HYD0085

Written evidence submitted by the University of Exeter Energy Policy Group

Dear Sir/Madam,

The University of Exeter Energy Policy group is a national centre of expertise for energy policy issues. This submission focuses on the potential use of hydrogen for heating, an area where we have particular expertise.

Research that we have undertaken, which forms part of the UK Energy Research Centre, has shown that elements of the heating industry have strongly been promoting hydrogen as a means to decarbonise heating. This promotion has primarily taken the form of political lobbying and directed innovation (1). As this lobbying has taken place, the idea of hydrogen for domestic heating has rapidly risen up the UK energy policy agenda and BEIS themselves suggest there is deep uncertainty over the optimal low carbon technology mix for heat with hydrogen possibly playing a significant role (2) but being associated with large uncertainties (3).

About 85% of domestic homes are heated by natural gas. A fossil based gas system has never been converted to a 100% hydrogen system in the world, nor has this been suggested, and so this approach is extremely novel. While a number of 'innovation' projects have taken, and continue to take place, no area of the UK, or indeed global fossil gas network has yet been converted.

We note that some blending of hydrogen with natural gas has taken place in a discreet UK gas network at Keele University. However, blending is not an approach which would allow a total conversion to hydrogen, and is therefore not an approach which, in theory, could eliminate emissions from heating. This is because, blending is limited to around 20% of hydrogen by volume because of the way gases act within appliances. Hydrogen burns much faster than methane (4). In energy terms, this 20% hydrogen is only around 7% of the total energy in the gas mix because methane is much more energy dense. Overall, the point is that blending hydrogen into the gas grid is not a technological approach which can go beyond only very limited decarbonisation and we believe it may lead to a dead-end. While there is proposed to be some potential learning around blending, we are unclear as to how this learning supports the full decarbonisation of heat and so we urge caution if this is being proposed as a long term solution.

While blending may be simple, and that is in part the point of arguing for it, converting the existing gas system to 100% hydrogen is complex and uncertain and we highlight a number of specific issues below:

- The existing gas networks are not suitable and are expected to require significant upgrading. This includes pipes and associated infrastructure such as pressure management.
- Major uncertainties remain over the suitability of pipework within homes and buildings. If this needs replacing that could result in significant upheaval.
- A geographically based conversion programme would be needed that converts whole areas at a time. This is because, the switch from fossil gas to hydrogen requires new appliances or upgrades to appliances that will need to be done by an engineer. A 100% hydrogen boiler couldn't burn methane and vice versa. As a result, a whole area would need to be switched off, appliances then changed, the gas network then converted to hydrogen and then all new hydrogen appliances commissioned. We have heard a suggestion that this could take at least three visits to each house to complete as there are significant safety issues if unsuitable appliances are missed.
- It's not clear how the conversion programme could be delivered or who would deliver it.
- The costs and performance of hydrogen appliances are unknown, while trials of boilers have taken place, it is not clear what will replace gas hobs and open fires.

- There is major uncertainty over how the hydrogen will be produced. The option suggested to be cheapest, produces hydrogen from methane using carbon capture and storage (CCS) (5). If this is used, this will increase methane imports and require CCS facilities at scale. While hydrogen can be produced from low carbon electricity, energy system modelling suggests this would be a very expensive option compared to other approaches (electrifying heating) because of the significant energy losses in the hydrogen production process

We believe the outlook for hydrogen as a heating fuel is deeply uncertain despite the political attention it is being given and its promotion by elements of the heating industry.

Historically, the view has been that the least cost way to decarbonise heating is via energy efficiency, heat pumps and heat networks and this has been outlined as a key option in a number of government documents and also shown as important in much academic analysis (including very recently here: (6)). Recent analysis has shown that installing heat pumps now can significantly reduce emissions compared to gas and as the electricity decarbonises further, heat pumps will become even lower carbon (7).

The timescales for heat decarbonisation are relatively short and every gas and oil boiler needs to be replaced with something by 2050. Yet heat transitions have historically taken decades (8) and therefore this transition needs to start immediately. We are concerned that the idea of the use of hydrogen for heating could be a negative distraction away from the technologies that are known to be able to reduce emissions from heating, that is energy efficiency, heat networks and heat pumps. If hydrogen is a distraction, it risks putting the UK climate change targets at even more risk of not being met. Moreover, hydrogen does not appear to be the economic option requiring increased gas imports. Nor does it appear to fit with a post-COVID, post Brexit Green New Deal where immediate low carbon energy deployment including energy efficiency and heat pumps can support employment and rapid GHG reduction.

Recent research which considered the perceptions of policy makers working on heat highlighted that ideas of ‘disruption’ and ‘uncertainty’ dominated perceptions of heat decarbonisation technology (9). We understand elements of that perception but would argue that the traditional means of decarbonising heat is actually straightforward and well known. In that paper we also proposed 3 steps which could support policy makers.

1. **Reduce uncertainty**: this can be achieved through further research and analysis of heat technology options. Whilst we believe that hydrogen may be an expensive dead-end, the uncertainty means that a full scale trial which produces low carbon hydrogen and demonstrates its use in existing gas networks and homes is needed in order to tease out all the issues which may occur.
2. **Focus on low regrets options**: there is a major requirement for a buildings energy efficiency programme whatever happens. It is also apparent that in areas off the gas grid, the electrification of heating will be necessary as hydrogen can’t play a role there. District heating or heat networks also appear cost effective across scenarios in dense urban areas.
3. **Accept uncertainty**: it is likely that the optimum heating mix will never be known and even if hydrogen could deliver for heating, it is not known when it could be able to. Therefore, as well as making progress in low regret areas, policy makers may need to plan as if hydrogen will not be able to deliver. This is because if it does fail to deliver, an no other progress is made, non-hydrogen technologies will need to be delivered at extremely rapid rates.

Finally, we would like to outline that we do not think the UK’s heat transition will be easy and by some metrics we are already well behind schedule. Our key concern associated with hydrogen for heating, is how

uncertain it is and if it causes delays to know options, there is a very significant risk emissions targets will be missed.

Please let us know if we can provide any further detail.

Yours faithfully,

Dr Richard Lowes, Lecturer and UKERC Research Fellow

Professor Catherine Mitchell, Professor of Energy Policy

References

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