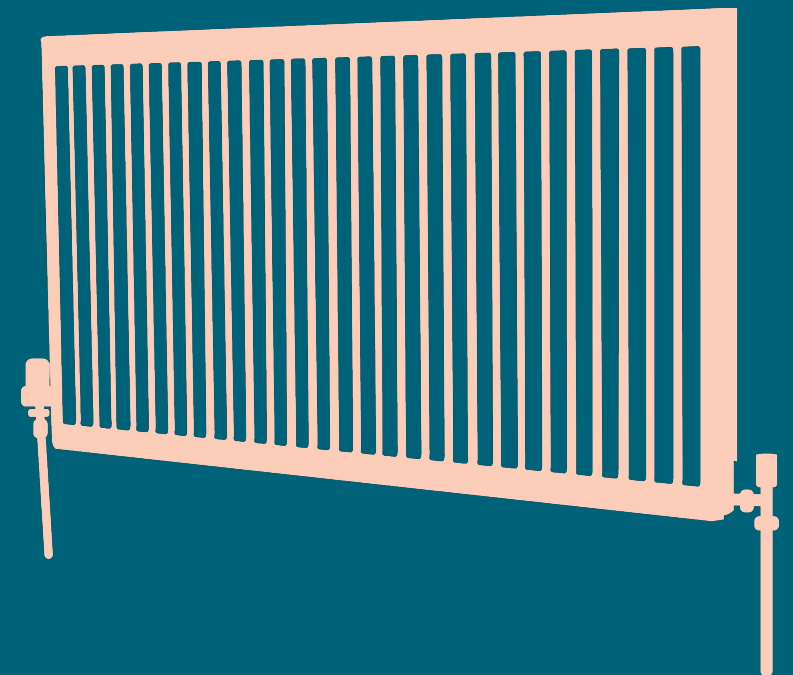


# Hydrogen for homes

Discussion paper

Questions about how hydrogen might work for homes  
in Great Britain



# Introduction

Citizens Advice provides free, independent and impartial advice to anyone who needs it. We are the statutory advocate for energy consumers and run the national consumer helpline. Last year we helped 2.7 million people with 6.3 million problems.

Decarbonising the way we heat our homes and businesses will represent a fundamental change for the vast majority of people. Heating and hot water are responsible for 20% of UK greenhouse gas emissions. The way we heat our homes will have to change for Great Britain to meet its target to reach net zero carbon emissions by 2050.

These changes will be intrusive. This will include everything from altering the fabric of buildings, interruptions to energy supplies and the widespread adoption of new technologies. Proposals include: heat pumps to replace boilers; heating buildings through heat networks; and, the introduction of hydrogen gas for heating and cooking.

Citizens Advice welcomes the government's recently stated intention to publish a Heat and Buildings Strategy. Instead of the original plans for a Heat Policy Roadmap.

It's crucial that heat is not considered in isolation. The transition to low carbon heat will only succeed if it takes place alongside energy efficiency and other key factors.

Citizens Advice is seeking to understand how hydrogen might be used for heating and cooking in homes. The CCC has recommended that hydrogen is best used selectively alongside electrification, resource efficiency and energy efficiency.<sup>1</sup> It raises a number of questions about how hydrogen might become part of the fuel mix for homes and small businesses across Great Britain.

This paper sets out some of our initial thoughts and understanding of the potential for hydrogen, as well as highlighting where more information is needed. It also highlights the gaps that it will be crucial to fill if hydrogen is to become a realistic and achievable option for consumers in the next decade.

This paper is set out under the following four headings. For each topic we outline the key questions we anticipate consumers will have.

- 1 Hydrogen as a fuel source**
- 2 Hydrogen boiler technology/changes to the home**
- 3 Costs of hydrogen**
- 4 Installation, repair and maintenance**

# 1. Hydrogen as a fuel source

Hydrogen is not a new household fuel. In the 19th century through to the mid 20th century, town gas was piped into people's homes and used a blend of up to 50% hydrogen.<sup>2</sup>

At present, the extent to which hydrogen is carbon neutral is dependent on how it is produced.

Hydrogen can be produced using several methods, but the two most common methods are by Steam Methane Reforming (SMR) or electrolysis. Steam reforming (also known as 'blue' hydrogen) is the most cost effective and popular way to produce hydrogen in bulk, accounting for 95% of production across the globe. Depending on the carbon intensity of the electricity used, electrolysis using renewable energy (also known 'green' hydrogen) will be the most environmentally friendly process, but it is also the most expensive.

For every tonne of hydrogen produced by SMR, a further 9 to 12 tonnes of carbon dioxide is produced.<sup>3</sup> To ensure that this results in a saving to carbon emissions, Carbon Capture and Storage (CCS) facilities must accompany hydrogen production, to capture and store the CO<sub>2</sub> produced in the process and prevent it from being released into the atmosphere.

Like natural gas, hydrogen is a gas that can be pumped around a network of pipes to where it is needed. The composition of hydrogen is different as it's less dense than natural gas with a high energy content by weight, not volume. This means to get enough energy from hydrogen it needs to be transported through pipes at a higher pressure. A benefit of hydrogen's lower density is that it is good for storage, as larger volumes can be stored at high pressure for use when needed.

In addition, hydrogen can affect certain metals making them brittle. This can cause some types of pipework to crack. Therefore, it is likely that any metal pipework in our existing gas network would need to be replaced.

Hydrogen is also similar to natural gas in that it is odourless (natural gas has an artificial smell injected into it so we can detect leaks). Because it has a lower density hydrogen can disperse more easily if there is a leak. Within a closed environment (like a house) there is little difference in the risks between natural gas and hydrogen.

# Hydrogen as a fuel source

Citizens Advice understands that trials are due to begin testing different blending options, and we look forward to learning more about the results.

## Some possible questions from consumers

Why will some areas have hydrogen and some not?  
Can anyone choose to have a hydrogen boiler installed?

What is green and blue hydrogen?

Will I have a choice between green and blue hydrogen?

How will I know if there's a hydrogen leak?

Who will be producing the hydrogen? What's the regulatory regime?

Will I have a choice - could I still use natural gas?

How is it more environmentally friendly than gas?

Will my energy supplier be the same?

Will I be able to switch suppliers?

Who can help me if things go wrong?

## 2. Hydrogen boiler technology and changes to the home

If we were to use up to 20% of hydrogen blended with natural gas, the majority of appliances currently in use in homes on the gas network would continue to operate as designed and will not cause additional safety concerns to the people.<sup>4</sup> All gas boilers manufactured after 1996 have been legally bound to withstand up to 23% hydrogen blend.<sup>5</sup> If different areas in Great Britain do transition to deliver a higher hydrogen blend or even 100% hydrogen to homes to provide heating and hot water then household appliances currently using natural gas will need to be replaced or altered.

Appliances that would need to be replaced with "hydrogen-ready" alternatives include boilers, hobs and ovens, and gas fires. It is also likely that external pipework that delivers the hydrogen to your home and boiler will need to be changed as hydrogen is a less dense gas and in order to have sufficient energy content for processes it is often compressed and stored under high-pressure.

New meters will also need to be developed and installed to ensure people are billed correctly, and billing methodology will also need to change to reflect the energy used in a home, rather than the volume of gas delivered to a home.<sup>6</sup>

# Hydrogen boiler technology and changes to the home

It is less clear if pipework and radiators inside people's homes will need to be changed. In theory, the pipework should remain the same as current systems pipe hot water around our homes to deliver warmth and hot water. Where this might differ is if hydrogen boilers are more efficient operating at lower temperatures. This might mean that over-sized radiators or underfloor heating are better options for heating homes. It might also mean that getting hot water instantly from a combi-boiler option is more difficult and therefore, a hot water tank would need to be installed.

People may need to change their habits in order to benefit from a hydrogen-fired direct central heating system. Oversized radiators and underfloor heating might be less responsive and need to come on earlier and for longer than we are used to. Households might need to programme their systems to ensure hot water is available when required.

Cooking may also be affected as the flame on a hydrogen-fired hob is less intense and pots and pans will need to be closer to the flame. It might also make cooking with heavy pans more difficult (we understand that the flame speed of hydrogen is greater than gas).

Finally, it may be that hydrogen is more valuable to delivering net-zero as part of a hybrid heat pump rather than for hydrogen boilers.

## Some possible questions from consumers

Will my radiators/pipework need to be changed?

Will I need to buy new appliances?

Will my cooker work in the same way? Will it be the same experience?

Will I need to change my behaviour (ie programme when I will have hot water instead of having instant hot water?)

Is it safe?

What are the energy efficiency requirements?

What changes do I need to make to my house?

Can I have a smart meter?

Will my boiler work in the same way as a gas one? (i.e. is there any difference in the responsiveness)

Will I need to have a hot water tank installed? What size will it be?

Will the new technology be easy to use for everyone?

Will it smell the same as gas? Or smell at all?

### 3. The cost of hydrogen

Difficult decisions will need to be made, and soon, about how best to fund the transition to a net-zero carbon future. It is crucial that this is managed through the development and publication of a clear heat decarbonisation strategy. It must set out unequivocally why the transition is needed - to tackle the most dangerous, long term and inevitable impacts of climate change.

There will inevitably be system-wide costs if we are to use hydrogen in Great Britain. The sunk costs of having a gas grid does not mean it will be lower cost to use that grid for hydrogen. The CCC's cost analysis shows little difference between transition pathways even those with a reduced gas grid or a decommissioned one.<sup>7</sup>

#### Some possible questions from consumers

Are hydrogen boilers more expensive than gas boilers to purchase? To install? To repair?

What's the difference in costs between Boiler/Green Hydro/ Blue Hydro/ Blue Hydro +CCUS (Unit cost?/compared to gas?)

Am I entitled to financial support? If so, what do I need to do to get this support?



## 4. Installation, repair and maintenance

The installation and maintenance of natural gas-fired boilers has to be undertaken (or signed off) by a Gas Safe engineer. Hydrogen ready and hydrogen-fired boilers will need an equivalent installation and maintenance regime.

It is our expectation that Gas Safe engineers should be able to install or carry out maintenance checks on appliances fuelled by hydrogen and it is likely that engineers would be able to undertake additional professional development training that would qualify them to work with hydrogen fuelled appliances.

In 2019, 1.67 million gas boilers were installed in the UK.<sup>8</sup> This equates to over 4,500 being installed every day. Gas engineers will need to be trained to install and work with hydrogen fired appliances but also incentivised to do so while installation numbers remain low. Additional training is costly and takes time out from working: as many Gas Safe plumbers are self-employed it is important that they feel this is worth their time.

It is likely that any switchover to hydrogen will have to happen on an area by area basis. This will require significant planning with a variety of organisations as part of the process including local authorities, gas networks, installers and energy suppliers. Some consumers might need additional support to help them manage the changes to their home.

### Some possible questions from consumers

Is there a deadline for making the changes?

Who is going to make the changes?

What if I can't afford it?

Are there enough installers?

How do I know my installer will be registered?

Will they be registered under Gas Safe?

Will I get to choose my installer?

How easy will it be to find someone to repair my system?

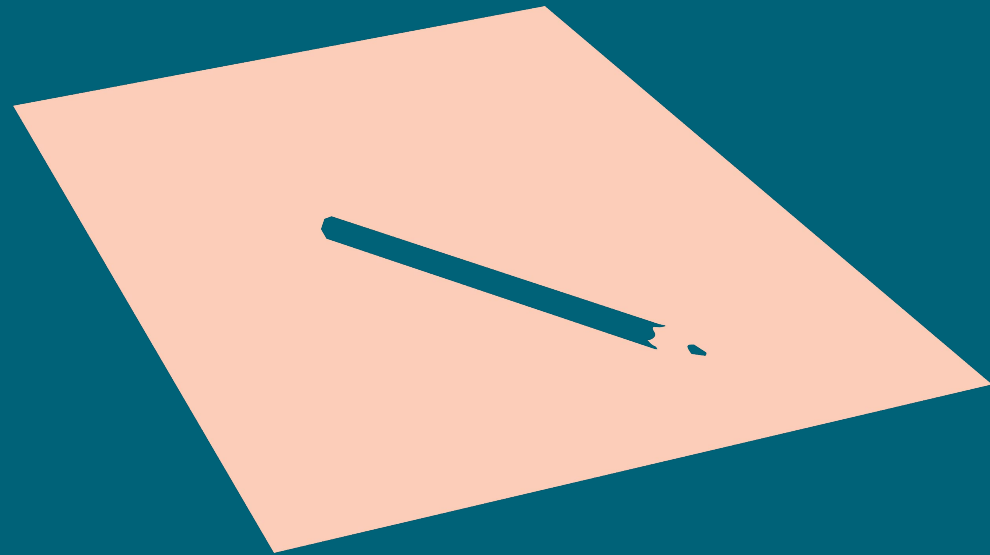
Are there any types of homes where the technology won't be suitable?

What will roll out be like?

What do I do whilst it's being installed/when is switchover - what if I'm not at home (in hospital/on holiday/work nights)

# Next steps

Industry groups, businesses and government are working together to develop and trial hydrogen technologies for homes. It is vital that people's needs are at the heart of any plans for using hydrogen in homes. The 'consumer journey' must be considered from the outset: this is a new technology and there are many unknowns. Providing people with the right information, advice, protection and support will be crucial if hydrogen is adopted as a source of low carbon heat for homes.





# References

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