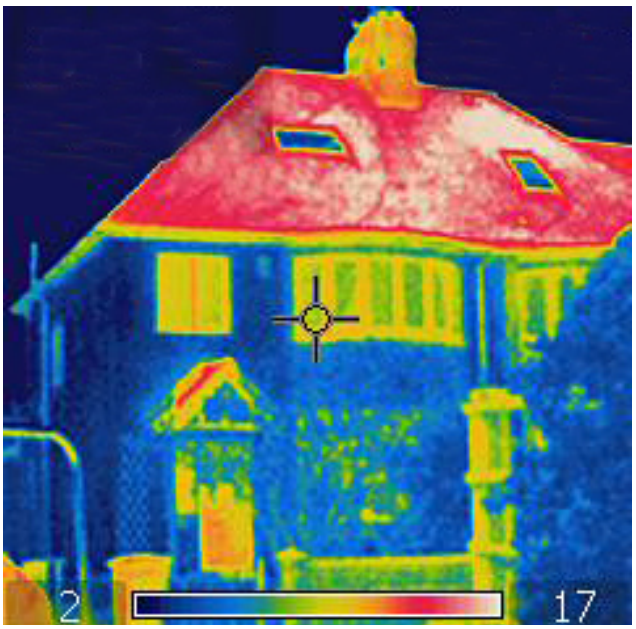
UNIVERSITY OF OXFORD
OXFORD Energy
Expert Meeting
November 2016

Decarbonising Heat

Over 60 energy experts gathered in the National Grid's central London offices on the 21st November to discuss the challenges of decarbonising heat in the UK. Building on Oxford Energy's last expert meeting, which identified heat as the 'mammoth in the room', delegates heard from four speakers who set out the issues faced by industry and policy makers in transitioning away from fossil fuel sources of heat generation.

Setting the context

Total UK heat consumption is estimated at 771 TWh per year: more than double electricity. Heating demand is diverse, varying by building type, location, fuel and season. Households spend more on heating than on electricity or petrol, and because the unit price of natural gas is four times cheaper, even a two pence increase per kWh for heating would be unpalatable. This makes the decarbonisation of this sector politically sensitive.



Two fundamental questions set the context for the discussion: (1) which vectors are optimal, and (2) where will the energy come from? For the former, three broad options are available: electrify the heating supply, expand heat networks, or repurpose the gas network for low-carbon fuel. Discussing the merits and limitations of each, we heard that no single network or fuel source delivers everything required for the low-carbon transition alone.

Economics

Without an effective carbon price, natural gas is artificially cheap. This means that all pathways to decarbonising heat will come at a cost. However, cost-mitigating strategies discussed at the meeting included using regulation and public ownership to obtain low costs of capital; dovetailing hydrogen conversion with the iron mains conversion so that these costs are not 'felt' on the consumer bill; and redoubling energy efficiency efforts.

Politics and governance

Cost is far from the only consideration. The physical disruption involved in building

underground heat networks, replacing household gas boilers or upgrading low voltage electricity networks should not be underestimated. It was suggested that the least invasive options are likely to have more public and political acceptability.

Unlike other infrastructures and energy sources, there is no central agency responsible for heat, meaning that governance is complex, involving local and central government, network monopolies and regulators.

Previous transitions such as the rapid deployment of condensing boilers in the mid-2000s were cited as successes, driven by strong regulation. Delegates agreed that similarly significant programmes and large scale investment and innovation would not be delivered by existing market structures alone.

> "For heat decisions, there isn't a well-established governance system"

Whilst route-maps exist for different technologies and demand reduction, the political path is not so easy. One delegate pointed out that 'some of this has the potential to look quite Stalinist'. Given the lack of appetite for top-down intervention and government borrowing, the importance of including politics in typically technological discussions about heat became clear.

> "We are absolutely primed to take advantage of this [hydrogen] opportunity [...] but if we don't put the funding in place [...] then there's a good chance other [countries] could take over"

Practical deployment and the skills shortage

Aside from the infrastructural challenges of electrifying heat, we heard that some scenarios identify a need to replace gas boilers at a rate of 1,000,000 per year. With only 20,000 heat pumps being deployed annually in the UK, this potential step-change presents 'a significant skills challenge'. Today, more than 80% of new homes being built are connected to the gas grid, and the withdrawal of the Zero Carbon Homes policy has slowed innovation in the sector.

It was proposed however, that hydrogen represents an opportunity for the UK to take a global lead in developing technologies, appliances and infrastructures, and benefit from the associated jobs, skills and export potential. The H21 project in Leeds would be a world first: demonstrating the potential for incremental hydrogen transitions by region.

Social equity and public acceptability

Several attendees emphasised the significance of fuel poverty and social equity in any discussion on the future of heat. It was suggested that better integration of energy efficiency and heat policy is an essential first step for equitable decarbonisation.

A significant challenge for any transition pathway is ensuring public support. If repurposing the gas grid occurs by region, how will residents be protected from comparatively higher costs? How might householders be persuaded to give up gas as their preferred cooking fuel? Whereas discussion often focuses on the macro-level, heating at the household level is synonymous with socially embedded

practices such as comfort or cooking, which must be understood and accounted for.

Concluding thoughts

Despite the scale and complexity of the challenge, delegates agreed on the need for urgent action. With no panacea, many urged incremental deployment, pursuing a range of technology options in different contexts such as rural or urban areas. Infrastructure decisions taken in the near term will have implications for decades. That said, one audience member emphasised that 'we can't have every option in every geography, because nothing's happening!'

'Brexit' negotiations are likely to dominate the UK policy agenda for at least the next two years, which some delegates felt threatened the chances of seeing evidence-based, well-modelled policy interventions. In his concluding comments, the meeting's chair reflected on a 'remarkable degree of consensus'. However, hinting at the scale and complexity of the challenge ahead, he drolly remarked: ''we didn't quite answer the question of *what to do*''.

> "We seem to be in that 'nice' situation of letting the technology debate go on endlessly without actually getting into enabling markets"

Options	Opportunities	Challenges
Electrification	• Progress is already being made towards grid decarbonisation • Readily available technologies currently exist • Additional load would be flexible	• Capacity would need to increase by ~50GW at a cost of ~£100bn, as well as inter-seasonal storage challenges • Deployment of heat pumps requires a skilled workforce and changes in home-heating infrastructures
Heat Networks	• Centralised generation can be systematically decarbonised • Efficient, low temperature networks are being developed	• Economics requires high heat density (e.g. urban areas) • Challenge of low carbon source remains as the UK is 'biomass poor', requiring input from gas and electricity networks
Gas Networks and Hydrogen	• Prevents the stranding of the national gas network assets • Can be phased in using blending, and local deployment • Potential synergies with transport, including freight • Building on iron mains replacement, costs could be flat-lined on bills	• Potential supply of biogas is not sufficient • Hydrogen is expensive, not only in capital terms, but as ongoing cost. • SMR requires CCS to be low-carbon • Requires home-heating infrastructure changes