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Hydrogen needs to be part of the UK's future energy mix

The Net Zero energy system of 2050 will look very different from today's energy system. We will no longer burn coal, oil and gas to generate electricity and power industrial processes, cars will no longer run on petrol and diesel and our homes will no longer be heated by natural gas. In 2050, most of our electricity will be generated from renewable sources, many industrial processes will switch to electricity, most of our cars will run on batteries and many of our homes will be heated by electric heat pumps.

But electrification won't to be the whole answer. Renewables alone are unlikely to meet all our power needs, some industrial processes can't be electrified; batteries won't be appropriate for all vehicles; and heat pumps won't be appropriate for all homes. Green gas – in particular hydrogen – is likely to have an important role to play in all these areas. Hydrogen also has the potential to provide valuable energy system flexibility, helping to manage inter-seasonal supply and demand imbalances and build system resilience.

The potential for hydrogen

Most commentators now agree that hydrogen will have an important role to play in the future energy system. In its 2019 report which prompted the Government to make its Net Zero commitment, the Committee on Climate Change (CCC) said that "by 2050, a new low-carbon industry is needed with UK hydrogen production capacity of comparable size to the UK's current fleet of gas-fired power stations."

However, there is not yet a consensus on the exact scale and scope of hydrogen's role versus other potential Net Zero solutions. This is particularly true for heating buildings, where electric heat pumps and district heating networks are also plausible options alongside, and possibly instead of, hydrogen.

Cadent believe hydrogen's exact role will ultimately be determined by three things,

- **Feasibility:** Is it technically feasible and safe to transport and use hydrogen?
- Economics: How do the economics of hydrogen compare to the alternatives?
- Consumers: What are consumers' (in particular householders) preferences for hydrogen versus alternatives?

Feasibility

Hydrogen has many advantages as an energy source. It is easily made, safe, storable, transportable and can produce energy with zero emissions at the point of use. And in order for hydrogen to be fully accepted by policy makers and the general public, further work needs to be done to strengthen the evidence base, in particular concerning its safety in the home.

Cadent and the wider gas sector are actively leading and funding a broad range of hydrogen-focused innovation projects and programmes. Activity is primarily focusing on the following six areas:

1. Home safety: Is it safe to use in the home?
2. Network safety: Can it be safely transported in the gas network?
3. Blending: Can blended hydrogen be used with existing infrastructure and appliances?
4. Household switchover: How will homes switch over to hydrogen in practice?
5. System operation: How will gas system operation need to evolve to handle hydrogen?
6. Industrial conversion: How will industry convert to hydrogen in practice?

A balanced Energy System

Multiple studies have concluded that a balanced energy system incorporating hydrogen in transport (for heavy goods vehicles), industry (for high grade heat), power (for peak generation dispatchable power) and buildings (alongside electric heat pumps and heat networks) is likely to have the lowest whole system cost. For example, Navigant's 2019 'Pathways to Net Zero' study concluded that whole system costs would be £13 billion cheaper per annum for a balanced scenario versus full electrification

However, it is important to note that, while the bulk of analysis on future energy system costs published to date points to balanced energy systems incorporating hydrogen having the lowest whole system costs, the differences between scenarios (in relative terms) is small and it is important to acknowledge this when drawing conclusions. It should also be remembered that whole energy system cost modelling is highly sensitive to assumptions such as production costs, network upgrade requirements and household switchover costs.

Given these caveats, economics alone are unlikely to be the deciding factor in determining the UK's optimum Net Zero energy system. In particular, consumer attitudes and behaviours could play an important role. This is particularly true in relation to buildings, where millions of individual homeowners will have to make potentially disruptive changes to their existing home heating systems. Hydrogen, heat pumps, hybrid boilers and heat networks are all viable options for homeowners currently on the gas network, but all come with their own pros and cons and offer different user experiences.

In many cases homeowners will ultimately have the power to decide which low-carbon heating solution to install, but in spite of this there has been limited focus on homeowners in the Net Zero debate to date. Recent experience of home insulation grants, the smart meter roll-out and the Green Deal shows how easily a lack of consumer engagement and customer 'apathy' can derail government policy.

From Cadent's review of existing research into consumer attitudes towards heating, we have identified three key themes:

- Disruption: Challenges faced by the Eco scheme (which provided grants to homeowners to install loft insulation and other energy efficiency measures) and the smart meter roll-out give a real sense of how much homeowners dislike disruption. In both cases, homeowners were

essentially offered free upgrades to their homes with demonstrable energy- and cost-saving benefits, and yet uptake was low, even following extensive marketing campaigns and outreach. This aversion to disruption could potentially have a significant bearing on consumers' preferred low-carbon heating solutions.

- User experience: Most consumers place significant value on heating solutions that provide good quality, on-demand heat and that are operated in a way they are familiar with. In our Bright Blue research, 86% of consumers said it was very important or quite important to be able to heat up their home whenever they like; 84% said it was very important or quite important to be able to heat up their home quickly; and 77% said it was very important or quite important to have a heating system that is familiar to them.
- Cost: Unsurprisingly, studies have consistently concluded that minimising cost is high on consumers' list of heating priorities. While consumers want to both minimise the up-front cost of new heating solutions and reduce ongoing heating bills, they tend to place far greater emphasis on minimising up-front costs, even if this means higher lifetime costs.

A comparison of the main low-carbon heating solutions for domestic heating suggests that hydrogen boilers cause the least disruption, offer the best user experience and have the lowest up-front switching cost. Hybrid hydrogen/heat pump solutions are slightly more disruptive but also score highly on user experience. Heat pumps are the most disruptive, score worst on user experience and have the highest up-front switching cost, especially where significant energy efficiency upgrades are needed. This suggests that, given the choice and all else being equal, many consumers may favour hydrogen boilers.

Next steps to develop the hydrogen economy

Cadent believe the following measures will be required to stimulate the hydrogen economy:

- Incentivising hydrogen supply, potentially through a Contracts for Difference (CfD) Mechanism, similar to offshore wind.
- Underpinning investment in Carbon Capture and Storage (CCUS) technology
- Mandating the rollout and installation of hydrogen-ready boilers
- Enable hydrogen-blending into the network for a no-regrets, carbon reduction method
- Establishment of low-carbon obligations
- Creating a hydrogen-ready distribution network
- Updating the Gas Safety Management Regulations (GSMR)

Developing a hydrogen economy and delivering Net Zero will only be possible with policy and regulatory certainty. Businesses and investors need it to be confident that their investments will deliver a reasonable return for risk. And consumers need it to be confident in upgrading their heating systems with potentially costly and disruptive Net Zero solutions.

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