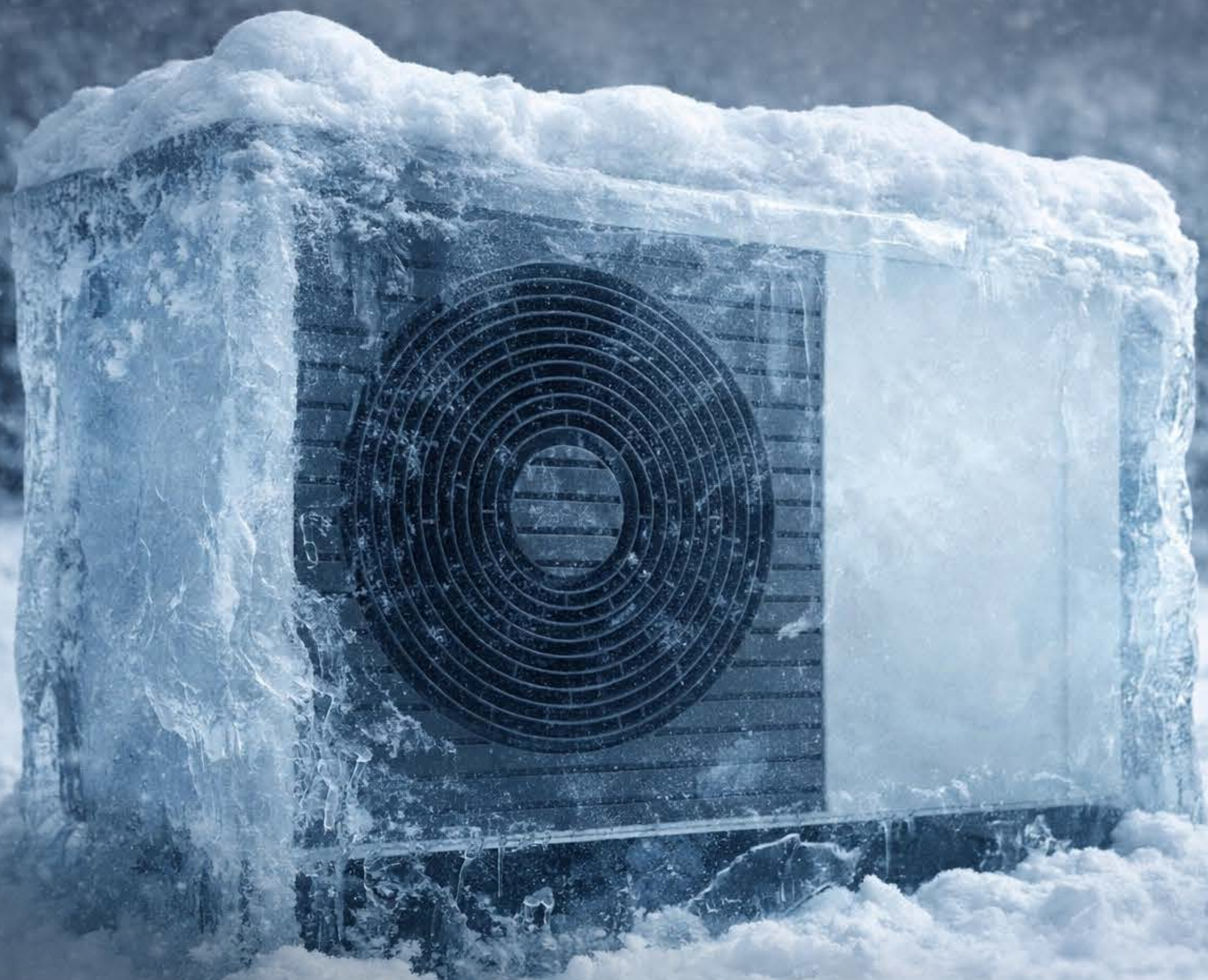
THE COLD HARD FACTS ABOUT HEAT PUMPS



JANUARY 2026

A GREEN BRITAIN FOUNDATION REPORT

CONTENTS

EXECUTIVE SUMMARY

The future of domestic space and water heating lies predominantly in electrification, and thus in heat pumps. Ecotricity has carried out this research in order to understand the actual experience of installing and operating a heat pump, from a consumer's perspective. The research is based on analysis of recent government-backed reports, and on data gathered from an independent survey of heat pump owners.

* In the conclusions section of this report there are notes to each of the summaries presented below. The notes are important for context, and should be read alongside the summaries.

Performance*

Two major recent UK Government-funded reports on actual heat pump performance put the median Seasonal Performance Factor (SPF = actual performance) of Air Source Heat Pumps (ASHPs) at 2.7 & 2.8 respectively[1]. The measured SPF of both ground and air source heat pumps is significantly lower than the Seasonal Coefficient of Performance (SCOP = designed performance), although the SCOP methodology has recently been improved to make it more realistic.

Running costs*

Based on an SPF of 2.8 for ASHPs and a gas price of 3.86 x the electricity price per kWh, to deliver the same amount of heat via an ASHP would currently cost 24% more than using a modern gas boiler. A well-designed GSHP may have similar running costs to a modern gas boiler.

Capital costs*

Ignoring the impact of any subsidy, the average capital cost of replacing a gas boiler with an ASHP, including necessary alterations to the distribution system, is approximately 4 times the capital cost of fitting a new a gas boiler. Costs for GSHPs are significantly higher.

Savings in CO2 emissions*

At present, ASHPs may be expected to deliver approximately 70% savings in CO2 emissions for domestic heating, when compared to a modern gas boiler. Ground Source Heat Pumps (GSHPs) will deliver even higher savings. The embodied carbon impact of changes to heat distribution systems and the environmental impact of upgrade to the National Grid must also be taken into account to get a true picture of the effect on UK carbon emissions from the electrification of heat.

Distribution systems*

Heat pumps work more efficiently with lower distribution temperatures. According to a major recent study, the SPF falls from 3.5 to 2.0 as distribution temperature increases from 35oC to 65oC.

[1] This means that for each kWh of electricity input, the heat output would be 2.7-2.8 kWh

EXECUTIVE SUMMARY

Type of property*

Heat pumps work most efficiently in buildings which are highly insulated, i.e. which have a low rate of heat losses, and relatively low heat demand.

Noise*

Our research did not reveal that noise was a particular issue for the majority of heat pump owners or their neighbours, although there are, of course, exceptions. Newer ASHPs have better sound performance, and a Quality Mark for heat pump noise is now available.

Overall conclusion

It is clear that well-designed and installed heat pumps can deliver substantial savings in CO2 emissions, but there are significant risks in terms of running costs; some buildings are better suited to heat pumps than others, capital costs are much higher than gas boilers, and it will be important to manage both the noise and the visual impact of heat pumps.

SECTION 1: INTRODUCTION

1.1 POLICY CONTEXT

Decarbonisation is the top priority[2] set out by the Department for Energy Security and Net Zero (DESNZ). In the domestic sector, in order to achieve this, the UK government currently takes the view that the future of domestic space and water heating lies predominantly in electrification, and therefore in heat pumps.

In May 2022 the government launched the Boiler Upgrade Scheme[3] (BUS) which provides up-front capital grants to support the installation of heat pumps (and biomass boilers) in homes and non-domestic buildings in England and Wales. This replaced the former Domestic Renewable Heat Incentive scheme (DRHI) which ran from April 2014 - May 2022, which was not a capital grant but instead paid a quarterly tariff to householders.

1.2 AIM OF THIS RESEARCH

The primary aim of this research by Ecotricity is to present a clear picture of the actual experience of installing and operating a heat pump from a consumer's perspective.

The research also aims to clarify the circumstances in which heat pumps will be more efficient, and less efficient.

1.3 SCOPE – TYPES OF HEAT PUMP

Air source heat pumps (ASHPs) will be the main type of heat pump that will be installed in dwellings in the UK as they are relatively simple to install.

Ground source heat pumps (GSHPs) are also included in this research, where data has been gathered at sufficient scale to make the results relevant. GSHPs are less common as, whilst more efficient, they are much more expensive to install, and require significant external space, or access for a borehole.

Water source heat pumps (WSHPs) are not included in this report as the opportunities to install them are comparatively rare. In practice they perform similarly to - or better than - ground source heat pumps.

1.4 METHODOLOGY

The research is based on:

- analysis of published empirical evidence from official government reports;
- data gathered from fresh independent survey of members of the public who own heat pumps;
- input from industry experts.

2. https://www.gov.uk/government/organisations/department-for-energy-security-and-net-zero/about
3. https://www.gov.uk/apply-boiler-upgrade-scheme

SECTION 2: ANALYSIS OF PUBLISHED DATA

2.1 ELECTRIFICATION OF HEAT DEMONSTRATION PROJECT

2.1.1 Description of the project

The "Electrification of Heat Demonstration Project" (EoH) report was published in December 2024. It reports on the most recent large-scale assessment of domestic heat pumps in the UK. The report was paid for by DESNZ, a department of UK Government, and issued on their behalf.

As noted in Section 1.1 above, the UK Government already has made a public commitment to the roll-out of heat pumps to help meet its policy commitments on CO2 emissions[4]. Note that the aim and title were to demonstrate rather than to assess the suitability of heat pumps for mass roll-out.

The EoH project was based on a total of 742 heat pumps, installed in a wide range of housing types, varied by age and construction – though this was perhaps not precisely representative of the UK housing stock (eg 8% of the buildings in the trial were pre-1919, as against >20% of the UK stock). A fair mix of urban, suburban and rural properties was used for the project.

1/3 of the properties initially considered for the trial were rejected for "practical", "technical" or "economic" reasons. Any conclusions drawn on performance based on the installations used in the trial must therefore take into account this initial triage. It is important to note that the economic barriers to installation (resulting in rejection from the trial) included properties where the cost of home upgrade measures was considered excessive – implying that many buildings are not suitable for heat pumps without upgrade. Some building which were included in the trial were also upgraded.

38 GSHP installations were included, but the majority of these were flats using a shared ground loop, so the data gathered is unlikely to be representative of GSHP installations in the UK. Hybrids - where a fossil fuel boiler is installed or retained (either integrated or separate) – were also included in the trial, and this has provided some useful data.

The heat output from the heat pumps was metered, along with electricity metering, so the actual performance of the heat pumps could be calculated based on real-life data, for the properties that were deemed suitable. Metering was installed according to the Ofgem Domestic RHI Metering Guidance Document[5], which is robust and well tested in the market. Measured data was published by DESNZ in December 2024, together with the underlying datasets.

4. The previous large scale field trials, the Energy Saving Trust's 2012 report yielded a set of results well below claims of heat pump manufacturers. The report was entitled was entitled "Getting There".

5. Domestic RHI: Guide to Metering

2.1.2 Analysis of results presented in the report

Seasonal Performance Factor

Seasonal Performance Factor (SPF) is the primary test of heat pump performance as it measures how many units of heat are produced for each unit of electricity input over the course of at least 1 year – i.e. a complete heating season.

This measure is used to indicate the likely level of CO2 savings available from fuel switching. This is of course dependent on the carbon intensity of the electricity supply, which varies.

The SPF will also indicate the relative cost of running a heat pump when compared to a gas boiler. However, it is not necessarily the case that the same amount of heat would be demanded from a heat pump system as for a gas boiler. Heat pumps are more efficient when used to maintain a constant temperature. If occupants use a wider temperature range, perhaps only requiring comfort temperatures for a few hours per day, the demand profile may be very different, depending on the rate of heat losses and other factors; for example, a householder may run the heat pump at night, if on a tariff with lower electricity prices, which makes it cheaper, but may lower SPF as it is cooler at night.

The EoH report derives a median SPF for ASHPs of 2.8

The EoH report advances several possible explanations for this improvement:

- the switch to more efficient refrigerants (R410a -> R32 & R290); note that the modern R32 and R290 are not only more efficient but also have lower GWP;
- improved heat pump models;
- improved control strategies.

The dataset on GSHPs was not sufficiently large to draw clear conclusions on SPF for GSHPs, but a better dataset was achieved from the metered installations under the Ofgem Domestic RHI – see Section 2.2.

Running Costs

The EoH report did not gather data on running costs. Assume an SPF of 2.8, an electricity price of 3.86[7] x the price of gas (per kWh) and a boiler efficiency of 90%:

According to these assumptions, to deliver the same amount of heat via a heat pump would cost 24% more than a gas boiler.

6. Energy Systems Catapult 2024 Electrification of Heat Demonstration Project Summary Report

7. Energy price cap | Ofgem

The same point was made in a 2020 report1 where the relative cost of gas and electricity were assessed in the context of the proposed mass roll-out of heat pumps:

> *"In summary, for a domestic property supplied with electricity and gas from the grid, the financial benefit is primarily influenced by the difference in energy supply tariffs. For a heat pump to be cost effective the cost of electricity must be less than 3.2 times the cost of gas. For the five trial participants considered in this research, the average unit price for electricity was 4.4 times that of the average unit price for gas. For this difference in electricity and gas unit rate, a CoP of over 4 would be required to make a heat pump cost neutral."*

As noted at the start of Section 2.1.2, working on an equivalent heat output between heat pumps and boilers may not be a reliable basis for comparison, as heat pumps will have a different usage profile to deliver the same level of thermal comfort as gas boilers.

It should also be noted that 15% of the dwellings in the EoH trial had fabric improvements to reduce heat losses at the same time as the heat pump was installed. This will have reduced heat demand, so it is not possible to compare costs before and after the change of the heat source, even if patterns of occupancy, weather conditions and all other factors remain equal. The fabric improvements (and consequent reduction in heat demand and running costs) is likely to have increased public acceptability of the heat pumps.

Installation costs

In 93% of installations, new heat emitters were required. In some cases, distribution pipe replacement may also have been needed – existing small-bore pipework is often not suitable for heat pumps. The costs of installation shown below include these new emitters but exclude the costs of fabric efficiency improvements.

Type of heat pump	Average Installed Cost[10]
Low temperature ASHP	£13,663
High temperature ASHP	£17,219
Ground source	£24,524
Hybrid	£9,817

As previously noted, the majority of GSHP installations were small units connected to a shared ground loop, so the costs in the table above are not representative of GSHP costs more generally, which would be higher. The significantly lower cost of hybrid installations may reflect fewer changes being needed to distribution systems.

On this basis, the capital cost of installing an ASHP, including alterations to the distribution system, is more than 4 times the capital cost of replacing a gas boiler, (est £3,000).

10. Adapted from: Energy Systems Catapult 2024 Electrification of Heat Demonstration Project Summary Report Table 4.1

Hybrid heat pumps/boilers

The EoH project also included hybrid ASHP/boilers. As the boiler takes over the provision of heat when the temperature of the heat source (air) is low, we would expect the SPF of the heat pump to be higher as it is only measured when the heat pump is operating more efficiently. However, the hybrid heat pumps did not deliver a higher SPF than conventional heat pumps.

Several reasons for this unexpected result have been put forward by industry experts.

1. The hybrid installations were heavily skewed to one manufacturer, an older unit using a refrigerant which is believed to be less efficient than others in the trial.
2. Hybrids were installed in less well insulated properties – though the SPF results for types of property presented in Section 2.1.2 above indicate that this was not a major issue.
3. The distribution system would have been optimised for boilers not for heat pumps. This would have the effect that flow temperatures were higher than would be optimal for heat pumps, reducing their performance. This is discussed further in "Distribution system and flow temperatures" below.

Distribution system and flow temperatures

It is well understood that heat pumps are more efficient when they have to work less hard. The EoH report found that the COP dropped sharply as flow temperature increased:

Flow temperature	COP: units of heat output for each unit of electricity input
35oC	3.5
55oC	2.4
>65oC	2.0

To achieve low distribution temperatures, the heat emitter should be as large as possible. Underfloor heating is optimal for use with heat pumps. If this is not possible in retrofit situations, radiators usually need to be increased to allow for lower distribution temperatures. Running the original radiators at high temperatures will reduce the performance of the heat pump.

Domestic hot water demand

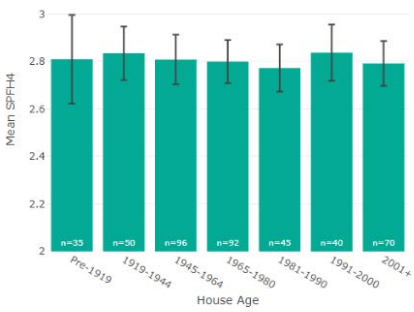
Heat pumps are less efficient when providing domestic hot water, as the delivery temperature of domestic hot water is normally higher than the delivery temperature of space heating. As noted above, the more work the heat pump has to do, the less efficient it becomes. The EoH report notes that:

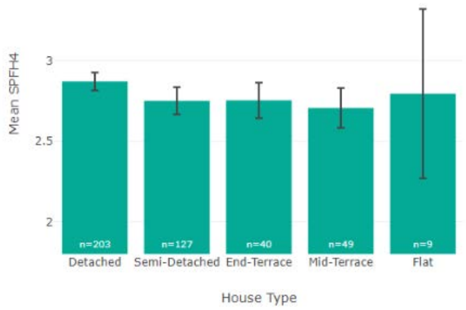
> *"Above 10°C, (external temperature) the COP (and energy use) decreased due to the proportion of the heat which was used for space heating (compared to less efficient hot water production) decreasing."*

This is an important and often overlooked phenomenon. As insulation levels increase with each iteration of the Building Regulations, the demand for space heating falls. This in turn means that demand for domestic hot water constitutes an ever-greater proportion of the work that a heat pump has to do, so it is likely to be running at lower efficiencies for more of the time, reducing the overall SPF[11].

Type of Property

The EoH project report analysed SPF for ASHPs by property type and property age. Surprisingly, the mean SPF varied little according to either.[12]





This would appear to contradict the common view that heat pumps do not perform well in older properties. However, the SPF does not indicate whether a heat pump is heating the dwelling effectively, it only measures the heat output from the heat pump for a given power input.

Older properties may lose heat more quickly due to lack of insulation or air leakage through the building fabric, but they also have higher thermal mass than modern properties, so they do have the capacity to store heat, so their interaction with lower distribution temperatures over longer periods is complex.

It is also important to remember that under the EoH, properties were included in the trial only if they were deemed suitable by the designers. A significant percentage were rejected as unsuitable at the triage stage, and others had fabric improvements, so it is not possible to conclude from this data that a heat pump can be installed successfully in any property type.

11. The Microgeneration Certification Scheme's Heat Pump System Performance Estimate (HPSPE) (MCS, 2018) uses default SPF values for DHW of 1.75 for ASHPs and 2.24 for GSHPs.

12. Electrification of Heat Demonstration Project: Insights from Heat Pump Performance Data. Energy Systems Catapult,

Customer satisfaction

Section 5 of the EoH Summary report presents conclusions. 5.2 is entitled "Demonstrate that HPs can deliver high levels of consumer satisfaction". The report notes:

> *"One aspect of the customer journey which should improve to increase consumer satisfaction is in the presentation of designed efficiencies. The project found that despite good performance results, the efficiencies which were calculated in the design were often higher than those observed in operation. Therefore, a review should take place to ensure consumers are given realistic information regarding likely installed heat pump performance."*

The main text in the EoH report (4.3) states:

> *"For 91.9% of the properties considered, the SPFH2 was lower than the SCOP. The mean difference between the two was -0.66 meaning the median SPFH2 was 17.9% lower than the median SCOP."*

Put more simply:

In 92% of measured installations, the actual performance was well below the designed efficiencies provided by the manufacturers.

Clearly this is a major question for the industry to address. The EoH Data Analysis report states that:

> *". . . the results indicate that a review should be conducted (including further research into the current methods for calculating building heat loss, designing heating systems and estimating efficiencies). This should aim to evaluate how and why designs consistently produce unrealistic estimates for many consumers."*[13]

The methodology for calculating SCOP as used in the Microgeneration Certification Scheme (MCS) was recently updated. This is explored further in Section 2.2.2.

The EoH summary report also notes a need to improve the customer journey in several further respects:

- reducing the disruption caused by installation;
- communications with District Network Operators (DNOs);
- addressing local planning requirements[14].

13. Energy Systems Catapult 2004 Heat Pump Performance Data Analysis report

14. https://mcscertified.com/new-permitted-development-rules-in-england-air-source-heat-pump-installations-must-now-comply-with-mcs-020-a/

2.2 IN-SITU HEAT PUMP PERFORMANCE: ANALYSIS OF OFGEM DATA 2017-2022

2.2.1 Description of the project

This project is based on Ofgem data from heat pump installations which are subject to metering for payment under the Domestic Renewable Heat Incentive (DRHI). Like the EoH report described in Section 2.1, both electricity input and heat output were metered, so the report is based on real measured performance data. Only certain installations subsidised were required to be metered – i.e.:

- where a heat pump and a gas boiler are combined in the same unit (i.e. hybrid systems);
- where a separate installation provides heat to the property (e.g a fossil fuel backup boiler was retained).
- if the property is occupied for <183 days in a 12-month period (exemptions apply) (i.e. the EPC "deemed heat use" figure cannot be used);

The report was funded by DESNZ, the Renewable Energy Consumer Code, and the Ground Source Heat Pump Association.

More than 1,700 installations of air-source and ground-source heat pumps were metered and analysed. Importantly, there were nearly 300 GSHPs in the final dataset, meaning that more robust results could be derived for GSHPs, when compared to the EoH project. There was a large spread of manufacturers and installer – compared to the EoH study - which only had 3 types. However, given the source of the dataset (bullet points above), only limited conclusions can be drawn for heat pumps as a whole.

Metering was installed according to the Ofgem Domestic RHI Metering Guidance Document, which is robust, and defines accuracy requirements of heat and electricity meters (in accordance with 2014 EU Measuring Instrumentation Directive) and sets out installation and metering arrangement requirements.

The Ofgem data analysis was focused on SPF and did not provide information on any of the following:

- Cost of installation
- Running costs (though these may be inferred from SPF)
- Customer satisfaction
- Impact of relative size of domestic hot water (DHW) demand

2.2.2 Analysis of results presented in the report

Seasonal Performance Factor (SPF)

The headline figures in the report compare the actual performance of the heat pumps (SPF) with the Design efficiency provided by the manufacturers – the Seasonal Coefficient of Performance (SCOP).

Type of heat pump	Median SPF (IQR) (Measured)	Median SCOP (IQR) (Manufacturers)
ASHP (1431)	2.69	3.59
GSHP (286)	3.26	3.93

It is clear from these results that:
GSHPs deliver significantly higher SPFs than ASHPs, as expected, because the temperature of the heat source (i.e. the ground[15]) is better in winter, when heat demand peaks. However, this is still well below the estimated SCOP.
ASHPs median actual performance (SPF) is 33% lower than the median SCOP.

The Ofgem data report derives a median measured SPF for ASHPs of 2.7

Although this median figure is lower than some might perhaps like to see, there are some positive aspects to the data analysis. For example, this median is above the threshold set for a heat pump to be considered renewable energy (2.5).[16]

The report also points out that 30% of ASHPs had an SPF in excess of 3.0. What this means is that, with improved quality of installation and the use of more efficient refrigerants, there is no technical reason why most ASHPs should not achieve an SPF of 3.0, in time. However, based on current prices, this would still not deliver a running cost saving over a gas boiler.

The median SPF of GSHPs is reported as 3.26. This begins to approach the SPF at which a heat pump would cost no more to deliver the same heat output as a 90% efficient gas boiler, based on the current relative prices of gas and electricity per kWh. This in turn raises the possibility of more widespread use of shared ground loop GSHPs in social housing, where addressing fuel poverty is a high priority.

Replacing gas with a heat pump is unlikely to reduce fuel poverty at current relative prices but, in time, it may make it no worse. On that basis, there may come a point where CO2 emissions can be reduced without raising this key concern.

Similarly to the EoH trial, the measured SPFs of hybrids were not significantly different from conventional heat pumps in this study.

15. The ground temperature approximates to the average air temperature, and is cooled gradually as heat is extracted by a GSHP. The ground temperature recharges during the summer months.
16. EU Renewable Energy Directive

The use of SCOP in MCS

Prior to 2017, the MCS estimate was based on heat emitter guide – a mathematical modelling of performance of flow temperature. From 2017, MCS changed method to be based on SCOP and product performance. MCS has now updated the SCOP performance estimate methodology[17], but there is still widespread use of SCOP as a 'proxy' for in-situ performance when it is known that this is likely to be misleading.

The Gap between SCOP ("Design" performance) and SPF (Actual performance)

The EoH report compared the SCOP forecast with the SPFH2 outcome. The comparison that is more important to the consumer is the gap between the SCOP prediction and the SPFH4 outcome.[18]

The EoH report found the gap to be 0.66 between the SCOP forecast and SPFH2 - which shows the mean SCOP was 3.59. The consumer experience, however, was a gap of 0.81 (using SPFH4) - which is much closer to the gap observed from the Ofgem data. In the final whole year cohort, the gap between SCOP and SPFH4 was over 1.0 for the ASHPs.

2.3 MANUFACTURERS' DATA

Manufacturers' SCOP figures are submitted to the MCS database and this formed the basis of the analysis of SCOP for comparison with SPF in the Ofgem report presented in Section 2.2. A further review was conducted of the principal information published on websites by the largest domestic heat pump manufacturers (by sales volume) in the UK.

2.3.1 Running Costs

The review found that manufacturers do not assert high SCOPs as headline items. This practice is more common among installers, which might be considered misleading.

In several cases, there were statements on leading manufacturers' websites implying that heat pumps (not differentiated between ASHPs and GSHPs) will save money for consumers, or that the SPF would be higher than the current evidence demonstrates. However, there were two notable exceptions were Vaillant and Grant, who made no such claims.

Based on the average SPF taken from independent field trials (see Section 2) and the current prices of gas and electricity, on average an ASHP will not at present deliver a saving in running costs when compared with a gas boiler.

17. https://mcscertified.com/an-update-to-mcs-031-the-heat-pump-pre-sale-information-and-performance-calculation/ Came into force in March 2025.
18. The SPFH2 electrical boundary measures the ratio of heat delivered and the electricity input from the compressor, fan, and defrosting cycle. The SPFH4 boundary also includes electricity used from the auxiliary heaters

2.3.2 Noise pollution

Sound performance is important, as one of the regularly heard objections to ASHPs (in particular) is that they are noisy, but clearly this need not be the case.

Many manufacturers assert that their products are quiet, and many provide measured decibel levels. However, several domestic heat pumps have already achieved the Quiet Mark Accreditation, which is not based solely on decibel levels, but on a more sophisticated assessment of sound transmission in context[19], which would appear to be more robust.

2.3.3 Fabric-first approach

Only one of the top 5 manufacturers websites reviewed was clear about the need to reduce heat losses in many dwelling types prior to introducing a heat pump.

Without extensive retrofit, for some dwellings the increased running costs of switching from gas to a heat pump would be prohibitive. While it is technically true that a heat pump can heat any type of building, the question is how efficient it would be at doing the job, when compared with the alternatives.

This question is addressed in the Electrification of Heat Demonstration Project where, in 15% of cases, significant fabric improvements were carried out as part of the heat pump installation process.[20]

19. https://www.quietmark.com/how-quiet-mark-certifies-products

20. There is also growing use of the term "heat pump ready" to describe buildings retrofitted to a standard where it would cost no more to heat than using the original system, prior to the fabric improvements. In other words, compared with the starting point, the building costs no more to heat, and CO2 emissions have been reduced. However, note that there can be a

2.4 OTHER DATA SOURCES

2.4.1 The Renewable Heat Premium Package (RHPP)

The RHPP was the precursor to the Domestic Renewable Heat Incentive. The RHPP ran from 2011 until 2014 and provided a grant incentive to participants. The RHPP, however, was metered, and this was the best data source prior to the EoH report released in 2024.

The field trial results (reported in 2017) were as follows[21]:

Type of heat pump	Median SPF (IQR) H4
ASHP (292)	2.44
GSHP (92)	2.71

It is clear from Sections 2.1 and 2.2 that efficiencies have improved significantly since this RHPP trial – now 2.7/2.8 for ASHPs, possibly on account of improved technology, improved refrigerants, improved installation and/or lower distribution temperatures.

2.4.2 The Non-Domestic Renewable Heat Incentive (NDRHI)

The Non-Domestic RHI scheme is entirely metered and covers several technologies but includes approximately 4,000 ground, air and water source heat pumps[22]. As electricity use and heat output are both measured for such large dataset, it should be possible[23] to derive a robust SPF for this class of installation.

As this dataset is all non-domestic, the results will not be strictly comparable to a domestic heat pump, for several reasons:

- Installations will have been designed & installed to commercial standards;
- Installations will be regularly serviced;
- Control systems will often be automated and optimised;
- Demand for hot water (DHW) will usually be lower than in domestic installations; in theory, this should deliver a slight improvement in SPF.

However, this dataset would add significantly to the overall evidence base available and provide additional calibration for the domestic results.

21. In situ Heat Pump Performance: Analysis of Ofgem Data 2017-2022

22. https://www.ofgem.gov.uk/sites/default/files/2024-07/NDRHI_Annual_Report_Scheme_Year_13.pdf

23. This data was requested from Ofgem but not received.

SECTION 3: SURVEY OF HEAT PUMP OWNERS

3.1 SCOPE AND METHODOLOGY OF THE SURVEY

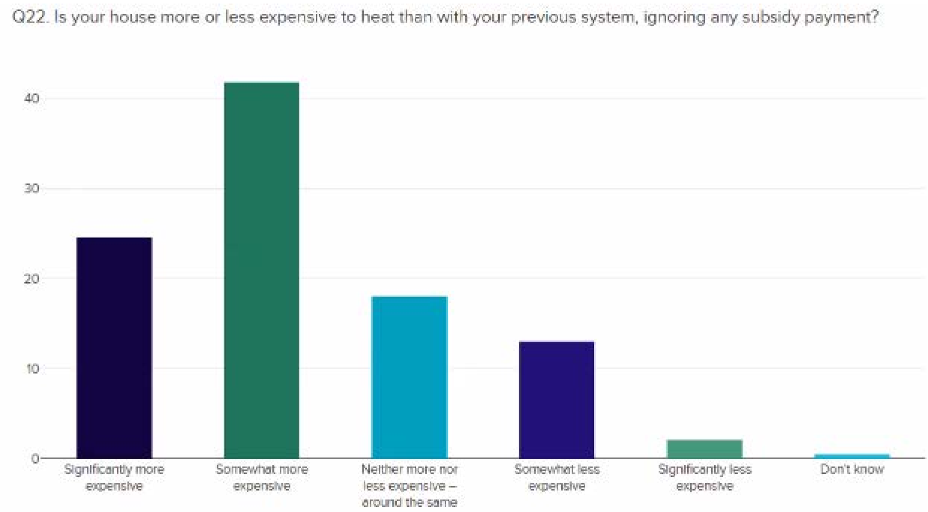
Market research was commissioned directly by Ecotricity and managed by Charlesbye. The research was conducted by Censuswide[24], using a sample of 1001 heat pump owners aged 18+. The data was collected between 09/07/2025 and 14/07/2025.

According to Censuswide, "The research uses pre-existing panels where respondents double opt-in to join and are regularly verified. Respondents have to complete digital fingerprinting and Google reCAPTCHA, then reconfirm that they fit the sample upon entering the link (through screeners). The survey is distributed to sufficient respondents to ensure that the sample is robust and broadly representative for UK Heat Pump Owners. Quotas were also applied to ensure 94% of air source users and 6% ground source."

3.2 ANALYSIS OF SURVEY RESULTS

Running costs

Relevant Survey Question Q22



[24] Censuswide abides by and employs members of the Market Research Society and follows the MRS code of conduct and ESOMAR principles. Censuswide is also a member of the British Polling Council.

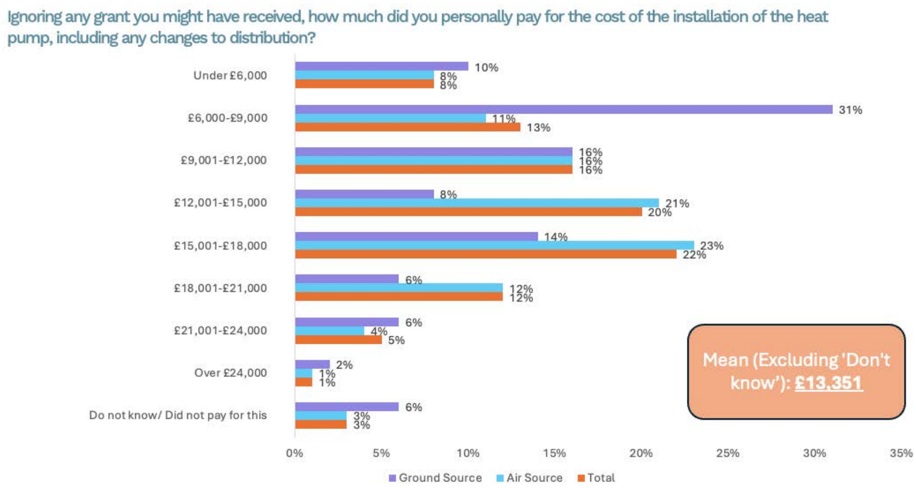
66% of respondents report that their homes are more expensive to heat than the previous system.

This is a significant outcome,[25] which agrees with the conclusions presented in Section 2 of this report – i.e. that at present a heat pump is likely to cost more to run than a gas boiler.

Only 15% of respondents overall reported that their homes are less expensive to heat, with the remaining 19% reporting no difference or they were unsure.

Capital cost

Relevant Survey Questions Q13, Q14, Q15



The data is not as expected. The reported cost of GSHPs is low – even taking into account the BUS vouchers. More ASHP owners spent £15- £18K than GSHP owners. In general, ASHP costs appear to be higher than GSHP costs.

Heat pump costs including changes to distribution

70% of respondents reported they had received a government grant towards the cost of a heat pump. When looking at the year of installation, this figure has increased gradually from 56% on 2010-2015. It is assumed that respondents are also including the Domestic RHI in their response as this was available from 2014 and whilst not a grant may have been considered as such in the responses.

Given the availability of the BUS voucher which in 2024-25 was £7,500 for both types of heat pump it is surprising that 28% of respondents did not install their heat pump with this support (2% did not know).

25. 25% significantly more expensive, 42% somewhat more expensive.

Year of installation	Government support available	Grant recipients
2024-2025	BUS Voucher scheme	70%
2021-2023	BUS introduced in May 2022 DRHI available until March 2022	67%
2016-2020	Domestic RHI	66%
2010-2015	DRHI introduced in 2014 RHPP ran from 2011-14	56%

Fabric improvement costs

Most respondents reported spending between £3,001-£4,000 (34%) or £2,001-£3,000 (26%) on fabric costs. 12% of respondents spent between £4,001-£5,000, and only 8% reported spending more than £5,000 on fabric improvements. The mean cost of fabric changes was £3,079. There was no significant difference on mean cost of fabric spend for ASHP or GSHP.

Effectiveness

Relevant Survey Questions Q17, Q23, Q27, Q27b

78% of respondents were in net agreement that their heat pump was the only source of heating needed to reach comfortable temperatures all year round (33% strongly agree, 45% somewhat agree). 71% of respondents report that hot water is provided mainly by the heat pump, with 27% stating that hot water is mainly provided by an immersion heater. Respondents who disagreed that the heat pump can reach comfortable temperatures all year round were also those more likely to be reporting that their hot water is mainly provided by an immersion heater.

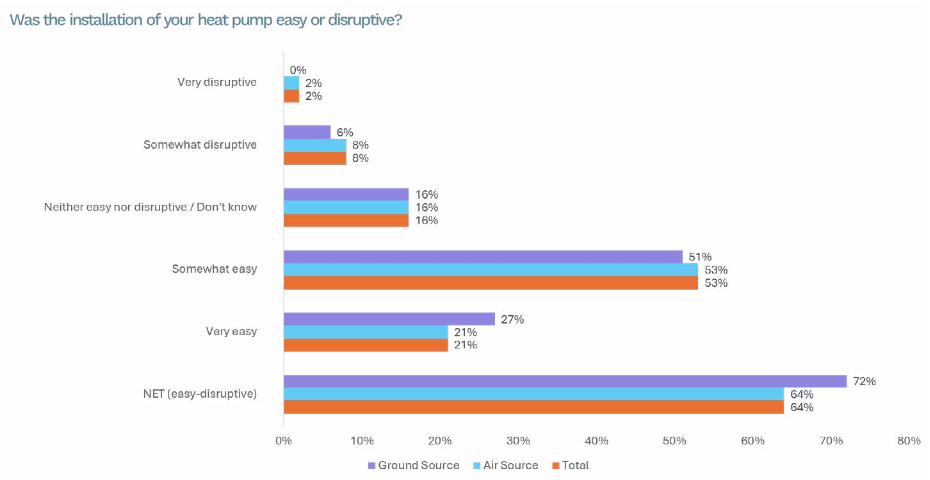
81% of respondents also report additional heating systems, with 57% retaining their existing gas or oil boilers and 40% of householders having log burners. This is much higher than expected and appears contradictory to the high number of respondents in net agreement as outlined above that the heat pump is the only source of heating that is needed. This may suggest that whilst boilers have been retained, the householders are not finding it necessary to use the backup in addition to the heat pump. If this response is accurate, it would explain why not everyone is taking up the BUS voucher as the installation needs to replace the existing fossil fuel boiler.

Disruption (including building fabric and distribution system upgrade)

(Relevant Survey Questions Q9, Q10, Q11, Q12)

64% of respondents stated that the installation of the heat pump was easy (21% very easy, 53% somewhat easy). This figure remained relatively consistent across households reporting to have also undertaken fabric improvements including wall insulation, roof insulation and window improvements.

The net 'easy' perceived ease of installation was slightly higher for GSHP (72%) compared to ASHP (64%). This is unexpected, as installing a GSHP requires major groundworks which adds to the complexity of the installation of a heat pump. Only 8% of respondents reported the installation as being disruptive, and only 2% as very disruptive.



Almost all respondents (95%) reported fabric changes were made to the building at the same time as the heat pump installation. Wall insulation improvements was the most common measure, followed by roof insulation improvements and window improvements.

Similarly, 95% of respondents reported changes were made to heat distribution systems at the same time as the heat pump installation. The most common measure was new controllers being installed, followed by underfloor heating (UFH) and oversized radiators.

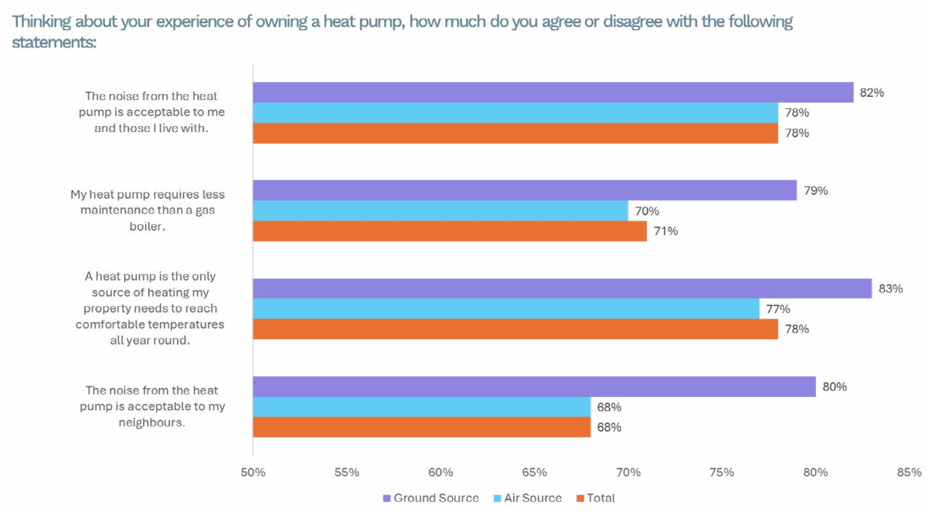
Only 5% of respondents reported no changes to the heat distribution system being made. As expected, a higher number of respondents with GSHP's reported that UFH was installed (53%), although 39% of respondents with ASHPs also reported the installation of UFH. This is significantly higher than expected, as the installation of UFH is highly disruptive, expensive, and technically very challenging in many properties.

In conclusion, it does not appear that heat pump installations are considered significantly disruptive, even when taking into account the building fabric improvements and changes to heat distribution systems carried out at the same time.

Noise

(Relevant Survey Questions Q25, Q26, Q31)

The majority of respondents (78%) agreed that the noise of the heat pump is acceptable to themselves and those living within the property (35% strongly agree, 43% somewhat agree). Less than 1% of respondents strongly disagreed that the noise of the heat pump was acceptable.



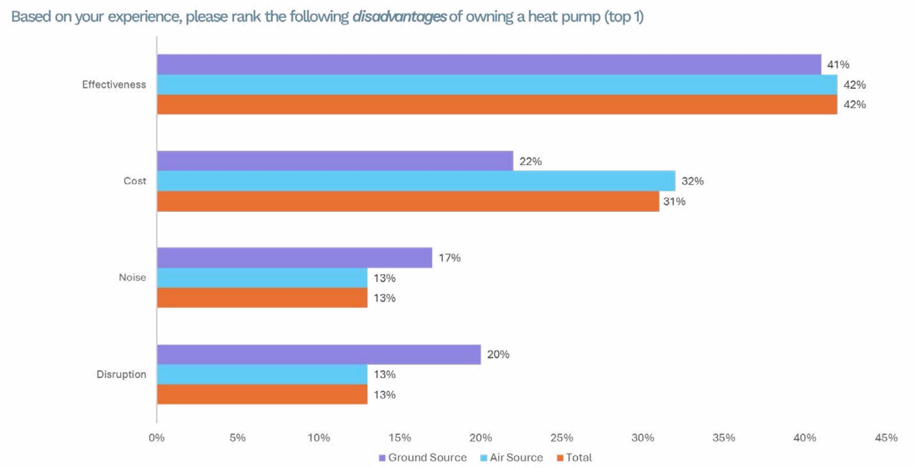
68% of respondents were in net agreement that the noise of the heat pump was acceptable to their neighbours (26% strongly agree, 42% somewhat agree). 12% of respondents were in net disagreement that the noise of the heat pump was acceptable to their neighbours (4% strongly disagree, 8% somewhat disagree). The net agreement was higher for GSHP (80%) than ASHP (68%), which is unexpected as the compressor units for GSHPs are installed within a property and therefore less likely to be heard by neighbours than an ASHP which will be located outdoors.

From the statistical responses to this question, it might be concluded that noise of heat pumps for either type is not a significant concern for the majority of respondents.

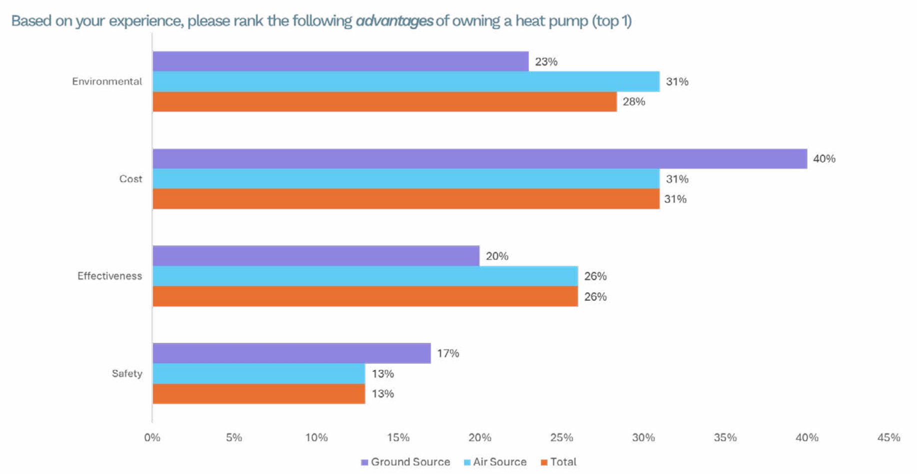
Advantages & Disadvantages

Relevant Survey Questions Q27, Q27b

In 42% of cases, respondents selected Effectiveness as the main disadvantage of owning a heat pump, indicating that their heat pump does not deliver year-round thermal comfort. Cost of heating is secondary. However, this is at odds with the overall favourability towards heat pumps (72%) quoted above.



Advantages were evenly split between the main categories offered:



Even though running cost is cited as a major advantage, only 15% of respondents thought that they had saved money by switching to a heat pump.

Solar PV and battery storage

Relevant Survey Questions Q18, Q19

64% of heat pump owners surveyed confirmed that they also had a Solar PV system installed (of these 65% were with ASHPs, 47% with GSHPs). 73% of heat pump owners confirmed that they also had battery storage.

According to the survey outcomes, the installation of solar PV did not appear to impact significantly on the cost of running a heat pump. We might expect that homes with solar PV may benefit from reduced electricity bills and that this would offset the cost of the heat pump. However, the survey data shows the opposite – homes with solar PV have a higher net agreement that their homes are more expensive to heat (73%) than homes without solar PV (24%). This could be due to the mismatch between PV supply (peak in summer) and space heating demand (peak in winter). Alternatively, it may be that respondents were basing their responses independently of any perceived savings attributable to the solar PV.

Overall favourability

Relevant Survey Questions Q3, Q22, Q23

72% of respondents were in net favour of heat pumps (39% strongly favourable, 33% somewhat favourable).

This figure is slightly slower than the 78% of respondents that agreed that their heat pump was the only source of heating needed to reach comfortable temperatures all year round and much higher than the 66% of respondents who reported higher costs of heating their home.

This suggests that despite the higher costs and the need for additional heat sources in some cases, heat pump owners remain broadly satisfied and in favour of heat pumps, though there is likely to be optimism bias among those who have already opted for a heat pump.

SECTION 4: CONCLUSIONS

4.1 SEASONAL PERFORMANCE FACTOR (SPF)

Two major recent UK Government reports on actual heat pump performance put the median SPF (actual performance) of ASHPs at 2.7 & 2.8 respectively.3

The measured SPF of both ground and air source heat pumps is much lower than the SCOP (designed performance).

Notes:

- GSHPs have, as expected, a higher median SPF of 3.3.
- In the empirical trials, some properties were rejected as being unsuitable for a heat pump; others had fabric improvements to make them more suitable.
- More efficient refrigerants are now being used and measured data demonstrates that higher SPFs can be achieved, so we may expect the median SPF to increase slightly over time, as the quality of installations improves.
- Predictions of performance provided to consumers should be based on data from field trials rather than on designed SCOP provided by manufacturers, given the substantial gap between the two.
- The SCOP methodology has recently been improved4.

4.2 DECARBONISATION

In-use CO2 emissions

At present, ASHPs may be expected to deliver approximately 70% savings in CO2 emissions for domestic heating, when compared to a modern gas boiler. GSHPs will deliver even higher savings.

Notes:

- The level of decarbonisation depends on the original fuel being replaced
- The level of decarbonisation depends the SPF of the heat pump (assuming that the heat output is the same as from the original boiler).5
- The carbon intensity of electricity is higher in winter – which is peak heating season.
- The carbon intensity of the electricity supply will continue to fall as more renewable generation is brought online and reliance on fossil fuels is reduced.

[26] i.e. for each kWh of electricity input, the heat output would be 2.7-2.8 kWh.

[27] https://mcscertified.com/an-update-to-mcs-031-the-heat-pump-pre-sale-information-and-performance-calculation/

[28] Based on relative carbon factors for gas and electricity: Greenhouse gas reporting: conversion factors 2024 - GOV.UK.

Embodied CO2 emissions

Decarbonisation is not just about the energy used to run heat pumps, the energy/carbon used to build and install heat pumps (known as "embodied carbon") must also be taken into account to get a true picture of their impact on UK carbon emissions from the electrification of heat. To this should be added the environmental impact of grid upgrade in due course.

Notes:

- GSHPs have a greater embodied energy impact than ASHPs as there are substantial groundworks needed to install the collector loop - this requires both energy and materials. However, the heat collector in a GSHP is expected to last significantly longer than the heat pump.
- The heat pump itself – ASHP or GSHP – is expected to last longer than a modern gas boiler (20 years is often asserted, as against 12 years for a boiler), which reduces the longer-term embodied impact of plant replacement.
- For retrofit installations, in many cases the distribution system will have to be upgraded. This adds to impact (and cost) for the initial switchover, but this work should not need to be repeated when a heat pump is replaced in due course.

4.3 RUNNING COSTS

Based on an SPF of 2.8 for ASHPs and a gas price of 3.86 x the electricity price per kWh, to deliver the same amount of heat via an ASHP would currently cost 24% more than using a modern gas boiler.

Notes:

- The pattern of heat demand from a heat pump will differ from a boiler, as will the total heat demand.
- According to our survey, 66% of respondents report that their homes are more expensive to heat than previously. Only 15% said that they had saved money.
- Any fabric improvements (in our survey and in the trial) will have reduced heat demand, so reported savings in running costs in some cases may be attributed to demand reductions, rather than the installation of a heat pump.
- According to our survey, the installation of solar PV and battery storage did not appear to have a significant impact on the cost of heating homes with heat pumps.[29]
- Running costs will be lower if using a hybrid heat pump/boiler. Hybrids are discussed in more detail in Appendix 3.

29. This could be due to the mismatch between PV supply (peak in summer) and space heating demand (peak in winter), though there would definitely be a positive impact during the "shoulder" months of spring and autumn.

4.4 CAPITAL COST

Ignoring the impact of any subsidy, the average capital cost of replacing a gas boiler with an ASHP, including necessary alterations to the distribution system, is approximately 4 times the capital cost of fitting a new a gas boiler.

Notes:

- The Boiler Upgrade Scheme, available at present, offsets the high capital cost of installing a heat pump. However, subsidies in the UK do not last indefinitely and, while capital costs may fall a little as the market expands, heat pumps have been in use for decades, so the installation cost is not expected to fall sharply.
- In the longer term, the cost of replacement at end of life also needs to be considered. Heat pumps last longer than gas boilers, but are a multiple of the cost, even without changes to the distribution system. Based on present prices and limited data on expected life of heat pumps, the long-term capital cost of heat pumps appears to be higher than for gas boilers.

4.5 SUITABILITY

Distribution system

Heat pumps work more efficiently with lower distribution temperatures. SPF falls from 3.5 to 2.0 as distribution temperature increases from 35oC to 65oC.[30]

Notes:

- Larger heat emitters (eg underfloor) have lowest distribution temperatures.
- It is not always possible to retrofit underfloor heating in existing properties.

Type of property

Heat pumps work most effectively in buildings which are highly insulated, i.e. which have a low rate of heat losses, and relatively low heat demand.

Notes:

- Fossil fuel boilers also work effectively in well-insulated buildings
- The analysis of property types in the EoH trial did not indicate a clear difference in SPF according to age of property.
- Heat pumps can of course provide heat to poorly-insulated buildings but, in some cases, they will not work efficiently due to high distribution temperatures needed, so CO_2 emissions savings would be reduced, and running costs increased.
- Planning considerations were one reason why some properties were excluded from the EoH trial - there is a risk to streetscapes, particularly in traditional terraced housing, including conservation areas and listed buildings.[31]

30. Electrification of Heat Report 2024

31. An assessment of significance is in any case required for retrofit of any traditionally-constructed dwelling when carrying our retrofit works in accordance with PAS 2035.

Noise

It is often claimed that ASHPs are noisy. Our research did not reveal that noise was a particular issue for the vast majority of heat pump owners or their neighbours.

Note that:

- It appears that some older ASHP models may have produced unacceptable noise, and for those affected it will be a major issue.
- Noise is less of an issue with newer models.
- Many domestic heat pumps have already achieved the Quiet Mark Accreditation, which is not based solely on decibel levels, but on a more sophisticated assessment of sound transmission in context[32].

Terraced streets and flats obviously raise particular challenges for noise. It has just been announced that a key planning barrier to heat pumps has been removed. Until now, planning permission has been required in order for a heat pump to be installed within 1m of a neighbour's property, and this has now been withdrawn in England.[33] Other restrictions have also been relaxed over size and number of heat pumps, and the option to use in cooling mode. These all now covered under Permitted Development Rights.

32. https://www.quietmark.com/how-quiet-mark-certifies-products

33. https://mcscertified.com/new-permitted-development-rules-in-england-air-source-heat-pump-installations-must-now-comply-with-mcs-020-a/

APPENDIX 1:
QUESTIONS TO HEAT PUMP OWNERS

Q1. Is your heat pump an air source or ground source heat pump?

Q2. What are the most important national issues facing the UK as a whole right now that you would like someone to do something about? Rank them in order of importance.

Q3. Below are the names of some activities and objects in UK life. Please say if you have a favourable, neutral or unfavourable view of each.

Q4. To the best of your knowledge, in what year was your current residence constructed?

Q5. How many bedrooms are there in your current residence?

Q6. What was your previous heating system, if any?

Q7. What is the size of your heat pump, if known?

Q8. When was the heat pump installed, if known?

Q9. Were you occupying the residency when the heat pump was installed?

Q10. Was the installation of your heat pump easy or disruptive?

Q11. What changes (if any) were made to the fabric of the building when the heat pump was installed? (Select all that apply)

Q12. What changes were made to the heat distribution system? (Select all that apply)

Q13. What was the total cost of the changes you made to the fabric of the building when the heat pump was installed?

Q14. Ignoring any grant you might have received, how much did you personally pay for the cost of the installation of the heat pump, including any changes to distribution?

Q15. Did you use a government grant to cover the costs of the heat pump?

Q16. Do you have radiators only, underfloor heating only, or a mix of the two?

Q17. Is your hot water provided mainly by the heat pump or mainly by an immersion heater?

Q18. Do you have a Photovoltaic (Solar PV) system?

Q19. Do you have battery storage?

Q20. Do you have any additional heating systems? (Select all that apply)

Q21. What was your primary reason for installing a heat pump?

Q22. Is your house more or less expensive to heat than with your previous system, ignoring any subsidy payment?

Q23. Thinking about your experience of owning a heat pump, how much do you agree or disagree with the following statement: A heat pump is the only source of heating my property needs to reach comfortable temperatures all year round.

Q24. Thinking about your experience of owning a heat pump, how much do you agree or disagree with the following statement: My heat pump requires less maintenance than a gas boiler.

Q25. Thinking about your experience of owning a heat pump, how much do you agree or disagree with the following statement: The noise from the heat pump is acceptable to me and those I live with.

Q26. Thinking about your experience of owning a heat pump, how much do you agree or disagree with the following statement: The noise from the heat pump is acceptable to my neighbours.

Q27. Based on your experience, please rank the following from the greatest advantage of owning a heat pump (ranked 1) to the smallest advantage (ranked 7).

Q27b. Based on your experience, please rank the following from the greatest disadvantage of owning a heat pump (ranked 1) to the smallest disadvantage (ranked 7).

Q28. Do you have the heat pump running for longer or shorter periods than the previous heat source?

Q29. Do you agree or disagree that heat pumps are a good alternative to traditional gas boilers?

Q30. Do you think the government should be doing more or less to promote the installation of heat pumps?

Q31. Is there anything else you'd like to add about the experience of installing and operating a heat pump?

APPENDIX 2: ACKNOWLEDGEMENTS

Ecotricity would like to thank:

Daniel Logue – lead author of the Electrification of Heat Report, Energy Systems Catapult, December 2024

and

Colin Meek – RECC Monitoring – lead author of In-Situ Heat Pump Performance: Analysis of Ofgem Data 2017-2022, September 2024

for their helpful clarifications regarding these reports.

APPENDIX 3:
HYBRID HEAT PUMP/BOILERS

Given the higher carbon intensity of the electricity supply in winter and the lower SPF of ASHPs in winter, there is a possibility that hybrid heat pump/boilers6 may have a role to play. On present prices they would be significantly less expensive to run than a straight ASHP at times of peak heat demand.

Hybrid systems use the ASHP when it would run efficiently, and the fossil fuel boiler when demand is highest and ASHP performance is poor. If installed as a complete system from new, the capital cost is of course higher, but some systems can make use of a retained fossil fuel boiler. Hybrids are slightly more expensive to maintain, as there are two heat generators to service.

At times of peak heat demand, it may not be efficient to burn the gas at the power plant, turning the energy into heat, heat into electricity, then ship it through the power distribution system, with energy losses at each stage of this process, then turn it back into heat again at the property (via a heat pump working at relatively low COP). It may be more efficient to burn the gas at the property to generate the required heat. The distribution system for gas already exists.

If heating is to be fully electrified in due course, the National Grid will need to be upgraded, at substantial financial and environmental cost. By using hybrids, at least as an interim measure, it is possible that peak space heating demand in mid-winter could be reduced, and the extent of grid upgrade could also be reduced – or at least delayed until renewable electricity becomes available at sufficient scale and the grid is fully decarbonised.

There are technical challenges with hybrids of this type, especially in optimising the distribution and control systems as there is a difference between boilers and heat pumps, so further research may be required.