Hydrogen Innovation Initiative

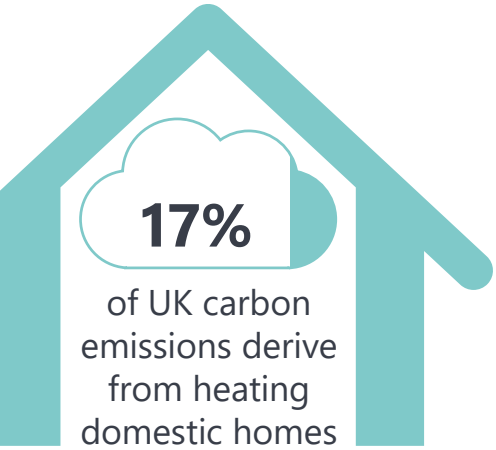
CATAPULT Energy Systems

Starting a hydrogen dialogue

- communicating with consumers to build positive perceptions and experiences

December 2023

Introduction



Climate Change Committee proposed that 5% of domestic heat demand may be met by hydrogen boilers by 2050

To meet its Net Zero Goals by 2050, the UK will need to decarbonise various sectors, including transport, manufacturing and heating. Hydrogen could play an important role in reducing carbon emissions in these sectors. However, the amount of carbon emitted will depend on the hydrogen production method, with 'green' and 'blue' hydrogen currently being targeted in the UK's Hydrogen Strategy [6]. Green hydrogen has zero carbon emissions, as it is produced with renewable energy, such as solar or wind energy [1]. Blue hydrogen is produced from methane, with the resulting carbon emissions being mitigated by carbon capture and storage technology [1]. The expectation is that green hydrogen will remain scarce in the near future, due to the scale of renewable energy that would be needed to produce enough hydrogen to meet demand [2].

This report focusses on heating for domestic homes, which in 2019 contributed to 17% of UK's carbon emissions. With 74% of households in England and Wales relying on mains gas central heating in 2021 [3] [4], the vast majority of homes will need to be converted to low-carbon heating sources to meet Net Zero goals. The main options consist of hydrogen, heat pumps, district heating and biogas [5]. Hydrogen for heating is not commercially available yet but a few trials have been conducted [6] [7] . The literature mainly focusses on a blended approach, where small quantities of hydrogen, usually 20% vol, are added to the gas supply, which requires minimal disruption to consumers and reduces carbon emissions [8]. However, there are also discussions around a 100% hydrogen approach and the implications for consumers, although this will require more infrastructure changes.

The extent of a domestic hydrogen rollout by 2050 is still unknown, pending a strategic decision from the UK government due in 2026 [9]. However, hydrogen for domestic heating will likely be limited to specific regions of the UK where electrification of heat cannot be easily achieved. In their Sixth Carbon Budget, the Climate Change Committee proposed that 5% of domestic heat demand may be met by hydrogen boilers by 2050 [10]. The UK government's Hydrogen Strategy thus stresses the importance of raising consumer awareness of hydrogen and engaging with them to secure buy-in for the transition [9].

This report will explore the current state of UK consumers' awareness and attitude towards hydrogen based on the literature and possible strategies to raise awareness in regions where hydrogen may be selected as a viable option for domestic heating.

Awareness is low and perceptions neutral

Consumer awareness of hydrogen remains low internationally [8] [11] [12]. In their nationally representative survey of the UK, Williams et al. [11] found that 51% of people never heard of hydrogen fuel boilers and, even after receiving more information during the survey, many still struggled to understand them. Scott and Powells [8] ascertained the public's level of understanding by asking them three questions about hydrogen, where 64.4% answered none or just one correctly. Consumers should not be expected to know the inner workings of hydrogen fuel cells. However, raising awareness of hydrogen use cases – and in particular the reasoning behind proposing a transition from current fuel sources to hydrogen – may help sway people's attitudes. Partly due to the general public's low awareness of hydrogen, most currently feel neutral towards the fuel [8] [13]. Fylan et al. [14] discovered that 10% of a representative sample were in favour of using hydrogen for heating, 12% were against it, whilst the significant remainder (78%) were unsure about hydrogen. It will be crucial to reach out to the latter group and ensure they are not subjected to misinformation that could negatively affect their attitude.

78%
of people are unsure about hydrogen heating

12%
Against hydrogen heating

10%
In favour of hydrogen heating

Consumers see few benefits to hydrogen but are concerned about costs, safety and practical factors

The key topics that consumers are interested or concerned about are [14]:

- reason for switching to hydrogen
- hydrogen source
- cost
- safety
- practicalities of the conversion
- behavioural changes to heating or cooking experience

Reason for switching to hydrogen

Most of the public are unaware that heating contributes significantly to carbon emissions [14] [11]. Raising awareness that hydrogen offers a low-carbon alternative to heat their home had a positive impact on consumers' opinions about hydrogen [8]. It is thus important that messaging around hydrogen keeps the reason for the conversion front and centre. Particularly as consumers may struggle to see tangible benefits of switching to hydrogen heating, viewing it as the least-worst option instead [11]. Some may accept the transition for its environmental benefits even if it does not provide them with direct benefits, especially as the public largely agrees for the need to decarbonise [6] [15]. However, to make it more appealing, organisations could combine the hydrogen conversion with an improvement in people's overall heating experience. For instance, by offering smart enabled heating controls additional insulation or reducing noise [16] [17].

Hydrogen source

Few consumers are aware of the various hydrogen sources, but some would like to know more about how it is produced and whether it is sustainable [14]. Although most accepted that, in the short-term, hydrogen might need to be derived from non-renewable energy sources, Gordon et al. [18] note that renewable-based generation is likely to secure stronger public support, whilst fossil fuel-based production pathways could pose a barrier to acceptance.

Cost

Cost and the potential of higher energy prices was a key worry [19] [6] [2]. Consumers expect hydrogen to be offered at prices equivalent to or possibly marginally higher than natural gas but are worried about affordability for more vulnerable households [15] [14]. Billing may also be affected due to the difference in volume of hydrogen, resulting in possibly more variable prices [20]. Another concern is the potential cost of purchasing new

hydrogen-compatible appliances, in the event of a higher hydrogen fuel blend being mixed into the gas supply. This could be a financial burden, particularly for consumers who recently purchased non-compatible appliances [14]. Incentives are likely required to garner support from the public, especially in the early stages, in the form of a boiler, hydrogen ready appliances or financial compensation for instance [15] [6].

Safety

Safety concerns are often raised when hydrogen is discussed. Scott and Powells [8] found that 44% of survey participants were worried about possible gas leaks, explosions and fires. However, many consumers assumed that, if the government approves the hydrogen heating roll out, it would have been robustly tested and found to be safe [14] [8]. In the HyDeploy trial in Keele, some trusted it implicitly, while others raised safety concerns which were assuaged by talking to the project team [6].

Practicalities of the conversion

The practicalities of the conversion, especially the level of proposed disruption, will influence the public's attitude towards hydrogen. The current perception is that hydrogen is more of a direct substitute to natural gas and therefore less disruptive to consumers than alternative technologies, such as heat pumps [13]. However, this strongly depends on the blend of hydrogen used. Research highlighted that at 20% vol the user experience is similar to that of natural gas, whilst 100% hydrogen will be more disruptive and include the potential replacement of infrastructure, external and internal pipework, radiators, meters and appliances [19] [21]. To avoid misleading consumers, messaging should be clear on what the practicalities of the conversion will look like for each scenario.

Behavioural factors

The hydrogen switchover process could take one to two weeks and includes the household being cut off from their gas supply, which may result in consumers lacking heating, hot water and hot food [11] [22]. This could be an inconvenience for some but a major concern for vulnerable consumers, especially when it comes to lacking hot water [22]. It will thus be important to consult the public to understand their needs and requirements in this transition and what support could be offered to avoid negative consequences. Negative word-of-mouth could be particularly detrimental to the rollout of hydrogen, with 24% of people trusting friends or family for advice on which heating system to install according to the Public Attitudes Tracker [23].

The final concern is whether consumers' heating and cooking experience will be the same with hydrogen, including ease of use, appearance and any changes in maintenance needs [18].

A big change to current heating and cooking practices could create uncertainty and act as a barrier to adoption [11]. In a survey conducted by Williams et al. [11] about hydrogen heating, only 17% of participants viewed the proposed lived experience as unsatisfactory. However, while the user experience for a 20% vol. hydrogen blend is very similar to that of pure natural gas, it is not yet clear whether boilers operating on 100% hydrogen will run at a different temperature and potentially require changes in heating habits on a similar level to heat pumps [19]. Consumers may be more likely to notice differences when cooking compared to heating, as the former requires more active engagement [18]. To keep consumers safe and maintain a familiar cooking experience, hydrogen odorization and flame coloration have been suggested [21].

Maintaining consumer choice is essential to engagement

Consumers may form preferences for certain heating technologies, as they become more aware of the different routes to decarbonise their heating. However, these preferences need to be balanced with feasibility for both the individual property and the local area. For instance, a home with an electric heating supply will be less suitable for a hydrogen conversion than one with a gas supply, as more work is required causing greater disruption to the consumer [15] [24]. It will therefore be important to manage expectations and explain the suitable options for each home. The Climate Change Committee [25] recommends that areas not suitable for hydrogen should be identified early on by the government, so that these residents can be offered alternative low-carbon heating sources sooner.

There is also a debate on the compulsory nature of hydrogen trials, where residents in one proposed trial in Whitby raised concerns about not being able to opt-out [26]. After a consultation process, they could choose whether to keep their natural gas supply, with those participating receiving a financial incentive. However, public opposition had already grown too strong, as people felt that they were being forced to switch, so the trial was cancelled [27]. This highlights the importance of engaging consumers as early as possible in the process to better understand their concerns and communicate with them more effectively.

Engage consumers early on highlighting the reason behind the transition and addressing any concerns

Hydrogen conversion public relations plan should be initiated 24-36 months before the intended start date.

Effective communication with consumers will be vital for a successful transition towards hydrogen heating. Organisations could develop a public relations program, outlining the key messages and when and how these are conveyed, as well as how the public will be consulted. DNV recommends that this plan should be initiated 24-36 months before the conversion is intended to start [16]. Consumers would like advance notice of the conversion start date and regular updates to better prepare [6]. For instance, preventing the purchase of new appliances that might become obsolete [14].

Several communication techniques should be utilised to ensure that as many consumers as possible are reached, including direct postal mail-outs, print and social media advertising or local community groups [16]. Short animations or videos could also be an engaging method to reach consumers online. It is Energy Systems Catapult's experience that messages which are built on an understanding of consumer needs and tested directly with consumers have the most impact. It is also key to identify trusted partners to help deliver messages to consumers to garner their support. A representative survey in Germany highlighted that environmental NGOs, consumer associations and scientific stakeholders enjoy the trust of the public, whilst the media and the government were deemed untrustworthy [28]. In the UK, Scott and Powells [8] found that consumers would not trust local MPs and the media but did find universities and the Health and Safety Executive trustworthy.

The messaging itself should focus first and foremost on why this transition is necessary. It will therefore be important to raise awareness of heating's significant contribution to carbon emissions and the need to transition to low-carbon alternatives, such as hydrogen. Sharing background information on hydrogen and potentially a glossary of terms that consumers may come across during the conversion could also be useful [14]. Organisations could stress the tangible benefits of the conversion, being careful not to over-promise to avoid later disappointment. It is also important to address potential worries, such as safety or bill increases in advance [8]. Real life case studies can help showcase the process from a user's perspective [8]. Another proposed option is setting up a real or virtual show house using hydrogen, featuring a heating a cooking demonstration, where people could ask questions and visualise the differences for their home [15].

Conclusion

1. Awareness and understanding of hydrogen remain low and people generally have a neutral attitude towards it. Providing people with more information could turn this positive.

2. Focus on the reason for the conversion, stressing the contribution of fossil fuel based heating systems on carbon emissions and hydrogen's potential to decarbonise the sector.

3. Tailor the messaging to focus on consumer benefits, potentially bundling other desirable services alongside the conversion to garner support.

4. It is important to consult the public, in particular vulnerable consumers, on their needs and requirements to ensure a good customer experience.

5. Inform residents of the practicalities of the conversion, providing ample time to prepare, in particular with a higher hydrogen blend.

6. Acceptance levels will partly depend on how closely the user experience matches that of their current heating source.

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CATAPULT Energy Systems

Energy Systems Catapult is an independent research and technology organisation. Our mission is to accelerate Net Zero energy innovation.

Launched in 2015 by Innovate UK, the Catapult has built a team of more than 250 people, with a range of technical, engineering, consumer, commercial, incubation, digital, and policy expertise. They draw on sector-leading test facilities, modelling tools, and data collected from our back catalogue of more than 500 research projects.

We use that 'whole energy' system capability to support innovative companies -- small and large – to test, trial and scale their new products and services. Our impact comes when those innovators attract new customers, new investment, and new grants so they can thrive in the future energy system.

Based in Birmingham, Energy Systems Catapult is part of a network of nine world-leading technology and innovation centres, established by Innovate UK. The Catapult Network fosters collaboration between industry, government, research organisations, academia, and many others to transform great ideas into valuable products and services.

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