GREEN HEATING

A REVOLUTION IN HOME HEATING IS NEEDED TO REDUCE CARBON EMISSIONS

Fundamental changes to the way we heat our homes will be essential if we are to create a low-carbon economy. Natural gas will most likely have to be phased out over the next few decades. It could be replaced either by electrified heating, or by green gases such as bio-gas or hydrogen. Major investment in new technologies will be needed.

A burning question

The EU has made a commitment to reduce its greenhouse gas emissions by 80% from 1990 levels by 2050. The scale of that challenge should not be underestimated. It will require massive changes in the way energy is supplied and used.

One area that has started to receive more attention in the last few years is space heating. In many countries, homes are heated by burning carbon-emitting, fossil-based natural gas (methane) in boilers. Most analysis suggests this form of heating will have to be almost completely eliminated if emissions targets are to be met.

In the UK, the Government estimates that providing heating for buildings and industry causes around 32% of total carbon emissions. That's more than the transport sector (24%). Heating technology has become increasingly efficient over time, lowering emissions and making for healthier homes. Further efficiency improvements are important and will no doubt be made, but they will not be enough, on their own, to meet carbon targets.

Decarbonising the supply of heat is therefore a big challenge. Two broad pathways have emerged as leading contenders, given the currently available technology.

Heat's electric

The first pathway involves wide-scale electrification of heating in buildings. This is most likely to mean using electric-powered heat pumps, alongside district heating schemes in built-up areas (for example like the system used to supply hot water and heating to converted flats at Arsenal Football Club's former ground, Highbury, in north London).

Going down this route would require a significant increase in the UK's electricity generation capacity. Major new investment in the electricity grid would also be needed, while homeowners would have to replace their boilers and heating systems. For the industrial sector in this scenario, reducing emissions would probably require the deployment of Carbon Capture, Use and Storage (CCUS) technology.

The need to store energy to supply peaks in heating demand during the winter months is a key challenge. Recent research shows that the current infrastructure in the UK can store 1,600 times more energy in the form of gas than in the form of electricity. New, cost-efficient ways of storing electricity could be developed – recent falls in the cost of electricity battery storage have been well documented. But storing electricity in batteries is still substantially more expensive than storing gas.

Letting off steam instead of carbon

The second pathway involves "greening" the provision of gas. This could involve blending – and eventually replacing – existing fossil sources of methane with emission-neutral synthetic gas or bio-gas, such as gas produced from waste.

Alternatively, methane could be replaced with hydrogen, which does not emit greenhouse gases when burned (instead producing only water or steam). This would require some modifications to the existing gas transportation and storage infrastructure, to make it compatible with hydrogen. Methane-burning technology in homes (primarily in boilers and hob cookers) would need to be adapted to work safely with hydrogen. Customers would have to be persuaded that it was indeed safe to switch over. And major investment would be needed in technologies that can produce hydrogen in sufficient quantities, which could also require industrial-scale CCUS infrastructure.

Warming alternatives

It would also be possible to combine the two strategies in potentially cost-effective ways – for example, reducing the need for investment in electricity capacity by using green gas during the peak winter period. Frontier's recent work in Germany suggests that such a combination could minimise total system costs once the entire value chain is taken into account – i.e., the aggregate costs of generation, storage, transportation and end-user applications.

New ways of using the storage capacity within existing gas infrastructure could also be developed. For example, electricity generated by renewables could be converted to gas in order to store and transport the energy content, then converted back to electricity closer to the time and place of consumption.

Alternatively a "patchwork" may emerge with different options preferred in different places – for example, using heat networks where population density is high; hydrogen where storage and CCUS are most readily available; and electrification elsewhere.

Clearly, the field is also wide open for technological development. Ideas like "smart jumpers" and "smart wallpaper" that can be programmed to respond to temperatures in the home might seem far-fetched, but such innovations could change the way we think about heating in future. Changes in the electricity sector have shown how the relative costs of different low-carbon options can shift dramatically and how rapidly new technologies can emerge.

Informing heated debate

In the last few years, major research programmes have begun looking into the costs and risks associated with different pathways for heating. In the UK, Frontier has worked on various projects with the CCC (e.g. on the future of gas regulation, how district heat can help reduce carbon emissions, the penetration of heat pumps, and the cost of capital for household low-carbon investment decisions); BEIS, the ETI, the EEIG and other industry players to evaluate the economics of various options.

There are big challenges and major unknowns associated with all of the options on the table. The only certainty is that the debate on the best approach for the UK and Europe to take will become increasingly urgent.

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