Title: Clean Heat Market Mechanism **IA No:** **Lead department or agency:** Department for Energy Security and Net Zero **Other departments or agencies:** None	Impact Assessment (IA) **Date:** **Stage:** Consultation **Source of intervention:** Domestic **Type of measure:** Secondary legislation **Contact for enquiries:** heatmarketmechanism@beis.gov.uk

Summary: Intervention and Options

RPC Opinion: NA

Cost of Preferred (or more likely) Option			
Total Net Present Social Value	**Business Net Present Value**	**Net cost to business per year**	**Business Impact Target Status**
£203m	- £116m	- £59m	Qualifying Provision

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

The government has set out an ambitious package of policy measures to help the United Kingdom move towards greater energy independence and become less dependent on volatile global gas markets. One crucial way to enhance the UK's energy independence is to reduce the energy used in buildings. In the Chancellor's 2022 Autumn Statement, the government committed to driving improvements in energy efficiency, announcing a new ambition to reduce the UK's final energy consumption from buildings and industry by 15% by 2030. In addition to measures such as insulation to improve the fabric efficiency of buildings, an important part of reducing energy demand is switching to more efficient heating appliances. Electric heat pumps have a crucial role to play in this as they can produce several units of heat for every unit of energy consumed, meaning that replacing a boiler with a heat pump is often the most impactful measure for reducing a building's energy demand.

As the previous consultation on this Clean Heat Market Mechanism policy and the 2021 Net Zero Strategy therefore set out, it is important that we rapidly grow the heat pump market towards around 600,000 installations per year by 2028 to make heat pumps a mainstream consumer solution alongside gas boilers, approximately 1.8 million of which are currently installed each year. This level of heat pump deployment, including in new-build properties, is strategically important for any of the potential transition pathways to net zero, including those where hydrogen heating plays a major role too.

To enable this level of deployment, the market and supply chains need to continue to develop substantially in order to provide a wide range of attractive choices for consumers, with compelling and simple consumer journeys, supported by a wide base of skilled advisors and installers. Heat pumps are largely unable to compete on lifetime cost with established fossil fuel and less efficient heating options, such as natural gas, oil, and direct electric heating appliances. 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. Additionally, the full societal costs of fossil fuel combustion are not reflected in their market prices, including for example impacts on health and climate change. In the absence of an effective policy framework, the heat pump market would not be expected to grow at the targeted rate. This would result in lower greenhouse gas emissions reductions from buildings than targeted in near-term carbon budgets. Furthermore, without policies to develop the heat pump market and supply chain to a sufficient capacity, their cost would remain high and the target of net zero emissions by 2050 could not be reached in a cost-effective manner.

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

The Clean Heat Market Mechanism (CHMM) consultation sets out plans to establish a platform for an industry-led transformation of the heating appliance market, through the introduction of a market obligation. This mechanism aims to provide the heating appliance industry – and wider market – with a clear, stable policy framework and the accompanying incentives to invest with confidence in scaling up the consumer market for heat pumps, thereby accelerating deployment and driving down energy demand and emissions from buildings.

The scheme aims to:

- *Support the development of the UK heat pump market in line with the targeted growth trajectory in the Heat and Buildings Strategy and Powering Up Britain paper (~600,000 installations p.a. by 2028);*
- *Contribute to decarbonising heating in the UK and to meeting carbon budgets and the 2030 energy demand reduction target.*

This proposed policy is part of a policy framework, described in the Heat and Buildings Strategy and in the Powering Up Britain publications, aimed at decarbonising heating as part of the government's net zero greenhouse gas emissions commitment. The wider aims of government intervention in this are to:

- *Reduce the upfront costs of heat pumps and support households and building-owners with heat pump installations to kickstart the market;*
- *Reduce the running costs of heat pumps, including relative to fossil fuel boilers;*
- *Support an expansion of heat pump manufacturing in the UK;*
- *Grow the numbers of skilled heat pump installers, and maintain high standards in the quality of heat pump installations; and*
- *Support a range of other innovations to broaden the appeal, efficiency and ease of adoption of heat pumps.*

Such a structural shift comes inevitably with high uncertainty, which is reflected in the estimates presented in this Impact Assessment.

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

The policy options considered in this impact assessment are:

- *Option 0 (counterfactual): do nothing.*
- *Option 1 (preferred option): introduce an obligation on the manufacturers of gas and oil boilers sold on the UK market to hold credits corresponding to qualifying installations of heat pumps in proportion to their relevant UK boiler sales. Under Option 1 the scheme would begin with relatively low targets, while the market adjusts to the obligation, before accelerating growth in later scheme years as the market scales*
- *Option 2 (alternative option): introduce the same obligation as in Option 1, but the yearly scheme targets would be higher in early years, set such that a roughly constant growth rate in retrofit heat pumps is applied towards the aim for around 400,000 retrofit installations in 2028.*

This policy is expected to continue to form part of a wider policy framework supporting heat decarbonisation; the combination of policies in this overall framework will have a bearing, for instance, on how policy costs are distributed across different groups.

The principal alternatives to option 1 or 2 would be to pursue only subsidy-based measures and/or regulatory measures focused on consumers or building-owners without an accompanying market obligation. Such alternatives are less likely to reach the policy goals and would be likely to lead to higher overall social costs; they have been therefore disregarded from analysis.

Both Option 1 and Option 2 have a positive Social Net Present Value (SNPV), meaning that they are expected to bring a net benefit to society, compared to the do-nothing scenario. Option 1 was selected as it is deemed to strike the best balance between driving heat pumps uptake, achievability for businesses, and affordability. Option 2 is shown to have a higher monetised SNPV, but the high targets risk potentially placing too much strain on supply chain capacity with a possible negative impact on heat pump costs. Under Option 2 there would also be a higher risk of non-compliance, which we have not quantified.

Will the policy be reviewed? It will be reviewed. **If applicable, set review date:** N/A				
Does implementation go beyond minimum EU requirements?		N/A		
Is this measure likely to impact on international trade and investment?		Yes		
Are any of these organisations in scope?	**Micro** No	**Small** No	**Medium** Yes	**Large** Yes
What is the CO_2 equivalent change in greenhouse gas emissions? (Million tonnes CO_2 equivalent)		**Traded:** 0.2	**Non-traded:** -2.1	

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: 27/04/2023

Summary: Analysis & Evidence - Policy Option 1

Description: To introduce an obligation on the manufacturers of gas and oil boilers sold on the UK market to hold credits corresponding to qualifying installations of heat pumps in proportion to their relevant UK boiler sales. Under Option 1 the scheme would begin with relatively low targets, while the market adjusts to the obligation, before accelerating growth in later scheme years as the market scales

FULL ECONOMIC ASSESSMENT

Price Base Year	PV Base Year	Time Period Years:	Net Benefit (Present Value (PV)) (£m)		
2023	2023	21 years	Low: -	High: -	Best Estimate: £203m

COSTS (£m)	Total Transition		Average Annual	Total Cost (Present Value)
Low	-		-	-
High	-		-	-
Best Estimate	-			£337m

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

The largest societal costs of the proposal are the additional capital costs associated with installing clean heating technologies, followed by traded carbon costs. These costs are estimated to be around £270mn in additional capital costs and around £50mn in traded carbon costs. Additionally, we have estimated administrative and familiarisation costs at around £10m and hidden costs associated with the installations of heat pumps at around another £10mn.

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

There will be some small costs to DESNZ and the administrator, which have not been monetised.

BENEFITS (£m)	Total Transition (Constant Price) Years		Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	-		-	-
High	-		-	-
Best Estimate	-		-	£541m

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 (around £420m), followed by air quality improvements (around £80m) and benefits from reduced long run variable costs (around £40m).

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. Development of competitiveness in UK's clean goods and services related to heat. Alignment with net zero strategy. Reduction of risks in other future policies. Growth in the market for low-carbon heating appliances and the businesses that produce, sell and install them, produce or operate ancillary goods (e.g., heat batteries) and services (e.g., smart energy management and flexibility services), etc. Policy framework stability, with market-wide application, enabling strategic confidence to invest in supply chains, training, etc.
Key assumptions/sensitivities/risks
The key assumptions, sensitivities and risks in the model are: the deployment level, deployment mix, future costs and performance of heating systems (actual in-situ performance of heating system), future fuel costs, carbon savings and target carry-forward. This IA presents the uncertainty through sensitivity analysis in the Risks and Uncertainties section of this report.

BUSINESS ASSESSMENT (Option 1)

Direct impact on business (Equivalent Annual) £m:			**Score for Business Impact Target (qualifying provisions only, 2019 prices, 2020 PV) £m**
Costs: £116m	**Benefits:**	**Net:** £116mn	£93m

Executive Summary

The government has set out an ambitious package of policy measures to help the United Kingdom move towards greater energy independence and become less dependent on volatile global gas markets. One crucial way to enhance the UK's energy independence is to reduce the energy used in buildings. In the Chancellor's 2022 Autumn Statement, the government committed to driving improvements in energy efficiency, announcing a new ambition to reduce the UK's final energy consumption from buildings and industry by 15% by 2030. In addition to measures such as insulation to improve the fabric efficiency of buildings, an important part of reducing energy demand is switching to more efficient heating appliances. Electric heat pumps have a crucial role to play in this as they can produce several units of heat for every unit of energy consumed, meaning that replacing a boiler with a heat pump is often the most impactful measure for reducing a building's energy demand.

As the previous consultation on this Clean Heat Market Mechanism policy and the 2021 Net Zero Strategy therefore set out, it is important that we rapidly grow the heat pump market towards around 600,000 installations per year by 2028 to make heat pumps a mainstream consumer solution alongside gas boilers, approximately 1.8 million of which are currently installed each year. This level of heat pump deployment, including in new-build properties, is strategically important for any of the potential transition pathways to net zero, including those where hydrogen heating plays a major role too.

The Clean Heat Market Mechanism (CHMM) will, from 2024, place an obligation on the manufacturers of heating appliances to meet targets for the proportion of low-carbon heat pumps they sell each year, relative to fossil fuel boilers. These targets will steadily increase year-on-year, providing firms with the certainty to invest in building the heat pump market.

The consultation proposes that a heat pump manufacturer will be able to earn a credit for the installation of a qualifying domestic-scale hydronic heat pump notified via an appropriate certification scheme (i.e. MCS or an equivalent scheme). In order to provide flexibility in how the obligation can be met, these credits will be tradable. Providing further optionality in how the obligation may be met, certain installations of hybrid heat pump systems that involve both a heat pump and a fossil fuel boiler element will also qualify, receiving 0.5 heat pump credits.

A range of policies, described in the consultation document, will contribute to achieving the overall ambition for heat pump market growth. In practice, the market-based mechanism is expected to complement many of these policies, for instance through improving the overall consumer appeal of heat pumps and thus supporting earlier decarbonisation action in response to heating regulations than in a counterfactual scenario. However, the focus of this Impact Assessment (IA) is only on the *additional* deployment beyond that anticipated from other policies so that the costs and benefits presented reflect the potential level of additionality of the CHMM.

The focus on the purely additional deployment allows us to minimise the risk of analytical overlaps with other policies: the costs and benefits shown in this IA are attributable to the CHMM and there is no double counting of the impact of other policies. However, we expect the mechanism to be an enabler of the other policies, which tend to have a positive Social Net Present Value (SNPV), meaning that the SNPV presented in this IA is likely to be lower than the SNPV associated with the whole retrofit deployment.

The IA estimates costs and benefits of the scheme for years 2024/25 and 2025/26, reflecting the targets proposed in the consultation documents under two alternative options. Targets for future years will be set considering the feasible growth rate of the heat pump supply chain, the contribution of wider policy action to heat pump deployment, and the pace of market development necessary to meet strategic aims related to energy efficiency and emissions reductions. Estimates have been produced by drawing on a range of sources, including market intelligence.

There is a high level of uncertainty as the estimated impact of the proposal will depend on how primary powers are used as well as on the impact of a suite of other policies. The costs and benefits presented in the IA should therefore be considered only as an illustration, based on current assumptions.

We anticipate that under Option 1, years 1 and 2 of the scheme could deliver 0.3, 0.5 and 0.5 MtCO2e of non-traded carbon abatement over Carbon Budgets 4, 5 and 6 respectively. Under Option 2 we estimate non-traded carbon savings to be 0.9, 1.3 and 1.3 MtCO2e in the same Carbon Budget periods. There's significant uncertainty in these estimates: under Option 1, Carbon Budget 5 non-traded savings could be as low as 0.3 MtCO2e or as high as 0.5 MtCO2e while under Option 2 the estimated range is between 0.9 MtCO2e and 1.4 MtCO2e.

There are also significant uncertainties in the SNPV of the scheme. For Option 1, we estimate that over Years 1 and 2, SNPV could vary between +£15m and +£392m, with a central estimate of +£203m. Under Option 2 the range is between +£49m and +£995m with a central estimate of +£522m over the 2-year period. The Risks and Uncertainties section shows the impact of different assumptions on the estimated SNPV and carbon savings.

Contents

Introduction & Background

Background

1. The UK was the first major economy in the world to set a legally binding target to achieve net zero greenhouse gas emissions by 2050. To achieve this, we need to transition to low-carbon ways of heating our homes, businesses and public buildings across the board.
2. Currently, heat in buildings is responsible for 23% of the UK's greenhouse gas emissions[1]. Meeting our legally binding target of a 78% reduction in carbon emissions by 2035, and to reach net zero emissions by 2050, means decarbonising virtually all heat in buildings and most industrial processes. This is a critical decade for action on the decarbonisation of heat and upgrading the energy efficiency of homes and other buildings.
3. Published in October 2021, the government's Heat and Buildings Strategy sets out the policy action that the government is taking to accelerate this transformation and plans to go further.
4. In the Chancellor's 2022 Autumn Statement, the government committed to driving improvements in energy efficiency, announcing a new ambition to reduce the UK's final energy consumption from buildings and industry by 15% by 2030. In addition to measures such as insulation to improve the fabric efficiency of buildings, an important part of reducing energy demand is switching to more efficient heating appliances. Electric heat pumps have a crucial role to play in this. Because most of the heat output of a heat pump is drawn from the ground or outside air, heat pumps produce several units of heat for every unit of energy consumed, making them three times more efficient than gas boiler[2]. Therefore, replacing a boiler with a heat pump is often the most impactful measure for reducing a building's energy demand.
5. As the previous consultation on this Clean Heat Market Mechanism and the 2021 Net Zero Strategy therefore set out, it is important that we rapidly grow the heat pump market towards around 600,000 installations per year by 2028 to make heat pumps a mainstream consumer solution alongside gas boilers, approximately 1.8 million of which are currently installed each year[3]. This level of heat pump deployment, including in new-build properties, is strategically important for any of the potential transition pathways to net zero, including those where hydrogen heating plays a major role too.
6. The Clean Heat Market Mechanism (CHMM) is designed to work as part of that wider policy framework in order to provide the further clarity and stimulus for investment and innovation throughout the manufacturing and installer supply chain and enable the heating industry to transform the consumer proposition of heat pumps in the UK.
7. Ensuring that the running costs of a heat pump are as affordable as possible is another key enabler to mass deployment; the government has accepted the Independent Review of Net Zero recommendation that it should commit to outlining a clear approach to the 'rebalancing' of gas and electricity prices and should make significant progress affecting relative prices by the end of 2024. Rebalancing prices will help to make it more attractive for households and businesses to switch to lower-carbon, more energy-efficient technologies like heat pumps.

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[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 (2020) 'Energy Consumption in the UK' (https://www.gov.uk/government/statistics/energy-consumption-in-the-uk).

[2] Catapult (2023), 'Interim Heat Pump Performance Data Analysis Report' https://es.catapult.org.uk/news/heat-pumps-shown-to-be-three-times-more-efficient-than-gas-boilers

[3] BSRIA (2022), Domestic boilers market analysis

Rationale for intervention

8. The current market for heat pumps is relatively small: only around 55,000 heat pumps were sold in the UK in 2021[4] in comparison to around 1.8 million fossil fuel boilers. Heat pumps are currently largely unable to compete on lifetime cost with established fossil fuel-based and less energy-efficient heating options, such as natural gas, oil, and direct electric heating appliances. 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.
9. A key element of the rationale for this intervention is the market failure with respect to the uncaptured negative externalities of conventional heating technologies, which renders their market price too low compared to the price of heat pumps. The full societal costs of heating based on fossil fuel combustion should consider the impacts on health (related to the air quality impacts) and the emission of greenhouse gases, leading to climate change. The need to deliver advancements in the decarbonisation of heating requires more urgent government action to correct the effects of this market failure within the UK heating system.
10. Likewise, the relative positive effect of heat pump deployment on air quality and emissions, and thus their lower societal cost, is not captured in their price. This is likely to result in under-investment in this technology, due to a lower expected payoff than would be provided by a market price reflecting the full range of social and private costs and benefits.
11. As outlined in the consultation document, there is already a set of planned policies to stimulate heat pump deployment, including heat pump subsidies (e.g. the Boiler Upgrade Scheme) and building regulations (e.g. the Future Homes Standard). However, this policy framework does not provide sufficient incentive and strategic confidence to relevant market actors to develop and promote products, offerings, and services that expand the consumer appeal and therefore uptake of heat pumps in retrofit settings. Without further intervention the heat pump market is unlikely to achieve the growth needed to meet the Government ambition of 600,000 installations per year by 2028.
12. Some further reasons for intervention related to the above include:
    a) Intervention in this market is needed to reduce the cost of decarbonising heat in buildings, as well as meeting legally binding emissions reduction targets. Given the price effects of market failures set out above, support for the heat pump market, through a clear market growth trajectory underpinned by a market-wide obligation, is likely to improve investor certainty and generate growth and development of the supply chain.
    b) Consumer research has shown that consumers are unfamiliar with heat pumps as an alternative to fossil fuel heating systems[5]. This introduces information asymmetry 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. One outcome from an intervention in the market would be to raise consumer awareness, addressing this market failure.
    c) Additional Research & Development and economies of scale are also expected to follow a successful intervention in the heat pump market. This will result in spill-over benefits to society, which are not currently reflected in the price of low-carbon heating.

Policy objective

13. The CHMM, for which enabling powers are being taken in the Energy Security Bill introduced to Parliament in July 2022, aims to provide the heating appliance industry – and wider

[4] Delta EE (February 2023), Electrification of Heat Service Market Forecast

[5] BEIS (2022), Winter public attitudes tracker. See Figure 2.1 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1140686/BEIS_PAT_Winter_2022_Heat_and_Energy_in_the_Home.pdf

market – with a clear, stable policy framework and the accompanying incentives to invest with confidence in scaling up the consumer market for heat pumps, thereby accelerating deployment and driving down energy demand from buildings. This long-term policy framework is expected to encourage the industry to take a range of steps, directly and in partnership with other actors, to improve the consumer appeal and awareness of heat pumps.

14. This scale of heat pump deployment is needed to make an electrification-led pathway to net zero a viable option at least-cost, which will require substantial further growth in annual installations by the early-2030s and is a strategic level of deployment even in a hydrogen-led transition.
15. The main aims are:
    a) To develop the UK heat pump market in line with the targeted growth trajectory in the Heat and Buildings Strategy (towards ~600,000 installations p.a. by 2028), with a focus on the retrofit market, working alongside other policies to deliver around 60,000 heat pumps installations in 2024 and 90,000 in 2025; and so
    b) To contribute to decarbonising heating in the UK and to meeting carbon budgets.
16. The consultation document sets out the wider aims of the whole suite of policies brought forward by the government in this space.

Outline of policy options

17. The policy options considered in this impact assessment are:
    a) **Option 0 (counterfactual)**: do nothing.
    b) **Option 1 (preferred option)**: introduce an obligation on the manufacturers of gas and oil boilers sold on the UK market to hold credits corresponding to qualifying installations of heat pumps in proportion to their relevant UK boiler sales. Under Option 1 the scheme would begin with relatively low targets, while the market adjusts to the obligation, before accelerating growth in later scheme years as the market scales
    c) **Option 2 (alternative option)**: introduce the same obligation as in Option 1, but the yearly scheme targets would be higher in early years, set such that a roughly constant growth rate in retrofit heat pumps is applied towards the aim for around 400,000 retrofit installations in 2028.
18. The consultation focusses on the deployment levels set for the years 2024 and 2025, so in this analysis we assessed the impact of the deployment in these years only. We have included a qualitative assessment of the potential impact on different businesses and consumers, as well as an indicative quantitative assessment of the possible scale of direct costs to business.
19. The proposed market-based mechanism is intended to work alongside targeted spending (e.g., the Boiler Upgrade Scheme) and regulatory measures (e.g., regulations on heating installations off the gas grid[6]) as part of an overall policy framework to support the development of the market in low-carbon heating. Future policies within this broader framework are currently at different stages of development. The principal overall policy alternative would therefore be to pursue either the same or further subsidy-based measures (e.g., 'heat pump grants') and/or the same or further consumer or building-owner regulatory measures (e.g., 'fossil fuel appliance installation bans') alone on the demand side without an accompanying market obligation.
20. In the 2022 Autumn Statement, the Chancellor announced new funding plans for energy efficiency initiatives, including heat pump deployment, to help deliver on the ambition of a

[6]BEIS (2021), Consultation on phasing out fossil fuel heating off the gas grid, https://www.gov.uk/government/consultations/phasing-out-fossil-fuel-heating-in-homes-off-the-gas-grid

15% reduction in energy consumption from buildings and industry by 2030. This amounts to a further £6bn of new funding over three years from 2025, which will include an extension to the Boiler Upgrade Scheme to 2028. However, meeting the heat pump deployment ambition solely through subsidy-based measures would increase government expenditure and reduce the confidence of achieving the targeted deployment outcome, relative to our preferred option; this is because the risk would remain that insufficient consumer demand (i.e. grant uptake) would come forward, likely because other non-cost barriers to uptake might not have been addressed. This option would also have lower incentives, relative to the preferred option, for industry to achieve downward pressure, through competitive market efficiencies, on the overall social cost. A large grant regime would risk locking in inefficiencies and higher prices. Further, this approach carries the usual risks associated with setting the correct subsidy level: grants too low would not generate the demand needed to meet the deployment ambition, while grants too high would over-compensate households reducing the benefit per pound of public spend. Therefore, this alternative is less likely to reach the policy goals and would likely lead to higher overall social costs.

21. The same level of heat pump deployment could be achieved through regulatory measures alone, such as fossil fuel appliance installation bans for specific household segments. However, in this scenario there would be reduced incentives for an industry-led transformation of the market through competition, since the policy would provide industry with an obligated consumer base, potentially locking in expectations around current costs and prices. Further, this option would have a negative distributional impact, with the targeted households forced to bear the full cost of heat decarbonisation. Therefore, this alternative is less likely to reach the policy goals and would lead to higher overall social costs or undermine the government's goal of decarbonising the energy system in a fair and affordable way for all energy users.
22. Finally, a combination of grants and installation bans would help to tackle only one of the market barriers (the higher installation cost of heat pumps compared to fossil fuel alternatives) but it would not provide any incentive for the market to experiment with efforts to address the other barriers preventing consumers from installing heat pumps. Therefore, under this option deployment might meet the 2028 ambition of 600,000 installations, but it could do so for a higher cost to consumers and government, compared to our preferred option.
23. For the reasons listed above, we discarded alternative options of meeting the deployment target without a market-based mechanism and only assessed the impact of different designs of the Clean Heat Market Mechanism. Policy alternatives with different overall heat pump deployment targets have not been evaluated since they would not be consistent with government's Powering Up Britain paper.

Short list of options

Option 0 (counterfactual): Do nothing

24. In this impact assessment, the quantified costs and benefits of an obligation on fossil fuel boiler manufacturers (option 1 and 2) are estimated against a counterfactual where no policy is introduced.

Option 1 (preferred option)

25. Introduce an obligation on the manufacturers of gas, oil and liquified petrol gas (LPG) boilers sold on the UK market to hold credits corresponding to qualifying installations of heat pumps in proportion to their relevant UK boiler sales. Only boiler installations after a certain threshold will count to calculate the credits required. Under this option, the credits target for years 1 and 2 of the scheme will be calculated as:

Table 1: policy design – Option 1

	Year 1: Jan 2024 – Dec 2024	Year 2: Jan 2025 – Dec 2025
Proportion of gas boiler sales	4%	6%
Gas boiler sales threshold	20,000	20,000
Proportion of oil boiler sales	4%	6%
Oil boiler sales threshold	1,000	1,000

For example, if a party sells 50,000 relevant gas boilers and 10,000 oil boilers between January 2024 and December 2024, its target would be:

(50,000 – 20,000) * 4% + (10,000 – 1,000) * 4% = 1,560

The same boiler sales performed between January 2025 and December 2025 would lead to a target of 2,340.

Option 2 (alternative option)

26. In this option, the yearly scheme targets for years 1 and 2 would be set such that a roughly constant growth rate in retrofit heat pumps is applied towards the aim for around 400,000 installations in 2028. The credits target will be set as:

Table 2: policy design – Option 2

	Year 1: Jan 2024 – Dec 2024	Year 2: Jan 2025 – Dec 2025
Proportion of gas boiler sales	5.5%	8%
Gas boiler sales threshold	20,000	20,000
Proportion of oil boiler sales	5.5%	8%
Oil boiler sales threshold	1,000	1,000

The same boiler sales considered in the example above, would lead to 2,145 credits in Year 1 and 3,120 in Year 2.

Scheme design

27. Aside from the target levels, options 1 and 2 are the same; the following paragraphs describe the scheme's key characteristics, common to both options. The consultation document sets out the rationale for the proposed scope of the scheme and discusses the policy design in more detail.
28. The sale of fossil fuel boilers fired by natural gas, liquefied petroleum gas (LPG), or oil on the UK market, up to 70kWth capacity, will be considered relevant boiler sales under the CHMM and generate a corresponding obligation. 'Hydrogen-ready' gas boilers – those that burn

natural gas but are designed to be readily convertible to burn 100% hydrogen if parts of the gas network are in future converted to supply hydrogen – will also be considered relevant fossil fuel boiler sales that will contribute to the calculation of a manufacturer's heat pump credit targets under the CHMM.

29. Scheme credits will be issued for the installation of 'air-to-water', 'ground-to-water' or 'water-to-water' heat pumps up to 45kWth.
30. High-temperature heat pumps will be treated the same as low-temperature heat pumps, but we will monitor market developments and consider whether any differentiation of treatment or weighting may be justified in later years of the scheme. For simplicity in this impact assessment, we have made the modelling assumption of all the installations under the obligation to be low-temperature air-to-water heat pumps.
31. Only installations in existing UK properties will count towards the obligation. Heat pump installations in non-domestic properties will be qualifying installations, provided that the other installation and appliance criteria (such as on maximum appliance capacity) are met.
32. Qualifying individual standalone heat pump installations will generate a single scheme credit for the manufacturer. Installations of qualifying hybrid heat pumps, systems that involve both a heat pump and a fossil fuel boiler element, will receive 0.5 heat pump credits. The proposed lower weighting for hybrid heat pump installations compared with standalone heat pumps is intended to reflect: (1) the lower carbon reduction potential of these systems (given their reliance on fossil fuels); and (2) the lower energy demand reduction potential given their lower overall system efficiency, when compared to standalone heat pumps.
33. In order to provide flexibility in how the obligation can be met, the scheme's credits will be tradable. Obligated parties will therefore be able to meet their credit obligation, in part or in whole, through acquiring credits from other heat pump manufacturers. As there are many routes to compliance, in this IA we have only modelled the impact of the heat pump deployment, regardless of the approach obligated parties decide to take to comply with the regulation. In principle, a secondary market will not affect the total number of heat pumps installed so we have assumed it to have no impact on the overall social net present value. However, an illustrative analysis of the possible distributional impact to businesses of such a secondary market is presented in the Impact on Business section.
34. Flexibility will also come from the fact that obligated parties will be able to carry forward a limited proportion of their target from one year to make up in the subsequent year, and from all scheme participants being allowed to carry forward some level of unsold or unused credits to the following year. We explore the possible impact of obligated parties carrying forward a share of their credit targets in the Risks and Uncertainties section.
35. Credits for the first year of the obligation will be generated with respect to heat pumps installed between 1 April 2024 and 31 March 2025 and between 1 April 2025 and 31 March 2026 for the second year of the obligation[7].
36. Where obligated parties fail to meet their credit obligation, and where this shortfall exceeds the obligation that can be carried over into the subsequent year under the target carry-forward rules above, they will be required to make a payment in lieu of the remaining shortfall. The consultation document recommends that this payment will be set on a per credit basis, at £5,000 per missing heat pump credit. This level would provide a strong incentive for companies to meet their targets through the sale and installation of heat pumps, or through the acquisition of heat pump credits, thereby ensuring the incentives align with the aim of the CHMM to support an expansion of the UK heat pump market. For these reasons, in the central scenario of this IA we have assumed full compliance of obligated parties. The Impact on Business section discusses the possible impact of payments-in-lieu on businesses.

[7] For simplicity, in this IA we have assumed the discrepancy between calendar and financial year to have no impact on the results.

Analytical approach

37. This section outlines the evidence base on which impacts of the policy proposals have been modelled and the overall analytical approach undertaken to assess the illustrative costs and benefits of the proposed market mechanism. The impact assessment presents the evidence of the impacts of the proposals for households, the business sector and 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 with a counterfactual scenario and then monetised using standard Green Book appraisal values. Net present values are derived by comparing the aggregate costs and benefits which are discounted by the social discount rate.
38. Assumptions are varied to produce sensitivity analysis to show the sensitivity of Social Net Present Value (SNPV) and carbon savings with respect to changes in the assumptions used.
39. 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 impact assessment is supplemented by a qualitative discussion on non-monetised costs and benefits which sets out the relevant evidence to wider strategic considerations. Therefore, the calculated SNPVs are not intended to be viewed in isolation but should be assessed in combination with the strategic considerations.

Evidence base

40. The appraisal values used in the analysis include:
    a. **Carbon values** – HMT Green Book supplementary guidance on valuation of energy use and greenhouse gas (GHG) emissions is used to value greenhouse gas savings.
    b. **Electricity and fossil fuel air quality damage costs** – HMT Green Book supplementary guidance is used to measure air quality damage costs (National average table).
    c. **Electricity and fossil fuel carbon emissions factors** – HMT Green Book supplementary guidance is used to measure carbon emissions from electricity and fossil fuels.
    d. **Long-run variable costs of energy supply** – HMT Green Book supplementary guidance is used to value the long-run variable costs of energy supply (LRVCs).
41. All prices in this analysis have been converted into 2023 prices using the GDP deflator. The Green Book social time preference rate ('discount rate') of 3.5% has been applied for social present values.

Monetised costs and benefits

42. Analysis has been conducted to estimate the costs and benefits associated with low-carbon heating technologies, relative to the counterfactual. The quantified costs and benefits contributing to the SNPV are:
    a. **Additional upfront capital costs** - These are the total additional upfront costs of the purchase and installation of low-carbon heating technologies, compared to the purchase and installation costs of the counterfactual heating system. This includes additional ancillary costs such as new radiators for heat pumps and incorporates cost reductions assumed to materialise as the market scales up.
    b. **Generation costs and benefits** - The estimated value of the change in energy demand due to low-carbon heating technologies displacing counterfactual heating systems.
    c. **Carbon savings** – The estimated value of the carbon abated in both the traded and non-traded sectors due to heat from low-carbon sources replacing heat from fossil fuels.
    d. **Air quality impacts** – The estimated value of the public health impacts of changes to emissions of nitrogen oxides and particulate matter.

e. **Maintenance** – The difference between the annual costs to maintain the different heating systems. For simplicity, we have assumed these costs to be the same across all scenarios and we have therefore not included them in the tables below.
f. **Hidden costs** – These include the time taken by householders to liaise with the installer, prepare the property for installation and any oversight. These costs are estimated to be small.
g. **Admin and familiarisation costs** – The costs associated with understanding the obligation and with compliance with the scheme once in force.

Non-monetised costs and benefits

43. 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 scheme will support the development of low-carbon heat supply chains. This will provide a 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. It will also help create green jobs and create opportunities for UK manufacturers. If monetised, this would have a positive impact on the SNPV.
    b. **Green jobs** – the expansion of heat pump deployment in line with the trajectory to 600,000 installations per year by 2028 is also expected to support 30,000 low-carbon and renewable energy ('LCREE') jobs by that year, predominantly in the installation and maintenance of heat pumps, and up to 90,000 LCREE jobs by 2035 in a high heat electrification scenario. This policy will contribute to securing these long-term low-carbon jobs.
    c. **Innovation and cost reductions** – DESNZ expects that supporting 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. The cost reduction and performance improvement benefits from low-carbon heating technologies installed after the period in scope of the market mechanism are not quantified in this impact assessment. If monetised, they 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. If monetised, this would have a positive impact on the SNPV.
    e. Consumer familiarity and perception towards renewable heat - the DESNZ Public Attitudes Tracker indicates that 51% of the public have little to no familiarity with air source heat pumps[8]. However, customers who have installed renewable heating technologies have expressed high levels of satisfaction[9]. Heat pumps would require consumers and businesses to operate their heating systems in an unfamiliar way compared to conventional heating systems. The installation of hundreds of thousands low-carbon heating appliances will improve the familiarity of the public with technologies essential to reach the net zero target. If monetised, this would have a positive impact on the SNPV.

[8] BEIS (2022), Winter public attitudes tracker - See Figure 2.1
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1140686/BEIS_PAT_Winter_2022_Heat_and_Energy_in_the_Home.pdf
[9] BEIS (2019), RHI evaluation interim report
https://www.gov.uk/government/publications/rhi-evaluation-interim-report-applicant-reaction-to-reform-announcements

Modelling approach and results

44. We have estimated the aggregate costs and benefits of clean heat installations over the years 2024 and 2025, appraised until the end of 2044, when all the appliances installed are assumed to have reached the end of their lifetime.

Deployment assumptions

45. The Heat and Building Strategy sets out the ambition of growing the heat pump market from the current 55,000 per year to 600,000 per year by 2028[10]. In this IA we have considered only the impact of the targets in 2024-2025 under the two policy options; the target levels are set up to support a smooth growth of heat pump installations from 2023 deployment to the 2028 ambition, giving enough time to build the supply chain and train installers.
46. Under Option 1, a 4% obligation target across a boiler market of 1,800,000 sales (the approximate size of the UK boiler market in 2021[11]), taking account of minimum thresholds, would lead to around 60,000 heat pump installations in the first year of the obligation. A 6% obligation target in Year 2 would support around 90,000 heat pumps being delivered. Under Option 2 the targets would be 85,000 and 125,000 in the first and second year of the obligation, respectively.
47. There are a wide range of UK Government schemes and policy action alongside the CHMM which are designed to support the heat pump deployment, alongside action being taken by the Devolved Administration. Any low-carbon heating retrofit installations performed in the years 2024-25 will count towards the obligation target set for those year.
48. We expect the Clean Heat Market Mechanism to support or enable part of this deployment, for instance through contributing to market conditions in which more consumers take decarbonisation action in response to heating regulations earlier than in a counterfactual scenario, but it is very difficult to produce a quantified estimate of its additionality. For simplicity, in the counterfactual scenario of this IA we have assumed that other policies would maintain the same level of low-carbon heating appliance deployment as in the absence of the market mechanism. Therefore, in the policy scenario we have estimated only the impact of the additional deployment not primarily driven by (and therefore attributed to) other policies. This has been calculated as the difference between the target and the deployment already taking place because of other policies (the counterfactual).
49. This approach allows us to avoid any double counting of the impact of other policies. However, as we expect the market-based mechanism to be a partial enabler of the other policies, which tend to have a positive SNPV, the SNPV presented in this IA is likely to be lower than the SNPV associated to the whole retrofit deployment set by the heat pump targets.
50. The 'market mechanism additional deployment' depends on the deployment levels of other policies. Estimating this level of deployment is challenging and subject to a high degree of uncertainty at this stage, especially since the installation of low-carbon heating appliances is only one of the possible outcomes for certain policies in consideration. In this IA we have assumed that heat pump installations driven primarily by other policies will contribute to 50,000 credits in 2024/25 and 60,000 credits in 2025/26.

[10] BSRIA (2022), 'Heat pumps market analysis'
[11] BSRIA (2022), **'**Domestic boilers market analysis **'**

Table 3: Deployment scenarios

	Option 1		Option 2	
	2024/25	**2025/26**	**2024/25**	**2025/26**
Overall retrofit market mechanism targets	60k	90k	85k	125k
Estimated credits from other policies	50k	60k	50k	60k
Market mechanism additional credits required	10k	30k	35k	65k

51. A lower level of installations driven primarily by other policies would lead to higher deployment attributed exclusively to the CHMM. Under this scenario we would have a higher social net present value, but also possible higher costs to businesses. There could also be a higher risk of non-compliance as obligated parties might struggle to deliver heat pump installations with more limited support from other policies. However, the lower level of the credit targets under the preferred Option 1 should minimise this risk.

Household characteristics assumptions

52. The design of the obligation leaves the obligated parties (and their consumer base) a high degree of freedom to choose in which buildings to install low-carbon heat appliances. There is, therefore, a high degree of uncertainty around the precise mix of building-types where heating systems primarily attributable to the market mechanism will be installed. In the central scenario of this IA, we have used data of heat pump installations from the Boiler Upgrade Scheme (BUS)[12] to calculate an illustrative deployment mix for the market mechanism additional deployment. For simplicity, we have assumed that heat pumps installed in fossil fuel off-gas-grid homes would replace an oil boiler.

Table 4: Illustrative deployment mix for the additional Market Mechanism deployment

	Deployment in each household type
On-gas-grid homes	56%
Electric off-gas-grid homes	10%
Fossil fuel off-gas-grid homes	34%

53. This deployment is illustrative and assumes that BUS historical data represents the best indicator of future deployment and is maintained even as deployment levels grow. The policy impact is very sensitive to the deployment assumption, so we have tested alternative scenarios in the Risks and Uncertainties section.
54. To test the impact of the weighting, we have assumed that hybrid heat pump installations will constitute 20% of the on-gas-grid deployment. The Risks and Uncertainties section shows the impact of alternative assumptions.

[12] BEIS (2022), Boiler Upgrade Scheme's, December statistics – See Table 1.4*
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1131006/Boiler_Upgrade_Scheme__BUS__Statistics_December_2022.xlsx
*For simplicity, we merged Oil, LPG and Coal fuel households into a combined Fossil Fuel off gas grid total and we excluded installations whose fuel type displaced is "None", "Other" or "Unknown".

Table 5: Illustrative additional market mechanism deployment

	Option 1		Option 2	
	2024/25	**2025/26**	**2024/25**	**2025/26**
Standalone heat pumps in on-gas-grid homes	5k	14k	17k	31k
Hybrid heat pumps in on-gas-grid homes	1k	4k	4k	8k
Standalone heat pumps in electric off-gas-grid homes	1k	3k	4k	7k
Standalone heat pumps in fossil fuel off-gas-grid homes	4k	11k	13k	23k
Total installations	**11k**	**32k**	**37k**	**69k**
Total credits	**10k**	**30k**	**35k**	**65k**

55. In both options, we assume installations to take place in the average household within each segment. We expect most of the heat pump deployment to take place in domestic buildings, but in practice it is possible that some installations may be in small non-domestic buildings. As only non-domestic buildings with the same characteristics (in terms of heat demand and installation costs) of domestic properties are within the policy scope, the proportion of non-domestic installations does not affect the quantifiable policy costs and benefits.
56. Current evidence suggests that heat pumps are technically suitable for most buildings. DESNZ modelling suggests around 85% have sufficient energy efficiency and internal electrical connection capacity to accommodate a low temperature heat pump system. The proportion goes up to over 90% if we consider high-temperature heat pumps, which are also in scope of the scheme. Other factors, such as space constraints, might reduce the proportion of buildings suitable for heat pumps in practice; however, it is unlikely that the obligated parties will target segments of the building stock where extensive new energy efficiency (e.g., insulation) measures are needed or where other factors could make the installation challenging. Therefore, in this IA we have not included the cost of any energy efficiency measures. We do however include the cost of in-home changes which we expect to be required in most buildings, such as hot water storage and larger radiators.
57. We expect some households to deploy energy efficiency measures, which will reduce their heat demand, between now and the obligation period. However, low-carbon heating installations under the Clean Heat Market Mechanism will be on a voluntary basis so it is difficult to accurately predict the possible level of heat demand reduction in households benefitting from the mechanism. Therefore, as a modelling assumption in this IA we have assumed no impact on households' heat demand because of energy efficiency improvements. This assumption carries the risk of overestimating both costs and benefits of the policy: a lower heat demand would lead to reduced heat pump installation costs and reduced carbon savings potential. Heat demand is assumed to change slightly from today's level to account for long-term climate and energy trends.
58. The model uses assumptions which draw on evidence which is discussed in the Annex.

Impact appraisal

59. This section of the impact assessment quantifies the costs and benefits of the market mechanism; in Table 6, we have summarised the key results in a central scenario compared to the do-nothing counterfactual scenario.

60. The capital cost shows the total difference between the capital expenditure (capex) of a heat pump and the capex of the counterfactual heating appliance. The market-based and market-wide nature of the policy should help to keep overall costs as low as possible, with obligated

parties competing to develop the heat pump market in the most efficient ways possible. A Eunomia report commissioned by DESNZ in 2022 (pending publication) 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% when deployment reaches 600,000 installations per year. Therefore, as an illustrative scenario, in this IA we have assumed that this level of cost reduction is achieved by 2028, with a linear reduction from 2024 prices. In practice, several market participants believe that significantly higher cost reductions can be achieved significantly faster, and the Government's stated ambition is for cost reductions towards parity on lifetime costs with gas boilers by 2030.

Table 6: Results of years 1 and 2 of the scheme

2023 prices, Present Value base year of 2023	**Option 1**	**Option 2**
SNPVs	**+£203m**	**+£522m**
Capital costs	-£267m	-£673m
Carbon savings	+£377m	+£945m
Long Run Variable Costs	+£41m	+£100m
Air quality benefits	+£76m	+£192m
Admin and familiarisation costs	-£12m	-£12m
Hidden costs	-£12m	-£30m
Lifetime Carbon savings 2024-2047 – MtCO2e	**2.1**	**5.2**
Carbon Budget 4 savings 2023-2027 – MtCO2e	0.3	0.9
Carbon Budget 5 savings 2028-2032 – MtCO2e	0.5	1.3
Carbon Budget 6 savings 2033-2037 – MtCO2e	0.5	1.3
Lifetime non-traded CCE - £/tCO2	**107**	**105**

61. The SNPVs of the monetised costs and benefits described in this IA show that the impacts of the proposed policy in Option 1 would lead to a net benefit overall from years 1 and 2 of the scheme. Carbon savings, savings in long run variable costs and air quality benefits more than offset the capital costs. The capital costs are negative as heat pump capex currently outweighs the capex of conventional technologies, such as gas or oil boilers. Long run variable costs are, overall, lower in the policy scenarios: households switching from gas boilers to heat pumps experience higher long-run variable costs because, although heat

pumps use less energy to heat homes, at present, electricity unit prices are much higher than gas unit prices; however, this is more than offset by the lower long-run variable costs experienced by homes off the gas grid where prices are more favourable to heat pumps. Maintenance costs are assumed to be the same in the policy scenarios and the counterfactual.

62. As the capital expenditure of heat pumps is the highest monetised cost it presents the highest risk to the SNPV. However, a break-even analysis shows that it would take a significant price increase of over 20% (equivalent to over £2000 increase on the cost of heat pumps installed on the average on-gas-grid home), in the first two years of the policy for the SNPV to become negative. We expect the development of the heat pump market to reduce costs as economies of scale emerge; therefore, we deem a scenario with high cost increase leading to a negative SNPV to be unlikely.

63. The SNPV over years 1 and 2 is higher in Option 2, driven by the higher heat pump deployment assumed in this scenario. However, there are significant non-monetised costs which we expect to be higher in this scenario compared to Option 1.

    a. **Risk of non-compliance**. The higher targets under Option 2 pose a higher delivery risk. A Delta-EE market report[13] suggests that the heat pump supply chain is already stretched because of the increased global demand and shortage of raw materials and semi-conductors. HMT Green Book guidance requires that central scenarios assume compliance with regulations; however, the higher risk to delivery indicates that obligated parties may find it harder to fully comply under Option 2, in which case the monetised impacts and carbon savings achieved may fall below those presented above.

    b. **Impact on cost reductions**. Possible supply chain constraints might decrease the ability of the policy to reduce heat pump costs over time. This risk is more significant under Option 2 where the targets are higher; if monetised, this would have a negative impact on Option 2's SNPV.

    c. **Industry and consumer confidence.** The potentially higher risk of non-compliance under Option 2 could affect industry and consumers' confidence in meeting future heat pump delivery targets, including the ambition for 600,000 installations per year by 2028. A negative perception towards this technology might slow down or increase the cost of heat decarbonisation.

    For these reasons, Option 1 is preferred over Option 2, despite the lower SNPV. This approach is consistent with the HMT Green Book guidance for economic appraisal which sets out that the best policy option is not necessarily the one achieving the greatest SNPV.

Risks and Uncertainties

64. The quantified impacts are sensitive to changes in the underlying assumptions. Sensitivities around the scenarios are conducted on the key factors, which are discussed here. The full list of sensitivity assumptions is included in the Annex.
65. Supplementary guidance to the Green Book on valuing energy use and greenhouse gas emissions[14] suggests that when capital is tied up in a specific project, alternative profitable

[13] Delta-EE (August 2022), *"The supply chain crisis – what does it mean for the EU heating sector?"*
[14] BEIS (2023), Green Book supplementary guidance, https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

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.

S1: Deployment assumptions – RHI deployment mix

66. In this sensitivity we have used data from the Renewable Heat Incentive (RHI) to calculate an alternative deployment mix for the market mechanism additional deployment that includes a higher proportion of off gas grid deployment.

S2: Deployment assumptions – Higher on gas grid deployment

67. In this sensitivity we have assumed a higher uptake on the gas grid to assess the impact of an alternative deployment mix.

S3: Deployment assumptions – hybrid deployment

68. Compared to standalone heat pumps, hybrids imply lower emissions savings as fossil fuels are used to meet part of the heat demand. The level of emissions savings for each fossil fuel hybrid installation is proportionate to the level of heat demand met by the heat pump component. In the central scenario we have assumed that 20% of the heat pumps installed in households on the gas grid are hybrids; in this sensitivity (S3), we explore the impact of a higher (50%) and lower (0%) proportion. Because of the planned credit weighting (0.5 credits for a hybrid installation vs. 1 credit for a standalone heat pump), varying the proportion of hybrid deployment has an impact on the total number of heat pumps (hybrid and standalone) deployed.

S4: Future capital cost reduction for heat pumps

69. A Eunomia report commissioned by DESNZ in 2022 (pending publication) 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. In the central scenario we assumed this reduction to take place by 2028, with a linear reduction trajectory from 2024 prices. In this sensitivity analysis (S4) we explore scenarios with linear cost reductions trajectories leading to 10% and 50% reductions by 2030.

S5: Efficiency of heating system

70. The efficiency of a low-carbon heating system has an impact on fuel consumption and running costs. This is expected to vary with weather conditions, the nature of the building stock, and the level of innovation. The low and high end of the assumption range is tested here (S5). This sensitivity test is also intended to reflect uncertainty with regards to future improvements of clean heat system performance.

S6: Energy prices

71. Low and high fuel price projections are used to test the sensitivity on energy prices, which are expected to be highly uncertain.

S7: Carbon prices

72. Low and high carbon value projections in the Green Book guidance are used for this sensitivity test.

S8: Target carry-forward

73. In this scenario we have assumed that obligated parties carry forward a proportion of their target from one year to the next, in line with the proposed flexibility.

Table 7: Sensitivity results for years 1 and 2 of the scheme

2023 prices, Present Value base year of 2023	Option 1		Option 2	
	NPV (£m)	CB5 savings (Mt)	NPV (£m)	CB5 savings (Mt)
Central scenario	£203	0.5	£522	1.3
S1: Deployment 1 - RHI Deployment	£314	0.4	£800	1.1
S2: Deployment 2 – Higher on grid deployment	£70	0.5	£189	1.3
S3: Deployment 3 – Hybrid Low	£198	0.5	£509	1.3
S3: Deployment 3 – Hybrid High	£213	0.5	£545	1.4
S4: Future capital cost reduction for heat pumps – lower	£183	0.5	£474	1.3
S4: Future capital cost reduction for heat pumps – higher	£228	0.5	£580	1.3
S5: Efficiency of heating system - lower	£165	0.5	£425	1.3
S5: Efficiency of heating system higher	£234	0.5	£600	1.3
S6: Energy prices - lower	£142	0.5	£370	1.3
S6: Energy prices - higher	£283	0.5	£719	1.3
S7: Carbon values-higher	£392	0.5	£995	1.3
S7: Carbon values-lower	£15	0.5	£49	1.3
S8: Target carry-forward	£112	0.3	£360	0.9

Sensitivity charts[15]

Figure 1 – Option 1 NPV impact sorted by highest impact to lowest.

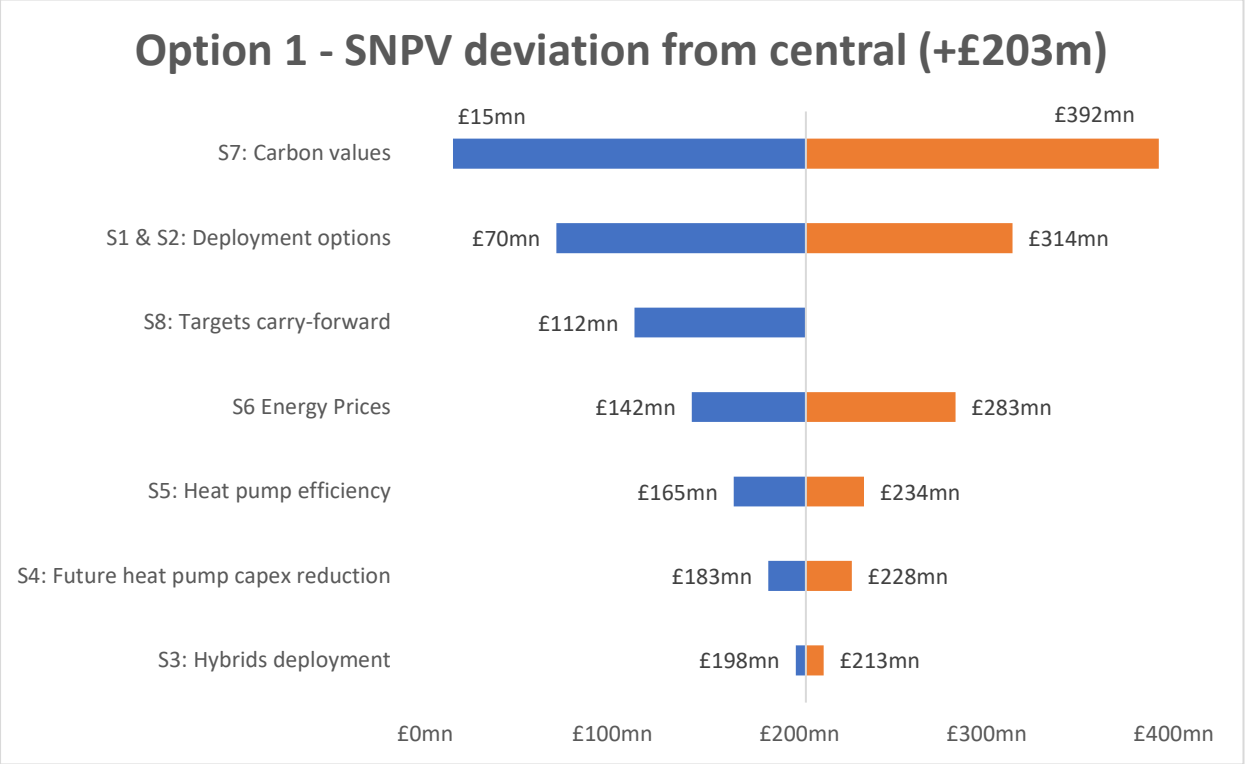
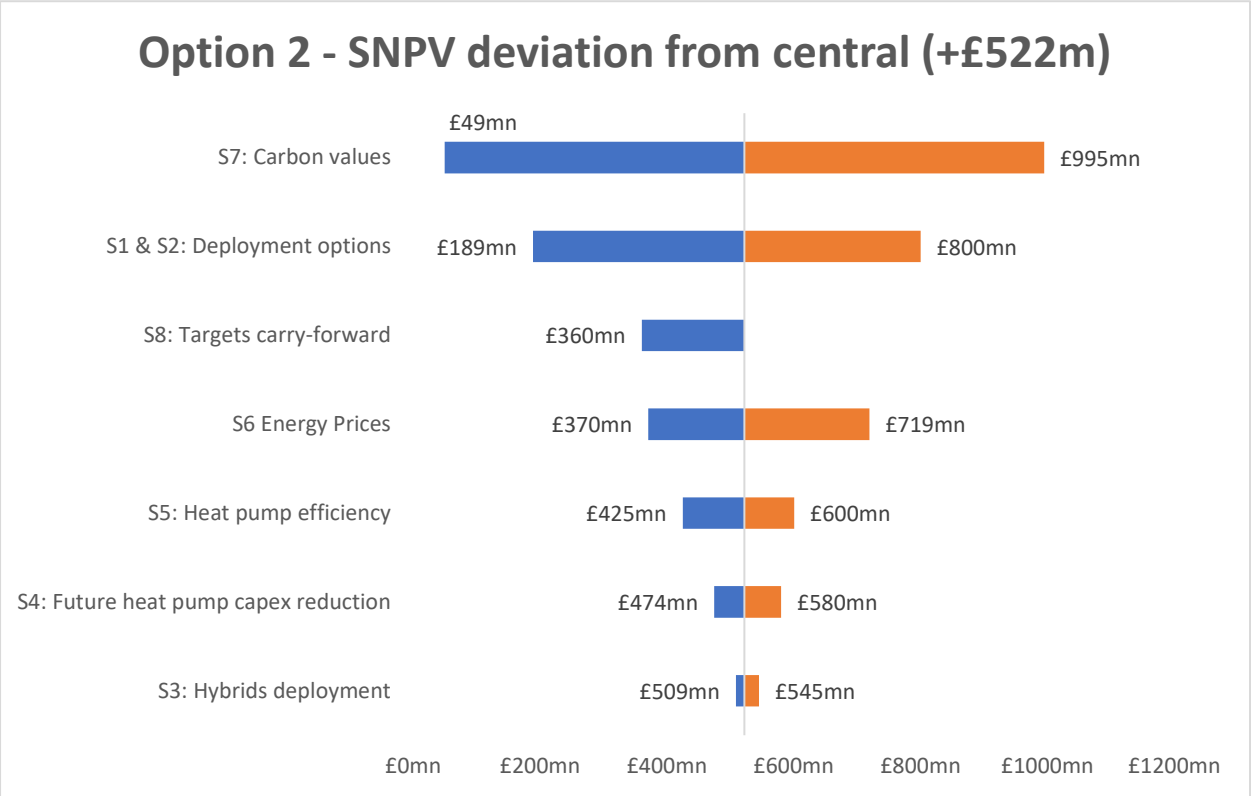


Figure 2 - Option 2 NPV impact sorted from highest impact to lowest.



[15] In Scenario 8: Target carry-forward we have not considered a 'high' scenario as there is no high variant of the sensitivity.

Distributional impact

74. As the Heat and Buildings Strategy set out, the government will be reviewing the overall policy framework for net zero, including how costs associated with the transition to low-carbon heating are distributed across different consumer groups. At the heart of this will be efforts to help ensure that low-income and fuel-poor households are not disproportionately affected and that there is support where it is needed to make sure the transition is accessible and affordable across society.
75. As heat pump uptake under this scheme will be on a voluntary basis, we don't expect any impact on fuel poverty. Households switching from direct electric heating to heat pumps will see a significant reduction in their energy demand because of the higher efficiency of heat pumps, with a positive impact on energy bills. Reducing the running costs of heat pumps, including relative to fossil fuel boilers, is one of the key aims of the wider government intervention. The Government has accepted the Independent Review of Net Zero recommendation that it should commit to outlining a clear approach to the 'rebalancing' of gas and electricity prices and should make significant progress affecting relative prices by the end of 2024. Rebalancing prices will help to make it more attractive for households and businesses to switch to lower-carbon, more energy-efficient technologies like heat pumps, while reducing any possible negative impact on fuel poverty.

Equality impact

76. Under the Public Sector Equality Duty, the government must have due regard to the potential impact of the market-based mechanism on people with protected characteristics as set out in s.149 of the Equality Act 2010 (age, disability, gender reassignment, marriage or civil partnership, pregnancy and maternity, race, religion or belief, sex, sexual orientation). This requires DESNZ to pay due regard to the need to:
    a) eliminate unlawful discrimination, harassment and victimisation and other conduct prohibited by the Act;
    b) advance equality of opportunity between people who share a protected characteristic and those who do not;
    c) foster good relations between people who share a protected characteristic and those who do not.
77. The main groups that will be affected by the policy are:
    a) Households – who will decide to install the heat pumps deployed by the obligated parties
    b) Installers of heat pumps – who will be contracted for installations of low carbon heat technologies
    c) Manufacturers – who will need to meet the obligation.
78. Our assessment at this stage – informed by stakeholder responses to the October 2021 Consultation – is that the proposed Clean Heat Market Mechanism should have limited or no disproportionately negative impact on people who share a protected characteristic. This is because deployment of heat pumps under the scheme will be on a voluntary basis. The main intended outcomes of the policy - carbon emissions reductions and strategic alignment to net zero objectives - are non-excludable public goods and therefore expected to benefit the majority of the population without distributional impacts for specific groups.
79. The cost of a low carbon heating system may remain a barrier to those on lower incomes, which may limit the direct benefits of the policy for this group. While lower household income is not itself a protected characteristic, it is often correlated with several protected

characteristics. On the other hand, without policies such as this to drive market scale and promote long-term cost reduction, costs and prices of low-carbon heating are less likely to reduce over time, meaning that the cost of switching to low-carbon heating will remain prohibitive for more households for longer.

80. We will continue to assess the potential impact on groups with protected characteristics and on wider inequalities during the present consultation period and the course of more detailed policy design.

Impact on Business

81. The impact of the policy on businesses, both in the heating appliance sector and more broadly, once implemented through secondary legislation, will depend upon the wider policy framework for heat decarbonisation of which it is part as well as wider market developments, which will be continuing in parallel to the further development of this policy. Therefore, the assessment in this section should be considered only as illustrative. A full Equivalent Annualised Net Direct Cost to Business (EANDCB) for the scheme, as well as a fuller assessment of indirect costs and benefits to businesses, will be prepared as part of the final impact assessment.
82. Under the implementation model anticipated in this consultation impact assessment, the obligation under the Clean Heat Market Mechanism would apply to the manufacturers of fossil fuel heating appliances sold in the UK. The supply chain will also be affected by the obligation, as third parties might be involved in delivering the installations to meet the targets. However, in line with Better Regulation Executive guidance, these changes are defined as 'resources used to comply with regulation' and so their impacts are not captured in the EANDCB. A qualitative assessment of the impact on installers is included below.
83. Fossil fuel heating appliance manufacturing is a relatively concentrated market sector, with four companies responsible for close to 90% of annual gas boiler sales (ca. 1.8m per year), and six companies responsible for around a further ~8% of sales. The four largest companies, and a number of the second-tier companies, are all multi-technology corporations producing and selling a range of appliances including heat pumps in several countries. In the oil boiler sector, four companies share around 93% of annual sales (over 57,000 per year), and another three companies a further 5%[16]. The largest four also produce heat pumps. The following sections provide illustrative estimates of the main costs that these businesses might face.
84. Companies with boiler sales less than 20,000 relevant gas boilers and 1,000 relevant oil boilers, corresponding to roughly 1% of the UK market, will be exempt. Companies subject to the small companies regime under the Companies Act 2006 at the time of their last filing of an annual report and accounts prior to the start of an obligation period will also not be in scope of the obligation for that period. These minimum thresholds and the exclusion of small companies will limit the number of obligated companies and limit the costs to smaller firms or those with only limited activities in the UK. It will also ensure that the administrative complexity and costs of administering the obligation are kept proportionate.

Familiarisation and admin costs

85. In delivering their obligation, businesses will incur familiarisation and administrative costs. These will vary by business - depending on factors such as their setup, size and decisions on how to comply with the obligation - but are likely to include items such as the cost of

[16] BSRIA (2022), 'Domestic Boilers Market Analysis 2021'

running IT databases, staff time and reporting measures installed to the scheme administrator. They may also include indirect costs, such as human resources and legal costs.

86. We estimate familiarisation costs at around £45,000[17], under both policy options. There are also likely to be administrative costs to these businesses associated with compliance with the scheme once in force, for instance from reporting and the provision of evidence of compliance subject to the final design of administrative processes, participation in audit processes, etc. Internal estimates, and comparisons with comparable schemes, produce an indicative high estimate of around £6.5m per year across all obligated parties[18]. We invite stakeholder views on the accuracy of our estimate; we will further assess the possible administrative costs during further scheme development.

Obligation costs

87. The costs to these businesses of meeting the obligation are difficult to assess with confidence, as is the extent to which such costs may be offset by higher revenue associated with such sales. The possibility to trade credits means that the costs faced by different obligated parties could vary significantly, depending on whether they decide to meet their credit obligation, in part or in whole, through acquiring credits from other heat pump manufacturers. Some of the costs that obligated parties will face are transfers between businesses; others will be offset by direct benefits to business. In line with Better Regulation Executive guidance, we have excluded these costs from the total.
88. Because of the uncertainty described above, costs to business could vary significantly. At the lower end of the range, they could amount only to the familiarisation and administrative costs estimated in the section above. However, the presence of market barriers and failures means that, in some cases, heat pumps may need to be subsidised to induce households to install them. This subsidy, or delivery cost, if present, would be a direct cost to business. As an illustrative example, we can consider a scenario where boiler manufacturing businesses decide to meet the obligation by selling heat pumps themselves. All the additional costs associated with manufacturing, marketing and installing the heat pumps over and above the equivalents for boilers should be considered direct costs associated with the scheme; however, they will be (fully or partly) offset by the direct revenues generated from the heat pump sales. This means that the only true cost to business would be the possible extra subsidy they might need to offer to persuade some households to install heat pumps, i.e. the delivery cost. This modelling approach is likely to overestimate the cost: extra subsidies might not be needed as obligated parties may find sufficient consumers willing and able to pay for the full cost of the heat pumps, especially if presented with affordable options for multi-year financing.
89. In this IA we have assumed that a combination of government support and consumers' willingness to pay would on average reduce the cost for obligated parties by £5000 per installation. This implies that obligated parties would be able to identify households willing to pay on average £4000 more for a heat pump than what they would pay for a fossil fuel boiler (including VAT). This illustrative estimate is based on evidence from the Boiler

[17] This is based on the illustrative assumption of 100 hours needed for familiarisation with the scheme and 13 companies in scope of the obligation. We have used the hourly wage for management consultants and business analysts (~£26/hr) from the ONS, uplifted with the non-wage cost uplift from RPC / Eurostat 2019 (21.78%)

[18] Using an estimate of £0.5m admin cost per year, based on the Renewable Transport Fuel Obligation post-implementation review, and assuming 13 companies will be in scope with the obligation. Alternative estimates, e.g. based on other comparable schemes, are lower, so our central scenario is likely to overestimate costs.

Upgrade Scheme[19], suggesting that applicants are willing to contribute, on average, around £8000 for the total cost of the heat pump (and therefore over £5000 on top of the cost of an average boiler). In future years one might expect the average willingness to pay to decrease as deployment increases; on the other hand, as the market develops, it is likely there will be increased consumer awareness as well as new financing arrangements that could combine to make it easier to find a greater number of willing-and-able-to-pay heat pump consumers. We will continue to refine estimates as new evidence is published and as the policy detail continues to develop.

Direct costs to businesses

90. For Option 1, we have estimated the indicative total costs to business over 2024-25 to range between £12m (considering only familiarisation and admin costs and no further delivery costs) and £188m (estimated calculating the total payments-in-lieu if all the targets were missed and no credits acquired). Under Option 2, the range would be £12m-£472m. As central estimates we have calculated business costs to be around £116m under Option 1 and £277m under Option 2. These are based on the central assumptions presented in this IA, specifically, a heat pump cost reduction of 20% by 2028, the additional market-mechanism deployment shown in Table 5 and the willingness to pay assumptions above.
91. Many factors will affect the cost to business:
    a. **Heat pump cost.** Regardless of the compliance route, the underlying cost to produce and install a heat pump might affect the cost to obligated parties. Significant cost reductions on appliances or installations as the market grows will reduce the costs to businesses, while not necessarily affecting their revenues (which depend on the households' willingness to pay for heat pumps).
    b. **Search and marketing costs.** Obligated parties will incur costs to market and promote heat pumps, as well as, to identify the most suitable properties. Willingness to pay varies across different households. Marketing activities, in particular if combined with affordable heat pump financing offerings, may find sufficient households that are willing and able to contribute towards the full additional cost of a heat pump and thus mean that the direct cost to obligated parties would be minimal or zero.
    c. **Boiler costs.** In the counterfactual scenario, households install boilers instead of heat pumps. The households' willingness to pay for heat pumps depend on the cost they would face in the counterfactual scenario, i.e. the cost of replacement boilers
    d. **Contribution of other policies to heat pump demand and deployment**. The range of UK Government and Devolved Administration schemes aimed at promoting heat pump deployment will affect the delivery cost. Consistent with the approach taken when calculating the SNPV, we have estimated the cost to businesses relative only to the additional deployment not primarily driven by (and therefore attributed to) other policies. In practice, the other Government schemes described in the consultation document, such as the support for heat training, are expected to reduce the cost to business by removing or reducing some of the market barriers.
92. We expect the actual cost to business to be lower than our central estimate: more ambitious heat pump cost reductions, in line with the Government's ambition for parity of lifetime costs by 2030, the increased appeal of heat pumps to consumers as the market grows, and the impact on the market of complementary wider policy would decrease the cost significantly. Table 8 below summarises the key costs to business.

[19] BEIS (2022), Boiler Upgrade Scheme's February statistics, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1146373/Boiler_Upgrade_Scheme__BUS__Statistics_February_2023.xlsx

Table 8: EANDCB central estimates for 2024-25

Cost (£m)	Description	Key data sources and uncertainty/robustness	Option 1	Option 2
Familiarisation costs	The cost to understand the obligation, based on the value of staff time	Based on illustrative estimates of 100 hours needed for familiarisation for the 13 companies assumed to be in scope. We used the hourly wage for management consultants and business analysts (~£24/hr) from the ONS, uplifted with the non-wage cost uplift from RPC / Eurostat 2019 (21.78%)	£45,000	£45,000
Administrative costs	Costs associated with compliance with the scheme once in force, for instance from reporting and the provision of evidence of compliance subject to the final design of administrative processes, participation in audit processes, etc	Assuming a cost of £0.5m for the 13 obligated company (based on Renewable Transport Fuel Obligation post-implementation review estimate, which includes the cost of reporting, trading, verification, policy, audit, marketing, general management and technical issues)	£12m	£12m
Delivery costs	The costs that obligated parties may need to incur to support households to install heat pumps.	We've assumed a heat pump cost reduction of 20% by 2028. This is a conservative assumption; the Government's ambition is for parity of lifetime costs by 2030. We've assumed that a combination of willingness to pay and future Government funding would reduce delivery costs by £5000 per installation.	£0m-£188m Central estimate of £116m	£0m-£472m Central estimate of £277m
Net costs – range			£12m-£201m	£12m-485m
Net costs – central estimate			£116m	£277m
EANDCB (Annualised)			£59m	£141m

93. As mentioned above, there is likely to be variation in the net impact on different businesses in this sector, with the possibility that certain businesses face a net cost and others a net benefit, through benefitting from trading surplus credits under the mechanism.

Indirect costs to businesses

94. The policy should have a significant positive impact for installers and maintenance engineers of the low-carbon heating appliances in scope, many of which are small or micro enterprises, through increased business activity. There are currently around 1,500 businesses in the UK certified with the Microgeneration Certification Scheme (MCS) to install heat pumps, estimated to employ around 4,500 installers. The total number of trained heat pump installers is, however, likely to be greater than this, as MCS Certification is only required for installations receiving Government grant funding. The increased level of deployment driven by the policy should increase the revenues of these businesses; furthermore, by providing certainty in the growth of the heat pump market, the policy should encourage businesses to invest in installer training, with a positive impact on the supply chain. To further support this, Government announced a £5m Heat Training Grant to support trainees in England taking training relevant to heat pumps and heat networks. This is expected to support 10,000 training opportunities up to 2025, including at least 6,000 for heat pumps.
95. If the policy contributes to a decline in fossil fuel boiler sales in future, then by the same token this could lead to a negative impact over time, through reduced business, for the

approx. 110,000 installers and service engineers of such products who do not diversify into the growing low-carbon market. We expect the negative impact to be small. Recent Government research found that around three quarters of heating and cooling installers could either install heat pumps already or are open to being persuaded to train to install heat pumps in the long term[20]. We expect the majority of heat pump installers in 2028 to be current heating engineers who train to install heat pumps alongside other heating technologies; those not willing to retrain are likely to be planning to retire within the timescales of the CHMM and therefore will not be negatively impacted. Overall, Government expects the installer workforce to expand, creating new opportunities for apprentices. A new three-year Low Carbon Heating Technician apprenticeship will launch in 2023, and the existing Plumbing & Domestic Heating Technician apprenticeship is being revised to ensure that all heating apprentices learn the core skills needed for low-carbon heating.

96. The policy is likely also to have a positive impact for other market actors involved in the promotion, retail, financing or installation of heat pumps, of ancillary equipment such as thermal storage, or of related services, for instance in relation to demand-side response. This may include certain energy suppliers and energy service companies, for instance.
97. Regarding impacts on businesses more broadly, i.e., outside the heating market and wider supply chain, while direct impacts are likely to be limited, it is likely that over time there will be an indirect benefit from reduced costs of low-carbon heating appliances and their installation, reducing the costs of switching to appliances that consume less energy and of compliance with present and future minimum energy efficiency standards and building regulations. Being indirect, such benefits don't feature in the EANDCB assessment calculation for the policy.

Competition and Trade Impact

98. We will continue to assess the potential impacts that this policy could have on competition and competitiveness throughout the development of both this policy and the wider policy framework of which it will be part. At this stage, we do not assess that the policy would lead to significant negative impacts on competition in terms of range of suppliers in the market, suppliers' ability to compete, suppliers' incentives to compete vigorously, or the choice and information available to consumers. Rather, our assessment at this stage is that the fossil fuel appliance market will remain highly competitive and that the low-carbon heating appliance market is likely to become larger, with more actors and more pressure to compete vigorously on costs and other differentiators, with benefits for consumers. The ability to trade in credits on the secondary market, target carry-forward and *de minimis* conditions are expected to limit the risk of a negative impact on competition.
99. The policy will apply equally to the manufacturers of fossil fuel heating appliances imported to the UK market as to those manufactured in the UK, thereby ensuring that competition and trade are not distorted in favour of overseas competitors. The policy could in principle deter new entry of boiler manufacturers to the UK market. In practice, however, the UK boiler market is highly mature and significant new entrants in the absence of this policy, while not impossible, would perhaps therefore be unlikely.
100. By providing a market signal of a firm and fast-growing UK heat pump market, the policy is likely to increase the attractiveness of the UK market to international actors in the heat pump market, either to begin or expand import of their products or services and/or to consider investing in establishing a UK presence, potentially up to and including

[20] BEIS (2023), Heating and cooling installer study, https://www.gov.uk/government/publications/heating-and-cooling-installer-study

manufacturing. To support this, the government plans to launch a £30 million Heat Pump Investment Accelerator Competition (HPIAC) in 2023. The Competition will award grant funding for eligible capital costs relating to the construction of new factories, or the expansion or retooling of existing factories, to produce heat pumps or their components. Attributing any increase in inward investment in the UK heat pump market solely to this policy, rather than to a combination of policy and market drivers, would though be very difficult.

101. Exports of fossil fuel heating appliances are not in scope of the policy and so would not be expected to be affected; on the other hand, the policy may contribute to a modest positive impact on exports of heat pumps if it contributes to e.g. investment decisions to locate heat pump manufacturing capacity in the UK (and subsequent export) and/or the development in the UK of exportable know-how, product innovations or successful ancillary services related to the heat pump market.

Small and Micro Business Assessment (SaMBA)

102. Micro businesses should not directly incur costs as a result of the proposed regulatory measures. The consultation document sets out the proposed *de minimis* threshold exclusions from the policy scope: manufacturers of fossil fuel appliances with less than 20,000 relevant gas boiler sales or less than 1,000 relevant oil boiler sales, currently equivalent to a little over a 1% market share in each case, will not be in scope of the obligation with respect to those appliances. Companies subject to the small companies regime under the Companies Act 2006[21] at the time of their last filing of an annual report and accounts prior to the start of an obligation period will also not be in scope of the obligation for that period. These minimum thresholds and the exclusion of small companies will limit the number of obligated companies and limit the costs to smaller firms or those with only limited activities in the UK.
103. The consultation proposes that the administration of the CHMM be based on corporate groups: related parties, business units, or brands within the same corporate group will be treated as one 'appliance manufacturer' entity for the purposes of determining targets under the scheme and awarding heat pump credits. The obligation will apply to all manufacturers of relevant fossil fuel appliances sold for installation in the UK, who are not excluded as per above, regardless of whether the manufacturing takes place in the UK or of whether the company has a UK corporate presence. This approach aims to ensure the obligation is applied fairly and does not have a disproportionate impact on UK manufacturers relative to non-UK manufacturers. Therefore, businesses with few or zero UK employees whose levels of UK sales are above the *de minimis* threshold will be considered in scope of the obligation. These businesses may class as small businesses in terms of numbers of UK employees (i.e. fewer than 49), but are almost certainly larger entities in global terms, with higher staff numbers in their headquarter and/or manufacturing locations.
104. It is possible that smaller businesses in scope of the obligation – for instance those with just over 1% of market share (around five in total at present) – may face proportionately higher costs compared to larger businesses in scope. For instance, the opportunity costs of upfront familiarisation with requirements and ongoing administration/reporting may be higher for a firm without dedicated compliance or regulatory affairs staff. However, it should be noted

[21] Companies Act (2006), https://www.legislation.gov.uk/ukpga/2006/46/part/15/chapter/1/crossheading/companies-subject-to-the-small-companies-regime

that any businesses in scope will have the option of purchasing credits from other heat pump manufacturers, reducing transition and other fixed costs for such firms.

105. Outside of parties in scope of the obligation, a substantial number of existing, diversifying or new micro and small businesses engaged in the installation of low-carbon heating are likely to benefit indirectly from the policy's increase in business in this area. Data from the Heat Pump Association indicates that the large majority of existing installers are small or micro businesses[22]. Since a key objective of the market-based mechanism is to build the supply chain, we expect the proposal to maintain existing small or micro low carbon heat businesses and create opportunities for growth and new businesses in this segment to emerge. There are currently approximately 4,500 such installers in the UK, but there is expected to be demand for around 30,000 by 2028[23], according to the Heat Pump Association.

Monitoring and Evaluation

Aims and Objectives

106. This plan sets out the monitoring and evaluation (M&E) aims for the Clean Heat Market Mechanism as well as proposing an approach to research planning, timelines and budget. Robust M&E will allow us to assess the extent to which the Clean Heat Market Mechanism achieves its objectives. It is also critical in identifying risks and highlighting areas for improvement, allowing in-flight policy changes to be made to the scheme once live. The aims of the M&E are to:
    a. Support regular reporting of progress against scheme benefits.
    b. Examine the extent to which the CHMM meets its objectives.
    c. Support scheme management, including tracking of delivery and amendments to the scheme.
    d. Provide evidence to understand the barriers and opportunities experienced during delivery to support design of future policies.
    e. Provide evidence of the impacts achieved by the scheme, to support both benefits reporting and design of future policies.
    f. Support an assessment of the value for money achieved.
107. Findings from the evaluation will be used to support the design and implementation of any future scheme which seeks to support the uptake of low carbon heating and will generate transferable knowledge which are also relevant in respect of other energy efficiency measures, and/or market-based mechanism policy interventions in other sectors. It will also provide behavioural insights findings in respect of domestic heating. The evaluation will also seek to explore the emergence of any perverse incentives or unforeseen impacts of the CHMM.

Monitoring metrics

108. The scheme administrator will be required to collect detailed monitoring data, with additional data collected by DESNZ to support impact reporting. Monitoring data will be reported to DESNZ on a regular basis. The expected key scheme metrics are set out in Table 9 below.

[22] Heat Pump Association (2019), Installer survey results, https://www.heatpumps.org.uk/wp-content/uploads/2019/11/Installer-Skills-Survey-Summary.pdf

[23] Heat Pump Association (2023), https://www.heatpumps.org.uk/about/installers/

Table 9: CHMM monitoring metrics

Metric	Unit	Source	Frequency
Delivery			
UK retrofit heat pump sales	#	Scheme administrator data derived from installer notifications	Monthly
of which hybrid	#	Scheme administrator data derived from installer notifications	Monthly
UK boiler sales	#	Scheme administrator data derived from boiler manufacturer reporting	Quarterly
Total number of HP credits presented vs total obligation for year	#	Scheme administrator data	Annually
Number of penalties issued	#	Scheme administrator data	Annually
Benefits Tracking			
Carbon abatement	MtCO2e	Scheme administrator will collect information on numbers and types of heat pump installed, allowing to estimate the carbon savings from displacing fossil fuel heating systems.	Quarterly
Renewable heat produced	MWh	Scheme administrator will collect information on the heat pump installed, allowing to estimate the renewable heat produced.	Quarterly
Air quality damage	£	Scheme administrator will collect information on the heat pump installed allowing to estimate the air quality impact.	Quarterly
Number of jobs supported in the low carbon heating industry, broken down by sector/role and region where possible.	#	Annual market intelligence reports. Or Apply an appropriate multiplier to installations. Or Use registration data from Competent Person Schemes (CPS)/ Microgeneration Certificate Scheme (MCS) to monitor the total number of heat pump installers.	Annually
Cost of heat pumps installed	£	MCS data	Quarterly
Cost-effectiveness	£ per MtCO2e abated and £ per TWh renewable heat generated	Calculated using the total cost of hp installations, the total carbon abated and the total renewable heat generated.	Mid-scheme / end of scheme reviews

Evaluation

109. Evaluation of the scheme will require:
    a. A theory of change.
    b. A process evaluation exploring the government implement of the scheme and how industry is complying with it.
    c. An impact evaluation exploring whether the policies achieved its intended impact and the extent and nature of any wider impacts or unintended consequences.
    d. An economic/value-for-money (VfM) evaluation.

Approach & Methodology

110. External evaluation suppliers will collect primary evidence to support a robust evaluation. The supplier will be recruited through a fair and open competition and will be assessed based on price and the quality of their bid for this project. Individual evaluation research activities will be piloted if they are deemed to be significant in achieving the overall evaluation objectives and require significant spend.
111. The process evaluation will be based on the analysis of quantitative data on heat pump sales and installations, boiler sales and installations, credits purchased, etc, collected through monitoring. This will be supplemented with data from primary data collection carried out under the evaluation in the form of surveys and qualitative interviews with a wide range of stakeholder groups.
112. We will consider different approaches for the impact evaluation, considering their feasibility and their capability to meet the M&E aims. At this stage, we believe that a theory-based approach, including contribution analysis might be the most appropriate for the CHMM as an experimental design might not be feasible to assess all impacts, given the challenges with attributing quantifiable additionality in a crowded policy landscape. Contribution analysis is likely to be the most viable and effective approach for a policy such as this, which works alongside rather than in isolation from other policies, to influence consumer uptake. This is only a possible approach, and in assessing bids submitted by suppliers, all approaches will be judged on individual merit, rather than the extent to which bids align with this approach. Desk research, analysis of scheme and secondary data, and survey and qualitative data collection might support any chosen approach.
113. The economic/VfM evaluation will be based on the analysis of the quantitative data collected through monitoring. We will follow the Green Book principles to calculate monetised costs and benefits and relevant cost-effectiveness metrics.

Annex – full list of modelling assumptions and risks

General assumptions

*Table 10: Appliances characteristics in central scenario**

	Capex (average price today exc. VAT)[24]	Capex reduction by 2028	Average annual efficiency	Lifetime (years)
Heat Pump	See Table 11 below	20%	280%[25]	20
Hybrid Heat Pump (Split)	£10,800	20%	280% for the heat pump component, 84% for the gas boiler component in 2024, 89% from 2025. 65%-35% heat pump/gas boiler split	20
Gas boilers	£2,500	-	84% in 2024, 89% from 2025[26]	15
Oil boilers	£4,300	-	84%	15
Storage heaters	£3,400	-	100%	20

**For simplicity we assume maintenance costs to be equal in all scenarios*

Table 11: Heat demand and HP Capex costs of households installing HPs

	Households on the gas grid (OnGG) - Average	Households heated by direct electric appliances	Households off the gas grid (OffGG) - average[27]
Average heat demand (kWh)[28]	9,900 kWh	7,200 kWh	13,600 kWh
Space heating demand increase after HP installation	10%[29]	10%	10%
Capex costs of installing a HP (average price today)[30]	£10,800	£10,600[31]	£12,000

Sensitivity analysis assumptions

S1: Deployment assumption 1 – RHI deployment mix

[24] DESNZ' analysis of the National Housing Model results.
[25] Based on evidence from the Electrification of heat demonstration project.
[26] Existing performance based on In-situ monitoring of condensing boilers report, future performance on the 2022 consultation to improve boiler standards and efficiency.
[27] Off gas grid households are assumed to all use oil boilers for heating.
[28] DESNZ' analysis of the National Housing Model results. Includes space and hot water heating.
[29] UCL (2017), https://discovery.ucl.ac.uk/id/eprint/1566603/
[30] DESNZ' analysis of the National Housing Model results. Heat Pumps capex costs are for air source, low temperature heat pumps. This includes the cost of the unit, fixtures, buffer tank and hot water cylinder, controls, labour and upgrade to radiators.
[31] Including the cost of installing a wet distribution system. Households currently heated by direct electric appliances tend to be smaller than average which partly offsets the increase in price due to the installation of a wet distribution system.

In this scenario we base the market mechanism's deployment mix on the deployment mix seen in the Renewable Heat Incentives air source heat pump's redemptions[32].

Table 12: Illustrative deployment mix for the additional Market Mechanism deployment based on the Renewable Heat Incentives redemption mix

	Deployment in each household type
On-gas-grid homes	21%
Electric off-gas-grid homes	37%
Fossil fuel off-gas-grid homes	42%

S2: Deployment assumption 2 – Higher on gas grid uptake

This is an illustrative scenario where we assume a higher deployment on the gas grid.

Table 13: Illustrative deployment mix for the additional Market Mechanism deployment

	Deployment in each household type
On-gas-grid homes	80%
Electric off-gas-grid homes	0%
Fossil fuel off-gas-grid homes	20%

S3: Deployment assumption 3 – Low/High hybrid deployment

In the high end of this scenario, we assume that half of the On Gas-grid market mechanism additional installations are hybrid heat pumps, in which a heat pump works together with a gas boiler. We also assume a low scenario where no hybrids are deployed. In all scenarios, we assume the heat pump component to meet 65% of the heat demand with the gas boiler meeting the remaining 35%.

S4: Future capital cost reduction for heat pumps – Low/High

In this sensitivity analysis we explore a scenario with 50% cost reductions by 2030. This assumption is dependent on innovation in the equipment as well as economies of scale benefits in heat pump installations. We have also assumed a lower cost reduction scenario with a 10% cost reduction by 2030. In both scenarios we have assumed a linear cost reduction from 2023 to 2030 as shown in Table 14 below.

Table 14: Heat pumps cost reduction

Example	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**
OnGG - Central	£10,800	£10,400	£10,000	£9,500	£9,100	£8,700
OnGG – High reduction (50% by 2030)	£10,800	£10,100	£9,300	£8,500	£7,700	£7,000

[32] BEIS (2022), See table s2.2 https://www.gov.uk/government/statistics/rhi-monthly-deployment-data-december-2022-annual-edition

OnGG – Low reduction (10% by 2030)	£10,800	£10,700	£10,500	£10,400	£10,200	£10,100

S5: Efficiency of heating system

We tested a low and a high scenario, with average heat pumps efficiencies of 2.50 and 3.10 respectively. These values represent the 25th and 75th percentile of data from the RHPP trial[33].

S6: Energy prices

Low and high fuel price projections come from the HMT Green Book supplementary guidance.[34]

S7: Carbon prices

Low and high carbon values series comes from the HMT Green Book supplementary guidance.[35]

S8: Target carry-forward

In this scenario we assume that firms are allowed to carry forward 25% of their deployment credits into the next year. This results in year 1 heat pump deployment being 75% of the year 1 target and year 2 deployment being 75% of the year two target, plus the remaining 25% of year one deployment that was carried over.

Table 15: Target carry-forward deployment levels for years 1 and 2 of the scheme

	Year 1 Heat pump deployment (2024)	Year 2 Heat pump deployment (2025)
Option 1	0k	24k
Option 2	15k	58k

[33] UCL (2017), Analysis of heat pump data, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/606818/DECC_RHPP_161214_Final_Report_v1-13.pdf

[34] BEIS (2023), Green Book supplementary guidance, https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

[35] BEIS (2023), Green Book supplementary guidance, https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal