LCPDelta

Executive Summary: Heating homes in different regions of Great Britain

A study on locational costs of electricity and gas network infrastructure

Citizens' Advice
[Final version]

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1. Executive Summary

Decarbonisation of heat will rely on a range of different low carbon options to be deployed in the future including electrification and potentially hydrogen. This report shows that the costs of different technology pathways will vary significantly across different regions, and so government and regulatory policy needs to take this into account when considering impact on consumers.

Context

To achieve full decarbonisation of UK buildings by 2050, it will be necessary to completely phase out natural gas and fossil fuel heating systems and replace them with appropriate low-carbon alternatives. However, there is no one-size-fits-all solution. Various technologies, such as heat pumps, heat networks, hydrogen boilers and others, will be required for scaling up decarbonisation.

The Heat and Buildings Strategy sets out the government's plan to ensure as many homes as possible achieve an Energy Performance Certificate rating of C and to phase out natural gas for heating by 2035. The government aims to make low-carbon heating systems as affordable as natural gas by 2030 and is funding research across a range of technology types, including critical trials of hydrogen for heat in 2023 and 2025.

Citizens Advice's research will contribute to the government's strategy by highlighting the need for a locational approach to heat decarbonisation and advocate for decisions in consumers' best interests. Understanding cost disparities across different geographical areas is critical in ensuring a fair and equitable transition to low-carbon heating. This information can help policymakers make informed decisions that consider the potential impact on consumers in different regions and communities.

To decarbonize British homes by 2050, an estimated £250 billion investment will be required, according to the Committee on Climate Change (CCC). Locational factors such as proximity to energy generation sources, type of building stock, infrastructure, and population density play a crucial role in determining the best low-carbon heating solutions. The CCC has recommended to the UK government that it should consider a

locational approach to heating decarbonisation (identifying areas which are suitable or unsuitable for hydrogen).

Citizens Advice and Net Zero

Citizens Advice is an independent charity that provides advice and campaigns for policy interventions to protect citizens' interests. They have raised concerns about the UK government's heat decarbonisation strategy, particularly regarding the need for a fair and equitable approach that considers locational cost implications. It is crucial to address these knowledge gaps to ensure a successful transition to net-zero that benefits all citizens.

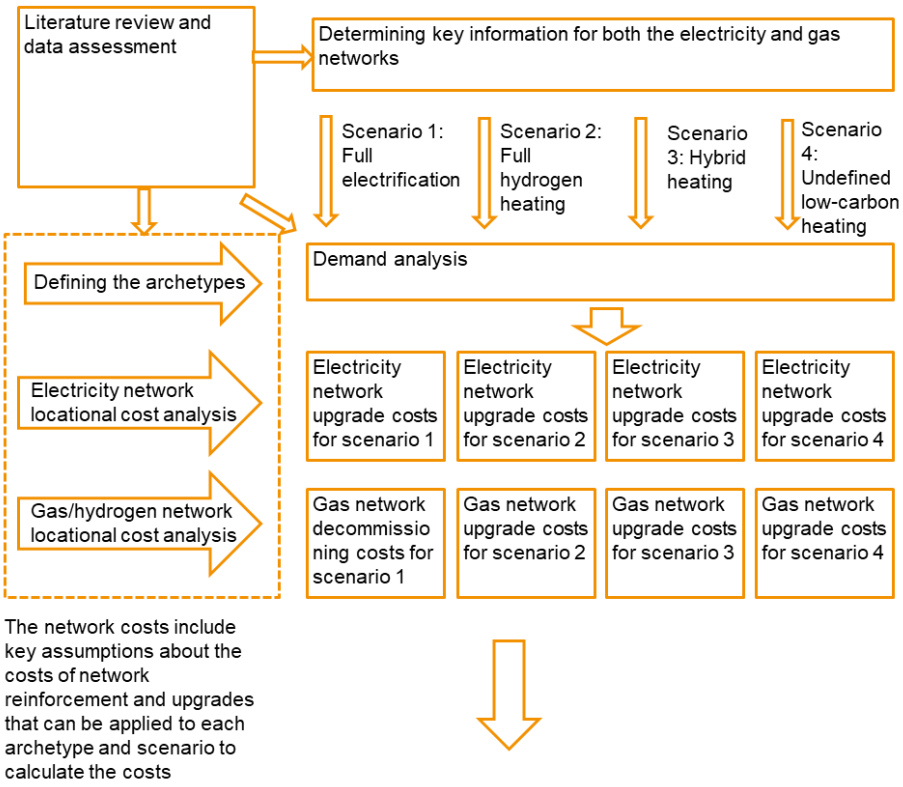
The Locational costs of heat technologies in Great Britain project

Citizen Advice has commissioned this project as it has identified a clear gap in the existing literature that pulls together evidence on the locational costs of heat decarbonisation.

LCP Delta has undertaken this research and analysis to:

- Contribute to this evidence gap on costs involved across a range of locational choices.
- Make recommendations to:
    - Inform government policy decisions, around heat pump market mechanism and the strategic decisions about the role of hydrogen for heating in 2026.
    - Ofgem decisions in the RIIO 3 framework and use of uncertainty mechanism in ED2.

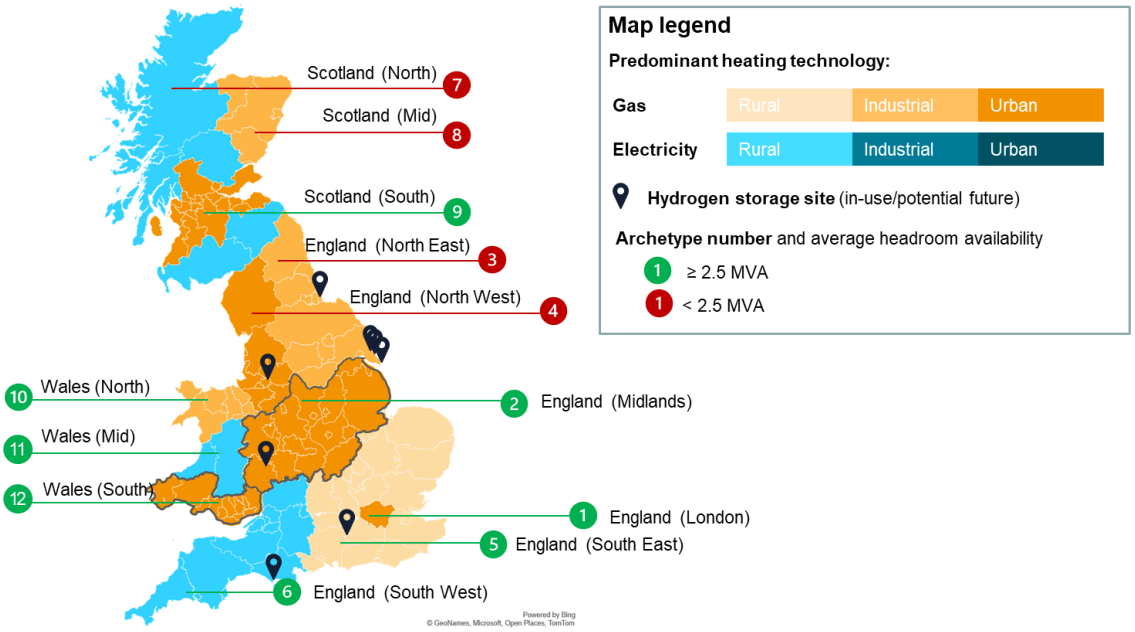
Methodology



Archetypes

To illustrate the cost variations of network infrastructure for net zero heating, we developed 12 illustrative archetypes of 5,000 homes across different regions in GB. In our selection, we have tried to give a broad range of key factors that might influence the network infrastructure costs.

Figure 1: Map showing current dominant heating technology for each regional archetype, hydrogen storage locations and areas with electrical headroom availability



Scenarios

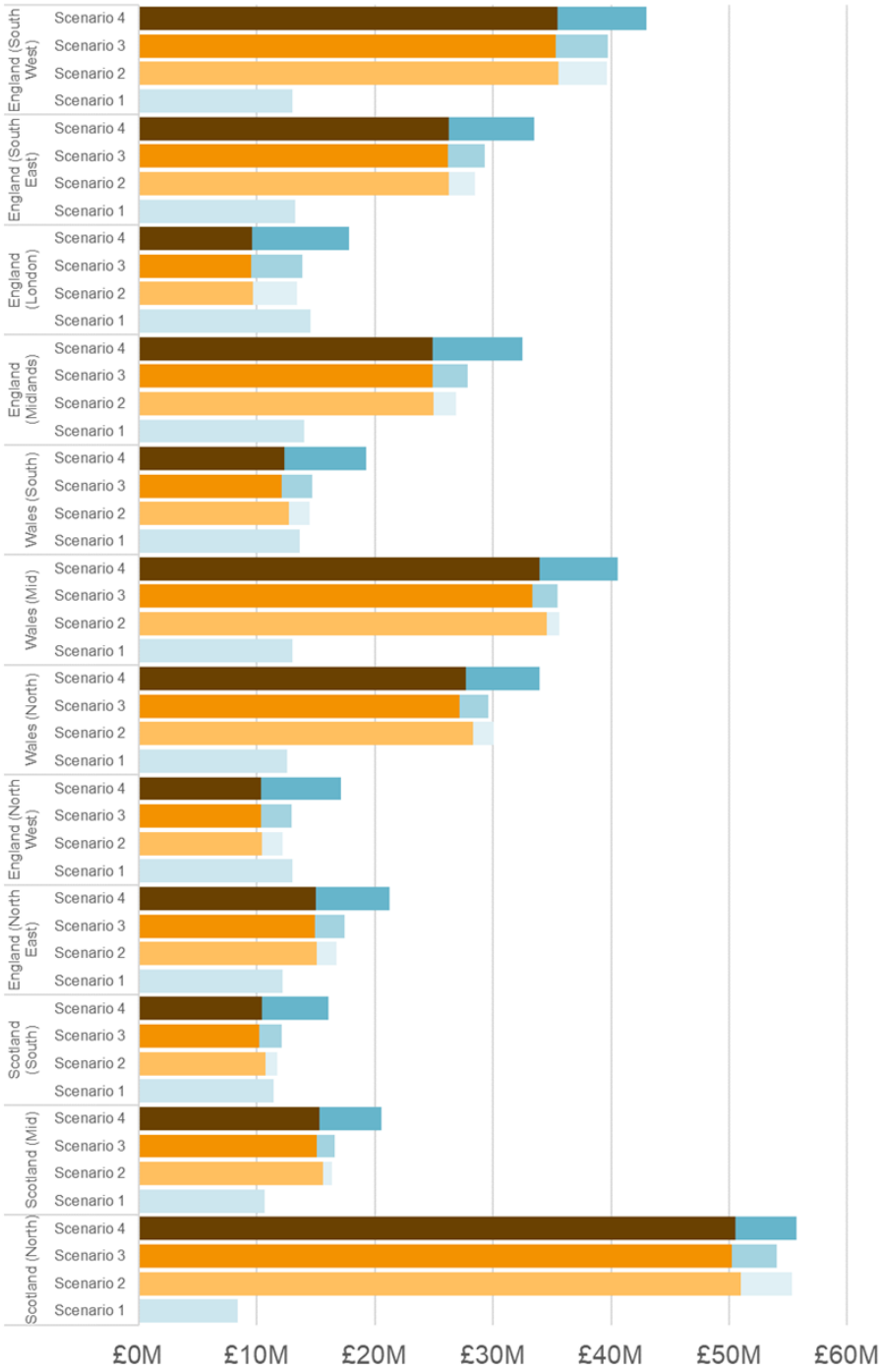
Given the large uncertainty for the technology route to decarbonising heating in homes across GB, we have developed four high level scenarios to apply across the chose archetypes. The table below outlines the four scenarios used within this study.

Scenario	Scenario description for domestic heating	Heating tech	Proportion of Electricity Network reinforcement required for heat	Proportion of Gas Network upgrade required for heat	Assumptions on network reinforcement
1	Full electrification of domestic heat	ASHPs	100%	0%	Only reinforcement costs specifically required to meet domestic heat demand included. Additional reinforcement due to increased demand from EV's excluded.
2	100% hydrogen boilers	Hydrogen boilers	Variable - dependent on % of regional archetype off the gas network	100%	Only dwellings already on the gas grid included (consistent with CCC).

3	Hybrid heating	Hybrid heating system	10% of properties on gas network + % of regional archetype off the gas network	100% of distribution + 20% of transmission costs	Hybrid heat pumps will run on electricity 80% of the time and hydrogen 20% - thereby reducing the pressure on the electricity network at peak times.
4	Undefined low-carbon heating	Choice of the three tech options above	50% of properties on gas network + % of regional archetype off the gas network	100% of distribution + 50% of transmission costs	Uptake of different heating technologies is uncertain so reinforcement/upgrade of both networks required.

Figure 2: Total reinforcement costs across each scenario (electricity network = blue shaded bars, gas network = orange shaded bars)

1.1. Key findings from the analysis



Network infrastructure costs per household are, on average likely to be much higher for hydrogen than for electrification. Network infrastructure reinforcement costs vary significantly by location for both electricity and gas network reinforcement. The variation between different regions is more pronounced for gas networks cost than electricity network costs.

- The gas networks cost differences are primarily driven by distribution costs per household. The significant variation is due to some regions including large land areas but low housing densities, which pushes up the cost per household. The transmission costs are primarily differentiated by the distance from hydrogen storage sites, although these costs are a smaller proportion of the total.
- The electricity networks cost are also primarily driven by the distribution costs per households, which accounts for two-thirds of all reinforcement costs. The proportion of properties already using electricity to heat their homes has significant impact here. Regions with a high level of electric heating have lower reinforcement costs as existing grid infrastructure is already present to meet significant demand. For archetypes with lower levels of electric heating, reaching 100% electrification results in substantially higher costs.

A small number of locations have comparable gas network reinforcement costs. These areas are more likely to be economically viable for hydrogen for heating. In such areas, other costs beyond network upgrades will become more important in determining whether hydrogen for heating is economically viable for the consumer.

In other areas, electricity network costs are significantly lower. Rural areas have significantly lower costs than urban archetypes, particularly at the distribution level due to above average usage of electric heating. Notably, archetypes located in Northern Scotland have lower transmission costs than those in Southern England because of its proximity to large renewable energy production sites.

Providing upgrades to the gas grid infrastructure in all parts of GB to allow consumers to choose if they want hydrogen or electrified heating will place a significant extra cost onto consumers. A locational approach to low-carbon heating would mean that gas network is only upgraded to hydrogen in certain regions where it makes financial sense to do so.

1.2. Recommendations for Policy makers

For DESNZ

- The first step for DESNZ should be to adopt a locational approach when it is developing its key policies on hydrogen readiness of gas boilers and heat pump deployment. Our analysis is a valuable first step towards a more comprehensive mapping of GB regions to determine which are more suitable for hydrogen use in domestic heating and which are not. For example, our

analysis has identified rural areas as most suitable for electrification of heat, particularly the North of Scotland and South West of England.

- If it is possible for DESNZ to determine specific regions where hydrogen is not suitable, the next step would be to share this insight to provide clarity for those areas sooner and enable them to start working on viable alternative solutions more quickly.
- Working with Ofgem through the adoption of a locational approach will help enable network companies to make firmer plans regarding the level of investment required for upgrade and reinforcement work to accommodate low carbon heating technologies.
- DESNZ should carefully consider the extent to which not adopting a regional approach. While it may be tempting to favour a blanket approach to network upgrades and reinforcement across GB to enable full consumer choice, our analysis in scenario 4 clearly shows this will lead to higher costs. Additional factors such as consumer appetite for ASHPs vs hydrogen boilers are difficult to gauge as gas heating is still available and consumers are currently receiving mixed messages regarding low-carbon heating options. A regional approach will ensure consumers are given clear signals regarding the choices they will have in the future.

For Ofgem

- Locational differences in cost need to be considered to ensure the energy transition is fair. This includes consideration of different network users. A first priority for Ofgem is to provide clarity regarding how regional system planners and the Future System Operator (FSO) will be able to determine the key characteristics of locations. This is necessary for these organisations to assess key data, as presented in this research, at the appropriate granularity so that local decisions can be made for the decarbonisation of domestic heating. Similar levels of transparency are needed from the networks to enable appropriate assessments to be made to further progress work.
- Secondly, Ofgem needs to consider how they will ensure sufficient network planning and investment is provided for the electricity grid to cope with mass electrification of domestic heat. Our analysis shows only a small number of areas will be potentially suitable for hydrogen.
- It is likely that if the gas distribution network is to continue, it will do so at a reduced size and scale from what is currently in place. Therefore lastly, Ofgem need to give consideration as to how and when relevant sections are decommissioned and who will pay for this.

