Department for
Business, Energy
& Industrial Strategy

A FUTURE FRAMEWORK FOR HEAT IN BUILDINGS

CALL FOR EVIDENCE

GOVERNMENT RESPONSE

December 2018

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Executive Summary

The context of a Future Framework for Heat in Buildings

In March, we published a Call for Evidence to seek views on how industry, government and consumers could work together to phase out the installation of high carbon fossil fuels from rural homes and businesses off the gas grid during the 2020s. The rationale was firmly rooted in delivering the benefits of affordable, clean energy in a low-carbon economy for all sectors of the UK economy, in line with the Industrial Strategy, while meeting national and international commitments to tackle climate change.

The diverse, distributed and consumer-led nature of the heat market means that decarbonising heat may be the greatest challenge we face in meeting our legally binding carbon targets. This view is shared by the Committee on Climate Change, who urge immediate action to ensure long-term and interim carbon targets are met.

This challenge in relation to decarbonising heat in buildings is reflected in the Buildings Mission announced by the Prime Minister on 21st May 2018 as part of the Clean Growth Grand Challenge. It aims to at least halve the energy use of all new buildings by 2030, including those off the gas grid, and highlights the ambition to shift to 'clean heating' in new build.

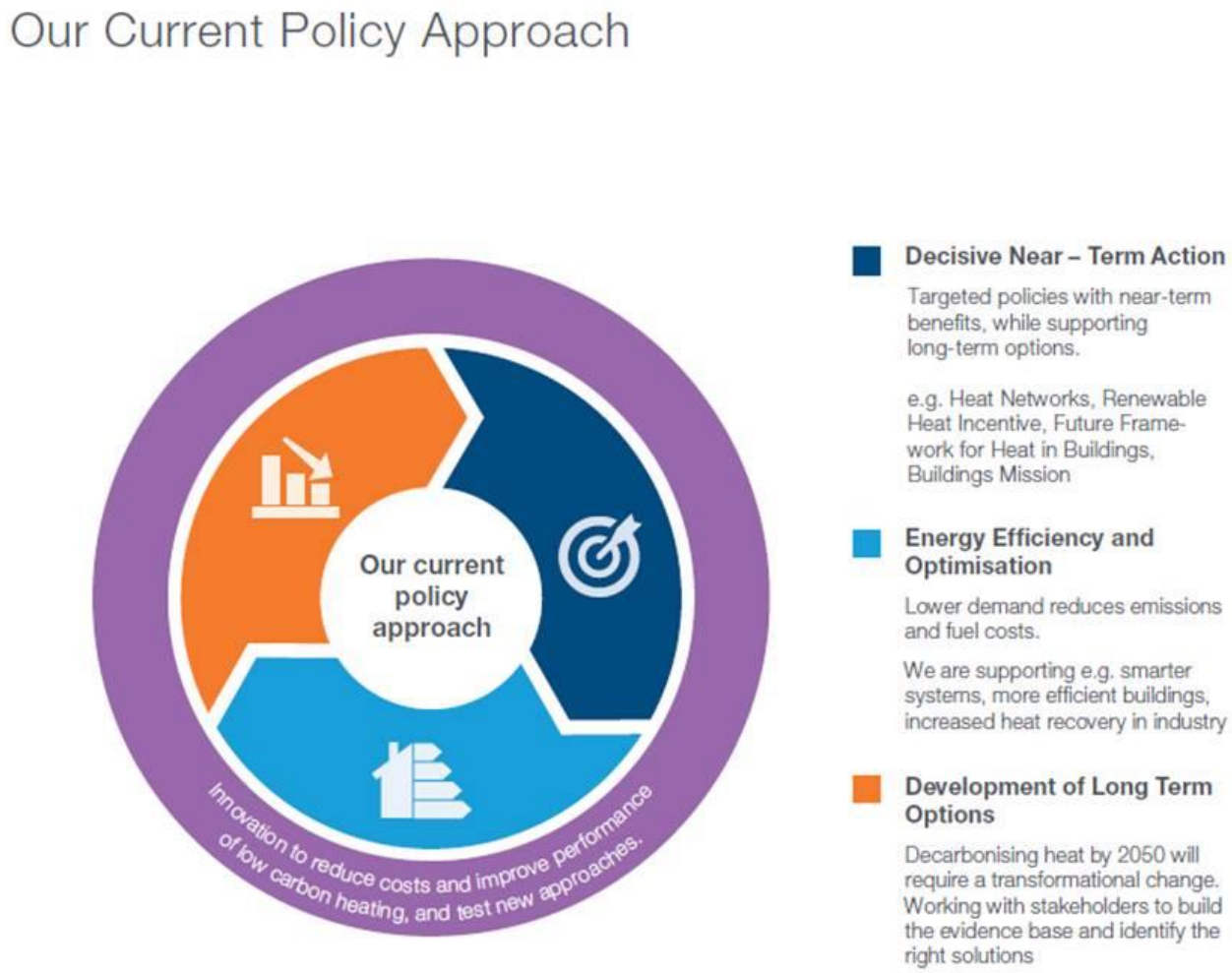
Through the Renewable Heat Incentive (RHI), we are spending £4.5 billion between 2016 and 2021 to support low-carbon heat technologies in homes and businesses, such as heat pumps, biomass boilers and solar water heaters. As set out in the Clean Growth Strategy,[1] we have reformed the RHI to focus the scheme towards long-term decarbonisation through greater uptake of technologies such as heat pumps and biomethane injection to the gas grid. We have also introduced the Assignment of Rights for the domestic scheme to support investment in technologies including heat pumps for low-income households.

Beyond the RHI, in the Clean Growth Strategy, we made a commitment to phase out the installation of high carbon fossil fuel heating in buildings off the gas grid in the 2020s, starting with new buildings. This means a significantly reduced role for oil and coal as heating fuels in new and existing buildings, and, for many, a significant change to systems that may have been in use for generations.

For over 50 years, we have relied primarily on natural gas, supplied through the national grid, to heat our buildings. That will need to change fundamentally as we transition away from a reliance on fossil fuels towards low-carbon energy sources. There are a range of heating technologies with the potential to support our 2032 and 2050 decarbonisation commitments. Whilst we don't yet know which approaches will work best at scale and minimise costs to UK taxpayers, consumers and businesses, we remain committed to laying the groundwork in this Parliament to prepare for decisions in the first half of the next decade about the long-term future of heat. This includes continuing to invest in innovation and test different technologies and approaches which have the potential to decarbonise heat at scale. We are also continuing to take decisive action in the near term to

[1] BEIS, Clean Growth Strategy, October 2017 https://www.gov.uk/government/publications/clean-growth-strategy

decarbonise heat in areas less dependent on the long-term infrastructure decisions. This includes supporting the deployment of Heat Networks and the uptake of low-carbon fuels in off gas grid buildings.



Heat decarbonisation also provides a huge opportunity for UK companies to develop solutions and products that can be marketed at home and abroad, and we are determined to play a leading role in providing the technologies, innovations, goods and services of the future. The low-carbon economy in the UK could grow 11% per year between 2015 and 2030, 4 times faster than the rest of the economy, and could deliver between £60bn and £170bn of export sales by 2030.[2]

The power sector has made great strides in moving away from using the most polluting high carbon fossil fuels to generate our electricity. The government has gone further, committing to end unabated coal generation by 2025 and through the Powering Past Coal Alliance, the UK is leading the world in phasing out unabated coal power. In doing so we

[2] Ricardo Energy and Environment for the Committee on Climate Change, UK business opportunities of moving to a low-carbon economy (supporting data tables) 2017 www.theccc.org.uk/publication/uk-energy-prices-and-bills-2017-report-supporting-research/

are not only cutting carbon, but we are improving the quality of our air, increasing investment and driving down the cost of key technologies.

The benefits of decarbonisation in the power sector are clear. It is time to scale up our ambitions on heat, so that those of us who live and work in buildings off the gas grid can share those benefits as we move to a low-carbon future.

Responses and next steps

Responses to the Call for Evidence have confirmed our understanding that government has an important role in realising this opportunity and this sits alongside our responsibility to support the Clean Air agenda, and the decarbonisation of vehicles. The challenge does not, however, sit with government alone. The continued engagement and expertise of the heating industry, energy suppliers, energy network operators and consumer advice groups are vital to developing a policy which enables the transition to low-carbon heating.

The Call for Evidence asked a wide range of questions across a number of different issues and policy levers. It sought to ensure that the policy framework following on from the Renewable Heat Incentive provides certainty to businesses, consumers and other decision-makers. Based on the evidence received, we continue to consider that, in combination with making properties more efficient, electrification offers the greatest decarbonisation opportunity for the majority of buildings off the gas grid.

One of the strongest overriding messages from the responses was the need for a clear, long-term framework set by government, ideally through regulations, that would enable industry to play their part. There was a clear view that this would allow industry to align their strategy and investment plans, and to drive forward innovation in technologies and business models. Many comparisons were drawn with transport's commitment to end the sale of petrol and diesel cars from 2040, which has provided the automotive industry with clear direction and opportunities for growth.

For heat in buildings off the gas grid, change can happen much faster. Respondents provided views on timing for an end to the installation of high carbon fossil fuels off grid, which ranged from 2020 to 2050, with a three quarters majority taking the view that it could be easily delivered by 2030. This aligns with the commitment set out in the Clean Growth Strategy, to "phase out the installation of high carbon forms of fossil fuel heating in new and existing homes and businesses off the gas grid during the 2020s, starting with new build". Industry will play a vital role in this transition, for instance through investing in research and development, taking the lead in developing industry standards and codes of practice, product innovation, creating opportunities for installer training and raising the profile of low-carbon technologies to consumers, who may be supported through new and empowering business models for heat.

We are seeking to develop a comprehensive policy framework to support this transition. It will aim to take forward the gains made by the Renewable Heat Incentive (RHI) and continue to build the market, backed by standards. The following are important next steps in developing this policy framework next year:

Proposed consultation on regulations, setting out options for a regulatory framework that enables investment in innovation, infrastructure, and long-term decisions to be taken by industry.

Proposed consultation on skills and training, setting out options for streamlining and/or adapting current installation standards, compliance and enforcement options, and what the government's role should be in low-carbon heat (re)training for installers.

Proposed consultation on Part L of the Building Regulations for England, covering the energy performance of buildings.

The UK government has worked closely with the devolved administrations in the past and we intend to continue to work with them as we move forward, while taking into account the devolved status of heat as appropriate.

Learning from the RHI scheme

The National Audit Office and Public Accounts Committee completed reviews of the Renewable Heat Incentive (RHI) scheme earlier in 2018.[3] Both reviews made a number of recommendations in relation to the RHI and to any future policy on heat decarbonisation. The following recommendations are relevant to the Future Framework for Heat in Buildings:

a. Address the issues of affordability for people less able to pay upfront costs, and how best to inform and influence the homeowners being targeted;

b. Ensure energy efficiency policy is integral to future plans for heat in buildings and show how they will work alongside each other and be cost effective;

c. Explain what lessons BEIS has learned from the RHI, how it is applying those lessons in its future plans for heat in buildings and how it will ensure there is a smooth transition from the current RHI to the successor policy; and

d. Set and publish clear milestones for developing the low-carbon heating supply chain within the RHI and successor policies, and BEIS' parallel project on heat networks.

We have taken these recommendations into account in our analysis and will continue to do so throughout the development of a Future Framework for Heat in Buildings.

The sections on 'Overcoming the cost barrier' and 'Information to consumers' have a special focus on addressing these recommendations. Gathering evidence on low-carbon heat supply chains was a key priority of the Call for Evidence and is an important step towards addressing the Committee's recommendation in this area. As improving our

[3] Public Accounts Committee, RHI Review, May 2018 https://www.parliament.uk/business/committees/committees-a-z/commons-select/public-accounts-committee/news-parliament-2017/renewable-heat-incentive-report-published-17-19/
National Audit Office, RHI Review, February 2018: https://www.nao.org.uk/report/low carbon-heating-of-homes-and-businesses-and-the-renewable-heat-incentive/

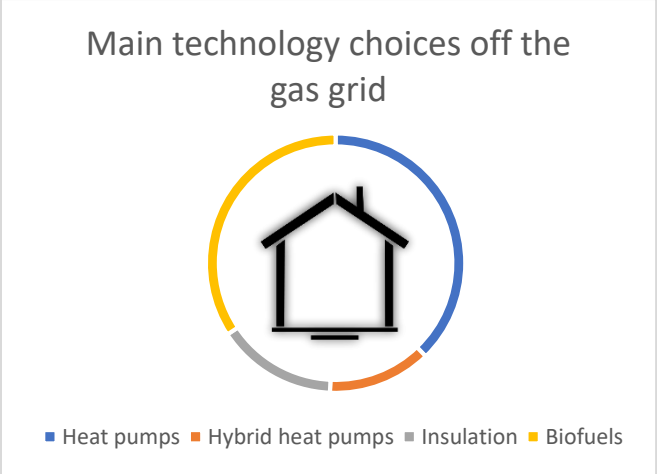
understanding of supply chains is integral to the development of the Future Framework, references to supply chains for specific technologies appear throughout the document.

In particular, the department is keen to demonstrate how it has learned lessons from previous policies. This includes the RHI, which has provided valuable learning on how to structure incentive schemes, how to influence consumer behaviour and reduce barriers to the uptake of renewable and low-carbon heating technologies, and how to encourage the market to deliver.

Chapter 1: Technologies in the off gas grid

The Call for Evidence asked about the technology choices that were most appropriate for buildings off the gas grid. Respondents felt that it was highly likely that a range of technologies would be needed and that there was no single solution. It was also highlighted that alongside all technology choices, it is important to consider buildings holistically and ensure that the heat demand of buildings is being reduced where possible through improved energy efficiency.

Across the technologies considered, there was most support for heat pumps, followed by bioliquids. There was some support for hybrids as a transitional technology (although not everyone agreed that there should be a phased approach). This section looks in more detail at those technologies identified through the Call for Evidence.



1.1 Electrification of heat

The government recognises that electricity, particularly when produced from low-carbon sources including nuclear and renewables such as wind and solar, has the potential to provide low-carbon heat. As such, electric heating is likely to play a key role in the decarbonisation of heat off the gas grid and is one of the key long-term options for decarbonisation that we are considering in our review of the evidence on long-term options for decarbonising heat.

1.1.1 Heat Pumps

Heat pumps are an important form of electric heating that can make a significant contribution towards the long-term decarbonisation of heat. We know from the RHI that the higher upfront costs of heat pumps compared to more conventional heating can be a barrier to consumers choosing this technology, so we are keen to understand the potential for costs to reduce over time. This aligns with the National Infrastructure Commission's July 2018 recommendation to "establish an up to date evidence base on the performance of heat pumps within the UK building stock and the scope for future reductions in the cost of installation."[4]

[4] National Infrastructure Assessment, July 2018, https://www.nic.org.uk/assessment/national-infrastructure-assessment/

The majority of respondents told us that they do see opportunities for costs to come down. Of those, most felt that the main cost reductions could be in installation costs, if heat pumps were to be installed at a larger scale. It was generally thought that the potential for the capital costs of the equipment itself to come down is limited, other than through incremental improvements and efficiencies due to a competitive market, although some key stakeholders thought there was still scope for reductions in kit cost.

In addition to deployment at a larger scale, there were some other key factors that respondents thought could help reduce costs. The importance of having a stable and clear policy framework was highlighted to enable investment and innovation. Investment in installer skills was seen as another opportunity for contributing to cost reductions, with several responses highlighting the importance of regulated installation standards for heat pumps. Responses also suggested mandated training for new and current installers of fossil fuel heating systems on low-carbon technologies (see Section 3.2). It was suggested that wider awareness of heat pumps amongst installers could lead to greater deployment and more developed supply chains, simply because installers may become more aware of the opportunities for installing this technology and pass this information on to the consumer.

The costs associated with heat pumps could also come down through enabling different business models to enter the market such as heat as a service. This option was identified in several responses, where manufacturers are starting to explore the benefits of including ongoing maintenance costs in their pricing models, which would provide consumers with peace of mind and manufacturers with an incentive to produce and install high-performing systems (see Section 2.2.2).

Respondents who thought there was limited or no potential for cost reduction argued that heat pumps are an established market. Concerns were also raised about the need to ensure that reduced costs do not lead to poor installation quality.

In addition to cost reduction, we also asked about performance improvements. The majority of respondents felt that improvements to heat pump performance would occur naturally over time, if encouraged by a competitive market. There were, however, some specific examples of innovations in this area which suppliers and manufacturers told us had improved performance. In particular, we heard from manufacturers and research centres that there is substantial scope to combine heat pumps with other technologies such as solar photovoltaic (PV) and solar thermal panels and/or heat storage. Combining technologies in this way could have benefits such as dealing with peaks in hot water/heating demand, impacts of variation in outside temperature and may improve the system efficiency compared to when they are the only measure installed in a building.

Similarly, many responses highlighted the importance of thinking about heat pumps in the context of a ‘whole-house’ approach. We heard that, when used in conjunction with energy efficiency measures and properly optimised smart controls, heat pumps may be a cost-effective heating technology for a wide range of domestic building stock. We will continue to build our evidence in this area, drawing learning from existing research projects and through the commissioning of further government research. Key areas to explore are the cost of retrofitting suitable energy efficiency measures, particularly in older or less thermally efficient building stock, and ways in which the hassle to consumers can be minimised.

In order to support much wider public awareness and confidence about electric heat pumps and hybrid systems it will be important to provide more easily accessible real-life evidence that systems work in a wide variety of homes and business – and that their impacts on the energy system are manageable and affordable.

1.1.2 Storage heaters

Another established form of electric heating is storage heaters. Improvements to this technology have resulted in increased efficiency and innovative products are entering the market which take advantage of smart technology. A range of responses were provided on these, though there was a majority of negative views on the potential for this technology to play an important role in the decarbonisation of heat.

Some felt that they were costly to run for consumers and can present difficulties for them in operating effectively. Some highlighted that heat pumps will provide the same benefits as storage heaters but do so more efficiently, making them cheaper to run. The need to consider the strain on the electricity network with different forms of electric heating was also highlighted. However, it was also raised that modern storage heaters could be installed alongside heat pumps as they can provide a complementary heating solution.

BEIS has commissioned further research to gather evidence on types of low-carbon heating technologies which may play a role in the decarbonisation of off gas grid properties, including electric storage heaters, electric boilers, electric panel heaters and direct electric heating.

1.1.3 Hybrid heat pumps

The majority of hybrid heat pumps available today are formed by combining a heat pump with a gas boiler on the same heating system. We asked for evidence and views on the role oil-, LPG- or bioliquid-heat pump hybrid technologies may play in supporting the transition away from high carbon heating. The responses received to this section could, broadly speaking, be put into two opposing and evenly split categories:

a. those who thought hybrids may play a role in the decarbonisation of heat; and

b. those who thought the costs to consumers and risks of delayed deployment of ‘fully’ low-carbon technologies were too great for this to be a viable option.

The split of views largely followed the make-up of the heating industry and its wider stakeholders. In general, those supportive of hybrids as a transitional or long-term technology included manufacturers of gas and oil boilers, other members of the oil, LPG and gas industry, consumer advice groups and consumers with an interest in heating older or listed properties. Those who opposed using hybrids as a transitional technology included manufacturers and suppliers of low-carbon heating systems, renewable energy trade associations, distribution network operators (DNOs) and some installers and consumers who declared a preference for lower carbon technologies. Responses received referred to ‘hybrid systems’ comprising two standalone technologies (heat pump and gas/oil-fired boiler) connected to the same system, rather than an integrated, single technology.

Some respondents felt it was not for government to decide whether hybrid heating systems should be permitted in the future framework, as the benefits may be highly dependent on the heating requirements of individual buildings. These responses suggested that the decision would be best left to building specialists to define for individual cases. A response from a gas and oil boiler manufacturer also suggested that the role of hybrids may be less important if a future framework permits the use of bioliquids for heating.

Given the variety in the responses received, further evidence in this area would be welcomed. A key source of evidence on in-situ performance of hybrid heating systems, which many responses also mentioned, will be the Flexible Residential Energy Efficiency Demand Optimisation and Management[5] project in Bridgend, Wales, which is scheduled to run until January 2019. This is a collaborative project designed to better understand if gas boiler/heat pump hybrid heating systems are technically capable, affordable and attractive to customers as a way of heating homes. It will help inform the development of policy, standards, commercialisation plans and network management responses for both the near- and long-term decarbonisation of heat, as learning about consumer behaviour and smart control optimisation may be drawn across to hybrid oil/LPG systems off the gas grid.

We understand that the overall costs of gas-hybrid heat pumps are broadly comparable to other decarbonisation options on a national level. For individual consumers, costs could be reduced through avoidance of radiator replacements, fabric efficiency improvements, hot water tank installation and changes to cooking equipment.[6] One study estimates that a gas boiler/heat pump hybrid system can be 25% cheaper than a stand-alone heat pump, although exact costs would depend on the system design.[7] While the cost relationship will be somewhat different for oil or LPG boiler hybrids, we consider that, on balance, hybrids may be an appropriate solution for a subset of off gas grid properties, in particular where the type or quality of building stock prevents the installation of heat pumps or other technologies powered by electricity, although the issue of potential cost barriers bears further careful consideration.

We are keen to explore the potential of oil, LPG and bioliquid hybrid heat pump systems for off gas grid properties, particularly in terms of upfront and maintenance costs to consumers, and whether these costs might be comparable to standalone boiler or heat pump systems.

[5] FREEDOM project, https://www.westernpower.co.uk/projects/freedom

[6] For example:
Element Energy for BEIS, Hybrid Heat Pumps study (2017), p. 34 and 88
Carbon Trust for BEIS, Evidence Gathering – Low Carbon Heating Technologies Domestic Hybrid Heat Pumps, November 2016, p. 24, 59, 78
Imperial College London for CCC, 'Analysis of Alternative UK Heat Decarbonisation Pathways', June 2018, p. 12

[7] Element Energy for BEIS, Hybrid Heat Pumps study (2017), p. 88
Values presented by Element Energy are broadly consisted with figures reported in other literature, for example:
Carbon Trust for BEIS, Evidence Gathering – Low Carbon Heating Technologies Domestic Hybrid Heat Pumps, November 2016, p. 59 – 62
Fourth Carbon Budget Review -technical report, Committee on Climate Change, 2013

1.2 Bioenergy

There are a range of heating technologies with the potential to support our 2032 and 2050 decarbonisation targets. For off gas grid buildings, the key challenge is phasing out the installation of high carbon heating systems. Whilst we recognise that there are benefits from a range of possible options, we continue to consider that, in combination with making properties more efficient, electrification will play a major role for decarbonising heat in buildings off the gas grid (see Section 1.1).

However, we also recognise that some existing off gas grid buildings are unsuited to electrification and harder to heat and treat than other properties. In these instances, bioenergy sources, particularly solid biomass, bioliquids and biopropane as a replacement for LPG, may have a continued role in decarbonising buildings. Bioliquid and biopropane solutions may appeal to those consumers with existing oil or LPG boilers whose properties are not suitable for electrification. Our study, 'Technical Feasibility of Electric Heating in Rural Off Gas Grid Dwellings' estimates that around 15% of off gas grid dwellings are currently not suitable for electric heating even if improvements to the low voltage network were made.[8] On 15th November, the Committee on Climate Change published their review on bioenergy "Biomass in a low-carbon economy",[9] which the government will take into account when considering its position on the overall potential of using bioliquids for heat.

In consultation with industry, we are considering whether bioenergy options meet a number of criteria, including affordability for the manufacturer and consumer, sustainability, the government's air quality criteria and security of supply. These will be affected by decisions around bioliquid concentrations: these currently range from around 20-50% bioliquid, and blends proposed by industry include 'B30K' and 'B50K'. In order to meet our decarbonisation objectives, we would need to be aiming for 100% bioliquid, with a clear trajectory for reaching this level for both new and existing installations. However, questions remain regarding the feasibility of this, particularly around availability of sustainable feedstocks and technological barriers, and we will continue to explore these in consultation with industry experts. There are also questions regarding the potential for blends to play a transitional role in decarbonising heat.

Responses to our Call for Evidence were generally in line with the government's thinking about off gas grid bioenergy applications. They highlighted the increased costs of using bioliquids and/or biopropane over fossil fuel equivalents and the cost impacts on the consumer, particularly those vulnerable to fuel poverty. They also generally agreed that using wood feedstocks, which are currently supported under the RHI, has a higher impact on air quality compared to other forms of biomass, particularly when wet, adversely impacting air quality.

Many responses pointed towards the environmental benefits and potential cost savings of using waste feedstocks, such as wood shavings and used cooking oil. Other responses were more cautious about the quantities of waste feedstocks available for heating, and we

[8] Technical Feasibility of Electric Heating in Rural Off Gas Grid Dwellings, (to be published shortly at https://www.gov.uk/government/collections/heat-pump-research#heat-pumps)
[9] Committee on Climate Change, Biomass in a low carbon economy, November 2018 https://www.theccc.org.uk/publication/biomass-in-a-low-carbon-economy/

would need to be confident that volumes could meet demand should the government choose to develop heat policy involving bioenergy.

We also need to consider lifecycle carbon emissions, and how operating costs and carbon savings might be increased through the high-quality installation, maintenance and operation of efficient, modern boiler systems, which could have the added benefit of reducing air quality impacts. We will continue to ensure any policy decisions around bioenergy are made in line with the Clean Air Strategy.

The evidence submitted to us did not provide all the necessary information to make informed decisions now about the role bioliquid could play in decarbonising off gas grid buildings. As a result, we are seeking further evidence by commissioning a technical study on bioenergy as part of a wider project also looking at electric heating options in off gas grid buildings. This is due to conclude next year. Questions we will be asking in this study include:

a. What are the installation operating and fuel costs of different types of bioenergy systems?

b. What might the impact of future technological developments be on bioenergy supply chains?

c. What alterations to existing oil/LPG boilers would be required to make them suitable for bioenergy?

Following this review, we will consider the role of bioenergy alongside other options for decarbonising off gas grid heating. We will need to consider the most strategic use of bioenergy resources across the economy.

We welcome the continued engagement of industry members who are exploring the advancements in technology and fuel production that would be needed for bioenergy to be a viable option for existing off gas grid buildings which are not suited to electrification.

1.3 Heat networks

Respondents were split on whether there is a role for heat networks off the gas grid. Opponents focused on the low demand density in rural areas, reducing the economic viability of such schemes. Advocates highlighted that many off grid sites exist with sufficient density for localised heat networks to offer value and potential for cost effective decarbonisation. Some suggested they are impractical though there was evidence provided showing smaller scale village biomass district heating in Austria.[10]

The responses supported the idea that heat networks can be suited to rural/off gas grid locations where they represent value for money. We recognise that many rural communities don't represent the same density of heat consumption as urban locations. Where schemes are strategic, low-carbon, optimised and represent value for money we

[10] Centre on Innovation and Energy Demand, Supporting diffusion of low-energy systems: what can the UK learn from the diffusion of Biomass District Heating in Austria, 2016 http://www.cied.ac.uk/publication/diffusion-biomass-austria/

would welcome them applying to the £320m Heat Network Investment Project launched during Green Great Britain Week in October.

Community ownership models were mentioned by a large proportion of respondents. These included an array of different types, including local community energy co-operative/not-for-profit schemes, part local authority part private ownership or joint-owned finance schemes.

Details are published alongside this document on our approach for delivering a future market framework for heat networks that will enable sustained investment.[11] This report includes our response to the CMA on how we intend to strengthen consumer protections.

The government has recently developed a guidebook to aid heat network sponsors, developers and funders to support them in understanding some of the issues, risks and opportunities around financing heat networks in the UK.[12] This guidebook covers several different ownership models including from outright local authority or Energy Service Company ownership to hybrid models.

Given the high upfront costs of purchasing or installing a new heating system, the heat as a service model was suggested several times. The concept of a company owning the heating system and covering maintenance costs within the price is a popular model in many European countries (see Section 2.2.2 for further details).

We encourage continued discussion with the industry as to how heat networks can be used to lower upfront and maintenance costs for consumers and how they can effectively be rolled out in areas where they are best suited to lowering emissions.

[11] BEIS, Heat Networks: Developing a market framework, December 2018
https://www.gov.uk/government/publications/heat-networks-developing-a-market-framework
[12] BEIS, Heat Networks: Guidance for developers and the supply chain, August 2018
https://www.gov.uk/government/publications/financing-heat-networks-in-the-uk-guidebook

Chapter 2: Driving uptake of low-carbon heat in buildings off the gas grid

2.1 New build

In this chapter we explore the responses to the Call for Evidence on driving uptake of clean heating in new buildings, both domestic and non-domestic, off the gas grid. Through the Call for Evidence, we sought to understand the barriers to uptake of cleaner alternatives to high carbon fuels such as oil, and how these barriers could be removed.

On 21st May, the Prime Minister set out the Buildings Mission as part of the Clean Growth Grand Challenge under the Industrial Strategy. It aims to at least halve the energy use of all new buildings by 2030, including those off the gas grid.[13] This will be achieved by:

a. making sure every new building in Britain is safe, high quality, much more efficient and uses clean heating

b. innovating to make low energy, low-carbon buildings cheaper to build

c. driving lower carbon, lower cost and higher quality construction through innovative techniques

d. giving consumers more control over how they use energy through smart technologies

e. halving the cost of renovating existing buildings to a similar standard as new buildings, while increasing quality and safety

Through the Buildings Mission we wish to combine multiple objectives, transitioning to a low-carbon economy and maximising the advantages for UK industry from the global shift to clean growth. This will be achieved through leading the world in the development, manufacture and use of low-carbon technologies, systems and services that cost less than high carbon alternatives.

2.1.1 Phasing out high carbon fossil fuels in new build

Despite significant advances in clean heating technologies, oil boilers are still being installed in approximately 1,500 new build properties per year.[14] In the Call for Evidence, we explored why oil continues to be installed in new build properties despite its considerable environmental impact. In particular, we wanted to investigate potential barriers to installation of clean heat technologies as an alternative to oil in new build.

Familiarity of heating engineers to oil boilers was often cited as a driving factor in the continued installation of oil heating. Respondents suggested the method of installing most alternative heat systems, except for some biomass boilers, is considerably different and

[13] This includes a building's use of energy for heating, cooling and appliances, but not transport.
[14] Live tables on house building: new build dwellings; Domestic energy performance certificate data 2011 to 2014.

requires a different skillset. Some respondents thought that opportunities for existing installers to retrain, or indeed new installers to train, in cleaner systems are limited. This creates a clear barrier to adoption of cleaner alternatives to oil.

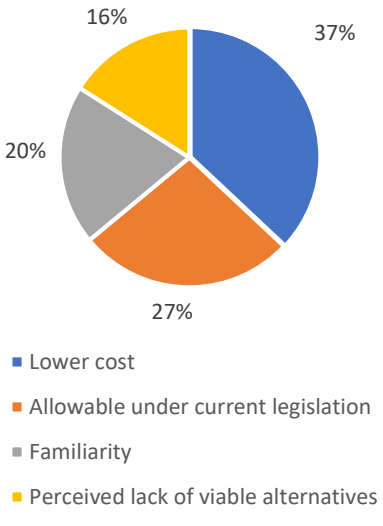
Respondents thought that this problem could be overcome if the sector was confident of consistent demand, which in turn would follow signals from government on the future direction of heat policy. It was also suggested that certification schemes should be expanded to ensure all installation companies are held to the same high standard and build consumer confidence.

Cost was often reported as being a major concern to developers and building owners. Despite historic volatility in the oil price, respondents still perceived it as being cheaper than the alternatives to oil in the off-gas grid. The high upfront cost of equipment such as heat pumps was presented as a significant barrier to their uptake, despite the lifecycle savings suggested by some respondents. Developers may prioritise low installation cost, as the building owner is responsible for running costs, which can further stifle uptake of clean heating systems.

Respondents also fed back on the importance of a strengthened regulatory framework, which they thought was needed to set a clear trajectory for the installation of clean heating in new build.

Part L of the Building Regulations is existing legislation which sets minimum energy performance requirements for new buildings and work in existing buildings. Consequently, it influences choices that developers make, such as the choice of heating system. The government has committed to review Part L of the Building Regulations for England, and we intend to use this exercise to consult on the most practical, safe and cost-effective ways to adapt building regulations to discourage the use of high carbon fuels in new buildings. The Part L compliance standards for new buildings are deliberately set in performance terms and do not prescribe the technologies, materials or fuels to be used. Any changes to the Part L standards will therefore need to be set on an outcomes-basis, rather than banning specific technologies or fuels.

Figure 1: Reasons for the installation of oil in new builds



We also want to ease the transition and put in place broader measures that will complement the changes to Part L of the Building Regulations for England. The government recognises the important role manufacturers and installers can play in building a stronger market for clean heating. We understand that developers will often rely on their advice in selecting a heating system, so manufacturers and installers have the potential to strongly influence the shift away from installing high carbon fossil fuels in new build.

2.1.2 Futureproofing new build homes

Previous research by governments and think tanks have incorporated futureproofing measures into their projections. We were interested to explore whether optimising new buildings (both on and off the gas grid) for the installation of clean heating systems, without necessarily installing them during the construction process, would be feasible and whether this approach had the potential to reduce costs and facilitate the clean energy transition.

The vast majority of respondents highlighted that efforts to promote futureproofing would drive additional costs for uncertain gain. They argued that technology moves on so rapidly that any futureproofing measures would be redundant soon after deployment and it is difficult to predict the requirements of innovative technologies. We also heard that there is an opportunity cost associated with selecting a specific futureproofing method, which may not serve alternative approaches or future innovations.

Many responses stated that it is more cost effective to install modern technologies now than to futureproof and (possibly) retrofit at an unspecified later date. Some respondents were additionally opposed to futureproofing as this was perceived as the government stalling on its environmental commitments – they wanted to instead mandate clean technologies for new buildings, creating a level playing field for developers. Many respondents stressed the need for strong legislation and training opportunities to translate the technologies already available into volume deployment.

Improving the efficiency of existing technologies and developing cleaner systems within the current technology was often cited. Some respondents highlighted the value joined-up technology could play; for instance, hot water cylinders are required for heat pumps, but could be linked via a solar diverter to photovoltaic panels to provide energy storage. It was suggested that such approaches could also be used to support the grid in balancing as the energy share of renewables increase.

This Call for Evidence resulted in a strong and clear view from respondents that futureproofing is often technically difficult and is not cost effective in many instances. We heard that technology advances more rapidly than the accommodations for such technology does, and consequently that policy should focus on promoting measures that would deliver the benefits sooner and with greater certainty.

We asked respondents about the costs of futureproofing measures as opposed to the investment needed to install clean heat in new buildings. Responses consistently stated the cost effectiveness of fitting clean technology in new build. Retrofit is often technically challenging, from the additional costs to connect systems to the electricity grid to replacing valves to ensure pipework is compatible.

Respondents told us that installing clean heating in new build prevents a need for later retrofit. They discussed how and when such a large scale retrofit scheme would be triggered, stressing that the standing cost of new technology within new build is far lower than retrofit. This means that consumers would be reluctant to agree to such schemes. The benefit to the environment begins sooner, as would any health benefit to building users from improved internal air quality.

Respondents suggested that the most cost-effective measures of decarbonising heat diverge for developers and consumers. Respondents suggested that electric storage heaters would present a lower cost to developers, but that heat pumps were the better investment for consumers in the long-term, considering lifecycle costs including running cost for the consumer.

Some respondents argued that hot water cylinders could be considered as a futureproofing measure, as they are necessary for later heat pump installation. This is because heat pumps cannot currently supply hot water on demand, and so require storage capacity.

The government recognises the role that stronger regulatory frameworks can play in decarbonising new properties off the gas grid. We have considered the responses in relation to many futureproofing measures and would require a strong evidence based on cost and benefit analysis for proposed measures. The responses did not include evidence of any potential futureproofing measure which meets this requirement for demonstrable benefit, but we remain open to the concept more broadly. Decisions made on improving the standards of new build will be firmly grounded on evidence, ensuring steps are cost-effective and are considered in the context of government housing supply objectives. This will be explored in the upcoming Part L Building Regulations review in England.

2.1.3 Decarbonising new buildings

We asked for information on the most cost-effective and affordable measures to decarbonise new buildings off the gas grid.

Heat pumps were frequently said to be the most promising alternative. Many believed integrated water, heating and electric systems to be the best solution, whilst others pointed to heat networks. Electrification in some cases served as the underlying framework to this. Reference to bioenergy was made in responses, which is considered in section 1.2. Several advocated a fabric-first approach, where modern insulation techniques reduce space heating requirements significantly. The Passivhaus model was pointed to as an existing successful scheme for this. The role of regulation as a driver of this was, again, often raised by respondents.

As expected, it is clear there is no single technical solution to decarbonising heat in new buildings off the gas grid. The government wants to see the most appropriate and cost-effective solution implemented in each building and for a vibrant and diverse clean heating sector to be created that will mobilise supply chains, create jobs and export opportunities, and offer quality solutions at good value to our building stock. Further details on our plan for taking this forward are included in the sections on Innovation and Regulation.

2.2 New and replacement heating systems in existing buildings

This section sets out government support for ensuring new and replacement heating installations in existing buildings are as clean as possible and accelerate the uptake of low-carbon options.

The Renewable Heat Incentive (RHI) was introduced in 2011 to support the transition from fossil fuel to low-carbon forms of heating. In November 2015, the government confirmed a continued budget for the RHI, setting out that it will rise from £430m in 2015/16 to £1.15bn in 2020/21. To date, the scheme has supported over 80,000 homes, businesses and public bodies in taking up low-carbon heating. But while we have made a strong start, we cannot be complacent. Consumer acceptance and comprehensive supply chains for low-carbon heating remain challenges.

Government and industry have important roles in overcoming these challenges. There is much that industry can do, and that some parties are already doing, but we understand that the market and regulatory framework needs to be right to enable industry to make long-term decisions. Putting into practice our learning from the RHI, we will respond to these challenges through:

a. Regulation: regulation is one action the government can take to provide long-term certainty about the direction and rate of change. This can enable manufacturers and installers to deliver cleaner and more efficient heating systems, and helps provide a stable environment for industry investment and for innovation to thrive;

b. Affordability: low-carbon heating in many cases is still more expensive to install than the conventional equivalents. Industry have already made progress in bringing down the cost of purchasing and owning low-carbon heating systems. Further innovation is a vital part of bringing costs down in the long-term. In section 2.2.2, we set out how we will continue to support the development of new low-carbon heating in the UK;

c. Consumer information: supporting consumers and businesses with the information they need will enable them to make informed decisions about how their heating choices affect their comfort and wellbeing, and the environmental impact. We will continue to work with industry, local authorities, consumer advice organisations and other relevant parties to promote the benefits of switching to low-carbon heating to households and businesses;

d. Market building measures: working hand in hand with industries to build on existing heat market infrastructure. We will work with industry to drive investment in innovation, explore and consider support for novel approaches such as ‘heat as a service’, and explore how to unlock private finance and opportunities such as green mortgages;

e. Buildings as a system: as discussed later in the document, we are keen to ensure that energy efficiency and heating solutions are considered together. Heating technology choices cannot be separated from understanding the building as a whole, particularly its heat demand and its potential for energy efficiency improvements.

These tools are unlikely to work in isolation, but together they can form a comprehensive policy framework to deliver change, in conjunction with industry and consumers.

2.2.1 Regulation

The Call for Evidence set out how regulation and supporting measures may work in partnership to drive change in the off grid heating market. 'Regulation' is discussed broadly in this section, rather than in relation to specific existing legislation.

Questions on this issue generated strong views from most respondents, with around two thirds fully supporting action and less than one in ten arguing against. The remainder expressed support for regulation, subject to various conditions, such as ensuring regulation works for small businesses.

The Industrial Strategy explained how our competition and regulatory frameworks are fundamental to our economic success and committed to support businesses with regulation that stimulates and facilitates innovation.[15] The government has used regulation to drive improvements in the efficiency of energy-related products, and the quality of installation standards. In 2005, minimum boiler ratings brought forward deployment of condensing boilers on a massive scale, making boilers manufactured in the UK the most efficient anywhere in the world. Earlier this year the new Boiler Plus standards replicated this success by further improving standards and introducing requirements for sophisticated control devices.[16]

There is much more that can be done to improve the efficiency of mainstream heating technologies, especially if we look beyond the boiler to consider the full range of elements that really determine the performance of a building's heating system. For example, heating engineers may consider the design of the whole hydraulic system, radiators, system balancing and advanced control of heating in different areas in the building. These are expected as standard elsewhere in Europe, but in the UK, they are often omitted. These considerations can increase the cost of installation, but also mean consumers spend less on heating bills, have greater comfort and control, and some parties believe heating systems could last up to twice as long (reducing the cost in the long-term). When we consider the building of the future, we should imagine well designed, intelligent systems such as those that are already commonplace in other countries. In section 3.2 we elaborate on how we might help installers achieve these higher standards.

However, with today's fossil fuel boilers these improvements still only offer incremental benefits, and to meet our Carbon Budgets and the commitments made in the Clean Growth Strategy, incremental improvements are not enough. A step change is needed in the fuel or the technology we use, to reduce carbon emissions and pollutants, while stepping up efficiency standards can minimise the amount of fuel that is needed and ensure new systems operate at their best.

It is clear from the Call for Evidence that there is support for a detailed and specific framework with a firm timetable, including an eventual end to the installation of high carbon fossil fuel heating in buildings off the gas grid. This will provide the certainty people have

[15] BEIS, Industrial Strategy: Building a Britain fit for the future, November 2017 https://www.gov.uk/government/publications/industrial-strategy-building-a-britain-fit-for-the-future
[16] BEIS, Heat in Buildings – The Future of Heat, December 2016 https://www.gov.uk/government/consultations/heat-in-buildings-the-future-of-heat

asked for in order to allow businesses and consumers to make decisions now, in a long-term context, and to unlock private investment. It also benefits consumers, as long-term certainty can reduce costs and enable new technologies and practices that improve comfort and wellbeing.

Regulation was seen by respondents as a prerequisite for novel business models to be developed, as it would provide the necessary certainty to drive this forward. This could reduce the cost of expensive installations while improving comfort and security in the home. It can provide the certainty needed to allow Distribution Network Operators (DNOs) to invest for significant uptake of electric heating, and in the Clean Growth Strategy we committed to work with Ofgem to ensure the necessary regulatory arrangements to support this are in place.[17]

There is little consensus amongst responses on how regulation should be designed to best drive this process, however there were several principles which were frequently identified

Long-term certainty should be provided as soon as possible to prevent investment and capabilities dropping off or being directed into avenues that are not compatible with the long-term ambition.

Change must happen at a pace that works for industry and consumers. Manufacturers need time to ramp up production of low-carbon heating to meet growing demand, installers and heating engineers need time to acquire new skills, and consumers need time for market confidence to bring prices down. Some non-domestic building owners, including the public sector, plan changes and upgrades to their internal infrastructure years in advance, and sometimes heating systems are integrated with security, fire safety and other building services.

Consumer welfare is paramount. There must never be any risk of consumers being left without functioning heating in their home or business, increases in fuel poverty, or compromises to health and safety.

The government agrees with these principles, which have a clear intrinsic value and are consistent with our understanding of clean growth.

Other aspects are less certain. Below are important questions raised in many responses to the Call for Evidence that will need to be resolved before firm decisions can be made:

Should government set interim targets for heat decarbonisation, ahead of a final end to high carbon fossil fuel installations?

Interim targets are an effective way of ensuring progress is made, and that it occurs at a steady pace. It ensures change does not occur suddenly, as a final deadline approaches, potentially putting consumers at risk of high prices and limited supply. However interim targets can also be a distraction from the ultimate

[17] Ofgem, Our Strategy for regulating the future energy system, August 2017 www.ofgem.gov.uk/publications-and-updates/our-strategy-regulating-future-energy-system

objective. Investment in 'stepping stone' technologies may lock us into a route that cannot achieve full decarbonisation, or may put assets at risk if sunk into developing and commercialising technologies that have a limited transitional role.

Should regulation require certain technologies and prohibit others, or should it remain entirely technology neutral?

Responses to the Call for Evidence included strong advocation for both options. A neutral approach might focus on measured emissions, irrespective of the heating technology in the system. This is likely to drive the uptake of the solutions with the lowest capital cost today. This may be regrettable if today's lowest capital cost option exposes consumers to high or unpredictable fuel bills in the future, or if it does not align with other strategic consideration, such as sustainability of supply. Conversely, regulation that identifies specific technologies to be mandated or prohibited need to reflect the diverse nature of our buildings, and the particular circumstances of any given household or business. As with a technology neutral approach, regulations that identify specific technologies can stifle development of new products that are not available today.

How should regulation reflect the differing circumstances, challenges and solutions that exist between domestic and non-domestic buildings?

Some non-domestic buildings are comparable to homes with respect to heat demand and in the sense that installations are often a distress purchase. For other non-domestic buildings, new heating systems are planned many years in advance and may be integrated with wider building operations including security, fire safety and retrofit cycles. This may mean there is sense in regulations that differentiate large non-domestic settings from small non-domestic and domestic buildings, such as by setting different time scales or standards.

In isolation, regulation is unlikely to be adequate to allow this market to develop. For regulations to drive the right outcomes, they will need to form part of a comprehensive policy package alongside potential measures such as guidance, standards and action taken at the local level. The government's Road to Zero strategy[18] provides an example of this, setting out a mix of regulatory and market measures to drive the transition to low emission vehicles.

We will need to consider how to develop this type of clear pathway. For example, the first step along a pathway designed in this way may use regulation in the early 2020s to set a clear, long-term trajectory for decarbonisation, with a view to providing direction and confidence to invest. These regulations may set a clear end date for the installation of high carbon fossil fuel heating in existing buildings. We are exploring the potential for a

[18] DfT, Reducing emissions from road transport: Road to Zero Strategy, July 2018 https://www.gov.uk/government/publications/reducing-emissions-from-road-transport-road-to-zero-strategy

regulatory framework that builds incrementally tightening requirements over time, to reach our 2050 targets.

To support regulations in this area, we expect to work with the heating industry in developing and implementing a range of non-regulatory levers, such as guidance to particular sectors on how to keep their plans for individual buildings in line with the long-term strategy for decarbonising heat, new standards for wet central heating systems and heat pumps, and retraining and support for installers to ensure quality remains high. As with regulations, these additional measures may need to differentiate between different circumstances, not only reflecting different building uses but also diverse locations, fabrics, and economic situations. Section 2.2.2 elaborates on the potential opportunities for helping everybody meet the cost of change and benefit from it. Section 2.2.3 explains how we bring consumers with us on this journey.

Looking ahead

It is our ambition to set a clear framework for the off-gas grid in regulations as early as possible, to enable meaningful change on an ambitious but deliverable timescale. It is essential that this regulatory framework is developed through close partnership with industry and consumers.

As part of this, it is our intention to publish a comprehensive consultation in 2019. This will set out a framework that conforms to the principles outlined above and present a range of scenarios to address the outstanding questions. At the same time, we will provide more information about the dynamism between regulations and supporting measures to help people comply with them.

Alongside the formal consultation we will take steps to engage consumers and the industry, including installers and heating engineers, to ensure all needs are understood and represented. We will draw on the valuable feedback from the Call for Evidence, which offers advice on the most effective way to do this (summarised in Annex A).

2.2.2 Overcoming the cost barrier

As set out in the Call for Evidence, a key barrier to the uptake of clean heating technologies, for both domestic and non-domestic consumers, is the difference in cost between current technologies and clean alternatives. The Public Accounts Committee's report on the Renewable Heat Incentive in Great Britain also noted this point and included a recommendation to "address issues of affordability for people less able to pay upfront costs, and how best to inform and influence the homeowners being targeted."[19]

The government response has already set out the role for regulation as part of a package of measures required to overcome these barriers. This section looks at the feedback we received on what scope exists to reduce the cost of low-carbon heating, and the responses we received to the questions on how government and industry could work together to reduce the cost of low-carbon heating technologies – most notably heat pumps – to encourage take up. The Call for Evidence sought views across a broad range of

[19] Public Accounts Committee, RHI Review, May 2018 https://www.parliament.uk/business/committees/committees-a-z/commons-select/public-accounts-committee/news-parliament-2017/renewable-heat-incentive-report-published-17-19/

financial instruments that could be used, including targeted subsidy, options to unlock private finance, encouraging novel business models, and innovation to drive down costs.

Scope to reduce costs

There were mixed views from respondents about the potential to reduce costs, but on balance respondents felt that there were opportunities to reduce costs in the following areas:

a. The installation, design and commissioning of heat pumps;

b. Increased volumes of sales, which would create economies of scale and a more experienced workforce;

c. Some manufacturers thought that there were still opportunities to reduce kit costs through innovative design as well as economies of scale; and

d. Reduced overheads for the industry.

Those who were more sceptical of the potential for cost reduction in heat pumps considered it to be an established market or, in some cases, the components to make heat pumps were already part of an established supply chain for air conditioners with little opportunity for further cost reduction. They did, though, recognise the potential to reduce the labour associated with installation and therefore make reductions. On balance, we consider that the overall cost of installing a heat pump can come down if the right conditions are created to further increase the levels of deployment.

We understand that the installation and kit costs for bioliquid may be lower than for other forms of low-carbon heating, such as heat pumps. However, we lack evidence about the costs of the fuel. Some of those who were supportive of the role of bioliquids in future off gas grid heating systems sought financial support from the government to mitigate against these costs. As set out earlier in the response, we have commissioned research to improve our understanding of the role bioliquids may have in those existing buildings that are harder to heat and treat.

Responses from manufacturers and trade associations also frequently noted that consumers were unlikely to plan ahead in terms of renewing their heating system, and that many sales were ‘distress purchases’ made after their existing heating system has broken down. In such cases, the consumer seeks to replace it as quickly as possible – often with the technology most familiar to them, with least disruption.

This element of consumer behaviour is a key component of the heating market’s current business models and is an area the government would like to explore further. In particular, we will need to develop our thinking on how to influence consumers in relation to distress purchases to avoid the installation of like-for-like fossil fuel replacements, and what support may be required to encourage the take-up of low-carbon alternatives. We welcome further views from industry in this space, particularly on the scope for new business models to lead changes in consumer behaviour.

Role of innovation to reduce costs

Innovation can play a role in reducing the upfront, installation and ongoing maintenance costs of low-carbon heating technologies. In addition, responses from some manufacturers highlighted the emergence of innovative new businesses models, including through offering a 'whole house' improvement package or energy as a service. We heard that this type of business model can allow manufacturers/suppliers to install the system at comparable costs to fossil fuel equivalents, while providing low cost, low-carbon heat and energy to building occupants.

The government is expanding its understanding of the way in which new business models may evolve to incentivise low-carbon heating and energy efficiency, in particular through the Energy Systems Catapult's Smart Systems and Heat programme.[20] This is a collaborative project exploring how to accelerate market innovations that decarbonise domestic heating, including through uptake of new business models to provide heat as a service. In addition, the government is keen to build further evidence in this area through hearing, confidentially, from industry about the financial and business innovations they are seeking to make.

What is heat as a service?

The way people consume and pay for heat is evolving. Heat is traditionally sold as a commodity in units of kilowatt hours (kWh), but the rise of the 'smart home' means that there are increasing opportunities to use technology and data to provide heat as a packaged service rather than simply as units of fuel.[21]

There are a number of ways this could be achieved, from simply financing the heating appliance, to selling a package of heat for a fixed price to suit different consumer lifestyles (for example, 21°C during waking occupancy hours). Features included with the package may comprise the cost of the heating appliance, the cost of ongoing maintenance and/or replacement, energy efficiency measures and/or demand-side response functionality.

The benefits of business model innovation using smart technologies are scalable and offer significant opportunity for decarbonisation. For individuals, the benefits of heat as a service may include greater control over the way their homes are heated, peace of mind that maintenance costs are taken care of and an energy package tailored to their needs. Such models would be particularly attractive for individual heating technologies which require high initial capital costs (i.e. heat pumps) as these costs would be offset by this technology being loaned to consumers. Wider societal benefits may include greater leverage of interconnectivity to bring about storage and demand-side response, which may reduce peaks in demand and improve energy security.

[20] Catapult Energy Systems, Smart Systems and Heat, Webpage https://es.catapult.org.uk/projects/smart-systems-and-heat-ssh/

[21] Catapult Energy Systems, Using the connected home to deliver low carbon energy services that people value, Online News Article, February 2018 https://es.catapult.org.uk/news/the-fight-against-carbon-how-technology-can-help-us-heat-our-homes-the-cleaner-way/

Role of obligations

Obligations placed on parties to deliver low-carbon energy or efficiency measures has proven to be an effective way of supporting the uptake of key technologies. Through the Energy Company Obligation (ECO), 2.3 million energy efficiency measures have been installed in approximately 1.8m homes since 2013, helping to reduce energy bills and saving carbon.[22] In our Call for Evidence we sought views on the role of obligations to drive the transition to clean heating during the early 2020s. This could reduce specific barriers and/or manage where the cost of decarbonisation falls during the transition.

Responses were very diverse. Around 40% of respondents supported some form of obligation while only 10% were explicitly opposed. Half of respondents gave answers that were noncommittal on the subject of obligations, instead taking the opportunity to highlight other forms of support, such as changes to VAT and other such options that are discussed elsewhere in this section. Those in favour of an obligation suggested that it could be useful in supporting installations after the Renewable Heat Incentive has closed to new applications. Those opposed flagged concerns about the costs of meeting obligations being passed onto consumers, the risk of incentivising low-quality installations and potential difficulties in administering and enforcing such an obligation.

The Call for Evidence set out a series of examples for how an obligation for low-carbon heating may work. There was no one model that appealed to respondents in significant proportions, however there was a consistent response against any obligation falling directly on installers. It was generally felt that this would have an adverse effect on small businesses, with limited positive impact. However, there was also strong agreement that the provision of information for consumers is crucial, and installers have an important role to play in that regard. Consumer engagement and the role of installers is discussed in sections 2.2.3 and 3.2 respectively.

Another model described in the Call for Evidence would place an obligation on larger providers of fossil fuel heating systems, either to produce a minimum number of renewable systems or otherwise eliminate carbon emissions from their products. While there is an important potential role for manufacturers, only 8% of respondents indicated an obligation that targets manufacturers directly would be an effective action. The Call for Evidence responses demonstrated that manufacturers are amongst the most influential parties in the heat market, and as such they have an important role to play in setting the ethos for the sector. In practical terms they are trusted training providers for installers, and many are household names. We have seen recent and historical changes to boiler standards drive significant improvements to product efficiency.[23] However, these standards tend to focus on what is installed rather than what is produced, so that imported and stockpiled boilers are also subject to standards. Manufacturers do respond to changes in installation standards, but respondents advised us that an obligation targeting manufacturers directly may not have the desired impact. Without other factors driving demand, manufacturers may struggle to sell low-carbon products, incurring production costs while valuable

[22] BEIS, Energy Company Obligation: ECO3, 2018 50 2022, March 2018
https://www.gov.uk/government/consultations/energy-company-obligation-eco3-2018-to-2022
[23] BEIS, Heat in Buildings – The Future of Heat, October 2017
https://www.gov.uk/government/consultations/heat-in-buildings-the-future-of-heat

commodities remain in the warehouse or are sold overseas, until demand in the UK catches up with the obligated supply.

We do not currently envisage an obligation for low-carbon heating on installers or manufacturers having a role in the future policy framework, although we continue to consider the role of an obligation and the appropriate group at whom it may be targeted. Suggestions include targeting an obligation at suppliers of heating technologies or fuels, or distribution network operators (DNOs), given the role they are likely to play in the widespread deployment of electrification technologies. Standards for products and installations remain a valuable way of driving change.

Another recurring message was that schemes such as ECO should prioritise support for low income households and those in fuel poverty, which is consistent with feedback to the government's ECO consultation held earlier this year. The next phase of ECO, through to 2022, will focus entirely on low income and vulnerable households, helping to meet the government's fuel poverty commitments.

The Clean Growth Strategy committed that funding would be continued at least at the current level of ECO (£640m per year) through to 2028. We will review the best form of support beyond 2022, recognising the need to both save carbon and meet the government's commitment to upgrade fuel poor homes to EPC Band C by 2030.

We will also continue to consider the role of a targeted obligation as part of the overall package of support measures as we develop the policy framework to phase out the installation of high carbon fossil fuel heating off the gas grid.

Unlocking private finance and encouraging novel business models

The Call for Evidence asked for views on how we could encourage and unlock private finance in the absence of subsidy as well as how we could bring forward novel business models, which are more common elsewhere in Europe.

Upfront cost is one of the most substantial barriers to clean heating. Some alternative business models present a possibility to overcome initial financial hurdles, potentially bringing scale to the clean heating market helping lower upfront costs.

Clarity and longevity of policy was the most commonly suggested solution to unlock private sector finance. Those responding on novel business models believed that the creation of a consistent and long-term policy framework would enable businesses to bring forward such ideas.

Collaboration between finance providers and the heating industry was put forward as one of the most important factors in unlocking finance. Some respondents argued that example case studies could be developed to show the benefits, to both finance providers and the heating industry, of collaborating in the low-carbon heating space.

Several respondents commented that government should also seek to encourage green mortgages, which could include preferential rates and mortgage terms for homes with higher energy performance ratings. They referenced the recommendations on green mortgages by the Green Finance Taskforce, whose report was published earlier this

year.[24] It was also suggested that government could help companies manage performance risk by agreeing to underwrite a percentage of these mortgages. In the Clean Growth Strategy, the government committed to working with mortgage lenders to help them develop green mortgage products. In April of this year, Barclays launched the first green mortgage product by a major UK lender. This product offers lower rates to consumers purchasing energy efficient new build properties, recognising the lower risk of loan default associated with these homes. It also presents an opportunity to help bring scale to the low-carbon heating market.

Some respondents suggested that the government will not be successful in unlocking private finance for low-carbon heating unless it increases the rate of tax on burning fossil fuels. A carbon tax making fossil fuel and fossil fuel technologies for heating unsustainable was suggested to encourage investment in low-carbon sources for heating domestic and non-domestic buildings. It was noted that Sweden has had a carbon tax in place since 1991, which is levied on all fossil fuels in proportion to their carbon content and is currently being applied both for domestic and non-domestic buildings. Tax was also raised in response to the question about a targeted subsidy.

In addition to a consistent, long-term policy and regulatory landscape, those responding on novel business models felt that the greatest barriers to their successful rollout were high upfront capital costs and the potential demand risk due to limited uptake associated with such an investment model.

Another barrier to bringing forward novel business models was a concern over heating engineers' and installers' ability to recommend, fit and maintain low-carbon heating systems. The investment risk increases in this case as there is potential for the consumer to refuse payment on the finance of the product if the product is not installed or performs as promised. Evidence from Ipsos MORI[25] shows that consumers rely heavily on the advice of the heating installer to guide their choice of replacement systems. We are aware that installers and heating engineers are comfortable installing certain heating systems. This is for several reasons, including concern over their reputation if they install an unknown product or being unaware of, or unfamiliar with, low-carbon alternatives. As these familiar systems are more likely to be high carbon fossil fuel heating systems, the option to move into cleaner technologies is restricted without further growth in the low-carbon heating sector. In our consultation in 2019, we hope to explore a number of the suggestions raised above on installer standards (see Section 3.2).

If new business models were to increase in popularity in the UK, further consumer protection measures may be required to protect these heat consumers. There may be several similarities in the issues faced by consumers on heat networks and those served by these new models. For example, there would be a need for clear guidelines on contract and services provided, transparency on how tariffs are calculated, particularly in relation to maintenance costs, and minimum standards on quality of service.

[24] BEIS, Accelerating green finance: Green Finance Taskforce report, March 2018 https://www.gov.uk/government/publications/accelerating-green-finance-green-finance-taskforce-report

[25] DECC, Research Report - Homeowners' Willingness to take up more efficient heating systems, April 2010 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/191541/More_efficient_heating_report_2204.pdf

We are continuing to work and maintain a dialogue with stakeholders who are developing novel business models for heating to understand what more can be done to ease their passage to market.

It was noted that the first phase of the Assignment of Rights for the RHI, launched in June this year, is already helping to support the development of innovative new business models.

A number of respondents suggested that tightening standards for new builds would help to encourage changes in approaches to selling heat. These standards combined with other levers could 'support competition and avoid market distortions.

Energy efficiency

We recognise the importance of both energy efficiency and heating measures to meet carbon reduction commitments. We also understand the synergies between the two for consumers and so our policy responses to drive those measures must make sense to them. Energy efficiency measures can play a valuable role in reducing the challenge associated with decarbonising heat, while also reducing consumer bills.

The government therefore published an aspiration in the Clean Growth Strategy that as many homes as possible should be upgraded to an Energy Performance Certificate (EPC) band C by 2035, where practical, cost effective, and affordable. To deliver this aspiration, we are developing a comprehensive suite of policies that work across all tenures: owner occupier, private rented and social rented sector. These could deliver a range of measures (heat and energy efficiency) and we will seek to ensure that future policy encourages consumer action across all measure types.

The 'Building a Market for Energy Efficiency' Call for Evidence, which closed in January this year, contained a range of proposals for increasing the installation rates of energy efficiency measures amongst homeowners and small businesses, including proposals on how to encourage lenders to offer green mortgage products. We are currently evaluating responses to this Call for Evidence and will publish an action plan that will set out a range of measures to shape the market for the future in line with the aspiration.

The role of subsidy

The Call for Evidence was clear that the government recognises the need to tackle the barriers to low-carbon heat, and that there are a range of options that could help us achieve this. Responses to the Call for Evidence offered general support for a subsidy, but views differed in how, and whether, it should be targeted.

Of those that responded, many referred to previous schemes to support their view on the type of subsidy needed or to suggest existing schemes that may be used to administer support. It was thought that those on low incomes, vulnerable or those households living in fuel poverty should be helped. The ECO3 government response confirms joint funding between RHI and ECO is permissible for ground source heat pumps in recognition of the high capital costs associated with installation of ground array. There will also be new innovation routes in the ECO scheme, to encourage more cost effective and energy efficient technologies to be delivered under the scheme that will help to meet the 2030 fuel

poverty target. The government has developed innovation guidance which sets out further details.[26]

For those able to pay, an upfront subsidy to address the initial capital costs was put forward and some specifically recommended a boiler, or tank, scrappage scheme. Scrappage schemes have been popular in the past as they provide simple access to upfront capital. However, such schemes typically come at high cost per building but do not necessarily provide the consistent, aggregated level of demand required to bring prices down for everyone, or to attract investment. Several car manufacturers and traders offer privately funded scrappage schemes, and we would welcome suggestions on how private funding may be unlocked to make a boiler scrappage scheme economically viable.

There were some who felt subsidy was not needed. Their concerns centred on the administrative costs associated with subsidy schemes, the boom-bust cycles it creates and the risk of bringing forward inappropriate technologies.

The government will reflect upon this evidence as it considers the options necessary to support any potential regulatory approach.

On 18 July 2018, we published a Call for Evidence on business energy, 'Helping businesses to improve the way they use energy',[27] as part of our work to deliver the ambition set out in the Clean Growth Strategy to improve business energy efficiency by at least 20% by 2030. The business energy Call for Evidence, in addition to seeking views on building standards driving efficiency (meant in its widest terminology and incorporating heating and cooling technologies) also explored financing options.

Local approaches

We also recognise the important role that local authorities can play to support the phasing out of high carbon fossil fuel installations. There was a clear view from many respondents that local authorities are a trusted source of information and that they often have a better understanding of the specific needs and circumstances of their communities than central government. We are also mindful of views that national policies can be necessary to support local authority actions, and that local authorities may face challenges such as resource and expertise constraints.

We will continue to explore how local approaches can form part of the transition to low-carbon heating. In particular, we will consider technical and commercial support that may be needed by local authorities, and other forms of support for community-led projects. There is also the opportunity for better alignment with DNOs through close working with local authorities, in order to support local heat pump deployment. Under ECO3 up to 25% of the scheme can be delivered under the 'flexible eligibility' mechanism. This enables local authorities to set their own eligibility criteria to identify households who need support and work with energy suppliers to provide heating and energy efficiency upgrades.

[26] Energy Company Obligation: innovation guidance October 2018 https://www.gov.uk/government/publications/energy-company-obligation-innovation-guidance

[27] BEIS, Helping businesses to improve the way they use energy: Call for Evidence, July 2018 https://www.gov.uk/government/consultations/helping-businesses-to-improve-the-way-they-use-energy-call-for-evidence

An important lever is local authorities driving action through local planning. Planning requirements could be used by local authorities to help support phasing out of high carbon fossil fuels in new buildings. However, many responses suggested that local setting of energy performance standards above those set by the Building Regulations should be done in a structured way that retains the benefits that national standards and approaches can bring such as driving innovation, economies of scale and competition in the market.

2.2.3 Information to consumers

Consumers are crucial to ensuring the transition to clean heating happens successfully. Our quality of life and wellbeing are dependent on our ability to regulate our temperature and comfort in our living and working environments. Poorly heated homes cause and worsen certain health conditions, such as cardiovascular and respiratory conditions. In turn, this has an impact on health and social care costs and waiting lists by necessitating increased GP visits, hospital admissions, rehabilitation and the need to ensure patients can be returned to a healthy home environment. Additionally, emissions from burning high carbon fuels pollute the air. Air pollution is the top environmental risk to human health in the UK, and the fourth greatest threat to public health after cancer, heart disease and obesity. It makes us more susceptible to respiratory infections and other illnesses.[28]

Any new policy framework must be designed with and around those affected, taking their different needs into account. The off-gas grid encompasses a wide range of consumers and we will need to understand their different routes to low-carbon heating, listen to consumers and learn from them. The scope of this work encompasses rural homes and businesses. As such, the new framework will be mindful of the needs and diversity of rural communities and consider these when developing future policy.

There is great potential for market growth for parties investing to commercialise the opportunities that a lower carbon heating pathway brings. Through the Clean Growth Grand Challenges and Buildings Mission, we are thinking about how to create the homes of the future. We want consumers to feel confident in understanding what kind of heating system best suits their needs.

Opportunities for increasing consumer awareness and confidence

Consistent messaging

Clear messages from government on the phasing out of high carbon heating technologies in off gas grid areas will signal the direction for consumers. With more certainty about the long-term trajectory and better information about the available options, consumers can make better long-term decisions. Clarity could help encourage consumers to make active purchasing decisions rather than ‘distress’ purchases. It will also contribute to raising awareness of the availability of low-carbon heating and encourage consumer confidence.

The government will need to work together with industry and consumer groups to ensure that there is a common and consistent message, across all elements of the consumer domestic energy experience.

[28] DEFRA, Air quality: draft Clean Air Strategy 2018, August 2018 https://consult.defra.gov.uk/environmental-quality/clean-air-strategy-consultation/

Installers and heating engineers

Installers and heating engineers will also play a crucial role in enabling consumers to make the transition and they can act as a gateway between industry and government, and the consumer. When choosing a replacement heating system, installers and heating engineers are the most trusted sources of information.[29] Many heating systems are a distress purchase when there is little time to research the subject more broadly, so consumers rely on installers. It is therefore necessary that there is a large and skilled network for consumers to rely upon. We want to support installers to help consumers make sustainable decisions and invest in low-carbon heat (see Section 3.2).

Awareness raising

In the short term, part of the challenge will be to improve awareness of low-carbon heating technologies amongst consumers and we will be looking into how we can best achieve this. While around 65% of people are aware of renewable heating systems, less than 10% claim to know a lot about them.[30] We asked in the Call for Evidence how to improve consumer awareness and interest, and the most popular suggestion was for clear and consistent, widespread communications. This could take many forms and in the upcoming months, we will be looking into what would be most effective. We will look at a range of delivery routes, including social media and more targeted local channels. We will also learn lessons and draw insights from past transitions and awareness campaigns.

Information sources

A trusted, impartial advice source will help consumers when they need to make decisions and was suggested by a number of responses to the Call for Evidence. The government has supported the development of the Simple Energy Advice service to provide this advice to consumers. The service was launched in October and has been developed based on detailed research with consumers into their needs for information and the most effective way to provide it. By delivering information and advice from the consumer perspective, the information provided can be better tailored according to consumer need, whether it be seeking options to replace heating systems or looking for information to reduce bills. A web led service backed by a phone offering will ensure that the new service can reach the broadest range of consumers possible.

We will also work with other trusted advice providers to ensure there is relevant and accessible information. This will contribute to raising awareness and ensure that once consumers have heard about low-carbon technologies, they have somewhere where they can learn more about them.

Well-informed consumers are better able to make the best decisions for their circumstances. The more information people have about low-carbon technologies, the more acceptable they become.[31] Accurate knowledge and a clear understanding of both

[30] BEIS, Energy and Climate Change Public Attitudes Tracker: Wave 24, February 2018 https://www.gov.uk/government/statistics/energy-and-climate-change-public-attitudes-tracker-wave-24
[31] ETI. (2017). An ETI Perspective - Public Perceptions of Bioenergy https://www.eti.co.uk/insights/public-perceptions-of-bioenergy-in-the-uk

the benefits and any potential risks will encourage consumer confidence and ensure the most appropriate technology for their home and circumstances is installed.

Maximising the effectiveness, benefits and fairness of a future policy framework

Consulting consumers

Consulting with consumers is fundamental to ensuring any future policy is rolled out in a fair and effective way. By talking to those who will be affected, we are able to understand the impact of any policies and likely uptake. We will continuously consult with consumers along the way, including through internet engagement and focus groups, and their views will be at the heart of the design of the future policy framework.

We have already conducted a wealth of research and consumer engagement looking at consumer attitudes and we will continue to build upon that. We will also continue to work closely with consumer groups, ensuring their views continue to influence policy direction.

Consumer protection

In the design of any policy, we must not forget consumer rights are paramount. We will ensure that whatever policy is decided upon, there will be adequate consumer protection. We will also ensure that the rights of the most vulnerable are safeguarded. We know that in off gas grid areas, homeowners tend to be older - approximately 45% are households with one person over 60.[32] There is also a sizeable proportion of the off-gas grid population that experiences fuel poverty. Approximately 20% of oil heated households are living in fuel poverty and oil heated households are more likely to be in severe fuel poverty.[33] Any future framework will place consumer's interests at its heart with adequate protection for the most vulnerable households.

[32] MHCLG, English Housing Survey, July 2018 https://www.gov.uk/government/collections/english-housing-survey

[33] This is approximately double the usual rate of fuel poverty found in the general population. The average fuel poverty gap for this group is also in excess of £900, three times the average. See BEIS Fuel poverty detailed tables: 2014.

Chapter 3: Putting UK business to the fore

3.1 Links to the Industrial Strategy

The work described in this government response will support ambitions laid out in the Industrial Strategy. It will do this by strengthening the foundations of the UK heating industry: workers' skills, quality infrastructure and in particular, a positive partnership between government and industry. The ambitions laid out in the Industrial Strategy include:

- Driving productivity
- Helping businesses to create better, higher paying jobs
- Maximising the advantages for UK industry from the global shift to clean growth – through leading the world in the development, manufacture and use of low-carbon technologies, systems and services that cost less than high carbon alternatives
- Driving national (and local) growth
- Being the world's most innovative economy
- Ensuring that there are prosperous communities across the UK
- Supporting investment in the skills, industries and infrastructure of the future
- Creating an innovative economy that boosts productivity and earning power throughout the UK
- Creating a Britain which is fit for the future
- Making the UK the best place to start and grow a business
- Allowing investment decisions to be made with confidence
- Supporting sectors to adapt to a changing and ageing workforce
- Tackling shortages of STEM skills
- Ensuring that everyone has an opportunity to enter into and progress at work and through the education and training system
- Investing in infrastructure to drive growth across the UK
- Making the UK the global standard-setter for finance that supports clean growth

The UK's transition to a low-carbon economy is a clear opportunity for economic growth. This is supported by the Committee on Climate Change, who found:

"The low-carbon economy will grow from around 2% of UK Total Output in 2015 to up to around 8% by 2030, and around 13% by 2050. The projected compound annual growth rate for the low-carbon economy is 11% per annum between 2015 to 2030, and 4% per annum between 2030 and 2050, which is substantially higher than the OECD's projection of average UK GDP growth of 2.3% per annum between 2015 and 2050."

"However, realising this potential growth rate depends on maintaining and improving on the UK's competitive position in the global low-carbon technology market, and investing in the development of new products and services across a wide range of technologies and applications."[34]

We will seek to do this in the work following on from the Call for Evidence.
Clearer direction from the government will encourage investment in innovation, de-risk investments and support installer and engineer upskilling. By harnessing clean heat innovations, we will help to boost productivity and earning power in the heat industry.

We want to ensure that consumers have access to clean, affordable heating solutions, supporting those in fuel poverty in particular. The government will reflect upon this evidence as it considers options to encourage and support consumers in transitioning to low-carbon heat. We also seek to ensure that our workforce has access to high-quality jobs with greater earning power.

We will save money and create the markets for clean goods and services by going faster on new build standards, including consideration of measures to move directly into clean heating.

These measures outlined above will help create prosperous communities across the UK and ensure that the UK heating industry is a great place to start and grow a business.

3.2 Supporting installers

The government believes that the installer community has an integral role to play in supporting its Clean Growth Strategy ambitions and the UK heating industry as a whole.

UK installers and heating engineers have diverse skill levels across a wide range of heating technologies. As well as designing, installing and maintaining our heating systems, they are the first and last point of advice for millions of consumers about their heating systems, and their support will be vital if the public's thinking about low-carbon heat is to change (see Section 2.2.3). Government will need to work closely with installers and heating engineers to take advantage of their unique position and to ensure that the right messages about low-carbon heat are being conveyed at the right time to the consumer.

[34] Committee on Climate Change, UK business opportunities of moving to a low-carbon economy, March 2017 https://www.theccc.org.uk/publication/uk-energy-prices-and-bills-2017-report-supporting-research/

The evolving heat sector presents opportunities for new, better-paid jobs for installers and heating engineers; but exploiting these opportunities also means investing in new skills.

One of the key challenges the UK faces in the next decade is how to work with industry to ensure the installer and heating engineer community is equipped to support the transition to low-carbon heat in off gas grid buildings. At present, this community is not yet equipped to meet our Clean Growth commitment to phase out the installation of all new high carbon heating installations in the 2020s in the UK. The transition is therefore likely to involve (re)training measures, and may also require important changes to standards, assessment and enforcement to ensure all installations are carried out in alignment with a clear framework.

Whilst our focus is on off gas grid buildings, the changes to training, standards, assessment and enforcement will also underpin broader, longer-term ambitions for decarbonising buildings. (Re)training our heating installers and engineers will provide them with the skills and knowledge to install and service a mix of heating systems, thereby positioning them within a much larger market.

These measures will be all the more important as we leave the European Union. A leading trade body representing installers has raised concerns that the UK heat industry will be less able to exploit growth opportunities from low-carbon heat imports if the skills gap is not addressed. By working with industry to equip the installer and heating engineer community for the transition to low-carbon heat, we will be paving the way for a stronger low-carbon heat economy in the UK.

We did not receive enough responses to our Call for Evidence from installers and heating engineers to form a representative view on the questions we asked. However, we:

a. held a widely publicised and attended webinar about our Call for Evidence;

b. built on information obtained from the workshops we organised for Boiler Plus;[35] and

c. consulted directly with experts (including from the Chartered Institute of Plumbing and Heating Engineering and the Institute of Domestic Heating and Environmental Engineers).

As a result, we are satisfied that we have an informed perspective. Nonetheless, work is underway to ensure we continue to engage closely with the installer and heating engineer community. When we consult on final options next year, we will act on advice provided by respondents about how to engage with this community, including use of platforms such as social media and trade press, and through representatives, suppliers and trainers.

Installation Standards

Respondents to our Call for Evidence repeatedly questioned whether current low-carbon heat installation standards are adequate. It is unsurprising that a number of responses highlighted the negative impact that poor quality low-carbon heat installations can have on

[35] BEIS, Heat in Buildings – The Future of Heat, October 2017 https://www.gov.uk/government/consultations/heat-in-buildings-the-future-of-heat

performance and customer satisfaction. Typically, low-carbon heat installations are more complex than traditional fossil fuel equivalents and require more training than other heating systems as they are more sensitive to the design and quality of installation.

The government recognises that there is a balance to be struck between accessible standards that keep installation costs down, and stricter, more nuanced standards that require more skill, pushing up standards but also quality.

Stricter quality enforcement measures could mitigate issues relating to quality and provide more robust protection for consumers. There was a clear call for this from respondents, which is supported by findings from the Hackitt Review and feedback on Boiler Plus standards.[36] It is clear that important changes in low-carbon heating installation standards – as well as how these are enforced – need to be considered.

In our consultation next year, we will consider further measures, including:

a. Working with the Ministry of Housing, Communities and Local Government (MHCLG), devolved administrations and existing installer certification schemes to build on current installation standards; and

b. Steps to minimise the number of poor-quality installations.

Training

In the Industrial Strategy, we committed to supporting our workforce to upskill and reskill, including supporting training to help the workforce transition or develop in response to changes in their sector. The transition into low-carbon heat is an example of a radical sector change, and we are currently exploring how this transition could be facilitated through training. We seek to ensure that our installers and heating engineers have access to high-quality training in line with our Industrial Strategy.

Qualifications

There is an established route for becoming a fossil fuel heating installer, but there are a number of different routes for becoming a low-carbon heat installer which are inconsistent, at times vague, and can have variable outcomes.

A low-carbon heat installer or engineer may (or may not) choose to become Microgeneration Certification Scheme accredited, join a Competent Person Scheme, or have a Building Control Body inspect their work. The options open to low-carbon heat installers and engineers means that their knowledge levels can vary considerably.

This presents an opportunity for government and industry to work together to produce a streamlined, simpler, universal set of qualifications for low-carbon heating installers and engineers.

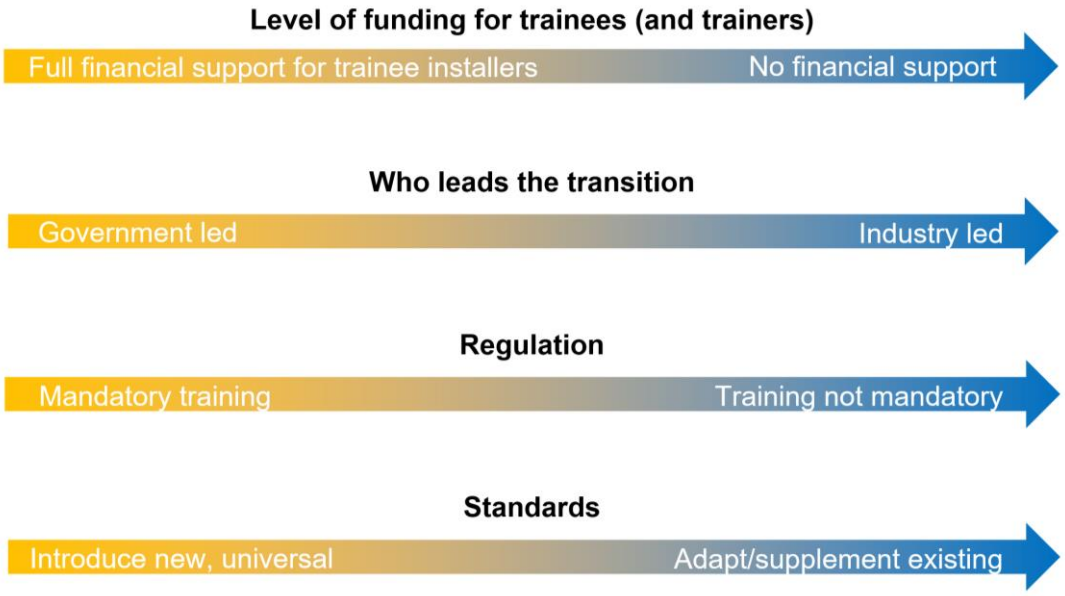
[36] MHCLG, Independent Review of Building Regulations and Fire Safety: Final report, May 2018 https://www.gov.uk/government/publications/independent-review-of-building-regulations-and-fire-safety-final-report and BEIS, Heat in Buildings – The Future of Heat, October 2017 https://www.gov.uk/government/consultations/heat-in-buildings-the-future-of-heat

As part of the changes to technical education, the Department for Education are leading on developing a single set of occupational standards. These standards will form the basis of apprenticeships and the new T Levels, which are new technical qualifications designed to sit alongside apprenticeships and A levels. BEIS is currently considering how it could draw on the occupational standards which underpin T Levels in order to provide future installers and heating engineers with a solid technical foundation for low-carbon heat installations and maintenance. This will enable future heat installers and engineers to adapt quickly and easily to future developments in the heat sector through supplementary training on specific heating systems, and to produce high-quality installations which will improve performance and customer satisfaction with low-carbon heat technologies.

BEIS will also look at current work being undertaken by the Department for Education to encourage more female students to achieve STEM qualifications, including heat engineering. According to data from Gas Safe, currently less than 1% of installers on the Gas Safe Register are female. This is a loss to the economy. As the government considers how it will support training for low-carbon installers, it will also consider how it can attract more women into low-carbon heat to ensure we are drawing on talent from all areas of the population. This will in turn drive future productivity and the wider UK economy.

The role of government

The Call for Evidence provided ideas about how government could work with industry to facilitate the installer and heating engineer community's transition to a highly skilled low-carbon heat workforce:



Of those respondents who called for mandatory training, many referred to laws passed in 2005 which led to the 'seamless transition' from non-condensing to condensing boilers. This involved a retraining scheme rolled out by government designed to equip installers and heating engineers to bring condensing boilers into UK homes. Responses to the Call for Evidence indicated that uptake was high.

Next steps

We plan to consult in 2019 to explore a number of the suggestions raised above, including:

a. Options for streamlining and/or adapting current installation standards;

b. Compliance and enforcement options; and

c. What the government's role should be in low-carbon heat training, learning lessons from previous schemes.

We will be engaging with devolved administrations regarding the scope of this consultation. For the purposes of decarbonising off gas grid properties, we would look to work with industry to implement these measures as soon as possible. In line with the Clean Growth Strategy, we seek to equip the installer and heating engineer community with the skills they need from the early 2020s in order to support our ambition to phase out the installation of high carbon heating systems during the 2020s.

As we develop consultation options, we will continue to work with colleagues across government to ensure that the UK technical education system is joined up with our low-carbon heating ambitions. In addition, we will ensure that any new standardisation or compliance regime is aligned. We will also look to work with existing installer certification schemes to ensure that any new regime builds on existing strengths.

3.3 Innovation

Responses to our questions on innovation were varied, touching on recent innovations made by industry, examples of best practice in the manufacturing and construction industries and the expectations of the role of government in fostering innovation. Broadly speaking, responses to this section fit into four categories:

a. Improvements to installer training and standards;

b. Technical improvements to technologies;

c. 'Whole-house' solutions; and

d. Innovative financing and business models.

Based on these responses, government will continue to consider the ways in which it can work with industry to create an environment in which innovation can flourish in the UK, in line with the wider goals set out in the Industrial Strategy.

Improvements to installer training and standards

Where installer training was mentioned, this was usually in the context of industry providing training to meet tighter requirements and standards that would be set by government. Responses set out that, without government setting standards, retraining would only occur where this is commercially viable – for example if we see an increase in consumer demand for low-carbon technologies, as manufacturers would have an incentive to train installers to fit their products and installers would benefit by adapting to a changing

market. Several responses perceived a need for government to mandate training in low-carbon technologies to ensure that installers were able to identify opportunities for low-carbon heating in buildings, rather than follow previous patterns of behaviour. As always, the balance between regulation and 'soft' levers such as voluntary training by manufacturers will require careful consideration to ensure that the benefits are seen with the minimum of disruption.

We also heard of some cases where industry had voluntarily moved towards improving standards. In general, the Energiesprong business model, originating in the Netherlands, was a common example cited by respondents of a novel approach combining standards and financing. Under this model the developer finances a retrofit (or new build) by combining savings on energy cost from tenants and on repairs and maintenance from landlords to bring homes up to very high standards of energy efficiency. This has been expanded to the UK where homes in Nottingham were part of a pilot programme.

While government does play a role in setting minimum installation standards, we would be keen to better understand the role that industry-led standards and codes of practice could play in pulling through best practice, as these may be more flexible and easily updated than regulation.

Technical improvements to technologies

Here, the majority of responses focused on technical improvements to heat pumps. These are covered in more detail in Section 1.1.1, however the general feeling was that incremental improvements to established technologies would occur naturally in a competitive market. Where responses touched on technologies other than heat pumps, we heard of innovations in solar thermal and photovoltaic (PV) technologies so that these could be retrofitted more easily into older or listed buildings and innovations in building heating and electricity systems that combined a number of technologies to ensure that consumers always had access to heat and hot water while minimising electricity demands from heat pumps. One response recommended mandatory thermal stores for properties to increase efficiencies, while responses from DNOs also suggested there could be scope for innovation in heat capture and storage to improve Demand Side Response.

'Whole-house' solutions – including energy efficiency measures and smart controls

Many responses highlighted the importance of energy efficiency solutions in reducing overall heat demand. Cost and hassle for consumers were commonly cited as barriers to installing energy efficiency measures, leading to several calls for this to be a focus for future research and development and/or government support. Smart meters and smart controls were also cited as areas where innovation may be welcome, for example in enabling 'heat as a service' business models or real-time diagnostic information to be sent to the manufacturer.

Financing/business models

Some responses from manufacturers or low-carbon heating providers explained how they had made changes to their business models to take advantage of cost-saving

opportunities in the market, or to improve their offer to consumers by including maintenance costs in the overall price of kit. We heard several examples of 'heat as a service' propositions, which change the way consumers pay for their heating and ensure an ongoing relationship with the provider, who has committed to providing maintenance support in addition to the system itself. This is covered in more detail in section 2.2.2

In addition, we were presented with a range of views on investment into Research and Development (R&D). Some responses felt that industry should be encouraged to invest in R&D, so long as the government produced a framework that made investing worthwhile. Others felt that the government should redirect its innovation funding towards installer training and demonstration projects. Many responses suggested successful innovation depended on a combination of both government and industry funding.

Role of government

When asked about the role of government in fostering innovation, responses were almost unanimous in asking for a clear direction and a stable policy environment. Many responses also highlighted the use of regulation as a way to pull through the 'correct behaviour' from consumers, installers and the wider industry, although there were substantially differing views on what that behaviour should be, and how it should be encouraged and enforced.

These responses also highlighted that the heating industry has a leading role in working with government to develop any new standards, and ultimately, in investing in research and development and finding marketable, cost-effective ways in which those standards could be met. Recognising this, responses commonly asked for 'technology neutral' regulations to be applied, so that innovators can explore a range of approaches to facilitate the roll-out of low-carbon heating.

Government will continue to consider options and the evidence provided in this space, with a view to consulting further on policy mechanisms in 2019.

3.4 Next steps

This response document highlights important areas of further work that will drive the decarbonisation of heat off the gas grid. Both government and industry have important roles to play in this transition:

Overarching commitments
Government: We will reflect upon this evidence as we consider the options necessary to support any potential regulatory approach.
Government & Industry: The Buildings Mission brings together government and industry to encourage innovation in clean heating systems, ensuring solutions are cost-effective and evidence-based.
Further research

Government: We have commissioned technical research on bioenergy and electric heating options in off gas grid buildings, which we expect to publish in 2019. This will inform our thinking about policy options for these technologies. We are also currently developing plans for a new demonstration project of modern electric heating solutions.
Further consultation planned for 2019
Government: We plan to consult on options for a regulatory framework consistent with the principles and values described in section 2.2.1, as part of a package of measures. Industry: Provide the valuable insights needed to our consultation regarding how the regulatory framework should be designed. It should enable investment in innovation, infrastructure, and long-term decisions to be taken by industry.
Government: We plan to consult on Part L of the Building Regulations in relation to England in 2019, covering energy performance of buildings. Industry: Respond to the consultation to help influence changing standards for new build.
Government: We plan to consult on skills and training to explore options, including streamlining and/or adapting current installation standards, compliance and enforcement options, and what the government's role should be in low-carbon (re)training. We will be engaging with devolved administrations regarding the scope of this. Industry: It is important that the installer and heating engineer community engages closely with government so that changes can be developed with its expert knowledge. Trade bodies, manufacturers and other professional bodies should function as an interface between government and installers/heating engineers to ensure this close engagement can take place.
Ongoing considerations
Government: We will continue to explore how local approaches can form part of the solutions for decarbonising heat off the gas grid, to optimise their success. Industry: Continue to seek opportunities to widen the deployment of low-carbon heating, through working with local partners and developing these models.
Government: We will look into forms of awareness raising for consumers, learning lessons and drawing insights from past transitions and awareness campaigns. Industry: Installers and engineers can be one of the most significant sources of advice for consumers, so should play an important part in raising awareness of alternatives to high carbon fossil fuels.
Government & Industry: Continue to work together to ensure that there is relevant and trusted guidance on low-carbon heating technologies available for consumers.

Industry: The government is keen to build further evidence and hear more from industry about the financial and business innovations they are seeking to make.

Progress with these actions will support the transition to low-carbon heating in homes and businesses off the gas grid. We are keen to continue building our evidence base to help develop a successful and effective policy framework. We are also committed to continuing our engagement with all those affected by this transition, to ensure consumers and businesses can take full advantage of the opportunities and benefits brought by this process.

ANNEX A: Summary of responses to the Call for Evidence

Policy framework and regulations

Questions 1 and 3

Do you agree that the policy framework should focus initially on enabling the market to drive the transition away from high carbon fossil fuels, and in the longer term on helping consumers and industry to comply with regulations?

How could a firm end date for high carbon fossil fuel installations be delivered through regulations? How much time do manufacturers, suppliers and installers trading in high carbon fossil fuels need to prepare for a firm end to new installations?

117 respondents commented on this. 65% agreed broadly with this the policy framework outlined, though many others expressed conditional support dependent on the right particulars. Fewer than 9% were explicitly opposed.

Clear demand was made for the government to set an explicit pathway with fixed targets and dates, including a majority supporting a resolute end date for high carbon fossil fuels within the next 10 years.

It was generally held that regulation is a necessary means for providing a clear pathway with sufficient certainty to drive investment and long-term decisions, and also that regulation is unlikely to be successful if not underpinned by targeted support measures.

Consumer wellbeing was seen as paramount, particularly for vulnerable consumers and households in fuel poverty.

Question 2

How should government best engage with existing and emerging heating markets, consumers and other stakeholders, to ensure regulations are designed in a way that works for everyone?

103 people offered advice on the best way to engage stakeholders. A clear consistent message was that an open process is necessary, that draws on insight from major market participants and small businesses, with recognition for the barriers to smaller businesses in making their voices heard. This includes but is not limited to installers and heating engineers.

Trade bodies and membership schemes were all highlighted as vital portals for accessing large numbers of industry participants, and working groups were explicitly identified by many as a way of bringing together diverse views and people for collaboration.

A large proportion of respondents highlighted the importance of engaging consumers at the right time in this process.

Question 4

What is the potential for non-domestic buildings to transition away from the use of high carbon forms of fossil fuel heating? Is the use of high carbon forms of fossil fuel driven by process heating requirements, with space and water heating requirements secondary to this? Are different solutions required for different heat uses and are there cleaner alternatives?

59 responses were received to this question. There was no consensus on the link between process heat and space heat, and feedback was based on specific experience, with a general indication that there was more process heat in off gas grid business buildings.

Feedback on potential solutions and cleaner alternatives were linked to whether the heat required was of high or low intensity. A range of alternative technologies was considered possible, including heat pumps. The majority view was that any potential solution would be a bespoke solution and should consider fuel alternatives rather than complete heating system changes.

Four main policy approaches were suggested:

a. Community based approaches
b. Providing a long-term framework for any future policy
c. Regulation
d. Financial support

Technology choices in the off gas grid

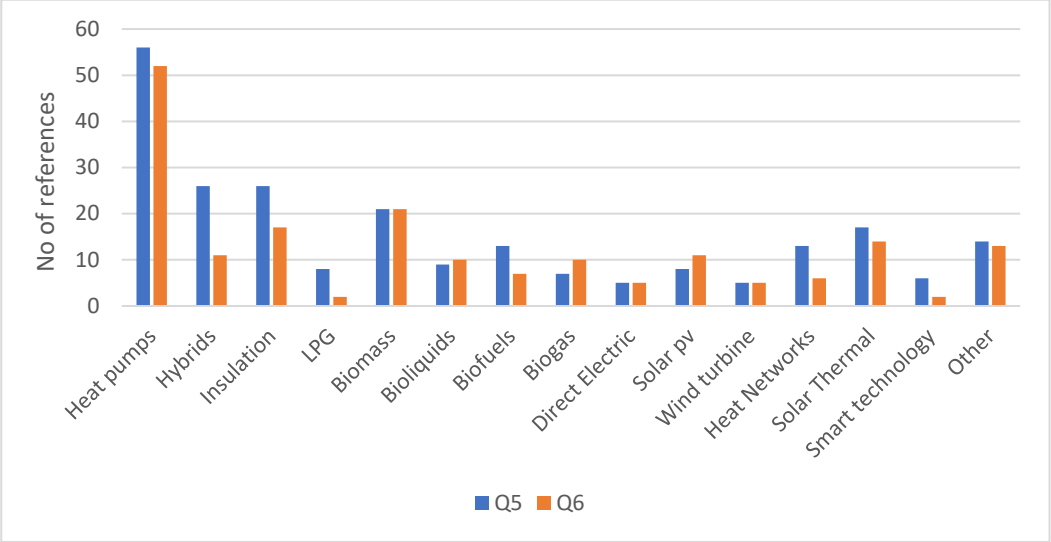
Questions 5 and 6

What do you think are the main technology choices for reducing heating emissions from off gas grid households, businesses and public sector organisations (e.g. transitional technologies)? Please provide comments.

What do you think are the main technology choices for achieving near zero emissions from off gas grid heating (technologies which are consistent with our 2050 targets)? Please provide comments.

There were 101 responses to question 5 and 89 responses to question 6. The chart below shows the number of times particular technologies were mentioned in each of the questions. Some responses suggested more than one technology. Indeed, there were responses which highlighted that buildings would need a range of technologies in order to decarbonise cost-effectively. Heat pumps were regularly cited as a key technology for buildings off the gas grid. However, bioliquids (pooling together the mentions of biofuels, biogas, bioliquids and biomass) came closely behind. Technologies included in the ‘other’ category included heat recovery, phase change materials and fuel cells.

Figure 2: Responses to questions 5 and 6



Heat networks were mentioned occasionally but more detail was provided in response to other questions.

Respondents were clear that heat pumps should be going in to new buildings off the gas grid and picked up the theme highlighted elsewhere that it was important to insulate buildings where necessary to get the maximum benefit from changes to the heating system.

There was no consensus over the role for particular technologies in a transition. Some felt a phased approach could be beneficial to consumers and industry to get used to the changes. Others were concerned about locking consumers in to technologies that may not be part of the future.

Bioenergy

Questions 7, 8 and 9

What evidence is there that bioliquids can provide an affordable and sustainable alternative to fossil fuel heating? What are the technical barriers and what might the impacts on domestic and business consumers be? How scalable are sustainable supply chains and is there a maximum amount of bioliquids which can be supplied?

What evidence is there that biopropane can provide an affordable and sustainable alternative to fossil fuel heating? What are the technical barriers and what might impact on domestic and business consumers be? How scalable are sustainable supply chains and is there a maximum amount of biopropane which can be supplied?

Do you have any evidence on the air quality impacts of the use of solid biomass, bioliquids and/or biopropane?

Of the total 136 responses received, 74 of those responded to our questions about bioenergy.

Bioenergy was a divisive topic, with 50% of respondents acknowledging the potential for bioliquids/biopropane as a drop-in fuel (for oil properties where cleaner heating alternatives are not viable) and 14% suggesting they should not be considered at all due to environmental impacts, and/or prohibitive associated costs. (The rest did not feel strongly either way or did not provide clear responses.)

Prevalent views/areas of agreement amongst respondents:

Affordability

a. Bioliquids and biopropane are typically more expensive than fossil fuel equivalents (particularly when imported). Respondents suggested measures to 'level the playing field' through a combination of tax and subsidy.

b. The cost of adapting oil boilers is a barrier to consumers switching from oil to bioliquids.

c. Using waste feedstocks (which attract a gate fee) would help mitigate costs and incentivise production.

Sustainability and air quality impacts

d. Biomass may have a higher carbon footprint than fossil fuel equivalents due to emissions from processing.

e. Efficient, modern boilers can increase the carbon saving potential of biomass (and reduce air quality impacts).

f. Neither land-based food crop nor wood feedstocks are sustainable unless they are waste (examples include used cooking oil and locally sourced waste wood).

g. The air quality impacts of different forms of biomass fall across a broad spectrum and tighter regulations on permitted fuel choices will ensure significant lowering of emissions.

h. Simple abatement measures, such as the installation of a flue, were mentioned in numerous responses.

i. Carbon Capture Storage (CCS) was also raised as an effective abatement measure.

Technical barriers

j. Bioenergy production will need to be scaled up and further developed in order to meet the UK's needs, and this will require significant financial investment.

k. Even the minority that felt that bio-technology is mature believed that more investment would be needed to make that technology work at the scale sufficient for UK heat requirements.

Impacts on consumers

l. The main impact would be cost. If government considered encouraging the use of bioenergy, it should also consider properties in or vulnerable to fuel poverty.

Scalability and security of supply

m. The bioliquid and biopropane supply chain will need development for wider roll-out across the UK, especially within the government's intended timescale. Opinion was divided on whether the benefits of using bioliquids and biopropane warranted this investment, however.

n. Feedstocks are in short supply, due largely to competition for transport applications.

Notable outliers

Efficient, modern boilers

A minority of responses suggested that the government's focus should move away from feedstocks onto the efficiency of biomass boilers (and burners), with calls for more stringent performance requirements to be introduced.

Technologies in development:

1) E-fuels

E-fuels, or electro-fuels, are chemically identical to fossil fuel equivalents, but are considered carbon neutral because they require as much carbon dioxide to create as is released when the fuel is burnt. This creates a sustainable closed carbon dioxide cycle.

This technology is still in the development stages and is used primarily for transport applications by some car manufacturers.

2) Hydrothermal Carbonisation (HTC)

HTC involves converting high-moisture biomass into solid fuel, or bio-coal. Feedstocks can include organic waste and processing uses less energy than thermal drying.

Hybrids

Question 10

Are there any oil and heat pump hybrids currently on the market (in the UK or elsewhere), and if so, how does the cost compare with conventional systems or with a heat pump? Could they be used with bioliquids? What impacts do they have for domestic and business consumers, for example in terms of ease of use and comfort levels?

52 responses were received to this question. Of these, 38% were unaware of any commercially available oil and heat pump hybrid heating systems (although the

FREEDOM gas/heat pump hybrid project was widely mentioned), with the remaining 62% either citing particular technologies or models on the market or referencing the option of making a hybrid system by combining standalone oil boilers and heat pumps to create bespoke systems, using bivalent switching controls. However, the 62% also flagged that both these types of system were currently the exception rather than the rule, with one social housing provider expressing concern over the complexity of such systems which would require the installations and maintenance of two different systems within a home.

Question 11

We understand there are gas heat pump hybrids on the market that can be used with LPG. How widespread are these (in the UK or elsewhere) and how does the cost compare? Could they be used with biopropane or other biogases? What impacts do they have for consumers, for example in terms of ease of use and comfort levels?

39 responses were received to this question. Of these, 15% were not aware of commercially available combined LPG/heat pump hybrid systems, and 15% referred instead to other technologies. The remaining 70% responses indicated awareness of LPG/hybrid heat pump systems or confirmed that it would be technically possible to create one. However, these responses also explained that current numbers of this kind of system were very small and had had a 'negligible' impact on the overall heating market. We heard that LPG hybrid systems were mainly being installed in new build properties, and with a higher concentration in Scotland than in other parts of the UK.

In terms of consumer impacts, the responses were varied. Benefits of an LPG hybrid system were reported as being able to install in two stages (for example, with LPG boiler first and heat pump later), which may reduce the pressure on consumers making distress purchases, and as perhaps better suited than a standalone heat pump system to lower temperatures and older, less thermally efficient buildings – although these points could also be said for other types of hybrid systems. Suggested drawbacks to an LPG hybrid were the increased installation cost, the impact on space within the property if both a boiler and a heat pump unit need to be installed, and the need to maintain two systems going forward. However, these points are also relevant to other types of hybrid system. The relative costs of LPG compared to other types of fuel were also considered, although many responses were confident that an LPG hybrid system could also be used with biopropane or other biogases.

Question 12

What role might hybrids have in the short term to facilitate the longer-term transition to clean heating off the gas grid?

70 responses were received in answer to this question. Of these, 30% envisaged hybrid systems playing a large, or essential role in the future long-term decarbonisation of heating. 31% thought they could play a transitional role, potentially being phased out later by fully electrified systems. 34% thought they shouldn't have a role, or that the role they played would be very limited, and 4% talked about other technologies.

Of the responses that thought hybrids would play a large role in future decarbonisation, common arguments were that not all properties are suitable for heat pump only systems,

and the cost of retrofitting energy efficiency measure for those properties to make them 'heat pump ready' might be prohibitive. Manufacturers of oil and LPG boilers and suppliers of oil and bioliquids also made the argument that encouraging hybrid systems would allow the industry some time to improve the carbon savings from using bio-fuels and would provide time for manufacturers and suppliers to redefine their business models, should oil be phased out completely. It was felt that this would create economies of scale that would result in a lower financial impact for consumers.

Those responses concluding that hybrids could play a transitional role felt an option would be getting heat pumps into buildings already using oil or LPG boilers, followed by a gradual phasing out of the boiler system. These responses suggested hybrids could be a 'behavioural change mechanism' enabling consumers to get used to heat pump systems with the safety net of a familiar boiler system still in place. It was emphasised that smart controls would be an essential part of this behavioural change, alongside carefully considered installation and emissions standards that could enable a cost effective and low-carbon transition.

Responses setting out that hybrids would play a limited role (or no role at all) in decarbonisation of off gas grid properties argued that installing a 'transitional measure' would delay the carbon benefits of installing a fully electrified system and add to the financial and hassle costs for consumers having to pay for and maintain two systems. Responses from consumers flagged concerns over paying the costs of converting their existing heating systems. These responses either suggested an alternative type of system (usually electrified - such as a standalone heat pump system, or a heat pump/solar PV hybrid), or suggested the government do more to encourage energy efficiency in properties to reduce fuel bills.

Electric heating and heat networks

Questions 13 and 14

To what extent are space requirements an issue during a heat pump installation? How often are heating distribution systems replaced (hot water tanks, radiators and/or pipework)? How often are additional thermal efficiency measures for the building required? - Please provide comments

What potential is there for heat pump costs to come down (both kit and installation)? How can industry show leadership in making this happen?

There were 54 responses. 70% thought that there is scope to reduce heat pump costs, 24% disagreed and 6% were neutral.

Those who felt there was potential for cost reduction predominantly referred to:

a. The need for scale of deployment, particularly citing the potential for installation costs but a small number of respondents also felt kit costs could reduce;

b. Heat as a service or novel business models;

c. The need for a stable policy/regulatory framework;

d. Installer skills.

Those who felt there was not potential referred to heat pumps being an established market, or in some cases, the components to them being part of an established supply chain for air conditioners, with little opportunity for further reductions in cost.

Question 15

Are there any drawbacks of smart/more efficient storage heaters, vs other types of electric heating? And, if so, how are these to be overcome? What are the benefits of smart and more efficient storage heater products compared to traditional storage heaters? In which types and tenure of buildings are storage heaters most likely to be useful? Would storage heaters be a likely solution where electric heating is not currently used? How about where electric heating is currently the secondary heating source? - Please provide comments

There were 60 responses to this question. 17% were positive about the role of storage heaters in the off-gas grid, 65% were not supportive and 18% of responses were unclear about their views.

This was a complex question that raised some strong views about the unsuitability of storage heaters and traditional electric heating. They highlighted:

a. The high cost and inconvenience for consumers;

b. That smart and/or well installed heat pumps or heat pump plus (e.g. solar) systems can achieve the same benefits but are more efficient;

c. The strain on the electricity network. Some highlighted local electricity generation/storage as a solution for this; and

d. 4 respondents suggested direct electric (including electric boilers) as a better solution than storage heaters.

A small number of responses (particularly from trade associations and companies with an interest in electric heating) reflected on the potential for flexibility and set out that modern storage heaters are complementary to heat pumps, e.g. useful in smaller properties with lower heat demands or where older electric systems are being replaced.

Question 16

Is there scope for more use of rural heat networks and communal heating systems? What are the barriers and how might they be overcome?

There were 89 responses to this question. Respondents were split 50/50 on whether there is a role for heat networks off the gas grid. Those who didn’t see a role for them focused on the low demand density in rural areas reducing the economic viability of such schemes. Those in favour highlighted that many off grid sites exist with sufficient density for localised heat networks, which would offer great value and potential for cost effective decarbonisation.

Question 17

Are there specific ownership and funding models that may be suitable for heat networks and communal heating systems in off gas grid areas?

44 respondents commented on this. Community ownership models were mentioned by 43% of respondents. These were either co-operative/not-for-profit schemes or joint-ownership finance schemes. 14% mentioned that a sensible regulatory environment is needed for certainty to develop the market. 9% of respondents put forward the energy as a service concept to alleviate the initial capital cost barrier.

Innovation

Question 18

What evidence is available about further innovations to improve the performance, efficiency and customer proposition of heat pumps? Are there opportunities for innovation in delivery and installation, particularly those innovations that might reduce kit and installation costs or hassle for consumers?

45 responses were received in answer to this question. Of these, 98% responses agreed that there was scope for the further innovation to improve the performance, efficiency and customer proposition for heat pumps, although there was great variation in terms of what form that innovation should take, and what would encourage it to come forward. Broadly speaking, the primary focus of responses was as follows:

Main Focus of Response	**Percentage of responses**
Scope for consumer awareness and education about heat pumps to improve	2
Scope for Distribution Network Operators, energy companies and manufacturers to innovate in terms of connection to electricity grid	7
Scope for manufacturers and suppliers to innovate new business models and finance propositions	7
Scope for manufacturers to innovate kit and make specific improvements to heat pump performance	20
Scope for government to design regulation and standards that pull through innovation from the market	18
Scope for installer training to be improved/widened to installers of fossil fuel technologies	4

Scope for innovation in terms of integrating heat pumps with 'whole house' solutions, such as energy efficiency measures and smart controls	13
A general sense that innovations to heat pumps will occur naturally, if the market is left to deliver	27
No opportunity for innovation	2

Question 19

What is the role of the heating industry in delivering cost reduction through innovation? What steps is the industry already taking and what more could be done?

66 responses were received in answer to this question. Again, there was wide variation, with many (often contradictory) views on the role of the heating industry in delivering cost reductions through innovation. Broadly speaking, the responses can be divided into the following categories:

Main Focus of Response	**Percentage of Responses**
The heating industry is continuously making improvements to its technology offer and business model, driven by market competition	14
The industry needs a clear steer from government as to the future direction of heat policy. This will encourage investment and pull through innovation.	35
Industry players are already creating novel business models to improve their consumer proposition	2
Distribution Network Operators need to invest in upgrading the electricity grid to encourage heat pump deployment	2
Industry players, such as manufacturers and suppliers of heating technologies and fuels, energy companies and Distribution Network Operators need to work with each other, as well as with the housing industry and local and national government to develop a joined-up offer for future decarbonisation	11
Industry needs to invest in research and development to bring forward innovative products and services	18

Manufacturers of heating systems need to exploit the benefits of 'smart' technology in designing products for the future	5
Manufacturers of heating systems need to think creatively about how to develop 'whole house' solutions encompassing energy efficiency measures and solutions that reduce the complexity of a hybrid/multi-part heating systems for consumers	3
Industry has a role to play in delivering innovation, but no specific answer provided	8
Industry has no role in delivering innovation	2

It is important to note that many of the suggestions outlined above are not mutually exclusive and demonstrate part of a possible picture of the future pathway to decarbonisation. In addition, we were provided with several accompanying examples of exactly what industry is already doing to deliver cost reductions through innovation, which are discussed in section 3.3.

Question 20

What other innovation opportunities and innovative technologies are available for rural homes off gas grid? At what technology readiness level are they and do they require government support to move them towards the market?

59 responses were received in answer to this question. Here, due to the nature of the question, we saw great variety in the answers and in the innovation work suggested. Broadly speaking, research and development and innovation is being undertaken across all sectors of the energy industry, although responses were again clear that government needs to provide a clear steer as to its plans for decarbonisation for this investment to continue or for government to see the outcomes it desires.

Some of the more common answers are set out below:

Main Focus of Response	**Percentage of Responses**
Battery storage solutions, perhaps combined with 'time of use' tariffs, to smooth demand	7
Government must regulate new standards to pull through innovation	14
Government backing (loans/subsidies) must be available to support consumer uptake of innovative technologies	5

The technologies to decarbonise heating are already available – there's no need to invent new technologies	7
The decarbonisation of heating will require a range of solutions – my business is innovating across many technologies	8
Bioliquids and biogas	8
Smart technologies and heating controls	4
Fuel cells	4
Hybrid heat pumps	5
Solar thermal, where this can be combined with other technologies in buildings	10
Combining a range of solutions in the same building, together with energy efficiency measures	8
Other specific technologies and measures	20

Question 21

What can government do to ensure that future policy encourages and supports future innovations and cost reductions in technologies?

We received 58 responses to this question. Answers were again varied, but it was clear that many felt that government has a range of options available to it to encourage decarbonisation, and that it should make full use of these options. The most common answer was that government has a duty to provide a clear, stable policy framework that can provide long-term certainty to industry and consumers.

48% cited that government should regulate clear, long-term standards for industry to follow. 17% felt that government subsidy would have a role to play in creating market opportunities for innovation and allowing consumers to overcome the cost barrier. 9% specifically mentioned that any future policy must be technology neutral and not be based on specific technologies that government thinks will bring about decarbonisation. 5% felt that government's role was to invest in education of installers and consumers, and demonstration of industry best practice. 7% specifically identified that government should continue to engage with the heating industry throughout the development of future policies, although this was implicit in many of the answers to this question. The final 14% identified specific ideas that government could mandate, such as insulation, Passivhaus standards and the recycling of waste heat.

Questions 22 and 23

Please provide views and evidence on how different obligation approaches could be used to drive the transition to clean heating during the early 2020s? Are there any

areas worth specifically targeting? Are there situations in which obligations would be counter-productive? Do you have any views on other long-term regulatory options that could be pursued, besides those considered above?

What do you think about the options set out above for an obligation? Do you have any evidence as to potential impacts, burdens or unintended consequences?

93 respondents commented. This was a very divisive topic with almost as many different views as there were respondents. There was general support for some manner of obligation, with no one of the examples modelled in the Call for Evidence having support from more than a fifth of respondents. The most discussed was Example 2, utilising the ECO model, which is likely to reflect the familiarity of ECO compared to the relatively abstract nature of the other examples.

There was a strong negative reaction to the example of an obligation on installers to provide quotes for low-carbon heat alongside like-for-like replacement quotes. This was seen as ineffectual, not enforceable, and unrealistic by all stakeholder groups.

There was a comparably strong reaction in favour of the provision of information for consumers, and particularly a role for government as a trusted source.

Question 24

What further options for long-term regulation exist that we have not considered in this Call for Evidence? Do you have any evidence as to the associated impacts or burdens of any further options suggested?

61 respondents commented on this. Around 28% implied improvements could be made to Part L, or Building Regulations more generally, in terms of stringency and/or enforcement. This includes the 10% of respondents who called for an extension to the boiler efficiency standards that came into force for some boilers in April 2018, and a further 8% who highlighted a need to improve fabric efficiency in the short term. The remaining 10% referred to Part L or Building Regulations more broadly in less specific terms.

15% called for a ban on high carbon fossil fuels in new build properties as soon as possible.

Question 25

How can Distribution Network Operators (DNOs) or Gas Distribution Networks (GDNs) take a leading role in deploying clean heating?

59 people responded. Around one fifth indicated that the most important role for networks is to take the lead on grid reinforcement, such as by socialising costs or anticipating where reinforcement will be needed. A clear government forward look is seen as necessary to support this.

Around 10% of respondents said DNOs must be clear, transparent and standardised in their processes for upgrading the grid, particularly with regards to costs to consumers.

About 14% reiterated their support for an obligation on DNOs to assist deployment of renewable heat and/or energy efficiency measures.

Finance

Question 26

How can we encourage and unlock private sector finance in the absence of a subsidy?

69 respondents commented on this. Clarity and longevity of policy was mentioned by 20% of respondents as being the most important factor to unlock private sector finance. 18% mentioned regulations specifically, though these ranged between assignment of rights, phasing out of fossil fuel-based heating and Building Regulations. 10% mentioned that the green mortgage concept should be encouraged, including the government helping companies manage demand risk.

It was pointed out that mis-selling on finance in the solar PV market, as highlighted in the recent Financial Ombudsman's Annual Review, led to reputational damage such that leading finance providers exited the market entirely.

Question 27

If there was some targeted subsidy, e.g. for low income or vulnerable households or for building local supply chains, what would this need to look like? Do you have any evidence that subsidy is necessary? Please provide comments.

There were 76 responses to this question. 84% supported a subsidy, 8% did not and 8% had mixed opinions. However, views differed in how (whether) it should be targeted. Many respondents referred to previous schemes to support the case for specific types of subsidy or the need for subsidy. There were specific mentions of:

a. Those living in fuel poverty or vulnerable must be helped;
b. ECO or Warm Home Fund could be an effective way of targeting support for the fuel poor;
c. Loans for the able to pay;
d. An upfront subsidy, plus some who suggested boiler/tank scrappage specifically;
e. Local approaches;
f. Tax.

The importance of energy efficiency was a recurrent theme. There were also references to the importance of: communication/messaging/education to go alongside any subsidy; the need to manage running costs of low-carbon technology as well as upfront cost; bioliquids; the need to maintain expertise in large scale projects such as CHP, heat networks and biomethane developed under the RHI; and heat as a service.

Question 28

Novel business models for selling clean heating have not taken off in the UK market, why is this? What is needed to stimulate the development of this market in the UK?

67 respondents commented on this. 13% mentioned the high upfront capital costs and the inherent risks associated with such an investment. 10% claim the assignment of rights are already supporting the development of innovative new business models. 7% mentioned the uncertain policy environment, particularly the RHI, but also the investment environment, in the context of Brexit.

Plumbing and heating practitioners will only recommend, fit and work with equipment which they are familiar with. Funders are concerned about the skills gap and the quality of installations being poorly policed. They are therefore averse to being drawn into disputes over perceived poor performance.

Question 29

What could be done, apart from subsidies, to encourage new approaches? Are there any approaches that have worked particularly well in other countries and that could be replicated in the UK?

61 respondents commented on this. 16% mentioned building regulatory standards. These can 'support competition and avoid market distortions.' 10% mentioned tax incentives rewarding low-carbon investment in installations. Sweden was given as an example where this already happens. 7% mentioned the Energiesprong model, which is a housing company that finances a retrofit (or new build) by combining savings on energy cost from tenants and on repairs and maintenance.

Two respondents suggested a carbon tax that specifically benefits buildings with higher energy efficiency might be beneficial if it is applied across the whole market. Several mentioned policy support for heat as a service.

Question 30

What could be done to support a whole-house approach of combining interventions and technologies? Please provide comments.

A range of ideas were presented, though without any strong themes:

a. Require action at sale/purchase;

b. Encourage collaboration between heat and insulation installers to make a joint offer to consumers, e.g. though incentivising integrated solutions and allowing use of multiple incentives;

c. Join up policy frameworks;

d. Provide advice for consumers so they understand that multiple measures may be better in the long-term – may need telephone or face to face, not just internet.

Consumers need encouraging as they tend to only want to/can only afford to do one measure at a time;

e. EPCs to be properly promoted and explained to customers;

f. Web portal to help installers recommend the right solution for a house;

g. Require insulation with new heating systems (all technologies), could be requiring insulation and smaller boilers as part of changes to boiler standards, or a requirement to provide information about insulation;

h. Require buffer tanks;

i. Education and skills as most traditional heating installers do not know enough about insulation and alternative options for heating;

j. GDNs could deliver a range of measures to help consumers reduce their energy use if the regulatory framework allowed;

k. Go beyond whole house, consider whole system.

Local approaches

Questions 31 and 33

How can government best tap into and support community and local authority efforts? Are there any successful examples that can be built upon?

Do local approaches provide a possible model for delivering a firm end to fossil fuel installations through regulation? For example, by establishing oil free zones starting where it is most deliverable and joining them up over time.

There were 70 responses to these questions. These are analysed together given common themes.

There was general agreement from the majority that local authorities are well placed to lead the transition, they are a trusted source of information and they are closer to conditions ‘on the ground’ so can support local groups/communities. Some respondents suggested that this could be devolved even more locally to community groups and parish councils. However, 20% highlighted the need for local authorities to be properly resourced, and 23% respondents mentioned that there needs to be a national framework in addition to local leadership.

The most common types of support suggested for local authorities mentioned were:

a. Technical and commercial support for community groups and local authorities developing projects; and

b. Subsidy available to support community projects.

Respondents also:

c. Suggested targets based on EPCs to encourage competition between local authorities; and

d. Mentioned the opportunity presented by local energy plans (and how these requirements could be strengthened)) for mapping heat zones, working with DNOs to support local heat pump deployment and integrating policy in this space across the local authority.

On oil free zones respondents were divided, with 49% in favour and 51% against. Those who were against cited the need for one regulatory approach across all areas, as well as the potential for unfair treatment for local residents and the risk of poor enforcement. One respondent suggested low-carbon zones might be more palatable.

Question 32

What could be done to drive action from local planning? What are the pros and cons of approaches that rely on local planning? What evidence is there that such approaches produce desired outcomes? Please provide comments.

There were 64 responses to this question.

54% of responses were positive about the potential for local planning to help drive the decarbonisation of heat off the gas grid. Many noted the potential for this to drive further ambition beyond national standards, and that local authorities were better placed to understand the particular needs of their communities and appropriate solutions. 17% suggested straightforward requirements being introduced through planning, such as not allowing oil in new build. Others noted the importance of striking the right balance between national standards set through Building Regulations and further ambition through local planning.

16% of respondents noted that there need to be improved decision-making processes within local authorities, in order to achieve better outcomes. Several highlighted that local authorities often do not have the necessary resource or expertise to set appropriate requirements. One respondent suggested partnerships between local authorities and private organisations to deliver low-carbon heating solutions as a way to plug this gap.

Other repeated points include:

a. Approaches in London and Scotland to planning have had positive outcomes in reducing carbon, from which lessons could be learnt;

b. There may be pressure from developers with local authorities and the requirements that are set;

c. Considerations regarding heritage should not always be prioritised over environmental or energy considerations;

d. Local authorities must take a holistic approach when setting further requirements;

e. There would be local benefits from authorities engaging with network operators early in the process; and

f. Fuel poverty is an important consideration, and local authorities should have a good understanding of this.

15% of respondents were negative about local planning being used to decarbonise heat. They generally thought that the right solution was to do this through national standards, so that there is consistency across regions and to drive greater economies of scale in developments.

Consumers

Question 34 and 35

How can we increase consumer awareness and interest in clean heating technologies?

What are the best methods of engaging directly affected consumers?

Responses to the two questions did not differ substantially, with many simply repeating the same answer, so we have looked at the responses together.

There were 91 responses altogether. The four most common themes were:

a. 52% suggested some form of communications/marketing campaign. This includes local demonstrations. However, 3% think that a communications campaign would not work;

b. 32% highlighted the role of installers/energy suppliers/fuel suppliers as sources of information;

c. 16% wanted some form of independent advice service;

d. 14% wanted a clearer signal from government.

Other responses looked at other barriers already identified and addressed elsewhere in the document, with 18% suggesting some form of grant, subsidy or incentive, 14% suggesting reducing the cost of low-carbon technologies and 11% suggesting bringing in regulations. 7% suggested reforming EPCs to make them more interactive.

Installer skills

Questions 36, 37 and 38

How can we best work with heating engineers to benefit from their knowledge and experience, and their access to customers?

What steps are needed to ensure installers, manufacturers and the entire supply chain have access to new skills frameworks?

What should the respective roles be for the fossil fuel market and the low-carbon heating market in ensuring installers have the skills they need for the future?

We received 69 responses to these questions.

Prevalent views:

a. There is a low-carbon skills gap in the installer/heating engineer community. (Re)training would be the most effective way to address this.

b. Effective training in low-carbon heating installations will require standardisation. Respondents suggested this could be done in conjunction with the newly launched T Levels.

c. Some called for a new, streamlined, universal standard; others suggested adapting current schemes (Microgeneration Certification Scheme and Competent Persons Schemes).

d. Stricter enforcement measures could mitigate issues relating to the quality of installations and provide more robust protection for consumers.

e. Financial support for training from government and/or industry is required.

f. Retraining for fossil-fuel installers and engineers should be mandatory.

g. Support for ‘drop-in’ fuels would lessen the amount of time spent on retraining current fossil-fuel installers and engineers.

Removing the barriers

Question 39

What other options should we be considering to target key barriers to taking up clean heating? Please provide comments.

There was considerable reiteration of points covered in previous questions alongside a wider range of topics. These were:

a. Stable framework for all investment;

b. Keep options open at this stage;

c. Continue the RHI for some technologies;

d. Avoid complex rules and subsidies – rely on the market;

e. Boiler scrappage scheme;

f. Financial support beyond subsidy (e.g. tax, loans, green mortgages);

g. Access to finance (both for innovative companies e.g. venture capital and consumers who want to fund new heating systems);

h. Support for training/Microgeneration Certification Scheme certification;

i. Support for more efficient oil boilers alongside smart meters (i.e. make oil as efficient as possible);

j. Public sector to take the lead in their buildings;

k. Empower local authorities to be bold and innovative in their building stock;

l. Network readiness is key;

m. Householders need advice, education and communication/marketing to increase confidence;

n. Consumer protection is key;

o. Engage landlords and freeholders/management companies who prevent leaseholders from taking measures up;

p. Extend the gas network where possible, then focus on the gas grid;

q. Set a biogas target;

r. Tradeable certificates of biogas/large scale clean heating (to replace the Renewables Obligation);

s. Take a systems approach to energy (e.g. make sure we take account of electricity grid costs of electrification of heat);

t. More support for innovation;

u. Increase oil price, decrease electricity price (through tax, taking account of grid carbon factor);

v. Resolve concerns with costs related to EPCs/Standard Assessment Procedure (SAP);

w. Solar thermal;

x. Bioliquids;

y. Ground arrays – government could recognise this as infrastructure and underwrite it to encourage investment.

Question 40

What intervention would make the biggest difference ahead of any regulation?

37 responses were received. 38% explicitly argued that setting out a clear pathway is the most important thing government can do in the short term to give as much secure and forward-looking stability for investment and development in the market.

14% urged government to focus on developing a strong awareness campaign to bring heat issues and low-carbon options to the attention of the consumer. 12% referred to various forms of financial incentivisation. Several referred to a continuation of the Renewable Heat Incentive in particular, but with a refocus on particular technologies or consumers.

New build

Question 41

Why is oil being installed in some new buildings currently? Are there particular factors or characteristics that are leading to oil being chosen over lower carbon alternatives? What are the barriers to installing a clean heating technology in these buildings?

We received 67 responses to this question:

a. Despite volatility, the cheaper cost of oil and of the necessary equipment is significant;

b. There is a lack of regulation, in the wake of the Code for Sustainable Homes being withdrawn in 2016;

c. Familiarity of oil boilers to developers, installers and consumers;

d. In some off grid properties, oil is the most cost effective of limited heating options. Concerns around reliability, meeting heating demand and cost of retrofitting were reported.

Question 42

Do you have any evidence of the cost of retrofitting clean heating in current new build, compared to the cost of building to that standard now?

We received 34 responses to this question:

a. Answers almost universally agreed that it is more cost-effective to install clean heating systems in new buildings instead of relying on later retrofit. Savings were in the range of several thousand pounds.

b. Futureproofing is technically difficult, as it hard to predict what measures would be low regret steps. Hot water cylinders were highlighted as an example.

Question 43

What are the relative costs and benefits of installing clean heating systems in new build compared to installing futureproofing measures?

We received 47 responses to this question:

a. Many emphasised the need for joined-up efficient technology, for instance the need for a hot water cylinder to provide storage when using a heat pump;

b. It is more cost-effective to install modern technologies now is installed, than to retrofit at an unspecified point;

c. There is a need for greater direction from the government in this area;

d. Some respondents were opposed to futureproofing as this was seen as stalling on government environmental commitments.

Question 44

What would be the most cost-effective and affordable measures to decarbonise new buildings? Please make reference to specific forms of clean heating or futureproofing measures.

We received 139 responses to this question:

a. The need for clear regulation of the construction industry, including an update of the Standard Assessment Procedure (SAP) methodology, was reiterated;

b. Many believed integrated water, heating and electric systems such as heat networks to be the best solution;

c. Others found heat pumps to be the most promising alternative for heating;

d. Also mentioned were solar, biomass, electrification and low-carbon fuels;

e. Several advocated a fabric-first approach, where modern insulation techniques largely negate the need for heating.

This publication is available from: https://www.gov.uk/government/consultations/a-future-framework-for-heat-in-buildings-call-for-evidence

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