Department for
Business, Energy
& Industrial Strategy

PHASING OUT THE INSTALLATION OF FOSSIL FUEL HEATING IN HOMES OFF THE GAS GRID

Closing date: 12th January 2022

October 2021

Any enquiries regarding this publication should be sent to us at:
enquiries@beis.gov.uk or offgasgridheatconsultation@beis.gov.uk

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General information

Why we are consulting

To set out policy proposals for phasing out the installation of fossil fuel heating systems in homes off the gas grid. We invite stakeholder views on our approach and seek further evidence in specific areas to help shape the design of the policy.

Consultation details

Issued: 19th October 2021

Respond by: 12th January 2022

Enquiries to: Buildings and Electrification Team.

Please do not send responses by post to the department.

Email: offgasgridheatconsultation@beis.gov.uk

Consultation reference: Phasing out the installation of fossil fuel heating in homes off the gas grid

Audiences:

This consultation will be of interest to stakeholders operating on the heat sector, business representative bodies, households, and those with a wider interest in the UK's net zero ambition.

Territorial extent:

This consultation is for England. It does not include Scotland, Wales, or Northern Ireland. We are working closely with the Devolved Administrations to understand the UK-wide implications of policies to decarbonise heat and improve energy efficiency.

How to respond

Respond online at: https://beisgovuk.citizenspace.com/heat/phasing-out-fossil-fuel-heating-offgrid-homes/

Or if you are unable to respond using Citizen Space:

Email to: offgasgridheatconsultation@beis.gov.uk

Please do not send responses by post to the department.

When responding, please state whether you are responding as an individual or representing the views of an organisation.

Your response will be most useful if it is framed in direct response to the questions posed, though further comments and evidence are also welcome.

Confidentiality and data protection

Information you provide in response to this consultation, including personal information, may be disclosed in accordance with UK legislation (the Freedom of Information Act 2000, the Data Protection Act 2018 and the Environmental Information Regulations 2004).

If you want the information that you provide to be treated as confidential please tell us, but be aware that we cannot guarantee confidentiality in all circumstances. An automatic confidentiality disclaimer generated by your IT system will not be regarded by us as a confidentiality request.

We will process your personal data in accordance with all applicable data protection laws. See our privacy policy.

We will summarise all responses and publish this summary on GOV.UK. The summary will include a list of names or organisations that responded, but not people's personal names, addresses or other contact details.

Quality assurance

This consultation has been carried out in accordance with the government's consultation principles.

If you have any complaints about the way this consultation has been conducted, please email: beis.bru@beis.gov.uk.

Executive Summary

Our homes are a key part of our national heritage. They have helped shape and define us as a society. They reflect our culture and environment, and change over time with new tastes and technologies, and to meet new priorities. Our buildings are responsible for around 23% of our national carbon emissions and generating heat accounts for the vast majority of this[1]. Decarbonisation of heat is recognised as one of the biggest challenges we face in meeting our legally binding target to achieve net zero greenhouse gas emissions by 2050.

Whilst hydrogen and electrification offer potential solutions to decarbonise the majority of UK homes connected to centralised or district energy systems, there are around 1.1 million fossil fuel heated homes in England[2] which are not connected to the gas grid and currently use some of the highest carbon heating fuels including oil and coal. Off the gas grid there is no strategic hydrogen option. Electrification of heat is the one pathway to net zero proven to work at scale across a broad spectrum of homes, and other low-carbon heating solutions are available in the small number of homes where heat cannot be decarbonised through electrification.

In the Clean Growth Strategy (2017)[3] the Government committed to 'phase out the installation of high-carbon fossil fuel heating in new and existing homes currently off the gas grid during the 2020s, starting with new homes'. This was followed by a call for evidence[4] in 2018 seeking views on the future policy framework for decarbonising heat in buildings – which found that a consistent, long-term policy framework, backed by regulation, will be needed to fully decarbonise heat. This consultation seeks views on the government's proposals to decarbonise heat in homes off the gas grid through targeted regulations, including:

1. An end to the installation of fossil fuel heating in homes off the gas grid from 2026;
2. A 'heat pump first' approach to replacement heating systems from 2026; and
3. Requiring high performing replacement heating systems where heat pumps cannot reasonably practicably be installed

We are also considering whether it is appropriate to end the use of fossil fuel heating in all homes off the gas grid, potentially by the late-2030s. The government is considering different options for how these changes could be introduced, including making changes to the Building Regulations, approved documents and associated guidance, or taking new legal powers in primary legislation. The government intends to launch further consultations on the technical changes to existing regulations or guidance, or other legislation, needed to deliver this policy ahead of implementation, and would intend to use that exercise to consider what additional support may be needed for households switching to clean heat under the regulations.

This consultation is being launched alongside the Heat and Buildings Strategy which sets out our immediate and medium-term plans to reduce emissions from buildings through deploying energy efficiency measures and low-carbon heating.

[1] BEIS (2021), 'Final UK greenhouse gas emissions national statistics: 1990 to 2019' (https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-to-2019) and BEIS (2021) 'Energy Consumption in the UK' (https://www.gov.uk/government/statistics/energy-consumption-in-the-uk)
[2] MHCLG. 'English Housing Survey', (2018), https://www.gov.uk/government/collections/english-housing-survey#2018-to-2019
[3] BEIS. 'The Clean Growth Strategy.' (2017) https://www.gov.uk/government/publications/clean-growth-strategy
[4] BEIS. 'A Future Framework for Heat in Buildings: A Call for Evidence' (2018) https://www.gov.uk/government/consultations/a-future-framework-for-heat-in-buildings-call-for-evidence

Chapter 1: Introduction

The UK is the first major economy in the world to set a legally binding target to achieve net zero greenhouse gas emissions by 2050[5]. The UK also aims to make significant carbon savings towards our carbon budgets; these are interim emission reduction targets, which will require a 78% reduction in emissions from across the UK economy by 2035 compared to 1990 levels.

The UK has already shown that environmental action can go hand-in-hand with economic success, having grown our economy by more than three-quarters while cutting emissions by over 40 per cent since 1990. The sixth carbon budget is another indication of this government's dedication to Britain's green industrial revolution, positioning the UK as a global leader in the green technologies of the future[6].

Going forward decarbonisation of heat is recognised as one of the biggest challenges we face in meeting our climate targets. While good progress has been made in deploying low-carbon heating technologies in buildings over the last decade, with over 110,000 installations under the Renewable Heat Incentive[7], much more needs to be done. Net zero can only be achieved if almost all heat in buildings is decarbonised.

Given fossil fuel heating systems are typically designed for a 15-year lifecycle,[8] action is needed now to prepare us for a low carbon heating future. This will require scaling up our UK low carbon heat market and supply chains during the 2020s. Heat pumps will play a substantial role in any net zero scenario, and we need to build the market for them now. In his ten-point plan[9] the Prime Minister announced our aim to install 600,000 heat pumps a year by 2028 – which will keep us on track for net zero and lay the groundwork for further deployment growth if required.

Across the entire housing stock, there are a range of heating technologies with the potential to support the scale of change needed to meet our 2050 targets, including increased use of low carbon heat networks and electrification of heating. We are also researching the safety and feasibility of using hydrogen in the gas grid as an alternative way of providing heat at the scale required for net zero. However, that cannot play a role in decarbonising homes which are not currently connected to the gas grid.

The evidence received from stakeholders in response to our 2018 call for evidence[10] reaffirmed our view that electrification of heat is the one pathway to net zero proven to work at scale in homes off the gas grid. This is reinforced by BEIS modelling which suggests that it would be feasible to install a heat pump in around 80% of off gas grid homes, based on their

[5] HMG. 'UK Becomes the First Major Economy to Pass Net Zero Emissions Law' (2019), https://www.gov.uk/government/news/uk-becomes-first-major-economy-to-pass-net-zero-emissions-law
[6] We have set a series of targets to reduce greenhouse gas emissions through legally-binding 'carbon budgets'. The sixth carbon budget covers the period 2033-2037
[7] BEIS. 'RHI Monthly Deployment Data August' (2021), https://www.gov.uk/government/statistics/rhi-monthly-deployment-data-august-2021
[8] Viessmann. 'Oil Fired Boiler Installation Guide, https://www.viessmann.co.uk/faq/heating-replacement-installation/oil-boiler
[9] HMG. 'The ten point plan for a green industrial revolution' (2020), https://www.gov.uk/government/publications/the-ten-point-plan-for-a-green-industrial-revolution
[10] BEIS. 'A Future Framework for Heat in Buildings: A Call for Evidence' (2018), https://www.gov.uk/government/consultations/a-future-framework-for-heat-in-buildings-call-for-evidence

current energy efficiency and internal electrical limits. Around 35,000 heat pumps are already being installed in the UK each year with evidence of a positive consumer experience[11].

Action to decarbonise heat in off gas grid homes is therefore a low regrets option as electrification of heat is the only strategic option for off gas grid homes. Emissions reductions will continue to grow as we further decarbonise our energy system and increase the role of renewables in our power generation. Where heat pumps cannot be used, other low carbon heating systems are available.

The Off-Gas Grid Homes Sector

Oil has been a mainstay of British heating for well over 100 years, although its use fell into steep decline during the 20th century as consumers chose to replace it with convenient, cleaner gas wherever possible. Today there are around 1.1m homes in England using fossil fuel heating which are not connected to the gas grid, of which 78% use heating oil, 13% use liquid petroleum gas, and 9% coal[12]. Modern oil installations have become more efficient, however, oil remains the most carbon intensive heating option commonly used by those who do not have access to the gas grid[13].

Oil heating benefits from consumer familiarity, established supply chains, and, at present, from lower capital cost (as well as lower operating costs at current oil prices) than low carbon heating systems. These factors all reinforce the ongoing use of oil fossil fuel heating in homes off the gas grid.

Consumers will typically consider changes to their heating system at the point of boiler breakdown – to maximise the lifespan of existing systems and push back the cost and disruption of replacement. For oil heated homes this replacement is once every 15 years or more given the designed lifespan of an oil boiler. Households will often need all aspects of the replacement process – from system design to physical installation – to take place quickly to avoid a lengthy break in heating and hot water services.

As long as the cost of low carbon heating systems exceeds the cost of fossil fuel equivalents, voluntary measures and incentives will not displace all off-grid fossil heating installations (around 50,000-70,000 p.a. in England[14]), nor tackle the full 1.1m population of off gas grid homes currently heated by fossil fuel systems in time to meet net zero obligations. Conversely, while deployment remains low, the sector is unlikely to achieve its full cost reduction potential from increased competition, economies of scale, and innovation in manufacturing and installation.

One of the strongest messages from the call for evidence in 2018 was that a consistent, long-term policy framework will be needed to underpin the transformation of heating our housing stock off the gas grid, ideally backed by regulations. The proposals laid out in this consultation document will deliver this by driving increasing demand for low carbon heating and giving the low carbon heat sector the certainty and time required to align strategies, investment plans and training; drive forward innovation in technologies and business models; and drive down costs.

[11] 89% of domestic and 82% of non-domestic ground source heat pump users, and 78% of domestic air source heat pump users receiving the Renewable Heat incentive reported they were satisfied with their system. https://www.gov.uk/government/collections/renewable-heat-incentive-evaluation

[12] MHCLG. 'English Housing Survey 2018' https://www.gov.uk/government/collections/english-housing-survey#2018-to-2019

[13] Carbon intensity of oil is 0.247 kgCO2e/kWh, compared to 0.184 kgCO2e/kWh for mains gas. BEIS and Office for National Statistics' estimates of properties not connected to the gas network 2015 -2018', (2019)

[14] Assuming replacement rate of once every 15-20 years with a total stock of 1.1m households

The increased certainty offered by regulation will also help Distribution Network Operators[15] to plan and deliver the extra capacity required more cost-effectively to accommodate a significant uptake of electric heating. This reduces the cost impacts on customer electricity bills.

This in turn will also help galvanise supply chains for low carbon heat and help pave the way for subsequent decarbonisation on-grid. It will also make a significant contribution to carbon savings for the fourth, fifth and sixth Carbon Budgets (which cover the period 2023 to 2037), help create green jobs and create opportunities for UK manufacturers.

[15] Distribution network operators own, operate and maintain the networks that bring electricity to our homes.

Chapter 2: The proposals

This section details the policies we have developed following extensive consultation with the heating industry, energy suppliers, energy network operators, consumer advice groups, industry and consumers, including the responses to our 2018 call for evidence.

#1 - An end to the installation of new fossil fuel heating in homes off the gas grid from 2026

It is clear from the responses to our call for evidence that there is a need for targeted regulation – as part of a wider package needed to allow the market for clean heat to develop – to drive the transition to low carbon heat in homes off the gas grid. However, change must happen at a pace that meets our net zero obligations and works for industry and consumers. This is critical as air source heat pumps - our lead technology for decarbonising heat in off gas grid homes (see proposal 2 - A 'heat pump first' approach to replacement heating systems from 2026) - currently cost off gas grid households £12,000 on average to install[16], which can be up to £8,000 more than equivalent fossil fuel systems.

Based on evidence from other countries and our engagement with industry, we believe that mass deployment of heat pumps in the UK could lead to a significant reduction in upfront costs for domestic-sized systems due to economies of scale and reduced overheads. As part of the Heat and Buildings Strategy we are setting an ambition of working with industry to reduce the upfront costs of installing a heat pump by 25-50% by 2025 and to achieve cost parity between heat pumps and gas boilers by 2030.

We are currently supporting heat pump deployment through the domestic Renewable Heat Incentive – which closes to new entrants in 2022 – and have consulted on proposals for a new £450m Boiler Upgrade Scheme (previously named the Clean Heat Grant) from 2022, to support the installation of low-carbon heating systems in households and small businesses. This will offer grants of £5,000 towards the cost of purchasing and installing air source heat pumps and biomass boilers, and £6,000 for ground source heat pumps. The Home Upgrade Grant is a £2.5bn manifesto commitment to provide energy efficiency upgrades and low-carbon heating to low-income households living off the gas grid in England, to tackle fuel poverty and meet our net zero targets. We are also consulting on a market-based mechanism to be introduced in 2024, which will create a market incentive for industry to accelerate growth in sales of heat pumps through reducing costs and improving the customer offer (e.g. through financing propositions and new consumer journeys).

We therefore propose to end the installation of fossil fuel heating[17] in off-gas grid homes from 2026 – giving funded measures and the market mechanism time to improve heat pump market conditions and underpin investment and innovation throughout the supply chain, reduce costs, improve and expand the consumer offer, and grow the base of skilled installers capable of installing heat pumps quickly and efficiently across a broad range of properties.

We know that consumers are most likely to consider, or seek expert advice, on changes to their heating system towards the end of their existing system's lifecycle. The proposed

[16] For a 10kW system excluding VAT. Estimate includes the HP unit and labour costs, HP tank and cylinder, control, and retrofit of radiators. Decommissioning of existing oil tank is not included.
[17] Fixed building services that provide heating and domestic hot water. Other energy-using appliances that may use fossil fuels – such as cooking – are not in scope of this measure.

regulation will therefore work with the natural replacement cycle as the key trigger to deploy clean heat. This will reduce disruption and costs to consumers.

We have considered bringing forward the date from which new fossil fuel heating installations would no longer be permitted in homes off the gas grid. This would deliver greater emissions reductions sooner, contributing further to meeting the UK's fourth, fifth and sixth Carbon Budgets. However, this is not needed to deliver net zero emissions by 2050 and would also mean less time for households to plan their future heating needs, including any potential upgrades to energy efficiency that may be needed to accommodate a heat pump. As noted above, it may also be an unreasonably short timeframe for the market to develop the necessary capacity in clean heat supply-chains. Further information on our plans to prepare consumers and the market for regulation is given in Chapter 3.

The government is considering different options to implement this measure, including making changes to the Building Regulations, approved documents and associated guidance, or taking new legal powers in primary legislation. We intend to launch further consultations on the technical detail of any legislation needed to deliver on this measure ahead of implementation.

Consultation questions:

1. Do you agree with the principle of working with the natural boiler replacement cycle as the key trigger to deploy low carbon heat? Please provide evidence to support your response.
2. Would a 2026 end date for the installation of fossil fuel heating in homes off the gas grid give industry and consumers sufficient time to prepare for the regulations? Please provide evidence to support your response.

#2 - A 'heat pump first' approach to replacement heating systems from 2026

Heat pumps are one of the primary technologies for decarbonising heat. Looking towards 2050, heat pumps could enable us to fully decarbonise heat alongside the decarbonisation of electricity generation. The Committee on Climate Change has recommended that the UK will need to increase deployment of heat pumps significantly in the 2020s to deliver our interim carbon budgets under all low carbon heat scenarios – including action to drive heat pump deployment in off-gas grid properties.

The evidence – set out in the Annex – indicates that low temperature air source heat pumps deliver high levels of energy efficiency, low carbon emissions and are consistent with net zero emissions as the electricity grid decarbonises (noting the need to move to non-hydrofluorocarbon-based refrigerants – see Annex). They are also commercially available, can be deployed at scale across most fossil fuel heated homes off the gas grid, and have lower running costs than many other low carbon heating systems.

We therefore propose to set a very high standard governing the choice of replacement heating systems – reflecting the performance that low temperature air source heat pumps can deliver – for households where it is reasonably practicable to install these systems. This approach will set low temperature air source heat pumps as the lead replacement technology in most cases, whilst creating space for consumers to use other high-performing low carbon technologies such as low carbon district heating or ground source heat pumps. This approach will also create space for and drive innovation in new heating technologies that may match or even better the all-round performance of current technologies.

The government intends to issue guidance ahead of the regulations being implemented on how households and installers should determine whether it is reasonably practicable to install a heat pump in the home. We would expect this guidance to consider factors such as heat loss, potential to upgrade energy efficiency if necessary, availability of appropriate space, and any legal constraints. We will also seek views through this consultation on how this guidance should be developed.

We also propose to extend this heat pump first approach to replacement heating systems in off-gas grid fossil fuel heated homes that can be made suitable for heat pumps through minor energy efficiency upgrades that can be installed quickly, including draught-proofing, cavity wall insulation, floor and loft insulation. BEIS modelling suggests that the cost of minor energy efficiency upgrades to make a home suitable for a low-temperature heat pump would be below £2,000, and that the average cost for homes requiring minor upgrades is expected to be around £1,000[18]. The cost of these minor upgrades will pay back within a few years in most cases, as without them households would need to install alternative low carbon heating systems – such as high-temperature heat pumps or solid biomass – which either cost more to run or have higher upfront costs than low-temperature heat pumps.

The government is considering different options to implement this measure, including making changes to the Building Regulations, approved documents and associated guidance, or taking new legal powers in primary legislation. We intend to launch further consultations on the technical detail of any legislation needed to deliver on this measure ahead of implementation.

Consultation questions:

3. Do you agree with a heat pump first approach to replacement heating systems in fossil fuel heated homes off the gas grid that can reasonably practicably accommodate a heat pump? Please provide evidence to support your response.
4. Do you have any views on the design or content of guidance that will help households and installers determine whether it is reasonably practicable to install a heat pump? Please provide evidence to support your answer.
5. Do you have any additional evidence on the size and characteristics of the cohort of homes off the gas grid that have the greatest deployment potential for ground source heat pumps?

#3 – Require high performing replacement heating systems where heat pumps cannot reasonably practicably be installed

There will be some homes that cannot reasonably practicably have a heat pump installed. For instance, we do not propose to apply the heat pump first approach to replacement heating systems where major upgrades such as external wall insulation would be needed at the point of boiler replacement to meet the heat demand of the home with a low temperature heating system. The government is considering how to support households making major upgrades to their energy efficiency, but where these upgrades have not been made by the time of boiler replacement the high cost, disruption and long installation time would make it impractical to require this to enable a low temperature heat pump to be installed.

Where households cannot reasonably practicably install a low temperature heat pump it will be necessary to enable the use of alternative low carbon heating solutions that are consistent with the pathway to net zero and wider government objectives on environmental sustainability and

[18] Analysis using National Household Model, assuming a heat loss threshold of <=100W/m2 for maximum heat loss for low temperature heat pumps

air quality. We intend to consult on the detailed criteria governing the choice of replacement heating systems where households cannot reasonably practicably install a low temperature heat pump ahead of implementation. We would expect these criteria to require that replacement systems must use fuels that are fully renewable or can demonstrate a clear and rapid trajectory to becoming so. Any fuels used in replacement heating systems will also need to minimise pollutant emissions and air quality impacts, and be produced using sustainable sources, meaning that their impact on biodiversity, the wider environment, and the level of carbon emissions in supply chains will be considered. We will also need to be clear that any replacement heating systems and associated fuels offer a positive experience for the consumer, so we must be confident that supply chains are able to meet demand and that there are sufficient competent installers for the relevant technology.

Based on evidence of system performance and deployment potential – as laid out in the Annex – high temperature heat pumps and solid biomass would currently be consistent with these principles, though solid biomass systems cannot be deployed in (mostly urban) areas subject to air quality control restrictions, and overall deployment must be limited in order to maximise its overall carbon abatement potential given limited supply of woody biomass from sustainable sources. We therefore propose that the choice of technology for households which cannot reasonably practicably install a low temperature heat pump system will need to reflect the high standards of performance and characteristics of high temperature heat pumps and solid biomass systems.

This approach will create space for industry to innovate and bring forward new low carbon heating solutions which are not currently commercially available. The government is exploring whether alternative electric heating appliances may in future have the potential to reflect the high standards of performance of high temperature heat pumps and solid biomass systems. The government also believes this may be the case for net zero-consistent liquid biofuels – low carbon biofuels which are 100% bio-derived or which can demonstrate a clear and rapid trajectory to removing all fossil fuel content, and with sustainable feedstock. We understand that industry is currently developing innovative ‘drop-in’ biofuels which may in future be consistent with net zero emissions and compatible with oil or liquid petroleum gas heating systems on the market today. These fuels are not yet widely available on the domestic heating market but may present an attractive proposition to some consumers in the future.

The government is considering different options to implement this measure, including making changes to the Building Regulations, approved documents and associated guidance, or taking new legal powers in primary legislation. We intend to launch further consultations on the technical detail of any legislation needed to deliver on this measure ahead of implementation.

Consultation questions:

6. Do you agree that the performance of replacement heating systems in homes off the gas grid that cannot reasonably practicably accommodate a heat pump should reflect the current high standards of performance that can be delivered through high temperature heat pumps and solid biomass systems? Please provide evidence to support your answer.
7. Do you agree that future use of solid biomass to decarbonise heat in homes off the gas grid should be limited to rural, off-gas grid areas where air quality can be better controlled, and in ‘hard to treat’ properties that are not suitable for other low carbon heating technologies? Please provide evidence to support your response.
8. Do you have any views on the development of heating fuels and systems which will be consistent with wider government objectives on net zero emissions, environmental sustainability and air quality, and offer a secure and affordable fuel supply to consumers, from 2026? Please provide evidence to support your answer.

A potential end to the use of fossil fuel heating in all homes off the gas grid by the late-2030s

We are considering whether it would be appropriate to reinforce the regulatory framework described above by signalling an end date for the use of any remaining fossil fuel heating systems in homes off the gas grid. This would reduce the risk that consumers continuously repair old, inefficient, and potentially unsafe fossil fuel heating systems to delay the installation of clean heat. This would also provide greater certainty to industry, giving firms the confidence to invest and prepare for a ramp up in clean heat deployment.

As oil boilers typically have a 15-year designed lifecycle, an end to the use of fossil fuel heating in all homes off the gas grid by the late-2030s would avoid stranding significant numbers of fossil fuel boilers installed before the end date was announced. This would also help accelerate deployment of clean heat through encouraging some consumers to install heat pumps in the years ahead of the 2026 end to the installation of new fossil fuel heating – as they would no longer be able to benefit from the full expected lifespan of an oil boiler.

We are seeking views through this consultation on how an end to the use of any remaining fossil fuel heating in homes off the gas grid by the late-2030s could be achieved. We seek evidence on the extent to which market forces and the 2026 end to the installation of fossil fuel heating could deliver on this goal. If that is not likely to be the case, we want to explore whether it would be appropriate to regulate to end the use of any remaining fossil fuel heating in homes off the gas grid. We are keen to understand what impact this might have. Equally, we are seeking views on whether we should introduce other mechanisms to accelerate deployment of clean heat in homes off the gas grid ahead of the late-2030s, potentially including using home sales or new tenancies as triggers to phase out fossil fuel heating.

Consultation questions:

9. Do you agree with an end date for the use of remaining fossil fuel heating in homes off the gas grid by the late-2030s? Please provide evidence to support your answer.
10. Do you have any views on measures the government could introduce to ensure that fossil fuel heating will no longer be used in homes off the gas grid by the late-2030s? Please provide evidence to support your answer.

Compliance

The government recognises that these measures will require a degree of enforcement to ensure compliance. The exact nature of this will be shaped by the final design of the policy and the legislative vehicles used to deliver it. The use of the Building Regulations to implement this policy would place responsibility on those carrying out the work, for example, agents, designers, builders, installers and the building owner. Local authorities have a duty to enforce the Building Regulations and can take formal action in line with Sections 35 and 36 of the Building Act. The creation of new powers to deliver this policy, if required, may necessitate the development of compliance measures separate to those used in the Building Regulations.

Consultation questions:

11. Do you have any views on how best to ensure compliance with the proposed regulations laid out through this consultation? Please provide evidence to support your answer.

Chapter 3: Ensuring the market and consumers are ready for regulation

Overcoming financial barriers

Deployment of heat pumps in the UK is low compared to many similar countries. Heat pumps in the UK tend to have been installed by early adopters of green technology, and in social housing. The higher upfront and running costs compared to incumbent fossil fuel systems are currently key barriers to driving the wider deployment of heat pumps. The average upfront cost of installing a low temperature air source heat pump is currently around £12,000 for an average fossil fuel heated household[19] off the gas grid, and this would be around £8,000 more than a like-for-like oil system replacement[20]. Evidence from other countries and our engagement with industry suggests that mass deployment of heat pumps in the UK could lead to a significant reduction in upfront costs for domestic-sized systems due to economies of scale and reduced overheads. As part of the Heat and Buildings Strategy, we are setting an ambition of working with industry to reduce upfront costs of installing a heat pump by 25-50% by 2025 and to achieve cost parity between heat pumps and gas boilers by 2030.

For an average home off the gas grid, the annual fuel cost of running a low temperature air source heat pump could currently be higher than the cost of running an oil heating system. However, there are a range of factors that will bring down the cost of running a heat pump over the next few years, which in combination could see households installing a heat pump making savings in their overall energy bills:

- Product and installation standards will improve heat pump system efficiency;
- Smart and time-of-use electricity tariffs will enable heat pump owners to use energy when it is at its cheapest;
- Installing basic energy efficiency measures alongside heat pumps can reduce space heating demand and improve the efficiency of the heat pump;
- Action to address existing price distortions on fuels will bring down heat pump running costs further.

We anticipate that these changes will result in heat pumps being no more expensive, and in many cases cheaper, to run than oil boilers by the second half of the decade, with the further benefit of insulating households from fossil fuel price volatility as the electricity grid decarbonises.

The government recognises that further action – including existing and planned measures outlined below – will be required to support unable–to-pay households and ensure that the cost to early movers of transitioning to clean heat is fair and proportionate.

Domestic Renewable Heat Incentive

The domestic Renewable Heat Incentive has delivered a significant contribution towards our legally binding carbon budgets and done much to build the supply chains for a range of low carbon heating technologies. To date, we have supported over 110,000 households to make

[19] 10kW system excluding VAT is assumed. Decommissioning of existing oil tank is not included.
[20] Assumes £4,000 which includes replacement of oil boiler and water tank. Oil tank replacement cost is excluded.

the transition to low carbon heat under the Renewable Heat Incentive[21]. Between 2016 and 2018, the government introduced a series of reforms to the Renewable Heat Incentive. These aimed to strengthen its focus on technologies considered to be more strategically important for the long-term decarbonisation of heat – including heat pumps and solid biomass. The Domestic Renewable Heat Incentive will be open to new entrants until the end of March 2022.

Boiler Upgrade Scheme

Last year we consulted on proposals for a new Boiler Upgrade Scheme (previously named the Clean Heat Grant) from 2022, to support the installation of low-carbon heating systems following the closure of the Domestic Renewable Heat Incentive. This will provide upfront capital grants to households and small businesses looking to install heat pumps and, in some circumstances, biomass boilers. In addition to growing low carbon heat supply chains and driving cost reductions across the market, it will also enable the introduction of planned regulatory and market-based policies later in the decade.

Home Upgrade Grant

The Home Upgrade Grant is a £2.5bn manifesto commitment to provide energy efficiency upgrades and low-carbon heating to low-income households living off the gas grid in England to tackle fuel poverty and meet net zero targets. The worst performing off-gas grid homes, ranging from Energy Performance Certificate Bands D to G, will be eligible to receive upgrades under the Home Upgrade Grant. The upgrade grants available will be on a sliding scale, according to the starting Energy Performance Certificate band and starting heating fuel type, and range between up to £10,000 and £25,000. The government is aiming to launch a first phase of the scheme in early-2022.

The Market Mechanism

In parallel to this consultation, we are also consulting on proposals for a market-based mechanism from 2024 which would create a market incentive to grow the number of low-carbon heating appliances installed each year, and, alongside other measures, provide industry with a clear, long-term policy framework for investment and innovation. We believe that through providing market-wide certainty and incentives, we can help businesses take the lead in finding innovative market opportunities to make the switch to a heat pump an increasingly attractive, mainstream choice for growing numbers of UK consumers.

The proposed sequencing of measures – a market mechanism to support growth in heat pump sales from 2024, and an end to the installation of fossil fuel heating in homes off the gas grid from 2026 – is intended to give the market mechanism and other near-term measures sufficient time to drive investment and innovation throughout the supply chain, helping to reduce costs, expand and improve the range of consumer propositions, and find ways to help make sure heat pumps can be installed quickly and efficiently across a broad range of properties.

Running costs

The cost of electricity is relatively higher than fossil fuel heating sources in the UK. In poorly insulated buildings, this has the potential to raise affordability issues for consumers and

[21] BEIS. 'RHI Monthly Deployment Data August' (2021), https://www.gov.uk/government/statistics/rhi-monthly-deployment-data-august-2021

discourage households looking to decarbonise their heating source. The government is committed to ensuring the costs of decarbonising the energy system are fair and affordable for all energy users. We are considering both the benefits and the costs of different pathways holistically across government and remain committed to working with industry and consumers to keep costs down and identify how costs can be allocated in a way that incentivises user behaviour and drives decarbonisation.

The government is also encouraging installation of energy efficiency measures alongside heat pump technologies to reduce demand for heat and offset potential higher running costs, and is providing support for this through the Energy Company Obligation.

Improving the energy performance of private rented homes

On 30 September 2020, government published a consultation[22] on proposals to upgrade as many private rented sector homes as possible in England and Wales to Energy Performance Certificate Band C by 2028, where practical, cost-effective and affordable. The lead option was a phased trajectory for achieving the improvements for new tenancies from April 2025, and for all tenancies by April 2028 under a maximum per-property spend of £10,000.

This would enable the transition to clean heat in homes off the gas grid through improving energy efficiency, and reducing heat loss, in homes which are currently poorly insulated. Improving the energy performance of privately rented homes will expand the deployment potential of low temperature heat pumps which cost less to run than other low carbon heating systems and drive down overall running costs through reducing space heating demand.

We are reviewing the responses to the consultation and aim to publish a response by the end of the year.

Electricity system readiness

The electricity system plays a vital role in enabling the ramp up of low carbon heating technologies, particularly in the case of heat pumps. Meeting the increased demand for electricity from heat pumps, alongside other sectors such as transport, will require increased electricity generation and reinforcement to the electricity distribution network. The majority of costs for this expansion will fall to electricity billpayers.

To keep these costs down, and reduce the requirement for large peak generation capacity, as well as supporting balancing the system in an age of low carbon energy, we need to deploy heat pumps in a smart and flexible way. Smart controlled heat pumps, installed alongside a smart meter and storage, can shift their electricity consumption to times when demand for electricity is low or low carbon generation (such as wind power) is high, thereby benefitting the grid. Acting as part of the energy system, smart and flexible heat pumps can reduce running costs for billpayers on time-of-use tariffs, as electricity is cheaper at off-peak times, and earn revenues for owners by providing flexibility services to the grid. This approach simultaneously benefits all electricity system users by reducing overall system costs and carbon emissions, while supporting system stability.

[22] BEIS. 'Improving the Energy Performance of Privately Rented Homes' (2020), https://www.gov.uk/government/consultations/improving-the-energy-performance-of-privately-rented-homes

We have published, with Ofgem, a new Smart Systems and Flexibility Plan[23] and the UK's first Energy Digitalisation Strategy[24], the latter of which was also jointly developed with Innovate UK. It includes measures to facilitate flexibility from consumers, removing barriers to flexibility on the grid including long-duration storage, reforming markets to reward flexibility, and digitalising our energy system. We are currently undertaking research to improve our understanding of the most cost-effective combination of technologies to facilitate smart and flexible heating systems and will use this analysis to develop policies to incentivise smart systems. We will consider options to encourage or adopt a 'smart as standard' approach to heating in off-gas grid homes.

However, even with a smart and flexible building stock and grid, any path to Net Zero will require significant additional network capacity, in particular on the lower-voltage electricity distribution networks. We have been engaging with Distribution Network Operators (DNOs) and the Energy Networks Association to understand the potential scale of the need for local network reinforcement and preparations for electrification of heat. For these reinforcements to be carried out effectively, we need to ensure that DNOs can make strategic investments that reduce the need for network upgrades, following the 'touch the network once' principle. Ofgem are in the process of setting the RIIO-ED2 price control for DNOs that will cover the period 2023 to 2028 and will enable DNOs to strategically invest in their networks to accommodate increased demand, especially from decarbonisation of transport and heat. We are working with Ofgem as they develop the price control mechanisms to reflect uncertain demand.

In some cases, an upgrade to the electricity connection of a building will be required to support a heat pump and some people may face a charge for this work. Upgrade costs and timescales will depend upon the existing connection, the capacity required, and available existing network capacity. We need to ensure that heat pumps can be quickly and affordably connected to the network, and that the connection process and costs do not represent an undue barrier to heat pump uptake. We are working with Ofgem and DNOs to gather data on connection costs and timescales, and establish approaches to charging, looking to standardise where possible. In this context, we are engaging with Ofgem as they progress consideration of potential connection charging reforms through their Significant Code Review of Access and Forward-looking Charges.

The government believes that when taken together, the above measures will significantly reduce the cost of installing and owning a heat pump ahead of the regulations coming into force in 2026; whether through supporting some households through the transition to clean heat, reducing overall upfront costs through increased economies of scale and competition, reducing the cost of low carbon fuels, or reducing overall space heating demand through improving energy efficiency.

We want to see the above measures drive significant price convergence between fossil fuel boilers and heat pumps, but we cannot quantify at this stage how far and how quickly heat pump costs will come down for off-gas grid households.

Following this consultation process, we will keep the cost of heat pumps and other low carbon heating systems under review. We intend to launch further consultations on the technical changes to existing regulations or guidance, or other legislation, needed to deliver this policy

[23] BEIS and OFGEM, 'Smart systems and flexibility plan 2021', https://www.gov.uk/government/publications/transitioning-to-a-net-zero-energy-system-smart-systems-and-flexibility-plan-2021

[24] BEIS, OFGEM and iUK, 'Digitalising our energy system for net zero: strategy and action plan', https://www.gov.uk/government/publications/digitalising-our-energy-system-for-net-zero-strategy-and-action-plan

ahead of implementation, and would intend to use that exercise to consider what additional support may be needed for households switching to clean heat under the regulations.

Consultation questions:

12. Do you have any views on what more could be done to address financial barriers to heat pump deployment? Please provide evidence to support your answer.
13. Do you have any views on how we should encourage smart-enabled heating in homes off the gas grid? Please provide evidence to support your answer.

Non-financial barriers

The government is also undertaking a holistic programme of work to reduce the barriers to deployment.

Electrification of Heat Demonstration Project

In 2019, BEIS launched a £14.6 million Electrification of Heat Demonstration Project. The project aims to raise awareness and demonstrate the feasibility of a large-scale rollout of heat pumps by installing them in a representative range of up to 750 homes, alongside new products and services designed to overcome many of the key barriers to deployment, such as operating costs, space, disruption, thermal comfort, noise and aesthetics.

Supply Chain Readiness

To deliver a significant ramp-up in electrification of heat, to 600,000 heat pumps per year by 2028 including 50,000-70,000 heat pumps installed in homes off the gas grid, we need to ensure supply chains can expand rapidly to meet increasing demand.

Manufacturers have told us that they can meet a significant increase in demand through expanding UK production and increasing imports by a minimum of 25-30% year-on-year for the next 15 years[25]. The UK currently manufactures 32% of the heat pumps installed in the UK, equating to 11,000 units per year. However, there is an important opportunity for growth in UK manufacturing in this sector, as analysis suggests that UK businesses are well placed to capitalise on this opportunity[26]. We believe that the UK could see a 30-fold increase in the number of heat pumps manufactured domestically by 2028.

Industry is also confident that investment in training and upskilling will drive an increase in the number of skilled installers – matching increased demand for heat pumps. They have said that there is sufficient training capacity to meet expected levels of demand through new installers entering the sector, and re-training and upskilling of existing heating installers - with over 30,000 new installers expected to be trained by 2028 as the number of heat pump installations increases rapidly. Existing oil and gas heating engineers can train to install heat pumps in one week or less[27], and we expect them to take up this training as demand increases. According to

[25] Heat Pump Manufacturing Supply Chain Research project, BEIS (2020), https://www.gov.uk/government/publications/heat-pump-manufacturing-supply-chain-research-project
[26] Ibid
[27] HPA. 'Training installers for the rollout of heat pumps' (2021), https://www.heatpumps.org.uk/training-heating-installers-for-the-rollout-of-heat-pumps/

BEIS research, over 70%[28] of existing fossil fuel boiler installers are willing to upskill in response to demand. We are also working with the Department for Education to ensure that the apprenticeship framework provides clear options for learning to install low carbon heating systems.

Government is also working closely with industry to ensure that installers have up-to-date, high-quality training, and that they are not undercut by installers providing cheaper, low-quality installations, avoiding poor quality installations which result in poorly performing systems.

Consultation questions:

14. Do you have any views on what more could be done to galvanise supply chains for low carbon heating? Please provide evidence to support your answer.

Equality Act 2010

Under the Public Sector Equality Duty, government must take steps to understand how policies will affect different groups in society in different ways, with a particular focus on removing or minimising disadvantages suffered by people due to the following protected characteristics: age; gender reassignment; being married or in a civil partnership; being pregnant or on maternity leave; disability; race including colour, nationality, ethnic or national origin; religion or belief; sex; and sexual orientation. Evidence suggests that occupants of homes off the gas grid tend to be older than average[29], meaning elderly consumers[30] may be more affected by the proposed regulations than younger consumers. This is due to the demographics of the off-gas grid housing stock, rather than a deliberate attempt to target this group of consumers.

Warm homes and thermal comfort play a crucial role in maintaining our health and wellbeing. Where this is not the case – for example, because heating systems are undersized or because there is a break in service when an oil boiler breaks down, various reports suggest that elderly[31], pregnant and disabled groups may be particularly affected and at an elevated risk[32,33] of negative health outcomes. We are addressing this risk through the work we are doing with industry, mentioned above, to ensure the heat pump installer base can rapidly expand to accommodate the increasing numbers of heat pump installations by 2026, and that heat pump installers are properly trained in low carbon heating technologies.

[28] Heating systems in off gas grid areas: installers' experiences and attitudes towards low carbon heating, BEIS (2021), https://www.gov.uk/government/publications/heating-systems-in-off-gas-grid-areas-installers-experiences-and-attitudes-towards-low-carbon-heating
[29] Analysis of English Household survey Ministry of Housing, Communities & Local Government (2018).
[30] Citizens Advice Scotland. 'Off-gas consumers: Updated information on households without mains gas heating' (2018), Consumer Futures Unit publication series 2018/19-3 https://www.cas.org.uk/system/files/publications/2018-08-15_off-gas_report_final_0.pdf
[31] Office for National Statistics. 'Excess winter mortality in England and Wales: 2018 to 2019' (2020) https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/excesswintermortalityinenglandandwales/previousReleases
[32] NHS. 'How to stay well in winter' https://www.nhs.uk/live-well/healthy-body/keep-warm-keep-well/
[33] NHS. 'Cold weather increases risk of heart attack and stroke' (2018): https://www.england.nhs.uk/north/cold-weather-increases-risk-of-heart-attack-and-stroke/

Consultation questions:

15. Do you have any additional evidence on how groups protected under the Public Sector Equality Duty may be affected by our proposals to phase out high-carbon fossil fuel heating in homes off the gas grid?
16. Do you have any views on what more could be done to ensure households, and communities, affected by our proposals experience a smooth transition to clean heat? Please provide evidence to support your answer.
17. Do you have any further comments to make on our proposals to phase out high-carbon fossil fuel heating in homes off the gas grid? Please provide evidence to support your answer.

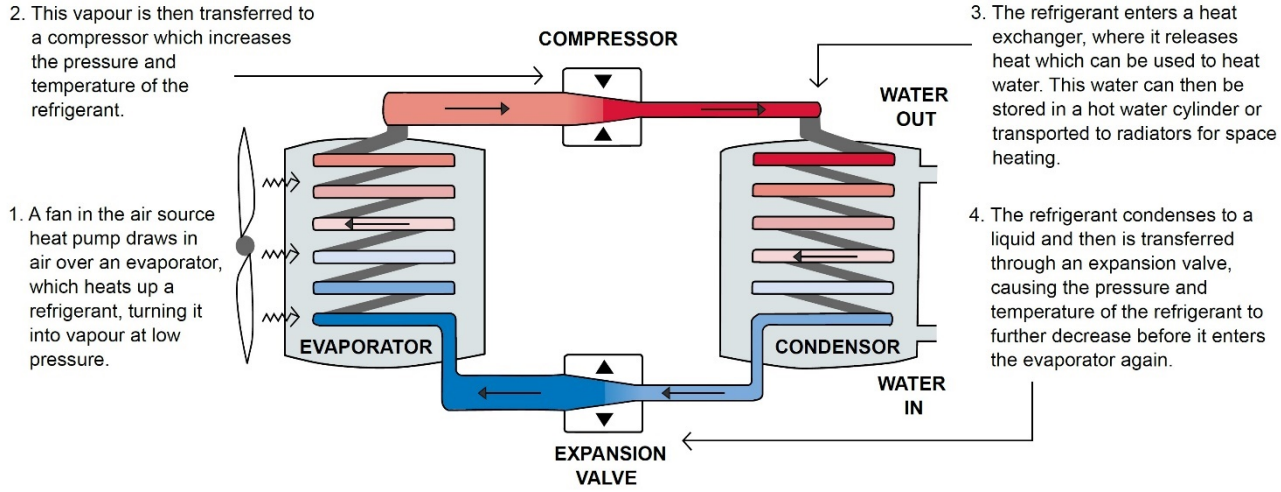
Annex: Low Carbon Heating Technologies

Air Source Heat pumps

How do air source heat pump systems work?

Air source heat pumps extract heat from the outside air to heat homes and can provide hot water. They can still extract heat when air temperatures are below 0°C. Air source heat pumps need electricity to run, but because they extract heat from the environment, a large portion of this heat is from a renewable source. In an air-to-water system – the most common type of heat pump currently used in UK homes – the heat pump distributes heat to the heating and hot water circuits of the house.

Figure 1: How does an air source heat pump work?



Low temperature heat pump systems output heat and hot water at lower temperatures – around 45° Celsius compared to at least 60° Celsius for an oil-fired system – and over much longer periods. This means that homes using low temperature heat pump systems may need higher levels of energy efficiency and lower levels of heat loss[34] to maintain thermal comfort than homes using high temperature systems such as oil. Large radiators may also be needed, along with hot water tanks to provide hot water.

High temperature air source heat pumps work in a similar way to low temperature heat pumps but can produce an output temperature of up to 65° Celsius – similar to incumbent fossil fuel heating systems such as oil[35] - and can therefore often be installed without upgrades to the home's energy efficiency or radiators. They run at lower levels of efficiency than low temperature heat pumps, and therefore cost more to run.

Low temperature air source heat pumps are associated with low levels of carbon emissions: 0.5t per year[36] in an average off gas grid household compared to 4.4t for an equivalent oil heated home[37]. High temperature heat pumps also deliver low levels of carbon, at 0.5t per year

[34] Assuming homes with heat loss <=100W/m2 are thermally suitable for low temperature air source heat pumps
[35] Oil boilers can output heat at 80°C or above
[36] Assuming 244% in-situ efficiency
[37] 15,000kWh of annual heat demand and current projection of grid carbon intensity is assumed (20 year average from 2026)

in an average off gas grid household[38]. As the electricity grid decarbonises with greater use of renewable energy sources, the use of air source heat pumps is consistent with our legally binding commitment to deliver net zero carbon emissions by 2050.

How much do they cost to buy and run?

Low temperature air source heat pumps currently cost on average £12,000 to install for an average[39] off-grid home.[40] As part of the Heat and Buildings Strategy we are setting an ambition of working with industry to reduce upfront costs of installing a heat pump by 25-50 per cent by 2025 and to achieve cost parity between heat pumps and gas boilers by 2030. Low temperature air source heat pumps currently cost on average £1,400 a year to run for a home with 15,000kWh annual heat demand[41], however going forward we expect them to be no more expensive to run than oil boilers, and in many cases cheaper, due to action including on energy efficiency upgrades, heat pump efficiency, and smart tariffs. The upfront installation cost of a high temperature air source heat pump system is expected to be comparable to the cost for a low temperature heat pump. However, as they run at lower levels of efficiency they are more expensive – around £150 more per year – to run than an equivalent low temperature heat pump system[42].

What is their deployment potential?

The evidence received from stakeholders in response to our 2018 call for evidence[43] reaffirmed our view that heat pumps offer the greatest heat decarbonisation potential for the majority of buildings off the gas grid and this concurs with the Committee on Climate Change findings[44]. This also aligns with a recent Carbon Trust report[45] on behalf of the Greater London Authority which found that 'with appropriate design, installation and operation, heat pumps are technically viable across all London building types'. The National Infrastructure Commission also notes electrification of heat using heat pumps as one of the potential large-scale solutions for rolling out low carbon heating across our housing stock[46].

BEIS analysis suggests that it would be feasible to install low temperature heat pumps in around 80% of fossil fuel heated off gas grid homes, based on their current energy efficiency and internal fuse limits. This potentially rises to around 90%, with fabric upgrades including draught-proofing, cavity wall insulation, floor, and loft insulation, and / or more major upgrades such as external wall insulation[47].

[38] Ibid
[39] Typically, a detached house with 100-150 m2 floor area
[40] A 10kW system is assumed excluding VAT. Estimate includes the HP unit and labour costs, HP tank and cylinder, control, and retrofit of radiators. Decommissioning of existing oil tank is not included.
[41] Year 2026. 244% in-situ efficiency is assumed. Use of heat storage, time-of-use tariff and higher HP efficiency would lead to lower running costs.
[42] Assume the SPF for a HT system is 0.4 lower than the LT equivalent, for a home with 15,000kWh annual heat demand. Evidence on the in-situ performance of HT-system is limited at this stage. 10% uplift in space heating demand is assumed for running a LT system.
[43] BEIS. 'A Future Framework for Heat in Buildings: A Call for Evidence' (2018), https://www.gov.uk/government/consultations/a-future-framework-for-heat-in-buildings-call-for-evidence
[44] The Committee on Climate Change. 'Net Zero: The UK's Contribution to Stopping Global Warming' May 2019 https://www.icax.co.uk/pdf/Net-Zero-The-UKs-contribution-to-stopping-global-warming.pdf
[45] The Carbon Trust, Heat Pump Retrofit in London, August 2020. https://www.carbontrust.com/resources/heat-pump-retrofit-in-london
[46] National Infrastructure Commission. 'National Infrastructure Assessment', July 2018 https://nic.org.uk/studies-reports/national-infrastructure-assessment/
[47] BEIS Analysis. Analysis based upon the National Household Model. BEIS. 'National Household Model', https://data.gov.uk/dataset/957eadbe-43b6-4d8d-b931-8594cb346ecd/national-household-model

Other factors beyond the home's level of energy efficiency may play a role in whether low temperature heat pumps can be installed. Homes with limited space may struggle to accommodate a low temperature heat pump, whose average size is typically larger than a fossil fuel boiler and may require the installation of internal and external components including a water tank, new radiators and outside unit to draw heat from the air. BEIS analysis indicates that most oil heated homes also use hot water storage tanks, which limits the additional footprint needed within the home to accommodate a low temperature air source heat pump.

Some homes with a heritage status or which are in a conservation area may also face legal constraints that may, in practice, prevent the installation of a low temperature heat pump system, particularly where building fabric may need to be upgraded to reduce heat loss. Heritage homes may be subject to more rigorous planning rules and may require more costly and bespoke solutions to heat decarbonisation to enable the character of the property to be retained. There around 1.3 million heritage homes in the UK, and low temperature heat pumps may not be suitable in a large proportion of these homes.[48]

As high temperature heat pumps deliver high output temperatures – similar to incumbent fossil fuel systems widely used in off gas grid homes – we believe these systems can be installed in almost all existing homes off the gas grid (although some may require upgrades to energy efficiency or heat emitters).

We also note that many heat pumps use hydrofluorocarbon-based refrigerants, which are themselves greenhouse gases. The UK is committed to reducing hydrofluorocarbon use by 85% by 2036, and future heat pump deployment will need to reflect this by ensuring that use of hydrofluorocarbons is phased out in favour of alternative technologies.

Heat pumps can also be used as part of a hybrid system using more than one technology (such as an air source heat pump and a combustion boiler) within the same heating system. Hybrid heat pumps are available today, combined with fossil fuel boilers. However, for hybrids to play a long-term role in the decarbonisation of buildings off the gas grid, the fuel used by the boiler must be net zero-consistent. This creates a clear synergy between hybrid heat pumps and the use of sustainable biofuels which are 100% bio-derived or which can demonstrate a clear trajectory to removing all fossil fuel content.

We recognise the need for further research to fully understand the deployment potential of heat pumps in homes off the gas grid. In August 2019, BEIS launched the Electrification of Heat Demonstration Project. This £14.6 million project aims to demonstrate the feasibility of a large-scale transition to electrification of heat in Great Britain by installing heat pumps in a representative range of homes, alongside new products and services designed to overcome the barriers to deployment.

Ground source heat pumps

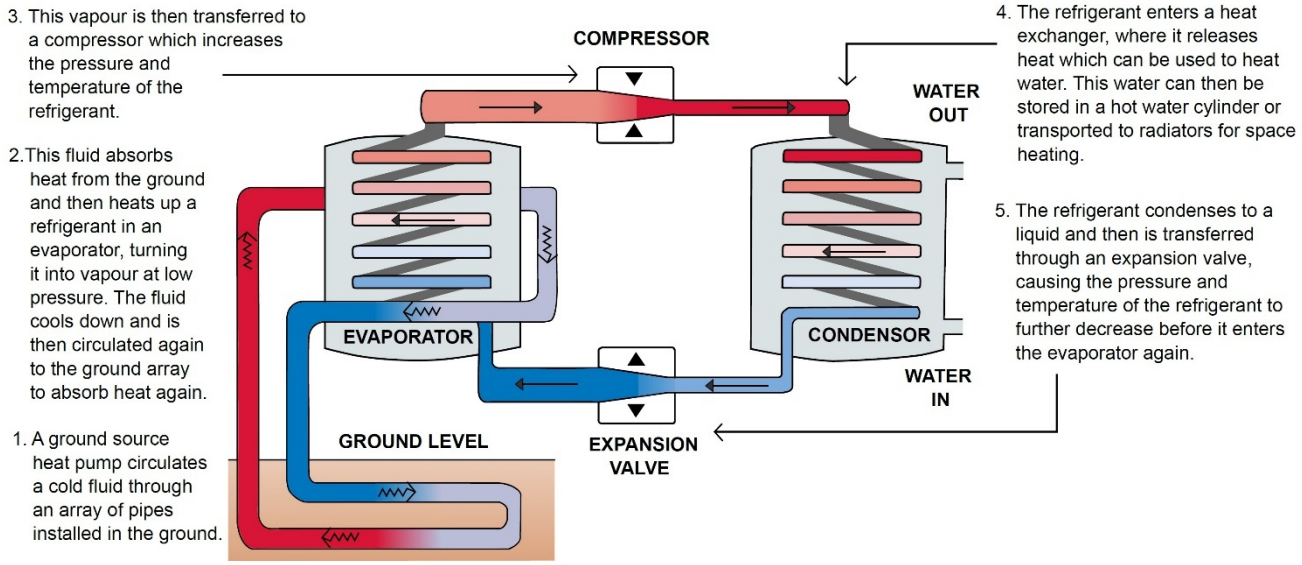
How do ground source heat pump systems work?

Ground source heat pumps extract heat from the ground to heat homes and provide hot water. Heat from the ground is extracted into fluid contained in a loop of pipe, called a ground loop, which is either buried in a shallow trench or a vertical borehole around 100m deep.

[48] The Committee on Climate Change, Net Zero Technical Report, May 2019, pp. 81, 82. https://www.theccc.org.uk/publication/net-zero-technical-report/

Like air source heat pumps, ground source heat pumps require electricity to run and their heat output is greater than their electricity requirement as they make use of heat from the environment. Because ground source heat pumps use a combination of renewable heat from the environment, and electricity, they are associated with low levels of carbon emissions, 0.4t per year in an average off gas grid household[49]. As the electricity grid decarbonises with greater use of renewable energy sources, the use of ground source heat pumps is consistent with our legally binding commitment to deliver net zero carbon emissions by 2050.

Figure 2: How does a ground source heat pump work?



Heat pump efficiency is dependent on the temperature of the heat energy extracted from the environment. For air source heat pumps this varies across seasons depending on the external air temperature throughout the year, for ground source heat pumps this is relatively stable particularly in winter when space heating demand is at its highest. Therefore, ground source heat pumps generally run at higher levels of efficiency than air source heat pumps.

How much do they cost to buy and run?

The upfront cost of a ground source heat pump system is higher than other low carbon heating technologies – currently at around £24,000[50] - although as they are highly efficient they can cost less to run – at around £1,300 per year for a home with 15,000kWh annual heat demand, however going forward we expect them to be no more expensive to run than oil boilers, and in many cases cheaper, due to action including on energy efficiency upgrades, heat pump efficiency, and smart tariffs[51].

[49] 15,000kWh of annual heat demand and current projection of grid carbon intensity is assumed (20 year average from 2026)

[50] Assuming an average system size of 11kW with a trench ground collector. Costs includes the heat pump unit, labour cost, HP water cylinder and tanks, trench ground collector, exclusive of VAT. Oil tank decommission cost is not included. BEIS analysis of Delta EE (2018) 'The Cost of Installing Heating Measures in Domestic Properties', https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/913508/cost-of-installing-heating-measures-in-domestic-properties.pdf

[51] Year 2026. In-situ efficiency of 284% is assumed. Use of heat storage, time-of-use tariff and higher HP efficiency would lead to lower running costs.

What is their deployment potential?

Due to the relatively high upfront costs of installing a ground source heat pump and the external space they require, they are typically installed in larger domestic properties which have access to ample outdoor space (and suitable access for light machinery for digging the trench or drilling the borehole). They may also be included as part of a communal heating system (e.g. for a block of flats), meaning costs can be shared and space can be saved as individual heat units would not be needed.

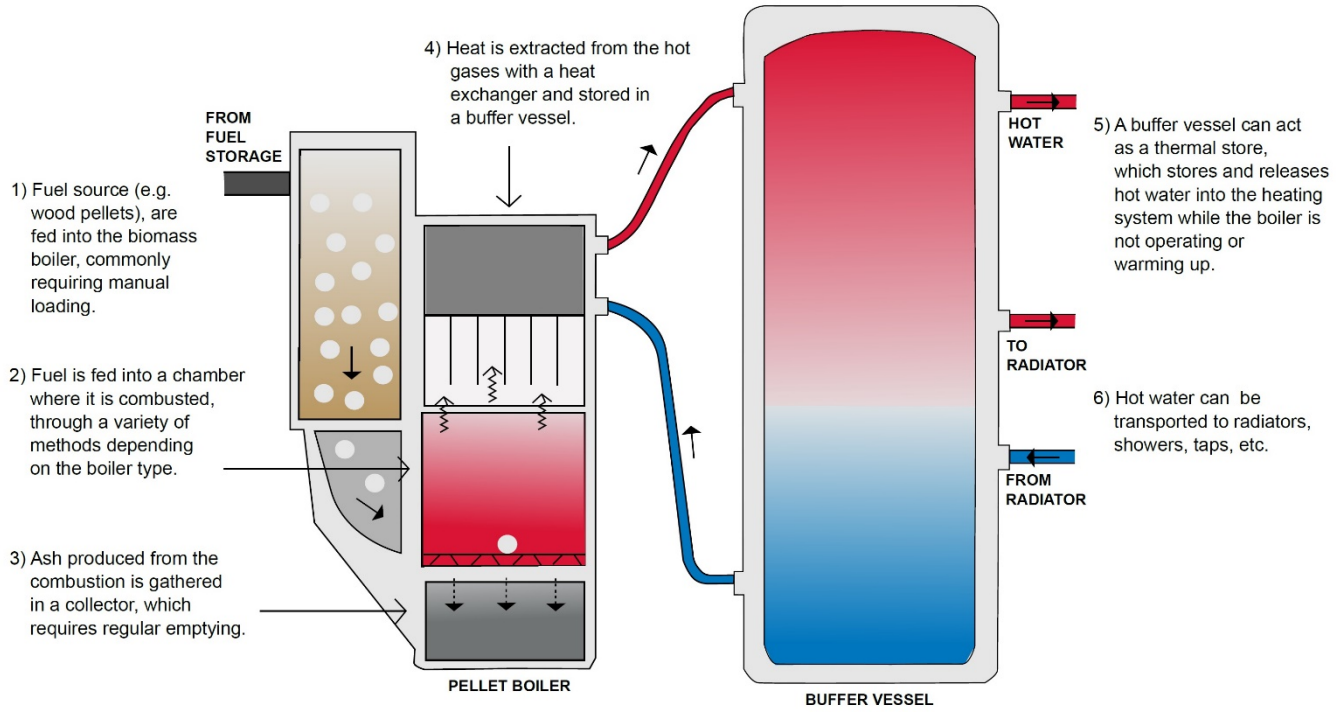
We also note that many heat pumps use hydrofluorocarbon-based refrigerants, which are themselves greenhouse gases. The UK is committed to reducing hydrofluorocarbon use by 85% by 2036, and future heat pump deployment will need to reflect this by ensuring that use of hydrofluorocarbons is phased out in favour of alternative technologies.

Solid biomass fuelled heating systems

How do solid biomass fuelled heating systems work?

Wood-fuelled heating systems, also called biomass systems, burn wood pellets, chips or logs to provide warmth in a single room or to power central heating and hot water cylinders to heat the whole house. Use of woody biomass for decarbonising heating differs from other responses to climate change in that the production of the fuel provides a mechanism to absorb carbon from the atmosphere, compared to other responses which focus on the reduction of carbon emissions[52]. Biomass boilers operate in a similar fashion to conventional gas and oil boilers, which involves burning the fuel source (e.g. wood pellets) to heat water, which is then circulated to provide the heating requirements for a building.

Figure 3: How does solid biomass combustion work?



[52] The Committee on Climate Change: Biomass in a low-carbon economy (2018) https://www.theccc.org.uk/publication/biomass-in-a-low-carbon-economy/

Solid biomass derived from sustainable sources is associated with low levels of carbon emissions, 1.1t CO2e per year in an average off gas grid household[53]. The combustion of solid biomass is considered compatible with the UK's net zero targets provided the fuels used are derived from a sustainable source that is being managed through the correct land use criteria.

How much do they cost to buy and run?

Solid biomass systems are one of several potential low carbon heating options for off gas grid homes that are not suitable for a low temperature air source heat pump. They cost between £13,000 and £25,000 to install in an average sized off gas grid home[54], and £900 to run per year for a home with 15,000 kWh annual heat demand.[55]

What is their deployment potential?

As solid biomass boilers provide heat and hot water at high temperatures, they do not typically require energy efficiency upgrades to deliver thermal comfort. This means that this technology can be installed across a range of properties that may not be suitable for a heat pump due to factors such as building fabric, high heat loss or 'heritage status.'

Solid biomass has a strategic role to play in UK decarbonisation – however, we believe that it should play a niche and limited role in decarbonising heat, in line with advice from the Climate Change Committee (CCC), in order to maximise its overall carbon abatement potential given limited supply of woody biomass from sustainable sources. Government currently supports solid biomass installations through the Renewable Heat Incentive, subject to high standards for the type and origin of biomass fuel used. This limits greenhouse gas emissions and ensure fuels are derived from sustainable sources.

In line with the government's Clean Air Strategy, we continue to place increasing importance on managing the air quality impact of burning biomass. Without appropriate abatement, use of solid biomass can increase levels of air pollution – including particulate matter and oxides of nitrogen - unless it involves a switch away from a dirtier fuel such as coal. This is particularly problematic when the burning takes place in or close to urban areas.

As a result, our consultation on the Clean Heat Grant proposed that future support for biomass boilers will be targeted at rural, off-gas grid areas where there is less potential for concern regarding local air quality than urban areas, and in 'hard to treat' properties that are not suitable for heat pumps. From 2021, the Government is considering introducing additional measures to improve air quality emitted from biomass boilers, including the introduction of annual maintenance checks for all participants on the scheme and ensuring that the quality of fuel used is of an approved standard.

[53] 15,000kWh annual heat demand and 0.05 kgCO2e/kWh carbon intensity is assumed. BEIS & DEFRA: 'Greenhouse gas reporting: conversion factors 2019', (2019), https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/847123/conversion-factors-2019-flat-file-automatic-processing.xls

[54] Average system size of 12kW is assumed. Costs include the biomass boiler unit, labour, buffer cylinders, control, and pellet store exclusive of VAT. Oil decommission cost is not included. Bigger homes will require a bigger biomass system. BEIS analysis of Delta EE (2018). 'The Cost of Installing Heating Measures in Domestic Properties', https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/913508/cost-of-installing-heating-measures-in-domestic-properties.pdf

[55] Year 2026. 70% in-situ efficiency is assumed

Liquid biofuels

Liquid biofuels are produced from renewable, biological sources such as vegetable oils or energy crops[56], and provide a potential alternative to fossil fuels such as kerosene heating oil or liquid petroleum gas (LPG). Biofuels blended with conventional petrol and diesel are used today in the transport sector, and there has been some limited deployment of biofuels in commercial or non-domestic heating. Biofuels are rarely used today in domestic heating, although there are a range of fuels with the potential to play a role in the future low carbon heating mix provided that they are shown to be consistent with net zero emissions, and compatible with the government's wider objectives on sustainability and air quality.

How do biofuel heating systems work?

Some biofuels can be considered 'drop in' fuels, compatible with existing fossil fuel heating systems, whereas others may require a new boiler or tank to be installed. The following paragraphs cover biofuels which are available today, and those which are under consideration by government and the oil and liquid petroleum gas industries.

Bio liquid petroleum gas (also known as biopropane) is a drop-in fuel which can be used in conventional liquid petroleum gas heating systems without any modifications needed. However – nearly all current use of bio liquid petroleum gas for domestic heating purposes currently involves some use of fossil fuels which are blended with limited bio resources before they are sold to customers. We are aware that the industry has an ambition to deliver 100% bio liquid petroleum gas by 2040, and that significant amounts of investment and research would be needed before this could be delivered.

Biodiesel can be blended with fossil fuel kerosene in various proportions. However, due to the chemical composition of the biodiesel used, industry have suggested limiting the blend to 30% biodiesel content (known as B30K). B30K can be considered a drop-in fuel for newer models of existing oil boilers and tanks with very little modification requirement; however, it is not compatible with net zero targets as a large proportion of the blend is heating oil.

100% biodiesel fuels, derived from a variety of vegetable oils, as well as from restaurant grease, various animal fats, and soap stock, are already available in the UK – mostly used in the transport sector and supported by the Renewable Transport Fuels Obligation, whereby fuel suppliers in the UK must be able to show that a percentage of their fuel comes from sustainable renewable energy sources. There are two biodiesel products which may play a role in the decarbonisation of heating:

- Fatty Acid Methyl Ester biodiesel: Used mostly in the transport sector and in some commercial boilers - we are not aware of any current use in UK domestic heating, beyond some small-scale trials. Not a drop in fuel - consumers would need to switch to a new boiler system designed to accommodate the fuel.
- Hydrogenated Vegetable Oil: Used mostly in the transport section – from a technical perspective it could work as a drop in fuel where existing oil systems are in use (with certain modifications), although its use in domestic heating is currently very low.

How much do they cost to buy and run?

Where biofuels are considered drop in fuels for existing modern oil systems, there may be a cost associated with conversion of either oil boiler or tank, depending on the fuel used and the

[56] NNFCC (BEIS Research Paper): 'Evidence Gathering for Off-Gas Grid Bioliquid Heating Options' (2019) https://www.nnfcc.co.uk/publications/report-bioenergy-off-grid-heating

condition of the system. This may be in the region of £500 for minor modifications, although evidence on these costs is limited. Bio liquid petroleum gas, which is chemically identical to fossil liquid petroleum gas, requires no conversion of existing LPG boilers or tanks. Evidence on the cost of Fatty Acid Methyl Ester boilers and tanks is again limited, as these are not widely available for domestic consumers, however BEIS research from 2019[57] suggests costs could be in the region of £6,000 if both boiler and tank need to be replaced[58]. Evidence on the cost of running a liquid biofuel heating system is currently limited, although we understand they are often more expensive to run than an equivalent fossil fuel heating system, reflecting the fact liquid biofuels are rarely used today in domestic heating.

What is their deployment potential?

As with solid biomass, the deployment of liquid biofuels for off gas grid heating will be limited by constraints on the global availability of sustainable biomass feedstocks. For this reason, government will seek to give priority to sectors which have fewer alternatives to decarbonisation – for example, aviation. A further constraint on deployment is the current limited availability of biofuels for the domestic heating sector, and higher running costs for consumers compared to equivalent fossil fuel systems.

It is not yet clear whether bio liquid petroleum gas could be deployed at scale consistent with net zero emissions. Current global production of bio liquid petroleum gas is less than 0.1% of total liquid petroleum gas supply[59]. The industry is currently investing in research and development, but we understand that blends of bio liquid petroleum gas are not yet widely available for domestic heating on a commercial basis.

Further evidence is therefore needed to consider what role these biofuels could play in the future low carbon heating mix off the gas grid, and to develop the policy framework which would support such a role. In gathering further evidence, we are giving consideration to the availability and sustainability of biofuel feedstocks, likely end user costs, the total lifecycle emissions for different fuels, and the best uses of biofuels across the economy.

The department recently published a call for evidence[60] to inform the development of a Biomass Strategy. This strategy will review the amount of sustainable biomass available to the UK, including liquid biofuels, and how this could be best used across the economy to achieve our net zero target. It will also assess the UK's current biomass sustainability standards, which are some of the most stringent in the world, to see where and how we can improve them even further.

Hybrid heating systems comprising of a biofuel boiler and air source heat pump may provide a route for limited bio-resources to stretch further. The market for hybrid heat pumps in the UK today is nascent, although the European market is slightly more developed and awareness of this technology amongst UK consumers and the heating and energy industries is increasing.

[57] NNFCC. 'Evidence gathering for Off Gas Grid Bioliquid Heating Options, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/831069/Bioenergy_heating_options_in_off-gas_grid_homes.pdf

[58] This excludes ancillary costs related to an oil system, such as new controls and water tanks.

[59] World Liquid Petroleum Gas Association. 'Bio LPG: The Renewable Future', https://www.wlpga.org/wp-content/uploads/2018/10/BioLPG-The-Renewable-Future-2018.pdf

[60] BEIS 'Role of biomass in achieving net zero: call for evidence' (2021), https://www.gov.uk/government/consultations/role-of-biomass-in-achieving-net-zero-call-for-evidence

Consultation questions

1. Do you agree with the principle of working with the natural boiler replacement cycle as the key trigger to deploy low carbon heat? Please provide evidence to support your response.
2. Would a 2026 end date for the installation of fossil fuel heating in homes off the gas grid give industry and consumers sufficient time to prepare for the regulations? Please provide evidence to support your response.
3. Do you agree with a heat pump first approach to replacement heating systems in fossil fuel heated homes off the gas grid that can reasonably practicably accommodate a heat pump? Please provide evidence to support your response.
4. Do you have any views on the design or content of guidance that will help households and installers determine whether it is reasonably practicable to install a heat pump? Please provide evidence to support your answer.
5. Do you have any additional evidence on the size and characteristics of the cohort of homes off the gas grid that have the greatest deployment potential for ground source heat pumps?
6. Do you agree that the performance of replacement heating systems in homes off the gas grid that cannot reasonably practicably accommodate a heat pump should reflect the current high standards of performance that can be delivered through high temperature heat pumps and solid biomass systems? Please provide evidence to support your answer.
7. Do you agree that future use of solid biomass to decarbonise heat in homes off the gas grid should be limited to rural, off-gas grid areas where air quality can be better controlled, and in ‘hard to treat’ properties that are not suitable for other low carbon heating technologies? Please provide evidence to support your response.
8. Do you have any views on the development of heating fuels and systems which will be consistent with wider government objectives on net zero emissions, environmental sustainability and air quality, and offer a secure and affordable fuel supply to consumers, from 2026? Please provide evidence to support your answer.
9. Do you agree with an end date for the use of remaining fossil fuel heating in homes off the gas grid by the late 2030s? Please provide evidence to support your answer.
10. Do you have any views on measures the Government could introduce to ensure that fossil fuel heating will no longer be used in homes off the gas grid by the late 2030s? Please provide evidence to support your answer.
11. Do you have any views on how best to ensure compliance with the proposed regulations laid out through this consultation? Please provide evidence to support your answer.
12. Do you have any views on what more could be done to address financial barriers to heat pump deployment? Please provide evidence to support your answer.
13. Do you have any views on how we should encourage smart-enabled heating in homes off the gas grid? Please provide evidence to support your answer.
14. Do you have any views on what more could be done to galvanise supply chains for low carbon heating? Please provide evidence to support your answer.
15. Do you have any additional evidence on how groups protected under the Public Sector Equality Duty may be affected by our proposals to phase out high carbon fossil fuel heating in homes off the gas grid?
16. Do you have any views on what more could be done to ensure households, and communities, affected by our proposals experience a smooth transition to clean heat? Please provide evidence to support your answer.
17. Do you have any further comments to make on our proposals to phase out high carbon fossil fuel heating in homes off the gas grid? Please provide evidence to support your answer.

This consultation is available from: www.gov.uk/beis

If you need a version of this document in a more accessible format, please email enquiries@beis.gov.uk. Please tell us what format you need. It will help us if you say what assistive technology you use.