UK Energy Research Centre

BEIS Select Committee inquiry: Decarbonising heat in homes

UK Energy Research Centre Response

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November 2020

Introduction to UKERC

The UK Energy Research Centre (UKERC) carries out world-class, interdisciplinary research into sustainable future energy systems.

It is a focal point of UK energy research and a gateway between the UK and the international energy research communities.

Our whole systems research informs UK policy development and research strategy.

UKERC is funded by the UK Research and Innovation Energy Programme.

Currently in its fourth phase running from 2019-2024, UKERC delivers an ambitious programme of research on the challenges and opportunities for delivering the transition to a net zero energy system and economy. The programme brings together engineers, natural scientists and social scientists to generate evidence that informs real-world decisions.

Our research programme encompasses major themes on global energy challenges and their implications for the UK; the role of local and regional energy systems; interdependencies between energy systems and the environment; decarbonisation of specific sectors including transport, heat and industry; and transitions in energy infrastructures.

The programme is complemented by a set of national capabilities. These will carry out systematic evidence reviews, host and curate energy data, map and monitor public engagement with energy systems, and improve the transparency and understanding of energy models. UKERC also supports the wider energy research community in the UK by promoting engagement with other stakeholders, supporting career development and capacity building, and enhancing international collaboration.

Introduction and key points

The UK Energy Research Centre (UKERC) has provided independent research and analysis across the whole energy system since 2004, with funding provided by the Research Councils through a succession of five year phases. Our whole systems research programme addresses the challenges and opportunities presented by the transition to a net zero energy system and economy. Our research themes include decarbonisation of heat and industry, mobility, and local governance. We also have a theme focused on the relationships between energy, environment and landscapes. UKERC has a long track record of engaging with the BEIS Committee and predecessors and we would be very happy to provide follow up information or to assist the Committee Secretariat in working through these substantial topics.

Due to the late submission of this response, we acknowledge the recently announced 10 point climate plan, and have included some initial comments as follows:

- We welcome that a target of 600,000 heat pumps is included in the plan as this provides some clear direction for industry. However this is purely a target and it requires a thorough policy and governance framework to both support deployment and protect consumers.
- Despite the clear case for district heating, it is overlooked in the plan, and there is a lack of focus on energy efficiency despite the expected centrality of both of these technologies.

In the remainder of this submission we address the inquiry questions where UKERC evidence and analysis provides us with relevant insights. We draw upon UKERC reports and the wider literature in order to provide evidence based answers to a number of the Committee's core questions.

Key points include:

Previous and current energy policies have failed to tackle the decarbonisation of heat and energy efficiency in homes. We need to learn lessons from the past and from international exemplars, to ensure that effective policies are developed that implement the changes required.

Government should legislate for the ban on new homes using fossil fuels as soon as possible.

Capital funding will be needed to support householders. The funding provided by the Green Homes Grant and the future Clean Heat Grant (as proposed) is not commensurate with the level of investment required.

Major community trials and public engagement activities are requires to identify key acceptability barriers associated with particular heat decarbonisation options.

Meeting statutory carbon targets should not place an undue burden of responsibility on households that are struggling to meet basic needs. The current approach of

funding low-carbon policies, via household energy bills must be reviewed, a general taxation approach would better align energy demand with policy costs, and would reduce costs for the majority of UK households.

There is an urgent need for a body, to provide heat decarbonisation oversight at a national level. The Government must take on a significant coordination role, a role which is currently not being filled by anyone.

An in situ hydrogen for heat trial is urgently required, to uncover costs and technical challenges. This should not detract for the urgent requirement to deploy known low carbon heating technologies now.

1. What has been the impact of past and current policies for low carbon heat, and what lessons can be learnt, including examples from devolved administrations and international comparators?

Previous UK energy policies have had a minimal impact on decarbonising heat in homes. This is primarily because only a few policies have had a specific focus on the decarbonisation of buildings and those policies that have specifically targeted this issue have tended to underperform. Further still, the cancellation of the Zero Carbon Homes policy - meant to have come into force in 2016 - means that the majority of new build homes are still being connected to the gas grid. Overall, because the number of homes connected to the gas grid each year far outweighs those which have low carbon heating systems installed, the number of homes with fossil fuel heating is increasing. Great Britain (GB) is effectively 'going backwards' with regards to heat decarbonisation.

A strategic issue for the decarbonisation of UK homes is also related to the deployment of energy efficiency measures which has fallen rapidly since 2012[1] following concerns over the impact on energy bills. It is worth making this point upfront because research shows that alongside low carbon heating, energy efficiency measures such as additional insulation and newer windows are cost effective in the pathway for decarbonised heating. Yet according to the Committee on Climate Change (CCC), the deployment of all energy efficiency measures is way below the required levels.[2] Energy efficiency measures can directly reduce carbon emissions, make buildings more suitable for low carbon heating systems and can offset some of the additional costs which are likely to be created as part of the move towards low carbon heating.

An example of one of these underperforming policies alluded to above, is the Green Deal. This was a scheme that the Government launched in January 2013 to provide

[1] Committee on Climate Change. Meeting Carbon Budgets - 2016 Progress Report to Parliament. https://www.theccc.org.uk/wp-content/uploads/2016/06/2016-CCC-Progress-Report.pdf (2016).
[2] Committee on Climate Change. Reducing UK Emissions: 2020 Progress Report to Parliament. https://www.theccc.org.uk/publication/reducing-uk-emissions-2020-progress-report-to-parliament/ (2020).

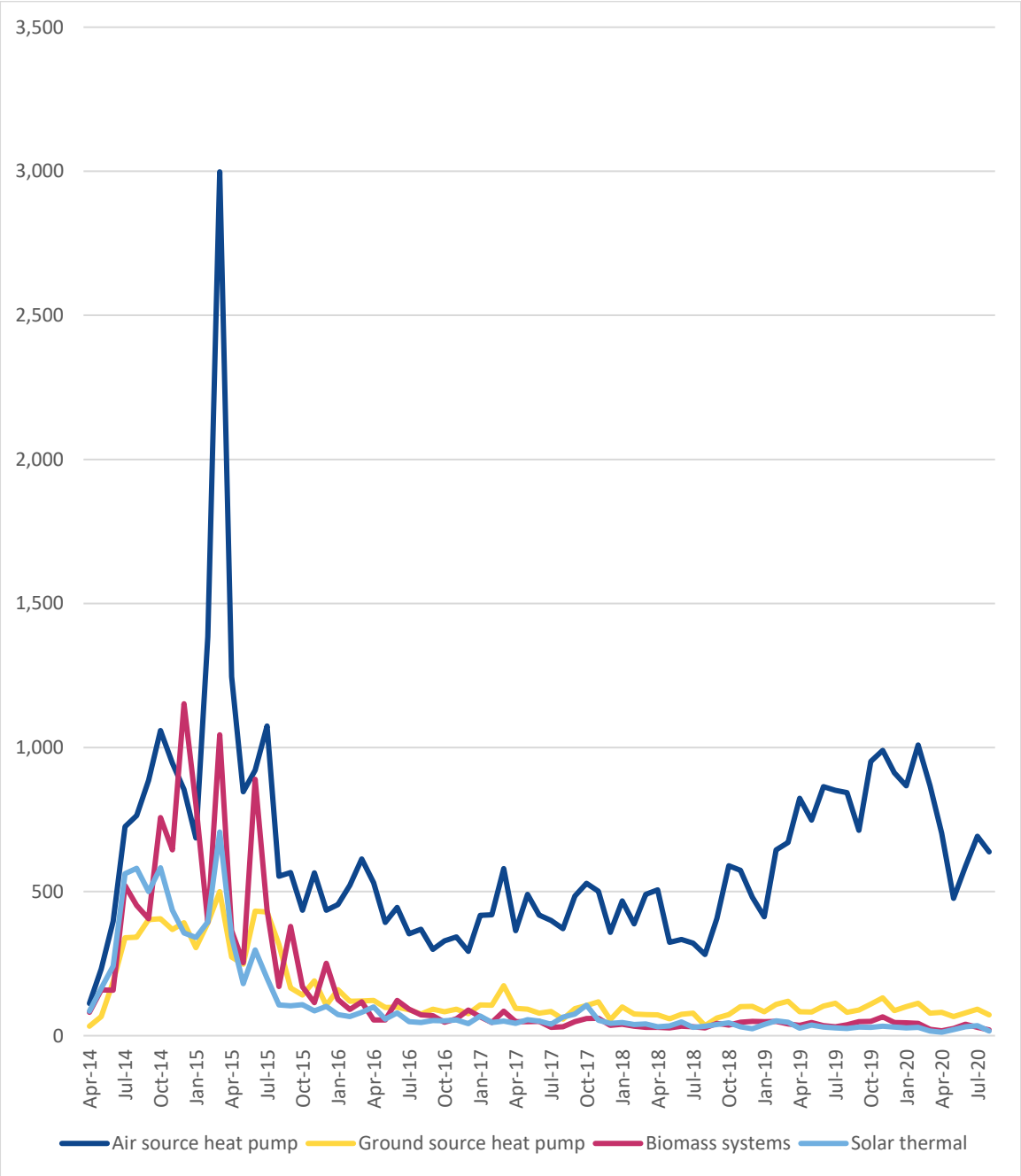
financial support for domestic building energy efficiency improvements. The scheme did not achieve “value for money” (according to a report by National Audit Office[3]) and therefore closed in 2015. Lessons learnt from the failure of the Green Deal[4] can help inform the design of effective support schemes in the future.

The Renewable Heat Incentive (RHI) has been the key GB policy to drive sustainable heating in homes although this was originally focused on ‘renewable’ rather than low carbon heat. Both the National Audit Office and the body of academic literature analysing the scheme have shown that the RHI has under-delivered in terms of the total number of installations and has primarily delivered technologies which may have only limited strategic value, such as biomass boilers.[5,6] Reforms of the domestic RHI scheme legislated for in 2018, increased support for the more strategically important technologies such as heat pumps.[7] Despite these changes, a key issue with the RHI remains, in that it only provides financial support to households once the renewable heating system has been installed and paid for upfront. Therefore for many, access to upfront capital remains an issue. While the development of a system which allowed payments to be made to a third party was introduced in 2018, it is unclear how this system is performing.

As shown below in Figure 1, deployment under the domestic RHI remains very low. For context a recent UKERC analysis suggested 19,000 homes would need to be decarbonised each week up to 2050, this represents a 76 fold increase in the scale of domestic heat pump installation compared to the 1000 per month under the RHI in February this year.

[3] National Audit Office. 2016. Green Deal and Energy Company Obligation https://www.nao.org.uk/press-releases/green-deal-and-energy-company-obligation/
[4] The Green Age. 2015. Why did the Green Deal fail? https://www.thegreenage.co.uk/why-did-the-green-deal-fail/
[5] Lowes, R., Woodman, B. & Fitch-Roy, O. Policy change, power and the development of Great Britain’s Renewable Heat Incentive. Energy Policy 131, 410–421 (2019).
[6] National Audit Office. Low-carbon heating of homes and businesses and the Renewable Heat Incentive. https://www.nao.org.uk/wp-content/uploads/2018/02/Low-carbon-heating-of-homes-and-businesses-and-the-Renewable-Heat-Incentive.pdf (2018).
[7] BEIS. The Renewable Heat Incentive: A reformed scheme. Government response. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/577024/RHI_Reform_Government_response_FINAL.pdf (2016).

Figure 1. Monthly accreditations under the domestic RHI split by technology, data from BEIS RHI statistics



Note the 2015 peak is a result of households registering systems funded slightly differently

Finally, heat networks have also been widely recognised as a low-regrets heat decarbonisation option in denser urban areas but developments remain small and slow, and limited UK expertise restricts their value as a net zero contributor - analysis suggests deployment rates need to triple to meet net zero goals.[8] The £320 million Heat Networks Investment Project (HNIP), announced in 2018 for England

[8] Rosenow, A. J., Lowes, R., Hawker, G., Wu, J. & Gross, R. The pathway to net zero heating in the UK. https://ukerc.ac.uk/publications/net-zero-heating/ (2020) doi:10.5286/ukerc.edc.000941.

and Wales, was a major step, but so far only £53 million has been allocated.[9] The March 2020 UK Budget also included £270 million for a Green Heat Network Scheme, whether this is repurposing HNIP budget is not yet clear. Scottish Government has led the UK with area-based heat and energy efficiency planning, with the regulation and licensing of district heating now proceeding to legislation in the heat networks bill. Overall however, UK progress on heat networks remains limited, despite recognition of the carbon saving value of economically-viable networks.

International comparators and examples are likely to provide useful evidence for how the UK should support plans for heat decarbonisation. Previous analysis by UKERC investigated cases where countries had successfully decarbonised heating systems and how this had been achieved.[10] This review highlighted the need for:

- Long term policy stability over decades;
- Combinations of incentives, taxation and subsidies;
- Information, regulation and standards to ensure high quality installations and build skills in the supply chain;
- Planning and regulatory frameworks for heat networks.

It is worth noting that currently GB has only one significant incentive suggesting there is a significant gap in policy and governance around heat.

2. What key policies, priorities and timelines should be included in the Government's forthcoming 'Buildings and Heat Strategy' to ensure that the UK is on track to deliver Net Zero? What are the most urgent decisions and actions that need to be taken over the course of this Parliament (by 2024)?

The domestic RHI is set to close in April 2022 and be replaced with the Clean Heat Grant. While a grant based system is a step in the right direction as it removes the need for upfront capital for households, the Clean Heat Grant will not fill the void of domestic heat decarbonisation policy. Contributing author Richard Lowes has analysed the Clean Heat Grant in detail, highlighting that the current impact assessment shows it is expected to deliver roughly the same amount of heat pumps as those being currently delivered under the domestic RHI, well below what is actually needed.[11] There are also concerns that the grant as proposed will only

[9] Triple Point. Successful Projects. https://tp-heatnetworks.org/funded-projects/ (2020).
[10] Hanna, R. & Gross, R. Best Practice in Heat Decarbonisation Policy (UKERC Working Paper for CCC, December 2016). https://www.theccc.org.uk/wp-content/uploads/2017/01/UKERC-for-the-CCC-Best-practice-in-heat-decarbonisation-policy.pdf (2016).
[11] Lowes, R. Heat: a policy chasm on the route towards net zero. http://blogs.exeter.ac.uk/energy/2020/05/05/881/ (2020).

support technologies with lower capital costs, such as air source heat pumps, but ground source systems may have significant strategic value.

The policy gap in heat decarbonisation must be filled or the UK will miss heat decarbonisation goals, it appears that a major restructuring of the heat market is required. Specific actions needed are:

- Acknowledgement by Government of the required speed and scale of the challenge.
- Government should legislate for the ban on new homes using fossil fuels as quickly as possible. This would provide a strong market signal and support expansion of the low carbon heat sector.
- Government should ensure that the funding provided by the Green Homes Grant is commensurate with the investment needed and that the scheme provides a smooth transition for those currently active in the heat market.
- Government should dovetail funding with regulation, and an initial focus on off-gas grid areas to drive out fossil fuels while at the same time providing financial support.
- A major energy efficiency programme is needed alongside the deployment of low carbon heat technologies.
- At the same time an in situ trial of hydrogen in an area on the gas grid could help reduce some technological uncertainties associated with the future heat mix.

3. Which technologies are the most viable to deliver the decarbonisation of heating, and what would be the most appropriate mix of technologies across the UK?

Research has primarily suggested that in the future, electricity will deliver a much greater share of UK heating. This is a scenario which is being challenged by some in the gas industry, as the industry could have a lot to lose in this scenario.[12] The fall in the cost of renewable electricity means that economic factors now appear to support this scenario. Recent analysis by UKERC suggests a considerable role for heat pumps using electricity, with houses not using heat pumps connected to heat networks.[6] The Committee on Climate Change also see an important role for heat pumps with their net zero analysis, highlighting a need for 19 million heat pumps by 2050 to meet net zero, although the CCC suggests some of these systems could be hybridised with boiler systems using low carbon gas.[13] National Grid's 'Consumer Transformation' and 'Leading the Way' scenarios also suggest the need for more than 20 million heat pumps by 2050.

[12] Lowes, R., Woodman, B. & Speirs, J. Heating in Great Britain: An incumbent discourse coalition resists an electrifying future. Environ. Innov. Soc. Transitions 37, 1–17 (2020).
[13] Committee on Climate Change. Net Zero Technical report. https://www.theccc.org.uk/wp-content/uploads/2019/05/Net-Zero-Technical-report-CCC.pdf (2019).

Fundamentally there are only currently limited options to deliver low carbon heating, the conversion of low carbon electricity (produced from either nuclear or renewables) to heating is a technology which can be rolled out today. Analysis suggests that a heat pump can today reduce the carbon emissions compared to gas by over two thirds.[14]

Research carried out by UKERC has highlighted the promotion of hydrogen as a solution by elements of the gas industry in spite of significant uncertainties around the potential costs and technical issues.[12]

As stated previously we support further research into the potential of hydrogen, to reduce perceived uncertainty around heating options.[15] Specifically it would make sense to develop a trial area, close to a potential industrial hydrogen cluster, and convert the fossil gas heating system to hydrogen, this project could also be linked to existing industrial decarbonisation programmes. However, while we support a limited hydrogen trial, it should not detract from the need to deploy energy efficiency, heat networks and heat pumps at a rate commensurate with net zero, whilst cautioning that hydrogen may not deliver. The multi-decadal nature of heat transitions means that there is no time for delay.

Further still, relying on hydrogen for heating, while deeply uncertain on cost and technology grounds, also has a number of known issues that could cause significant issues for the UK's energy system. These include requiring a much larger electricity generation capacity (potentially six times greater) for green hydrogen compared to an electrification pathway[16] or potentially relying on imported gas to produce hydrogen. Hydrogen would also require geographic area based conversion programmes and it is unclear if these conversion programmes would be any less disruptive than a non-gas pathway. Overall we are concerned that the Government's interest in hydrogen for heating risks detracting from the need for the deployment of known low-carbon technologies now.

4. What are the barriers to scaling up low carbon heating technologies? What is needed to overcome these barriers?

Low carbon heating and energy efficiency measures have been deployed at scale across the world, however progress in the UK has been slow. Important barriers to implementing low carbon heating include affordability and political leadership. That is not to say heat decarbonisation will be simple or easy but many issues could be solved by a growing market. Specific current issues are:

[14] Staffell, I., Green, R., Gross, R., Green, T. & Wilson, G. Electric Insights. https://www.drax.com/wp-content/uploads/2020/02/200207_Drax_19Q4_Report_3.pdf (2020).
[15] Lowes, R. & Woodman, B. Disruptive and uncertain: Policy makers' perceptions on UK heat decarbonisation. Energy Policy (2020) doi:10.1016/j.enpol.2020.111494
[16] Cebon, (2020), Hydrogen for heating, http://www.csrf.ac.uk/2020/09/hydrogen-for-heating/

- Skills and installer experience;
- Supply chains;
- Consumer willingness to change;
- Performance of systems.

Citizen acceptance, over and above the simple issue of affordability, may also be a major issue for the scaling up of low carbon heating technologies, particularly in the home. UKERC and other UKRI funded research suggests that promoting change here needs to look well beyond the simplistic ideas often promoted of individual 'behaviour change' (i.e. fitting the individual to the new technology). For example, such technologies may prove unacceptable if they do not provide an equivalent level of comfort, convenience and security (the latter in terms of both affordability and heating reliability) as that enjoyed currently.[17]

People do not consume energy but the services that energy provides, much of which is in support of culturally embedded practices involving our interaction with and care for close friends and family. Such practices are likely to prove highly resistant to change, even where the case for decarbonisation has been accepted by people.[18] This implies the need for major user/community trials and public engagement to identify key acceptability barriers associated with particular heat decarbonisation options, as seen from the consumer's own perspective and in relation to their existing practices. Such trials will also need to take account of the particularities of how specific heat technologies will impact people's valued practices, and the design solutions that can be brought to bear (i.e. fitting the technology to the individual or family or other user).

5. How can the costs of decarbonising heat be distributed fairly across consumers, taxpayers, business and government, taking account of the fuel poor and communities affected by the transition? What is the impact of the existing distribution of environmental levies across electricity, gas and fuel bills on drivers for switching to low carbon heating, and should this distribution be reviewed?

UKERC research published in 2019 found that the British public are supportive of the energy transition, but that they assign primary responsibility for paying for energy transitions to energy companies and government because they are perceived to have the financial means and structural power to effect major change. People are willing to accept some cost on their bills to fund the energy transition (between 9-

[17] Butler, C., Parkhill, K.A., Pidgeon, N., 2013. Deliberating Energy Transitions in the UK—Transforming the UK Energy System: Public Values, Attitudes and Acceptability. UKERC, London.
[18] Groves, C., Henwood, K., Butler, C., Parkhill, K. A., Shirani, F. and Pidgeon, N.F. (2016) Invested in unsustainability? On the psychosocial patterning of engagement in practices. Environmental Values 25(3).

13%), but this is dependent upon a number of conditions, in particular people expect other energy system actors to share that responsibility.

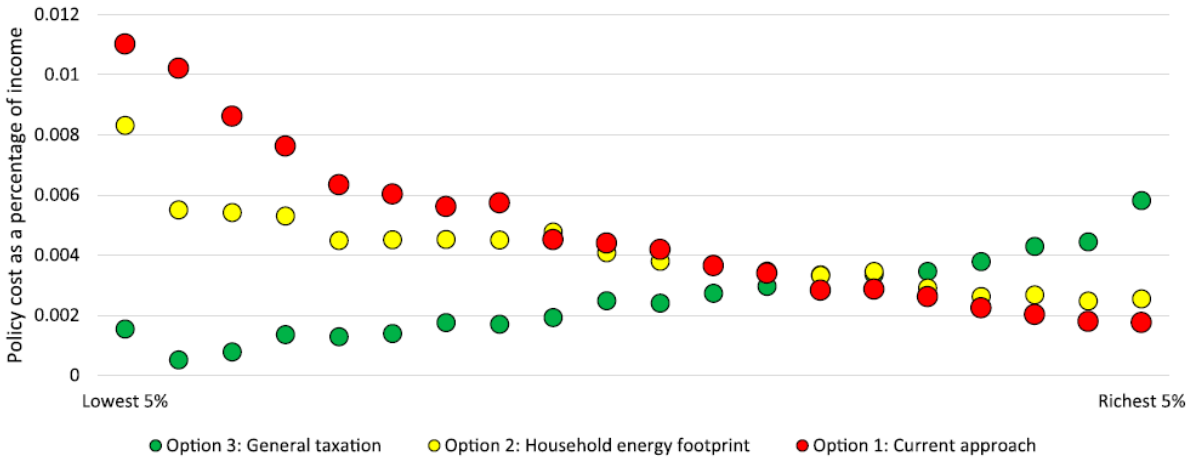
The heat transition will entail major capital investment some of which, for example heating systems and energy efficiency, will be at a household level. Major investment, in heat and electricity networks will also be required at a system level. A pincer approach may prove to be valuable whereby regulation such as carbon taxes reshape the market while simultaneously capital support is provided for households, allowing those without capital to invest. The level and type of support required would need to be tailored to households.

With regards to the second question, yes, we believe the system of levy/tax allocation should be reviewed and modified. The current system has increased the cost of electricity relative to gas as a result of the carbon price on electricity and various renewable energy and energy efficiency support schemes.[19] If the cost differential can be reduced, this could support switching from gas to electricity for heating. In addition to this reform, a carbon tax on gas bills could further support switching although we believe that if such a measure was introduced, it must come alongside protections for the most vulnerable.

In the UK, the current approach has been to add the costs of low-carbon policies, such as renewable energy subsidies, household retrofit and installation of smart meters, to household energy bills increasing them by an additional 13% (option 1 in figure 2 below). Given that the lowest income households spend 10% of their income on heating and powering their homes, whereas the highest income households spend less than 1.5%, any increase in prices hits the poor disproportionately. Low-carbon policy costs are placed on a small percentage of household energy demand – perversely on items representing a higher proportion of expenditure for low income households. Option 2 in the graph below, tracks the distributional impact of a “polluter pays principle” tracking embodied energy to deliver all household expenditure, and provides a similar distribution to option 3. Funding low-carbon policy through general taxation (option 3) would better align energy demand with policy costs, and would reduce costs for 65% of UK households.

[19] Barnes, J. & Mothilal, S. The economics of heat pumps and the (un) intended consequences of government policy. Energy Policy 111198 (2019) doi:10.1016/j.enpol.2019.111198.

Figure 2: Distributional impacts of energy policy costs (Owen and Barrett, 2020)[20]



Meeting statutory carbon targets should not place an unfair burden of responsibility on households in the UK that are struggling to meet basic needs. The lifestyles of the richest require nearly four times more energy than the poorest, but because levies are only raised on household electricity and gas bills the richest only pay 1.8 times more towards the energy policy costs. The scale of investment needed and the combination of potential new financial models and support schemes and their impacts on different types of household means that understanding the equity issues associated with heat decarbonisation is complex. It is an area worthy of specific and significant further investigation.

Overall however, placing policy costs on businesses, or funding the costs from general taxation would lower the burden on the poorest households, would better align energy demand with policy costs, and would reduce costs for the majority of UK households. Under one scenario, the poorest households would pay nothing, saving them £102 a year, while the richest households would pay an additional £410 a year (under £8 a week).[21] Such a taxation approach would require leadership and a long term commitment to avoid leaving the policy vulnerable to short term budgetary changes. This approach would also need to be balanced against other wider policy issues.

[20] Owen A. and Barrett J. (2020) Reducing inequality resulting from UK low-carbon policy, Climate Policy, 2020, Vol. 20, No. 10, 1193-1208. https://doi.org/10.1080/14693062.2020.1773754 Our methodology documented in the paper is now being used by HM Treasury and the Cabinet Office to assess the distributional impacts of energy policy costs.
[21] Barrett, J., Owen, A. and Taylor, P. (2018) Funding a Low Carbon Energy System: a fairer approach? UKERC, London. URL

6. What incentives and regulatory measures should be employed to encourage and ensure households take up low carbon heat, and how will these need to vary for different household types?

As explained previously, a combination of measures is likely to be needed.

- A carbon price on all fossil fuel use could fundamentally reshape the market but on its own is unlikely to drive change rapidly enough and could result in unfair outcomes.
- Regulation, standards and certification could be an important driver for appliance choice and building energy efficiency. These standards should come alongside training and skills programmes to support high quality low carbon heating installations.
- Capital support may be needed in the form of grants on an ongoing basis to support the additional costs of low carbon heating systems, these could be means tested.
- Policy makers should also support the development of financial models such as heat as a service or leases that spread the costs of low carbon heat across the lifetime of systems.

The type of measure needed will vary depending on the type of household. For social housing, the housing provider will likely be the regulated entity and will ultimately be responsible for decarbonising those homes. This may be similar to rental properties, where tenants have little control over their heating system or the fabric efficiency of the building; regulation for low carbon heat may therefore need to cover landlords.

While owner occupiers are more likely to have the financial resources to pay for low carbon heat systems, not all owner occupiers have access to the cash needed for low carbon heat investments. In these situations, financial models around removing upfront costs may have most value.

7. What action is required to ensure that households are engaged, informed, supported and protected; during the transition to low carbon heat, including measures to minimise disruption in homes and to maintain consumer choice?

There is a huge amount of work to be done here, some of which is mentioned in our answer to question 4.

The existing scheme for low carbon heat, The Micro Generation Certification Scheme, currently offers some consumer protection but this may need to be reviewed as a when deployment is scaled up. Heat networks remain unregulated

and the industry itself has called for greater regulation, not just to protect consumers but also to support the market to grow. Fundamental reform around heat networks appears to be needed and there may be a role for Ofgem to regulate heat network as it regulates other energy networks and companies.

8. Where should responsibility lie for the governance, coordination and delivery of low carbon heating? What will these organisations need in order to deliver such responsibilities?

As previously mentioned in this response, the responsibility for meeting UK carbon budgets fundamentally sits with the Government and as such it is the Government which should be responsible for governing heat decarbonisation. The Government also has control of nearly all policy and financial levers to drive change, many of the policy levers we have discussed already.

There is a coordination role which is needed at a local level and therefore local authorities may be important actors from a coordination perspective. This could particularly be the case for the deployment of heat networks and also for area based energy efficiency and retrofit schemes.

Delivery of low carbon heating, under the UK's current market approach, looks likely to primarily sit with the private sector although some state involvement in heat networks will be likely. As such, there is a key role for policy makers to ensure that the governance framework protects consumers.

Finally, with regards to coordination, this can only be achieved at a national level because of the systemic nature of these heat changes. Therefore the Government must take a significant coordination role, a role which is currently not being filled by anyone. Some authors involved in this response contributed to the development of new a fit-for-purpose net zero governance framework as part of the UKRI funded Innovation and Governance project led by Professor Catherine Mitchell[22]. In this new governance framework, a new 'Energy Transformation Commission' is proposed[22] and this body could provide a key coordination role for heat (alongside wider system) decarbonisation. The diagram below illustrates how this new body could fit into and work with existing governance structures.

[22] Mitchell, C. et al. The IGov institutional framework for energy governance: Co-ordinated national and local governance of electricity, heat and energy services. https://projects.exeter.ac.uk/igov/new-thinking-the-igov-institutional-framework-for-energy-governance/ (2019).

Figure 3. Proposed new institutions and responsibilities from Mitchell et al (2019)[16]