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RESPONSE TO THE CALL FOR EVIDENCE 'DECARBONISING HEAT IN HOMES'

The Energy and Climate Change Division (ECCD) and the Sustainable Energy Research Group at the University of Southampton lead on research, development and teaching in energy. These encompass renewable energy, energy efficiency, energy for development, energy and cities, including ongoing projects on the decarbonisation of heat. Further details on the work undertaken including list of project and publication can be found at this link www.energy.soton.ac.uk.

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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?**

If a policy is targeting saved carbon as its metric it will prioritise interventions against high energy use households (who are generally high income). Policies need to focus on delivering affordable comfort. This means that we need to consider **both** the de-carbonised provision of heat/cool **and also** vastly improved building fabric performance. Undertaking the latter will require less energy to attain comfort and so make the former much easier to achieve. In some cases, this may lead to interventions which actually save little or no carbon due to the pre-bound effect, but rather deliver better health and therefore societal impacts. Deep retrofits in a social housing context are such a case in point (Teli D. et al, 2016).

Furthermore, past policies seem to ignore the important role of local authorities who govern cities, where most consumption occurs, in delivering low carbon heat. The past Eco scheme is something to refer to as partially successful, especially in social housing. However, it was totally undermined by a sudden national policy announcement (mainly against utilities) that resulted in undermining the then carbon price, making most projects financially nonviable.

In international cities, especially in Scandinavia, low carbon heat is delivered through CHP based heat networks. These can be low carbon, through many energy vectors (including hydrogen). This can be an important and flexible infrastructure which will need financial support through coherent and sustained policy. Furthermore, it feasible (as the current work in Southampton City is endeavouring to) to link up such CHP sites to work collaboratively in delivering heat city-wide, with the potential of connecting waste incinerator heat (energy from waste) to such networks.

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)?**

In the UK there is a significant skills gap in terms of both capacity and expertise to deliver on any buildings and heat strategy. It is imperative that skills gap is addressed by training / apprenticeship programmes. The skills gap is across assessors, system designers, installers and maintenance teams.

Low carbon comfort is synonymous with highly efficient buildings (see 1 above). It is therefore crucial that the UK legislates to ensure any new refurbishment or new build should have the highest standard possible through mandating the lowest practically achievable energy intensity outcome – such as the PassivHaus space heating standard of 15 kWh/m^2. This will need national policy change and we note that New Zealand has just closed a consultation on exactly this approach for new builds as a pathway to a similar standard for retrofits (https://www.mbie.govt.nz/have-your-say/building-for-climate-change-transforming-operational-efficiency-and-reducing-whole-of-life-embodied-carbon/). At the same time, it is important to ensure that building retrofit strategies do not result in a transition from winter heating to summer overheating risk.

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?

Air Source Heat Pumps offer a decarbonised heat pathway which is not site specific which makes them attractive for deployment at scale, in both retrofit and new build contexts. In terms of new build housing, the use of Mechanical Ventilation and Heat Recovery (MVHR) provides the opportunity of extremely low / net zero housing. However, analysis of the use of heat pumps suggests that they may add substantially to morning and evening peak electricity demand peaks (Eggimann et al, 2019). Even without this extra demand, these peaks are problematic for a non-dispatchable renewables-based electricity system. Sufficient energy storage whether thermal, grid based or through system flexibility will be needed to ensure that air source heat pumps do not inadvertently increase the carbon intensity of supplied electricity. (Anderson B. et al, 2018)

Furthermore, ground source pumps can also be adopted as solutions at scale not only at building level but also as part of district heating and cooling networks. The start will be to augment existing networks with such technology coupled with interconnectivity and expansion with city boundaries.

In addition to the above, the most viable approach to deliver the decarbonisation of heating at scale is to give a priority to heat networks in cities. The initial phase envisaged will be the mapping of existing networks and addressing city-wide connectivity, investigating heat from waste incineration to support such networks, heat support through deep ground source heat pumps and utilising renewable fuels (such as green hydrogen) to run CHP plants. This approach will provide a nucleus to build on own and learning entities to support evidence and further scale up.

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

As per 2, the skills gap in the UK to design, deploy and maintain low carbon heating systems at scale is a current barrier. The UK's electricity grid was not developed to accommodate significant additional household electricity demands, to which heat pumps and electric vehicles represent a particular challenge. (Anderson B. et al 2020). Electricity charging mechanisms which support the aggregation of domestic loads by electricity providers to maintain grid demands within limits will be required. Households will have to accept third party control of significant loads (electric vehicles, heat pumps, hot water – as has historically been the case in France and New Zealand), probably scheduling / dynamic control by their energy provider in return for a preferential per kWh tariff.

The SENSE study (https://energy.soton.ac.uk/projects-research-timeline/) undertaken by UoS has recently (2019-20) assessed hybrid heat pump (HHP) acceptability with predominantly high income, owner-occupier households. Here we report the key findings of the online workshops. *"Regarding the HHP most of the people feel it is very expensive and not affordable. Even when the Renewable Heat Incentives by the government are mentioned people have trust issues with the RHI because of prior failure of the government incentives and loan schemes. A positive response about the HHP is that the system is suitable with the existing boiler. So, the participant doesn't have to abandon the boiler which is still working. On the whole people are only ready to invest in a technology if there is good support from the government in the form of promising incentives and scheme." Raveena Singi, MSc Dissertation, 2020*

In addition to technology barriers there is a poor understanding of domestic occupancy profiles in a UK context. Aragon et al (V. Aragon et al, 2017) showed that the occupancy categories most frequently used in UK building simulation of (a) a family with dependent children where the parents work full time; and (b) a retired elderly couple who spend most of their time indoors, represent only 19% of England's households. We simply cannot robustly estimate heating demand on this basis. This topic will need to be revisited post COVID-19 where we would expect a sustained change to increased homeworking and therefore heating practices.

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?**

Having exemplar projects as learning entities to guide the decarbonising of heat will unboundedly provide the evidence needed on costs shared whilst protecting the fuel poor. Furthermore, any Green Deal type mechanism should not apply the 7.5% interest rate. Ensure that any such approach does not bypass vulnerable sectors such as private rented.

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?**

Incentives should be made available to support appropriate and evidence-based refurbishment programmes, perhaps deliver through local authorities. This will allow variations for different household perhaps targeting areas with high deprivation to start with.

In terms of regulation, any new refurbishment should be made to the highest standard to support energy efficiency. Any new build should at least be zero carbon in operation.

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?**

Trusted partners are key to ensuring both initial and sustained engagement with households. Giving leadership to local authorities in any engagement is a must. Furthermore, universities and colleges could also play a role in surveys and establishing community-based focus groups. Younger generation leadership in required to provide longevity and acceptability as we progress to 2050.

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?

It is our view that governance must be central with nationally defined standards or regulations which Local Authorities are at liberty to *exceed*.

Local Authorities are best place to ensure local co-ordination and delivery should be left to agile contractors bidding for contracts let by large owners or developers.

Local Authorities can play a key role here in aggregating local demand from private homeowners, acting as a procurement mediator ensuring best value and quality so that national standards are met or exceeded.

Governance will require the alignment of both:

- MHCLG – who must set appropriate standards and processes via planning and building control documents for both new build and retrofit ***so that no building constructed after 2021 needs any decarbonisation intervention at all***;
- BEIS – who must ensure appropriate mechanisms and support for interventions in those buildings that for whatever reason escape the planning and building control process

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