Replacing methane with hydrogen to heat homes is a bad idea—here's why

April 27 2023, by Ran Boydell

Credit: AI-generated image (disclaimer)

Hydrogen is an energy-rich gas, which releases no carbon emissions when burned. It can be used in most equipment where fossil fuels such as natural gas (methane) or LPG (liquefied petroleum gas) are currently used. In your home, that might mean a gas boiler, heater, cooker or all three.

It can also power combustion-engine vehicles which might otherwise run on petrol. And it can generate enough heat for heavy industry processes such as steelmaking, which is overwhelmingly done by burning coal at present.

These qualities make hydrogen gas an attractive replacement for the fossil fuels driving climate change. But could (and should) it heat your home?

How is hydrogen produced?

Hydrogen is one of the most abundant elements on Earth but because it reacts so readily with other elements, there is very little pure hydrogen available (it's only 0.00005% of the atmosphere). Instead, hydrogen must be extracted and stored.

If renewable electricity generated by wind, solar and other sources is used to separate hydrogen from water, it could create an entirely sustainable energy cycle. This is called "green" hydrogen but, at the moment, it accounts for only 0.1% of global hydrogen production. The infrastructure necessary to produce green hydrogen at scale hasn't been built yet as there is insufficient incentive to do that while it's cheap and simple to make hydrogen using fossil fuels.

Most hydrogen currently made worldwide is extracted from fossil fuels, about half of it from methane and the rest from oil or coal. Extracting hydrogen from fossil fuels releases carbon. Only about 1% of global hydrogen production is subject to an industrial process known as carbon capture, use and storage (CCUS), which filters out most of the carbon (the current best capture rate is about 90%) to create "blue" hydrogen.

The vast majority of hydrogen is labelled "grey," where the carbon is simply emitted to the atmosphere. So while it may be clean at the point

of use, hydrogen's production is contributing to global heating.

Should we use hydrogen in homes?

While hydrogen has the potential to be a green substitute for fossil fuels, this is still very much a future prospect.

To decarbonise home heating and hot water, the UK's recent energy security bill promoted heat pumps as a replacement for gas boilers. Most countries in Europe and North America have done the same.

Heat pumps work like a refrigerator in reverse, pushing heat into rather than out of a space. The reason heat pumps are so useful is that they can convert one unit of electricity into two or more units of heat, referred to as a coefficient of performance or COP of 2. By comparison, gas boilers have a COP of about 0.9. It's even lower if they burn hydrogen, perhaps less than 0.5.

The bill set a target of fitting 600,000 homes with heat pumps each year by 2028. The UK Climate Change Committee (UKCCC), an independent body that advises the government, projects that 52% of home heating will come from heat pumps by 2050. All of those homes will be progressively disconnected from the gas grid.

At the same time, households are being encouraged to become more energy-efficient by installing insulation in windows, walls and lofts. This could reduce the average energy demand for space heating by as much as 75% if retrofitted to Passivhaus standard (an international benchmark for very low-energy construction).

Even tougher rules apply to new build homes. In Scotland, building regulations will prohibit the installation of gas boilers in homes built after 2024 and legislation was recently passed to introduce a Scottish

Passivhaus-equivalent standard.

With fewer homes connecting to the gas grid and much lower energy demand for those that are connected in future, maintaining the national gas grid for domestic use seems wasteful. Maybe it's time to think about turning off the gas for good.

The gas grid

A recent report by a government advisor known as the Hydrogen Champion recommended blending up to 20% hydrogen into the gas grid, similar to how most petrol now has 10% ethanol blended in. This is listed in the report under the heading "Stimulate Demand" and it seems clear the aim is to encourage hydrogen production rather than reduce carbon emissions.

The report states:

"Hydrogen blending alone could support up to approximately 5GW of hydrogen production near term and has the lowest risk profile of off-takers [potential buyers]. This significantly helps to make CCUS-enabled hydrogen projects investible during scale-up."

Domestic gas use is considered "low risk" because most householders simply don't have an alternative.

In the short term, using any hydrogen for home heating would almost certainly increase carbon emissions because, as noted above, hydrogen has a lower COP than methane and the vast majority is produced from fossil fuels without CCUS.

In the longer term, hydrogen is much more likely to be used in transport and heavy industry than in houses. The report states that the Department

for Energy Security and Net Zero has "strongly emphasised the need to prioritise industrial consumers." The UKCCC projects that only 5% of domestic heating will come from hydrogen and that will be predominantly as a secondary supply for hybrid heat pumps.

The message from UK gas network operators is that they are transitioning the gas grid to hydrogen, with work already underway planning the upgrades to regional pipelines that will be required and for pilot projects with small groups of houses. Boiler manufacturers are also promoting hydrogen-ready boilers that can be installed now in anticipation of 100% hydrogen supply.

But transitioning the entire gas grid to hydrogen would be an enormous task. More likely is that some hydrogen hubs develop in places with surplus renewable energy generation to produce green hydrogen, alongside high industrial demand and a high density of buildings where heat pumps and retrofitting will be difficult.

What should households do?

You have no control over what sort of gas gets delivered through the pipes to your house. If an 80:20 blend is introduced, it will be to stimulate business investment in the production of hydrogen, and it will have to first be deemed safe for all existing household uses such that no modifications are required. In the longer term heavy industry and transport will suck up the vast majority of hydrogen produced.

What you can do, if you can afford it or are eligible for government support, is insulate your home and install a heat pump, which will immediately reduce your household carbon emissions as well as save you money.

As for hydrogen, forget about it.