National Audit Office

REPORT

Decarbonising home heating

Department for Energy Security & Net Zero

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Key facts

18%

of the UK's greenhouse gas emissions in 2021 (the most recent year for which data are available) were from heating homes

55,000

heat pumps sold in the UK in 2022, according to Heat Pump Association estimates

600,000

the Department for Energy Security & Net Zero's (DESNZ's) ambition for the number of heat pumps to be installed per year by 2028

Up to 6% real terms reduction in the cost of installing a heat pump in UK homes from 2021 to 2023. DESNZ's ambition is for industry to reduce costs by at least 25% by 2025 compared to 2021

£7,500 grant available to households in England and Wales towards the cost of a heat pump since October 2023, with the scheme running to at least March 2028. This is an increase from the £5,000-£6,000 grant that had been available between May 2022 and September 2023

2026 year when DESNZ will take decisions on the role of hydrogen in home heating. In 2023 DESNZ decided to not proceed with a trial intended to provide evidence to support its decisions

£162 billion Climate Change Committee estimate of the additional investment that will be needed from 2020 to 2050 for installing low-carbon heating in existing UK homes

Summary

Introduction

1 Heating the UK's 28 million homes accounted for 18% of all UK greenhouse gas emissions in 2021, the most recent year for which data are available. The main source of these emissions is from burning natural gas to heat homes. Reducing emissions from heating homes is therefore a key component of the government's overall target to achieve net zero greenhouse gas emissions by 2050.

2 Reducing emissions from heating homes means that households using fossil fuels will need to switch to a low-carbon alternative. The Climate Change Committee has estimated that £162 billion of additional investment will be required to install low-carbon heating in existing UK homes between 2020 and 2050. This could involve installing a heat pump, which uses electricity to generate heat; connecting to a low-carbon heat network – a communal source of heating delivered to multiple dwellings; or potentially using hydrogen instead of natural gas. The suitability of these alternatives depends on factors including regional geography, house type and the heating system currently in use. Emissions from heating homes can also be reduced by improving energy efficiency, for example by improving insulation, to reduce overall energy usage and associated emissions.

3 In October 2021, the government published its *Heat and Buildings Strategy*. The Strategy made a range of commitments aimed at developing markets and consumer choices for heat pumps and heat networks, and stated the government's ambition to end the installation of new fossil fuel boilers by 2035. It committed to:

- growing the supply chain for heat pumps to a minimum market capacity of 600,000 heat pump installations per year by 2028; and
- developing the evidence base to inform strategic decisions in 2026 on the future role of hydrogen in home heating, and therefore the future heating technology mix.

4 The government also committed £6.6 billion from 2021-22 to 2024-25 for schemes to improve energy efficiency and install low-carbon heating, and an additional £6 billion from 2025-26 to 2027-28. This includes **t**he Boiler Upgrade Scheme, which provides households in England and Wales with an up-front grant to help cover the cost of replacing fossil fuel heating systems with a heat pump or biomass boiler.

5 In October 2023, the government clarified that heat pumps and heat networks will be the primary low-carbon technology for decarbonising home heating over the next decade and will play a key role in all pathways to 2050. Also in October 2023, the National Infrastructure Commission, which advises the government on major long-term infrastructure challenges, recommended that the government should not support hydrogen for home heating. The government maintains that it needs to establish the evidence base before taking decisions on hydrogen, but has also stated that no one should hold back on installing a heat pump or connecting to a heat network on the basis that hydrogen might be an option later.

6 The Department for Energy Security & Net Zero (DESNZ) has overall responsibility for decarbonising home heating in England, including meeting interim emissions reductions targets for five-year periods known as carbon budgets. It must reduce emissions while also meeting statutory fuel poverty targets. The Department for Levelling Up, Housing & Communities (DLUHC) also has an important role, given that it oversees building and planning regulations in England, and Energy Performance Certificates, which rate buildings' energy efficiency, in England and Wales.

Purpose and scope of this report

7 This report examines the progress DESNZ has made in decarbonising home heating since the government published its *Heat and Buildings Strategy* in 2021, including whether it has established a clear pathway to decarbonising home heating in a way that is value for money. We have also assessed the progress in rolling out heat pumps, which the government expects to be the main low-carbon technology households use to heat their homes. We have made recommendations aimed at supporting DESNZ to maximise value for money as it develops its approach to decarbonising home heating.

8 The report focuses on the deployment of low-carbon heating and does not consider energy efficiency.[1] The report also does not evaluate the value for money of specific schemes or programmes aimed at decarbonising home heating, such as the Boiler Upgrade Scheme.

1 Our most recent report covering energy efficiency was: Comptroller and Auditor General, *Green Homes Grant Voucher Scheme,* Session 2021-22, HC 302, National Audit Office, September 2021 (accessed on 19 February 2024).

Key findings

Establishing a pathway to decarbonising home heating

9 Some aspects of DESNZ's plans to test the feasibility of hydrogen for home heating are behind schedule or have been cancelled, meaning it will have less evidence to make decisions in 2026 on the role of hydrogen. DESNZ committed to supporting industry to conduct large-scale trials of hydrogen ahead of strategic decisions on the role of hydrogen in 2026. A gas distribution company plans to start a neighbourhood trial, originally planned for 2023, in 2024. DESNZ is no longer proceeding with supporting a village trial that it originally planned for 2025. DESNZ stated that this is due to issues with identifying a local hydrogen supply. DESNZ told us it is considering alternative plans to address gaps in evidence resulting from the cancellation of the village trial, but that the evidence available will be less than had the village trial gone ahead. Other aspects of its Hydrogen Heating programme are progressing; for example, around half the safety evidence expected from the programme had been submitted to the Health and Safety Executive as at January 2024. DESNZ is still developing an appraisal framework for making its 2026 decisions, which will be based on the costs, benefits and risks of deploying each low-carbon technology, including findings on the safety, feasibility and acceptability of hydrogen. The later the appraisal framework is agreed, the greater the risk that there will be gaps in the evidence base required for decisions on the government's preferred low-carbon technology mix (paragraphs 2.3 to 2.6).

10 Ongoing uncertainty over the role of hydrogen could slow the progress of decarbonising home heating. Some stakeholders told us that the government should provide more policy certainty and stability as a priority, given the substantial capital needed to decarbonise home heating. Without this, it could limit the ability of local authorities and industry to plan and invest on a wider scale. DESNZ has already indicated that it expects hydrogen to play a limited role. Stakeholders from consumer and industry representative organisations and other government bodies have told us the government should bring forward its 2026 decisions on hydrogen, to reduce uncertainty, help strategic planning and stimulate demand for heat pumps (paragraphs 2.7 to 2.10).

11 DESNZ is yet to determine how to decarbonise home heating in around 20% of homes that may be exempt from the 2035 phase-out of new fossil fuel boilers. In September 2023, the government announced it would exempt homes that are not suitable for heat pumps or otherwise warrant exemption. Homes fitting these criteria could include those requiring energy efficiency or electrical connection upgrades, lacking space for a heat pump, or located in zones likely to be connected to a heat network. DESNZ recognises it will need to set out how it expects these homes will be heated, and how it will ensure people living in them are not unfairly penalised. DESNZ intends to consult in 2024 on alternative options for homes not suitable for a low temperature heat pump off the gas grid, such as liquid biofuels. It expects future innovations in heat pump technology and installation practices to enable some of these homes to become suitable for a heat pump by 2035 (paragraphs 2.21 and 2.22).

12 DESNZ is working to develop its understanding of the consequences for gas networks of decarbonising home heating, and how these will be paid for. Parts of the gas network may need to be decommissioned if natural gas is no longer used, and hydrogen is confined to certain areas of the country, although any decommissioning is unlikely to start until the mid to late 2030s. Gas networks are regulated monopolies that depend on private investment to fund ongoing operation and maintenance. There is therefore a risk that investment will reduce if investors expect these assets to be decommissioned. It is also uncertain who will pay for the networks to continue in service with a decreasing customer base, or to be decommissioned, and how the government will ultimately manage the transition for the last remaining customers on a gas network. In June 2023, DESNZ stated that it has limited understanding of the costs and feasibility of decommissioning the gas network and is working to improve this (paragraph 2.20).

13 The government has started establishing roles for local and regional bodies in decarbonising home heating. In December 2023, DESNZ launched a consultation on its proposal for local authorities to play a key role in the planning, delivery and monitoring of heat networks through a new Zoning Coordinator role. In November 2023, Ofgem announced it intends to involve local authorities in energy network planning through Regional Energy Strategic Planners. More broadly, local authorities' understanding of the local housing stock, residents' needs and availability of local suppliers means local authorities could be well placed to support decisions on low-carbon home heating solutions in their local area, though the Local Government Association told us that local authorities need more clarity on their roles and powers. Stakeholders we spoke to told us that they expected the transition to low-carbon heating would require a more regional approach, given variations in local infrastructure, such as energy networks (paragraphs 2.11 to 2.13).

14 DESNZ has developed a campaign and tools to promote heat pumps but does not have an overarching long-term consumer engagement plan for decarbonising home heating. Decarbonising home heating will require almost every household to make a decision that will have a significant impact on their homes. Yet public awareness is low: around 30% of respondents to a government survey in summer 2023 had never heard, or hardly knew anything, about the need to change the way homes are heated to reach net zero. DESNZ has promoted heat pumps as part of its 'Welcome Home to Energy Efficiency' communications campaign, launched in October 2023, and provides information through its online heat pump suitability and energy efficiency tools. Research published by Energy Saving Trust in December 2023 indicated that homeowners were unsure where to get independent, impartial advice on making improvements to reduce their homes' emissions. DESNZ is developing advice tailored to housing tenure, type of installation and the information needed (such as the most suitable measures, available grant schemes, or approved installers). However, it has no overarching long-term consumer engagement plan to support its key milestones for decarbonising home heating, such as the phase-out of the sale of new fossil fuel boilers by 2035 (paragraphs 2.14 to 2.17).

Progress installing heat pumps

15 Uptake of the Boiler Upgrade Scheme has been lower than DESNZ expected, leading it to increase the grant that is available. The Boiler Upgrade Scheme funded the installation of nearly 18,900 heat pumps in England and Wales from May 2022 to December 2023. The original business case budgeted for up to 50,000 installations by this point. DESNZ underspent by £100 million in the scheme's first year. To increase uptake, in October 2023 DESNZ increased the grant value available through the scheme to £7,500 per household, up from £5,000 for an air source heat pump and £6,000 for a ground or water source heat pump. It covers nearly 60% of the average cost of installing a heat pump, based on the average cost in 2023. The grant uplift has enabled some energy suppliers to offer heat pump installations starting at £500. The number of applications to the scheme in December 2023 increased by nearly 50% compared with December 2022, and applications in January 2024 increased by nearly 40% compared with January 2023. Data over a longer period will be required to determine whether the change is sustained (paragraphs 1.9, 3.4, 3.19, and Figure 3).

16 Average heat pump installation costs have fallen, but more slowly than DESNZ hoped, and it has not made the progress it had planned on reducing running costs.

- **Installation costs:** DESNZ considers installation cost a key factor affecting demand for heat pumps. As at December 2023, the average market rate for replacing a gas boiler with a heat pump was around four times higher than replacing like-for-like. In 2021, DESNZ set an ambition for industry to reduce the costs of installing a heat pump by at least 25–50% by 2025 and to ensure heat pumps are no more expensive to buy and run than gas boilers by 2030. Data from MCS (Microgeneration Certification Scheme), a quality assurance scheme, indicate the average cost of installing a heat pump in 2023 reduced by up to 6% in real terms compared with 2021, to £11,287 (in 2021 prices).[2] Installation costs will need to fall around three times faster over the next two years if they are to reach the minimum 25% reduction ambition. DESNZ told us that costs had not fallen significantly, due to pressures in the global supply chain. This includes, for example, a shortage of semiconductors that are a key heat pump component; manufacturers not being able to keep up with increased global demand for heat pumps; and high energy prices increasing the cost of manufacturing (paragraphs 3.7, 3.8 and Figure 4).
- **Running costs:** Electricity remains more expensive per unit than gas, making heat pumps potentially more expensive to run than a gas boiler. The government has committed to rebalance energy prices over the course of the 2020s, including shifting energy levies and obligations from electricity to gas bills, but its plans around this have been delayed by nearly two years. DESNZ told us that its focus for energy bills in 2022 was tackling the high energy costs since autumn 2021, and that price rebalancing remains essential but politically challenging (paragraph 3.10).

2 We have adjusted the MCS cost data to 2021 prices.

17 DESNZ does not have all the information it needs on heat pump installations to monitor whether progress is on track and to identify key barriers to uptake. DESNZ does not have a single measure of the number of heat pumps installed. DESNZ told us it is considering how it can combine a range of datasets to produce a publishable series. It is planning to monitor uptake of the Boiler Upgrade Scheme grant among different socio-economic groups through an externally commissioned evaluation, for which interim results are due in the second half of 2024. DESNZ's understanding of the key barriers to installation is based on commissioned research, industry insight and qualitative information. However, it tracks progress against some barriers in more detail than others, and does not monitor the reasons why some applications to the Boiler Upgrade Scheme do not progress to heat pump installation. It told us it intends to take a more systematic approach to monitoring these barriers and will gather six-monthly insights through the Boiler Upgrade Scheme evaluation. Regular monitoring of progress in reducing all key barriers would help DESNZ better understand whether it is on track to deliver the anticipated increase in heat pump installations and where further intervention may be required from government or industry (paragraphs 3.3, 3.5, 3.16 and 3.17).

18 DESNZ, along with DLUHC, has developed plans for further measures aimed at increasing heat pump uptake. In 2023, DESNZ stated it would introduce the Clean Heat Market Mechanism in April 2024. This is an obligation on the manufacturers of fossil fuel heating systems to sell a certain level of low-carbon heat pumps proportional to their fossil fuel boiler sales in the UK market. In February 2024 there were media reports that ministers were considering whether to delay or remove the mechanism. DESNZ has told us that as at early March, no decision has yet been made. From 2025, DLUHC's Future Homes Standard is expected to require all new homes in England to be built to a higher standard of energy efficiency and to have low-carbon heating. DESNZ estimates this will account for 200,000 new heat pump installations a year (paragraphs 3.23, 3.24 and Figure 6).

19 DESNZ is relying on optimistic assumptions about consumer demand and manufacturer supply of heat pumps increasing substantially to achieve 600,000 installations per year by 2028. Heat Pump Association data indicates that 55,000 heat pumps were sold in the UK in 2022. Achieving the target of 600,000 annual installations by 2028 requires an elevenfold increase from 2022 to 2028, using sales as a proxy for installations. DESNZ regards the target as viable given the planned policies and regulation for 2024 onwards. This relies on the Clean Heat Market Mechanism and the Boiler Upgrade Scheme delivering 400,000 heat pump installations per year by 2028, supported by other energy efficiency and low-carbon heating retrofit schemes such as the Social Housing Decarbonisation Fund (SHDF) and the Energy Company Obligation (ECO). A third of respondents to the 2023 consultation on the Clean Heat Market Mechanism reported that the government's targets would be unachievable under market conditions at the time, although this pre-dated the increased grant available through the Boiler Upgrade Scheme. Some of the government's net zero policy announcements in September 2023, such as the delay to the phase-out of fossil fuel heating systems for off-gas-grid homes, make this target more challenging (paragraphs 3.3, 3.6, 3.23, 3.26, 3.27 and Figure 6).

20 DESNZ will have important decisions to make over how it will approach the rollout of heat pumps after 2028 and how to balance costs between taxpayers and households. DESNZ projects that to achieve its 2050 net zero target, heat pump installation rates will need to continue increasing after 2028, with up to 1.6 million installations per year by 2035. Currently, the Boiler Upgrade Scheme and Clean Heat Market Mechanism are only in place until 2028, after which the government will need to decide the relative roles of public engagement, taxpayer-funded grants, obligations on manufacturers and costs incurred by households. By drawing on evaluations of its current schemes, DESNZ can make informed decisions about the combination of policies and regulations that will increase heat pump uptake in a way that achieves value for money (paragraphs 3.28 to 3.30).

21 DESNZ recognises that its overall delivery model for heat pump installations will need to be kept under review. Some stakeholders told us they expect the most efficient delivery model for mass rollout of heat pumps in the 2030s and beyond will be to adopt a 'street-by-street' approach to install multiple heat pumps in the same area around the same time, rather than the current approach of demand being driven by individual households. This might enable better planning of upgrades to local electricity networks to carry increases in demand and reduce installation costs. Such a delivery model would require careful planning and public engagement. DESNZ told us it currently expects that the approach of installing heat pumps on a house-by-house basis would endure for the whole rollout, but that it would keep this under review as new evidence emerges (paragraph 3.31).

Conclusion on value for money

22 Decarbonising home heating represents one of the biggest challenges to the government achieving net zero, requiring almost all households to engage in the transition. Aspects of DESNZ's overall pathway remain unclear, particularly as DESNZ works towards determining the role of hydrogen in home heating. It should not extend this work beyond what is necessary to come to an informed decision, recognising that uncertainty could hamper progress and drive up costs while consumers and businesses wait for further clarity. DESNZ also needs to get to grips with other longer-term challenges, such as the future of the gas networks and plans for reaching harder-to-decarbonise homes, to ensure it has a clear, enduring plan that maximises the value of public and private investments in the transition.

23 Despite these uncertainties, it has become increasingly clear since the 2021 *Heat and Buildings Strategy* that the government's approach will centre on heat pumps as the main technology. But DESNZ's progress with encouraging households to install heat pumps has been slower than planned because costs remain high and public awareness remains low. DESNZ must ensure its mix of incentives, engagement and regulations draws on ongoing experience to address these issues, and support the rollout of heat pumps in a way that minimises the long-term costs to both taxpayers and consumers.

Recommendations

24 On establishing a pathway towards decarbonising home heating, DESNZ should:

a Establish an overarching long-term consumer engagement plan to support achieving key milestones, such as the phase-out of the sale of new fossil fuel boilers by 2035. This should include clarifying roles and responsibilities for existing organisations in central and local government. DESNZ should also consider introducing a new body with specific responsibility for consumer engagement.

b Publish an updated *Heat and Buildings Strategy* by early 2026 at the latest, that takes account of its revised expectations around the relative roles of electrification and hydrogen for home heating.

c Consider whether it is possible to provide more certainty on the role of hydrogen in home heating before 2026 to help industry plan and invest. This could include:

- making some aspects of the decision before 2026. For example, indicating that hydrogen will only be used in locations where certain conditions exist, such as proximity to hydrogen production facilities; and
- providing clarity on what is in scope for the 2026 decisions, for example whether it will decide on hydrogen as an option for all consumers, or if it will determine hydrogen has a role in specific areas and/or circumstances.

d Continue its work to consider the cost implications of a potentially reduced role for gas networks, including how to ensure sufficient investment in their ongoing operation while still in use, and how the costs of decommissioning will be met.

25 On the deployment of heat pumps, DESNZ should:

e Accelerate its work to rebalance the costs of energy, for example by moving levies and obligations from electricity to gas bills. As part of this it should ensure households that are unable to switch away from fossil fuel boilers do not experience disproportionate adverse consequences.

f Establish a single measure for the number of heat pumps installed regardless of policy, and report to Parliament annually, indicating whether deployment is ahead of or behind DESNZ's expectations and the reasons why.

g Ensure it has regularly updated information on all key barriers to heat pump installations, including reasons for Boiler Upgrade Scheme attrition, and use this to inform its approach. This should include key potential barriers such as costs, public awareness, supply chain capacity and others identified through behavioural insights research.

h Develop a decision framework for its approach after 2028, particularly the balance of taxpayer-funded grants, manufacturer regulations and consumer costs. This should draw on evidence from DESNZ's evaluation of ongoing programmes. It should consider the thresholds at which government financial support can be reduced, such as the cost of heat pumps and availability of installers.