Sunk costs? Gas and the future of heat

While government grapples with policy decisions about how to decarbonise heat in the UK, consumers, the housing sector and industry have been taking individual decisons on how to meet the needs. What do they tell us about the likely future scenarios? Janet Wood took soundings

What is the future for heating and what are the implications for the gas and electricity sectors? This question is one that the energy industry and policymakers have been grappling with for at least a couple of decades. Now it is rising up the agenda, as heat is lagging far behind electricity in decarbonising.

In the early days of decarbonisation there was a simplistic assumption that heat could be power-led. In short: decarbonise the electricity sector and then switch to electric heating. But the sheer scale of energy required to meet heat needs – delivering seven times the amount of energy to consumers that electricity does at some periods – and the useful inherent storage in the gas network meant that view was quickly seen to be both impractical and perhaps inadvisable.

Times have moved on again and so has the debate. There have been structural changes that were not really taken on board in early centralised plans. For example, individuals have grabbed the agenda and are turning electricity into a consumer-led industry. Some already have an electric vehicle, photovoltaics, a home battery system and electric heating. At the same time, home management systems have begun to take off that mean consumers can manage their electricity needs in a way that was not possible before, and accommodate more power use without necessarily needing as much grid reinforcement.

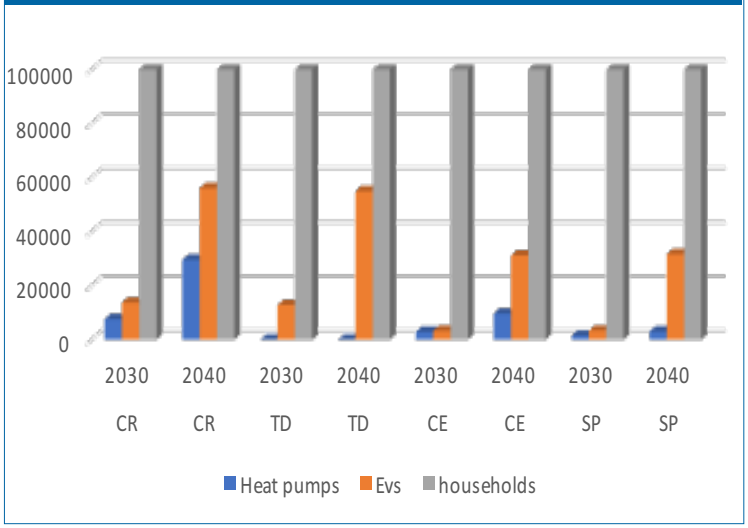
This has shifted the heat question – but only for that one customer group. Because the most important thing that has to be said about the future of heat is that it is varied. Solutions for the existing building stock are different from those for new-build. Solutions for heat-dense areas will be different from those in the suburbs or rural areas. And solutions for areas with industrial customers will be different from those that apply for pure domestic usage.

The Scottish government has tried to grapple with this in developing a 'heat map' that gives local authorities and public sector bodies access to regional data that reveals the potential for district heating and links the need for need with that for improved energy efficiency in the housing stock.

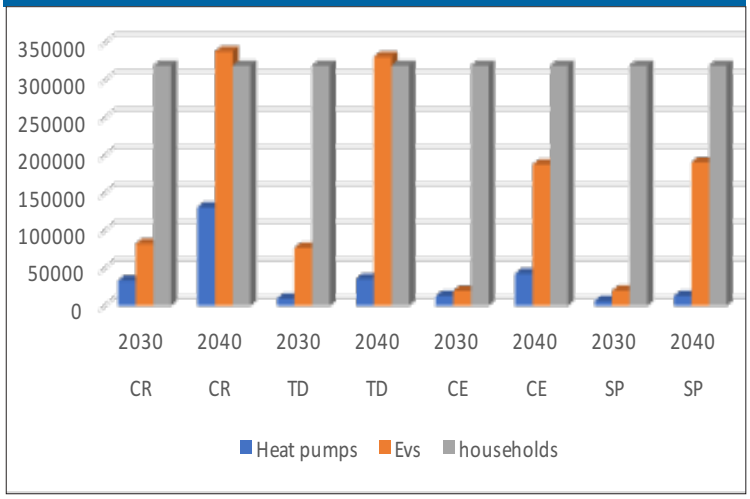
But the future for customers across the UK is that their heat choices will inevitably be limited, depending on where they are located, and in some cases the choices will change. There will be costs in changing the system and policymakers will have to make sure that they are allocated equitably and some customer groups do not lose out.

How do we decarbonise heat? We can't see the future but we can see some trends emerging. >

POTENTIAL FUTURES IN HACKNEY



POTENTIAL FUTURES IN LEEDS



Source: National Grid's Future Energy Scenarios
CR: Community Renewables
TD: Two Degrees
CE: Consumer Evolution
SP: Steady Progression

HOW DO NEW USERS CONNECT TO HEAT?

New Power sees that the use of the gas network will change in some areas. One example is areas of high heat demand, typically city centres. Here the switch is towards heat networks.

Bristol, for example, expects new developments in its 'high heat demand' areas to connect to an existing heat network if one is available. Where there is no heat network, new developments have to be 'future proof', which means they must be able to connect to a district heat network in future.

Heat networks are a priority and their use is growing – the government has made £340 million available in funding to install and extend such networks.

But in areas further from heat networks, the choice is more difficult. "We are not accepting individual gas connections in residential developments," *New Power* was told by one planning authority. Instead, new developments of up to a few tens of homes would be expected to have a communal heating system, ready for conversion to a low-carbon fuel in future. In these areas, gas is a temporary solution – and one that no longer applies to individual dwellings.

Communal heating systems at present are often in the form of gas-fuelled combined heat and power (CHP) projects. But the expectation is that these will eventually be replaced. What with? Consultant WSP thought it likely that communal CHP installations would stick with gas in their next replacement cycle – typically a 15-year term – but the following replacement could be a large heat pump. WSP noted that a communal heat pump recently went into operation in a pilot project.

New housing regulations change from 2020 (so-called Part L) and after that time it will be hard to make a case for gas CHP, WSP believes.

It seems that usage in some areas is shifting from individual property to bulk supply to large communal heating systems. That coincides with other changes in gas network customers, caused by changes in the electricity supply business. A new class of small scale gas engines installed in city centres and industrial parks that are connected to the local gas grid where they are large and intermittent customers, who start up for a few hours driven by demand for electricity.

GAS GRID DEFECTION

In the outer suburbs and rural areas, heat density is still lower and heat networks are unlikely. Nevertheless, planners say developments must be "at least future proofed for a world without gas". What does that mean in the long term? At the moment, the most likely choice appears to be heat pumps. In its Future Energy Scenarios, National Grid includes some scenarios where there is huge growth in heat pump installations looking out to the 2040 horizon (see charts left).

Other scenarios see less enthusiasm for the technology and at the moment they are by no means the only choice. The view of planners is taking time to filter through to experience on the ground and developers are less inclined to move away from gas. When *New Power* asked what mix companies that provide the utility connections to new-build properties were seeing, one said: "Our sense is that developers are still utilising the traditional model of gas as the primary source for individually heating residential properties, but there are distinct areas where it's being excluded and these are in the cities such as London, Manchester, Birmingham and >

Glasgow when apartments in multistorey dwellings are being developed."

There is an intermediate option. 'Hybrid' heat pumps work in electric mode to supply heat for most if the time, but use gas at times to provide extra heat or at times when the ambient temperatures (or grid load) do not favour the electric option. Pilots have produced favourable results. But once again, use of the gas network has changed. There are islands of gas connections and islands of electric heat – and in some areas, where gas connections exist, they are an investment for occasional backup use.

A 'FREE RIDE' ON ELECTRIC VEHICLE UPGRADES?

The steer from BEIS to local authorities is that they should be cautious about switching to electric heating, because the government has taken on board a key message about the scale of heat requirements: switch to electricity and the power grid will have to accommodate huge peaks, requiring a massive infrastructure upgrade. It is not wrong, on simple addition. But is it the full picture?

National Grid's heat pump scenarios are "a credible view", according to Northern Powergrid's Jim Cardwell. National Grid breaks down its forecast of heat pumps by grid supply point for each of its four scenarios. An order of magnitude comparison against the number of households is shown for two city areas – Leeds, and Hackney in London.

In some scenarios the FES projections in heat pumps look dramatic, but set them alongside the growth in electric vehicles and they look less like the game-changer. Electrically, the two assets are similar in scale: WSP says at the moment a typical heat pump would draw 3.4kW, while an electric vehicle might charge at around 7kW. Over the year, in broad terms the 2.5MWh used by a typical car driver (travelling around 10,000 miles) compares to heat pump use of the order of 2MWh. But the number of electric vehicles is all scenarios far exceeds the number of heat pumps.

Is the advent of electric vehicles charging the equation on whether electrification is the best choice to meet heating needs?

Clearly there will be a volume change in the supply of gas and electricity. But implications for the grid depend very much on usage. Cardwell said that in trials, electric vehicles added 1kW to the peak load of a typical house and so did heat pumps – each of them doubling the peak load and potentially requiring large grid reinforcements if both were used simultaneously. However, Cardwell notes that the two figures come from separate trials and shifting the loads was not taken into account. Those trials, "were not joined up", he said.

A more recent project, which saw smart systems employed to adjust charging of electric vehicles and heat pumps to reduce stresses on the system, suggested that a £1 billion bill for reinforcement could be reduced by up to 40%. We are in the early days – both of the rollout of heat pumps and electric vehicles, and of smart systems – but such changes are encouraging.

Settling all customers half-hourly should sharpen incentives to work with the system instead of against it, and Ofgem is consulting now on the timing of a move to half hourly settlement. Giving customers the option of taking control themselves (or ceding it to a third party, see box, next page) makes the use of smart charging more likely.

HEAT PUMPS FOR THE SUBURBS?

Cardwell sees heat pumps as a likely solution for rural areas that are not connected to the gas grid. He sees that as an opportunity for hybrid heat pumps, reducing gas use for most of the time.

But he too noted that this applied to new users; for existing users of 'wet' heating systems "the hassle of retrofit is massive".

WSP agreed, noting that "the cost of converting form a wet system to electricity is significant and it needs investment in the building fabric".

HYDROGEN FOR INDUSTRY

The 'same but different' option in decarbonising heat is to use the existing gas network to transport a low or zero carbon gas.

That may be 'green' methane from anaerobic digesters. Or it may be hydrogen, produced via electrolysis using renewable energy (a boost for the power generation sector) or from gas with carbon capture and storage (CCS). This is an attractive option for areas where industry has a high heat demand that cannot be served using electricity (Cadent is investigating this solution for its north-west region). It also meshes well with transport options that require non-electric solutions, such as replacing diesel for heavy goods vehicles or for trains in areas where electrification is not an option.

However, current systems and appliances can only accommodate 20% hydrogen – above that level both domestic and industrial users would have to invest in different technology. Who pays for that change?

Until then, a 20% switch to hydrogen only solves (because of its lower energy density) 7% of the gas decarbonisation problem.

WHO PAYS AND HOW?

Jim Cardwell says: "Don't turn the gas off, it serves customers well." But as we have seen, although it may not be turned off, in different areas the gas grid will be used in new ways. What does that mean for existing users? And WSP notes that some of the >

gas grid has been in the ground for 100 years and more. The company suggested that "How do you pay the legacy costs?" is a key question.

This is a changed gas network, where the system supplies a small group of large customers who have variable and relatively unpredictable demands, instead of thousands of individual households. Connections companies also saw "a move towards district heating schemes and heat pumps, so the gas usage in some areas is at a more centralised level than individual property connections".

However, it applies only to new users. Alongside and among this group remains a network of existing users who do have individual connections. When it comes to the way that network costs are shared out the interests of these customer groups may be very different.

Similar questions will arise in other areas where existing domestic gas connections are increasingly mixed with other options. If new developments have communal heating systems using CHP, how will they share the costs of the gas network? How will hybrid heat pump users be charged if they use the gas network on an infrequent basis? At the moment gas distribution charges are largely volume-based (although on the high-pressure gas network, at least, a new charging regime will move more to a capacity-based charge). And how will the need for flexibility to serve large users like gas engines affect other gas customers?

In areas where there is a shift to hydrogen, other charging questions arise. Hydrogen is less energy-dense than natural gas, so customers need larger volumes to provide the same amount if heat. How will the costs regime accommodate that?

The lesson from electricity networks has been that adjusting a charging regime is a complex process with winners and losers

Those charging questions have still to be answered – or even asked. In the immediate future gas distribution networks are grappling with questions over how to plan expenditure now for the five-year price control period from 2021. WSP notes that some of the current gas grid has been in the ground for 100 years and more. Should networks be installing assets to last for a similar period where there will be few customers to pay for them?

Investment now will be paid off over 45 years. Which customers will still be paying at the end of that term?

WHO DECIDES?

Some trends are emerging: heat networks in high heat density areas, a move to heat pumps elsewhere, balanced with EVs, and a change in use of the gas network from domestic connections to bulk supply and a new customer base.

But this picture is very much around new customers. Existing customers are likely to retain their preference for the existing gas network. Few will want to take on the cost and disruption of change.

Nevertheless, decarbonisation will affect them. Some will have limited choices as the region changes around them. The cost base of the network will change, and that will not affect consumers equally.

Alongside the question of who pays as the gas network changes, the question arises: who decides?

Network companies are set up, incentivised and required to act as neutral facilitators: is it their role to decide on a partial or full switch to hydrogen, or tell customers that they have to use electric heating?

Regional decisions look like a role for local authorities but it is not clear that they currently have that role – or the ability to share the associated costs.

These are is the policy gaps that BEIS faces as it decides on the future of heat. But at this stage, there are at least some indications on how to address the problem. NP

THE HEAT SERVICE OPTION OPENS

Bristol Energy has become the first energy supplier in the UK to trial selling 'heat as a service', offering households the chance to buy a tailored 'Heat Plan'.

The government-backed trial is being run by Energy Systems Catapult. Heat Plans provide consumers with room-by-room, hour-by-hour control over their heating. Using data collected via a smart heating control system, the energy provider can calculate a fixed monthly cost that is bespoke to the triallist's home and lifestyle and does not fluctuate with the weather.

The approach provides a commercial incentive for energy providers to deliver comfort using as little energy (and carbon) as possible and could provide a route-to-market for low carbon technology.

Energy Systems Catapult has been running detailed trials over the past two years with residents in a 'Living Lab' of 100 homes spread across the UK. Each property has been upgraded to smart home levels that are predicted to be common by the middle of 2020s. Now, Bristol Energy has partnered with Energy Systems Catapult to offer Living Lab trialists the chance to switch to a newly designed Heat Plan. Energy Systems Catapult consumer insight lead Matt Lipson said: "Energy services create opportunities for entirely new business models and policy options."

Energy Systems Catapult is also releasing initial findings from last winter's simulated Heat Plan trials in the Living Lab where approximately 50% of residents 'opted-in' to a Heat Plan.