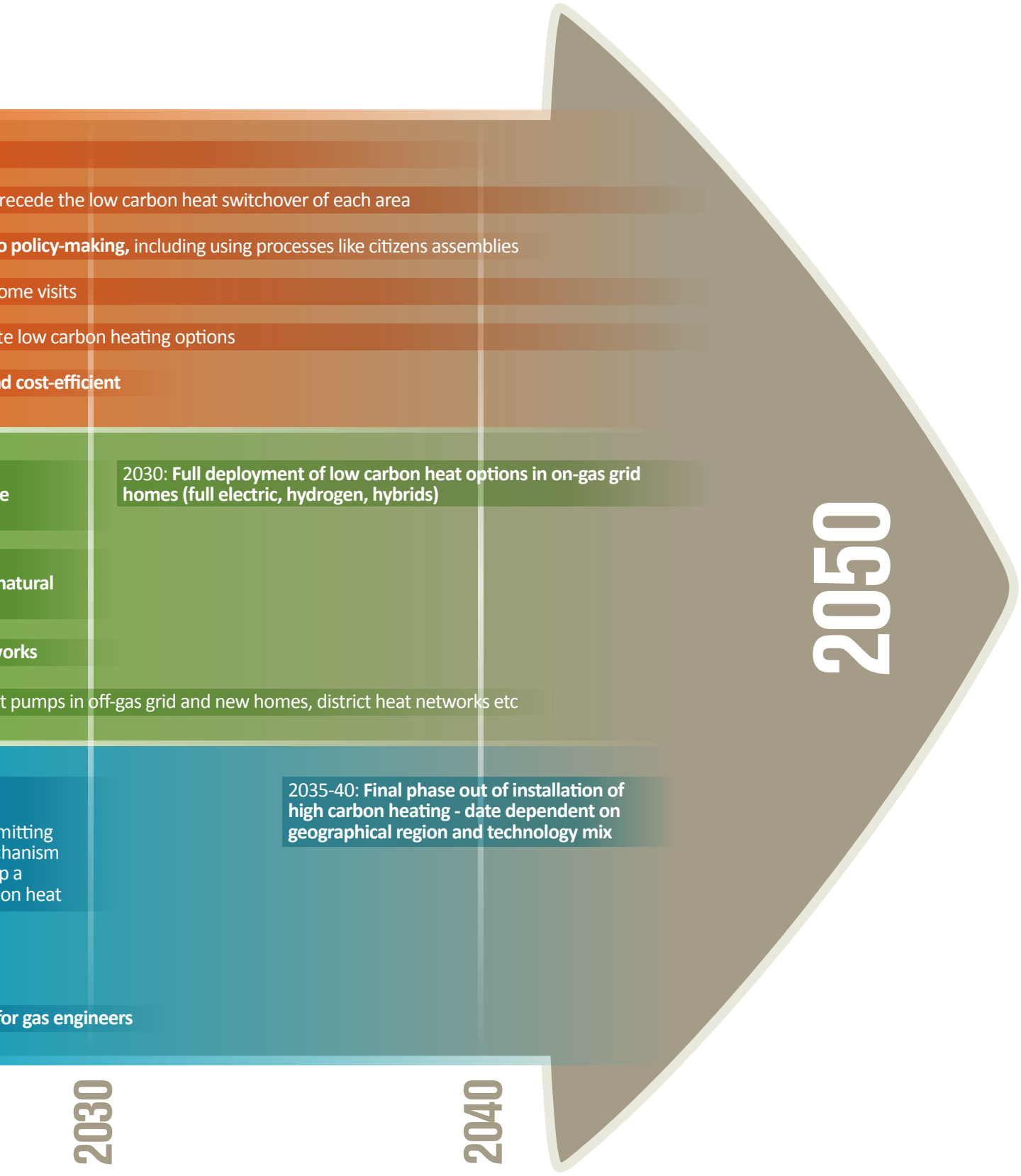
c) The upcoming Treasury review of the costs of decarbonisation should consider major market interventions to drive a transition, such as a gradually strengthening carbon obligation on the energy sector. It should also explore how government can ensure costs for decarbonisation are shared equitably across the UK.

5. Consumer protections must deliver for all, especially low income households

a) BEIS's review of the energy retail market should ensure that consumer protections are sufficient for the scale of heat transition required and will be properly enforced.

b) Fuel poverty must be properly addressed as part of the transition to low carbon heat. If the Just Transition Commission for Scotland were replicated on a UK-wide basis, heat should be considered as a priority area within its remit.

Action plan for reaching net zero in buildings


recede the low carbon heat switchover of each area
o policy-making, including using processes like citizens assemblies
ome visits
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d cost-efficient
2030: Full deployment of low carbon heat options in on-gas grid homes (full electric, hydrogen, hybrids)
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2035-40: Final phase out of installation of high carbon heating - date dependent on geographical region and technology mix
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INTRODUCTION

Overview – gas and domestic heat

Heat currently represents around one third of the UK's total greenhouse gas emissions, with 45% of the UK's energy consumption used for heating buildings. Much of this comes from natural gas. Decarbonising gas is therefore likely to play an important part in decarbonising heat.

Overall, to meet our legally binding climate change targets to reduce emissions to net zero by 2050, serious work needs to be undertaken to decarbonise heat. The Committee on Climate Change's report on reaching net zero emissions by 2050 identifies decarbonising UK heating systems as one of the key areas to tackle[1]. The government's 2018 report *Clean Growth – Transforming Heating* also acknowledges the importance of tackling emissions from heat, and sets out its aim to achieve "substantial growth in no or low-regrets low carbon heating in the shorter term" and "a new long-term policy framework for heat".

> **...the way heating is supplied to nearly 24 million homes, business and industrial users connected to the gas grid will need to change [in the UK].** (BEIS, 2018)

The scale of the challenge should not be underestimated. Domestic consumers are responsible for some 60% of final energy consumption for heat, predominantly to warm homes, but also for hot water and cooking. Currently around 84% of UK households use natural gas for heating. The remaining 16% of households – around 3.5 million – are not connected to the gas grid and use other energy sources to provide heat and hot water. The Committee on Climate Change's scenario for reaching net zero emissions by 2050 sees the percentage of low carbon heat in existing homes increasing from 4.5% in 2017 to at least 90% by 2050[2]. Even to meet the UK's former climate change target of an 80% reduction by 2050, let alone the new net zero target, 20,000 households would need to switch from the gas grid to low carbon heating every week between 2025 and 2050[3].

> **...Over ten years after the Climate Change Act was passed, there is still no serious plan for decarbonising UK heating systems and no large-scale trials have begun for either heat pumps or hydrogen.** (CCC, 2019)

Not only will this be logistically difficult, it also presents issues concerning engagement and awareness of households and the public acceptability of a large-scale transition to low carbon heat. Questions around safety, disruption and the costs of low carbon heat are critical to successfully decarbonising heat. The awareness of low carbon heating technologies is an additional consideration, particularly when a significant number of heating systems are currently bought when a household's current heating system has broken and there is little incentive or time to weigh up replacement options beyond a simple like-for-like replacement.

[1]Committee on Climate Change (2019) Net Zero: The UK's contribution to stopping global warming

[2]Committee on Climate Change (2019) Net Zero: The UK's contribution to stopping global warming

[3]Energy Technologies Institute (2015) Smart Systems and Heat: Decarbonising Heat for UK Homes

The Future Gas Series

The first two reports in the Future Gas Series examined the technical and infrastructure challenges associated with the decarbonisation of the gas grid. This third and final part in the Future Gas Series investigates downstream issues relating to the role of the household in decarbonising heat in the UK. In addition to examining the economic, regulatory and technical implications of delivering such a large-scale transition, this inquiry explores public attitudes towards heat, the acceptability of different decarbonisation methods, how open households might be to accepting changes to their homes, issues of financial equity, and the rights and protections that households might expect from a transition to low carbon heat.

Many of these downstream issues are the same across different types of low carbon heating. It is also widely expected that a mixture of different heating systems - including heat pumps, smart hybrid heat pumps, hydrogen, biogases and district heat networks - will be the best way to decarbonise heating in the UK, rather than one nationwide solution. Given this, this final report in the Future Gas Series has a wider focus on the downstream opportunities and challenges in a transition to low carbon heat, rather than solely issues related to low carbon gas, although we do focus on low carbon gas where appropriate.

Box 1: Energy Efficiency*

Energy efficiency is an extremely important part of a transition to low carbon heat. Energy efficiency is crucial to reducing demand for energy from households, as well as improving thermal comfort and balancing out the cost of climate policies levied on energy bills.

This report initially aimed to focus on the implications of a transition to low carbon heat in isolation, but clearly it makes sense for energy efficiency to be deployed at the same time as low carbon heat installation, when work is already being undertaken in homes. There have been many reports looking at the challenges, opportunities and implications to householders of an increase in deployment of energy efficiency installation. Therefore, for ease of focus, we assume that energy efficiency will be deployed at the rate suggested by the Committee on Climate Change in their 'Further Ambition' scenario, which is likely to be required to meet our 2050 net zero target. In this scenario, there is a 25% reduction in energy demand as a result of fabric efficiency measures. This includes around 6 million cavity walls and 6 million solid walls insulated, and increased rates of loft insulation. Energy efficiency upgrades are therefore implicit in any discussions of heating upgrades.

**See: Committee on Climate Change (2019) Net Zero Technical Report*

Box 2: Terminology

When discussing policies and their impact upon people, it is important to be clear who is affected. Members of the public are sometimes referred to as '**consumers**', or '**customers**'. The definition of a 'consumer' is a person who purchases goods and services for personal use – so in the context of this report would be the person buying energy for heating and cooking. Therefore, whilst 'the consumer' can be a convenient generalisation, it clearly does not include all members of the public who might for various reasons not be in a position to be active consumers, but who will be subject to the outcome of someone else's decision (e.g. a landlord's).

The term '**householder**' is also sometimes used, referring to the occupants of the property. This can be helpful in delineating who will be affected by policy delivery, but is a much more passive term and can imply the lack of active engagement with heat and energy. It also excludes landlords, who may be the ones with decision-making powers over energy use in their properties, and not the tenants.

'**Publics**' (as opposed to 'the public') is used to refer to groups or communities of individuals, the totality of said groups being 'the public'; 'publics' can be differentiated according to interests and concerns related to low carbon heat whereas 'the public' is a far more generalised and non-specific 'catch-all'. '**Citizens**' relates to rights and responsibilities of individuals which suggests more active and fuller roles, including in politics, compared to the above categories. This is an important group when considering disruption to communities from infrastructure upgrades etc.

Low-carbon vs renewable heat

There is a distinction between 'renewable' and 'low carbon' heat. For example, the extent to which hydrogen can be considered a low carbon fuel depends on its production method. If it is produced using a natural gas feedstock (Steam Methane Reforming) then it is not renewable, but may be low carbon if production is combined with Carbon Capture and Storage. Conversely, if produced using electrolysis of water, then it may be renewable depending on the source of the electricity used – but only if renewable electricity is used to drive the electrolysis process will the hydrogen generated be both renewable and low carbon. This was discussed in detail in our previous report in the series *'Producing Low Carbon Gas'*.

Fuel poverty

The term 'fuel poor' is very specifically defined - a household in England can be described as being in fuel poverty if their income is below the poverty line (taking into account energy costs) and their energy costs are higher than is typical for their household type. Current government estimates suggest that 2.55 million households in England are affected by fuel poverty, although BEIS are consulting on a change to the methodology to take account of home energy efficiency; this would increase the number to 3.66 million.

The Devolved Administrations have adopted their own targets and measures for fuel poverty. In Wales and Northern Ireland a household is deemed to be in fuel poverty if it needs to spend more than 10% of its income on energy in order to maintain a satisfactory heating regime (21°C in the living room, 18°C in all other occupied rooms); extreme fuel poverty is used to describe those spending more than 20% of income to achieve this. Scotland has recently revised its definition for fuel poverty, to cover a household needing to spend more than 10% of their adjusted net ('after housing costs') income on energy, and where after deducting fuel costs and any childcare costs the remaining income is insufficient to maintain an acceptable standard of living. The 'acceptable standard' is based on a Minimum Income Standard.

Regional and local

This report sometimes mentions regional and local leadership in heat planning. In this case regional applies to the larger geographical regions represented by Combined Authorities and Local Enterprise Partnerships in England and Strategic Development Planning Authorities in Scotland. Local refers to smaller areas, including those represented by Local and City Authorities.

PART ONE

HEAT IN THE UK: SETTING OUT THE CURRENT CONSUMER ENVIRONMENT

1. Domestic heat in the UK today

1.1: Domestic heat in the UK

84% of all homes in Great Britain use mains gas as their main heating fuel (over 22 million). In comparison, 8.6% of homes are heated by electricity, 4.1% by heating oil, 0.8% by solid fuel, and 0.7% by LPG. In total, around 3.7 million homes in Britain use non-mains gas fuels for their primary heating[4]. The UK is relatively unusual in Europe for being having such a high penetration of natural gas for heating, beaten only by the Netherlands[5].

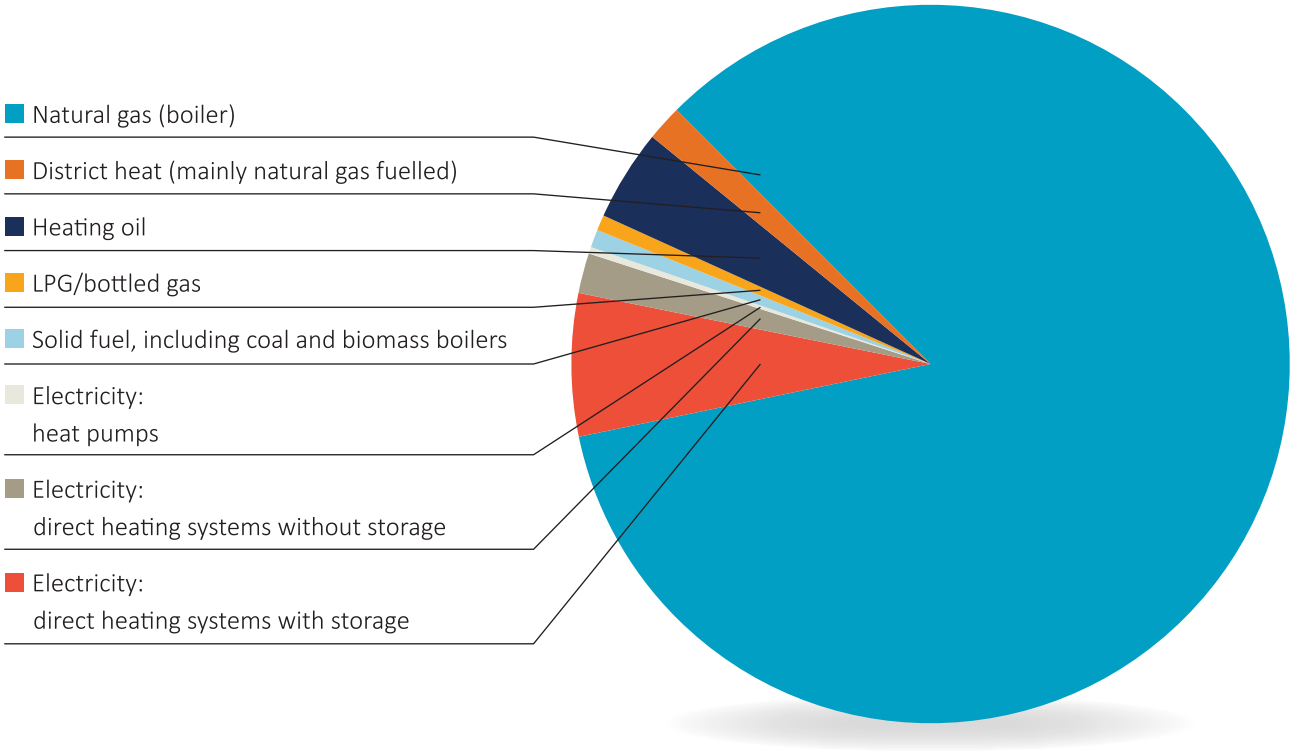


*Figure 1 - Chart showing primary heating systems used by households in Great Britain: this doesn't include secondary heating systems (wood burning stoves etc.)**

Every year around 1.6 million natural gas boilers are installed in the UK. By comparison, only 1 million homes in total have low carbon heating systems in the UK. Around 20,000 heat pump units were sold in 2017[6].

**Data from Citizens Advice Scotland (2018) Off-gas consumers: Updated information on households without mains gas heating; and Ofgem (2015) Insights paper on households with electric and other non-gas heating. Data is from the latest dataset available (2013)*

[4]Citizens Advice Scotland (2018) Off-gas consumers: Updated information on households without mains gas heating.
[5]UKERC (2016) Best practice in heat decarbonisation policy: A review of the international experience of policies to promote the uptake of low-carbon heat supply.
[6]European Heat Pump Association (2017) Heat pumps – key technology to achieving Europe's energy and climate goals: 2017 Market development and outlook.

1.2: Current policy landscape for heat

1.21 Current policies related to domestic low carbon heat

Table 1: Policy levers used by government related to low carbon heat, energy efficiency and low carbon gas	
Taxation and levies	• **Both electricity and gas are subject to taxation and a reduced rate of VAT.** • **Most incentives and levies are only applied to electricity**, including the Feed in Tariff, Renewable Obligation, Contracts for Difference, capacity payments, EU ETS and the Carbon Price Floor. Levies for smart meter payments, the Energy Company Obligation and the Warm Home Discount are shared between gas and electricity.
Regulation	• **Technology regulation** was used to drive uptake of condensing boilers (see Lessons Learned 2), and later in the strengthened Boiler Plus legislation (2018) which required minimum standards of efficiency for boilers. • **Building Regulations** specify minimum levels of energy efficiency and carbon emissions rates required for new buildings[7]. This is done through **Energy Performance Certificates** (EPCs) which are used to compare energy efficiency of homes. In 2018 12% of all the new homes built were EPC rated C, with 7% rating D or below)[8]. • **Minimum energy efficiency standards** in the Private Rented Sector prohibits landlords from letting properties if they are rated below EPC Band E.
Obligations	• **The Energy Company Obligation** (ECO) drives delivery of energy efficiency in fuel poor households. • **The Renewable Transport Fuel Obligation** (RTFO) is used to support the production of biogases (e.g. biomethane and bioSNG) that can also be injected into the gas grid. • **The Renewable Obligation** (RO) provides support for large-scale renewable electricity generation in the UK by obligating electricity suppliers to provide an increasing proportion of their electricity from renewable sources.
Incentives	• **The Domestic Renewable Heat Incentive** (RHI) was designed to drive uptake of renewable heat technologies. Since 2014, those who install eligible heat generating technologies can receive quarterly payments for seven years for the amount of renewable heat their system produces[9]. The RHI is only funded for new applicants to 2021.

1.22 Current targets that affect domestic heat

Table 2: Targets set by government related to energy efficiency and low carbon heat	
Current targets set by national government on low carbon heat and energy efficiency	The Clean Growth Strategy stated an ambition to upgrade all fuel poor homes to EPC C by 2030, with a wider aspiration to upgrade as many homes as possible to EPC Band C by 2035, where practical, cost-effective and affordable.
	The Clean Growth Strategy also states an ambition to phase out the installation of high carbon fossil fuel heating in new and existing off gas grid buildings during the 2020s[10].
	The government announced an ambition to cut the energy use of all new buildings by half by 2030[11] as part of the Grand Challenges of the Industrial Strategy in 2018.
	The government intend to implement a 'Future Homes Standard' by 2025 that requires new build homes to have low carbon heating and world-leading levels of energy efficiency.
	The government also pledged to increase the amount of low carbon gas being used in the gas grid in the 2019 Spring Statemen[12].

[7]MHCLG (2013) Approved Document L1A: conservation of fuel and power in new dwellings, 2013 edition with 2016 amendments
[8]MHCLG (2018) Live tables on Energy Performance of Buildings Certificates
[9]Ofgem (2019) About the Domestic RHI (see: https://www.ofgem.gov.uk/environmental-programmes/domestic-rhi/about-domestic-rhi)
[10]BEIS (2017) Clean Growth Strategy
[11]https://www.gov.uk/government/publications/industrial-strategy-the-grand-challenges/missions
[12]Spring Statement 2019: Philip Hammond's speech: https://www.gov.uk/government/speeches/spring-statement-2019-philip-hammonds-speech

Lessons Learned 1: Ineffective policymaking and the Renewable Heat Incentive (RHI)*

The number of accredited domestic applications for the RHI has hovered around the 2,000 per quarter mark since its peak in 2015. The vast majority of installations from late-2015 have been air-source heat pumps, with 36,000 accredited installations since the domestic scheme began in 2014 (54% of the total).

In 2018 the National Audit Office (NAO) published an analysis of the RHI which reported that as of December 2017, only 78,048 installations had been delivered by the RHI, in comparison to the 513,000 installations by 2020 anticipated by BEIS. Based on current take-up rates, the NAO estimates that the number of installations under the RHI will reach 111,000 by its end date in 2021, only 22% of original expectations. The reasons that the RHI did not have the expected uptake includes the high initial cost of purchase and installation of low carbon heat, and the uncertainty over returns arising from the system of automatic tariff reductions known as degression. BEIS admitted it had not carried out enough consumer research to understand these barriers prior to launching the scheme. To address these barriers, BEIS introduced an Assignment of Rights scheme in 2018, whereby a third party can fund the purchase or installation of a heating system in exchange for the rights to RHI payments. However, none of the RHI-supported installations in 2019 thus far have made use of this. This could have implications for 'heating assets as a service' models discussed later in the report.

Lesson Learned 2: Effective policy-making and the condensing boiler roll-out**

In 2005 the government introduced legislation as part of Building Regulations mandating that all boilers installed after 1st April - either as new installations or to replace existing boilers - had to be condensing boilers with an A or B SEDBUK (domestic gas boiler efficiency) rating. These new condensing boilers were 15-30% more efficient than conventional boilers, and therefore cost less to run and reduced CO_2 emissions from domestic heat. As a result of these regulations the proportion of condensing boilers in UK homes rose from just below 6% in 2004 to nearly 43% by 2011. Modelling suggests that the carbon savings from the 2005 condensing boiler regulations will be 11 MT CO_2e by 2020, and 368 MT CO_2e by 2050 cumulatively.

Implementation of the Condensing Boiler Legislation was not without controversy; media coverage at the time reported homeowners and installers expressing concern at suspected increased costs and doubts over reliability. However, government provided support to installers to increase their trust in the technology, including through an industry awareness programme and training and upskilling programmes for boiler installers. Similarly, households were supported through 'one-stop-shops' for advice and information on condensing boilers and a comprehensive communication strategy to raise awareness and trust in the technology. Various demonstrators were also run to show households how condensing boilers worked. It has been concluded that the Condensing Boiler Legislation was "unambiguous, clear to installers and homeowners, and simple to enforce" and thus highly effective policy.

**Information from: BEIS (2019) Non-Domestic and Domestic Renewable Heat Incentive (RHI) monthly deployment data (March 2019); National Audit Office (2018) Low-carbon heating of homes and businesses and the Renewable Heat Incentive; Public Accounts Committee (2018) Renewable Heat Incentive in Great Britain*

***Information from: DECC (2014) Energy Consumption in the UK; Technical Report; Hamilton et al. (2013) Energy efficiency in the British housing stock: energy demand and the homes energy efficiency database; Energy Policy: Volume 60, pp. 462-480; The Guardian (2005) https://www.theguardian.com/money/2005/apr/02/consumerissues.jobsandmoney (Accessed May 2019); Elwell et al. (2015) Determining the impact of regulatory policy on UK gas use using Bayesian analysis on publicly available data; Energy Policy: Volume 86, pp. 770-783; evidence given to this inquiry*

2. Current engagement with heat

2.1: Current awareness of heat

2.11 Is the public aware of low carbon heat and the need to decarbonise heating?

As discussed in more detail in later chapters, a transition to low carbon heat will require change in almost all homes in the UK. It would therefore ideally involve an engaged public who are aware of, understand and support the overall aims for the roll-out. However, research frequently points to a low awareness amongst the public of both the need to transition to low carbon heat, and of the types of low carbon heating available. For example, the Committee on Climate Change found that 57% of people had never heard of or knew very little about the need to switch away from natural gas for heating. 51% had never heard of hydrogen boilers[13]. Similarly, BEIS data shows that 68% of people had never heard of - or didn't know much about - renewable heating systems, and only a third of respondents claimed to be aware of heat pumps[14].

This means there is also a low awareness of the relative benefits or disadvantages of low carbon heating systems. Even amongst those who claim to be aware of low carbon heating systems, there is a lack of knowledge about whether they might be more reliable or better at heating a home than conventional heating systems. The main perception by the public is that they are expensive to install[15].

There is also a disconnect between the perception of the environmental impact of heat and its actual contribution to the UK's carbon footprint. Although the public are supportive of a transition to low carbon heat when directly prompted - 76% of people said they believe it is important to switch to lower carbon sources for heating homes[16] - polling conducted for Carbon Connect by Survation found that the public tend to rank it low on areas to prioritise in tackling emissions in the UK[17]. People, perhaps unsurprisingly, tended to choose high-profile areas like waste or petrol and diesel cars, whereas only 16% prioritised heating for cutting carbon emissions[18]. This is despite domestic heat contributing 13% to the UK's annual carbon footprint[19] - three times greater than waste's contribution and comparable to that of all petrol and diesel cars in the UK[20]. Clearly, the case for changing to low carbon heat has not been made to the public.

The public also has a low understanding of how a transition to low carbon heat would work in practice. When some of the specific implications of a switchover to different types of low carbon heat on their household were explored, support for the transition lessened[21].

Politicians also do not prioritise the need to transition to low carbon heat in tackling climate change. Polling conducted for Carbon Connect by YouGov in March 2019 showed that, when asked to rank the top sources of emissions that the government should prioritise in tackling emissions, only 5% chose gas boilers. They also tended to choose areas that had already had high profile policy discussions in recent years like petrol and diesel cars and coal power. Politicians will be important in championing switching over to low carbon heat in their constituencies, so this evidence points to the need to raise the profile of heat in parliamentary and constituency discussions around climate change.

[13]Committee on Climate Change (2018) Public acceptability of the use of hydrogen for heating and cooking at home
[14]Department for Business, Energy and Industrial Strategy (2019) Public Attitudes Tracker Wave 28
[15]Department for Business, Energy and Industrial Strategy (2019) Public Attitudes Tracker Wave 28
[16]Committee on Climate Change (2018) Public acceptability of the use of hydrogen for heating and cooking at home
[17]Our own polling data: see Supporting Material 2
[18]Our own polling data: see Supporting Materials 2
[19]Department for Business, Energy and Industrial Strategy (2017) Clean Growth Strategy
[20]Committee on Climate Change (2018) 2018 Progress Report to Parliament
[21]Madano (2018) Public acceptability of hydrogen in the home- full report

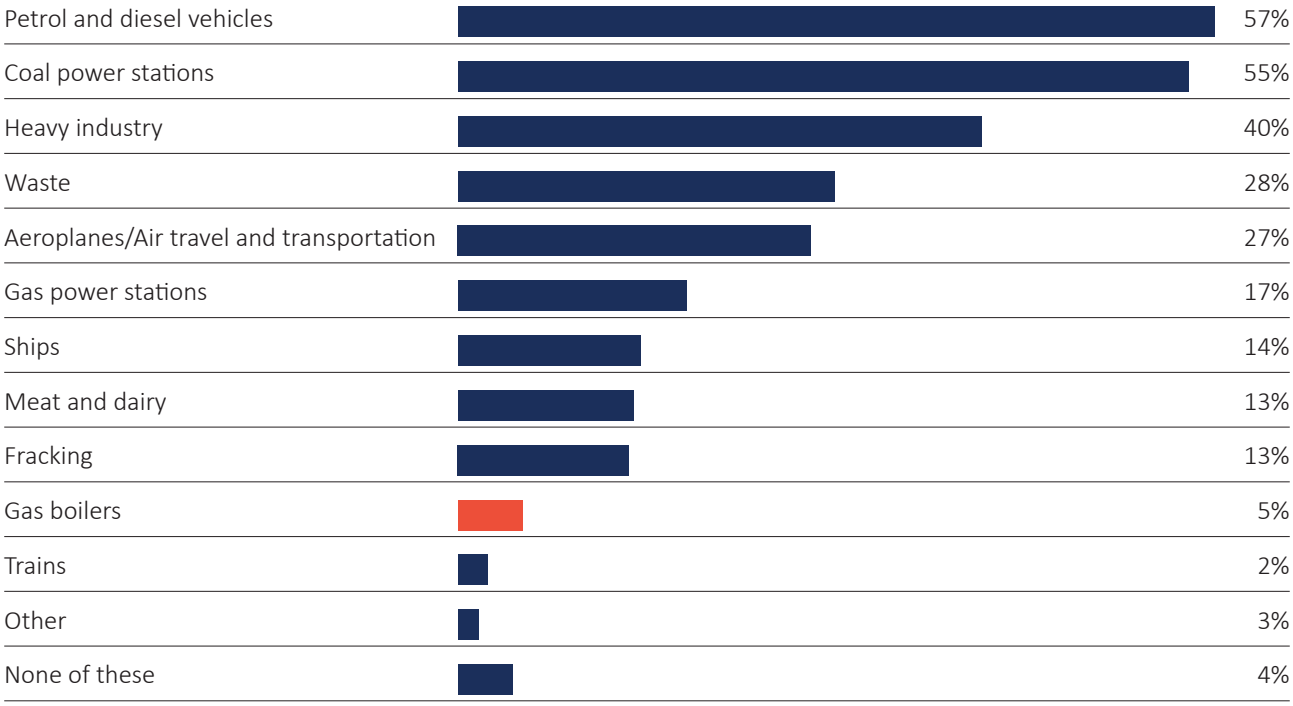


Figure 2 - Which of the following sources of emissions that contribute to climate change should the government prioritise tackling? Please select up to three options. [Data from our polling, please see Supporting Materials 2].

2.12 How is the public engaging with heat currently?

The low awareness of low carbon heat is likely to be further complicated by the relationship many households have with their heating systems. Research has shown that people would generally prefer to put up with poorly performing heating systems rather than have to suffer the hassle and disruption of installing a new one[22]. The majority of people only think about installing a new heating system when their current one has broken down or needs substantial repairs, even though around two thirds of households report issues like draughts or overheating in their homes, which a new heating system might help to tackle[23].

Similarly, many people are also not engaged with the way they use energy in the home. 44% of people have never changed energy supplier[24] despite potential bill savings on new tariffs, and 32% of people pay little or no attention to the amount of heat they use in their home[25]. The Energy Systems Catapult likewise found that people struggle to report how they use energy and frequently underestimate how much they rely on heat to enhance their daily life[26]. On the other hand, households which are fuel poor or at risk of falling into fuel poverty are likely to be much more engaged with how they use the energy at home than other households[27].

[22]Energy Systems Catapult (2018) How can people get the heat they want, without the carbon?
[23]Energy Systems Catapult (2018) How can people get the heat they want, without the carbon?
[24]Department for Business, Energy and Industrial Strategy (2018) Public Attitudes Tracker, Wave 25
[25]Department for Business, Energy and Industrial Strategy (2018) Public Attitudes Tracker, Wave 28
[26]Energy Systems Catapult (2018) How can people get the heat they want, without the carbon?
[27]Department for Energy and Climate Change (2014) Understanding the behaviours of households in fuel poverty

2.13 What do the public value about their current heating systems?

90% of on-gas-grid households would opt to install a natural gas boiler as their next heating system, as they consider it cheap, easy to install and a familiar technology[28]. Furthermore, a significant number of consumers only acquire new heating systems as a 'distress purchase' when their current heating system breaks down or requires significant repairs[29,30,31]. This creates a challenging cycle of boiler replacement, where households only replace their system in an emergency, and therefore are not likely to be willing or able to consider trying an unfamiliar technology or a system they perceive to be more difficult, expensive or lengthy to install. Given the current ubiquity of natural gas heating systems, installers are also unlikely to be sufficiently knowledgeable about the range of low carbon systems available to provide timely and impartial advice on these options.

It is generally found that people would only be motivated to change to a new heating system if there is a strong financial case for doing so, and only then if there is readily available cash to pay for the upfront purchase and installation, such as a grant[32,33]. This requires households to be certain of reduced energy bills in the future, and for there to be a significant financial incentive that could be paid back over a reasonable timescale. Low carbon heating, on the other hand, tends to be perceived as more expensive to install than a comparable fossil fuel system[34]. Other important factors that consumers value in a new heating system include reliability, provision of instant heat and hot water, control and ease of use, and the longevity of the system. Environmental factors are less important in choosing a new heating system[35].

However the characteristics that households value from their heating systems does depend on other factors. For example, work has shown that in a real-world situation, costs can be less important than the way the technology fits in with the aesthetic and space of a particular property, and whether the technology sounds, on an intuitive level, as though it will be effective at keeping a property warm[36]. Similarly, other work has shown that the public may not necessarily prefer the cheapest option if it also comes with other undesirable aspects, such as continued fossil fuel reliance, likely long-term fluctuations in fuel prices, or perceived unfair or unjust outcomes in the energy system[37].

Nevertheless, the evidence suggests that the biggest barrier to installing new heating technologies is the cost and disruption of installation, and that overcoming this barrier would require the new heating system to offer tangible benefits, either because they heat the house better than previous heating systems - as was evidenced in the rollout of condensing boilers (see Lessons Learned 3) - or because they offer bill savings, which is unlikely given the lower price of natural gas compared to low carbon alternatives.

Altogether, this section leads to an important question: given the low consumer awareness of low carbon heat as a technology or as a requirement to meeting our climate objectives, how can low carbon heat be made visible, desirable and trusted?

[28]Department for Energy and Climate Change (2013) Homeowners willingness to take up more efficient heating systems
[29]Department for Business, Energy and Industrial Strategy (2018) Public Attitudes Tracker, Wave 24
[30]Wales and West Utilities (2015) Consumer Willingness to Pay for Alternative Heating Systems
[31]Department for Energy and Climate Change (2013) Homeowners willingness to take up more efficient heating systems
[32]Wales and West Utilities (2015) Consumer Willingness to Pay for Alternative Heating Systems
[33]Department for Business, Energy and Industrial Strategy (2017) Renewable Heat Incentive Evaluation Synthesis
[34]Department for Business, Energy and Industrial Strategy (2017) Renewable Heat Incentive Evaluation Synthesis
[35]Energy Networks Association (2018) Consumer attitudes to decarbonisation of heating
[36]Department for Energy and Climate Change (2013) Homeowners willingness to take up more efficient heating systems
[37]UKERC (2013) Transforming the UK energy system: public values, attitudes and acceptability

2.2 Who talks to the public currently about heat?

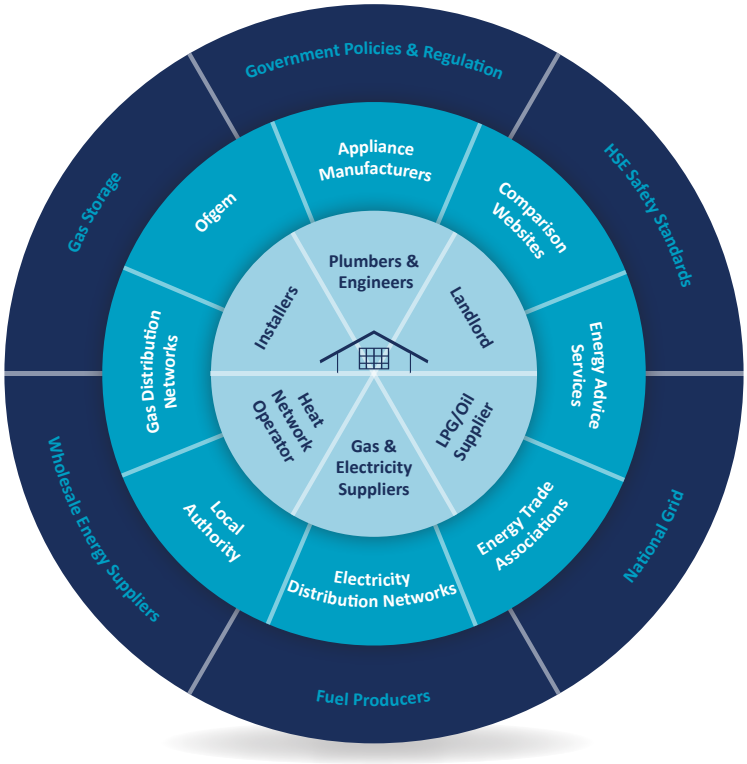


Figure 3 - Schematic showing the different channels who talk to households about their heating systems.

Generally, consumers do not distinguish between the different players in the energy market. Academic work has found that people tend to refer to 'energy companies' rather than energy suppliers, energy networks or system operators. People also have low awareness of organisations like Ofgem[38] and gas distribution networks[39].

Research suggests that the public does not trust energy suppliers to provide impartial information since they are perceived to be opaque and driven by shareholder profits rather than by societal good[40]. However, other research suggests that despite this the public is generally satisfied that their energy supplier delivers an expert service[41]. On the other hand, tradespeople like gas installers, builders and plumbers are the sources that people most trust to provide specific advice on installing a heating system[43]. Public advice bodies like Citizens Advice also enjoy a high level of trust for providing impartial information on energy systems[43].

The evidence therefore indicates that there are a number of potential channels that could be effective at communicating and engaging the public on low carbon heat. This is explored in more detail in Section 3.

[38]BEIS (2018) Public Attitudes Survey Wave 26
[39]Delta Energy and Environment (2018) Freedom Project: Business Opportunities Report
[40]UKERC (2019) Paying for Energy Transitions: public perspectives and acceptability
[41]Ofgem (2019) Household Consumer Perceptions of the energy market
[42]BEIS (2019) Public Attitudes Tracker Wave 28
[43]BEIS (2018) Public Attitudes Tracker Wave 27

PART TWO

LOW CARBON HEAT IN THE UK: CHALLENGES AND OPPORTUNITIES

3. Governance of low carbon heat

Chapter Overview

Low carbon heat is expected to involve a highly regionalised delivery, but this requires strong coordination between central government, devolved administrations, local authorities, local industry and business and community groups. Overall, central government has an important role to play in setting the long term policy direction on low carbon heat and shaping the policy environment through taxation, incentives and regulation of the market and buildings. Devolved administrations also have an important role in driving change in Wales and Scotland. While local and regional organisations should be closely involved with a low carbon transition, there are important questions about their current capacity and how this will shape their role in low carbon heat. Overall, the requirement for strong coordination of different organisations across the UK suggests a need for a Central Delivery Body that can ensure roll-out is delivered efficiently, on time and on-budget.

Governance of low carbon heat covers all the organisations, regulations, incentives and policies related to low carbon heat, and the processes that establish those regulations, policies and incentives. Governance structures shape how the energy system operates and how it will change in the future

Extensive international evidence shows that setting clear, stable policy through a package of incentives, taxation, regulation and subsidies is critical to delivering low carbon heat[44]. This means that there is an essential role for government to provide consistent targets and trajectories for a transition to low carbon heat.

3.1 Setting the policy direction - regulation, standards and skills

3.11 Regulation of heat in buildings

An important part of signalling the future direction for heat in the UK is defining a trajectory of increasing standards for allowed emissions from heating systems and clear date for reaching net zero in the housing sector. This must be implemented alongside tightened minimum standards of energy efficiency in homes, principally in private rented and social housing, but potentially extended further into owner-occupier homes.

Energy UK has suggested that government should set incremental improvements to standards for heating systems to effectively ban the most carbon-intensive heating technologies in the 2020s and eventually phase out installation of carbon-emitting boilers by 2040[45]. The Committee on Climate Change also makes the case for effectively banning the installation of carbon-emitting heating technologies in new homes from 2025, with a Heat Strategy that sets out the route to full decarbonisation of buildings by 2050[46]. Regardless of the exact date for reaching net zero emissions from heat, the government should pursue the principle of setting a long-term emissions target in the housing sector, with tighter targets in higher priority housing such as new houses, social housing and private rented homes. There should also be a strengthening trajectory of standards towards that goal. Setting such a date can also help to raise awareness of the importance of decarbonising heat with the public, as has been shown with the 2040 ban on conventional petrol and diesel vehicles[47].

[44]UKERC (2016) Best practice in heat decarbonisation policy: A review of the international experience of policies to promote the uptake of low-carbon heat supply
[45]Energy UK (2019) The Future of Energy: Reducing Emissions from Buildings
[46]Committee on Climate Change (2019) Net Zero: The UK's contribution to stopping global warming
[47]BEIS (2018) Future Framework for Heat in Buildings: Government Response

BEIS has committed to publish a Low Carbon Heat Roadmap by summer 2020. In this strategy the government should set out a long-term target and trajectory for reaching net zero emissions in the housing sector. It should also include strategies for immediate at-scale deployment of 'low regrets' options such as decarbonisation of heating in new build and off-gas-grid homes, deployment of energy efficiency and the roll-out of district heat networks, heat pumps and smart hybrid heating systems in appropriate buildings[48]. Some options for regulation for different housing sectors are considered in Table 3 below. BEIS should also commit to publishing a complete heat decarbonisation strategy before 2025, once on-going pilots have provided evidence as to the safety, technical and economic case for different long-term options for decarbonisation of heat.

Table 3: Options for regulating different housing sectors
For new homes: New homes should not have to be retro-fitted with extra energy efficiency and low carbon heating before 2050. The new 'Future Homes Standard' should set out a tightening of standards from now out to 2025 such that by 2025, all new homes will have a low carbon emissions rating per unit of warmth delivered (less than a space heat requirement demand of 15kWh/m^2/year).
For home and building owners: Other reports have suggested extending the minimum energy efficiency standards to the owner-occupier sector[49]. However, doing this on a whole-house basis is likely to be politically difficult. Therefore, rather than strengthening regulation, in the short term the government should aim to commercialise the most successful pilots of financial incentives for energy efficient upgrades from the Green Home Finance Innovation Fund[50]. These pilots should include tests of the feasibility of green mortgages or reduced stamp duty for energy efficient homes[51] but could also include low carbon heating, to test whether these types of incentives encourage uptake of low carbon heat. Subsequent commercialisation should build on learnings from the Green Deal (see Lessons Learned 4).
For private rented homes: Minimum energy efficiency standards in the private rented sector should be set on a strengthening trajectory out to 2030 alongside visible monitoring and enforcement. The government should review and implement the findings of the Hackitt Review, especially in relation to enforcement and a clear and identifiable duty holder[52]. There should also be stronger sanctions for those who do not meet the minimum standards for energy efficiency. Private rented homes will also be affected by financial incentives currently being trialled by the Green Home Finance Innovation Fund.
For social housing: Minimum energy efficiency standards should be strengthened to achieve the Clean Growth Strategy's target of all being EPC Band C by 2030, and then strengthened further to EPC Band B or A by 2050, in conjunction with tightening standards on carbon emissions from heating systems. This should be put in place alongside enabling funding sources like an extended Renewable Heating Incentive or the Scottish Home Energy Efficiency Programmes.
For off-gas grid homes: Government should set a trajectory of tightening standards that ends installation of highly carbon emitting heating systems by the end of the 2020s, but effectively excludes installation of the highest carbon emitting heating systems (oil and coal) at an earlier date. This could be put in place with a tank scrappage scheme.

Urgent at-scale action taken from now, with a full decarbonisation strategy in delivery by 2025

BEIS should publish its Low Carbon Heat Roadmap early in 2020 that includes:

- ✓ An action plan for the immediate deployment of at-scale low regrets low carbon heat retrofit around the UK, including a national energy efficiency retrofit programme and a mandatory target for energy efficiency of new homes.
- ✓ Funding for pilots of low carbon heat in homes around the UK.
- ✓ A timeline for delivery before 2025 of a strategy for complete heat decarbonisation.
- ✓ A long term target for reaching net zero emissions in the building sector.

[48]Committee on Climate Change (2019) Net Zero: The UK's contribution to stopping global warming
[49]Energy UK (2019) The Future of Energy: Reducing Emissions from Buildings
[50]BEIS (2019) Green Finance Strategy
[51]Green Finance Taskforce (2018) Accelerating Green Finance
[52]MHCLG (2018) Building a Safer Future Independent Review of Building Regulations and Fire Safety: Final Report

3.12 Regulation of the market

Ofgem currently plays an important role in regulating the energy market to ensure electricity and gas is provided at a fair price, whilst achieving certain sustainability and social imperatives. Electricity and gas network companies are regulated via a five year performance-based price control where businesses are allowed to recover additional revenue based on improved outputs, while energy suppliers are regulated separately. It is likely that Ofgem will play a key role in a widespread transition to low carbon heat.

Ofgem and the current regulatory system will need to change as the energy system is decarbonised. There is not currently a low carbon heat market - heat is instead regulated through the electricity and natural gas market. This means new heat systems and services that do not use traditional infrastructure or business models - including heat networks, 'heat as a service' models and hydrogen trials - are currently unregulated. Ofgem needs to support the growth of a viable market for investors and ensure protections for these heat consumers.

Furthermore, the current regulatory model is relatively prescriptive, which may not be well suited to a more distributed, decentralised energy system that has multiple products, retailers and ways for consumers to interact with their energy. This has led to some arguing for a fundamental energy market redesign, including reallocating risk in such a way that encourages innovation in service offerings by offering business more freedoms; developing a more adaptive regulatory mechanism; and establishing an 'essential services consumer regulator' that merges the consumer parts of Ofwat, Ofcom and Ofgem[53]. Other research has also argued that the complexity of transitioning to a future energy system requires the replacement of Ofgem with a simpler universal operator system, where capacity is auctioned out as required[54].

While specific Ofgem recommendations are out of scope of this report, it is clear that the way the market is regulated will need to become more adaptive and flexible to the changing energy system, and particularly in allowing innovation. This should be addressed in BEIS' forthcoming Future Energy Retail Market Review, which was consulted on over summer 2019[55].

3.13 Up-skilling of gas engineers and installers

Gas engineers and installers are a highly trusted source of advice on heating systems for households, and are often consulted by households for information on new heating systems[56,57]. Furthermore, since a significant number of heating systems are a distress purchase when there is little time to research alternatives, consumers ultimately rely on installers to inform them of alternative options to natural gas boilers[58]. Installers have also proved crucial in getting the public on board with previous technology roll-outs, including the move to condensing boilers[59]. Gas installers are therefore likely to be highly influential in the transition to low carbon heat, but there is very limited knowledge of, or research into, the heating installer industry. Previous reports have called for more research into this industry and how to realise its pivotal role[60].

[53]Redesigning Regulation (2019) Imperial College London
[54]Dieter Helm (2019) The Systems Regulation Model
[55]https://www.gov.uk/government/publications/future-energy-retail-market-review
[56]BEIS (2019) Public Attitudes Tracker Wave 28
[57]BEIS (2017) RHI Synthesis Review
[58]BEIS (2018) Future Framework for Heat in Buildings
[59]Evidence given to this inquiry
[60]UKERC (2018) Incumbency in the UK heat sector and implications for the transformation towards low-carbon heating

Currently there are many more registered installers of gas boilers than of renewable heating technologies, with boiler sales being 1.6 million per year, compared to about 20,000 sales per year for heating pumps, for example[61]. There is therefore an urgent need for a nationwide up-skilling and accreditation of gas installers so they are equipped to explain the options for low carbon heat objectively to householders and install low carbon heating technologies to a high standard, including hydrogen boilers, heat pumps and hybrid heat pumps[62,63].

Government should work with industry, training centres and certification bodies to develop and deliver training modules that are appropriate for installing low carbon heating technologies. These modules should embed core knowledge, including basic building physics, design stage and consumer interaction into relevant vocational and professional pathways[64]. There is a case for government to subsidise this training, to encourage uptake by current gas installers.

Training should also be regionally specific, so that skills of local tradespeople match the mix of heating technologies most suitable for their local area. This could fall into the remit of Local Enterprise Partnerships (LEPs) (discussed below). There is already some precedent for this in Local Skills Advisory Panels (SAPs), which are made up of local employers and local authorities in collaboration with LEPs and Mayoral Combined Authorities. SAPs aim to develop a post-18 skills system most appropriate to the needs of their area. Similarly, in Scotland, regional skills assessments delivered by Skills Development Scotland produce demand forecasts, which are then used to negotiate with training providers to ensure they adapt training to the forecasted needs of their region[65]. Grant funding is provided for institutions to offer the required training. This type of regionally-adaptive partnership is likely to be important in developing re-training options for gas installers.

Households must feel properly informed, advised and engaged

Regional collaborative bodies like the Local Skills Advisory Panels in England or Regional Skills Assessments in Scotland should be involved in developing upskilling programmes for gas engineers to ensure there are fully informed and qualified low carbon heating installers that households can trust.

[61]Committee on Climate Change (2016) Net Zero Britain
[62]Jan Webb et all (2016) Heat and energy efficiency: making effective policy
[63]Committee on Climate Change (2016) Next Steps for Heat Policy
[64]MHCLG and BEIS (2016) Each Home Counts: Review of Consumer Advice, Protection, Standards and Enforcement for Energy Efficiency and Renewable Energy
[65]https://www.skillsdevelopmentscotland.co.uk/what-we-do/skills-planning/regional-skills-assessments/

3.2 Roles and responsibilities in a transition to low carbon heat

The transition to low carbon heat is likely to require a localised approach. Each area will be best suited to a particular mixture of heating technologies to reach zero emissions in buildings. This suggests there must be significant involvement of local or regional actors alongside central government action. This section discusses the potential roles and responsibilities of different organisations in delivering low carbon heat.

3.21 Central government and devolved nations

The importance of central government in setting clear, stable policy through a package of incentives, taxation, regulation and subsidies was covered in Section 3.11 above. A number of other public and trade bodies have also supported a strong central strategy for decarbonising heat[66,67]. The public also sees the government as having ultimate responsibility for encouraging a transition to low carbon energy, as they have the structural and financial ability to effect change[68]. This includes setting targets for a transition to low carbon energy[69] and delivering a transition to low carbon heat[70]. Clearly, there is an essential role for central government in setting a consistent policy direction for low carbon heat before decisions can be taken on a regional and local level.

Devolved administrations also have a key role to play. Scotland and Wales are already leading on delivering low carbon heat and energy efficiency. Scotland has already set stringent long term emissions targets, including a target of having a mostly decarbonised building sector by 2050[71] and a more recent target to be completely net zero by 2045[72]. They are also leading on a programme of low carbon heat and energy efficiency through their programme 'Energy Efficient Scotland'[73]. The Welsh Government, meanwhile, is developing plans for thousands of Welsh on-gas and off-gas homes to be part of a large-scale smart hybrid-heating trial before making decisions for a 30 year housing programme to 2050 for the rest of the 1.4m existing homes in Wales[74]. Allowing devolved nations to take the lead on decarbonisation can also make such a transition more acceptable to local people as it fosters a sense of ownership and helps to engage people with the trade-offs required[75].

Devolved nations are already leading on decarbonisation, so it makes sense to share policy lessons and strengthen joint policy action. Many aspects of a transition to low carbon heat are already devolved to Wales and Scotland, including housing and planning. Some aspects, however, are still held by central government, including regulation, licensing and taxation programmes like the Renewable Heat Incentive (although Northern Ireland has a fully devolved energy system). Since further devolution is a politically sensitive issue, it makes sense, at least in the short term, to allow for a dynamic relationship between devolved nations and central government, supporting them to lead in areas where powers are already devolved, and ensuring strong coordination in those areas that aren't. The mechanism for this coordination is covered in Section 3.24.

[66]Committee on Climate Change (2019) Hydrogen in a low carbon economy
[67]Energy UK (2019) The Future of Energy: Reducing Emissions from Buildings
[68]UKERC (2019) Paying for energy transitions: public perspectives and acceptability
[69]Madano (2018) Public acceptability of the use of hydrogen for heating
[70]Our polling results: see Supporting Materials 2 for full results
[71]Committee on Climate Change (2018) Progress report to parliament: reducing emissions in Scotland
[72]BBC News story , 2019 Climate change: Scotland to set faster target for net-zero emissions: https://www.bbc.co.uk/news/uk-scotland-48123960
[73]Scottish Government (2018) Energy Efficient Scotland
[74]Evidence given to this inquiry- announcement expected later this year
[75]Evidence given to this inquiry

3.22 Local and regional authorities

The importance of local or regional authorities in delivering higher energy efficiency and low carbon heat has often been highlighted[76,77,78,79]. Local authorities have most granular knowledge of the housing stock; the best vehicle for engaging and involving local people in the transition; and through public procurement the power to drive the market through their ownership of social housing and public buildings.

Local Authorities are also already involved in some aspects of energy planning. For example, in Scotland, leading Local Authorities are being supported to develop Local Heat and Energy Efficiency Strategies (LHEES). LHEES will help each area to develop pathways to improve the energy efficiency of, and provide low carbon heat to, their area[80]. Meanwhile, in England, collaborations between Local Authorities and local businesses called Local Enterprise Partnerships (LEPs) were supported by central government to develop local energy strategies in 2018[81] and are now being supported to deliver on these strategies through Regional Energy Hubs. These hubs will act as sources of expertise and build bridges between ongoing energy projects being developed by LEPs, Local Authorities, industry and local community energy groups[82].

However, although most agree that a transition to low carbon heat needs a locally specific plan, the exact role that Local Authorities should play is uncertain. Many argue that Local Authorities will struggle to assemble the capacity and resources needed to bring about energy transitions in an area-based way, despite many wanting to do so[83]. This is reflected in research, which has shown that Local Authorities are the least popular option for leading the process of phasing out high carbon heating [84]. The public think that a nationally-led process would be streamlined, in comparison to one managed locally which was expected to be disorganised and slow[85]. Local government can also be involved in ways other than full heat planning, including through investment and ownership. Furthermore, if service models that offer individualised household upgrades (such as heat as a service) become popular, Local Authorities might anyway naturally assume a less involved role[86].

In the short term, LHEES should continue to deliver local area energy in Scotland, and heat planning could continue to be incorporated into the remit of Local Enterprise Partnerships (LEPs) in England[87]. LEPs do have some issues around their limited expertise in energy and heat planning and the fact that LEPs and Local Authority areas do not always overlap. Nevertheless, they provide a basis from which collaborative local area energy and heat planning could be developed, especially in collaboration with Regional Energy Hubs. Such a model ensures extensive local authority input without expecting them to take on full planning and delivery.

[76]Jan Webb et al (2017) What we know about Local Authority engagement in UK energy systems,
[77]UK100 (2017) Financing the Transition: harnessing UK cities' ambition for clean energy
[78]Friends of the Earth (2018) Delivering on the Paris Climate Agreement – the future of home heating
[79]Energy System Catapult (2018) Local Area Energy Planning Review: supporting clean growth and the low carbon transition
[80]Scottish Government (2018) Energy Efficient Scotland
[81]Energy Systems Catapult (2018) Local Area Energy Planning Review: supporting clean growth and the low carbon transition
[82]Evidence given to this inquiry
[83]Webb, J., Hawkey, D. and Tingey M. (2016) Governing cities for sustainable energy: The UK case
[84]Our polling: See Supporting Materials 2 for results on this
[85]Madano (2018) Public acceptability of the use of hydrogen for heating
[86]Cowell and Webb (2019) Local Area Energy Planning- a scoping study
[87]Department for Business, Energy and Industrial Strategy (2017) Letter to LEPs, Local Energy capacity support for LEPs and local authorities

Some upskilling and extra resource is also required in the short term to ensure that relevant Local Authority officers have the expertise on low carbon heat and energy technologies. While some of this upskilling could be provided by local LEPs as part of year-long CPD programmes, extra resource to allow prioritisation of energy planning is needed from central government. Ongoing work in LEPs and LHEES can continue to build up an evidence base for skills gaps and where training is required.

An issue on the longer term for full low carbon heat deployment is the political risk to both central and local government of regionalised planning, particularly in the case where a rollout of technologies in one region is unsuccessful or more disruptive and expensive than in other regions. This would be a major political risk for either central or local government, depending on where responsibility (and blame) lies for transitioning to low carbon heat. There needs to be clear allocation of responsibilities and subsequent distribution of resources and powers appropriate to that level of responsibility. Since the role Local Authorities will play is still uncertain, it makes sense to carry out a review to help decide what role Local Authorities should be expected to play in decarbonising heat, including of the necessary statutory powers, technical capacities, data access and resources required for strategic planning for low carbon heat and area-based energy efficiency, and the lead-in times required for local actors to be at full operational capacity if they are to be involved with heat planning.

There must be strategic governance and financial structures to drive long-term action

BEIS should review the necessary statutory powers, technical capacities, data access and resources required for strategic planning for low carbon heat and energy efficiency, to decide the role of Local Authorities will play in decarbonising heat.

3.23 Industry and the market

Industry and business clearly also have a key role to play in delivering low carbon heat through innovation and investment. The question is therefore how much government intervention is needed to ensure the market can deliver, given the absence of financial or commercial incentives for low carbon heat. International experience has shown that market forces in combination with policy can drive transitions for low carbon heat - for example, in the early deployment of heat networks and heat pumps in Sweden, Denmark and Norway[88]. However, this was also driven by rising electricity and oil prices creating an advantageous price differential, which raises questions over whether the market can drive a transition to low carbon heat in the absence of this.

Some argue that markets can achieve the most cost-effective path to heat decarbonisation if government sets an overall economy-wide carbon price. This avoids government 'picking winners' from the available low carbon technologies[89]. On the other hand, electricity and potentially gas networks will be the primary method for delivering low carbon heat, and they act as regulated monopolies. This means they cannot deliver the necessary future infrastructure upgrades without more involved government intervention[90]. Clearly, although there is a role for industry in leading innovation, it won't decarbonise heat on its own.

[88]BEIS (2017) International Comparisons of heating, cooling and decarbonisation practices
[89]Policy Exchange (2016) Too Hot to Handle
[90]Imperial College London (2016) Managing Heat Decarbonisation

3.24 Making the case for a central delivery authority

A transition to low carbon heat requires coordination between different regional and local bodies, including LEPs, Local Authorities, local community groups and local businesses and industry. It also requires delivery of programmes from across the Department for Business, Energy and Industrial Strategy (BEIS), the Ministry for Housing, Communities and Local Government (MHCLG), the Treasury (HMT), and Ofgem. Decisions and implementation of policy at each level and in each department need to be sequenced in the right order and at the right time to ensure efficient deployment of technologies. To help coordinate this, it makes sense to create a central delivery body for low carbon heat.

A central delivery authority has been important for delivering large infrastructure projects before. For example, the Olympic Delivery Authority was a non-departmental public body set up by government to coordinate the delivery of the London 2012 Olympic and Paralympic Games and to manage the £9.3billion public sector funding for the Games[91], ultimately leading to the Games being delivered on time and with high environmental standards. Similarly, the digital television switchover between 2008 and 2012 was delivered by Digital UK, a single purpose organisation created solely to deliver this transition (See Lessons Learned 3 opposite).

In Scotland, meanwhile, the creation of either a directorate or a non-departmental public body has been identified as the two most promising options for delivering their Energy Efficient Scotland programme. This body will be in charge of coordinating Local Authorities and facilitating partnerships between stakeholders; providing capacity, support and expert advice to Local Authorities; enforcement of national regulation; providing consistent customer protections, including advice and redress service; and providing a national marketing, communication and education service[92]. Other work has also recommended establishing a central consumer-facing hub that could collect best practice on standards, guidance, statistics and information for renewable and energy efficiency retrofit[93]. The IGov research group has also recently suggested setting up an 'Energy Transformation Commission' to implement a low carbon transition through a process of brokering, co-ordination, consensus-building and engagement, advised by the CCC and NIC[94].

We envision that a central delivery body for low carbon heat would be a public body with a remit covering:

Table 4: Main duties for a central delivery body	
1	Coordination of low carbon heat planning between organisations on a national, regional and local level, for example, between different LEPs and Local Authorities across the UK, and making sure that there is correct sequencing of policy implementation between national, regional and local levels.
2	Holding a central point of information and expertise for low carbon heat planning, including holding a central database for existing energy and heat data for different regions.
3	Coordination and facilitation of public engagement and awareness raising activities on a national, regional and local level. For example: planning and contracting out activities before a region begins a switchover to low carbon heat, and coordinating, joining up and mapping out public engagement.
4	Alignment and coordination of standards for installation of low carbon heating options for example, between Trustmark, Gas Safety Trust and the Microgeneration Certification Scheme.
5	Coordination of regional skills planning for local tradespeople, for example with Skills Advisory Panels or Regional Skills Assessments in Scotland.

[91]Department for Digital, Culture, Media and Sport (2015) Olympic Delivery Authority 2006-2014: Final Report
[92]Scottish Government (2019) Energy Efficient Scotland programme: analysis of delivery mechanism
[93]MHCLG and BEIS (2016) Each Home Counts: Review of Consumer Advice, Protection, Standards and Enforcement for Energy Efficiency and Renewable Energy
[94]IGov http://projects.exeter.ac.uk/igov/new-thinking-the-igov-institutional-framework-for-energy-governance/ (Accessed August 2019)

Since the devolved nations have their own policy priorities and are already developing their own low carbon heat plans, it makes sense for Wales, Scotland and England to have their own central delivery authorities or similar mechanisms. This can also help to achieve a dynamic, coordinated relationship between Central and Devolved Government.

It is worth noting that although we only focus on a transition to low carbon heat in this report, a transition to a zero carbon society also requires extensive cross-departmental and cross-sector working. From a whole-systems perspective, a Central Delivery Authority for Net Zero might make more sense than one dedicated to heat only. It may be worth considering this as part of a review of governance going forward.

Lessons Learned 3: Digital UK*

Digital UK was an organisation created to coordinate and deliver the switchover of 27 million homes from analogue to digital television between 2008 and 2012. The Department for Digital, Culture, Media and Sport and Ofcom provided the policy and regulation to drive the switchover, and Digital UK provided the practical delivery of the project, including consumer support and communications, coordinating transmitter network upgrades and coordinating agreement across network operators, broadcasters, Ofcom and government.

Digital UK's engagement strategy was multi-layered, with national communication at the highest level, community support and one-to-one support for vulnerable consumers at the most granular level, and local and regional communications in between. The local and regional communications campaign was targeted at areas that were within 2 years of being switched, ramping up to a higher intensity campaign when an area was six months from switching. They used a number of channels, including TV, radio, outdoor and press advertising and a 'Guide to the switchover' information booklet that was delivered to each household. There were also over 2000 roadshow events, a schools programme, and regional teams that could coordinate activity in each area. Digital UK also partnered with local charities to form a consortium 'Digital Outreach' that could coordinate community outreach, provide advice points and provide grants for community events.

They also provided phone and web support to the public and practical one-to-one support for vulnerable and older people. They also developed training for a 'Digital Tick' logo to signal accredited retail staff and stores to the public, and established cross-industry groups to secure agreement on how to tackle the technical complexities of the switchover.

There must be strategic governance and financial structures to drive long-term action

Government should establish a new Central Delivery Authority in England with cross-departmental authority to coordinate regional leadership on low carbon heat delivery. Devolved nations should continue their work in delivering low carbon heat in Wales and Scotland.

**References: 'Digital UK (2012) Digital TV switchover 2008-2012: Final Report'*

4. Options for heating the home

Chapter Overview

Most of the low carbon heating options likely to be used for long-term heat decarbonisation in the UK are not widely deployed, which means it is important there are at-scale pilots to establish how well they work in households around the UK. Different low carbon heating options have different implications for households from the perspective of disruption, choice, heating experience and installation cost. Hybrid heat pumps may present a good medium term option, with relatively low impact on heating experience, disruption or choice. Full electrification or switching to low carbon gas for heat have relative advantages and disadvantages, but both are likely required to be in the long term to reach full decarbonisation of heat. Pilots should work to reduce some of the barriers these low carbon heating options currently face to enable at-scale deployment later on.

4.1 What do different low carbon options mean for households?

In this section low carbon heating technologies are grouped into three categories[95]:

1. Low carbon gas powered heating technologies, which theoretically work in the same way as current natural gas boilers, burning low carbon gas that is supplied via a gas grid to generate heat and hot water. This can include options that blend natural gas, biomethane and hydrogen as well as 100% low carbon gas.
2. Electrically powered heating technologies, which includes heat pumps. Heat pumps use residual heat extracted from the air, ground or nearby water sources to heat radiators, underfloor heating and hot water tanks. Direct electric heating is discussed more in Table 2 of the Supporting Materials.
3. Hybrid heating technologies, which includes hybrid heat pumps. Hybrid heat pumps which work in the same way as air- or ground- source heat pumps, but also have a conventional gas boiler (potentially natural gas, biogas and/or hydrogen) to produce additional heat when needed during peak times.

District heat networks are also covered in more detail below. They sit across all the above categories as they can theoretically use any of these technologies as sources of heat.

4.11 Low carbon gas powered heating technologies

Low carbon gases like biomethane and bioSNG are already being blended into the gas grid. Since they are chemically identical to natural gas, increasing injections of biogases will require no changes in people's homes. However, this unlikely to be the best use of bioresource in the long-term[96] so it is considered no further here.

Hydrogen is not currently used as a source of energy in the UK. However, it is expected that it will also be possible to blend it into the gas grid up to 20% by volume (7% by energy) without requiring any changes to heating systems in homes or to gas grid infrastructure. This is currently being confirmed in a pilot in Keele University campus[97]. Gas with a higher percentage of hydrogen would have to be burnt in boilers designed especially for hydrogen. Various hydrogen boilers are currently being developed, including through BEIS's Hy4Heat programme[98]. This includes 'hydrogen-ready' boilers which can be switched from burning natural gas to hydrogen through a relatively easy conversion process. Other 'hydrogen-ready' appliances such as hobs, ovens or fires are also being developed. Other work is looking to provide evidence as to the risk and efficiencies of different hydrogen appliances and to develop certification and standards for new hydrogen appliances[99].

[95]NB: Please see Tables 1, 2 and 3 in Supporting Materials 1 For quantitative impacts on households of different low carbon heating solutions
[96]Committee on Climate Change (2018) Biomass in a low-carbon economy
[97]https://hydeploy.co.uk/keele/ (Accessed June 2019)
[98]Hy4heat https://www.hy4heat.info/wp1 (Accessed June 2019)
[99]SGN https://www.sgn.co.uk/about-us/more-pipes/investing-in-innovation/hydrogen-100 (Accessed June 2019)

It is thought that hydrogen boilers could match key features of existing gas appliances like efficiency, lifetime, maintenance and size[100], but would require complete replacement of the natural gas boiler at the time of a switchover. On the other hand, hydrogen-ready boilers are likely to require only a short conversion (currently estimated to be 70 minutes[101]) to switch from components that burn natural gas to those that burn hydrogen. This could be done in situ in people's homes. Hydrogen-ready boilers could therefore minimise disruption to households during a low carbon heat transition, although work is still on-going as to whether pipes within the walls of older buildings would need to be replaced to carry hydrogen, and the home would still have to be disconnected from the gas grid for a period of time, during which it would be powered by temporary options. Hydrogen boilers could also reduce disruption because they would not require new radiators or significant additional energy efficiency upgrades, although it is important to emphasise that some energy efficiency measures will need to be installed to meet carbon targets for buildings regardless. Hydrogen boilers are also expected to deliver a similar heating experience and operate in the same as natural gas boilers so they would not require significant behaviour change in how households interact with their heating system.

The Hy4Heat programme will provide more evidence around the costs of conversion of each household and expected costs for hydrogen boilers when it is completed in 2021. One recent estimate gives the combined cost of converting existing gas appliances as £3000 per household, including the cost of their installation[102].

Depending on whether hydrogen-ready boilers function as efficiently and cost a similar amount to natural gas boilers, there could be a case for requiring new gas-fired boilers and appliances installed after a certain point in the 2020s to be 'hydrogen-ready', if government decides to proceed with a scenario where hydrogen is used for domestic heat in some regions. The disadvantage is that not all households will end up using hydrogen for heat, and these homes might therefore suffer higher costs without receiving the benefits later on. On the other hand, all the households that are connected to hydrogen networks or that have hybrid heat pumps installed will ultimately require boilers that burn hydrogen to reach very low emissions from heat. It makes sense for government to consider the economic implications of this regulation on different types of households, once decisions have been made on the overall contribution hydrogen is expected to make to low carbon heat.

Rollout scenarios for hydrogen networks

In a scenario where 100% hydrogen networks are rolled out, whole areas will need to be switched over simultaneously from one heating system to another as the gas grid moves from carrying methane to hydrogen. This means there will likely be a significant period of time during which homes will be disconnected from the gas grid, and where they will need to use temporary alternatives for heating and cooking such as portable electric heaters and cookers. There would also be disruption outside the home as any necessary adjustments to pipework are made.

[100]Frazer-Nash Consultancy (2018) Appraisal of Domestic Hydrogen Appliances
[101]Evidence given to this inquiry
[102]Northern Gas Networks (2017) H21 Leeds Citygate

The H21 Leeds City Gate study determined that each household would only need to be disconnected from the gas grid for one week during the summer[103]. The H21 North of England report, which proposes a 7-year roll-out covering 3.7m domestic properties, assumes an average of one property conversion per day[104]. The conversion is anticipated to take place only during the summer months where there is low heating demand, and alternative cooking arrangements will have to be put in place for those with gas appliances. HyNet North-west, on the other hand, proposes early use of hydrogen to power industry and as a blend for heat in 2 million homes, with full hydrogen for heat suggested only in new-build domestic and commercial buildings[105]. On-going work is investigating the potential of having different concentrations of low carbon gas in the national transmission and distribution networks alongside natural gas, and 'de-blending' this gas mixture into its relevant components on a small area (even potentially at a street level). If feasible, this would allow for a more gradual phased transition for households[106].

Overall, a roll-out of hydrogen requires a high degree of coordination between the switching over of appliances in households between natural gas, temporary alternatives and hydrogen-fuelled versions; associated building upgrades, including pipework; and network switching and upgrading. Households will also have limited choice as to when the switchover happens. It makes sense to draw on learning from other similar transitions to overcome these issues, including the transition from town gas to natural gas in the 70s and the roll-out of natural gas heating in the Isle of Man more recently.

4.12 Electrical powered heating

8% of current domestic heat in the UK is provided by electricity: and over 50% of off-gas-grid households use electricity as their primary source of heat. This tends to be direct electrical heating like storage heaters[107] rather than heat pumps, although there have been 50,000 heat pumps installed in the UK since 2014 under the RHI[108]. Heat pump technology is well developed and widely deployed in other European countries.

Full heat pumps are well-suited to homes off the gas grid. Ground source heat pumps (GSHPs) are more efficient than air source heat pumps (ASHPs), but they are also more costly and disruptive to install, and are only suited to properties with gardens. If garden space is limited, vertical boreholes can be used instead but this is likely to be more expensive unless done for multiple properties. The local geology also needs to be suitable.

Crucially, in order for heat pumps to operate optimally the property needs to be well-insulated. Heat pumps provide lower grade heat and are therefore unsuited to poorly insulated homes. Existing radiators may need to be replaced with larger radiators or underfloor heating, and if the property only has electric storage heaters additional pipework and a sufficiently large hot water cylinder will be needed. Overall it is estimated that the installation of the heat pump itself would require 2 days, with additional time for energy efficiency, radiators, and groundwork for GSHPs. Furthermore, complete electrification will require replacement of any gas appliances in the home, both for heating and cooking. Reducing disruption in installation will be an important challenge during a wider roll-out of heat pumps.

[103]Northern Gas Networks (2017) H21 Leeds Citygate
[104]Northern Gas Networks (2018) H21 North of England Report
[105]Cadent (2018) HyNet NorthWest
[106]Evidence given to this inquiry
[107]Ofgem (2015) Insights paper on households with electric and other non-gas heating
[108]BEIS (2019) Renewable Heat Incentive Monthly Deployment Data May 2019
[109]Energy Systems Catapult (2019) Living Carbon Free: Exploring what a net-zero target means for households

The heating experience itself is also different to that of a gas-fired central heating system. In order to operate optimally, heat pumps may have to run continuously[109]. Radiators tend not to get as hot and in the winter the heating may need to be on all of the time to maintain a comfortable temperature. This can be managed with appropriate consumer support and education.

Finally, heat pumps do have a relatively high cost, with the appliance and installation costs for GSHPs currently costing £10,000-£18,000 [110]. ASHPs are forecast to cost £6,500 by 2025,[111] not including the required fabric retrofit. Some argue that these costs could reduce by 20-30% with volume,[112] although others contend that the supply chain is already developed, so there is limited scope for reduction[113].

Roll-out scenarios for electrically powered heating

Whilst deployment is low, electrical options like heat pumps and storage heaters can be installed incrementally, as natural gas boilers break and require replacement. This means in the short term there is no need for coordinated, simultaneous switch-over of technology across communities.

However, in the longer term, in the case of higher rates of technology deployment, increasing demand from growing electrical heat will require significant upgrades and reinforcement of both the electricity transmission and distribution network[114]. This means deployment of heat pumps will have to be well-coordinated with wider energy infrastructure changes on a regional and national level, although households would still have some choice as to when the switchover of appliances in their home happens. It also means there will be potential disruption to homes and communities during the reinforcement of the grid. Mass roll-out will also need to take account of other major changes such as the impact on the grid of the move to electric vehicles.

[110]Energy Savings Trust https://www.energysavingtrust.org.uk/renewable-energy/heat/ground-source-heat-pumps (Accessed May 2019)
[111]Committee on Climate Change (2019) Net Zero: The UK's contribution to stopping global warming
[112]Evidence supplied to this inquiry
[113]BEIS (2018) Future framework for heat in buildings
[114]Rambol (2019) alternative heat solutions converting a town to low carbon heating

4.13 Gas hybrid heat technologies

Hybrid heat pumps have been suggested as a potential transition step in decarbonising heat[115], and may offer longer term decarbonisation in combination with low carbon gas. A recent collaborative demonstration – the Freedom Project – was conducted to examine the potential for domestic hybrid heat pumps[116]. Wales is also developing plans for thousands of homes to be part of a large-scale smart hybrid heating trial[117].

Hybrid heat pumps can be retrofitted around existing natural gas boilers. Given that the natural gas boiler supplies heat at peak demand when it is coldest and the heat pump is least efficient, there is no need for the extensive energy efficiency upgrades or larger radiators that are required for full heat pumps. This could minimise in-house disruption[118]. It also reduces the peak demand on the electricity grid, which is in turn minimises disruption to communities by reducing required reinforcement to electricity infrastructure.

The majority of heat in a hybrid heat system is delivered through the ASHP, so for most of the time the heating experience will be similar to that covered in the electrical heat section above, and will have some of the same challenges. The key difference is that heat from the boiler is provided at the coldest periods, so homes would still have the type of heat currently delivered from their natural gas systems at the times when experience of heat is most important to households. Hybrid heat pumps do typically require a reasonably large external unit fitted to the outside of the property as well as the existing boiler, which may prove a barrier aesthetically, and for smaller properties. The size and design of this may improve through further deployment[119.]

Hybrid heat pumps are forecast to cost around £7300 to install in 2025[120]. Lifetime costs of hybrid heat pumps, including capital and operation costs is around £19,000 without the RHI or any other policy rebalancing or new incentives[121]. This means that without new financial policies it is still not cost-effective for on-gas-grid homes, although it is already cost-effective in off-gas-grid homes that use LPG (see box 3).

Roll-out scenarios for hybrid powered heating

Hybrid heat pumps are considered a useful transition technology. Firstly, they can increase awareness and familiarity with heat pump technology. Secondly, they can minimise disruption to households because radiators will not need to be replaced and additional energy efficiency would not be required. Finally, they enable optimisation of existing gas and electricity infrastructure by reducing demand on the electricity network at peak times, particularly if used in combination with smart controls. This minimises the need to upgrade the electricity network, which means that households can switch incrementally onto hybrid heat pumps as and when natural gas boilers break and require replacing, without requiring coordination with larger infrastructure changes.

Ultimately to reach very low levels of emissions, the back-up boiler would either need to be run off biomethane or converted to run off 100% hydrogen, or the system would need to be upgraded to a full heat pump or full hydrogen system, depending on eventual direction of heat policy[122]. This does therefore run the risk of being a less efficient pathway to decarbonising heat than other roll-out scenarios discussed. Given that hybrid systems eventually require the gas supply to be very low carbon, having 'hydrogen-ready' boilers in place may be something the government should consider, as discussed above.

[115]Committee on Climate Change (2018) Hydrogen in a low carbon economy
[116]WWU (2018) Freedom Project
[117]Evidence given to this inquiry- announcement expected later this year
[118]WWU (2018) Freedom Project [119]Evidence given to this inquiry
[120]Committee on Climate Change (2019) Net Zero: The UK's contribution to stopping global warming
[121]Evidence given to this inquiry
[122]Committee on Climate Change (2019) Net Zero: The UK's contribution to stopping global warming

4.14 District heat networks

District heating is well established in other countries, such as in Scandinavia. In the UK, the Heat Networks Delivery Unit supports local authorities in England and Wales with funding for heat network development. Thus far over £19 million has been awarded, supporting more than 200 projects spread over 140 local authorities[123].

District heat networks are suited to dense urban areas. While many existing networks use heat from a natural gas source, alternative heat sources (such as waste heat from industrial processes, heat pumps or other sources of low carbon heat) could be added to the network without disruption to the end user[124]. However, housing does not generally have the density and heat demand profile to make heat networks worth investing in, unless it is also connected to buildings with a constant heat demand like swimming pools.

The initial building of district heat networks may be relatively disruptive both to homes and communities. Heat supply pipes and cooler return pipes need to be laid between the heat generation source or the thermal store of heat, which would require some disruption to roads and other communal areas. Within homes themselves, boilers would need to be removed and new secondary heat supply pipes would need to be installed. However, once connected, district heat networks tend to be lower maintenance than other systems from a householder perspective (with no heating generation asset to replace or repair) and the heat experience of those on district heat networks, in combination with smart controls, should be similar to natural gas heating, with hot water supplied to radiators and hot water tanks. In an optimal scenario district heat networks could save an average consumer £100 a year compared to those using gas[125]. In reality, however, there have been some negative experiences of higher costs for consumers on heat networks[126], which is partially due to the current lack of statutory consumer protection for heat networks[127].

Roll-out scenarios for district heating

District heat networks require the public or private sector sponsoring organisations which are planning to own the heat network to coordinate building new heat infrastructure with removing heating appliances in homes that are connecting to the network. One problem with planning a roll-out of district heat networks is ensuring that demand will be high enough to ensure certainty of return on the high capital cost of building the network, and reduce the risk of investment[128]. In Denmark, where 60% of homes are supplied by district heat networks, they overcame this by introducing zoning of certain areas. This required areas to connect to district heat networks, thereby ensuring a certain level of demand[129]. This might be an option in the UK, especially as much of the interest in district heat networks in the UK thus far has been through publically owned social housing, which would be easier to 'zone' than the owner-occupier sector. However, this does mean that these households get a fairly limited choice over when and how their heating systems are decarbonised.

[123]BEIS (2019) Heat Networks Delivery Unit
[124]Energy Systems Catapult (2019) Living Carbon Free: Exploring what a net-zero target means for households [125]The Association for Decentralised Energy https://www.theade.co.uk/resources/what-is-district-heating (Accessed June 2019)
[126]BEIS (2017) qualitative research with consumers and operators of heat networks
[127]Competition and Markets Authority (2018) Heat networks market study
[128]Energy Technologies Institute (2018) district heat networks in the UK potential, barriers and opportunities
[129]Anna Chittum et al, Energy Policy (2014) How Danish communal heat planning empowers municipalities and benefits individual consumers

4.2 Importance of pilots of low carbon heat

There are already many low carbon heating pilots planned or in development, so the next step is ensuring these projects are supported and in progress soon. However, care should be taken to reduce the possibility of participants in these trials having a negative experience. Pilots must be carried out in safe way, with work done to a highest standard, and it is important that understanding and consent of households is ensured prior to moving to a new heating system, and that there is good follow up and troubleshooting if things go wrong. Trials should also be coordinated to ensure there is no duplication. The Central Delivery Authority proposed in Section 3 could be in charge of this.

Box 3: Decarbonising off-gas grid homes*

Homes off the gas grid make up about 15% of the homes in the UK, and include heating systems fuelled by direct electric, LNG, oil and solid fuel systems. The government has an ambition of phasing out high carbon heating systems in off-gas-grid residential buildings during the 2020s, starting with new build. Off-gas-grid homes tend to be rural and with lower energy efficiency than on-gas-grid properties.

The potential technologies that could replace these heating technologies are similar to those on-gas-grid properties, and include heat pumps, hybrid heat pumps and district heat networks in areas where building density makes it most cost-effective, such as in flats. There is also greater scope for biofuels like bio-LPG to play an immediate role either on their own as a replacement for LPG or in combination with hybrid heat pumps, given the greater bioresource in more rural areas than in typical on-gas-grid areas. Some evidence suggests that hybrid heat pumps may already be cost-effective in off-gas-grid homes that are heated by LPG. Biofuels are likely to be more expensive than their fossil fuel equivalents, but may reduce the disruption and hassle factor to households - for example, bio-LPG can just be 'dropped into' existing LPG supply chains as it doesn't require new infrastructure or heating assets. This may be a medium-term option, depending on whether government judges this is the best use of bioresource out to 2050.

Urgent at-scale action taken from now, with a full decarbonisation strategy in delivery by 2025

BEIS' 2020 Heat Roadmap should be published in early 2020 and include funding for at-scale pilots of low carbon heat in homes around the UK.

**Information from: BEIS (2017) Clean Growth Strategy; Energy Networks Association (2016) Biopropane for the off-grid sector; BEIS (2018) Future Framework for Heat; Wales and West Utilities (2018) Freedom Project; evidence given to this inquiry by UKLPG*

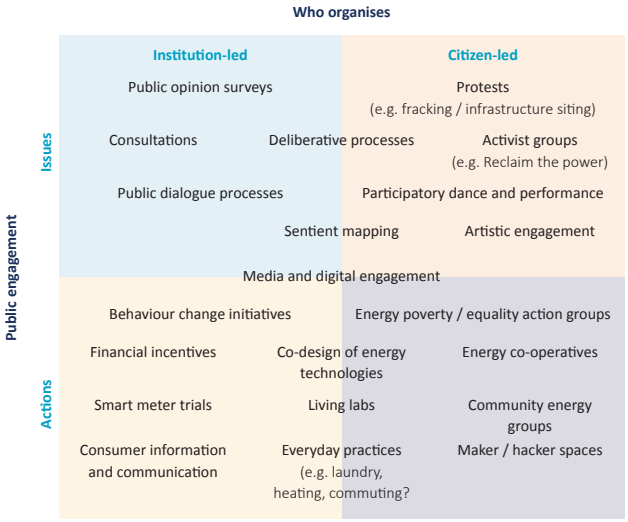
5. Public engagement with a heat transition

Chapter Overview

A low carbon heat transition requires changes in almost every home in the country. Government needs to be sure that their strategy for heat decarbonisation is widely acceptable to the public, and that the public is at the very least aware and informed, and ideally engaged and supportive. There needs to be national and regional information campaigns to raise awareness of the transition that are clear, easy to understand and honest. On a local level, BEIS should pilot different ways of engaging communities, including through community owned heat, road shows and showrooms. As well as supporting increased engagement, BEIS should explore options to better understand and integrate public preferences into low carbon heat policy, for example, through processes like citizens' juries and better mapping of engagement initiatives, including those that are not government-led. Finally, low carbon heat also needs to be able to offer some tangible benefits over current heating systems. There should be continuing trials of innovation like heat as a service that can help to make low carbon heat attractive, visible and responsive to the needs of households.

5.1 What would a good engagement strategy look like?

Engagement with policy can range from one-way communications campaigns and awareness raising, to consultation or knowledge-exchange activities, to the public actively participating in decision-making[130]. In energy, public engagement activities tend to focus on specific engagement (e.g. testing public opinion or attitudes through polling or focus groups) in specific parts of the energy system (e.g. certain technologies, transitions or policies), from which policy decisions can be made. In contrast, a broader approach to public engagement with energy is likely to be required to facilitate the profound societal changes necessary in a transition to a low carbon society[131,132]. This type of engagement strategy is important firstly to ensure a more engaged public, and secondly to help policy-makers make better policy through improved understanding and integration of public attitudes and preferences.



Overall, a public engagement strategy with low carbon heat should support citizen-led, grassroots, and community engagement, as well as more traditional communications and consultative processes (see Figure 4 overleaf)[133]. It should be a multi-level public engagement process, including at a national and local level, that delivers a mixture of different activities that encourage active reflection and participation and tap into positive social norms[134,135]. Public engagement activities have to take place alongside a programme of other interventions to produce lasting impact: for example, financial incentives and regulations that create an enabling environment where changing to lower carbon behaviours and heating systems is easy[136]. These different aspects of an engagement strategy are explored in more detail in this section.

Figure 4 - The Energy Public Engagement Matrix, from UKERC (2017) Public Engagement with Energy: broadening evidence, policy and practice.

[130] Burgess and Chilvers (2007) Science and Public Policy, Issue 34
[131] Pidgeon, N.F., Demski, C.C, Butler, C., Parkhill, K.A. and Spence, A. (2014) Creating a national citizen engagement process for energy policy. Proceedings of the National Academy of Sciences of the USA, 111 (Sup 4), 13606-13613.
[132] Chilvers J, Pallett H and Hargreaves T. (2018) "Ecologies of participation in socio-technical change: The case of energy system transitions." Energy Research & Social Science 42: 199-210
[133] Chilvers, J., Pallett, H. & Hargreaves, T., UKERC (2017) Public engagement with energy: broadening evidence, policy and practice
[134] Parliamentary Office for Science and Technology (2010) Climate Change: Engagement and Behaviour
[135] Climate Outreach (2019) Mainstreaming low carbon lifestyles
[136] Parliamentary Office of Science and Technology (2010) Climate Change: engagement and behaviour

5.11 Nationwide communications and awareness raising campaign

Narratives to frame a transition to low carbon heat

Government policy must provide a clear sense of direction for where heat in the UK is headed. This should include why the transition to low carbon heat is needed; how it fits into wider changes of decarbonisation, decentralisation and digitalisation in the energy system; who will benefit from the transition; and a vision for how low carbon heat in the UK will look[137]. This wider framing and vision should be subject to wider public debate early on and then built into subsequent engagement strategies to provide a clear sense of purpose.

Framing is particularly important in engagement strategies. Low carbon heat will impact on more than just reducing our carbon emissions, and therefore the framing of the transition should be on more than just climate change. It is also important that the framing is used to tell an authentically positive story about how low carbon lifestyles can have many and varied co-benefits [138]. For example, low carbon heat in combination with energy efficiency upgrades and smart appliances could promote better health by providing a home with exactly the right temperature and humidity to promote inhabitants' health: an important angle, given the large number of deaths directly linked to too-cold or too-hot homes in the UK[139] and that two thirds of homes in the UK report issues with draughts, damp or mould[140]. Similarly, low carbon heat could promote healthier air in larger urban centres: in London, natural gas boilers are predicted to overtake transport as the biggest source of nitrogen oxide (NOx) pollution in London by 2025[141]. Switching from natural gas will also reduce illness and death from CO poisoning. The framing of low carbon heat should also try to align with people's general understanding and experience of energy, which in the UK tends to be as a basic right rather than as a commodity[142].

There are plenty of possible framings. It is important that whatever framings are ultimately used, they are simple to understand and honest. Previous technology roll-outs demonstrate the risk to public acceptability and uptake in the absence of this. For example, the smart meter rollout was originally promoted on the financial case that smart meters could save consumers money, rather than the main reason government wanted to roll them out, which was to enable an energy system fit for the future by putting a data point in every house. People were also confused about what actually constitutes a smart meter. Confusion and scepticism on the financial case for smart meters are two reasons for low public acceptance of smart meters to date[143]. Similar reasons led to the failure of the Green Deal, which was also sold on the pretext of the financial case rather than on improving comfort or health (see Lessons Learned 4 on the next page). Any framing will also have to respond to how public debate and societal concerns about decarbonising heat emerge over time. We cover how framings for low carbon heat might adapt to public debate in Section 5.14.

[137]Evidence provided to this report by multiple respondents
[138]Climate Outreach (2019) Mainstreaming low carbon lifestyles
[139]Committee on Climate Change (2019) UK Housing: Fit for the Future?
[140]Energy System Catapult (2018) How can people get the heat they want at home without the carbon?
[141]Greater London Authority (2018) Domestic Boiler Emissions Testing
[142]Christina Demski et al (2019) Acceptance of energy transitions and policies: Public conceptualisations of energy as a need and basic right in the United Kingdom
[143]Centre on Innovation and Energy Demand (2018) The smart meter rollout: Social questions and challenges

Lessons Learned 4: The Green Deal*

Launched in 2013, the 'Green Deal' was designed to help homeowners improve the energy efficiency of their properties without the upfront capital costs. Instead the cost of the improvements would be paid for in instalments via energy bills. A key part of the policy required that improvements complied with the 'Golden Rule' whereby the anticipated savings on bills from enhanced energy efficiency must be greater than the loan repayments. Available improvements included loft- and cavity-wall insulation, solar thermal generation and air source heat pumps. Should the occupier move, the burden of the payments remained with the property and the new owners or tenants became liable for the costs.

In July 2015 the government announced that the Green Deal would be scrapped, a mere two and a half years after its launch. The policy is now considered to have been a failure. This has been attributed to a combination of factors, including poor policy design. Interest rates were higher than those for mortgages or high street loans, thus limiting the scheme's financial appeal. Consumer engagement was focused primarily on the financial benefits of the policy and failed to communicate the potential for enhancing comfort, health and well-being.

National Audit Office analysis provides an insightful comparison between the Green Deal and the Energy Companies Obligation (ECO), both policy tools designed to improve domestic energy efficiency. By 2015, accessing Green Deal finance had led to 20,000 installed measures across 14,000 homes, resulting in anticipated carbon savings of 0.4 million tonnes of CO_2 over the lifetime of measures installed by 2017. In stark contrast, ECO – an obligation on suppliers – resulted in 1.7 million measures installed across 1.4 million homes over the same time period, with anticipated carbon savings of 33.7 million tonnes CO_2.

Using different channels to engage the public nationally

Since awareness of low carbon heat is currently very low, an awareness raising and information strategy at a nationwide level should aim to engage people from all parts of society. Not everyone will want to engage in the same way, and many people will not want to engage with low carbon heat at all. Creative approaches and a variety of different channels are needed to reach as many people as possible.

Experience demonstrates the importance of using different channels to engage the public. For example, in the digital switchover (see Lessons Learned 3), Digital UK used TV, radio, outdoor and press advertising nationally[144]. Similarly, during Switzerland's deployment of heat pumps (see Lessons Learned 5), the Swiss Government carried out direct TV advertising[145] alongside regional community events in each Swiss region.

Awareness raising at a national level could therefore include national media pieces; traditional advertising by government and industry, including through social media and television; encouraging a discussion in popular media (for example, on national radio and television talk-shows or in the home improvement genre[146]) and exhibitions in public spaces such as in large museums.

**References: Rosenow, J. and Eyre, N. (2016) A post mortem of the Green deal: austerity, energy efficiency and failure in British energy policy. Energy Research & Social Science, 21. pp. 141-144; National Audit Office (2016) Green Deal and Energy Company Obligation*

[144]Digital UK (2012) Digital TV switchover 2008-2012: Final Report
[145]UKERC (2016) Best practice in heat decarbonisation policy: A review of the international experience of policies to promote the uptake of low-carbon heat supply
[146]UKERC (2016) Best practice in heat decarbonisation policy: A review of the international experience of policies to promote the uptake of low-carbon heat supply

Ensuring good quality public discourse on low carbon heat

Encouraging conversation and debate around low carbon heat will be important in exploring the acceptability of different aspects of the transition and raising awareness of the issue. However, caution must be taken to ensure good quality public discourse. Decarbonising heat is a complex area, and the temptation to simplify the discussion should be avoided. Similarly, negative perceptions and misinformation could easily distort the discussion. This must be mitigated for in a public engagement strategy. A key way of ensuring this is to make sure that policy is responsive to how public debates evolve over time. Attempts to control public debate around the introduction of new technologies have often been shown to fail (for example, with fracking).

5.12 Options for local and community engagement with low carbon heat

Local and community engagement with low carbon heat can help households to see how low carbon heat will work on a tangible level in their community, and, in the case of community-owned energy, can help to generate local buy-in for the transition to low carbon heat[147]. Government should pilot a number of different engagement options with communities to ascertain which will provide the best quality engagement. Some of these options are explored below.

Using different channels to engage with local communities

Government should use a number of different channels to increase local engagement with low carbon heat. This might include coverage in local media; public exhibitions, displays and roadshows in visible local buildings; and meetings, planning events and local consultations. Research by UK100 suggests that public displays, roadshows, exhibitions and local press are the best ways to engage community members in environmental decision making[148]. International experience has also pointed to the importance of engagement with local communities through local trade fairs and information dissemination events in public places to encourage uptake of low carbon heating[149]. Previous local engagement in the UK, such as Digital UK (see Lessons Learned 3) also used multiple channels to reach a wide audience, including local TV, radio, outdoor and press advertising, roadshow events and information booklets delivered to each household. Digital UK also partnered with local charities to deliver community outreach events and advice points. In the condensing boiler roll-out, they also used show-rooms to demonstrate to households how the technology worked (See Lessons Learned 2).

Large scale pilots of low carbon heat

Larger pilots for low carbon heating options will be key in engaging communities with the transition to low carbon heat and building trust in the reliability of low carbon heating technologies. For example, work by the Energy Systems Catapult showed that those already involved in a pilot of new heating services were much more likely to be open to installing low carbon heating than those who were just targeted through online advertising (over 25% vs. 0.1%)[150]. Larger scale pilots can also begin to test public acceptability for disruption at a community scale, for example, digging up roads for new pipelines or electricity network upgrades. There is already some research happening in this field: for example, Hy4Heat is developing plans for early community trials of using hydrogen for heat. As we covered in Section 4, care needs to be taken that participants in pilots are well supported and that the pilots are well designed and carried out to the highest standard to minimise negative experiences and reduce the risk of a subsequent loss of trust in low carbon heating systems.

[147]Community Energy England (2014) What is Community Energy & Why Does it Matter?
[148]UK100 (2017) Powerful People, powerful places
[149]UKERC (2016) Best practice in heat decarbonisation policy: A review of the international experience of policies to promote the uptake of low-carbon heat supply
[150]Energy Systems Catapult (2019) Smart Systems and Heat Phase 2 Summary of Key Insights

Community-owned low carbon heat and demonstration projects

Meaningful consent for energy transitions requires a sense of involvement with decisions taken locally[151]. Research suggests that a significant portion of people want local energy and environmental projects that see local benefit, and may want to be involved if opportunities arise[152].

Community owned heat projects may therefore be one way to engage communities with the low carbon heat. There are already various community owned heat projects across the UK. These are primarily biomass boilers or CHP, with only about 0.3MW of community owned heat coming from heat pumps in 2017[153]. However, there have recently been some promising community pilots using heat pumps, for example, using residual heat in parks to generate heat for local community buildings[154]. There has also been some international experience of community owned heat: for example, in Denmark the majority of district heat networks - which supply over 60% of homes - are municipal or community owned cooperatives. This means that any profits are returned to consumers in the form of cheaper heat, and consumers have control over many aspects of how the district heat network operates and who controls it, which has made them popular with the Danish public[155].

Community engagement will be especially important for whole areas switching over to one type of low carbon heat in a single programme of work, due to new or upgraded infrastructure requirements. In these areas, the public will have to be highly aware of the transition, and some may want to be closely engaged. Community owned heat might be one of the ways for those who want to be involved to have some control over the switchover to low carbon heat in their area.

It is out of scope of the report to suggest what policy mechanism should be pursued by government to support community energy and heat, but there are a number of options that have proved successful in the past. This includes facilitating training opportunities and workshops in the community, and facilitating the creation of a 'community champions programme' for specific issues, where residents are invited to take leadership on an issue of importance and engage their fellow neighbours.

5.13 A nation-wide deliberation process for low carbon heat

Deliberative engagement processes include citizens' juries, citizens' assemblies, citizens' panels and large-scale liaison and consultation programmes. These processes would allow participants to explore in detail the implications of a transition to low carbon heat and the trade-offs that may be required. Deliberative public engagement can inform policymakers on in-depth public views on an energy transition and help navigate a publicly acceptable path to decarbonised heat. The aim of this would be better-informed decisions on how the overall transition to low carbon heat should be implemented, managed and governed[156].

[151]Centre for Sustainable Energy (2017) Towards meaningful public consent to cut UK emissions
[152]UK100 (2017) Powerful people, powerful places
[153]Community Energy England (2018) State of the Sector Report
[154]Owen Square Community Energy (2017) CHOICES Phase 3 Project Report
[155]Anna Chittum et al, Energy Policy (2014) How Danish communal heat planning empowers municipalities and benefits individual consumers
[156]Involve https://www.involve.org.uk/resources/knowledge-base/what/deliberative-public-engagement (Accessed May 2019)

Deliberative engagement, and particularly citizens' assemblies, have been extensively discussed recently as a way of facilitating a transition to a clean energy system. Six UK select committees recently announced they would be holding a citizens' assembly on the fairest and fastest way to end the UK's contribution to climate change[157]. This builds on their success in helping the Health and Social Care Select Committee develop a range of principles behind the government's Green Paper on long term funding for adult social care in 2018[158], and in helping the Irish Government in addressing a variety of issues, including abortion and equal marriage rights[159].

This type of engagement could also be a way of helping policymakers to understand in particular how low carbon heat can benefit low income, fuel poor or vulnerable households. Such households are very diverse, so engagement could help policymakers to learn from the households themselves how they can best be supported through the low carbon heat transition - including whether they should be involved in early trials[160].

Deliberative processes can be resource intensive, and the process must be carefully designed to ensure it is transparent and that recommendations are properly considered in eventual policy development. But given that they could result in a better-informed decision on how the overall transition to low carbon energy is managed they should be considered seriously as a valuable tool for government in its engagement strategy.

5.14 Mapping engagement

Engagement should not only be in the form of a centralised process managed by government and agencies. Many diverse forms of engagement will emerge around decarbonising heat beyond formal government-led engagement process. Alongside deliberative processes and citizen's assemblies to inform decision-making, there is an additional need to map and understand existing and emerging public engagement with decarbonising heat on an ongoing basis to ensure that policies incorporate public perspectives and values. The UK Energy Research Council (UKERC) is currently setting up an 'observatory' of public engagement in energy and zero carbon transitions that will map public engagement with heat over the next 5 years. This process is likely to become increasingly important as heat decarbonisation is rolled out[161]. Government should consider how to incorporate the findings of the Observatory into low carbon heat policy on a continual basis.

Households must feel properly informed, advised and engaged

Government should lead a public engagement programme on low carbon heat, including:

- ✓ A nationwide information campaign.
- ✓ Regional awareness strategies and local community-led schemes, potentially including community-owned heat, roadshows or showrooms.
- ✓ Citizens' juries type arrangements to shape heat strategies at a national or regional level.
- ✓ Processes to map, monitor and incorporate public engagement initiatives with low carbon heat into policymaking on an on-going basis.

[157]BEIS select committee https://www.parliament.uk/business/committees/committees-a-z/commons-select/business-energy-industrial-strategy/news-parliament-2017/climate-change-and-net-zero-chairs-comments-17-19/ (Accessed July 2019)
[158]Involve (2018) Citizens Assembly on Social Care
[159]The Citizens Assembly (2018) The Citizens Assembly Fact Sheet
[160]Evidence given to this inquiry
[161]Chilvers, J., Pallett, H. & Hargreaves, T., UKERC (2017) Public engagement with energy: broadening evidence, policy and practice

5.2 Who should lead on awareness raising and engagement?

5.21 Different actors who could raise awareness of low carbon heat with the public

Research shows that people trust organisations to provide them with information principally when they demonstrate expertise in the issue at hand, or when it is believed that they will act in good faith and in a way which respects the consumer's own interests rather than simply their organisation's financial objectives. Different actors therefore have different strengths in the eyes of the public. Research by UKERC shows that the perception of not consistently acting in the consumer's best interests generates considerable scepticism about energy suppliers, notwithstanding having expertise in energy[162].

On the other hand, while being perceived as acting in the citizen's interest is likely to be less of an issue for Local Authorities, people may doubt their expertise and capacity to enact change. Research commissioned by Carbon Connect (see Figure 5 below) showed that the highest ranked organisations that people would trust to provide them with information about heat decarbonisation is from energy regulation organisations (like Ofgem), independent advice services and their own energy supplier, with local government the least popular option. Our polling results are different to other polling in this field where gas installers tend to be highly trusted - this is probably due to the phrasing of our question around changes to the whole energy system, rather than just to their personal heating system.

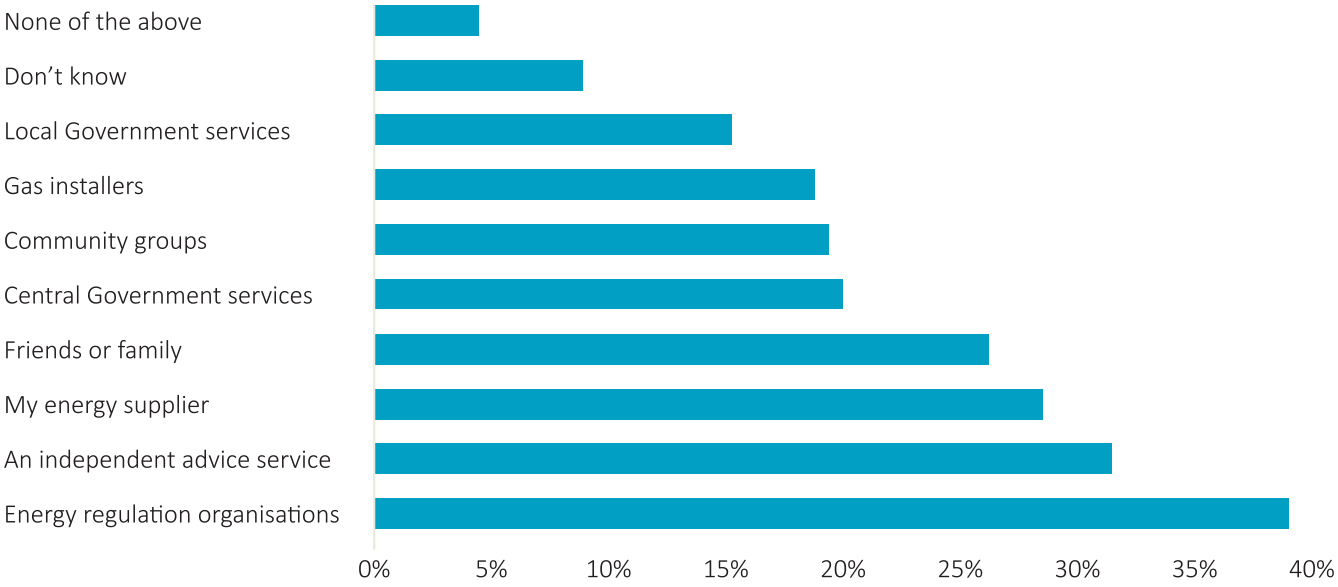


Figure 5 - Polling data for the question: 'Which of the following, if any, would you trust to provide you with information about the way in which heating systems will change, and how this change will affect you?'

[162]Becker, S., Demski, C.C., Evensen, D. and Pidgeon, N.F. (2019) Of profits, transparency, and responsibility: Public views on financing energy system change in Great Britain Energy Research and Social Science, 55, 236-246

5.22 Role of a central, independent body for coordinating engagement

Given the local nature of low carbon heat delivery and the variety of people the strategy would be aiming to reach, it makes sense to have a mixture of local and national channels for awareness raising. To avoid the risk of diluting or complicating messages about heat, it would be beneficial to have a central body to coordinate both government-led processes and wider engagement processes. Previous experience in communicating energy policy suggests that best practice would include using a single source of information that can provide a harmonised message and a streamlined approach across schemes[163]. International evidence has also shown how a single body that coordinates communications and engagement can help to harmonise different programmes of work (see Lessons Learned 5). This was also demonstrated during the analogue to digital television switchover, when Digital UK was set up to coordinate and deliver the switchover, including the national, regional and local communications and engagement strategy (See Lessons Learned 3)[164].

Overall, this suggests that a trusted, independent agent should be put in place to deliver on national engagement and awareness raising, including working with different stakeholders to reach the widest audiences possible and with local bodies implementing community-led heat decarbonisation projects. This agent could sit with the Central Delivery Authority that we propose in Section 3 and tie into ongoing UKERC with an 'observatory' on public engagement with energy.

Lesson Learned 5: Establishing A Heat Pump Market In Switzerland*

In Switzerland, a Swiss Heat Pump Association was established to promote heat pumps and coordinate marketing, coordinated by manufacturers, energy suppliers and government. They were involved in several activities to raise awareness and build trust in heat pumps, including:

- Establishing a heat pump test facility, that lead to larger heat pump field trials. Independent performance data from the test centre and field trials was promoted to gain consumer and installer trust in heat pump performance.
- Community events took place in each Swiss region, involving local utilities, installers and manufacturers, as well as local communities. Some companies also carried out more direct advertising through TV advertising: in contrast to the UK, where low carbon heat is very rarely advertised in the media.
- A new installer certification scheme, standardised training and creation of a quality label was created by the Heat Pump Association to guarantee high quality heat pumps performance.

This helped to increase trust in the heat pump technologies, contributing to the heat pump market doubling in Switzerland between 1993-1998 despite falling oil prices which made heat pumps less attractive financially and would otherwise have been expected to lead to a fall in heat pumps sales.

5.3 Engagement Strategies: How can low carbon heating be made visible and desirable?

It is important that low carbon heat can also offer something desirable to households. Below we set out some options for making low carbon heat more visible and attractive to households.

**Information from: UKERC (2016) Best practice in heat decarbonisation policy: A review of the international experience of policies to promote the uptake of low-carbon heat supply*

[163]Committee on Climate Change (2016) Next Steps for Heat Policy
[164]Digital UK (2012) Digital TV switchover 2008-2012: Final Report

5.31 Improving heating controls

Smart controls like automation, zonal control or weather compensators can offer an enhanced heating experience. Research has shown how maximising the control people have over how they heat their homes can be a powerful way to engage them with the energy they use at home. Once they can control the heating in their homes, people become much more aware and able to articulate the heating experiences they want, and when and how they want that heat delivered[165].

Smart controls don't lead to people installing low carbon heat technologies on their own, but if smart controls are embedded in new low carbon heating upgrades in such a way that increases thermal comfort and control, it could create a market pull towards low carbon heating[166]. For example, in one pilot that combined smart controls with low carbon heating, an app that allowed remote control of heating was one of the most appealing aspects of the whole trial, building trust in the system and engendering a feeling of control[167]. There is also an important opportunity to increase the appeal of low carbon heating if it can help to solve widespread problems like damp, overheating and draughts[168]. Smart controls in heat do require education of households in how the controls can be used, and a high standard of consumer service should anything go wrong[169]. Government must also ensure that consumer's energy data is properly protected (covered in Section 6).

5.32 Heat as a service and other business models in energy

Heat as a service re-imagines the energy utilities sector, moving to consumers paying for an outcome (such as a having a comfortable home), rather than paying for the means to get there (such as paying for gas or electricity for heat). Heat as a service may involve business models that would look more like they do in the communications sector, where consumers pay a competitive fixed monthly amount for the warmth they want (for example, selling a 'heat plan', which functions in a similar way to a mobile phone plan for data, minutes and texts)[170]. This plan could also include payments towards the heating asset itself - 'heating assets as a service', where the energy retail company effectively owns the heating asset, and the household pays a monthly fee to use it, although in reality this appears challenging from a consumer protection perspective, as we cover in Section 6.6.

Heat as a service could have various benefits. For example, it encourages the energy supplier to offer a better, tailored service to consumers which helps to engage consumers with their energy usage. The concept of buying a warm home may also be more intuitive than buying a certain number of kilowatt hours[171]. Building a longer-term relationship between energy retailers and consumers can also help to build trust in the energy system.

Similarly to smart controls in heating, heat as a service will not, in itself, help drive a low carbon transition without a suitable package of decarbonisation policies in place, but some emerging research suggests it can create an environment where people are more open to taking up low carbon heating[172]. For example, Energy System Catapult's pilots of energy services, including 'Heat Plans' (which offered different plans for certain number of 'warm hours' a week, with differing flexibility for additional heating use), found that participants who used their 'Heat Plans' were particularly open to having an alternative heating option than households not using these types of energy services[173].

[165]Energy Technologies Institute (2018) How can people get the heat they want at home, without the carbon?
[166]Energy Systems Catapult (2019) Pathways to Low Carbon Heating: Dynamic Modelling of Five UK Homes
[167]Wales and West Utilities & Western Power Distribution (2018) Freedom Project
[168]Energy Technologies Institute (2018) How can people get the heat they want at home, without the carbon?
[169]Evidence given to this inquiry
[170]Energy Systems Catapult (2019) Smart Energy Services for Low Carbon Heat
[171]BEIS (2018) Public Attitudes Tracker Wave 26
[172]Energy Systems Catapult (2019) Smart Systems Services for Low Carbon Heat
[173]Energy Systems Catapult (2019) SSH2: Field Trail Learnings Insight report

5.33 Energy efficiency upgrades

As we covered at the start of the report, we have assumed that energy efficiency will be deployed at rates advised by the Committee on Climate Change Net Zero report, since energy efficiency is crucial to reducing demand for energy from households[174]. However, improving the energy efficiency of buildings as part of a low carbon heat upgrade is also an important way both to make low carbon heat more visible and attractive to the public, and to engage households in a transition to low carbon heat.

Improving efficiency and reducing waste is an important principle that people believe should underpin an energy system change[175]. Improving energy efficiency is an intuitive way to get households thinking about their contribution to climate change. Furthermore, homeowners are interested in comfort and reducing universal problems such as draughts, which could be tackled with energy efficiency upgrades. Messages focused around improved comfort and warmth, alongside messages around saving money[176], is therefore one way to make low carbon heating in combination with energy efficiency upgrades more attractive to householders. Such messaging would be especially effective if targeted at those households who are already looking to undergo other types of home improvements like renovations[177].

Energy efficiency has historically not been perceived by households as increasing the value of their home or contributing to wider environmental issues like climate change[178]. This means that a package of other mechanisms which reinforce this message is required, as discussed elsewhere in the report, including financial incentives like green mortgages or reduced stamp duty for energy efficient and low carbon homes; near-term strengthened regulations in the private rented and social housing sector; and an awareness raising and engagement campaign linking emissions from the home to wider climate change.

5.34 Funding innovation in low carbon heating and energy efficiency

Overall, it makes sense to invest in continuing innovation that seeks to make low carbon heat visible and attractive to consumers. This includes innovations that improves the efficiency and cost-effectiveness of existing low carbon heating options and through further development of new energy service models like heat as a service and smart controls in heating. Other commentators have suggested this could be through a nationally funded innovation competition for heat[179].

This inquiry also heard that there is an additional need for funding to protect consumers and businesses who are early adopters of technologies and innovations in heat. This can ensure that if something goes wrong in an innovation trial for low carbon heat, solutions can be quickly put in place without households being put at risk from a poorly performing heating system, or businesses suffering reputational risk. This can mitigate the risk of negative experiences and reduce the risk of damaged trust in low carbon heat.

Low carbon heat must become attractive and visible to households

BEIS should run an innovation competition for low carbon heat to reduce barriers for existing and new entrants to the market and make low carbon heat more attractive or visible to households, for example through heat as a service.

[174]Committee on Climate Change (2019) UK Housing: fit for the future?
[175]UKERC (2013) Transforming the UK Energy System: Public Values, Attitudes and Acceptability Synthesis Report
[176]Consumer Focus (2012) What's in it for me? Using the benefits of energy efficiency to overcome the barriers
[177]Energy Saving Trust (2015) Connecting with homeowners: making energy efficiency relevant
[178]Citizens Advice (2016) Energising homeowners
[179]Exeter Energy Policy Blog http://blogs.exeter.ac.uk/energy/2019/08/09/a-heat-and-buildings-decarbonisation-policy-framework-for-a-zero-carbon-uk/ (Accessed August 2019)

6. Consumer rights and protection

Chapter Overview

Government has to be confident that consumer protections are sufficient to protect the large number of households who will be transitioning to low carbon heat. Current protections do and do not cover sources of heat that use non-traditional channels (such as district heat networks), and current schemes for installer standards often overlap and do not cover all the different low carbon heating options. There are also insufficient advice services in much of the UK. In contrast, Scotland's regional energy advice services which offer free home visits provide a gold standard the rest of the UK should follow. Finally, more developed thinking is needed on how to place households at the centre of decisions around when, where and how low carbon heat is delivered, particularly for low carbon heating solutions that require zoning. This includes guidance on required engagement from communities, acceptable levels of choice, and acceptable disruption for households.

6.1 Consumer rights in a transition to low carbon heat

6.11 Choice and mandating

One of the more difficult issues in decarbonising heat is around the extent to which consumer choice and market forces can be allowed to dictate how the transition to low carbon heat is delivered, rather than local or national government mandating the roll-out of certain technologies.

This is a particular problem for retrofitting low carbon heat in existing buildings. For new build, government has already signalled its ambition that all new homes will have low carbon heating by 2025. Government therefore only needs to ensure the capability of construction companies and local infrastructure to install low carbon heating in this sector. On the other hand, the issue is more complicated for existing homes that people already live in. What are a person's rights over their heating technology? Should they be able to choose what technology is installed in their home, even if it isn't the most efficient choice for the energy system as a whole?

There must be a certain amount of government intervention on a nationwide level. Firstly, given that natural gas is currently cheaper than low carbon heating fuels, there is no economic incentive to move away from high carbon heating systems without government setting long-term targets that remove these as heating options at some point in the future[180]. Secondly, the transition to low carbon heat requires new or upgraded infrastructure. Decisions on this new infrastructure, including how it will be funded, are currently made centrally. The electricity, gas and other energy networks are also regulated monopolies and therefore need government and regulatory support and direction to move towards decarbonisation[181].

Whilst on a national level a certain amount of government intervention is required, on a local level there is still debate around the extent to which specific low carbon heat technologies should be mandated. On the one hand, it makes sense for particular technologies to be mandated to some extent. It is not likely to be practical to deploy infrastructure for every type of low carbon heat solution in all areas[182], and each location may be best suited to a certain technology mix, depending on factors like housing stock, local resources, demographics of local populations, and whether it is rural, urban or somewhere in between[183].

[180]Energy Systems Catapult (2018) Cost Reflective Pricing in Energy Networks
[181]Imperial College London (2015) Energy System Crossroads – Time for Decisions
[182]Imperial College London (2016) Managing Heat System Decarbonisation
[183]Energy Systems Catapult (2018) Local Area Energy Planning: Supporting clean growth and low carbon transition

However, this is difficult from a householder perspective. First, the technology or level of fabric retrofit that is most appropriate for a particular household will vary widely even between identical house types, due to factors like occupancy, particular heat needs relating to age or health, and lifestyle[184]. Second, academic literature has tended to point towards the danger of viewing the public as passive participants who are 'told what to do' in energy transitions, which evidence shows often leads to ineffectual or counterproductive outcomes[185]. Finally, mandating what technology should be installed in the privacy of a home, especially if it requires the inhabitant to undergo substantial disruption, is likely to be difficult from a political point of view[186].

6.12 How much choice do households want over their heating systems?

Evidence given to this inquiry suggested that households don't always require absolute choice over what type of heating system is installed in their home, as long as they can have other types of choice. For example, research carried out for the Committee on Climate Change found that many people are willing to have constrained choice over what heating system is installed in their home in exchange for a long-term reduction in their heating bills. However this research also found that a small number of people found this unacceptable in all circumstances, believing absolute choice over their heating technologies to be paramount[187].

New business models like 'heat as a service' are promising in that they can offer other types of choice. One of the key findings from Energy Systems Catapult's Smart Systems and Heat Programme is that people care more about how heat is delivered than where it comes from[188]. New service models in energy could therefore maximise consumer choice over the heating experience in the home, even if it doesn't allow choice over the actual heating system being used. However, this will strongly rely on low carbon heating being able to offer a similar or better level of comfort, cost and convenience to current heating.

Other research has shown that people do not necessarily want choice over their heating system at all if choices are perceived to lead to unfair outcomes. For example, one study found that people were supportive of government mandating what heating technology households across the UK should install. The primary reason for this was that people wanted to avoid a 'postcode lottery' for energy, where different regions use different heating systems, which people perceive to be unfair (for example, if one area receives a certain system that performs better or is cheaper than a different system in another area)[189].

[184]Energy Technology Institute (2018) how can people get the heat they want at home, without the carbon?
[185]Royal Society (2018) Reaching a 1.5°C target: socio-technical challenges for a rapid transition to low-carbon electricity systems
[186]Evidence heard in this inquiry
[187]Sciencewise (2016) Public views on low-carbon heat technologies
[188]Energy Systems Catapult (2018) Local Area Energy Planning: Supporting clean growth and low carbon transition
[189]Madano (2018) Public acceptability of the use of hydrogen for heating and cooking in the home- Full Report

6.13 How can we place households at the centre of decisions on heating?

In reality, there will need to be a balance between allowing some consumer choice within local constraints and alongside national targets and regulation. To achieve this, government needs to develop a framework for deployment of low carbon heat that places households at the centre of decisions on when, where and what technology is deployed within local and national constraints. This means providing guidance on how different technologies should be deployed, how to maximise other types of choice, and measures of acceptable disruption and required engagement.

This must include various options that can help people to feel in control of the way heat is being delivered, for example:

- Offering different ways of paying for installation of low carbon heat or for heating bills.
- Incentivising energy companies to offer different types of energy services.
- Offering choice over what model of heating technology is put in (for example, a basic or premium model).
- Offering choice over when a low carbon heating technology is installed, where possible. For example, some technologies such as hybrid heat pumps can be installed as part of the normal boiler replacement cycle, minimising disruption. These technologies should be maximised in appropriate areas. Other heating options - particularly 100% hydrogen in the gas grid and district heat networks - require that certain communities all move onto the new network in a single programme of work. These areas would benefit the most from strong community engagement in the heat transition process.

Ultimately the extent to how much choice over a specific heating system is desired will also depend on a number of factors, including the attractiveness of the new heating systems in terms of cost, visual impact and heat delivery.

6.2 What would a good consumer protection strategy look like?

Overall, government needs to be certain that the consumer protections in place are sufficiently strong and broad enough for the large numbers of different households that will be switching heating systems over the next 30 years. It also has to be sure that protections cover all the different types of low carbon heating options and how low carbon transitions are implemented regionally, particularly in the case where the low carbon heat switchover in one region is comparatively less successful, more expensive or disruptive than in others.

BEIS is already considering consumer protection in future energy systems[190]. We suggest a review of consumer protections in the context of a future transition to low carbon heat should be a next step from this. On the following pages we consider different principles and elements that ought to make up good consumer protection in a transition to low carbon heat, and what remains to be done with regards to protections in low carbon heat.

[190]BEIS (2019) Flexible and responsive energy retail markets consultation

6.21 Principles for developing a consumer protection strategy for low carbon heat:

Learning from current low carbon heat roll-out in the UK suggest a number of principles that should underpin the development of consumer protection for a transition to low carbon heat. These include:

1. The rights of consumers must be the same no matter how they obtain their heat and energy[191]. Even if protections for technologies differ, the outcome should be the same.
2. Consumer protections need to be in place before the technology is rolled out. Early consumer protections in low carbon heat will be critical in shaping views about low carbon heat - for example, the lack of consumer protection in early heat networks have led to them being perceived negatively by the public[192]. However, early consumer protection needs to be flexible enough for companies undertaking pilots to establish what works, and so that if something goes wrong, solutions can be quickly put into place.
3. Consumer protections in low carbon heating systems needs to be designed and tested in a safe, iterative way to pave the way for wider roll out in the future. Early design of consumer protection can prevent problems happening before the technology is rolled out to mass market.
4. Excellent consumer service must complement high quality consumer protection. This should include highly trained installers, an easily-accessible trouble shooting service, and excellent communication before and after installation. In particular, consumers must know what they are signing up for before they switch their heating system[193]. Commercial bodies leading the transition to low carbon heat could be incentivised to offer excellent service by measuring their success using metrics of consumer loyalty or customer service[194].

6.22 Key elements of a consumer protection strategy- quality assurance and standards

Ensuring the consumer is protected during a transition to low carbon heat is clearly going to depend on a number of different components. The 'Each Home Counts' Review has already set out a number of important actions to ensure that those who are retrofitting new low carbon systems into their homes are receiving a high-quality experience[195]. Many of these actions are also supported by international experience[196] and include:

1. Establishing a quality mark for the domestic retrofit sector that clearly indicates that the installer, designer or assessor will deliver the best standards in the sector.
2. Establishing an approved certification body that awards the quality mark to installers and businesses.
3. Setting up a code of conduct for businesses that sets out the minimum requirements of good business practice, including guidance on how companies are expected to behave, operate and report.
4. Creating a consumer charter that sets out expectations around response times, redress processes and financial protections.
5. An overarching standards framework for the end-to-end delivery of retrofit of energy efficiency and renewable energy measures that has a whole building approach incorporated into the process.

[191]Evidence given to this inquiry
[192]Frontier Economics (2015) Research on district heating and local approaches to heat decarbonisation- Annex 1: Overcoming barriers to district heating
[193]Evidence given to this inquiry
[194]Evidence given to this inquiry
[195]MHCLG and BEIS (2016) Each Home Counts: Review of Consumer Advice, Protection, Standards and Enforcement for Energy Efficiency and Renewable Energy
[196]UKERC (2016) Best practice in heat decarbonisation policy: A review of the international experience of policies to promote the uptake of low-carbon heat supply

Installer standards

Some of these recommendations were recently implemented for retrofit of some types of low carbon heat through the widening of the remit of Trust Mark to incorporate retrofit and domestic energy efficiency installations in October 2018[197]. Trust Mark is currently the government endorsed quality mark for any work that is undertaken in and around the home, and it has its own consumer charter and code of conduct. It is too soon to evaluate whether Trust Mark will be effective in improving the quality of domestic retrofit of energy efficiency and heat pumps. If it proves effective at raising the standards of installations, then all low carbon heat retrofit could be included in its remit. However, it is important to point out that Trust Mark is one of many such schemes for installers - for example, the Microgeneration Certification Scheme is another government endorsed quality scheme for low carbon heating and energy efficiency. The number and complexity of schemes make it difficult to navigate and costly for installers, and could also reduce the visibility of the various quality marks to consumers, undermining their purpose.

Furthermore, installer standards for gas engineers are approved against the Gas Safety Register. They also have a customer charter and a code of conduct in their Registration Policy. If retrofitting of low carbon gas boilers forms part of a heat decarbonisation strategy, expected standards of installation, customer charters and codes of conduct could come under the Gas Safety Register's remit.

Overall, government should look to simplify the certification landscape to reduce the burden on installers. If different certification schemes are used for different types of low carbon heating, the standards must align and ensure the same outcomes for a household's experience and protections. There may also need to be increased resource for ombudsman services relating to installations of low carbon energy generation and energy efficiency.

Supplier standards

Some of these elements of consumer protection are also demonstrated by Ofgem in their Standards of Conduct for gas and electricity suppliers[198]. These standards need to be adapted for other networks that might have a single supplier (as is expected with early hydrogen networks) building in the work of the Heat Trust for heat networks (see Lessons Learned 6 below).

Lesson Learned 6: The Heat Trust*

The Heat Trust is a voluntary body set up by the Association for Decentralised Energy, launched in November 2015 in response to concern that district heat network consumers did not have the same rights as other energy customers. It is a voluntary scheme that sets out a Code of Conduct that specifies a common standard in the quality and level of customer service that heat suppliers should provide their customers, including for expected service, terms of contract and provision of information before a household joins the network . It also provides an independent process with the Energy Ombudsman for settling complaints between customers and their heat supplier. Users of district heat networks that are not part of the Heat Trust cannot access these services.

BEIS found that those heat suppliers who were signed up to the Heat Trust schemes were more likely to have excellent consumer service, rectify service interruption quicker, and provide more comprehensive billing information than those district heat networks not signed up to the Heat Trust[200]. The Competition & Markets Authority has also suggested that a future nation-wide regulator for district heat networks should draw on the principles of the Heat Trust's framework for consumer protection[201].

**Information from: https://www.heattrust.org/*

[197]Trust Mark https://trustmark.org.uk/aboutus/what-is-trustmark (Accessed June 2019)
[198]Ofgem (2017) Licence Guidance Standards of Conduct
[199]Heat Trust (2019) Scheme Rules
[200]BEIS (2017) Heat Networks Consumer Survey, Research Paper Number 27
[201]Competition and Markets Authority (2018) Heat networks market study: final report

Consumer advocacy

International experience demonstrates the importance of having an independent complaints board to help those who were miss-sold or had faulty low carbon heating technologies installed. For example, in Sweden, their 'Heat Pump Court' allows customers to bring a claim directly against installation companies if heat pumps are perceived to underperform. This helped to raise consumer confidence in these technologies[202].

Citizens Advice are the official consumer advocate in the energy sector in the UK. They monitor energy suppliers and the energy market to ensure consumers are receiving a fair deal. There also is an energy ombudsman for complaints related to energy suppliers in the UK (for example, over bills, the supply of energy to a home etc.) who can carry out Alternative Dispute Resolution (ADR) services for the supply of energy. For installations of low carbon technologies, there are also a number of ADR bodies where consumers can escalate complaints in the case of poor installations.

Overall, it is important that there continues to be a strong advocate for energy consumers that is easy to access and clearly sign-posted. All households should have access to the same quality of advocacy and complaints services, regardless of the low carbon heating they have installed. This has particularly been a problem for district heat networks to date, and must be addressed early on in the transition to low carbon heat to avoid negative experiences and damage to public trust later on.

Consumer protections must deliver for all, especially low income households

BEIS's review of the energy retail market should ensure that consumer protection are sufficient for the scale of heat transition required and will be properly enforced.

Public energy advice services

Trusted, independent energy advice services are a powerful medium for providing people with information on different low carbon heat options[203]. They tend to be very highly trusted by the public. For example, BEIS data found that 82% of people trust Citizens Advice to provide them with impartial information, compared to just 40% for energy suppliers[204]. Likewise, polling commissioned by Carbon Connect found that independent advice services was the second most popular option selected by respondents as the organisation they'd like to provide them with information on how the transition to decarbonised heating will affect them[205]. Currently, organisations like Citizens Advice and the Energy Saving Trust only provide impartial information and advice to those who seek it out. Given that a transition to low carbon heat will require widespread engagement and a highly informed public, having organisations properly funded to carry out proactive advisory work will be vital moving forward.

Currently, Scotland, Wales and Northern Ireland provide free energy advice from trained advisors on how households could make energy efficiency improvements (see Lessons Learned 7 opposite). England used to have a nationally coordinated, locally delivered energy advice service until 2012. This was replaced by a national call centre, the 'Energy Saving Advice Service', removing local aspect of energy advice. This was then replaced by an online service, 'Simple Energy Advice' in 2018, removing the access to a trained advisor[206].

The transition to low carbon heat is expected to be delivered regionally. This means that energy advice services are best offering support through local centres that can give advice tailored and relevant to each area. Services should also use trained advisors to help the public navigate the complexities of installing new heating technologies in their homes.

[202]UKERC (2016) Best practice in heat decarbonisation policy: A review of the international experience of policies to promote the uptake of low-carbon heat supply
[203]Energy Efficiency (2014) Lessons from energy efficiency policy and programmes in the UK from 1973 to 2013
[204]BEIS (2018) Energy and Climate Change Attitudes Trackers Wave 26
[205]See Supporting Material 2 for polling data
[206]Energy Saving Trust (2019) Response to the BEIS Committee inquiry into the government's approach to delivering energy efficiency improvements to buildings

Lesson Learned Part 7: Energy Advice In Scotland

Home Energy Scotland provides a network of local energy advice centres in Scotland, funded by the Scottish Government and delivered by the Energy Saving Trust.

The centres offer free, expert, impartial advice by telephone and online, including on energy saving measures and low carbon heat and energy technologies. The service includes free home visits from energy advisers to assess the energy performance of a property; explain the options for generating heat and power from low carbon sources; providing resources on - and the option of visiting - homes that are already using low carbon heat and energy; and a list of accredited installers of low carbon technologies[207].

Home Energy Scotland provides support to 90,000 households a year, including more than 33,000 low income homes[208]. Part of the funding for this advice service comes from Scotland spending four times as much per capita on energy efficiency than England[209].

Consumer protections must deliver for all, especially low income households

BEIS's review of the energy retail market should ensure that consumer protection are sufficient for the scale of heat transition required and will be properly enforced.

6.22 Protection for new business models and data-driven services in energy

New smart controls and data driven energy services present issues around data protection. Business models like 'heat as a service' will also require new consumer protections because they require the consumer to interact with the energy system, and their heating system, in a different way to how they do currently. For example, consumers will need to know what they are buying and who from, how their data is being used, who to go to if something goes wrong, how to compare offers and how to avoid being unfairly locked into contracts[210]. They must also have control over who owns their data and how it is being used.

Research has shown the importance of pre-installation communication and high quality costumer services in ensuring understanding and acceptance of households. However, even with these in place, the evidence suggests that there is still a significant lack of understanding on where consumers should go if they have any issues with their system, how their data is being used, and whether they can compare innovative offers of 'warm hours' with standard offers of kilowatt hours[211]. 'Heating assets as a service' also has particular consumer protection issues, given the serious ethical and legal implications of removing someone's source of heat if they default. It makes sense to use learning from other sectors where using finance to rent assets is normal, including property, vehicles, furniture and communications, when developing protections for new heating services.

Overall, this is a new area and the risks and issues are still not well understood, so the protections that need to be in place are not yet clear. This means it is important that the energy sector is able to design smarter protection based on the issues faced by real consumers in pilots and trials. A recent review of the Data Access and Privacy Framework for the smart meter roll-out concluded that this framework was helping to ensure safeguarding of consumer privacy, and that consumers received up to date and timely information on how their data was being used. Learning from this framework could therefore be a basis for wider data protections required for new business models in energy. Nevertheless, ensuring that protections can be designed by the energy sector for these types of energy services should also be addressed as part of BEIS' on-going Future Energy Retail market review[212].

[207]Home Energy Scotland) https://www.energysavingtrust.org.uk/scotland/home-energy-scotland (Accessed May 2019)
[208]Energy Saving Trust (2019) Response to the BEIS Committee inquiry into the government's approach to delivering energy efficiency improvements to buildings
[209]E3G (2018) Press Release: Home Insulation Crash in England
[210]Citizens Advice (2019) Smarter Protection: Potential Risks for consumers in a smart energy future
[211]Citizens Advice (2019) Designing smarter consumer protection in a smarter energy world Using field trials to explore how people understand energy as a service
[212]Department for Business, Energy and Industrial Strategy (2019) Future Energy Retail Market Review

7. Economics, funding and financing of low carbon heat

Chapter Overview

Low carbon heating will be more expensive than the current natural gas system. Early support is needed to start at-scale uptake of low carbon heat once the Renewable Heat Incentive finishes in 2021, and longer term policy is needed to fund full heat decarbonisation. This chapter considers various options that government could take to stimulate short and long term action. Overall, it is important that the distributive impacts of different mechanisms are properly explored, possibly as part of HM Treasury's upcoming review of the costs of decarbonisation. Finally, it is important that fuel-poor households are well protected in the transition. BEIS should consider setting up a commission like Scotland's Just Transition Commission aimed at exploring ways to mitigate fuel poverty in the transition to low carbon heat.

7.1 Options for funding a transition to low carbon heat

7.11 Public acceptability of the costs of heat decarbonisation

None of the available or proposed options for low carbon heat are currently cheaper than existing natural gas heating systems. Some may have lower running costs but high capital expenditure, while others may be cheaper to install but will incur higher fuel costs. Analysis by the Committee on Climate Change concluded that in the long-term low carbon heating systems (including household energy efficiency upgrades) add £15 billion a year to the current annual heating system costs of £29 billion for a net-zero scenario in 2050[213].

This all means that taxation for energy policy is likely to increase. Increasing energy bills is an important political issue, to the point that a price cap on energy suppliers achieved cross-party support in 2018. This may have been partly driven by the public's low trust in energy suppliers, highlighted by a series of recent reports showing them to be overcharging disengaged and vulnerable consumers[214,215]. Since research shows that the British public tend to view energy as a basic right, the price of energy and reports of the large profits of energy companies are perceived as particularly unfair by the public[216].

However, although there is distrust around energy bills currently, this doesn't necessarily mean the public will find contributing to the costs of decarbonisation unacceptable. Research has shown that the public willingness to contribute to the costs of decarbonisation is not only decided by financial circumstances, but also by concerns over procedural and distributive justice – for example, if they perceive there to be open and honest decision making around the transition; if they perceive themselves to have a voice; and whether they perceive there to be equitable cost sharing. This research also showed that the public attribute responsibility for the transition principally to energy companies and the government, but both are distrusted due to beliefs about profit motives and collusion respectively[217]. This implies a need for better transparency and accountability in the energy sector, and also reinforces the importance of a national engagement strategy for heat.

[213]Committee on Climate Change (2019) Net Zero: The UK's contribution to stopping global warming
[214]Ofgem (2017) State of the Energy Market Report
[215]Citizens Advice (2018) The cost of loyalty
[216]Energy Research and Social Science, Vol 48 (2019) Acceptance of energy transitions and policies: Public conceptualisations of energy as a need and basic right in the United Kingdom
[217]UKERC (2019) Paying for energy transitions: public perspectives and acceptability

7.12 Policy mechanisms to drive early uptake of low carbon heat

The Renewable Heat Incentive (RHI), which is the current government scheme for driving uptake of low carbon heat, is due to end in 2021. It makes sense to continue to support early deployment of low carbon heat into the mid-2020s, while decisions are made on longer term options to fund full decarbonisation of heat. We consider some options to support early deployment of low carbon heat below.

Balancing out policy costs between gas and electricity

A key issue for low carbon heat is the disparity in pricing between electricity and natural gas for a comparable unit of energy. Carbon pricing has been levied on electricity, reflecting the decarbonisation of the power sector, but this leaves electricity substantially more expensive per unit of energy than natural gas. Carbon emissions are currently not priced into residential gas costs, and VAT is charged at a reduced rate of 5% for both electricity and gas[218]. Addressing the balance of costs between electricity and gas is an important first step in beginning to move the market away from natural gas. Below we consider some cost-neutral options (for the average dual fuel household) for balancing out of policy costs between gas and electricity in the short term. Further consideration is needed to assess how many highly gas consuming households would see a cost-positive impact from these policies[219].

Table 5 - Cost-neutral ways to rebalance gas and electricity costs (a version of this table was provided as evidence by a submission to this inquiry)

Scheme type	Policy cost rebalancing options
Schemes for low carbon and renewable energy generation	The costs of CfD, RO and FiT schemes could be recovered evenly between gas and electricity consumption rather than just on electricity, or it could be recovered by general taxation. Future low carbon heat and energy efficiency schemes could be levied mostly on gas.
Fixed cost charging	Recovering more costs on a fixed basis could reduce the incremental cost of electricity consumption. This is already being considered by Ofgem for some network costs and could be extended to other policy costs[220].
Differential charging of VAT on electricity and gas	Differential charging of VAT on electricity and gas could be cost neutral, and is particularly an option post-Brexit, when VAT charges on fuels do not require approval by the EU.

Policies to drive low carbon heat post-RHI

Beyond rebalancing the policy costs between electricity and natural gas, policy support could look to both overcome existing barriers to installing low carbon heating and to begin to ramp up production of low carbon gas. Three potential options for beginning to drive a market in low carbon heat are covered below:

1. Introduce a Renewable Heat Obligation on gas suppliers, requiring them to supply a certain proportion of fuel for heat from low carbon sources. This would mainly affect gas companies, and would therefore require energy suppliers to buy Renewable Obligation Certificates from low carbon generators like biomethane producers or low carbon hydrogen producers for injection into the grid.

[218]Energy Systems Catapult (2019) Rethinking Decarbonisation Incentives: Future Carbon Policy for Clean Growth
[219]A version of Table 5 was supplied by a submission to this inquiry
[220]Energy System Catapult (2018) Cost Reflective Pricing in Energy Networks

2. Offer a small up-front capital grant to households installing low carbon heating. Evidence to this inquiry suggests this needs to be no more than £3000 - less than the current grant for purchasing Ultra Low Emissions Vehicles - alongside some re-balancing of policy costs between gas and electricity, to make certain low carbon heat types (hybrid heat pumps) cost effective over a lifetime period[221]. Up-front grants are also the most accessible incentives for fuel poor and vulnerable households.
3. Reducing VAT rates for installation of low carbon heating systems, which are about to increase from 5% to 20%[222].

The costs of these policies would be passed back onto consumers, either through higher energy bills or through general taxation. General taxation is the preferred method of revenue-raising from the perspective of fuel poor and vulnerable households, as the level of taxation is properly weighted against ability to pay[223], although raising taxes is a politically difficult issue. If costs are placed on energy bills, there should be a means-tested component added. This is discussed further in Section 7.2.

Low carbon heat must become attractive and visible to households

BEIS should incentivise at-scale early uptake of low carbon heating, with a new scheme in place by 2021 when the Renewable Heat Incentive comes to an end. This could include consumer support such as grants and VAT incentives, and industry-wide measures such as a low carbon gas obligation.

7.13 Mechanisms to drive complete heat decarbonisation

By 2050, near-total heat decarbonisation is required in the building sector in the UK. The mechanism to drive this therefore has to be broader and more disruptive than the policies described above, to reflect the profound and urgent change that is needed. On the following pages we consider two potential mechanisms for long-term heat decarbonisation: an obligation on suppliers, and economy-wide carbon pricing.

Overall, whichever mechanism is ultimately chosen, it is important that costs of decarbonisation of heat are shared equitably across the country. This includes ensuring that funding mechanisms are fairly leveraged on low income or vulnerable households, and ensuring costs are fairly shared between regions. For example, on the one hand it could be perceived to be unfair for one area to pay higher costs for decarbonisation of heat, perhaps due to their geographical location or because the switchover was not well handled in their area. On the other hand, it also might be perceived to be unfair for costs of heat decarbonisation to be shared equally across all tax-payers, since the last regions to switch may not see the benefits of heat decarbonisation for decades after the first regions to switch. These questions of equity in heat decarbonisation could be explored as part of the upcoming Treasury review of the costs of decarbonisation.

[221]Evidence provided to this inquiry
[222]HMT (2019) Energy-saving materials and heating equipment (VAT Notice 708/6)
[223]National Energy Action (2017) Heat decarbonisation - potential impacts on social equality and fuel poverty

Option 1 - an obligation on energy suppliers

A number of obligations are currently active in the energy sector, including the Energy Company Obligation (ECO), the Renewables Obligation (RO) and the Renewable Transport Fuels Obligation (RTFO). ECO is the latest in a series of obligations upon energy suppliers to drive uptake of domestic energy efficiency measures. The current iteration of ECO now focuses entirely on providing low-income and vulnerable households with insulation and improvements to their heating system[224].

Table 6 - A comparison of cost vs implementation rates by policy tool

Policy	Cost	Implementation Rates
ECO (Obligation)	**£3bn** (from Jan 2013-Dec 2015; cost to suppliers)[225].	**1.4 million homes improved; 1.7 million individual improvements by Dec 2015**; 33.7 million tonnes CO_2 saved over the lifetime of measures installed by 2017; £6.2 billion notional lifetime savings on fuel bills in low income and vulnerable households[226].
RO (Obligation)	In 2017-2018, there was a total scheme value of **£5.3bn**[227].	The percentage of renewable electricity has increased from **3.5% in 2004 to 27.9% in 2017**[228].
RTFO (Obligation)	The total value of the RTFO **for 2017-18 is £497.7 million**. The RTFO budget for 2019 is forecast at £682 million[229].	Biofuels supplied under the RTFO in 2017-18 generated average greenhouse gas savings of 74% compared to their fossil equivalents. **This equates to a savings of 2.86 million tonnes CO_{2eq} for the year**[230].
RHI (Incentive)	**£1.4bn** (from Nov 2011 – 2021; final payments anticipated to cost £23bn by 2040-41)[231].	The NAO estimates that by 2021 take-up will be **around 111,000 installations, only 22% of original government projections**[232]. In 2017, 7.7% of heating and cooling was from renewable sources[233]. The aim of the RHI is to reach 12% renewable heat by 2020.

The evidence presented in Table 6 demonstrates the cost-effectiveness of obligations in energy policy, and suggests that incentives - at least on their own – will not drive uptake of low carbon heat. An obligation-based policy mechanism therefore merits serious consideration. This could be in the form of a tightening carbon obligation for the energy sector, as proposed in recent research from Energy Systems Catapult. They advise that increasing carbon intensity standards should be set across different sectors to shape the market towards decarbonisation, alongside establishing a UK emissions trading system[234]. The costs for this type of obligation should either be recovered through general taxation or means-tested energy bills.

[224]BEIS (2018) Energy Company Obligation: ECO3, 2018-2022
[225]National Audit Office (2016) Green Deal and Energy Company Obligation, HC 607
[226]National Audit Office (2016) Green Deal and Energy Company Obligation, HC 607
[227]Ofgem (2019) Renewables Obligation Annual Report 2017-18
[228]Ofgem (2019) Renewables Obligation Annual Report 2017-18
[229]Department for Transport (2019) Renewable Transport Fuel Obligation Annual Report 2017-18
[230]Department for Transport (2019) Renewable Transport Fuel Obligation Annual Report 2017-18
[231]National Audit Office (2018) Low-carbon heating of homes and businesses and the Renewable Heat Incentive
[232]National Audit Office (2018) Low-carbon heating of homes and businesses and the Renewable Heat Incentive
[233]BEIS (2018) UK Energy Statistics, Q1 2018
[234]Energy System Catapult (2019) Rethinking Decarbonisation: Incentives-Future-Carbon-Policy-for-Clean-Growth

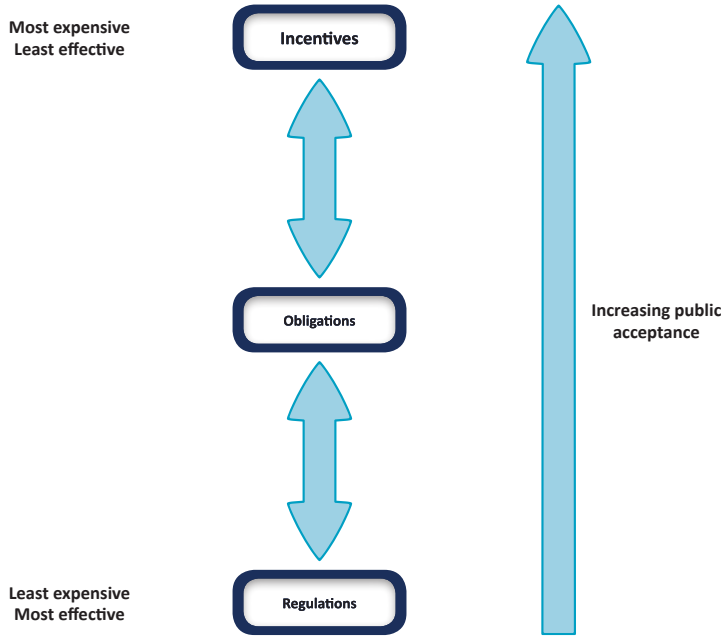


Figure 5 - Different policy mechanisms, compared for cost, effectiveness and acceptability.

Furthermore, as we demonstrate in Figure 5 above, different funding mechanisms have different levels of public acceptability, with incentives the most popular policy with the public[235]. Regulation is the least publicly acceptable, despite being the most effective overall. Obligations represent a middle-way for public acceptability and effectiveness.

[235]UKERC (2013) Public Preferences and Acceptability of Energy System Change – A Comprehensive Summary

Option 2 - Economy-wide carbon pricing

A recent report by the Grantham Institute states that "Carbon has been under-priced in most sectors to date, stalling the development of low-carbon solutions, particularly in sectors that are more difficult to decarbonise"[236]. Research by the Energy Systems Catapult also highlights the extent to which the current UK policy framework creates carbon prices which are unequal and imbalanced, and are collectively failing to drive the investment and innovation required to reduce carbon emissions[237].

There are a number of options to balance out the distortion of pricing across different heating fuels. At the lower end of intervention, a gradually increased carbon price could be added to natural gas, to even out pricing across different heating fuels[238]. This sector-specific carbon price has worked well in the power sector, where the Carbon Price Floor has driven substantial investment in low carbon generation capacity[239].

At the most disruptive intervention, all current carbon levies could be scrapped in favour of a gradually increasing economy-wide carbon price that steadily rises as we approach 2050. This was favoured by Policy Exchange, who argue it avoids the government 'picking winners'. They suggested returning revenue raised by the carbon tax to the public in the form of a 'carbon dividend' to ensure such a carbon tax is socially acceptable[240]. A carbon dividend has proved popular in the Canadian provinces of British Colombia and Alberta, where the revenue from a carbon tax is either returned to those adversely affected by the tax, or re-invested into further green spending. Other research suggests that returning revenue raised from carbon taxes into environmental and social programmes helps to make carbon taxes more socially acceptable[241]. However, this would require government to hypothecate tax, and even then, transitioning to low carbon heat will still need some government intervention for reasons covered in Section 6. Carbon pricing has also proved difficult to implement on an economy wide scale[242] and without a 'carbon dividend' faces substantial public opposition[243].

There must be strategic governance and financial structures to drive long-term action

The upcoming Treasury review of the costs of decarbonisation should consider major market interventions to drive a transition, such as a gradually strengthening carbon obligation on the energy sector. It should also explore how government can ensure costs for decarbonisation are shared equitably across the UK .

[236]Grantham Research Institute on Climate Change and the Environment (2019) How to price carbon to reach net-zero emissions in the UK
[237]Energy Systems Catapult (2019) Rethinking Decarbonisation Incentives: Future Carbon Policy for Clean Growth
[238]Frontier Economics for BEIS (2018) Market and regulatory frameworks for a low carbon gas system
[239]House of Commons Library (2018) Carbon Price Floor (CPF) and the price support mechanism
[240]Policy Exchange (2016) The Future of Carbon Pricing
[241]Grantham Research Institute in Climate Change and Energy (2017) How to make carbon taxes more acceptable
[242]Energy System Catapult (2019) Rethinking Decarbonisation: Incentives-Future-Carbon-Policy-for-Clean-Growth
[243]Nature Climate Change, Vol 8 (2018) Making carbon pricing work for citizens

7.2 Fuel poor and vulnerable households in a transition to low carbon heat

7.21 Fuel poverty and low carbon heat

Fuel poverty is a key issue for a low carbon transition. Currently, the government estimates there are 2.55 million households in fuel poverty in England alone, using the English definition of fuel poverty[244]. Low-income households are most affected by price changes in energy: the poorest households spend 10% of their income on heat and power in their homes, whereas the richest households only spend 3%. This means that any increase in prices hits the poor disproportionately[245].

Furthermore, one in five UK citizens - 14 million people - live in income poverty, which is strongly correlated with fuel poverty[246]. Even if these people are not yet in fuel poverty, they are vulnerable to becoming fuel poor if increased fuel prices are not properly mitigated. Research has suggested that the total additional costs from heat decarbonisation, if recovered evenly across 20 years through levies on energy bills, could create an extra 0.6 million to 2.6 million fuel poor households in Great Britain[247]. On the other hand, if programmes are properly targeted towards supporting fuel poor and vulnerable households alongside energy efficiency upgrades, the required emissions reductions from domestic heating to meet the fourth carbon budget could lift around 75% of those who are currently fuel poor out of fuel poverty by 2030[248]. This demonstrates how important it is to consider the distributional impact of any funding policies for low carbon heat and properly support fuel poor and vulnerable households during a transition to low carbon heat.

7.22 Learning from the past - protecting the fuel poor in policy design

Previous policy mechanisms designed to encourage the uptake of low carbon heat have not always been designed in such a way that positively impacts on the poorest in society. For example, the cost of the Feed in Tariff (FiT) was spread over all energy consumers, causing an increase of about £20 on energy bills per year. Taking into account bill savings, the difference in energy bills between those households receiving a FiT and those who were not was between £55 and £90 per year[249]. Since richer households disproportionally took advantage of the scheme, and poorer households pay more of their income on energy bills than richer households, poorer households were contributing proportionally more than richer households to the FiT scheme, without receiving any of the benefit[250]. The key reason for this was that there was no policy mechanism in place to support low income households to access the scheme.

[244]National Energy Action (2019) Fuel Poverty Statistics
[245]UKERC (2018) Funding a low carbon energy system: a fairer approach?
[246]Joseph Rowntree Foundation (2018) UK Poverty 2018
[247]National Energy Action (2017) Heat decarbonisation: potential impacts on social equity and fuel poverty
[248]Centre for Sustainable Energy (2014) Research on fuel poverty The implications of meeting the fourth carbon budget
[249]National Energy Action (2017) Heat decarbonisation: potential impacts on social equity and fuel poverty
[250]Centre for Climate Change Economic and Policy (2013) The British Feed-in Tariff for small renewable energy systems: Can it be made fairer?

Learning from previous schemes suggest a number of principles that should be incorporated into policy to ensure it benefits low income households[251]:

1. Any scheme that is driving uptake of a certain technology should be based on up-front grants, rather than on-going payments: or if the scheme is based on on-going payments, it should have a ring-fenced component to widen access to those who are fuel poor and vulnerable.
2. Any scheme should be funded through general taxation where possible, as this most fairly takes into account household's ability to pay. If it is levied on energy bills, a form of mean-testing should be introduced to make household contributions to the scheme correlated to their income.
3. Schemes must benefit the fuel poor at least proportionally compared to the general population: and ideally more. There should also be additional support for those in fuel poverty to cover a general increase in energy prices resulting from decarbonisation.
4. Schemes should not penalise those who are late to switch, for example by ensuring that charging frameworks for energy networks are fit for expected changes in the future.

7.23 Joining up fuel poverty policy with other government departments

Fuel poverty isn't just caused by some households not being able to pay their energy bills. It is closely linked to wider causes of poverty, including income poverty, poor housing quality, poor health and a lack of access to the information and advice. Fuel poverty policy has up until now been the responsibility of the Department for Business, Energy and Industrial Strategy (BEIS). This means that policies intended to reduce fuel poverty have tended to be siloed within the energy sector, without recognising the wider causes and implications of fuel poverty for other government departments[252]. This is best demonstrated by Figure 6, which shows how responsibility for the underlying vulnerabilities that can lead to fuel poverty could be placed with a number of government departments. This will be exacerbated still further as energy becomes more dependent on smart control and data-driven tariffs, making access to smart phones and internet ever more important to engaging with the energy market[253].

Furthermore, as discussed above, it is important that support mechanisms for the fuel poor and vulnerable are well targeted to avoid putting more people into fuel poverty when transitioning to low carbon heat[254]. This requires more than just a policy programme delivered by BEIS. Fuel poverty would be better addressed through a holistic, separate programme delivered as a collaboration between the Department of Work and Pensions, Department of Communities and Local Government and BEIS. This programme could also tie into other government programmes aimed at reducing poverty and protecting vulnerable people[255].

[251]National Energy Action (2017) Heat decarbonisation: potential impacts on social equity and fuel poverty
[252]Imperial College London (2018) Redesigning Regulation
[253]Energy Policy, Volume 128 (2019) Temporality, vulnerability, and energy justice in household low carbon innovations
[254]Centre for Sustainable Energy (2014) Research on fuel poverty The implications of meeting the fourth carbon budget
[255]Let's Beta Fuel Poverty https://letsbetafuelpoverty.org/ (Accessed May 2019)

NATURE OF VULNERABILITY	APPROPRIATE RESPONSIBILITY	POSSIBLE RESPONSE
MARKET DESIGN		
Disengaged from the market	Ofgem	More consumer-centric market design
Paying the loyalty penalty	Ofgem	Price cap
ECONOMIC		
Unable to access the best online deals from multiple markets	Ofcom/Department for Culture, Media and Sport	Internet use/ digital inclusion
Very low income/debt	Department for Work and Pensions	Increase incomes to accommodate essential service cost increases
Bad housing	Ministry for Housing Communities and Local Government	National refurbishment programme/improved housing standards and LA enforcement across current housing stock
HEALTH / AGE RELATED		
Health-critical connection requirement	Across utilities, including telecoms	Wraparound service from a consolidated list for essential provision
Elderly with greater need for heat	Department for Health and Social Care/DWP	Targeted benefits
Disabled	DHSC/DWP	Targeted benefits
Learning difficulties/ mental health	DHSC	Wraparound service across all essential services

Figure 6 - Box showing how responsibilities for different aspects of vulnerability fall on different government departments. From Imperial College London (2018) Redesigning Regulation.

A slightly different approach is also being developed through the Just Transition Commission in Scotland. The Commission has been set up to advise on how a transition to a low carbon society can mitigate the risks of inequality and poverty and create decent, fair and high value work for the current workforce as far as possible[256]. The Commission will provide recommendations for action to Scottish Ministers and departments. If such a commission was replicated for the rest of the UK, one of its priority areas could be ensuring that fuel poverty is tackled from a cross-sector and cross-department perspective during a transition to low carbon heat.

Consumer protections must deliver for all, especially low income households

Fuel poverty must be properly addressed as part of the transition to low carbon heat. If the Just Transition Commission for Scotland were replicated on a UK-wide basis, heat should be considered as a priority area within its remit.

[256]Just Transition Commission Scotland https://www.gov.scot/groups/just-transition-commission/ (Accessed May 2019)

Methodology and steering group

Carbon Connect carried out this inquiry between October 2018 and October 2019. Evidence was gathered in a series of evidence sessions held between January and April 2019, interviews with those working in and around the sector, written submissions, desk-based research and input from our steering group of experts.

We also ran two polls. The first was of MPs, administered by the polling company YouGov. 100 MPs weighted by party, gender, electoral cohort and geographical region were polled in March 2019. The second polling was of the general public, and was administered by the polling company Survation. 1006 members of the public, weighted by gender, age, education level, income, geographical region and most recent political votes were polled in April 2019. Please see the supporting materials (available for download on our website) for full results.

The views in this report are those of the authors and Carbon Connect. Whilst these were informed by the steering group and listed contributors, they do not necessarily reflect the opinions of these organisations.

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With many thanks to **Dr Keith MacLean** who acted as a special advisor to this inquiry.

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Contributions

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IPPR
Madano
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Ofgem
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University of East Anglia
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About Carbon Connect

Carbon Connect is the independent, cross-party forum that seeks to inform and guide a low carbon transformation underpinned by sustainable energy.

In 2009 the Rt Hon Ed Miliband MP, then Secretary of State for Energy and Climate Change, delivered a keynote address at the Westminster launch of Carbon Connect. Since then Carbon Connect has been at the forefront of policy debate, parliamentary engagement and research related to sustainable energy.

Over a number of years, Carbon Connect has built up an unrivalled portfolio of parliamentary roundtables and conferences, detailed policy briefings and highly respected reports. This has been achieved by drawing on the expertise of Carbon Connect members and working with a wide range of parliamentarians, civil servants, business leaders and experts who give their time and expertise to support our work.

Carbon Connect's main activities comprise facilitating discussion between industry, academia and policymakers on low carbon energy and producing its own research and briefings in this area. We do this by:

- Holding regular events and seminars in Parliament
- Producing concise briefing papers on energy and climate change policy
- Publishing research reports with evidence-based recommendations for policymakers
- Disseminating updates to parliamentarians and our members, with summaries of relevant stories, industry news, and other political developments

About Policy Connect

Policy Connect is a cross-party think tank improving people's lives by influencing public policy. We collaborate with government and Parliament, through our APPGs, and across the public, private and third sectors to develop our policy ideas. We work in health; education & skills; industry, technology & innovation and sustainability policy.

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