

THE HEAT DECARBONISATION TWO-STEP

How hybrid heat pumps can secure
the pathway for decarbonisation

Supported by 

March 2026



Contents

01	Executive Summary	03
02	Context	05
03	Current trajectory	07
04	Conclusion	19
05	Methodology Annex	25

Executive Summary

The UK's transition hinges on making low-carbon heating affordable at scale. The Climate Change Committee's (CCC) Balanced Pathway sets out a rapid scale-up in heat pump installations: from 60,000 in 2023 to 450,000 per year by 2030 and 1.5 million by 2035, with 80% of homes using heat pumps by 2050. Yet current deployment rates remain far below this pace, and progress is still heavily subsidy-dependent, suggesting the UK is unlikely to meet these milestones under current conditions.

The UK's electrification-led strategy for heat decarbonisation is heavily influenced by the success of heat pumps seen in other countries, notably Scandinavia. However, these countries are poor comparators: electricity was cheaper, and the incumbent heating technologies (oil and direct electric heating) were more expensive than gas, making heat pumps a more attractive option for consumers. The Netherlands offers a more relevant case study for the UK, given its similarly gas-dominated heating system. There, heat pump deployment has been driven by pricing reform to narrow the spark gap, as well as technology-agnostic subsidies. These subsidies have supported the deployment of hybrid heat pumps, which accounted for over 42% of 2024 heat pump sales.

Low-temperature air-source heat pumps (ASHPs) will remain the most appropriate route to decarbonisation for many households. However, we estimate that 18% of English homes would require significant internal works to make them viable and cost-effective. Under a fully electric pathway, these properties would need high-temperature heat pumps to meet heat demand without deep retrofit or significant radiator upgrades.

For this segment, hybrid heat pumps offer a pragmatic alternative, delivering the required heat output while avoiding disruptive upgrades and reducing upfront costs. Our analysis indicates that for these homes, the installation of a high-temperature heat pump costs £10,700 on average, £2,700 more than an integrated hybrid system. Scaling our estimate of hard-to-abate homes to Great Britain, we find that decarbonising these homes with standalone high-temperature heat pumps to reach 80% deployment by 2050 would cost £36 billion; deploying hybrids instead reduces this to £28 billion.

Beyond upfront installation costs, hybrids also have important system-level benefits. They reduce pressure on the electricity grid by switching to gas during peak periods, smoothing network reinforcement investment. Deploying hybrids in the hard-to-abate homes could deliver:

£830m

per year in levelised reinforcement savings.

£21.5b

avoided distribution capital expenditure by 2050 compared to standalone electrification.

£9.5b

reduction in consumer charges over the same period.

Hybrid heat pumps are currently excluded from the Boiler Upgrade Scheme (BUS) on the basis that their adoption would entrench fossil fuel use and lock households into higher carbon emissions. But the most significant lock-in risks sit elsewhere: the spark gap and the UK's leaky housing stock, neither of which can be addressed through technology alone.

Without compelling and affordable consumer options now, households will continue installing high-carbon heating, delaying emissions reductions. We would also forgo the opportunity to make incremental progress whilst building, through narrowing the spark gap and smoothing network investment, the public trust and political capital needed to deliver full heat decarbonisation.

Concerns that hybrids entrench fossil fuel use assume that full electrification is inevitable, and that hybrid adoption prevents later conversion to a standalone heat pump, neither of which is inherently true. Hybrids do not foreclose later electrification; they can respond dynamically to price signals, increasing heat pump use as the spark gap narrows. By narrowing gas use to residual demand, they secure near-term emissions reductions while enabling a staged transition for households. Lock-in is not intrinsic to a technology; it reflects the policy and market context in which it is deployed.

When treated as a bridging technology, hybrids can:

- Deliver near-term emissions reductions.
- Build consumer familiarity with heat pumps.
- Allow households to stage investment.
- Preserve optionality for full electrification or decarbonised gases.

The greater lock-in risk lies in inaction, delaying emissions reductions while waiting for ideal economic conditions.

Policy Recommendations

To incentivise hybrid deployment as a bridging technology that preserves long-term decarbonisation pathways, Government should:

1. Expand BUS eligibility to include hybrid heat pumps.
2. Reform the Clean Heat Market Mechanism (CHMM) to better reflect hybrid emissions performance.
3. Include hybrids in the Warm Homes 'dual quotes' pilot to widen consumer choice.
4. Gradually tighten performance requirements to encourage heat-pump-mode operation and maximise emissions savings.
5. Promote adaptable installation practices to minimise disruption of future conversion.
6. Align gas and electricity network planning, embedding adaptability, equitable cost recovery, and clear responsibility for biomethane delivery.



Context

A race to decarbonise – a race we’re losing

Government has committed to decarbonise heat at pace, but debate across academia and industry has yet to produce a clear, credible delivery pathway. While public and industry support for decarbonisation is strong in principle, the economic pressures facing the UK are increasingly shifting attention toward affordability and practical delivery rather than distant end goals.

Britain is not deploying heat pumps at the pace implied by the Climate Change Committee’s (CCC) Seventh Carbon Budget advice. The CCC’s Balanced Pathway envisages 80% of British homes relying on heat pumps by 2050. This means installations need to increase from 60,000 in 2023 to 450,000 per year by 2030, rising to 1.5 million per year by 2035.¹

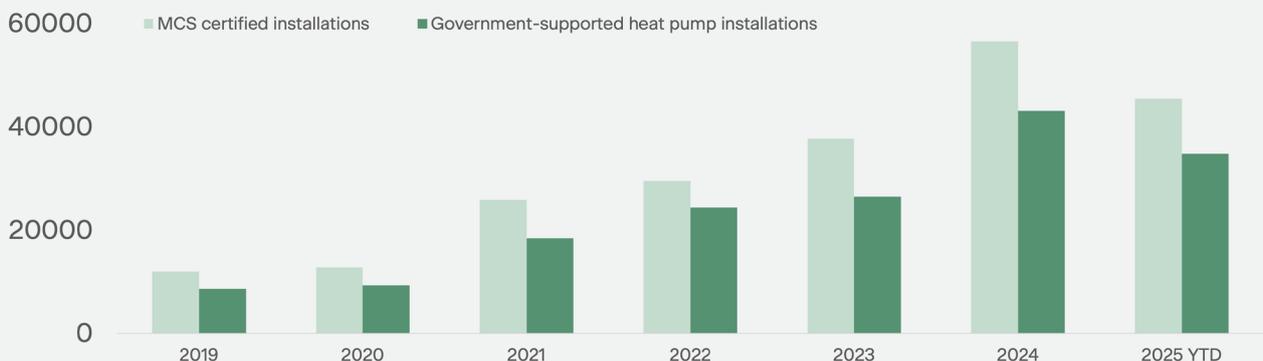
Relying on a single technology for decarbonisation concentrates risk – and the risks associated with

heat pumps, while acknowledged, are not being mitigated quickly enough. A central barrier to heat pump uptake is the high upfront cost of installation, as well as running costs, which remain higher than gas boilers. While the BUS is designed to alleviate the former, it is not sustainable to subsidise widespread deployment indefinitely. Deployment and cost trends (Figures 1 and 2) show little sign that the need for subsidies will wane. The average installation costs have increased by over 7% in real terms from January 2019 to January 2026, and the consumer proposition for heat pumps is heavily dependent on the BUS grant, which appeared to narrowly avoid significant cuts in the most recent Budget. Over the last four years, government-supported schemes accounted for around 76% of air-source heat pump (ASHP) installations (the dominant heat pump type in Britain) when compared with MCS-certified installations (see Figure 1).

1 The Seventh Carbon Budget - Climate Change Committee

Figure 1. ASHP installations January 2019 – September 2025

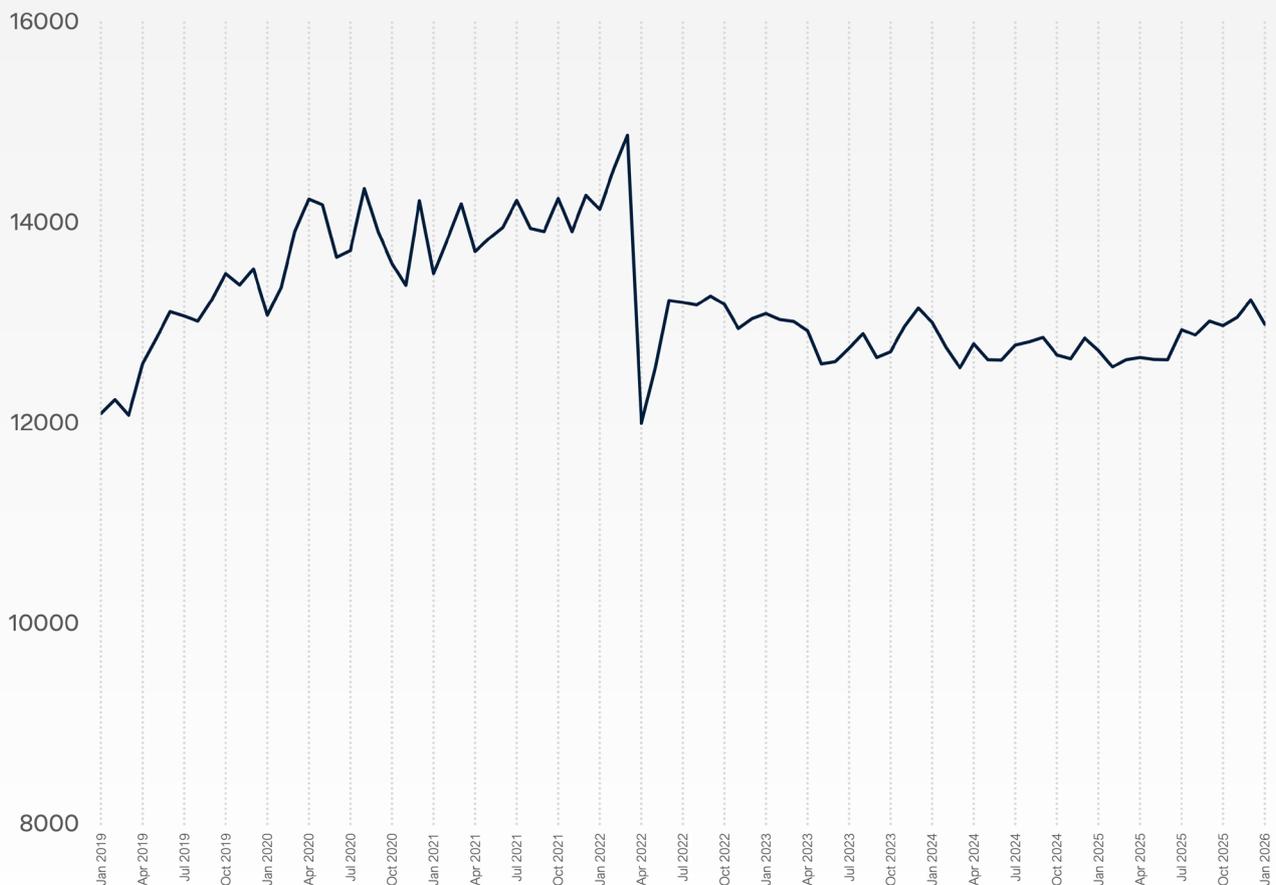
Installations



Source Calculations from MCS Dashboard; DESNZ Heat Pump Deployment Statistics

Figure 2. Average ASHP installation costs January 2019 – January 2026

£ 2024 prices



Source Calculations from MCS Dashboard



Moreover, while the Budget represents a step-change in the Government’s approach to reducing energy bills, it remains unclear whether moving 75% of Renewable Obligation (RO) costs to general taxation will significantly improve the heat pump proposition. The spark gap – the ratio between electricity and gas prices – remains well above the level required for a heat pump to deliver running cost savings under minimum performance standards. Recent analysis indicates that the energy price cap for April has reduced the spark gap from 4.7:1 to 4.3:1,² a welcome improvement, however this still exceeds the 3:1 ratio required for heat pump running costs to reach parity with gas boilers,³ and may face headwinds from network

cost pressures under the ED3 framework. In this context, and amid growing scrutiny on the size of the fiscal envelope afforded to transition policies, the Government must find ways to decarbonise at pace without sacrificing political capital. The Government’s current electrification-led pathway assumes heat pump deployment rates comparable to those seen in other countries. The following section explores the extent to which these comparator markets reflect conditions that the UK can realistically replicate, and what their experience reveals about the drivers of rapid uptake.

² [How does this energy price cap impact electrification? | Nesta](#)

³ Harrington, N. (2024). [The running cost of domestic heat pumps in the UK](#). UK Collaborative Centre for Housing Evidence.

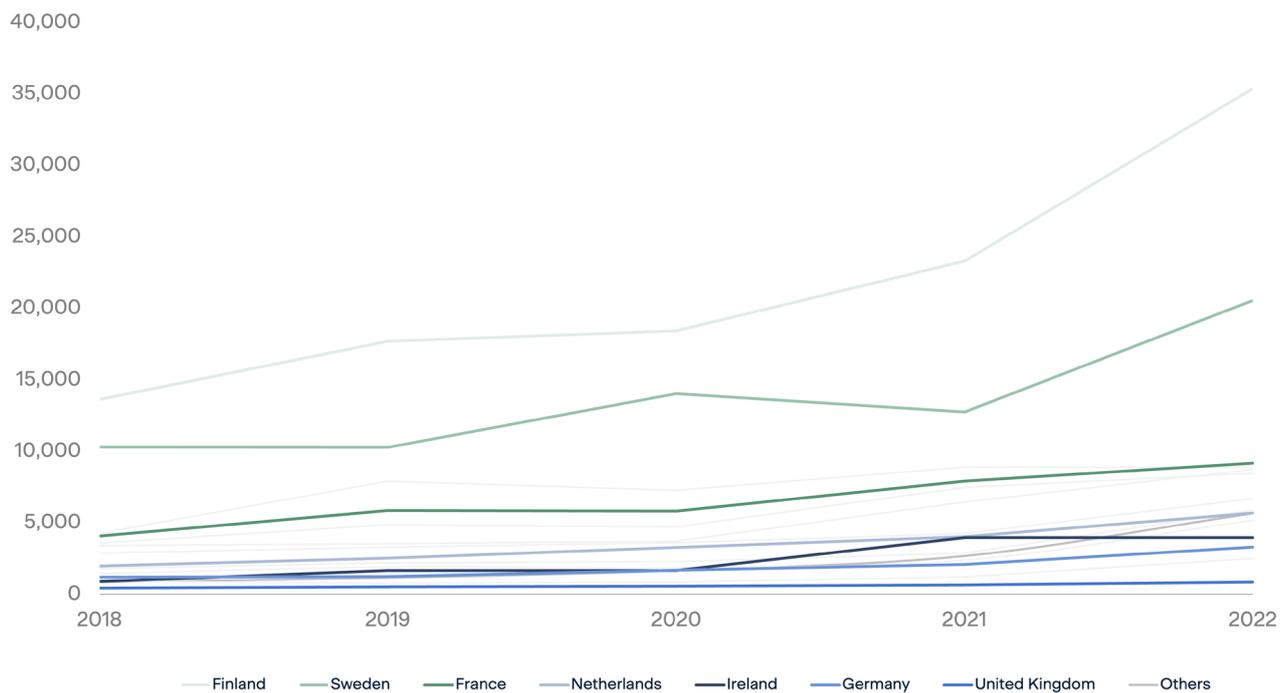
Current Trajectory

Comparator Markets

The CCC's assumptions about future heat pump deployment rates draw on installation rates observed across other European countries (see Figure 3).⁴ However, upon closer inspection, these countries prove to be weak comparators for the UK. Heat pump market growth in countries like Sweden, Finland, Norway and the Netherlands does not simply show that markets can scale quickly. Instead, it reflects country-specific factors, including energy prices, housing stock and policy design, which have enabled rapid deployment in some countries and slower progress in others.

Figure 3. Comparison of heat pump roll-out rates across Europe

Annual heat pump installations per million people



Source Seventh Carbon Budget

STONEHAVEN

⁴ The Seventh Carbon Budget - Climate Change Committee. Likewise the Warm Homes Plan cites deployment rates in Norway, Finland and Sweden as evidence of scalability.

Scandinavian countries like Sweden, Finland and Norway are limited comparators because their electricity prices have historically been significantly lower than the UK's, and heat pumps were replacing more expensive incumbent heating technologies. As a result, the trajectories of heat pump rollout in these three countries have much more in common with each other than they do with the UK. In Sweden, the heating sector was dominated by oil boilers, but their popularity declined in the wake of the 1970s oil crisis, which made them uncompetitive. Low-cost electricity made heat pumps more attractive.⁵ Finland and Norway have very limited gas networks, which left a high share of homes reliant on oil boilers and direct electric heating.⁶ Across all three countries, the success of heat pump rollout was driven by two factors: the efficiency gains they offered over direct resistance heating, and their cost-competitiveness over oil boilers in the wake of the 1970s oil crisis, enabled by low electricity prices.⁷ This experience is not directly transferable to the UK, as heat pumps are not replacing a more expensive incumbent fuel.

Rather than looking to Scandinavia, the Netherlands offers a more instructive comparison. Heat pump deployment there has accelerated despite direct competition with gas boilers. The share of heat pumps in heating system sales has risen steadily,⁸ and by the end of 2024, one in 12 Dutch homes had a heat pump installed.⁹ Central to the success of heat pump uptake is the Netherlands' low spark gap, averaging 1.47:1 in 2024.¹⁰ Unlike Norway, Sweden and Finland, where an abundance of hydropower and nuclear power makes electricity structurally cheap, the Netherlands' electricity mix is still predominantly fossil fuel-based. The narrow spark gap is the result of deliberate pricing reform rather than market fundamentals. This has included gradually decreasing excise taxes on electricity and increasing them on gas, as well as a fixed meter-point rebate on electricity.¹¹

The Dutch experience diverges further from the UK in an important respect: a sizable portion of heat pump installations are hybrid systems. In 2024, over 42% of heat pump sales were hybrids.¹² As sales figures include integrated hybrid products but exclude bolt-on installations, the true share may be higher. Heat pump deployment in the Netherlands is supported by technology-agnostic subsidy schemes, including the Warmtefonds loan for private homeowners¹³ and the ISDE subsidy, which covers roughly 20% of investment costs of approved models.¹⁴

The deployment of hybrid heat pumps in the Netherlands has demonstrated significant gas savings, with one trial showing an average gas saving of almost 75%.¹⁵

Hybrid heat pumps are not only recognised as a cheaper low-carbon alternative to all-electric heat pumps,¹⁶ but also as a source of system flexibility that can lower the demands placed on electricity networks.¹⁷ Dutch regional network operators manage both gas and electricity infrastructure, enabling a holistic assessment of clean heat technologies and their network impacts.¹⁸ In this context, the lower impact of hybrid heat pumps on grid capacity has been highlighted by the network operators and government statements alike.¹⁹ Grid-friendly integration is a key objective of residential heat decarbonisation,²⁰ providing a key rationale for continued hybrid heat pump support. Moreover, the new coalition government agreement proposes that from 2029, in locations where district heating is not appropriate, smart hybrid heat pumps will be promoted and set as the default solution.²¹ This is a marked difference from the UK, where network operators are single-vector, and hybrid systems remain ineligible for subsidies.

The role for hybrids

Low-temperature air-source heat pumps, which have a maximum flow temperature of around 55°C, are the most common type of ASHP installed, and will remain the most appropriate route to decarbonisation for many households. They perform best in homes with low heat loss, enabled by good insulation and when paired with underfloor heating or oversized radiators that can meet the heat demand at a low flow temperature. However, our analysis of the English housing stock suggests that around 4.8 million homes in England would require significant internal works (such as radiator upgrades and new pipework) to make low-temperature ASHPs viable and cost-effective. This is equivalent to 18% of all English homes. For these properties, a high-temperature heat pump can meet heat demand without the disruption and cost associated with deeper retrofit or radiator upgrades.

However, high-temperature heat pumps are not without their challenges. They still represent a significant upfront investment and tend to be less efficient than low-temperature heat pumps, resulting in similar running cost challenges. For an 80/70°C flow/return, the Clade Elm models indicate a SCOP (Seasonal Coefficient of Performance) of 2.0.²² Likewise, at high flow temperatures (70°C and above), Mitsubishi models typically achieve COPs below 2.0 when operating in cold ($\leq 7^\circ\text{C}$) outdoor temperatures.²³ For these homes, hybrid heat pumps offer a compelling alternative – delivering emissions reductions while building consumer familiarity needed for a transition to a fully decarbonised home.

5 Kiss, N., et al. (2014). Heat Pumps: A Comparative Assessment of Innovation and Diffusion Policies in Sweden and Switzerland. In Gruber & Wilson, Energy Technology Innovation: Learning from Historical Successes and Failures.

6 Guest post: How heat pumps became a Nordic success story - Carbon Brief

7 The many faces of heating transitions. Deeper understandings of future systems in Sweden and beyond - ScienceDirect, Guest post: How heat pumps became a Nordic success story - Carbon Brief

8 LCP Delta. (2024). Analysis of the EU heating market: Work package 2.

9 Sales figures: 1 in 12 homes with heat pump since the end of 2024 | Heat Pump Association

10 Calculated from Eurostat.

11 Making Electricity Cheaper: Redistributing policy costs for affordable household head electrification

12 European Heating Industry. (2024). Heating Market Report 2024.

13 Rentetarieven Nationaal Warmtefonds voor particulieren - Warmtefonds

14 Subsidie warmtepomp: bedrag en voorwaarden | Milieu Centraal

15 How hybrid heat pumps are making a difference in the Netherlands | The Institution of Gas Engineers and Managers (IGEM)

16 Hanegraaf, R. (2023). Dutch hybrid heat pump action plan.

17 Letter to the House of Representatives on new measures to reduce grid congestion | Parliamentary Paper | Rijksoverheid.nl

18 Netimpact van warmtealternatieven

19 Measures against full electricity grid (grid congestion) | Renewable energy | Rijksoverheid.nl

20 Betreft Kamerbrief afronding actieplan hybride warmtepompen

21 Aan de slag - Coalitieakkoord 2026-2030 | Kabinetsformatie

22 LEADING THE TRANSFORMATION IN GREEN HEATING AND COOLING

23 Ecodan ATW Databook R290/R32 Vol.6.0 - Document Library - Mitsubishi Electric

Hybrids are cheaper than standalone high-temperature heat pumps

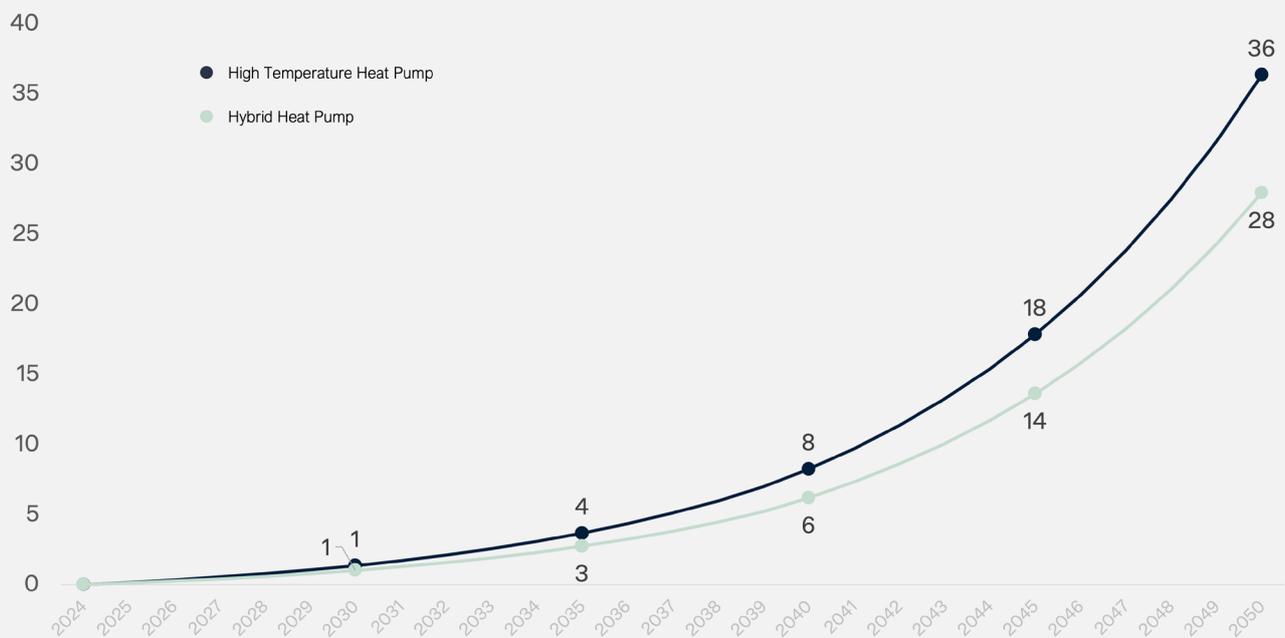
While high-temperature heat pumps can avoid major upgrades to the home, they often do so at the cost of lower efficiency when operating at high flow temperatures, and their higher equipment costs shift rather than eliminate upfront expense. Hybrid systems can similarly avoid extensive insulation, pipework and radiator upgrades, while reducing performance risk by using the boiler during periods of peak demand.

Recent estimates suggest that including hybrids in the BUS could deliver 1.5 times more carbon savings per pound spent than standalone heat pumps under the current scheme.²⁴

Our analysis indicates that installing a high-temperature heat pump costs on average £10,700 for the typical hard-to-abate home. This is £2,700 higher than the average integrated hybrid installation cost for these homes (£8,000).²⁵ Integrated hybrids combine a boiler and a heat pump in one unit. Bolt-on hybrid systems, in which households add a heat pump to an existing boiler, will typically cost less. Scaling our English estimate of hard-to-abate homes to Great Britain, we find that decarbonising these homes with high-temperature heat pumps at the pace required to reach 80% deployment by 2050 will cost £36 billion, even accounting for an optimistic 5% learning rate. This falls to £28 billion if these homes adopted integrated hybrid systems instead.

Figure 4. Cumulative Cost Comparison Hybrid Scenario vs. High-Temperature Scenario

Cumulative Installation Cost (£ billion)



Source Stonehaven analysis

STONEHAVEN

24 Worcester Bosch (2025). *Hybrid Heat Pumps Win: Helping to achieve UK climate targets*.

25 Average installation costs for property type derived using estimated from Eunomia's Cost of Domestic and Commercial Heating Appliances.

Hybrids smooth network reinforcement costs

By switching to gas during periods of peak electricity demand, hybrids reduce pressure on the electricity system. This reduction means that investment to reinforce electricity networks can be smoothed. Mass electrification of home heating will reshape daily demand patterns, strengthening the link between cold weather conditions and electricity demand.²⁶ Evidence from the Neighbourhood Green trial indicates that households tend to operate their heat pumps at similar times of the day, increasing peak loads on distribution networks.²⁷ Simulations based on observed demand profiles similarly find that heat pump penetration at the low-voltage distribution level intensifies existing peak periods: 50% penetration across all housing types increases peak demand by 47%, rising to 120% above the baseline at full penetration.²⁸ This exacerbates existing grid management challenges, to which hybrids can represent a solution. This is echoed in an analysis of smart-meter data from more than 6,000 Dutch homes, which found that homes with standalone heat pumps contribute higher coincident peak demand (2.8 kW) than homes with hybrid heat pumps (1.7 kW).²⁹

Our analysis finds that, on a levelised basis (averaged across the deployment horizon), deploying hybrid heat pumps instead of standalone heat pumps in 80% of hard-to-abate homes (equivalent to around 15% of all GB homes) would save almost £830 million a year in network reinforcement costs. This is equivalent to over £30 per household per year, or roughly £210 of avoided network reinforcement for each hybrid installed.³⁰

These figures represent levelised reinforcement savings rather than direct bill savings. Under a Regulated Asset Base (RAB) framework for network cost recovery, hybrid deployment primarily delays network reinforcement, particularly into the 2040s.³¹ Across the deployment horizon to 2050, hybrid deployment avoids almost £21.5 billion in additional distribution network capital expenditure compared to standalone heat pump deployment. This corresponds to a reduction in consumer charges of £9.5 billion over the same period.

The model captures reinforcement at the secondary level only, excluding primary level reinforcement. It also assumes that hard-to-abate homes are not geographically clustered across low-voltage networks. Clustering could increase reinforcement requirements by raising local peaks and triggering upgrades sooner.

26 Heat pumps and household energy use on the coldest days - Energy Systems Catapult

27 ERM. (2024). Work Package 6 – Additional Heat Pump Demand Profiles: Neighbourhood Green Project Report, "Electrification of Heat" data analysis.

28 Electricity demand in electrified UK homes: the role of heat pumps, seasons, and property type - ScienceDirect

29 BDH. (2025). Netimpact woningen met warmtepomp op basis van slimme meterdata.

30 Hybrid heat pumps are modelled as optimising fuel prices based on the SPF and relative gas and electricity prices at each half-hourly period. Hybrid heat pumps and standalone high-temperature heat pumps are modelled at an SPF of 2.88, based on Electrification of Heat trial data.

31 RAB results assume a 40-year asset life and a nominal WACC of 5%

Price and Prejudice

Comparisons with other markets demonstrate that the UK's barriers to heat pump deployment cannot be overcome by technological advancements alone. Wider systemic issues – chief among them, the spark gap and the quality of housing stock – are constraints that efficiency gains will not entirely offset.

For heat pumps to deliver running cost savings, two conditions typically need to be met: a spark gap of no more than 3:1 and a seasonal performance factor (SPF) of at least 3.³² In contrast, the median ASHP SPF in the Electrification of Heat trial was 2.80, a 0.3 increase since the Renewable Heat Premium Payment (RHPP) scheme trial (2011 to 2014).³³ While SPFs may have improved since, running costs are still primarily determined by the spark gap, which can outweigh incremental efficiency gains.³⁴

Moreover, the condition of the British housing stock remains a major constraint. In England, 56% of homes were built before 1965, prior to the introduction of uniform national building regulations which introduced basic limits on heat loss,³⁵ and 45% of homes still lack any form of wall insulation.³⁶ Reducing heat loss through insulation or airtightness lowers overall space-heating demand. This allows a heat pump to operate at lower flow temperatures, improving its efficiency. While advancements in refrigerants have made

high-temperature heat pumps more efficient, they cannot compensate for high heat loss rates. In most house types, energy efficiency remains a prerequisite for cost-effective heat pump performance.³⁷

The aforementioned Electrification of Heat trial focused on homes with 'suitable levels of loft and wall insulation', meaning that the reported median SPF of 2.8 is unlikely to reflect performance across the wider housing stock, and likely overstates performance in less energy-efficient homes.³⁸ Improving performance in these properties would require measures such as deep retrofit, which are often expensive and, in many cases, impractical.

For this reason, a one-size-fits-all approach to heat decarbonisation – one that hinges on technological breakthrough or major policy progress to overcome these structural barriers – risks foregoing emissions reductions now in the hopes of a perfect solution later.

While some proponents may argue that hybrids risk lock in to higher carbon emissions, it is inaction on these systemic blockers that run the real risk of lock-in. Hybrids offer a pragmatic bridging solution: a low-capex, less-disruptive bridging technology that accelerates progress today while preserving a pathway to full electrification.

32 Harrington, N. (2024). *The running cost of domestic heat pumps in the UK*. UK Collaborative Centre for Housing Evidence.

33 *Heat Pumps 3 x More Efficient than Boilers | Energy Systems Catapult*

34 *Policy plan for decarbonising homes*

35 *The Building Regulations 1965*

36 *Analysis of English Housing Survey*

37 *Cambridge Architectural Research. (2023). Faster Deployment of Heat Pumps in Scotland: Settling the Figures.*

38 *The great heat pump mystery: where's the COP? - UK Collaborative Centre For Housing Evidence*

The Real Lock-In: Paralysis, not Hybrids

The real lock-in is systemic, not technological

Technological lock-in describes a situation in which incumbent technologies accumulate economic and cultural advantages, creating barriers to the adoption of potentially superior or equally valuable alternatives.³⁹ Lock-in is not an inherent trait of any technology, but rather a result of how technologies are incentivised, regulated and perceived, dynamics that may entrench advantages at odds with future transitions.

Hybrid heat pumps can respond to changes in the relative prices of electricity and gas, whether in real time through time-of-use tariffs, or through structural price reforms. Structural reforms to the price ratio can shift hybrids towards higher heat pump usage, even under flat tariffs, while time-of-use tariffs unlock real-time optimisation by responding to hourly changes in the spark gap.

This makes hybrids amplifiers of price signals, as hybrids will automatically shift towards higher heat pump utilisation as the spark gap narrows, reducing gas consumption without disruptive retrofit. Viewing hybrids as a source of lock-in risks confusing symptoms for the cause. Hybrids are not a substitute for system reform – which tackles the real source of lock-in – but can accelerate its effects.

Whether hybrids result in or alleviate lock-in depends not on the kit itself, but on the theory of transition embedded in policy and its compatibility with future pathways. Treating hybrid heat pumps as an endpoint technology, or reinforcing rather than remedying the spark gap, risks entrenching existing systems. By contrast, a framework that positions hybrids as transitional and aligns incentives with emissions performance can deliver near-term emissions reductions without foreclosing full decarbonisation. Parallel efforts to improve the consumer proposition for standalone heat pumps are essential to preserving an electrification pathway. In this context, the key

question is the extent to which hybrid deployment, with the right policies, can mitigate rather than exacerbate gas lock-in.

The concern is that hybrid deployment entrenches fossil fuel use by maintaining gas infrastructure (such as gas boilers and networks), by reducing the incentive to retire these assets and slowing the transition to full electrification.⁴⁰ To presume that hybrids create a lock-in to high-carbon fuels is to make two assumptions. The first is that full electrification is the inevitable end-state, when current evidence on deployment does not support such certainty. This also implicitly assumes that the gaseous component of hybrid systems does not transition to low-carbon alternatives such as biomethane, discounting the possibility of non-electric decarbonisation pathways. The second is that hybrid deployment today precludes full electrification later. However, this need not be the case.

Hybrid heat pumps are not inherently incompatible with full electrification. When treated by policy as a bridging technology, hybrids can deliver emissions reductions in the near term while preserving the option to convert to fully electric systems as the consumer proposition improves. By enabling partial decarbonisation, hybrids can reduce the risk of lock-in by lowering the disruption of further conversion.

Gas network decommissioning would require some households that remain wholly reliant on gas boilers to have their entire heating system replaced during the decommissioning process, creating a disruptive cliff edge. In contrast, households that have adopted hybrid heat pumps have already undertaken a partial transition, including the installation of heat pump components and associated controls.

39 Foxon, T.J., 2013. Technological lock-in. *Encyclopaedia of Energy, Natural Resource, and Environmental Economics*. Vol. 1(2013): 123-127

40 One foot in the past: The role of hybrid heat pumps in Europe

While conversion to a fully electric system would still necessitate a full commissioning process and some level of disruption, the scope of intervention is narrower than for a wholesale replacement. Even where further heating system adjustments are required, households that have adopted hybrids are likely to experience a lower degree of disruption and associated costs. For example, where the remaining barrier is hot water decarbonisation, a thermal store for domestic hot water could be added. In this sense, hybrid heat pumps can alleviate rather than contribute to gas lock-in.

At the system level, the concerns about hybrid heat pumps precluding electrification can be understood as a risk of stranded assets. The concern is premised on the notion that electrification renders hybrid heat pumps obsolete. However, given the heat pump deployment gap, this is unlikely to manifest in the near to medium term.

More importantly, the stranded asset concern implicitly assumes a level of political consensus on gas network decommissioning in the near future. This is difficult to sustain while the majority of the population remain reliant on gas boilers. In this context, the concern remains speculative and may increase the risk of lock in by discouraging emissions reductions in the near term and deferring hard choices to the future.

The transition we face today is fundamentally different from the transition from town gas to natural gas. The latter had a clearly defined end-state set by policy rather than consumer preference. The case for switching was unambiguous: natural gas was safer and cheaper to produce, and the transition was funded by government rather than households.⁴¹ The reality we face today is significantly more complex. A market-led approach means that cost-effective low-carbon heating looks different for different households. This heterogeneity makes it impossible to define the end-state and eventual balance between 'final fuels' from the outset. The Dutch approach recognises this, viewing multiple technologies including heat networks, hybrid heat pumps with sustainable gas, and full electrification as equally possible outcomes, anticipating – but not assuming – an equal mix between the three.⁴²

The assumption of a known end-state facilitates the perception of hybrids as a deviation from the presumed optimal path and pits them against standalone heat pumps.

This obscures the real issue: without compelling and affordable consumer options now, we risk lock-in to high-carbon heating and miss out on emissions reductions. We would also miss the chance to make incremental progress whilst building the public trust and political capital required for a full clean-heat transition by reforming the spark gap and smoothing network investment.

41 Thomas, R. (2023). *Lessons Learnt : Past Energy Transitions in the Gas Industry*. Wales & West Utilities, WSP and Northern Gas Networks.

42 *Navigating the Grid Challenges and Solutions in the Netherlands' Energy Transition - HPT - Heat Pumping Technologies*

The majority of homes in the UK use combi boilers which eliminate the need for a hot water cylinder. Transitioning to a heat pump therefore typically necessitates additional hot water storage for those homes, a constraint hybrid systems can avoid at the point of installation. Consequently, a chief argument against hybrids is that by offering partial decarbonisation, they lock in continued fossil fuel use for domestic hot water. However, this relies on assumptions about hot water storage that are looking increasingly outdated. You can only plausibly replace a boiler in a hybrid system without consumer downside if you can deliver domestic hot water in the same spatial footprint. Advancements in thermal energy storage, chiefly in phase change technology, mean that hybrid adoption today need not foreclose future hot water decarbonisation.

Modern heat batteries for hot water are capable of delivering 200 litres of hot water equivalence without compromising performance. This means homes adopting hybrids can decarbonise their hot water at a later date, smoothing the costs of full decarbonisation over time, and the chief physical constraint has significantly diminished. For example, SunAmp's Thermino 210xPlus delivers around 270 litres of mixed hot water at 40°C while occupying roughly a third of the installation volume of a comparable 'slimline' hot water cylinder model.⁴³ While phase change materials (PCM) are likely to retain a small capital premium, lower standing losses mean that lifetime costs may be similar to that of a hot water cylinder. The remaining barrier – capital cost – affects uptake but doesn't close off the pathway to full electrification. Government should treat these advancements as a window of opportunity, not a guaranteed destination. Advancements in thermal storage technology may unlock additional routes to decarbonisation, as homes that are not suitable for heat pumps can instead install heat batteries for space heating alongside those for hot water, delivering a fully decarbonised solution. To realise the potential of PCM innovation as a method of decarbonisation, Government should help cultivate the environment within which the consumer proposition can become more attractive.

Hybrids neither inherently represent a deviation from the decarbonisation pathway nor a panacea. It is the role of policy that determines their ultimate impact. With the appropriate policy framework, they can serve as a pragmatic supplementary tool to accelerate emissions reductions now while we tackle systemic blockers that will enable full decarbonisation later.

⁴³ Compared to the 200 L Megaflo Eco Slimline cylinder, which in fact delivers slightly less hot water (247L) at 40°C. See specifications [MEGAFLO-ECO-SLIMLINE-DIRECT-DATASHEET-ISSUE-4](#) and [Thermino-xPlus-Data-Sheet_English_Low_res_aag-uk-th-ds-v5.pdf](#)

Hybrids narrow the role of gas to residual need

Hybrid heat pumps can be configured in either parallel or in switch modes. In a parallel system, both the heat pump and gas boiler are connected to the same circuit and can operate simultaneously, whereas in switch systems the heat sources work in isolation from each other. Switch systems can operate different flow temperatures depending on the heat source in use. In both configurations, the heat pump can be the lead heat source, meeting the majority of the heat demand. In a parallel system, this can look like the gas boiler operating as an auxiliary top up. In a switch system, the boiler can act as a last resort when temperatures drop too low for efficient heat pump performance. Central to both configurations is the control unit, which among its roles, can determine how and when each heat source is used. The control unit can optimise operation according to user needs and wider conditions, for example by modulating boiler output to match shortfalls in heat supply, or by selecting the most appropriate fuel source in response to external temperatures or dynamic changes in price through time-of-use tariffs.

It may be assumed that a hybrid system which pairs a heat pump with a gas boiler has a fuel mix split evenly between the two devices. In practice, this is not the case.

Empirical evidence of marginal, targeted gas use includes the Phoenix Energy trial in Belfast, which found that installing a cost-optimised hybrid heat pump resulted in a 51% reduction in heating emissions compared to a gas-only system, where the ASHP provided 84% of the heating load. The hybrid system was optimised to factor in user comfort and cost, choosing the heat source based on price and temperature signals, resulting in the boiler providing backup if the house had not reached the desired temperature after 1.5 hours.⁴⁴ Similarly, Worcester Bosch's latest trial found that the heat pump component of a hybrid system can deliver 94% of the annual heating demand. In this

trial, heat pumps were in a parallel configuration and achieved approximately 77% of the carbon savings of a full heat pump. This challenges the notion that a hybrid heat pump is 'half a heat pump', reflected most strongly in the Clean Heat Market Mechanism (CHMM). The CHMM gives manufacturers credits for certified installations of heat pumps, but in the case of hybrids, manufacturers receive half a credit.⁴⁵

Hybrid heat pumps limit gas consumption to the hours when gas provides the most system and comfort value under current conditions. In doing so, hybrids constrain gas usage. However, this need not position natural gas as a permanent backstop. Whether this results in entrenchment depends on the extent to which policy ensures cleaner fuels, such as electricity or low-carbon gases, are cost-competitive with gas, and whether the wider system is designed to accept them. Compatible with both decarbonised gas and electrification pathways, hybrid heat pumps preserve optionality in the long term and can be incentivised to behave as heat pumps for the majority of their operation in the interim.

Central to achieving this outcome is the control architecture. It is worth noting that the current policy landscape recognises the importance of control architecture and seeks to mitigate the risk of misconfiguration. A consultation in December 2024 proposed an Ecodesign and energy labelling definition of hybrid systems which explicitly includes the concept of a master control to optimise performance, as well as a Minimum Energy Performance Standard (MEPS) of 125%.²⁶ While the MEPS doesn't guarantee heat-pump-dominant operations, it does ensure that heat pumps contribute significantly under test conditions, as standalone fossil fuel boilers cannot deliver a performance standard higher than 100%.

However, real-world performance depends on control design, and for this, we look to the MCS's MIS 3005-D which covers what Ecodesign and ecolabelling legislation cannot. MIS 3005-D sets

out installation requirements for hybrids to be sized to meet at least 55% of the calculated heat load at a 55°C flow temperature, and for controls to be capable of prioritising the heat pump.⁴⁷ Moreover, the more expansive definition of a hybrid under MCS terms ensures this covers bolt-on hybrids, whereas energy labelling legislation takes effect at product placement rather than installation, and can therefore only cover packaged and integrated hybrids. These policies demonstrate that there are mechanisms available to encourage optimised carbon savings, ensuring hybrids function as a genuinely transitional technology.

Hybrids deliver emissions reductions now

The uncertainty surrounding an electrification end-state has an important implication. For hard-to-abate homes, the relevant emissions savings comparison is not hybrids versus full electrification, but hybrids versus a continued reliance on gas boilers. While adopting a hybrid for a transitional period may be viewed as economically inefficient under stylised assumptions, e.g., by delaying costs of retrofit, or incurring additional installation costs in the case of later conversion to full electrification, this doesn't account for the benefits to consumers of staging household investment. Such advantages may drive higher uptake and increase the overall quantum of emissions reductions compared to immediate full electrification.

Relatedly, hybrids' targeted and minimal consumption of gas addresses the concern that subsidising hybrids will lead to sub-optimal adoption, specifically that hybrids will be adopted in homes that are suitable for a full heat pump solution. The strongest case for this concern is where homes that can adopt a full heat pump without retrofit expenses instead opt for a hybrid. However, even in this scenario, hybrids still deliver substantial emissions savings relative to a gas boiler. Moreover, hybrids need not foreclose more optimal outcomes where policy levers improve the consumer proposition for standalone heat pump adoption and facilitate subsequent conversion.

If hybrids followed the CCC's heat-pump trajectory and reached 80% of hard-to-abate homes by 2050, heat pumps would only deliver greater total emissions savings if they achieved at least 60% uptake in this group. This assumes a conservative 75/25 electricity-gas split for hybrids.⁴⁸ Using more optimistic mixes from the literature, such as an 80/20 split or Worcester Bosch's 94/6 trial result - the required heat-pump uptake rises to 64% and 75%, respectively.⁴⁹ Given the trajectory of heat pump sales and prices (see Figures 1 and 2), and the nascent state of the high-temperature heat pump market, these levels of heat-pump penetration appear highly challenging for these homes.

Taking into account the possibility of biomethane injections, 50 TWh total in 2030 and 120 TWh in 2050, the required heat pump uptake would have to increase to 72% to reach parity. These figures are based on analysis of potential future sustainable feedstocks.⁵⁰ Importantly, this 72% threshold only reflects the carbon savings from biomethane allocated to this housing cohort rather than to the whole residential sector.

Partial decarbonisation through hybrid heat pump deployment does not inherently lock in higher carbon fuels but rather offers a route to delivering significant emissions reductions in the near term. Whether hybrids become a 'bridge to nowhere' or a truly transitional technology depends less on the technology itself than on the surrounding policy framework. A two-step hybrid pathway should therefore include clear guardrails that support continuous progress toward full decarbonisation.

44 Refresh & Phoenix Energy. (2024). Hybrid Heating Trial 2024.

45 Clean Heat Market Mechanism: fossil fuel boiler sales, targets and credits - GOV.UK

46 Raising product standards for space heating

47 MCS has published an updated version of MIS 3005-D: The Heat Pump Design Standard.

48 Manufacturers recommend an ideal split between 70/30 and 85/15. Element Energy. (2017). Hybrid Heat Pumps. Page 26.

49 Environmental life cycle assessment of heating systems in the UK: Comparative assessment of hybrid heat pumps vs. condensing gas boilers - ScienceDirect

50 Green Gas Taskforce. (2025). A Green Gas Future: Outlining the feedstock potential for biomethane generation.

Inconsistency in valuing partial decarbonisation

If partial decarbonisation is rejected on the grounds that it risks lock-in, then the inclusion of air-to-air heat pumps (AAHPs) in the BUS invites confusion. AAHPs decarbonise space heating but not domestic hot water. In this respect, they offer partial decarbonisation in a similar manner to hybrids; however, hybrids remain excluded from government support.

The conditionality attached to BUS support for AAHPs attempts to resolve this discrepancy by mandating that homes with fossil-fuel heating, for example for hot water, are excluded – this ostensibly rules out partial decarbonisation.⁵¹ However, there is no parallel support to decarbonise hot water: homes cannot receive two vouchers. This creates a significant contradiction. If strict monitoring is applied, uptake of the BUS for AAHPs is likely to be extremely limited. If monitoring is lax, partial decarbonisation is incentivised by default.

Taken together, this suggests that partial decarbonisation is recognised as an inherent feature of certain technologies, including hybrids and AAHPs, rather than as a failure of policy design. While MEPS and MCS requirements seek to mitigate this partiality, the manner in which AAHPs have been included in the BUS treats partiality as an eligibility issue – ironically entrenching partiality through policy design instead of managing the transition from partial to full decarbonisation.

This tension is also visible across wider policy. While the BUS attempts to mitigate the implications of partial decarbonisation through regulation of AAHPs and exclusion of hybrids, heat network zoning regulation articulates a more tolerant approach. In its response to the latest consultation, Government has set the emissions limit for heat networks which explicitly permits the use of natural gas alongside electricity as a heat network heat source.⁵² This permits fossil fuel generation for heat networks with the expectation that it will be phased out to meet net zero by 2050, explicitly endorsing a staged approach to accelerate deployment and reduce costs – reconciling lock-in concerns with the need for rapid deployment.

51 Part 1: Amendments to the Boiler Upgrade Scheme - government response

52 Heat Network Zoning: government response to 2023 consultation

04

Conclusions

Recognising the strategic value of hybrid heat pumps

Heat pump rollout in the UK is not proceeding at the pace needed to achieve the Government's decarbonisation goals. The countries from which the Government is drawing its assumptions have fundamentally different contexts to the UK - chiefly, heat pumps are replacing more expensive technologies such as oil boilers and direct electric heaters, not gas boilers, and this replacement is enabled by low electricity prices.

Instead of modelling our approach on Scandinavian countries, the Government would be better served by looking at the approach adopted in the Netherlands, which offers closer parallels to our own country, given its greater reliance on natural

gas than its Scandinavian counterparts. Dutch policymakers have made decisive policy changes to narrow the spark gap and have embedded a technology-agnostic approach to decarbonising heat that reduces concentrated risk, including subsidising hybrid heat pumps.

In the UK, hybrid systems have faced concerns about potential lock-in, rendering them ineligible for support under the BUS. But lock-in is determined by policy choices and can be mitigated by policy design. Hybrid heat pumps offer advantages that justify designing a policy framework to secure these advantages while minimising the risks.



The following recommendations are designed to secure these advantages:

Recommendation 01

Resolve inconsistencies in the Boiler Upgrade Scheme

DESNZ should expand the eligibility of the BUS to include hybrid heat pumps, both in bolt-on and integrated configurations. Given the difference in capital costs, the subsidy amount for hybrid heat pumps can be lower than the £7000 for standalone heat pumps. The inclusion of hybrids would resolve the inconsistency in the BUS treatment of partial decarbonisation technologies, in light of the inclusion of AAHPs.

Recommendation 02

Amend the CHMM to reflect hybrid heat pump performance

Currently, manufacturers receive 0.5 credits per hybrid heat pump installed, compared to 1 credit per standalone heat pump. The credit system should more accurately reflect the emissions potential of hybrid heat pumps. This can be done through top-up credit fractions after manufacturers provide performance report data proving reductions in gas use.

Recommendation 03

Include hybrid heat pumps in the 'dual quotes' pilot

Hybrid heat pumps should be included in the 'dual quotes' pilot announced in the Warm Homes Plan, which will encourage installers to offer heat pump quotes to consumers when changing a heating system.⁵³ By offering three quotes, consumers would benefit from greater choice, informed by installer experience on which technology is most feasible for their home.

The other side of the bridge

If lock-in is determined by policy choices, it follows that policies are needed to ensure hybrids are truly a bridging technology to clean heat. The deployment of hybrids as a transitional technology is not in tension with decarbonised gas as a ‘final fuel’ or indeed, full electrification. Hybrids can be configured to allow for full electrification, and guardrails are crucial to achieving this.

Our recommendations show how these guardrails can be implemented:

Recommendation 04

Encourage heat pump mode performance to maximise emissions savings

In the medium-term, support for hybrids must be complemented by continued efforts to reduce the spark gap. This in turn will make heat pump operation more cost-competitive, encouraging hybrids to perform predominantly in heat pump mode. Government should also consider ratcheting performance requirements of new hybrid sales through gradual changes to MEPS regulations. This would mirror the approach adopted for hybrid cars, where later models had more stringent carbon requirements. While this would not in itself guarantee heat-pump-first operation in situ, it would progressively raise the minimum contribution of the heat pump component. Performance requirements can also be embedded into any expansion of BUS eligibility to ensure subsidies only apply to better performing models.

Recommendation 05

Promote adaptable installation practices to minimise disruption of future conversion

The ability to switch out a hybrid heat system with a fully electric system is partly contingent on the quality of the installation. Concerns have been raised that hybrid heat pump components are undersized to meet the entire heat load and therefore would necessitate further disruption to convert to full electrification, or that different end-of-life points between the boiler and heat pump risk lock-in to hybrid systems.⁵⁴ However, installer evidence suggests these concerns are not inherent to the technology itself. Rather, barriers to conversion are largely contextual and are strongly shaped by installation quality, system design choices and property-specific constraints.

While replacing a heat source will necessitate a full system recommissioning, there are ways to mitigate some of the disruption faced when switching from a hybrid to a fully electric system. Consequently, future-proofing measures can help reduce but do not eliminate disruption.

Government should therefore encourage proportionate installation practices that, where appropriate and without compromising cost-effectiveness or performance, avoid embedding gas boilers in ways that add significant complexity to later removal. In this respect, the UK has the chance to lead internationally by explicitly designing installation guidance that supports adaptable hybrid heat systems, without mandating one-size-fits-all solutions.

Such guidance can help address both aforementioned challenges by reducing the risk that

design choices actively constrain future conversion. MIS 3005-D as it stands does not consider measures to future-proof hybrid installations for potential transition to standalone operation. Exploring flexible guidance on adaptable hydraulic layouts could support future adaptation. This may include, where appropriate, hydraulic separation and separate circuits for bolt-on hybrids, and in the case of integrated hybrids, pipework arrangements such as isolatable branches that can facilitate boiler removal or the addition of a second heat source without wholesale reconfiguration of the distribution pipework.

Moreover, Government should explore ways to encourage the interoperability of hybrid heat pumps to preserve consumer choice. To this end, the Government's requirement for smart controls for hybrids under Energy Smart Appliance regulations is a welcome step, as well as the reaffirmed commitment to the adoption of an open standard communication protocol.⁵⁵ Given the nascent stage of the hybrid heat pump market in the UK, mandates for cascade-ready models or smart open-protocols may not be appropriate at this stage. However, eligibility for BUS subsidy can be linked to approved heat pump components (for both bolt-on and integrated hybrid configurations) as is done in the Dutch example.

Recommendation 06

Joint planning between networks to enable strategic place-based decarbonisation

To ensure that hybrid heat pumps act as a bridging technology to full decarbonisation of heat, there needs to be a clear principles-based framework for the future of the gas grid. Without this, hybrid heat pumps risk being a bridge to nowhere.

The long-term outlook for hybrids, like any clean heat technology, is closely entwined with the evolving role of the gas network. Consequently, greater strategic alignment is required between residential decarbonisation policies, including subsidies, and policies that shape the future of the gas grid. While a full exploration of the gas network's evolving role is beyond the scope of this paper, three key principles set out below should be embedded in the framework for residential heat decarbonisation. These principles can function as tests for decisions on gas network decommissioning.

⁵⁴ One foot in the past: The role of hybrid heat pumps in Europe

⁵⁵ Delivering a smart and secure electricity system: implementation - government response

Test 01

Adaptability to market reality

The long-term framework governing hybrid deployment must be adaptive and respond to market reality and therefore cannot be decided a priori. For example, rapid reductions in heat pump costs can remove a key barrier to deployment, while concentrated uptake of standalone heat pumps can strengthen the case for earlier decommissioning and an off-ramp for hybrid support in those areas.

In practice, this adaptability implies a spatially differentiated approach to decommissioning, given that heat pump deployment is likely to vary by location and consumer preference. This creates a need for proactive and coordinated spatial planning between gas distribution networks and distribution network operators to identify areas where hybrid heat pumps offer significant system value given electricity capacity constraints, and where decommissioning is more appropriate.

This adaptability also has implications for fuel pathways. If government policy disincentivises gas boilers and consumers opt for hybrid systems rather than fully electric solutions, then a greater policy emphasis on biomethane will be crucial to keep decarbonisation on track. Conversely, if consumers have gone for full electrification, decommissioning could be brought forward in those areas that are entirely off gas. In all cases, any phase-out date for hybrid sales must reflect the expected lifetime of those assets.

The announcement of an area-based approach to heat decarbonisation in the Warm Homes Plan opens an avenue through which hybrids can act as a transitional solution and decisions on the gas grid can be surgical and contextual. However, even within an area-based approach, the practical mechanisms for decommissioning the gas grid in specific zones remain unclear and require further work.

Test 02

Equitable cost recovery

Any decommissioning framework needs to account for fairness and distributional impacts.

Households that are constrained by cost and therefore retain reliance on gas should not be penalised for being late adopters of cleaner heat technologies. Consequently, mechanisms for cost recovery should be designed to avoid regressive outcomes.

Clear responsibility for biomethane delivery

The transition of the gas network needs clear accountability for the delivery and prioritisation of biomethane.⁵⁶ Regional Energy Spatial Plans (RESPs) are expected to map the spatial context of biomethane as part of future gas system planning. The RESP methodology explicitly states that Spatial Context for natural gas and biomethane will include mapping future gas demand across all gas distribution networks and mapping future biomethane injections into the network.⁵⁷ These spatial projections are intended to inform the identification of Strategic Investment Need, where further network investment is necessary to meet the complex strategic energy needs.

What is therefore needed is a set of mechanisms to ensure that biomethane is deployed in line with RESP-identified system needs. Gas distribution networks, while currently not responsible for biomethane deployment, are well placed to ensure efficient allocation. However, current licensing provisions limit the ability of gas networks to actively drive biomethane deployment beyond their role of network planning, by preventing networks from procuring and prioritising biomethane deployment. Pre-empting the delivery gap implied by RESP pathways would require new demand-side mechanisms, such as gas supplier obligations, or a more substantive refinement of the role of gas networks.

A bridge worth building

Hybrid heat pumps offer emissions reductions now and should therefore be included under subsidy schemes that reflect and reward their value, as demonstrated by the Netherlands. Their long-term implications on the transition to fully decarbonised heat are not a foregone conclusion but rather determined by the policy landscape we develop today. There is substantial evidence that mass adoption of standalone heat pumps is neither likely nor appropriate for all households. The role of Government, therefore, is to build the structures within which other technologies, including those that offer partial decarbonisation, can accelerate the transition, rather than waiting for the perfect solution and conditions to materialise.

⁵⁶ This also applies to natural gas with CCUS, however, its use is expected to be limited primarily to the transmission network and to a small number of high-pressure locations on the local transmission system.

⁵⁷ Regional Energy Strategic Planning: Draft methodology for consultation.

Methodology Annex

Identification of hard-to-abate homes

Data from the BEIS Electrification of Heat trial was used to estimate the proportion of English homes that would necessitate a high-temperature air-source heat pump (HT ASHP). Homes were grouped into archetypes based on property type (semi-detached, terrace, detached or flat), age and wall insulation type (insulated or not insulated). Our analysis of the trial data found these three variables to have the most explanatory power on whether a heat pump was recommended and the type of heat pump recommended.

We used the English Housing Survey to estimate the total number of homes in each archetype, restricting properties to those whose main fuel type is gas. We combine the archetype-level HT ASHP recommendation rates with the corresponding housing stock estimates to calculate the total number of homes that would require a HT ASHP. Homes recommended hybrids were reallocated based on insulation status, with uninsulated archetypes treated as requiring HT ASHPs.

Installation cost analysis

We modelled installation costs of the homes needing HT ASHPs under a deployment pathway consistent with the CCC's target of 80% heat pump adoption by 2050. We derive a constant annual growth rate needed to reach this target given 2024 deployment levels, expressed as a percentage of total housing stock, and we assume this rollout rate applies to HT ASHPs.

Installation cost estimates for HT ASHPs and hybrid heat pumps are taken from Eunomia and tailored to reflect the archetype composition of the housing stock, using archetype-specific size estimate derived from National Energy Efficiency Data (NEED) statistics to derive bespoke installation costs for each archetype. These were then aggregated to produce weighted-average installation costs for hybrid and heat pump installations.

We compare the installation costs of deploying HT ASHPs and hybrids for these homes under the same rollout trajectory and adjusting cost estimates in both cases by accounting for a learning rate of 5% in line with the learning rate estimate for equipment price in Renaldi et al. (2020).⁵⁸ We scale the estimate of homes per archetype by the ratio of English homes to GB homes to convert our estimates into GB level estimates.

We also assume a 15-year lifespan for both technologies, with replacement costs included at end of life; these costs are likewise adjusted for learning effects. For hybrids, the replacement technology is assumed to be a HT ASHP.

⁵⁸ Renaldi, R., Hall, R., Jamasb, T., & Roskilly, A. (2020). Experience rates of low-carbon domestic heating technologies in the United Kingdom. Copenhagen Business School [wp]. Working Paper/Department of Economics. Copenhagen Business School No. 16-2020 CSEI Working Paper No. 14-2020.

Network cost analysis

We modelled the implications of the aforementioned HT ASHP deployment pathway on network reinforcement, comparing it also to a counterfactual of hybrid heat pump deployment. This was done using a nationally representative GB low-voltage network model. This model is based on domestic secondary substation archetypes classified by size and rurality using UKPN and

NGED data, which were scaled to the national level by estimating the distribution of secondary substations from GB-wide primary substation data from Zhou et al. (2024).⁵⁹ Secondary substation reinforcement costs were scaled from National Grid's (2023) LV installation cost ranges according to archetype size.⁶⁰

Emissions analysis

The parity point is estimated by comparing total emissions savings from heat pumps and hybrid heat pumps in hard-to-abate homes. Parity is reached when the deployment share of heat pumps multiplied by their per-home emissions savings equals the corresponding total emissions savings from hybrids. Electricity grid emissions are excluded, as both technologies rely on the grid, so the effect on the relative comparison is negligible. Hybrids are assumed to displace a share of gas-based emissions in line with their fuel split, therefore under a 75/25 split, we assume that the per-home emissions savings from hybrids are 75% of those from standalone heat pumps.

The analysis is extended to include biomethane by comparing cumulative emissions savings over time. Emissions savings from biomethane are applied only to the residual gas demand in homes with hybrids and are allocated solely to this housing cohort. The emissions savings are calculated based on projected grid emissions intensity under a scenario where 50 TWh of biomethane is injected in 2030 and 120 TWh in 2050. Per-home emission savings from biomethane is determined by residual gas consumption and the resulting reduction in gas grid emissions intensity.

59 [2403:16313] Datasets of Great Britain Primary Substations Integrated with Household Heating Information

60 Statement of Methodology and Charges for Connection to National Grid Electricity Distribution (South West) PLC's Electricity Distribution System.

