**Title:** Phasing out the installation of fossil fuel heating in homes off the gas grid
**IA No:** BEIS015(C)-21-CH

**RPC Reference No:** N/A
**Lead department or agency:** Department for Business, Energy and Industrial Strategy
**Other departments or agencies:** None

# Impact Assessment (IA)

**Date:** 18/10/2021

**Stage:** Consultation

**Source of intervention:** Domestic

**Type of measure:** Secondary Legislation

**Contact for enquiries:** offgasgridheatconsultation@beis.gov.uk

## Summary: Intervention and Options

**RPC Opinion:** Not applicable

| **Cost of Preferred (or more likely) Option** (in 2019 prices, 2020 present value) | | | |
|---|---|---|---|
| **Total Net Present Social Value** | **Business Net Present Value** | **Net cost to business per year** | **Business Impact Target Status** N/A |
| £9,800m | -£442m | £30m | |

**What is the problem under consideration? Why is government action or intervention necessary?**

The UK's net zero target require government to take actions to fully decarbonise the heat sector. Deployment of low carbon heating technologies is currently low due to significant market and system barriers, including negative externalities and system lock-in. Government actions are required to prevent the continuing reinstallation of high carbon fossil fuel systems in off gas grid homes, preventing further system lock-in, and creating the condition for market expansion, cost reduction, and accelerate innovation to enable rapid transition towards cleaner heating fuel.

**What are the policy objectives of the action or intervention and the intended effects?**

The policy is intended to drive large scale adoption of cleaner heating fuels in homes off the gas grid in England. This is to support meeting our legally binding carbon budget targets. The intended effects are to: reduce carbon emissions from heating systems; provide certainty to support investment in supply chains; create and expand markets for clean heating technologies supporting green jobs and creating opportunities for UK industry; to drive down costs and accelerate innovation; to deliver air quality benefits.

**What policy options have been considered, including any alternatives to regulation? Please justify preferred option (further details in Evidence Base)**

**Option 1.** End installations of fossil fuel heating systems in off gas grid domestic buildings from 2026 with a low temperature (LT) heat pump first approach and a possible end to the use of fossil fuel heating in the sector by the late-2030s. Households are not required to upgrade their properties to accommodate for LT heat pumps.

**Option 2 (preferred option):** End installations of fossil fuel heating systems in off gas grid domestic buildings from 2026 with a LT heat pump first approach and a possible end to the use of fossil fuel heating in the sector by the late-2030s. Households are required to undertake minor upgrades to their properties where needed to accommodate for low temperature heat pumps

**Option 3:** End installations of fossil fuel heating systems in off gas grid domestic buildings from 2026 with a LT heat pump first approach and a possible end to the use of fossil fuel heating in the sector by the late-2030s. Households are required to undertake major upgrades to their properties where needed to accommodate for LT heat pumps

Past policies using a non-regulatory approach have not resulted in large scale take up of low carbon heating in off gas grid homes with sales of fossil systems still many times greater than low carbon systems. Regulatory approaches are most likely to deliver the large scale take up needed to meet carbon budgets and provide certainty to support investment in supply chains[1]. Option 2 is preferred to option 1 as minor fabric upgrades have a quick payback period and will allow more consumers to access more efficient low carbon heating (thereby reducing their heating bills compared to option 1). Option 2 is preferred over option 3 as while major fabric upgrades would further increase the number of consumers on higher efficiency heat, the high capital cost, level of disruption and long installation time associated with these could make this impractical for many households.

**Will the policy be reviewed?** It will be reviewed. **If applicable, set review date:** Month/Year

| | | | | |
|---|---|---|---|---|
| Does implementation go beyond minimum EU requirements? | | N/A | | |
| Is this measure likely to impact on international trade and investment? | | No | | |
| Are any of these organisations in scope? | **Micro** Yes | **Small** Yes | **Medium** Yes | **Large** Yes |
| What is the $CO_2$ equivalent change in greenhouse gas emissions? (Million tonnes $CO_2$ equivalent) | | **Traded:** +3.3 | **Non-traded:** -63.9 | |

[1] BEIS (2018) A future framework for heat in buildings - call for evidence: government response https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/762546/Future_Framework_for_Heat_in_Buildings_Govt_Response__2_.pdf

***I have read the Impact Assessment and I am satisfied that, given the available evidence, it represents a reasonable view of the likely costs, benefits and impact of the leading options.***

Signed by the responsible Minister  Date:15/10/2021

# Summary: Analysis & Evidence

## Policy Option 2

**Description: Preferred option-** End installations of high carbon heating systems from 2026 in domestic buildings, and a possible end to the use of high carbon heating systems from late-2030s. Requirement for households to undertake minor energy efficiency improvements to install LT heat pumps, where reasonably practicable to do so.

**FULL ECONOMIC ASSESSMENT**

| Price Base Year 2020 | PV Base Year 2026 | Time Period Years 20 | Net Benefit (Present Value (PV)) (£m) | | |
|---|---|---|---|---|---|
| | | | **Low:** Optional | **High:** Optional | **Best Estimate**: **£12,200m** |

| **COSTS (£m)** | **Total Transition** (Constant Price) Years | | **Average Annual** (excl. Transition) (Constant Price) | **Total Cost** (Present Value) |
|---|---|---|---|---|
| **Low** | Optional | | Optional | **Optional** |
| **High** | Optional | | Optional | **Optional** |
| **Best Estimate** | | | | **£4,300** |

**Description and scale of key monetised costs by 'main affected groups'**

The largest societal costs are the capital costs associated with installing clean heating technologies followed by carbon costs in the traded sector

**Other key non-monetised costs by 'main affected groups'**

- Retraining costs associated with the upskilling of oil, coal and LPG installers or new low carbon heat installers

| **BENEFITS (£m)** | **Total Transition** (Constant Price) Years | | **Average Annual** (excl. Transition) (Constant Price) | **Total Benefit** (Present Value) |
|---|---|---|---|---|
| **Low** | Optional | | Optional | **Optional** |
| **High** | Optional | | Optional | **Optional** |
| **Best Estimate** | | | | **£16,500** |

**Description and scale of key monetised benefits by 'main affected groups'**

The largest monetised benefits are the carbon emissions savings in the non-traded sector, followed by reduced LRVC costs and air quality improvements.

**Other key non-monetised benefits by 'main affected groups'**

- Innovation benefits, reduced technology costs due to learning from wider deployment leading to future decarbonisation being more cost effective.
- Growth in the market for low-carbon heating appliances and the businesses and supported jobs that produce, sell and install them, produce or operate ancillary goods (e.g. thermal storage) and services (e.g. smart energy management and flexibility services, etc)
- Policy framework stability, enabling strategic confidence to invest in supply chains, training, etc

| **Key assumptions/sensitivities/risks** | **Discount rate** | 3.5 |
|---|---|---|

Cost reduction and performance of heating systems (actual in-situ performance of heating system), counterfactual replacement rate assumption, future fuel cost, carbon prices, housing stock within scope of the policy by 2026, and technologies deployment under regulations. This IA presents the uncertainty through a sensitivity analysis.

**BUSINESS ASSESSMENT (Option 2), 2019 prices, 2020 present value**

| **Direct impact on business (Equivalent Annual) £m:** | | | **Score for Business Impact Target (qualifying provisions only) £m:** |
|---|---|---|---|
| **Costs:** 37.0 | **Benefits:** Not quantified | **Net:** 37.0 | 150 |

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## Problem under consideration and context for heat decarbonisation

1. 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[1]. To ensure continued progress, we have set a series of legally-binding 'carbon budgets', covering interim periods, which are among the most stringent climate targets in the world.
2. Decarbonisation of heat is recognised as one of the biggest challenges we face in meeting our climate targets – approximately 23% of UK emissions is associated with heating buildings[2] and meeting net zero will require that virtually all heat in buildings will need to be decarbonised.
3. Given fossil fuel heating systems are typically designed for a 15-year lifecycle[3], 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. Only around 35,000 heat pumps[4] are currently installed annually compared to approximately 1.7m fossil fuel boilers[5].
4. Approximately 86% of households in England and 65% of non-domestic buildings are connected to the gas grid and use natural gas for heating. Those off the gas grid use other forms of heating, including oil, liquid petroleum gas (LPG), coal, biomass, electric heating and heat networks[6].
5. There are around 834,000 oil heated households in England, with a further 141,000 LPG-heated and 101,000 coal-heated households[7]. These homes are more likely to be larger, rural, detached properties compared to households on the gas grid.
6. Fossil fuel heated off gas grid homes produce a disproportionately larger share of emissions due to the higher carbon intensity of the fuels used[8] as well as the fact they are larger and have a lower level of building fabric efficiency.
7. 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.
8. As set out in the Heat and Building Strategy, for off gas grid homes we consider that electrification via heat pumps represents a low regrets option as the only strategic approach shown to work at scale. Current evidence suggests that most off-gas grid homes are already suitable for heat pumps or could become suitable with minor energy efficiency upgrades. Where heat pumps cannot be used, other low carbon heating systems are available. Emissions reductions will continue to grow as we further decarbonise our energy system and increase the role of renewables in our power generation.

## Policy objective

9. The consultation sets out plans to adopt a 'heat pump first' approach to replace the installation of fossil fuel heating systems(those that use oil, LPG, or coal) in homes off the gas grid from 2026.

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[1] 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

[2] 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)

[3] Viessmann. 'Oil Fired Boiler Installation Guide, https://www.viessmann.co.uk/faq/heating-replacement-installation/oil-boiler (viewed 08/10/2020)

[4] BSRIA (2020), 'Heat pumps market analysis' https://www.bsria.com/uk/product/rg76mr/world_market_for_heat_pumps_2020r2019_8a707622/

[5] BSRIA (2020), 'Domestic boiler market analysis' https://www.bsria.com/uk/product/nEjGED/domestic_boilers_world_market_for_heating_boilers_2020r2019_8a707622/

[6] BEIS analysis based on the English Housing Survey (2018)

[7] Analysis of English Household survey Ministry of Housing, Communities & Local Government ( 2018 ) https://www.gov.uk/government/collections/english-housing-survey. Coal figure include anthracite nuts, smokeless fuel, and house coal. We assume that following the ban of sales of house coal in the early 2020s most households using house coal as their main heating system will switch to smokeless fuel.

[8] https://www.theccc.org.uk/wp-content/uploads/2017/01/Annex-2-Heat-in-UK-Buildings-Today-Committee-on-Climate-Change-October-2016.pdf

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.

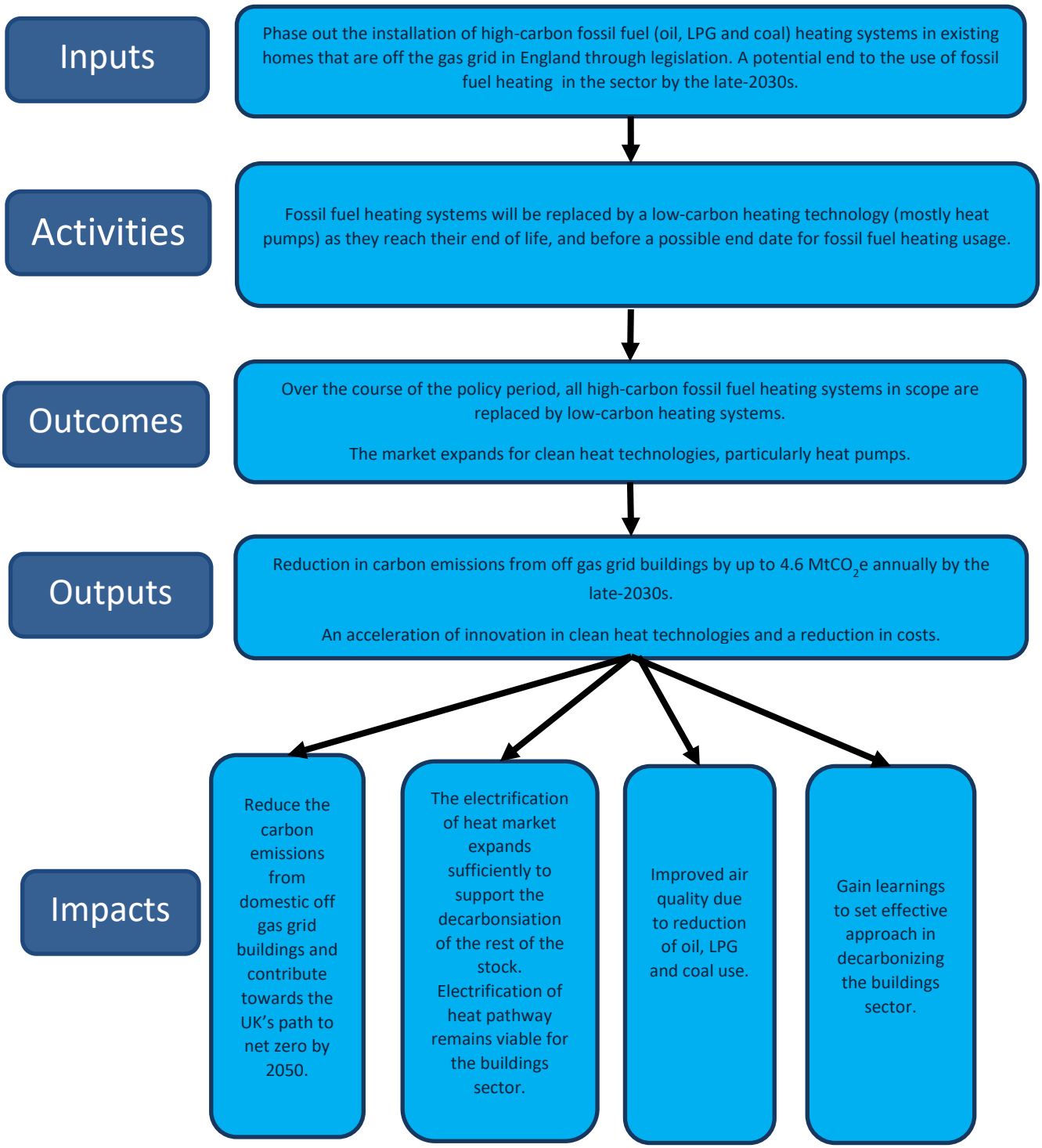
10. Introduction of these regulations will lead to a decline in the use of fossil fuels for heat in homes off the gas grid over the 2020s and 2030s which will produce significant reductions in carbon emissions from buildings, supporting efforts to meet carbon budgets as well as keeping the building sector on a path to meet net zero.
11. The regulations also intend to drive a significant increase in the deployment of low carbon heating systems, particularly heat pumps. The regulations will provide the low carbon heating sector with the certainty in the policy framework to align strategies, investment plans and training, and drive forward innovation in technologies and business models. The growth in the supply chains is also expected to support an increase in green jobs and create opportunities for UK manufacturers.
12. Growth in the heat pump supply chain for homes off the gas grid is also intended to align with the wider strategy on decarbonising heat from buildings. The Heat and Buildings Strategy has set out an ambition for an annual heat pump deployment of around 600k heat pumps by 2028 to keep the UK on track for net zero regardless of strategic decisions on the role of hydrogen in heating.
13. Widespread use of highly efficient heating appliances like heat pumps will also deliver air quality benefits.

## Policy overview

14. The Government intends to legislate to implement this measure and we are considering different options 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.

15. Below is a light-touch logic model, giving a visual representation of our policy and demonstrating the intended relationships between the actions and the objectives stated above. It is included to

give an understanding of the logic underpinning the policy and the path we expect the policy to take.




## Rationale for intervention

16. The current market for low carbon heat is relatively small, and these technologies are largely unable to compete on cost with conventional heating options, such as natural gas, oil and direct electric heating. This is partly due to the emerging nature of low carbon heating, which means that it does not benefit from economies of scale or from mature supply chains to the same degree as conventional technologies. Significant market and system barriers exist which has led to continued low uptake of low carbon heating technologies. Without government actions fossil fuels will continue to dominate UK's heating systems, stifling low carbon innovation and acting as barriers for the growth of markets for low-carbon technologies and services.

17. The main aspects of the economic rationale for regulating heating in the households off the gas grid are:

    a. **Externalities.** A key element of the rationale for this intervention is the market failure with respect to the uncaptured negative externalities associated to the use of conventional heating technologies. The full societal costs of heating based on fossil fuel combustion should consider the emission of greenhouse gases, leading to climate change and the impacts on health (related to the air quality impacts). Likewise, the relative positive effect of low-carbon heating on air quality and emissions, and thus the lower societal cost, is not captured in its price. This is likely to result in under-investment in low-carbon heating. The benefits of adopting low carbon heating technologies grow as the number of deployment increases, through a positive feedback effect between scale of market, learning, innovation, and cost reduction. This is not factored in individual decision or the private price of low carbon technologies.
    b. **System lock-in**. The Heat and Building Strategy sets out the need to completely decarbonise the heat sector in off gas grid buildings in the 2030s to stay on track with the net zero target. Conventional heating systems typically have a lifetime of about 15 years. Therefore, without a government intervention in the 2020s we would see the installations of conventional heating systems that could last well into the 2040s. This would imply having to remove fossil fuel systems at a rapid rate in later years, which would lead to higher disruption and costs to consumers, or even to premature scrappage of still functioning heating systems, which would increase the overall cost paid by consumers. This system lock-in also impedes opportunity for clean heating technologies to compete with the current system comprising of infrastructure, skills, engineering and consumer practises, and consumer familiarity.
    c. **Imperfect information**. Consumer research has shown that consumers are unfamiliar with heat pumps as an alternative to fossil fuel heating systems. This introduces imperfect competition by reducing the ability of consumers to choose the heating appliance based on merit, and thus constraining the technology's ability to compete in the market. This also contributes to information asymmetry between heat consumers and suppliers. An intervention in the market would raise consumer awareness, addressing this market failure.

## Policy scope

12 The 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

13 The proposed heat policy for domestic buildings would target households not connected to the gas grid using fossil fuel heating systems. 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[9].

14 Existing buildings with electric heating, biomass and heat networks as their main heating source are out of scope for the analysis as they will not be directly affected by the proposed regulation.

## Technology choice in the off-gas grid under proposed regulation

15 The domestic heat regulation sets out a heat pump first approach. This approach will set low temperature (LT) 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. Alternative technologies such as high temperature (HT) air source heat pumps and biomass boilers are also in scope with the regulation but will be permitted only when LT heat pumps cannot reasonably practicably be installed.

16 LT 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 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. They are established technologies and represent an efficient use of energy. Higher efficiencies are possible with the correct system design, installation and operation, and with higher thermal insulation of the property.

17 HT 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 - and can therefore often be installed without upgrades to the home's energy efficiency or radiators. We believe these systems can be installed in almost all existing homes off the gas grid. They run at lower levels of efficiency than low temperature heat pumps, and therefore cost more to run.

18 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, and are expected to be technically suitable for all buildings without further energy efficiency upgrades. As for HT heat pumps, biomass boilers will be permitted only when LT heat pumps cannot reasonably practicably be installed.

19 Current evidence suggests LT heat pumps are suitable for most buildings. BEIS modelling based on analysis of English Housing Survey data suggests around 80% have sufficient energy efficiency and internal electrical limit to accommodate a low temperature heat pump system. 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. We also intend to gather more evidence through the consultation process.

20 Most households which cannot currently install a low temperature heat pump due to heat loss can be made suitable through different levels of energy efficiency upgrades. Therefore, the heat pump first approach can be extended to more households than those currently suitable if sufficient energy efficiency measures are installed. In this Impact Assessment we evaluated

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

three options reflecting different levels of energy efficiency upgrades required to accommodate LT heat pumps.

21 In this Impact Assessment we distinguish between minor and major energy efficiency upgrades. Minor energy efficiency upgrades are generally cheaper and can be installed quickly: they include measures such as draught-proofing, cavity wall insulation, floor and loft insulation. Major energy efficiency upgrades are instead associated with higher costs and disruption and include measures such as solid wall insulation and double/secondary glazing.

22 Households which cannot reasonably practicably install a low temperature heat pump will have a choice of high performing, commercially available alternative heating technologies which are consistent with net zero emissions, offer a secure and affordable fuel supply to consumers, and are consistent with air quality and sustainability objectives. Based on evidence of system performance and deployment potential high temperature (HT) heat pumps and solid biomass would currently be consistent with these principles and represent viable choices for all homes affected by the regulation. Alternative heating technologies allowed under the regulations will need to meet the same standards of performance and characteristics of high temperature heat pumps and solid biomass systems.

## Outline of Policy Options

23 The option scenarios in the impact assessment are compared against the do-nothing scenario:

**Option 0: Do-nothing.** Under the counterfactual existing oil, LPG and coal heating systems will continue during the appraisal period to be replaced by the same systems at the end of life, assumed to be once every 15 years.

**Option 1.** End installations of fossil fuel heating systems in off gas grid domestic buildings from 2026 with a LT heat pump first approach, and a possible end to the use of fossil fuel heating in the sector by the late-2030s. Households are not required to upgrade their properties to accommodate for LT heat pumps.

**Option 2 (preferred option):** End installations of fossil fuel heating systems in off gas grid domestic buildings from 2026 with a LT heat pump first approach, and a possible end to the use of fossil fuel heating in the sector by the late-2030s. Households are required to undertake minor upgrades to their properties where needed to accommodate for LT heat pumps.

**Option 3:** End installations of fossil fuel heating systems in off gas grid domestic buildings from 2026 with a LT heat pump first approach, and a possible end to the use of fossil fuel heating in the sector by the late-2030s. Households are required to undertake major upgrades to their properties where needed to accommodate for LT heat pumps.

## Analytical approach

24 The IA presents the evidence of the impacts of the proposals for households, the business sector (private landlords), and the wider society. It follows the principle of the Green Book guidance in identifying the key direct costs and benefits for these groups. The changes are compared against a counterfactual scenario and are then monetised using standard Green Book appraisal values. Social net present values (SNPV) are derived by comparing the aggregate costs and benefits which are discounted by the social discount rate. Equivalent Annual Net Direct Cost to Business are also calculated for the business sector. Assumptions are varied to produce sensitivity analysis to show the sensitivity of SNPV with respect to changes in the assumptions used.

25 A cost benefit approach is limited in assessing non-marginal change, such as the creation of markets and accelerated innovation, which are among the objectives of the proposal. As such, the IA is supplemented by a qualitative discussion on wider impacts which sets out the evidence that are relevant to wider strategic considerations. The calculated SNPVs are therefore not intended to be viewed in isolation but should be assessed in combination with strategic considerations.

26 The analysis for domestic regulation is appraised over the timeframe between 2026, the regulation start date, and 2045 when low-carbon heating appliances installed in 2026 are assumed to have reached the end of their lifetime. We are therefore capturing costs and benefits of a single replacement cycle of the heating systems.

## Monetised costs and benefits

27 This section explains the key costs and benefits considered in the quantitative analysis.

- **Additional upfront capital costs**: this is the total additional upfront costs of the purchase and installation of low carbon heating technologies (excluding VAT), compared to the purchase and installation costs of the counterfactual heating system across the off gas grid sector. This includes additional ancillary costs such as new radiators for LT heat pumps. Evidence suggests that deployment and R&D could bring down the total capital cost of heat pumps, including both appliance and installations costs, by around 20% in a mass market scenario[10], while we assumed the cost of fossil fuel boilers to stay the same. In this impact assessment we assume that the 20% heat pump cost reduction is achieved by 2030. Unanticipated factors such as reduction in manufacturers margins could result in greater cost reduction. In the Risks and uncertainties section we test this assumption via sensitivity analysis. In practice, several businesses believe that significantly higher cost reductions can be achieved significantly faster; government shares this ambition.
- **Net energy savings** – Heat pumps are more efficient in producing heat, thus lowering the energy demand required. This is a benefit to the society and is valued using the long-run variable cost of energy supply. Energy efficiency measures taken to bring homes to LT heat pumps standard will also lead to energy savings. HMT Green Book supplementary guidance is used to value the long-run variable costs of energy supply (LRVCs)[11].
- **Carbon savings** – The replacement of fossil fuel will lead to a reduction in carbon emissions in the non-traded sector and to a small increase in the traded sector. These are monetised in accordance with appraisal values in HMT Green Book supplementary guidance.
- **Air quality benefits** –The displacement of fossil fuel will lead to improvement in air quality. Appraisal values from the Department for Environment, Food and Rural (Defra) are used to monetise this benefit[12]. Biomass air quality assumptions can be found in the Annex.
- **Hidden costs:** These include the time taken by households to research potential installations, to liaise with the installer, prepare the property for installation and any oversight, as well as clean-up or redecoration costs associated with the installation. The assumptions used to quantify hidden costs are based on a report by ECOFYS of domestic energy, updated to 2020 prices[13].
- **Maintenance costs:** this covers the annual costs to maintain the heating system.

## Non-monetised costs and benefits and strategic considerations

28 There are several non-monetised costs and benefits that are not captured in the cost-benefit analysis, including:

a. **Supply chain development** – by incentivising additional deployment of low-carbon heat technologies relative to the counterfactual, the regulation will support the development of low-carbon heat supply chains. This will provide certainty to the low carbon heat sector, allowing businesses to align strategies, investment plans and training, and drive forward innovation in technologies and business models. It will also help create green jobs and

[10] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/498962/150113_Delta-ee_Final_ASHP_report_DECC.pdf

[11] Green Book supplementary guidance: https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

[12] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/793632/data-tables-1-19.xlsx Rural activity damage costs for coal is used in appraising the air quality impacts of displacing smokeless fuel. Since smokeless fuel emits lower levels of air pollutants, current estimates of air quality benefits from displacing smokeless fuel is likely to be optimistic. This will be reviewed ahead of the final stage Impact Assessment.

[13] ECOFYS (2009). *The Hidden Costs and Benefits of Domestic Energy Efficiency and Carbon Saving measures*.

create opportunities for UK manufacturers. The development of the supply chain will be the base for the mass roll-out of low-carbon heating in the 2020s and subsequent decades, which will be needed to achieve the government's target of net zero carbon emissions by 2050. If monetised, this would have a positive impact on the SNPV.

**b. Innovation and cost reductions** – BEIS expects that increased deployment of low-carbon heat deployment will reduce costs and possibly increase performance over time, as supply chains develop and barriers that customers currently face are reduced through technologies being deployed successfully. Improved efficiency and cost reduction constitute a benefit also to all the low-carbon heating installations not within the scope of this policy, which have not been quantified. If monetised, they would have a positive impact on the SNPV.

c. **Reduced scrappage** - Given the expected lifetime of boilers of around 15 years, the later we start to end new installations of fossil fuel systems the greater number of systems we would need to phase-out at a later-date, and before their designed lifetime. This will incur higher level of capital and hassle costs for households and businesses. If monetised, this would have a positive impact on the SNPV.

**d. Health benefits** – switching away from fossil fuels can lead to improved indoor air quality for occupants improving their health. In addition, making energy efficiency improvements ahead of installing a low carbon technology can lead to a warmer home and therefore improve the health of occupants, for example by reducing their risk of cardiovascular and respiratory diseases as a result of warmer internal temperatures. If monetised, this would have a positive impact on the SNPV.

e. **Grid reinforcement** – electrification of heat increases the demand for electricity, potentially increasing the amount of electricity grid reinforcement needed (as well as costs and disruption associated with it). If monetised, this would have a negative impact on the SNPV. However, the increased certainty offered by regulation will help Distribution Network Operators to plan and deliver the extra capacity required more cost-effectively to accommodate an uptake of electric heating

## Modelling approach and results

### Modelling assumptions

29 The modelling analysis uses assumptions which draws on the evidence presented in the Annex.

30 Households expected to have clean heating systems installed between now and 2026 are excluded from the counterfactual and policy scenarios, as these buildings will not be affected by the proposed heat regulations. It is difficult to quantify the number of households that will fall in that category. As a modelling assumption in this Impact Assessment we have assumed that by 2026 the number of households in-scope for the heat regulations will have reduced by around 10%, as a consequence also of existing and announced policies such as the Renewable Heat Incentive. Different assumptions are tested through sensitivity analysis.

31 In the counterfactual we assume that fossil fuel heating systems are installed at a natural replacement rate of once every 15 years; this corresponds to around 50,000, 8,500 and 6,000 oil, LPG and coal[14] systems being replaced every year respectively.

32 In the central scenario fossil fuel heating systems are replaced by clean heat systems from 2026 and are assumed to be completely phased out by 2039. This corresponds to a replacement rate of once every 14 years, or around 70,000 low-carbon heating appliances installed every year. The choice of 2039 is a purely a modelling assumption; in the consultation we are 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. We will update the modelling assumption in future Impact Assessments.

[14] These are assumed to be smokeless fuels rather than traditional house coal, following the government's proposal to phase out sales of house coal and wet wood between 2021 and 2023 https://www.gov.uk/government/news/government-takes-action-to-cut-pollution-from-household-burning

33 The analysis estimates the aggregate costs and benefits of clean heat installations and energy efficiency measures over the period between 2026 and 2045, compared to the counterfactual scenario. Capital costs for heating systems and fabric measures are pro-rata-ed by their design lifetime to reflect the costs and benefits appropriately. This means that we have calculated the fraction of the capital cost proportionate to the number of years the heating appliances will be used within the appraisal period.

34 As described in paragraph 17 the policy takes a heat pump first approach, installing low temperature heat pumps wherever it is practical and reasonable and alternative low-carbon heating technologies otherwise. In this Impact Assessment we modelled the following technologies:

- **Low temperature heat pumps:** air-source heat pump (ASHP) and ground source heat pumps (GSHP)[15].
- **Alternative technologies**: high-temperature ASHP[16], solid biomass boilers.

35 The proportion of households installing low temperature heat pumps depends on the level of energy efficiency upgrades which are required, which varies across the 3 appraisal options:

a. Option 1 is expected to lead to the smallest number of households installing LT heat pumps and minimum number of properties undergoing energy efficiency upgrades to accommodate a LT heat pump. Only homes that are technically suitable for a LT heat pumps once the regulations have come into force would be required to install one at the point of boiler replacement.

b. Option 3 would lead to higher number of households installing LT heat pumps and a higher level of energy efficiency upgrades in the off-gas grid housing stock, as a direct result of the heat regulations. We assumed that households not already suitable for LT heat pumps will be required to spend £15,000 on average in energy efficiency upgrades to become suitable. This would allow major energy efficiency measures such as solid wall insulations to be in scope with the regulation. Alternative low carbon technologies are therefore limited to a smaller number of 'hard to treat' homes under option 3.

c. Option 2, the preferred approach, is expected to lead to some buildings to undergo minor efficiency upgrade to make installation of LT heat pumps viable. We assumed that households will be required to spend up to £2,000 (£1,000 on average) in energy efficiency upgrades to become suitable for LT heat pumps. This would allow only minor energy efficiency measures, such as cavity wall insulations, to be in scope with the regulation.

36 We expect some households to deploy energy efficiency measures before having to comply with the regulation. Installation of energy efficiency measures might increase the total number of households technically suitable for a LT heat pump. However, there is significant uncertainty around how many households within the scope of the regulation will have installed energy efficiency measures and on the impact those measures might have. Therefore, as a modelling assumption in all the options presented in this impact assessment, we used current evidence on heat pump suitability without assuming any energy efficiency upgrade at the baseline. This assumption carries the risk of overestimating the policy costs. For the same reason, we are not capturing the impact that energy efficiency upgrades (that are not installed to comply with the regulation) would have on households' heat demand, which would reduce the carbon savings potential.

37 In all scenarios we assume no improvement on the efficiency performance of fossil and low carbon technologies. In the sensitivity scenario this assumption is relaxed.

[15] Low temperature WSHP is modelled in the same way as GSHP in the analysis.

[16] ASHPs are used as the representative heat pump technologies to simplify the analysis.

38 Table 1 below summarises the key assumptions that differentiate options 1-3 in the modelling.

**Table 1: Key parameters of modelling scenarios for option 1-3**

| | **Option 1 – no requirement for energy efficiency upgrades** | **Option 2 (preferred option) – minor energy efficiency upgrades to install LT heat pumps** | **Option 3 – minor and major energy efficiency upgrades to install LT heat pumps** |
|---|---|---|---|
| Share of homes installing LT-heat pumps without fabric improvements | 81% | 81% | 81% |
| Share of homes upgrading fabric and installing LT heat pumps | 0% | 4% | 15% |
| **Total share of homes installing LT heat pumps** | **81%** | **85%** | **96%** |
| **Share of homes installing alternative low carbon technologies** | **19%** | **15%** | **4%** |
| **Average spend on fabric upgrades** | **£0** | **£1,000** | **£15,000** |
| Technology deployment mix for LT-heat pumps | 90% LT-ASHP, 10% LT-GSHP | | |
| Technology deployment mix for homes installing alternative heating technologies | 50% HT-ASHP, 50% Solid biomass boilers | | |

39 The share of households that are suitable for LT heat pumps without fabric improvements, and the average fabric upgrade costs required to meet minimum heat loss threshold, are informed by heat loss calculation in the National Household Model using the Standard Assessment Procedure.

40 We made the modelling assumptions that, amongst those installing LT heat pumps, 90% will install ASHP and 10% GSHP. This assumption is based on market intelligence suggesting that in recent years about 10% of total low-temperature heat pumps installed in the UK were GSHP[17]. However, consumers will have the choice to install the type of LT heat pumps they prefer, so the actual split might be different.

41 For homes not installing LT heat pumps, high-temperature ASHP and solid biomass are modelled to reflect the performance of alternative technologies that are also commercially available now. There is a high degree of uncertainty on what the deployment mix for this

[17] BSRIA (2020), 'Heat pumps market analysis' https://www.bsria.com/uk/product/rg76mr/world_market_for_heat_pumps_2020r2019_8a707622/

category of homes will be. For modelling purposes, in this Impact Assessment we have assumed a 50/50 split between HT heat pumps and biomass boilers

42 Sensitivity tests, including testing the assumption on heat pumps suitability, are discussed in Risks and Uncertainties section.

## CBA Results

43 This section presents the modelled CBA results. Table 2 shows that net benefits are estimated across option 1-3.

**Table 2: Quantified costs and benefits for policy options (PV base year 2026, £m, 2020 prices), 2026-2045**

**Figures are rounded to nearest £100m.**

| | **Option 1 - no requirement for energy efficiency upgrades** | **Option 2 – preferred option/ central scenario** | **Option 3 – minor and major energy efficiency upgrades to install LT heat pumps** |
|---|---|---|---|
| **Social Net Present Value (SNPV) (£m)** | **11,600** | **12,200** | **14,300** |
| **Quantified Benefits (£m)** | **16,100** | **16,500** | **18,800** |
| *Carbon savings, non-traded sector* | 13,300 | 13,400 | 14,200 |
| *Energy savings (LRVC)* | 2,000 | 2,100 | 3,100 |
| *Net air quality benefits*[18] | 800 | 1,000 | 1,500 |
| **Quantified Costs (£m)** | **4,500** | **4,300** | **4,500** |
| *Capital costs* | 3,700 | 3,500 | 3,600 |
| *Hidden costs* | 100 | 100 | 200 |
| *Maintenance costs* | - | - | - |
| *Carbon costs, traded sector* | 700 | 700 | 700 |
| **CB4 NT savings (Mt)** | **1.0** | **1.1** | **1.7** |
| **CB5 NT savings (Mt)** | **8.4** | **8.5** | **9.8** |

[18] Counterfactual coal consumption assumed in this IA is higher than industry sales figure presented in Defra's Impact Assessment (2019) https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/933097/burning-wood-consult-ia.pdf . The counterfactual will be reviewed ahead of the final stage Impact Assessment.

| | Option 1 - no requirement for energy efficiency upgrades | Option 2 – preferred option/ central scenario | Option 3 – minor and major energy efficiency upgrades to install LT heat pumps |
|---|---|---|---|
| **Lifetime NT Carbon savings 2026-2045 (Mt)** | **63.5** | **63.9** | **67.2** |
| **Lifetime non-traded CCE (£/tCO2e)** | **£27** | **£20** | **-£2** |

44 Across the options the capital cost of installing heating and energy efficiency measures represents the largest overall cost. The overall upfront costs for clean heat decrease with increasing levels of energy efficiency measures taken to install LT heat pumps. This is because energy efficiency measures reduce the size of the heating system required, and LT heat pumps are on average less expensive than some HT heat pumps and solid biomass. However, the total capital costs under Option 3 is higher than under the other options as the reduction in the capital cost of low-carbon heating appliances is offset by the increase in the capital cost of energy efficiency upgrades. These costs represent the total capital cost required to transition from fossil fuel to low-carbon heating and not what consumers are expected to pay. The Government recognises that further action – including existing and planned measures such as the funded schemes to encourage energy efficiency and the market-based mechanism set out in the Heating Market Mechanism consultation – 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.

45 Hidden costs (which include the time cost of researching appropriate upgrades and overseeing installations) represent a smaller proportion of the overall costs and are broadly similar across the options. Maintenance costs are assumed to be the same in the counterfactual and policy scenarios so balance to zero.

46 Carbon savings represent the biggest monetised benefit across the options. Savings increase as more energy efficiency measures are installed to accommodate for LT heat pumps, which reduce aggregate fuel consumption across the housing stock. Under Option 3, a higher share of deployment of LT heat pumps also reduce the overall fuel consumption level as they are higher in efficiency performance.

47 Monetised air quality benefits and energy savings also represent a significant share of the overall quantified benefits. These also increase as more energy efficiency measures are deployed to accommodate for LT heat pumps. There is a small cost in traded sector emissions across the policy options as a result of the increase in electricity consumption.

48 Not all relevant costs and benefits can be quantified in a cost benefit analysis. Other relevant and strategic considerations for the policy are discussed in the earlier Non-monetised costs and benefits and strategic considerations section. Distributional consideration and direct costs to businesses estimate are discussed in the Distributional analysis – domestic and the Equivalent Annualised Net Direct Cost to Business (EANDCB) sections.

## Risks and uncertainties

49 The quantified impacts are sensitive to changes in the underlying assumptions. Sensitivities around the lead option (option 2) are conducted on the key factors discussed here.

**S1: LT heat pump suitability**

50 BEIS' modelling suggests that around 80% of fossil fuel heated off gas grid homes currently have sufficient energy efficiency and internal electrical requirement to accommodate a low temperature heat pump. This assumption is tested to reflect the uncertainty of households ready to accommodate a LT heat pump. Lower and higher shares of HP suitable homes not requiring

fabric upgrades are modelled (70% and 90% respectively). This also reflects the uncertainty with future improvement of energy efficiency performance across the housing stock in England, as a result of current and future policies on energy efficiency.

**S2: Future capital cost reduction for heat pumps**

51 Evidence suggests that deployment and R&D could bring down the capital cost of heat pumps by 20% in a mass market scenario[19], with majority of the reduction associated with non-equipment costs (e.g. labour associated with installation). In the central scenario we assumed this reduction to take place by 2030. In this sensitivity analysis we explore scenarios with 10% and 50% cost reductions by 2030. The higher cost reduction sensitivity assumption is dependent on innovation in the equipment as well as economies of scale benefits in heat pump installations.

**S3: Efficiency of clean heating system**

52 The efficiency of low carbon heating systems has an impact on fuel consumption and running costs. They are expected to vary with weather conditions, quality of the building stock, and level of innovation. The low and high end of the assumption range shown in the annex are tested.

**S4: Energy prices**

53 The low and high long run variable costs projections, from the HMT Green Book supplementary guidance,[20] are used to test the sensitivity on energy prices, which are inherently hard to project with any certainty.

**S5: Carbon values**

54 HMT Green Book supplementary guidance on valuation of energy use and greenhouse gas (GHG) emissions is used to value greenhouse gas savings. To reflect the uncertainty of carbon values, low and high carbon values are tested to assess the impact on the NPV.

**S6: Number of buildings directly in-scope under the heat regulations**

55 The number of buildings assumed to be within the scope of the proposed regulation is based on EHS survey and reflect 2018 figures. This directly affects the estimated NPV, as the aggregate costs and benefits are a function of the number of homes affected by the regulations.

56 We assume that roughly 10% of households within scope of the proposed regulation will have installed a low carbon heating technology by 2026 brought about by other policies. This is highly uncertain, so to reflect this we explore scenarios where 2% and 20% of households within scope install a low carbon technology by 2026.

**S7: Counterfactual replacement rate of fossil fuel heating systems**

57 The counterfactual scenario assumes that fossil fuel heating systems are replaced at a rate of once every 15 years. Anecdotal evidence suggests that oil boilers tend to last longer than gas boilers and the design lifetime can be prolonged via repair. To reflect the uncertainty around the counterfactual replacement rate of fossil fuel heating systems, a slower replacement rate of once every 20 years is tested on the impact of NPVs.

**S8: Clean heat deployment profile**

58 The central scenario assumes that clean heating systems are installed at a linear rate of around 7% pa between the start of the regulation (2026) and 2039. A backloaded deployment profile is modelled to reflect the uncertainty on behavioural responses to the regulation. The sensitivity scenario assumes that 50% of the clean heat installations in the sector will happen in the 5 years to 2039. Clean heat is deployed at a rate of just below 6% pa between 2026 and 2034, and 10%

[19] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/498962/150113_Delta-ee_Final_ASHP_report_DECC.pdf

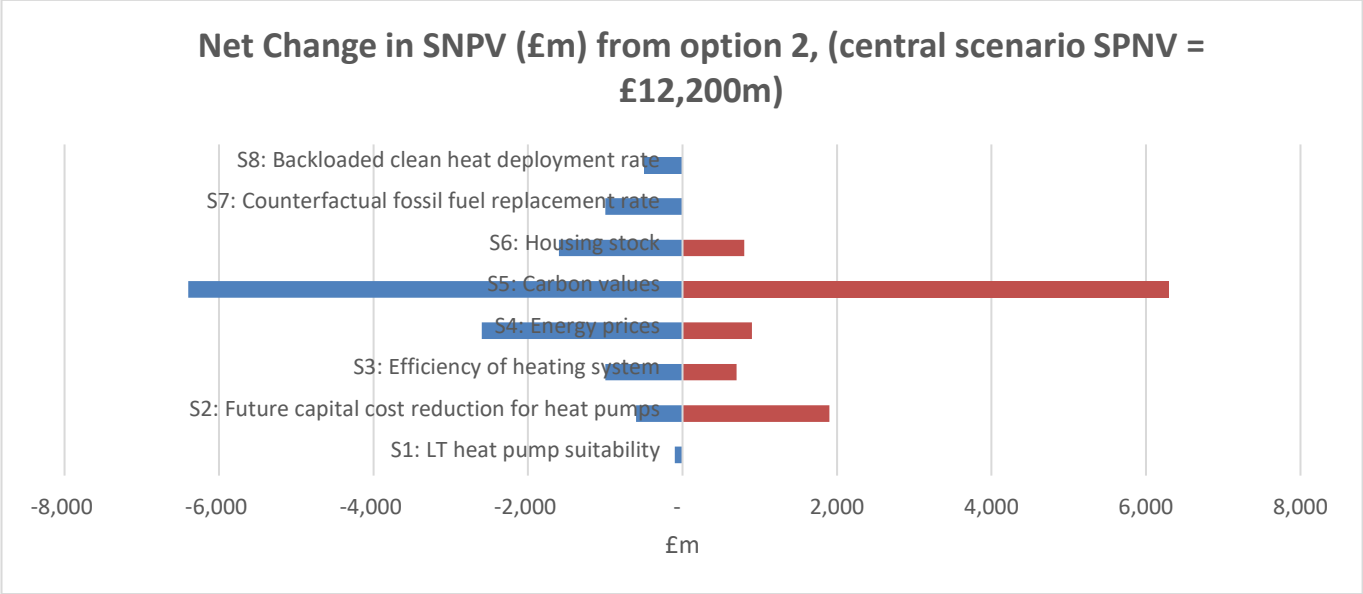
[20] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/685903/The_Green_Book.pdf

pa between 2035 and 2039. This is by assumption as there is very little evidence on the likely behavioural response, which is likely to be complicated with different incentives.

**Table 3: Sensitivity tests results (rounded to nearest £100m), PV base year 2026, 2020 prices**

| | SNPV (£m) | CB4 Non-traded sector savings (Mt) | CB5 Non-traded sector savings (Mt) |
|---|---|---|---|
| **Central scenario on option 2** | **£12,200** | **1.1** | **8.5** |
| **S1: LT heat pump suitability – lower share (70%)** | £12,100 | 1.1 | 8.7 |
| **S1: LT heat pump suitability – higher share (90%)** | £12,200 | 1.0 | 8.3 |
| **S2: Future capital cost reduction for heat pumps - lower** | £11,600 | 1.1 | 8.5 |
| **S2: Future capital cost reduction for heat pumps - higher** | £14,100 | 1.1 | 8.5 |
| **S3: Efficiency of clean heating system - lower** | £11,200 | 1.1 | 8.5 |
| **S3: Efficiency of clean heating system higher** | £12,900 | 1.1 | 8.5 |
| **S4: Energy (LRVC) prices - lower** | £9,600 | 1.1 | 8.5 |
| **S4: Energy (LRVC) prices - higher** | £13,100 | 1.1 | 8.5 |
| **S5: Carbon values- lower** | £5,800 | 1.1 | 8.5 |
| **S5: Carbon values- higher** | £18,500 | 1.1 | 8.5 |
| **S6: Housing stock in scope – lower** | £10,600 | 0.9 | 7.5 |
| **S6: Housing stock in scope – higher** | £13,000 | 1.2 | 9.2 |
| **S7: Counterfactual fossil fuel replacement rate - slower** | £11,200 | 1.1 | 8.5 |
| **S8: Backloaded clean heat deployment** | £11,700 | 0.8 | 6.7 |

**Figure 1: Sensitivities in SNPV estimates (£m, central scenario SNPV = £12,200m )**




59 The SNPVs are positive showing that in all sensitivity scenarios, the policy impacts lead to a monetised net benefit. Of the sensitivity scenarios conducted, the uncertainty on carbon values , future capital cost reduction for heat pumps and energy prices have the biggest impact on SNPVs.

60 Uncertainty on the lower energy prices, carbon values, efficiency of the low carbon heating systems and counterfactual fossil fuel replacement rate have the biggest negative impact on the estimated SNPV. A slower natural replacement rate of fossil systems in the counterfactual means lower capital costs in the counterfactual and therefore a decrease in the SNPV of the policy.

61 Changes to the number of households in scope with the regulation, as shown in sensitivity S6, have a moderate impact on the SNPVs, resulting from the lower/higher overall net benefits associated to the installations of less/more low-carbon heating systems.

62 The SNPV estimate is less sensitive to the uncertainty on the share of homes readily suitable for LT-ASHP and LT-GSHP without fabric upgrades. A higher share of homes suitable to LT-ASHP and LT-GSHP with no energy efficiency upgrades required reduces the capital costs of the heating systems being installed as LT-ASHP, which are expected to be deployed in 90% of homes that do not require energy efficiency upgrades, are typically cheaper than alternative low carbon technologies. However, homes already suitable to LT-ASHP and LT-GSHP tend to have a lower heat demand, which reduces the carbon emissions and LRVC benefits when they are decarbonised.

63 Realising the benefits 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. Alternatively, 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.

64 One potential unintended consequence resulting from the policy could be a surge of new installations of fossil boilers ahead of the regulation. A possible end date in the use of fossil fuel heating by the late-2030s could minimise the impacts of system lock-in of fossil systems. This will avoid the risk that consumers continuously repair old, inefficient, and potentially unsafe fossil heating systems to delay the installation of clean heat. In the consultation we are consulting on

views for other measures government could introduce to accelerate deployment of clean heat in homes off the gas grid ahead of the late-2030s.

65 The backloaded clean heat deployment scenario described in paragraph 58 attempts to capture the uncertainty with respect to consumer behaviour. A backloaded deployment profile leads to a reduction in the estimates of CB4/5 savings and lifetime carbon savings, and a slightly increase in the estimated SNPV (caused by a slight reduction in capital costs which more than offset the reduction in carbon benefits). We note that the capital costs in the sensitivity scenario are likely to be underestimated as current modelling does not fully capture the additional costs associated with a slower replacement rate in the early regulatory years. This includes any repair costs to prolong lifetime of existing fossil boilers, and the additional capital costs resulting from a surge of new installations of fossil boilers ahead of the regulation.

66 In terms of risks of supply chain readiness, the industry 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 30,000 new installers expected to be trained by 2028 as the number of heat pumps installations increases rapidly. The Government is facilitating new entrants into the market through the new construction T-Levels and the Apprenticeship Levy Programme, which is led by the Department for Education. Industry has given us assurances that gas and oil boiler engineers are likely to re-train as demand grows, and we have tested this through a sector wide skills survey and installer skills research project, with over 70% of existing fossil-fuelled boiler installers willing to re-train in response to demand[21]. The Market Mechanism is also expected to scale up the market for heat pumps ahead of off gas grid regulation.

67 Supplementary guidance to the Green Book on valuing energy use and greenhouse gas emissions[22] suggests that when capital is tied up in a specific project, alternative profitable use of such capital is ruled out and there is a foregone social benefit. The opportunity cost of capital where private funds are used to achieve social aims vary and is subject to final policy design. At this stage this has not been monetised and this will be reviewed ahead of the final Impact Assessment.

## Distributional analysis – domestic

### Impact on fuel poverty targets for England

68 14.4% of households off the gas grid (excluding those with direct electric as main heating systems) are in fuel poverty in 2019[23], compared to 12.7% using mains gas[24].

69 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 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 we 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 that drives decarbonisation. The Government is also encouraging installation of energy efficiency measures alongside heat pump technologies to reduce demand for heat and

[21] 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

[22] Available at: https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

[23] A household is considered to be fuel poor if: 1- They are living in a property with a fuel poverty energy efficiency rating of band D or below and 2- When they spend the required amount to heat their home, they are left with a residual income below the official poverty line.

[24] BEIS analysis of Fuel Poverty Statistics England 2021 (2019 data) https://www.gov.uk/government/statistics/fuel-poverty-detailed-tables-2021

offset potential higher running costs and is providing support for this through the Energy Company Obligation.

### Impacts on households in rural vs urban areas

70 98% of fossil fuel heated households are estimated to be in rural areas[25]. As such the policy is expected to affect households in rural areas more than those in urban areas. The Government will consider what additional support households transitioning to clean heat may need following the conclusion of HM Treasury's review into funding the transition to a net zero emissions economy.

**Table 4: Share of households using oil, LPG or coal heating systems in buildings[26]**

| | **Share of households using oil, LPG or coal heating systems in buildings** |
|---|---|
| **City centre, Urban** | 2% |
| **Rural, suburban and village centre** | 98% |

## Equality impacts

71 In line with the government's guidance on the Equality Duty, this section presents the analysis on how different groups of people may be affected by the policy. The guideline includes the following characteristics of social groups:

- Age
- Disability
- Gender reassignment
- Marriage or civil partnership
- Pregnancy and maternity
- Race – including ethnic or national origins
- Religion or belief
- Sex
- Sexual orientation

72 Equality analysis of this policy is limited to those characteristics captured by the English Housing Survey. These are age (Table 5), ethnic minorities (Table 6), and disabilities (Table 7). The tables show that fossil fuel heated off gas grid households are more likely to be older and from a white ethnicity background. Fossil fuel heated off gas grid households are slightly more likely to have a household member with a long-term illness or disability. However, as previously noted, the Government will consider what additional support households transitioning to clean heat may need following the conclusion of HM Treasury's review into funding the transition to a net zero emissions economy.

**Table 5: Percent of the stock by age of household reference person**

| **Age of household reference person** | **16-24** | **25-34** | **35-44** | **45-54** | **55-64** | **65 or over** |
|---|---|---|---|---|---|---|
| **Fossil fuel heated off gas grid** | 1% | 3% | 10% | 20% | 20% | 46% |
| **All** | 3% | 14% | 17% | 20% | 17% | 29% |

[25] Analysis of English Household survey Ministry of Housing, Communities & Local Government ( 2018 ).

**Table 6: Percent of the stock by ethnicity of household reference person**

| | White | Others |
|---|---|---|
| **Fossil fuel heated off gas grid** | 99% | 1% |
| **All** | 88% | 12% |

**Table 7: Percentage of the stock by whether a member of the household has a long-term illness or disability**

| | Yes | No |
|---|---|---|
| **Fossil fuel heated off gas grid** | 39% | 61% |
| **All** | 37% | 63% |

73 Due to the nature of the policy, we do not expect this policy to negatively affect groups with protected characteristics. During the course of consultation, we will continue to explore the possible impacts of the proposed policy on the protected characteristics groups.

## Equivalent Annualised Net Direct Cost to Business (EANDCB)

74 This section considers the direct costs to assess the net regulatory impact to businesses. For the analysis we have assumed that landlords in the private rented sectors are businesses but not social landlords. The type of businesses directly affected by the proposed regulation are installers and private landlords. Direct benefits have not been quantified.

### Direct costs to landlords in the PRS sector

75 The majority of PRS properties are owned by landlords owning fewer than 5 properties. All landlords are assumed to be small or micro businesses. The direct costs to landlords that are being monetised for the EANDCB analysis are:

- Capital costs of installations
- VAT (at 5%)
- Familiarization costs - One hour of familiarisation time is assumed to be required for each landlord to understand the heat Regulations[27]
- Hidden costs – the additional time cost taken to install the measures by landlords[28.]
- Operating costs, excluding fuel

Opportunity cost of finance for landlords have not been included at this stage and this will be reviewed ahead of the final stage Impact Assessment.

76 The Department for Business, Energy and Industrial Strategy's Impact Assessment Calculator[29] has been used to generate the headline ENADCB metrics below for policy options 1-3, alongside with the estimated Business Impact Target score. The direct costs to business are the sum of the costs over the appraisal period of the policy (20 years).

[27] The Department for Transport's estimation of the value of free time, at £6.18/hr, is used to monetise the time costs.

[28] The hidden costs of installing measures are drawn from ECOFYS (2009) "The hidden costs and benefits of domestic energy efficiency and carbon saving measures" http://webarchive.nationalarchives.gov.uk/20111011153039/http://www.decc.gov.uk/assets/decc/what%20we%20do/supporting%20consumers/saving_energy/analysis/1_20100111103046_e_@@_ecofyshiddencostandbenefitsdefrafinaldec2009.pdf

[29] Available at: https://www.gov.uk/government/publications/impact-assessment-calculator--3

**Table 8: EANDCB and BIT score estimates**

| | Option 1 | Option 2 (central) | Option 3 |
|---|---|---|---|
| Estimated PRS landlords affected | 74,000 (mid-point estimate) | 74,000 (mid-point estimate) | 74,000 (mid-point estimate) |
| EANDCB per year<br>2019 prices, 2020 PV | £39m | £37m | £40m |
| BIT Score | 158 | 150 | 163 |

## Impacts on small and micro businesses

77 Latest data from MHCLG[30] shows that most landlords own less than 5 properties. The share of landlords owning a single property has fallen to less than a half in 2018, as shown in the table below. All private landlords are assumed to be small and micro business given that the majority of landlords own less than 5 properties[31].

78 There are estimated to be between 2.2 and 2.8 million private landlords in England[32.] Direct data is not available by source of heating fuel. According to English Housing Survey 2018, around 3% of Private Rented Sector (PRS) households use fossil fuel heating in the off gas grid sector. This suggests that there are around 66,000-84,000 landlords which will be affected by the heat regulations.

**Table 9: Estimated distribution of property portfolios for private landlords**

| **Number of properties** | **1** | **2-4** | **5-9** | **10-24** | **25-100** | **>100** |
|---|---|---|---|---|---|---|
| **2010 - proportion of private landlords** | 78% | 17% | 3% | 1% | 1% | 0% |
| **2018 - proportion of private landlords** | 45% | 38% | 10% | 5% | 1% | 0% |

## Direct costs to installers

79 There are currently more than 6,000 oil boiler installers, 130,000 Gas Safe Register engineers and around 3,000 heat pump installers, as estimated by the Heat Pump Association[33] . Under the proposal a significant number of oil and gas installers would have to be retrained to meet the new demand for the installation of low carbon technologies. Installers will also face

[30] https://www.gov.uk/government/collections/english-private-landlord-survey

[31] The definition of a small or micro business is less than 50 employees.

[32] P57 https://www.gov.uk/government/publications/english-private-landlord-survey-2018-main-report

[33] HPA (2020) https://www.nibe.eu/en-gb/about-nibe/news/2020/2020-06-04---building-the-installer-base-for-net-zero-heating-supporting-a-green-recovery

one off familiarisation costs to understand the regulation. These costs have not been quantified at this stage, and we seek to understand the direct costs to installers through the consultation.

## Monitoring and Evaluation

We plan to implement a robust monitoring and evaluation which will demonstrate the impact and outcomes of the proposed regulations. A thorough evaluation plan will be developed in advance of the implementation of the regulations and will be integral into the delivery of the policy. It is expected that the evaluation will seek to answer questions such as:

- To what extent has the regulation achieved its aims?
- How has the design of the regulation influenced the impacts that were achieved?
- To what extent has the regulation been complied by the sector?
- What is the quality of installations?

More information on our monitoring and evaluation strategy will be provided in the final impact assessment. This will include proposed timelines for evaluation.

## Annex- Detailed modelling assumptions for domestic analysis

### A. Housing stock by main heating systems and tenure

Table 10: Demographics of households in England with LPG, coal and oil as main heating fuels, 2018[1]

| | | **% share of households (1,076,000)** |
|---|---|---|
| **By main heating system** | LPG | 13% |
| | Coal[2] | 9% |
| | Oil | 78% |
| **By tenure** | Owner occupied | 83% |
| | Private rented sector | 14% |
| | Social Housing | 3% |

### B. Modelling assumptions on heat demand and average energy efficiency (EE) upgrade capital spending, 2020 prices

Option 2 – Preferred scenario

| | **Properties installing heat pumps without EE upgrades** | **Properties installing LT heat pumps with minor EE upgrades (up to £2000)** | **Remaining properties - install alternative technologies without EE upgrades** |
|---|---|---|---|
| **Share of properties under each category** | 81% | 4% | 15% |
| **Average heat demand (before EE)** | 15,000 | 16,000 | 19,700 |
| **Average heat demand (after EE, if applicable)** | 15,000 | 13,800 | 19,700 |
| **Average EE spend, if applicable** | NA | £1,000 | NA |

[1] Analysis of English Household survey Ministry of Housing, Communities & Local Government ( 2018 ). Numbers may not add up due to the availability of data for each segment https://www.gov.uk/government/collections/english-housing-survey.

[2] Includes anthracite nuts and smokeless fuel

Option 1

| | Properties installing heat pumps without EE upgrades | Properties installing LT heat pumps with minor EE upgrades (up to £2000) | Remaining properties - install alternative technologies without EE upgrades |
|---|---|---|---|
| **Share of properties under each category** | 81% | 0% | 19% |
| **Average heat demand (before EE)** | 15,000 | NA | 19,000 |
| **Average heat demand (after EE, if applicable)** | 15,000 | NA | 19,000 |
| **Average EE spend, if applicable** | NA | NA | NA |

Option 3

| | Properties installing heat pumps without EE upgrades | Properties installing LT heat pumps with minor EE upgrades (up to £2000) | Remaining properties - install alternative technologies without EE upgrades |
|---|---|---|---|
| **Share of properties under each category** | 81% | 15% | 4% |
| **Average heat demand (before EE)** | 15,000 | 18,300 | 21,600 |
| **Average heat demand (after EE, if applicable)** | 15,000 | 10,200 | 21,600 |
| **Average EE spend, if applicable** | NA | £14,800 | NA |

## C. Capital costs for heating systems, 2020 prices

**Table 11: Average capital costs for counterfactual systems**

| | Properties installing heat pumps without EE upgrades | Properties installing LT heat pumps subject to minor EE upgrades (modelled as up to £2000) | Rest of properties - install alternative technologies without EE upgrades |
|---|---|---|---|
| **Oil**[3] | £4,400 | £4,600 | £4,700 |
| *System size* | 16kW system | 18kW system | 21kW system |
| **LPG**[4] | £2,800 | £2,700 | £3,700 |
| *System size* | 24kW system | 24kW system | 24kW system |
| **Coal**[5] | £2,600 | £2,600 | £2,600 |
| System size | Assumed average floor area 100m2 | Assumed average floor area 100m2 | Assumed average floor area 100m2 |

- Oil tank removal costs: £1,000
- Oil tank installation costs: £1,000

**Table 12: Average capital costs for low carbon heating systems before cost reductions**

| | Properties installing heat pumps without EE upgrades | Properties installing LT heat pumps subject to minor EE upgrades (modelled as up to £2,000) | Rest of properties - install alternative technologies without EE upgrades |
|---|---|---|---|
| **LT-ASHP**[6] | £12,500 | £13,100 | Not modelled |
| *System size* | *10 kW* | *12kW* | |
| **LT-GSHP**[7] | £23,900 | £24,300 | Not modelled |
| *System size* | 11kW | 12 kW | |
| **HT-ASHP** | Not modelled | Not modelled | £14,600 |
| *System size* | | | *14kW* |
| **Solid biomass** | Not modelled | Not modelled | £21,000 |
| *System size* | | | *18kW* |

- Oil tank removal costs: £1,000

[3] Capex assumptions are based on analysis of Delta-EE (2018) The Cost of Installing Heating Measures in Domestic Properties. The capex estimates include oil boiler unit, fittings, buffer tank and cylinder, control, labour cost. £1,000 old oil tank removal cost and £1,000 new oil tank installation cost is also added to the modelling to reflect lifetime CAPEX of oil boiler systems. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/913508/cost-of-installing-heating-measures-in-domestic-properties.pdf

[4] Ibid. Cost estimates include LPG boiler unit, fittings, control and labour costs.

[5] Cost curves from Element (2018) , based on average floor area of 100m2 for coal heated households https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/831079/Electric_heating_options_in_off-gas_grid_homes.pdf

[6] Analysis of Delta-EE (2018). The capex estimates include the cost of the HP device, labour fee, fittings, new buffer and cylinder tanks, retrofit of radiators and new controls. £1,000 oil tank removal cost is added to the cost of existing oil heating systems.

[7] In the cost-benefit analysis the CAPEX of the ground collector element of a GSHP system has been pro-rated to account for its longer lifetime.

## D. Annual maintenance costs of heating systems

| | Annual maintenance costs | Source |
|---|---|---|
| **Oil** | £100 | BEIS assumption |
| **LPG** | £100 | |
| **Coal** | £100 | |
| **LT-ASHP** | £100 | |
| **LT-GSHP** | £100 | |
| **HT-ASHP** | £100 | |
| **Solid biomass** | £100 | |

## E. Capital costs for energy efficiency measures (2018 prices)

| | Dwelling Type | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Measure Description** | **Small Flat** | **Large Flat** | **Small Semi-detached House** | **Large Semi-detached House** | **Small Detached House** | **Large Detached House** | **Small Mid-terrace House** | **Large Mid-terrace House** |
| Loft insulation | £189 | £452 | £242 | £389 | £326 | £672 | £231 | £357 |
| Low cost cavity wall insulation | £399 | £452 | £555 | £693 | £714 | £998 | £483 | £530 |
| High cost cavity wall insulation | £1,680 | £2,625 | £2,205 | £3,570 | £2,415 | £3,885 | £2,835 | £4,515 |
| Hot water cylinder insulation (tank) | £36 | £36 | £36 | £36 | £36 | £36 | £36 | £36 |
| Draught proofing | £50 | £86 | £81 | £129 | £109 | £225 | £76 | £120 |
| Low energy lights | £36 | £60 | £60 | £84 | £72 | £96 | £60 | £84 |
| Cylinder (hot water tank) thermostat | £315 | £315 | £315 | £315 | £315 | £315 | £315 | £315 |
| Heating controls (appliance thermostat) | £473 | £473 | £473 | £473 | £473 | £473 | £473 | £473 |
| Replacement warm air unit | £2,100 | £2,100 | £2,100 | £2,100 | £2,100 | £2,100 | £2,100 | £2,100 |
| Double/secondary glazing | £2,880 | £4,320 | £6,600 | £7,680 | £7,080 | £9,960 | £4,680 | £6,000 |
| Solid wall insulation (external) | £5,565 | £7,035 | £8,190 | £8,820 | £10,710 | £12,075 | £7,140 | £7,875 |
| Floor insulation | £504 | £860 | £813 | £1,287 | £1,095 | £2,249 | £761 | £1,193 |

## F. Hidden costs assumptions

The hidden costs of installing measures are estimated using the 2009 ECOFYS report [8] used in recent PRS Regulations Impact Assessment[9].

| 2020 prices | Hidden cost for owners (£/measure) | Hidden cost for occupiers (£/measure) | Total |
|---|---|---|---|
| Loft insulation | £ 68 | £ 68 | £ 135 |
| Low cost CWI | £ 78 | £ 21 | £ 99 |
| High cost CWI | £ 78 | £ 21 | £ 99 |
| SWI (external) | £ 208 | £ 10 | £ 218 |
| Floor insulation | £ 114 | £ 52 | £ 166 |
| Draught proofing | £ 57 | £ - | £ 57 |
| Double glazing | £ 73 | £ - | £ 73 |
| Appliance thermostat | £ 42 | £ 10 | £ 52 |
| Room thermostat | £ 42 | £ 10 | £ 52 |
| Time temperature zone controls | £ 42 | £ 10 | £ 52 |
| Hot water cylinder insulation | £ 5 | £ - | £ 5 |
| Hot water cylinder thermostat | £ 42 | £ 10 | £ 52 |
| Low energy lighting | £ 5 | £ - | £ 5 |
| Gas combi boiler | £ 21 | £ - | £ 21 |
| Oil combi boiler | £ 21 | £ - | £ 21 |
| Storage heater | £ 21 | £ - | £ 21 |
| ASHP | £ 161 | £ 31 | £ 192 |
| GSHP | £ 218 | £ 31 | £ 249 |
| First time central heating | £ 83 | £ 31 | £ 114 |
| Solar hot water | £ 114 | £ 31 | £ 145 |
| Solar PV | £ 135 | £ 26 | £ 161 |

For the modelling analysis loft insulation is used to represent the hidden costs for low cost measures, as it is expected that most of homes undergoing minor EE upgrades will install loft insulation. External wall insulation is used to represent the hidden costs for major EE upgrades.

[8] ECOFYS (2009) "The hidden costs and benefits of domestic energy efficiency and carbon saving measures" http://webarchive.nationalarchives.gov.uk/20111011153039/http://www.decc.gov.uk/assets/decc/what%20we%20do/supporting%20consumers/saving_energy/analysis/1_20100111103046_e_@@_ecofyshiddencostandbenefitsdefrafinaldec2009.pdf

[9] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/932403/prs-epc-c-consultation-stage-ia.pdf

## G. In-situ performance of fossil heating systems

| | Central |
|---|---|
| **Oil** | 84%[10] |
| **LPG** | 84%[11] |
| **Coal** | 65%[12] |

## H. In-situ performance of clean heating systems

| | Central | Low | High |
|---|---|---|---|
| **LT-ASHP**[13] | 244% | 215% | 267% |
| **LT-GSHP**[14] | 271% | 248% | 302% |
| **HT-ASHP**[15] | 201% | 180% | 201% |
| **Solid biomass**[16] | 70% | 68% | 76% |

## I. Biomass air quality assumptions

Biomass air quality emissions factors are based on MEP/EEA air pollutant emission inventory guidebook[17]. Current policy on the RHI imposes a limit on oxides of nitrogen (NOx) and particulate matter (PM) emitted by biomass products. Applicants are required to provide a valid emissions certificate to show their boiler does not exceed these limits. The Ofgem website provides further information on RHI limits and emissions certificates.[18] The regulations will impose the same emissions limits and certificate requirements. Biomass air quality damage costs are based on Defra's 2020 air quality appraisal guidance[19]

| | PM2.5 domestic | NOx domestic |
|---|---|---|
| Emission factors (kg/kWh) | 0.000216 | 0.000288 |
| Damage costs (£/kg) 2017 prices | 89.46 | 12.45 |

[10] We assume oil boilers to have the same in-situ efficiency as gas boilers https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/180950/In-situ_monitoring_of_condensing_boilers_final_report.pdf

[11] Ibid

[12] Average of smokeless fuel MF1 and MF2 is used for an old stove. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/933099/burning-wood-consult-bsria-report1.pdf

[13] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/606818/DECC_RHPP_161214_Final_Report_v1-13.pdf The low and high efficiencies represent the 25th and 75th of the data from the RHPP trial

[14] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/606818/DECC_RHPP_161214_Final_Report_v1-13.pdf The low and high efficiencies represent the 25th and 75th of the data from the RHPP trial

[15] Evidence on the in-situ efficiency of HT- heat pumps is limited. 55C flow temperature is assumed for central and high, and 65C flow temperature is assumed for low. Estimates on in-situ efficiencies of HT-ASHP at different flow temperature is based on BEIS's triangulation of figures of COP of HTASHP, COP of LTASHP and SPF of LTASHP. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/565239/Domestic_High_Temperature_HPs-_FINAL2.pdf

[16] Measurement of the in-situ performance of solid biomass boilers (2019) https://www.gov.uk/government/publications/biomass-boilers-measurement-of-in-situ-performance

[17] http://efdb.apps.eea.europa.eu/?source=%7B%22query%22%3A%7B%22match_all%22%3A%7B%7D%7D%2C%22display_type%22%3A%22tabular%22%7D

[18] Emission Certificate (RHI): https://www.ofgem.gov.uk/key-term-explained/emission-certificate-rhi

[19] https://www.gov.uk/government/publications/assess-the-impact-of-air-quality/air-quality-appraisal-damage-cost-guidance.

## J. Heat pump suitability assessment methodology

Modelled technical suitability of electric low temperature heat pumps is based on consideration of thermal and electrical constraints at dwelling levels. This does not consider additional constraints such as space, noise, aesthetics and the implications for the low voltage network. The modelling uses the National Household Model (NHM)[20]. Technical suitability is based on a peak heat loss limit of 100W/m2 for the dwelling and a maximum draw of 80A for a heat pump. We intend to gather more evidence through the consultation process and assumptions will be reviewed ahead of the final stage Impact Assessment.

The thermal comfort and electrical fuse limit criteria builds on the analysis from the BEIS commissioned report *Technical feasibility of electric heating in rural off-gas grid dwelling* (2018)[21] . The MCS heat emitter guide[22] recommends a maximum 100W/m2 peak heat loss for a heat pump running at 45oC a temperature to meet an internal temperature of 19oC for 1 in 20 coldest day. The maximum current draw of 80A from a heat pump assumes that DNOs will provide an upgrade to the dwelling fuse when electric heating is installed in a dwelling[23], leaving 20A reserved for other appliances.

[20] https://data.gov.uk/dataset/957eadbe-43b6-4d8d-b931-8594cb346ecd/national-household-model

[21] https://www.gov.uk/government/publications/electric-heating-in-rural-off-gas-grid-dwellings-technical-feasibility

[22] MCS is the Microgeneration Certification Scheme is a UK standards organisation which certify low carbon products and installations such as LTASHP.

[23] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/831079/Electric_heating_options_in_off-gas_grid_homes.pdf