# Heat decarbonisation modelling

## Impact of our new Regional Heat model for FES 2021

**A wide range of options for decarbonising heating exist and the varying pathways will lead to quite different energy systems in the UK. Modelling future heat demand is complex, and each year we aim to improve our modelling and how we model different sectors.**

**Here we present the impact of our new Regional Heat Model on our analysis of heat decarbonisation options and what this means for our 2021 Future Energy Scenarios (FES).**

In our Future Energy Scenarios, we aim to cover the range of credible outcomes for technology deployment across different sectors. When it comes to heat, while there are many potential pathway choices, no clear consensus has emerged regarding the most appropriate approach to heat decarbonisation at a national scale.

We have developed a new heat model through a collaborative innovation project. It was NIA (Network Innovation Allowance) funded through National Grid ESO and National Grid Gas and developed by Element Energy, with both gas and electricity distribution companies on the Advisory Group. The new model is intended to enhance our understanding of the potential decarbonisation routes, their likelihood, and the impact of these on networks as well as on consumers. However, its main additional functionality over and above the model used for FES 2020 (that it replaces for FES 2021) is that it provides results at a regional rather than national granularity.

## Why do we need this model?

We believe that the solutions to decarbonising heat which deliver the best efficiencies in costs and emissions reduction are driven mainly by local factors, which cannot be understood by a top-down assessment framework. We have therefore worked in collaboration to develop a first-of-a-kind spatial demand modelling platform for Great Britain which incorporates all low-carbon heating options to determine plausible local decarbonisation pathways to 2050. Regional analysis will be used to support discussions with distribution companies and to enhance our understanding on a national level. The motivations for this project are:

### A changing body of knowledge

Useful datasets on technology performance, costs, and sustainability are being gathered but have not been integrated in a manner that facilitates cross-comparison and development of coherent strategy, either at national or local levels.

### Shift of customer requirements

Existing national pathway optimisation models do not represent the heating sector well. They lack the spatial granularity and understanding of consumer behaviour required to model heat decarbonisation pathway choices and to explore local differences and constraints required to support planning decisions.

### Changing risks

The uncertainty in heat decarbonisation pathways creates difficulties in planning investment, in assessing system operability, and in developing policy. There are proposals that would require business plans for the forthcoming energy network price control periods to be compatible with emission targets.

As we move into our new price control period as the ESO we will be increasingly focused on more granular regional outputs both as part of our modelling and through the insights we provide to the industry. This model is a first stage in this capability which we will be developing further as we move forwards to FES 2021 and beyond – both in relation to heat but also more broadly across the energy sector. We are hopeful that this drive for more regionalisation in our ESO Future Energy Scenarios will simplify and optimise the interface with the more bottom-up scenarios developed by electricity and gas distribution companies. We also hope that it will assist in supporting understanding of future energy policy at a local level.

## How does the model work?

The heat decarbonisation pathways generated by the model are not constrained to just follow a high-level top-down scenario framework. Instead, the user can define a number of detailed key scenario parameters, set in line with the levers within each scenario, describing a range of policy, social, and macroeconomic conditions, and the model will produce a forecast of the heat decarbonisation pathway based on:

- the economics of different technology choices,
- the decision-making of individual consumers, and
- local infrastructure investment decisions.

We build up a picture of current heating demand from a range of data sources on building stock attributes and occupancy profiles, including housing survey data, EPC data, and metering data from small geographical areas (lower super output areas or LSOAs). The model also takes account of our assumptions on housing growth, affected by new build and demolition rates, which are fixed across the four scenarios. The model ensures that there is full competition between the various building level technologies, district heating and hydrogen networks at the lowest spatial granularity relevant to the technology or infrastructure choice.

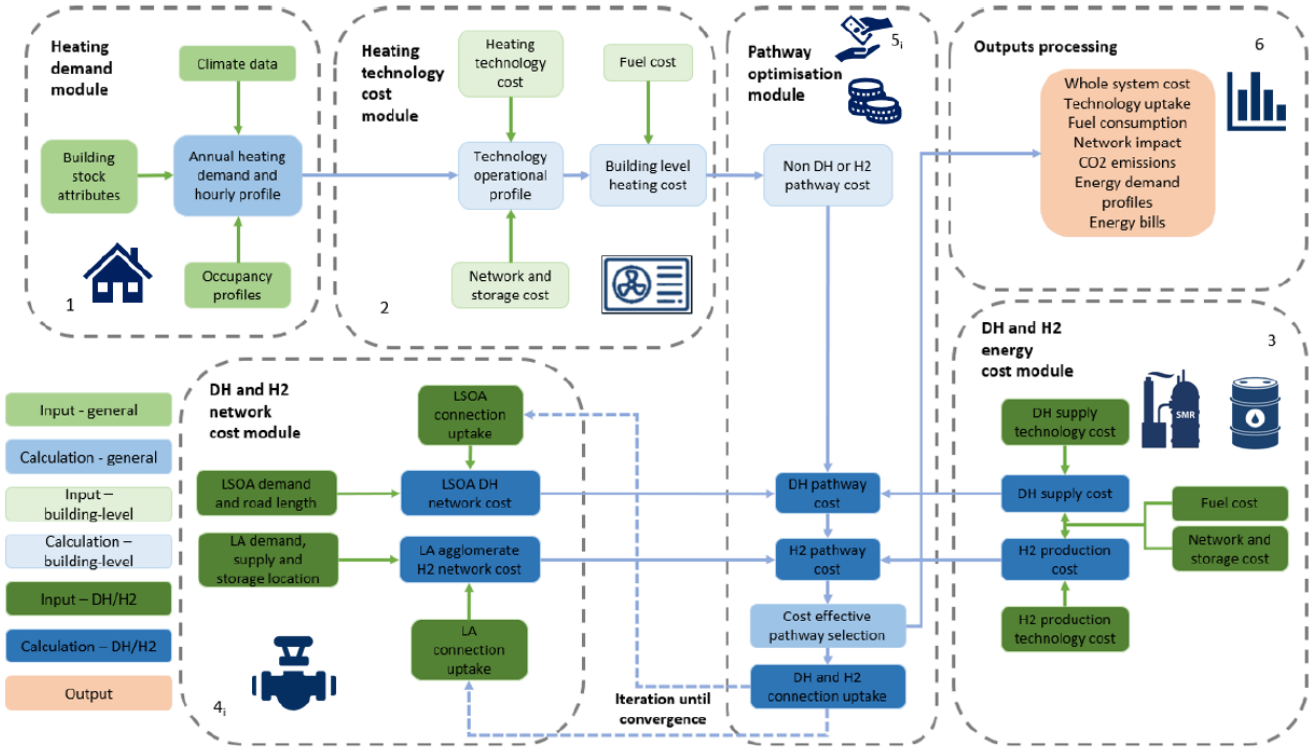


*Figure 1: Schematic of the GB Heat Decarbonisation Model*

The low carbon technologies we currently use in the model are:

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|---|---|
| ASHP (Air Source Heat Pump) | Hybrid: electric heat pump + natural gas boiler |
| GSHP (Ground Source Heat Pump) | Hybrid: electric heat pump + biofuel boiler |
| Solar thermal (combined with a baseline technology so that all the demand can be met) | Hybrid: electric heat pump + electric resistive element |
| Electric storage heaters | Hybrid: electric heat pump + hydrogen boiler |
| Electric resistive heating | Hydrogen boiler |
| Electric boiler | District Heat |
| Biomass boiler | Gas CHP (combined heat & power) |
| BioLPG/BioKerosene boiler | Biomass CHP |

## What value does it deliver?

The improvements the model offers over our existing heat modelling capabilities include much improved spatial resolution, down to LSOA level. In addition, it allows detailed modelling of hydrogen infrastructure, district heating infrastructure, over 7,000 building types, thermal storage, and heat demand.

The model can also take account of many different aspects of heating and optimise the associated costs across one integrated system, including insulation, appliance, energy and infrastructure costs. The output is fully costed scenarios on this basis using one of two different optimisation methods:

- Minimising 'levelised cost of ownership' across a building, a local area, and nationally; or
- Consumer choice driven, reflecting willingness to pay, disposable income, level of engagement, temperature settings, subsidies and penalties, sensitivity to hourly price signals.

Heat is a challenging area to decarbonise, nevertheless it is essential to make progress in this area. To meet the net zero target there must be no gas burnt in homes in 2050, and therefore existing gas heating solutions need to be replaced with zero carbon alternatives. The value that this project delivers to consumers, and to society as a whole, is through enhancing the modelling of heat within our Future Energy Scenarios and enabling quality decision making on heat decarbonisation options in three key ways:

- Improved network investment planning;
- Enhanced forecasting capability; and
- Enhanced engagement across the energy industry.

## Get involved in the conversation

This was a collaborative innovation funded project and so final outputs from the project will be made public, you can find more detail here. We'd also love to hear your thoughts on the future of heat decarbonisation and how this may vary across the country. Get in touch with us at FES@nationalgrideso.com.