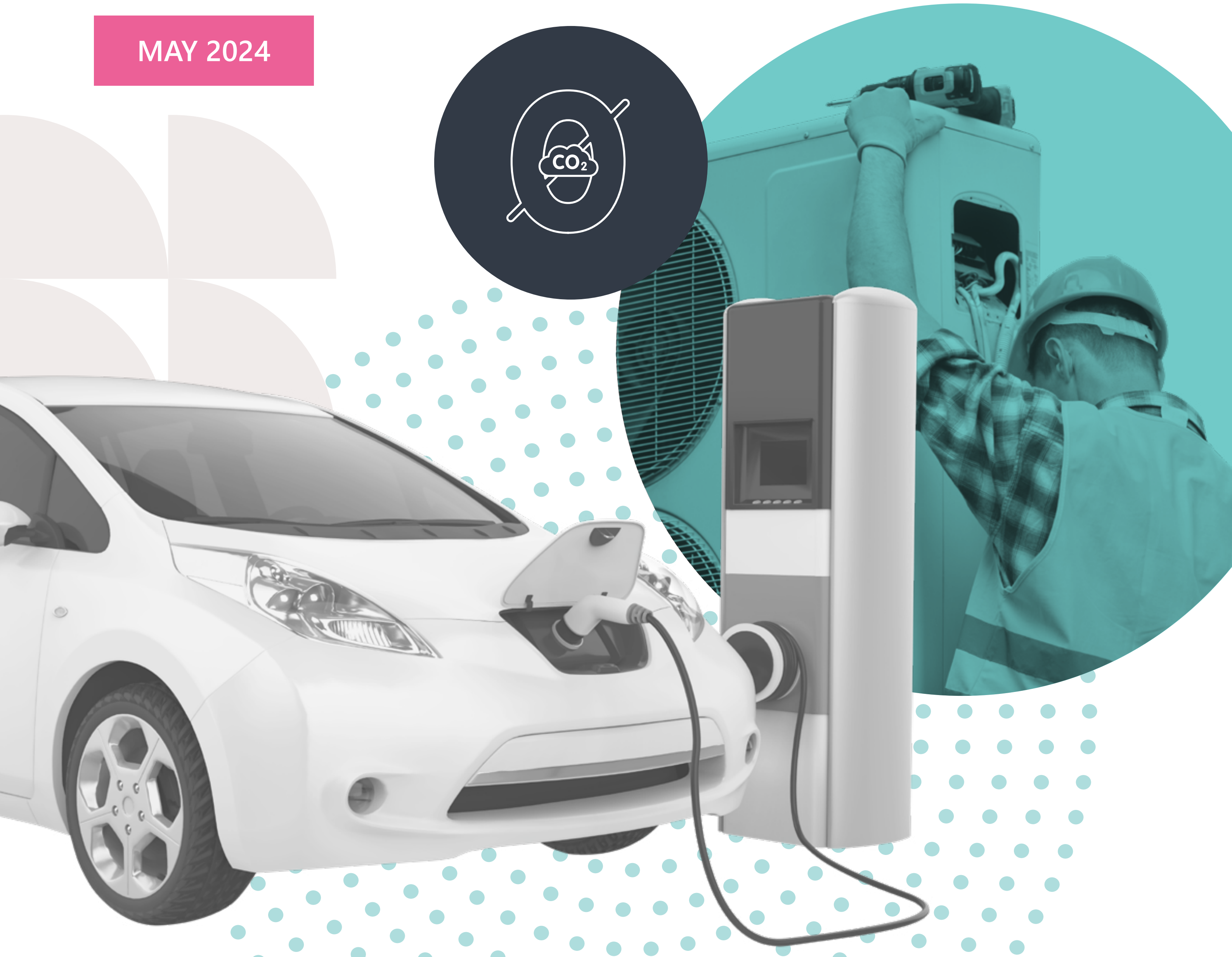
Extending the UK Emissions Trading Scheme to heating and road transport fuels:

What role can it play in decarbonising the UK economy?

MAY 2024



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Contents

1. Executive Summary

This report examines the potential for reducing economy-wide emissions through extending the UK Emissions Trading Scheme (ETS) to domestic heating and transport fuels, when implemented alongside existing policies.

Our analysis can help inform a number of government criteria for assessing UK ETS expansion, including practicality, suitability, and distributional impacts.

Modelling

We modelled extending the UK ETS to fossil fuels used in heating, road transport, and a combination of both sectors using illustrative carbon prices of £40/tCO2e (low) and £80/tCO_2e (high). For the purposes of the model used, a carbon price does not explicitly represent a carbon tax or an emissions trading scheme, but applies a price signal that could be operationalised under either design. While the model illustrates consumers switching their spending from high carbon fuels to their low carbon counterparts in response to a carbon price (e.g. from gas to electricity for home heating), it does not include a built-in assumption about the precise technologies that they will switch to (e.g. heat pumps) in enabling that.

Our modelling aims to illustrate how pricing domestic heating and road transport fuels affect economy-wide emissions, economy growth, inflation, and household consumption. We also present the potential distributional consequences, and demonstrate the impact of coupling it with transfers to (partially) offset these distributional effects.

Insights

The modelled contributions to emissions reduction under both our low and high carbon price scenarios illustrate that carbon pricing alone will not be sufficient to reduce emissions to meet the legislated target to reach Net Zero greenhouse gas emissions by 2050. If introduced, carbon pricing would need to be part of a package of coherent and complementary policies.

The results show a bigger impact on economy wide emissions reductions from applying a carbon price to domestic heating than road transport. This is because there is currently no (implicit) carbon price on gas heating, while road transport already sees an effective carbon price via fuel duty. Our model also assumes higher price elasticity in heating than in transport. When comparing the impact of applying the same price to domestic heating and transport fuels, greater economy wide emissions reductions are estimated to come from pricing domestic heating with smaller inflationary pressures.Together, this suggests that carbon pricing in the heating sector has potentially higher salience (a measure of the support towards and effectiveness of a policy).

Even though carbon pricing has potentially higher salience in the heating sector, it results in lower-income households being disproportionately impacted by the policy. This is not surprising, but it reinforces the case to use carbon pricing revenue to offset these impacts. Mitigating distributional impacts is a political choice that is possible to achieve with revenue redistribution. Failure to do so could undermine public and political support for extending carbon pricing to the domestic heating fuels sector.

The revenue that could be raised is potentially significant – up to 0.62% of gross domestic product (GDP) when the high carbon price is applied to both sectors – and sufficient to mitigate distributional impacts of 50% of all income deciles with surplus to spend on other priorities.

We also found that redistribution back to households and firms significantly increases the fiscal multiplier effect (i.e. the impact on GDP). Here, the modelling points to a “double dividend”, where carbon pricing and revenue redistribution lead to a boost in GDP. Importantly, redistribution to households has very limited rebound effects on emissions. Overall, this suggests that achieving both environmental and economic goals is possible when deploying a carbon price.

Policy Recommendations

Domestic Heating

- **Ensure continued development and delivery of a coherent mix of policies,** including investment in grid infrastructure, supply chains, and skills for low carbon heating, and Energy Performance Certificate reform. Carbon pricing alone will not be sufficient to incentivise a complex value chain to provide low carbon heating technologies in a market where there is no 'one-size-fits-all' solution, and where decarbonisation can be disruptive and come with high capital expenditure.
- **Over time, phase in extending the UK ETS to cover heating fuels, beginning with natural gas,** and eventually extend it to cover other fuels. Alongside this, **implement complementary policies that mitigate distributional impacts,** which could be funded through redistributed revenue generated from the UK ETS.
- **Place the UK ETS obligation on energy retailers.** This would mitigate potential double counting issues while maximising the carbon price signal on households. Innovative business models could be developed to support building owners in decarbonising their heating systems, and energy retailers are already well placed to support households.
- **Make extending the UK ETS part of an approach to rebalance electricity and gas prices.** Explore options for addressing the effective carbon price gap between electricity and gas caused by policy cost recovery, and what role revenue from an extended UK ETS could have in addressing this imbalance.

Road Transport

- **Ensure continued development and delivery of a coherent mix of policies,** including support for the development of infrastructure and services (e.g. electric vehicle (EV) charging infrastructure, cycling lanes, public transport network) to make low carbon transport options more attractive for consumers. This should help to counteract the risk that extending the UK ETS to road transport fuels might impose additional costs on low-income households if existing policies are retained.
- **Strengthen existing policies that have started to enable the decarbonisation of road transport** as the most effective approach in the near term.
- **If the UK ETS is extended to road transport fuels:**
  - Consider this in conjunction with targeted support to households to improve their ability to mitigate exposure to higher prices through mode and/or technology switching.
  - Consider placing the obligation upstream at the fuel producer/importer level as this would present the most practical and least cost option.
  - Phase in its introduction and use it as an opportunity to comprehensively reform revenue collection from transport, including by simplifying the myriad of local schemes into a national road pricing system, and by exploring the option to reform fuel duty in light of the substantial revenue shortfalls forecast by the continued electrification of vehicles.

2. Introduction

In this report, we explore the recommendations made in the Independent Review of Net Zero regarding the extension of the UK Emissions Trading Scheme (UK ETS) to new sectors.[1] We specifically focus on pricing domestic heating and road transport fuels

We set out the potential role, if any, that the UK ETS may have alongside the existing policy mix in incentivising decarbonisation efforts. As part of this, we seek to understand the macroeconomic and distributional impacts that could arise as a result.

To achieve this, we have modelled the impact of extending the UK ETS in terms of:

- Effectiveness in reducing emissions
- Impact on economic growth
- Distributional impacts

The aim is to provide estimates of macroeconomic and distributional consequences of implementing the UK ETS in domestic heating and road transport to curb emissions, coupled with transfers to partially offset distributional effects.

The report is structured as follows:

- **Section 2** introduces the purpose of the report and describes the policy context in which the UK ETS and carbon pricing[2] sit within the broader policy mix.
- **Section 3** describes the existing policy landscape for the domestic heating and road transport sectors with regards to decarbonisation.
- **Section 4** discusses the modelling approach presented in this report and the results used to inform our policy recommendations.
- **Section 5** explores the potential implementation of the UK ETS in both sectors, specifically the placement of the UK ETS obligation in the value chain.
- **Section 6** makes policy recommendations relevant to each sector.

[1] Rt Hon Chris Skidmore MP (2023). Mission Zero: independent review of Net Zero

[2] References to "carbon pricing" relate to the need for a signal as to the societal cost of greenhouse gas emissions, while "UK ETS" refers to how a carbon price is delivered.

2.1 Policy Context

The UK ETS is the primary policy to directly reflect the cost of emissions – targeted at some of the highest emitting economic activities – and it remains a key policy for achieving the UK's target of reaching Net Zero emissions by 2050. It became effective on 1st January 2021, following the UK's departure from the European Union's Emissions Trading Scheme (EU ETS).

In 2023, the UK government confirmed[3] that it would be taking a series of steps to increase the role that the UK ETS has in enabling the UK to achieve its Carbon Budgets and Net Zero. These included making the cap consistent with Net Zero from 2024,[4] phasing out aviation free allocation between 2024 and 2026, and expanding its scope to new sectors and subsectors.

While figuring out these more short-term details sits at the top of the government's priority list for the UK ETS, there are also considerations for the long-term strategy of the UK ETS. As the Independent Review of Net Zero recommended, setting out a new vision for the future design and operation of the UK ETS is critical. Without extending the UK ETS, new allowances will continue to decline, and, with a tighter cap, prices are expected to rise. Excessive allowance price spikes and volatility have the potential to undermine political acceptance and support for emissions trading as a central carbon policy instrument.[5] In order to enhance liquidity and maintain its role as a cornerstone of UK carbon policy, the UK ETS must be successfully evolved to include new sectors.

Much of the work is already underway, with the government publishing an updated position in December 2023 regarding the long-term pathway for the UK ETS.[6] This confirmed the intention to continue the UK ETS beyond 2030 to 2050, giving businesses the long-term clarity they need to invest in decarbonisation. The government is also minded to evaluate sectoral expansion across five factors, comprising practicality, suitability, business impact, distributional impact, and timing. Although this report will not evaluate all of these factors, our:

- Modelling and analysis will be able to directly inform 'suitability' from a macroeconomic perspective and 'distributional impacts' across income groups (see Section 4).
- Discussion on the placement of the UK ETS obligation in the value chain can inform the 'practicality' from an implementation perspective (see Section 5).

[3] HMG (2023). Developing the UK Emissions Trading Scheme: main response

[4] The cap sets a limit on the total emissions for all sectors covered by the UK ETS – it reflects the cumulative effort over time of all participants under the scheme. The UK ETS Authority has aligned the cap with Net Zero so that it is consistent with the UK government's plans to enable Carbon Budget Four to be met, and will also assist in enabling Carbon Budgets Five and Six to be met.

[5] Rickels et al. (2022). Procure, bank, release: carbon removal certificate reserves to manage carbon prices on the path to net-zero

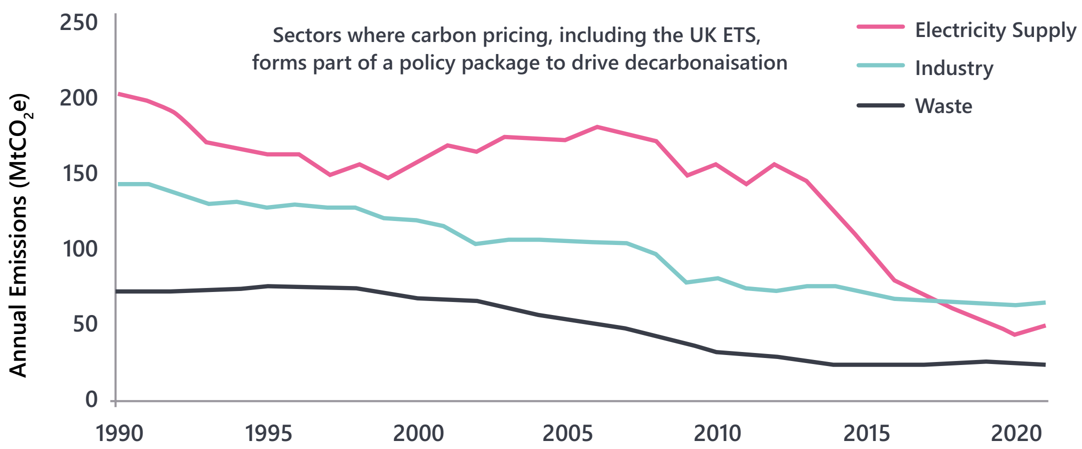
[6] HMG (2023). UK Emissions Trading Scheme long-term pathway

Road transport and heat and buildings are both high emitting sectors: in 2021, road transport accounted for 23% of UK territorial emissions, while heat and buildings contributed 18%.[7] It has so far been possible to successfully concentrate carbon pricing on particular sectors while shielding others, but such differentiation becomes harder to justify with slow progress in the aforementioned sectors (see Figure 1).

[7] DESNZ (2023). 2021 UK greenhouse gas emissions: final figures – data tables

[8] Data from Climate Change Committee (2023). 2023 progress report to Parliament

[9] Bowen (2011). The case for carbon pricing



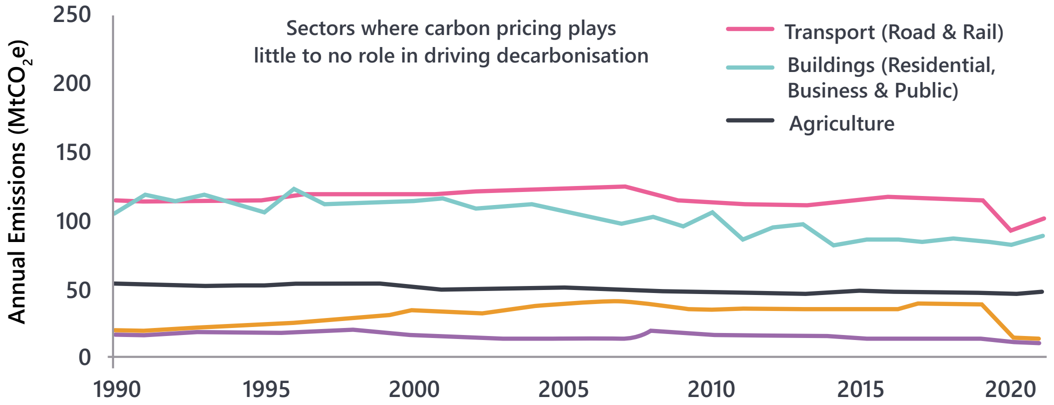


Figure 1. Progress in reducing emissions.[8]

2.1.1 Extending Carbon Pricing can be Challenging

In theory, and in the absence of other market distortions, a uniformly applied carbon price across all emissions and sectors is the most cost-effective method for reducing emissions.[9] While the economic rationale is compelling, this is challenging in practice because other distortions (such as behaviour change) can impede a uniform carbon price from working effectively across sectors. Carbon pricing can change the sectoral composition of the economy, increase inflation, and reduce GDP. The adoption of carbon pricing can be hampered by concerns over its potential macroeconomic implications, especially at times of high inflation and weak economic growth, which the UK is currently experiencing.

Furthermore, some sectors are highly responsive to price signals relative to others, which reflects the presence or absence of other distortions. For unresponsive sectors, the price required to decarbonise may be so high that it results in substantial redistribution of incomes between low and high carbon emitters, consumers, and government that may stretch the political consensus. It has been argued that the distributional effects of carbon pricing – where the financial burden as a share of income is larger on lower-income households compared with higher-income households – make them unpopular and thus unlikely to be implemented, unless they are combined with other (e.g. compensatory) measures.[10]

The literature demonstrates how a perceived unfairness of carbon pricing can lead to low public support for and/or acceptability of the policy.[11] Evidence from surveys shows that acceptability increases when regressive impacts are managed through cash transfers,[12] but this will depend on the design and credibility of the revenue redistribution measure itself. Addressing both the perceived and actual poverty and inequality implications is a critical precondition for social acceptability.

In contrast, surveys also show that the majority of UK citizens favour, or at least do not ostensibly oppose, other types of policies such as bans on combustion engines,[13] despite these policies also potentially having regressive impacts and being less cost efficient than a carbon price.[14] This highlights the difficulty of designing decarbonisation policies – be they price-based or otherwise – that do not carry a risk of unintended distributional impacts, and that perceived fairness of policies need not match actual outcomes.

With UK households experiencing a cost-of-living crisis – as inflation reached its highest level in 41 years as of January 2023,[15] and pay in real terms has shrunk – the political and public sensitivity to carbon pricing reforms will be particularly acute, especially if they entrench existing inequalities.

10 Sterner et al. (2020). The carbon tax in Sweden

11 See Maestre Andrés et al. (2021). Carbon tax acceptability with information provision and mixed revenue uses; Maestre Andrés et al. (2019). Perceived fairness and public acceptability of carbon pricing: a review of the literature; and Bolderdijk et al. (2017). Understanding effectiveness scepticism

12 Dechezlepretre et al. (2023). Fighting climate change: international attitudes toward climate policies

13 ibid.

14 Doda and Fankhauser (2020). Climate policy and power producers: the distribution of pain and gain

15 Resolution Foundation (2023). The living standards outlook 2023

2.1.2 Carbon Pricing in the Policy Mix

When confronted with the challenges of extending carbon pricing to new sectors, policymakers have often adapted the design of carbon pricing policies to mitigate the impact on societal groups. Preferential treatment and tax exemptions are common, which makes the incentives for emissions mitigation less stringent and more coherent across sectors.[16]

This combination of factors means that the salience (a measure of the support towards and effectiveness of a policy) and impact of carbon pricing will vary sector to sector. Political realities will likely necessitate a balance between carbon pricing and other types of policies and regulations. The choice between policy instruments is not binary and should not be presented as such. No country has relied solely, or even predominantly, upon the standard economic recommendation of carbon pricing for climate mitigation – all have used a mix of policies.[17]

A study suggests that the addition of a carbon price to a sector without any or minimal pricing (e.g. domestic heat) is particularly beneficial from a cost-effectiveness standpoint.[18] It also shows that where pricing already exists in a sector (e.g. road transport), then gains in cost effectiveness are relatively small because of the diminishing benefits of increasing the role of carbon pricing in the policy mix. The same study found that a policy mix that achieves 20% of its emission reductions via carbon pricing (and 80% through standards) is 32%–57% less costly than a standards-only approach that achieves the same total emissions reduction. Another study similarly emphasised the importance of complementarity rather than competition between carbon pricing and other policy instruments.[19]

Extending the same price placed on the power sector – which peaked at approximately £97/tCO_2e in August 2022 – to other UK sectors may not be politically desirable, and there could be a need for different price levels to account for sector-specific factors.

The EU, for example, plans to cap prices in its ETS 2 at almost half the price of the ETS 1 because of distributional concerns. And a Social Climate Fund (SCF) is being developed to channel ETS 2 revenue to offset distributional impacts (see Box 1 for more details).

[16] Khan and Johansson (2022). Adoption, implementation and design of carbon pricing policy instruments

[17] See Hoppe et al. (2023). Three decades of climate mitigation policy: what has it delivered?; and Energy Systems Catapult (2018). Rethinking Decarbonisation Incentives: International Policy Case Studies

[18] Dimanchev and Knittel (2023). Designing climate policy mixes: analytical and energy system modelling approachs

[19] Grubb et al. (2023). Policy complementarity and the paradox of carbon pricing

More broadly, domestic heating and road transport sit within a wider context of existing policies and decarbonisation strategies. The result is a complex policy landscape that can undermine effectiveness.

Ultimately, determining the desired function that the UK ETS can provide within the broader carbon policy mix is essential for the effective implementation of policy and its contributions to decarbonising the domestic heating and road transport sectors.

[20] The EU ETS will continue operating with its existing coverage.

[21] International Carbon Action Partnership (2023). EU ETS for buildings and road transport ("EU ETS 2")

[22] Energy Post (2023). Understanding the new EU ETS (Part 2): buildings, road transport, fuels. And how the revenues will be spent

[23] European Parliament (2022). Deal on establishing the Social Climate Fund to support the energy transition

Box 1: The EU ETS 2

The UK is not the only jurisdiction looking to expand its carbon market. The EU is in the process of developing a separate ETS, known as EU ETS 2, to cover emissions from buildings, road transport, and fuels in other, yet-to-be defined sectors.

The EU ETS 2 proposal is intended to expand the trading system for emissions not currently priced across the entire EU. It is planned to enter operation from 2027 or 2028, but can be postponed by one year in the event of exceptionally high energy prices.

In the initial phase, the carbon market will act more akin to a carbon tax, with a maximum allowance price cap of €45/tCO_2e until at least 2030.

Alongside developing EU ETS 2, the EU is creating a new Social Climate Fund in response to concerns that exposing new sectors to a carbon price would disproportionately burden economically weaker states and citizens. The SCF will be set aside to help vulnerable households, micro-enterprises, and transport users that are particularly affected by energy and transport poverty. The EU plans to implement the SCF one year before the EU ETS 2 comes into effect, and it will be initially financed through revenue from auctioned allowances under the original EU ETS. A combination of auctioned allowances under EU ETS 2 and national resources will start funding the SCF once EU ETS 2 comes into effect.

The SCF will finance two types of initiatives: (1) temporary direct income support measures to tackle the increase in road transport and heating fuel prices; (2) long-lasting structural investments, including buildings renovation, decarbonisation solutions and integration of renewable energy, and purchasing and infrastructure for zero- and low-emission vehicles, as well as the use of public transport and shared mobility services.

3. Existing Policy Landscape

3.1 Domestic Heating

For heating, this report focuses on domestic consumers with an emphasis on natural gas. Of the 28 million households in the UK, heating is provided by:[24]

- ~83.3% natural gas
- ~7.2% heating oil
- ~7.5% electricity
- ~2% district heating

The UK ETS already indirectly covers some two million households using electricity for heating. In 2022, the carbon price applied to electricity generators through the UK ETS averaged £78/tCO_2e, with a further £18/tCO_2e added by Carbon Price Support costs. Extending coverage of the UK ETS implies covering the remaining 26 million households, which are a mixture of on or off the gas grid.

In addition, the UK's current policy landscape already distorts incentives for electricity consumers, with additional costs resulting from policies such as Feed in Tariffs, Renewable Obligation Certificates, and Contracts for Difference, which are almost solely placed on electricity bills. During 2021, these combined costs, along with social policy costs, accounted for approximately 25.5% of the average electricity bill, compared with about 2.5% for gas.[25]

This imbalance between electricity and gas prices for consumers tilts in favour of the higher carbon heating methods, minimising the incentive to transition to low carbon alternatives. The net result is an effective carbon price of £305/tCO_2e[26] on electricity and £0/tCO_2e on gas.[27]

Reasons for not covering heating fuels in the UK ETS to date include:

- Incentivising switching to low carbon technologies is inherently difficult, especially as there is currently a shortage of suitable alternatives, supply chains, and skills to deliver at scale.

[24] Climate Change Committee (2020). The Sixth Carbon Budget: Buildings

[25] Ofgem (2021). Bills, prices and profits

[26] The effective carbon price on domestic electricity results from the combination of UK ETS (annual average of £78.73/tCO2e) and Carbon Price Support (£18/tCO2e) costs passed onto consumers through the wholesale market, plus the cost of support schemes for renewable generation: Feed in Tariffs, Renewable Obligation Certificates, and Contracts for Difference.

[27] For the purpose of this calculation, we have not treated the reduced value-added tax rate (5%) seen on energy bills as an implicit subsidy. This is contrary to the International Monetary Fund, which treats forgone VAT receipts on fossil fuels as an implicit subsidy (see here for more details). Regardless of how VAT is treated in these calculations, it is the overall differential between gas electricity prices that is important, rather than the absolute price.

- Using a market-driven approach to placing an effective carbon price on emissions clearly has merit; however, the societal consequences of expanding the UK ETS to cover heating fuels may prove politically sensitive and challenging. Answering the key question of 'who pays' for emissions reductions is therefore a key consideration, which we discuss in Section 5.1.
- There is a clear risk of regressive distributional impacts if such a policy is not considered in tandem with additional support for fuel poor households and the wider policy package for the sector. It is also important to note that these risks should be considered and compared with the risks associated with alternative policy approaches that have been implemented or could be adopted to drive the switch to low carbon heating technologies, rather than a 'do nothing' counterfactual.

These issues will need to be addressed before implementation.

Introducing a carbon price on heating fuels through the UK ETS could contribute to increasing the uptake of low carbon heating systems. It could also form part of the approach taken by government to rebalance electricity and gas prices. Our model is designed to illustrate consumers switching their spending from high carbon fuels to their low carbon counterparts in response to a carbon price (e.g. from gas to electricity), but it does not include a built-in assumption about the precise technologies that they will switch to (e.g. heat pumps) in enabling that.

3.1.1 Existing Policies

For heating, this report focuses on the potential role that the UK ETS could have on decarbonising the sector and will not go into the details of the existing policy landscape. However, any decisions around extending the UK ETS must take these into account when considering its design and implementation.

In summary, the current heating decarbonisation policy landscape consists of:

- **Funding –** for heat pumps, the government is providing £6.6bn in public funding between 2021 and 2025, with a further £6bn committed from 2025–2028.[28] This includes £450m for the Boiler Upgrade Scheme in England and Wales.[29]

[28] HMG (2023). Heat pump investment roadmap

[29] DESNZ (2023). Boiler upgrade scheme

[30] MHCLG (2023). The Future Homes Standard

[31] MHCLG (2023). The Future Buildings Standard

- **Regulation –** the Future Homes Standard[30] and Future Buildings Standard[31] will ensure that all new buildings from 2025 are zero carbon ready, requiring no further retrofit. In addition, the government aims to phase out the sale of new and replacement gas boilers by 2035,[32] recently delayed from the previous target of 2026. The government will also make a decision on the possible role of hydrogen for domestic heating by 2026.[33]
- **Market-based –** from 2025, a market-based mechanism for heating appliance manufacturers will be introduced to support developing a market for heat pumps.[34]
- **Price signals –** zero-rated VAT on energy saving materials[35] and reviewing electricity market arrangements to better align price signals in the electricity market with decarbonisation targets.[36]

3.1.2 Related Policies and Double Counting of Emissions

Introducing a carbon price for domestic heating may result in double counting (also referred to as double pricing or double charging) if not carefully accounted for.

Climate Change Levy (CCL)

The CCL applies at various rates to electricity, gas, and solid fuels for end users in the agriculture, commercial, industrial, and public service sectors. Therefore, while an additional charge resulting from a UK ETS obligation will affect both business and domestic consumers, the potential impact of double pricing will only affect the former.

Energy retailers are responsible for charging the appropriate CCL, which is displayed as a separate line item on gas and electricity bills. For energy-intensive businesses, there is an opportunity to pay a reduced rate of CCL by entering into a Climate Change Agreement (CCA) with the Environment Agency. A CCA is a voluntary agreement that aims to reduce energy use and emissions. This can result in the following percentage discounts:[37]

- 92% for electricity
- 88% for gas
- 77% for liquefied petroleum gas

[32] HMG (2023). PM speech on Net Zero: 20 September 2023

[33] DESNZ (2023). Enabling the hydrogen village trial

[34] BEIS (2023). Market-based mechanism for low-carbon heat.

[35] HMRC (2023). Energy-saving materials and heating equipment

[36] DESNZ (2023). Review of electricity market arrangements

[37] HMG (2022). Climate Change Levy rates

In addition to this, exemptions currently apply to businesses that use less than 1,000 kilowatt hours (kWh) of electricity and/or 4,397 kWh of gas per month, as well as for charities and schools.

Phasing out the CCL with a phasing in of UK ETS coverage of fuels would reduce the overall administrative burden on businesses and also mitigate the risk of double counting.

Fuel Duty

Fuel duty is currently not levied on oil for heating, nor is it imposed on gas if it is used for heating, industrial, or scientific purposes.

3.2 Road Transport

The transport sector is the largest contributor to territorial emissions in the UK[38] and is where progress in cutting emissions has been relatively slow to date,[39] with the majority of these emissions arising from road transport.

In 2022, the 38 million tonnes of oil equivalent consumed in the UK road transport sector came from:[40]

- ~93% petroleum
- ~6% bioenergy and waste
- ~0.8% electricity
- ~0.2% natural gas

Decarbonising road transport emissions to Net Zero will involve:

- Reducing the total amount of energy consumption in the sector through demand reduction and modal shifts; for example, through greater use of public and/or active transport.
- Replacing petroleum use with low carbon forms of energy, primarily through a transition from internal combustion engine (ICE) vehicles to EVs.[41]

The use of petroleum, biofuels, and natural gas in road transport is already subject to an effective carbon price through fuel duty and vehicle excise duty (VED). In 2019, the effective carbon price for the sector was estimated at £162/tCO_2e.[42]

[38] DESNZ (2023). Provisional UK greenhouse gas emissions national statistics 2022

[39] DfT (2023). Transport and environment statistics: 2023

[40] DESNZ (2023). Energy consumption in the UK 2023

[41] Our modelling does not include a built-in assumption about the precise technologies that consumers will switch to. This is discussed in Section 4.

[42] Energy Systems Catapult (2019). Rethinking decarbonisation incentives: current economic signals for decarbonisation in the UK

Where electricity is used in road transport (e.g. for EVs), this is already indirectly subject to the UK ETS through coverage of electricity generators.

In the presence of a relatively high effective carbon price on road transport fuels, the benefits and challenges of extending the UK ETS should be assessed against this counterfactual. Operationalising a carbon price through the UK ETS (rather than a tax) would have the benefit of serving as a quantity-based backstop that the government could use to constrain road transport emissions in line with the Net Zero target.[43] The UK ETS may also be more enduring than a tax when it comes to consumer acceptability, given that the price is driven by market dynamics.[44]

There are limitations on the availability of low carbon transport propositions that will not be overcome by pricing measures alone. These include insufficiencies in public and/or active transport infrastructure and services (such as in rural areas or locations where non-road transport investment is lacking), and the high upfront costs of technology-switching (e.g. the still nascent second-hand market for EVs). As these limitations affect households across different income groups and locations differently, the use of carbon pricing in road transport can have unwanted distributional impacts.

A mix of policies, including carbon pricing, is more likely to be effective in driving emission reductions in road transport.

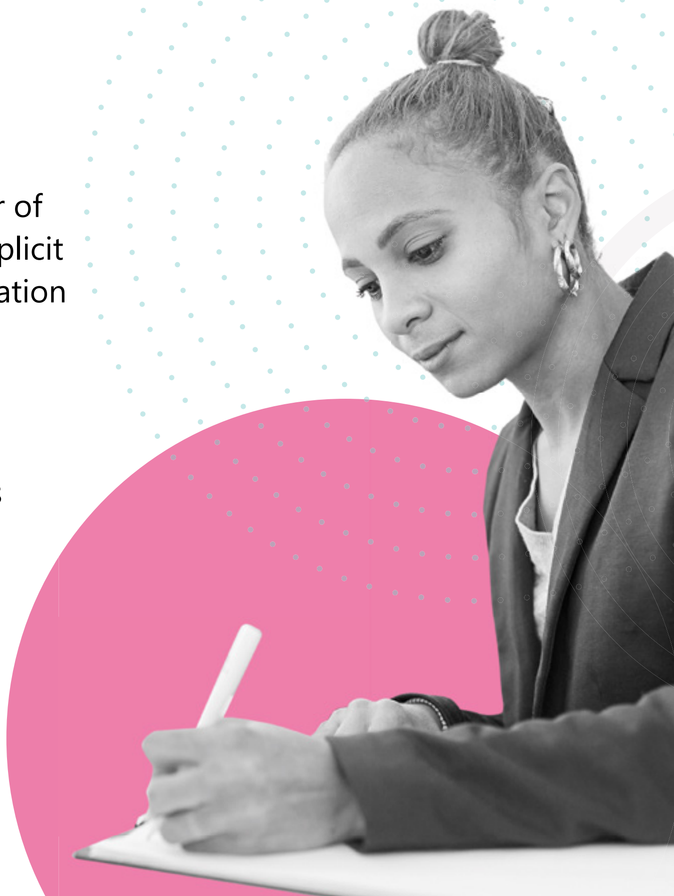
3.2.1 Related Policies and Double Counting of Emissions

Road transport in the UK is already subject to a number of taxes. While none of these were introduced with the explicit objective to reduce emissions, their existence and operation implicitly serve this purpose.

Introducing a carbon price for road transport could result in double counting if not carefully accounted for. In considering extending the UK ETS, potential overlaps with existing policies would need to be proactively identified and managed to ensure policy efficiency.

[43] Pollitt and Dolphin (2021). Should the EU ETS be extended to road transport and heating fuels?

[44] Burke et al. (2022). The future of UK carbon policy: how could the UK Emissions Trading Scheme evolve to help achieve net-zero?



Fuel Duty

Fuel duty is levied per unit of fuel purchased and covers petrol, diesel, biodiesel, bioethanol, LPG, and natural gas use in road transport. EV owners do not currently pay fuel duty.

Fuel duty currently represents a significant source of revenue for public finances, but it has been "frozen" at the same headline rate (i.e. not raised in line with inflation) since 2011,[45] and was subject to a temporary cut of 5 pence between 2022-23, which has subsequently been extended until 2025.[46]

The Climate Change Committee estimated in its Sixth Carbon Budget that the transition to Net Zero puts £28bn of annual government revenue from fuel duty at risk.[47] Given the two policies would substantially overlap if implemented at the same time, the inclusion of road transport in the UK ETS could be considered in conjunction with the option to phase out fuel duty.

Further analysis is needed to accurately forecast fuel duty revenue decline and expected revenue from a UK ETS extended to cover road transport, including under a range of different scenarios to predict with higher confidence the interrelationships between fuel duty and carbon pricing. One other option proposed for addressing the expected loss of revenue from fuel duty is a national road pricing system, where travel is priced based on mileage and vehicle type.[48]

Vehicle Excise Duty

VED is a yearly tax levied on every vehicle used or kept on public roads in the UK. Broadly, the more emissions that a vehicle produces, the higher the VED it is liable to pay. EVs are currently exempt from VED, including the luxury supplement.

[45] Finnegan (2018). Why the UK Government has frozen fuel duty – again

[46] Office for Budget Responsibility (2024). Fuel duties

[47] Climate Change Committee (2020). The Sixth Carbon Budget: the UK's path to Net Zero

[48] Transport Committee (2022). Road pricing: act now to avoid £35 billion fiscal black hole, urge MPs

3.2.2 Other Existing Policies

There is a suite of existing policies designed to enable the decarbonisation of road transport. The implementation of any new policies will need to be considered along with their interactions and complementarities with other policies, both existing and forthcoming.

In summary, the current road transport decarbonisation policy landscape consists of:

- **Funding** – £470m of public funding available over three years from 2022 towards developing EV charging infrastructure. From February 2023, £200m of public funding for new walking and cycling schemes.
- **Regulation:**
  - A ban on the sale of new petrol and diesel cars and vans from 2035 (delayed from its original 2030 date).[49]
  - From 2021, vehicle emissions performance standards were strengthened to define permissible emissions at 95 gCO_2/km for cars and 147 gCO_2/km for vans. Manufacturers need to achieve reductions of 15% for both cars and vans by 2025, and of 37.5% for cars and 31% for vans by 2030.[50]
  - The Renewable Transport Fuel Obligation requires suppliers of transport fuels to demonstrate that a percentage of their fuel supply comes from renewable and sustainable sources.
  - Low emission zones were introduced to mitigate air pollution, but by their nature disincentivise ICE use and can support decarbonisation efforts in the sector, as studies have shown.[51]
- **Market-based** – the zero-emissions vehicle mandate came into effect in 2024, obliging vehicle manufacturers to increase the proportion of zero-emission new vehicle sales.

[49] HMG (2023). PM speech on Net Zero

[50] HMG (2020). Consultation outcome CO_2 emission performance standards for new passenger cars and light commercial vehicles.

[51] Ma et al. (2021). Has the ultra-low emission zone in London improved air quality?

3.2.3 Distributional Impacts

Decarbonising road transport is a consumer-facing issue and any consideration of imposing a carbon price on the sector will require consideration for those disproportionately impacted. This must include a first principles assessment of the relative efficacy of pricing versus other forms of regulation such as standards, which can vary substantially in their emission reduction efficacy and distributional outcomes when taking into account the consumption patterns and technological preferences of high and low carbon households.[52]

For example, low-income households would be particularly vulnerable to increased fuel prices. It has been shown that UK households with low incomes do not significantly reduce the amount of fuel they buy in response to increasing fuel prices, suggesting they might be compromising spending on other essential items such as food and heating instead.[53]

There is a clear risk of regressive distributional impacts if such a policy is not considered in tandem with additional support for low-income households and the wider policy package for the sector, with potential consequences illustrated by the gilets jaunes (yellow vests) protests that broke out in France in 2018. While carbon pricing (in the form of higher fuel taxes) may have been the main driver, the underlying cause of the protests was the perceived unfairness of the overall tax reform package, which cut taxes for wealthier households at the same time as hiking up fuel prices.[54]

[52] Zhao and Mattauch (2022). When standards have better distributional consequences than carbon taxes

[53] Mattioli et al. (2018). Vulnerability to fuel price increases in the UK: A household level analysis

[53] Burke and Serin (2021). UK carbon pricing needs to be part of comprehensive tax reform

4 Modelling Results and Insight

4.1 Overview

We modelled extending the UK ETS to fossil fuels used in heating,[55] road transport, and to a combination of both sectors, using illustrative carbon prices of £40/tCO_2e (low) and £80/tCO_2e (high). Carbon prices do not explicitly represent a carbon tax or an emissions trading scheme, but apply a price signal in the model that could be operationalised under either design.

All new carbon prices are relative to the baseline scenario, which models the current pricing and policy status quo. For example, carbon prices extended to transportation fuels are additional to existing implicit carbon prices such as fuel duty. The results are presented as a snapshot in 2040, where the carbon price steadily increases from zero above the current policy status quo in 2024 to either £40/tCO_2e or £80/tCO_2e in 2040, depending on the scenario.

Our modelling offers an economy-wide perspective in which we test the effects of extending the UK ETS with and without redistribution of revenue to households and firms. We model different scenarios correspondingly based on the following assumptions:

- Economy-wide impact with no redistribution of revenue to households or firms.
- Economy-wide impact with redistribution of revenue to households only (i.e. revenue collected on households is only used for redistribution to households, while revenue collected on firms is not redistributed). The redistribution is modelled as a reduction of the representative household's income tax.
- Economy-wide impact with redistribution of revenue to households and firms, but without cross-transfers between either. Revenue collected on firms is redistributed proportionally to sectoral employment.

[55] While the focus of our report is on domestic heating, the model places a carbon price on heating for both domestic and commercial users. This is because within the model the carbon price is operationalised as an economy-wide price signal on the consumption of natural gas.

The modelling also offers a more granular assessment of the impact on households by income decile without redistribution of revenue, as well as the following two options for redistributing revenue:

1. Uniform lump-sum redistribution of all available carbon price revenue paid by households to all households.
2. Calibrating a targeted redistribution of all available carbon price revenue to all households so there is no negative impact on income deciles 1–4 (measured at the national level).

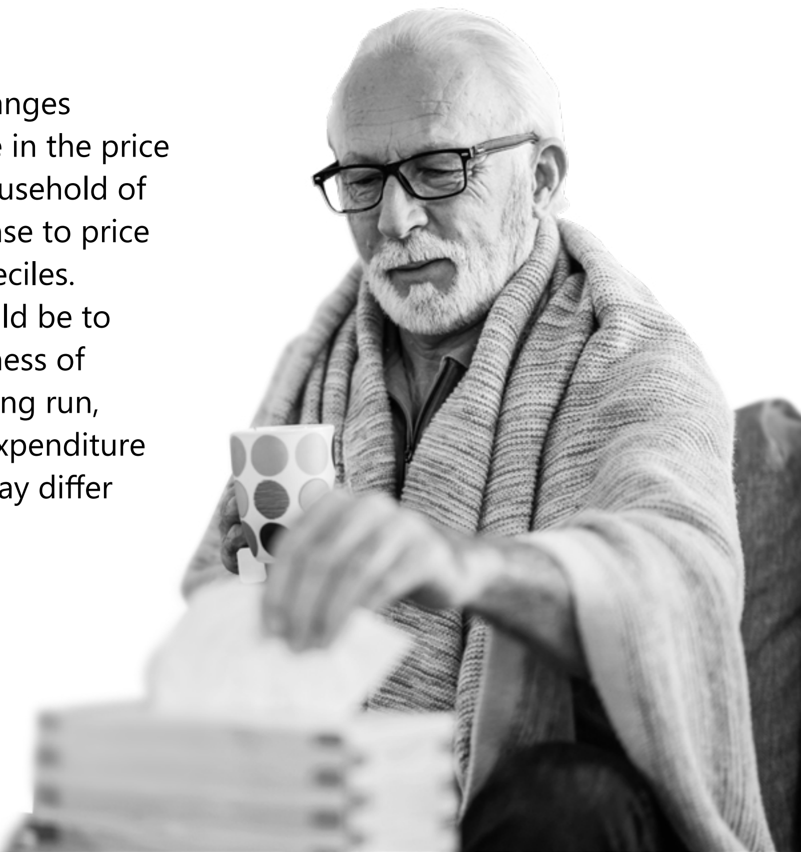
Income decile 4 was chosen to protect the most vulnerable households in terms of the incidence of fuel poverty. For example, in England fuel poverty only occurs in income deciles 1–4.[56]

Demand for heating and transportation fuel is elastic in the economy-wide model, but there is no heterogeneity in household price response across income groups. In the economy-wide model, consumer behaviour changes in response to increases in the cost of fossil-intensive goods caused by a new carbon price. While the presence of a carbon price ensures the redistributed proceeds get spent preferentially on non-carbon-intensive goods – whose relative prices have gone down versus their carbon-intensive counterparts – there is no built-in assumption in the model regarding the precise technologies that consumers will switch to (e.g. heat pumps or EVs).

Limitations of the Model

The microsimulation model only considers changes in household demand resulting from a change in the price of goods obtained from the representative household of the macroeconomic model. Household response to price signals is not heterogeneous across income deciles. A potential extension of the present study could be to take into account the higher price responsiveness of lower-income households. Further, over the long run, households may change the pattern of their expenditure in systematic ways. These changes in spend may differ according to a household's level of income.

[56] Office for National Statistics (2023). How fuel poverty is measured in the UK



We used the ThreeME model, which only looks to 2040. A further limitation of this model – as with almost all Computable General Equilibrium models – is that net emissions will never reach zero. Residual emissions will remain because of three important features of the ThreeME model:

1. Elasticities of substitution calibrated on historical data determine the rigidity of demand for carbon-intensive goods in the model.

2. The model does not consider greenhouse gas removal methods, which will be necessary to reach Net Zero.

3. The model is built around carbon pricing, which is a stylised representation of the UK's policy mix.

An overview of the modelling approach can be found in the Appendix, and a more detailed description can be found in Pareliussen et al. [57]

4.2 Results

A selection of macroeconomic output variables from the model simulation is presented in this section, including the impact on emissions, household consumption, GDP, and inflation (measured as the increase in the price index of household consumption within the model). All figures are presented as a difference from the baseline in percentage.

4.2.1 Impact on Emissions

Figure 2 illustrates that the introduction of a carbon price to domestic heating and road transport fuels induces economy-wide emissions reductions. While the imposition of a carbon price is seen to reduce emissions, the modelling suggests that greater emissions reductions result from pricing domestic heating fuels:

- Economy-wide emissions reductions from pricing road transport fuels in 2040 range from 6.1% under the low price scenario and 10.6% in the high price scenario.
- When focusing on the heating sector in 2040, economy-wide reductions relative to the baseline range from 10% under the low price scenario and 14.7% in the high price scenario.
- When the carbon price is extended to a combination of both sectors, economy-wide emissions reductions range from 16.3% under the low price scenario and 25.8% in the high price scenario.

[57] Pareliussen et al. (2022). Macroeconomic and distributional consequences of net zero policies in the United Kingdom

However, against a backdrop of achieving Net Zero emissions by 2050, the modelled economy wide emissions reductions indicate that carbon pricing for road transport and heating fuels will be insufficient without wider, whole of economy decarbonisation policies. Moreover, emissions reductions in the combined scenarios are greater than the sum of the reductions in the corresponding road transport and heat scenarios. This suggests that moving forward with carbon pricing to new sectors simultaneously has a greater impact on total emissions reductions, albeit a very minor one.

Greater emissions reduction occur when targeting heating fuels for two reasons:

1. There is higher elasticity of demand substitution compared to transport fuels in the model.
2. The marginal cost increase from new carbon prices is smaller in the transport sector than in the heating sector. This is because of existing policies that already price transport fuel, such as fuel duty, which contrasts with the heating sector where there is an absence of policy measures in place that price the carbon content of gas.

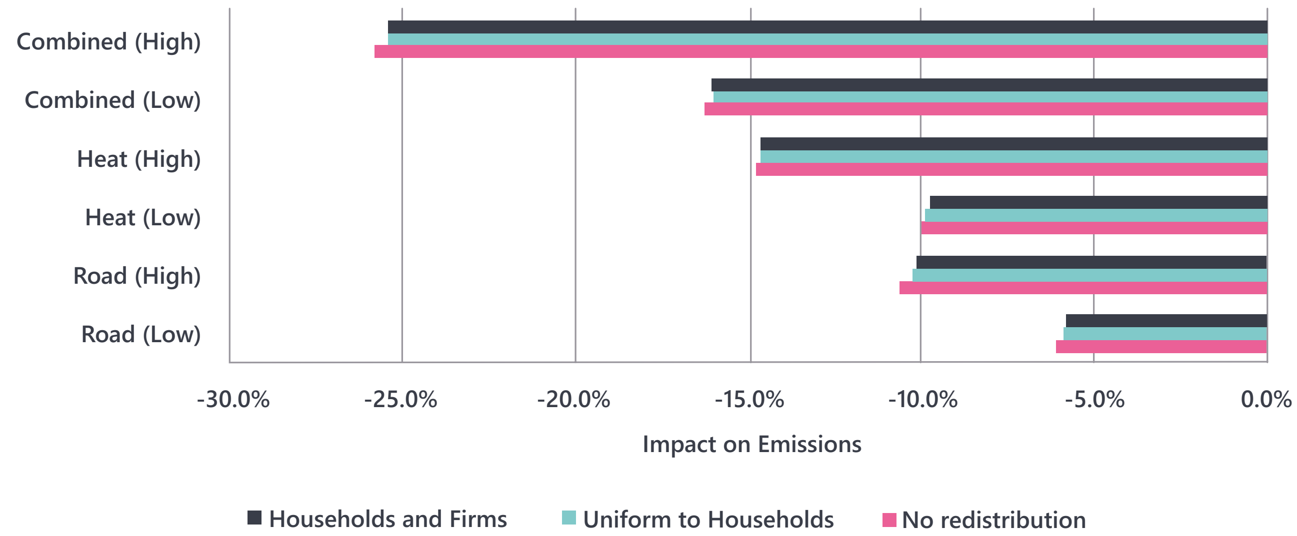


Figure 2. Impact on economy-wide emissions across the three macroeconomic scenarios.

Across the three macroeconomic scenarios, emissions are only marginally affected by how carbon pricing revenue is redistributed. Under a combined high price scenario, economy-wide emissions are reduced by 25.8%, which falls to 25.5% when revenue is redistributed to households only. In other words, we find negligible 'rebound effects'.[58]

However, protecting consumers by redistributing the carbon pricing revenues has the potential to lead to a 'respending rebound', where the outcome is to consume more products and services as seen by changes in aggregate demand. Carbon pricing limits this because the policy increases the cost of polluting activity, making cleaner alternatives more competitive. Switching to cleaner alternatives reduces the carbon price burden on consumers.

4.2.2 Impact on Household Consumption

As illustrated in Figure 3, household consumption is reduced under all price scenarios when there is no redistribution to households or firms. Household consumption is reduced the most when a high carbon price is applied to both heating and road transport sectors simultaneously. Reductions in household consumption are lower when a carbon price is applied only in the road transport sector.

However, the model shows an increase under all scenarios if carbon pricing revenue is redistributed to households and/or firms. This is a function of a feature of the model in which government spending is assumed to spark economic activity because the recipients of the redistributed revenue will spend the money on goods and services – which is known as the 'fiscal multiplier effect'.

When redistributing revenue, household consumption rebounds less when carbon pricing is applied to heating, rather than road transport fuels. In the scenarios considered, the road transport fuel tax base is larger than that of heating. As a result, the amount of carbon price revenue available for redistribution is larger in the road transport scenario than in the heating scenario. The fiscal multiplier effect assumed in the model means that redistributing this larger revenue amount in turn yields a larger macroeconomic benefit. This drives a higher positive impact on household consumption in the road transport scenario than the heating carbon price scenario.

[58] Rebound effects have been typically discussed in the context of energy efficiency measures, where the resulting cost savings stimulate more consumption. The concept can be extended to carbon pricing with revenue redistribution, as we do in this section.

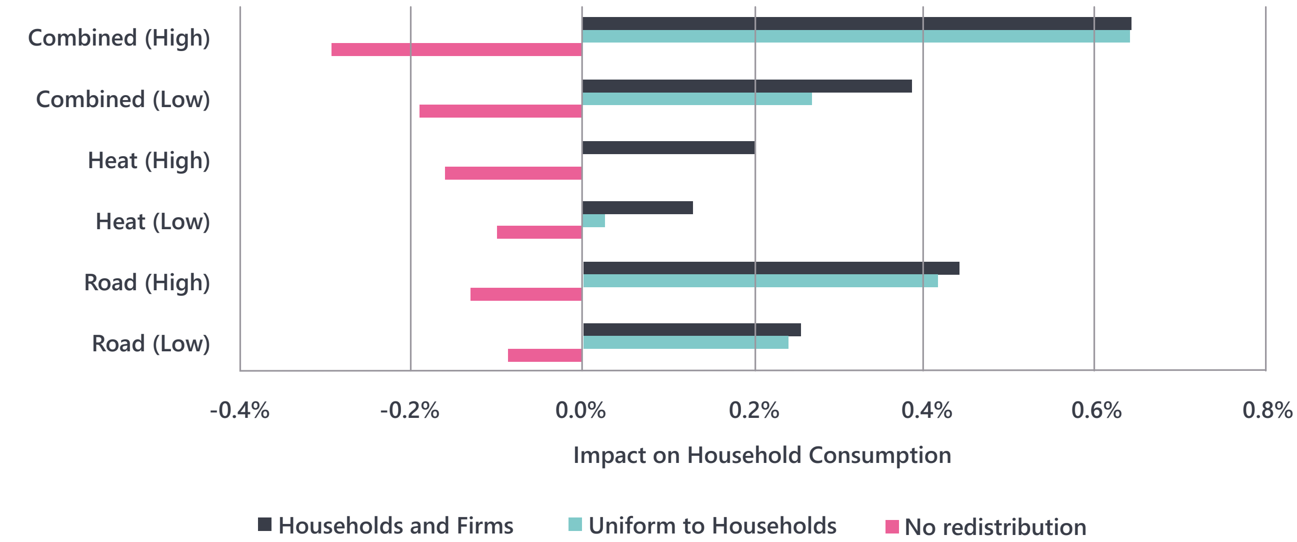


Figure 3. Impact on household consumption across the three macroeconomic scenarios.

4.2.3 Impact on GDP

In the absence of revenue redistribution, Figure 4 illustrates that there are very modest GDP losses across the economy, with the largest impact being under a high carbon price scenario applied to both sectors. Applying a carbon price to domestic heating reduces GDP slightly more than equivalent carbon pricing in the road transport sector. These reductions in GDP correspond with the changes detailed in Section 4.2.2.

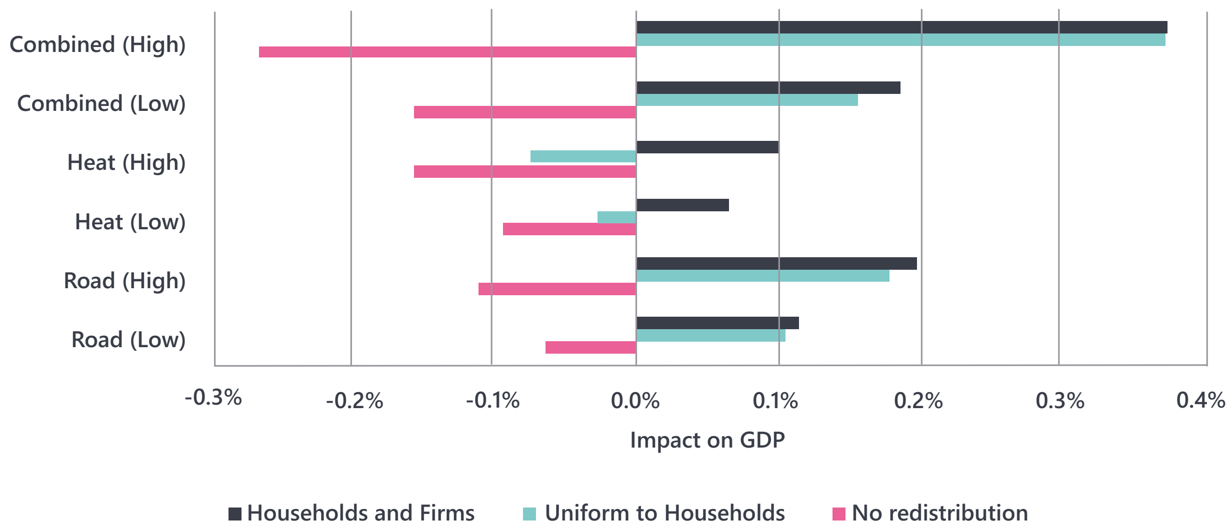


Figure 4. Impact on GDP across the three macroeconomic scenarios.

Of note is that when there is only revenue redistribution to households, the impact on GDP under a carbon price for heating remains negative, whereas the impact is positive with redistribution to both households and firms. In comparison, redistribution to households results in a positive GDP impact under the road transport pricing scenarios. This is because a larger share of the carbon price is levied on firms in the heat scenarios than in the road transport scenarios.

Clearly, how the revenue is used matters. Redistribution back to households and firms increases the fiscal multiplier effect (i.e. the impact on GDP). Here, the macroeconomic modelling points to a double dividend where carbon pricing and revenue redistribution lead to a boost in GDP. This suggests that where carbon pricing is used to incentivise emissions reductions, it can also be used to compensate those that are negatively impacted.[59] The redistribution of revenue under such an approach can improve overall fiscal efficiency (e.g. reduction of the distortionary taxes on labour and capital) while boosting GDP (fiscal multiplier effect), but this is ultimately a political decision. Overall, this suggests that achieving both environmental and economic goals is possible when deploying a carbon price.

4.2.4 Impact on Inflation

As illustrated in Figure 5, the model suggests that pricing carbon in heating and road transport increases economy-wide inflation (measured as the increase in the price index of household consumption within the model) by as much as 1.1% under a high carbon price scenario without any revenue redistribution.

When comparing the impact across sectors, pricing carbon in the road transport sector is slightly more inflationary than in the heating sector. This is because road transportation represents a larger share of fuel consumption within household consumption compared to heating fuels. Transport fuels also feed into more aspects of the economy (e.g. transportation of goods) than heating fuels. Thus, any increase in the cost of transport fuels will have a larger overall inflationary impact on the price of the household consumption bundle.

[59] Freire-Gonzalez and Ho (2019). Carbon taxes and the double dividend hypothesis in a recursive-dynamic CGE model for Spain

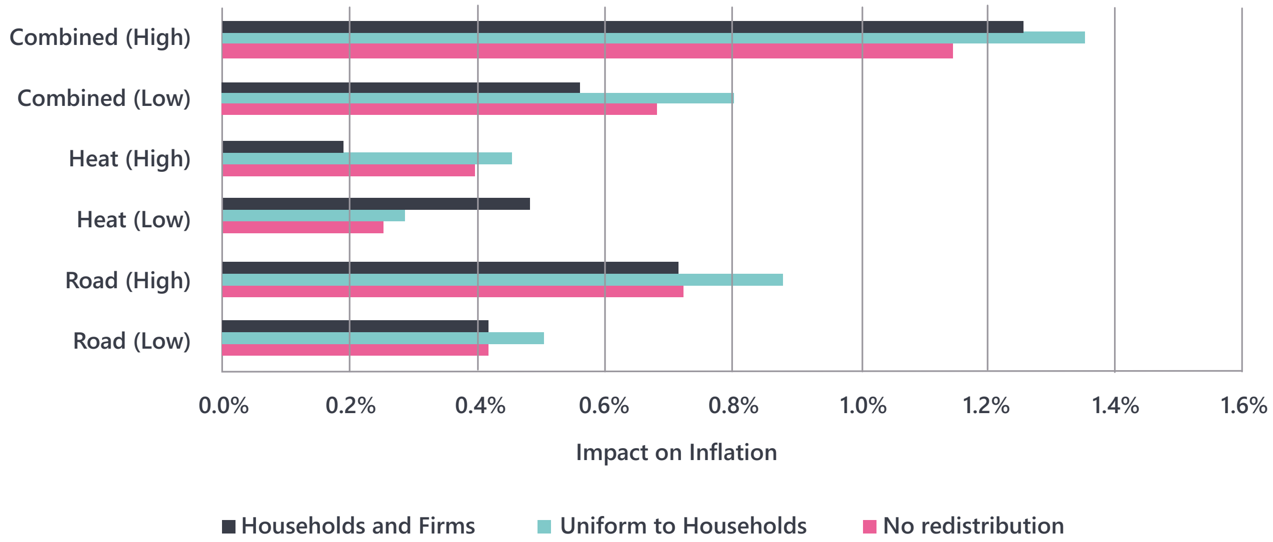


Figure 5. Impact on inflation across the three macroeconomic scenarios.

When revenue is redistributed only to households, this has the largest inflationary impact as it effectively acts as a stimulus programme. Conversely, the model treats redistribution to firms as a reduction in the cost pressures they face, leading to a reduction of their sales prices. So when revenue is redistributed to both households and firms, the inflationary impact is smallest.

4.2.5 Distributional Impacts

Figure 6 illustrates the distributional impacts of the low and high carbon price scenarios on UK household income groups, where income decile 1 represents households with the lowest income. Impacts are relative to the baseline scenario and expressed as a proportion of income. The purpose of this modelling is to:

- Illustrate the magnitude of distributional impacts and how this varies between heating and road transport sectors.
- Demonstrate the extent to which carbon pricing revenue could be used to mitigate unwanted distributional impacts.

Lower-income households typically spend a larger proportion of their income on heating compared to transport costs. The introduction of new carbon prices to these sectors exacerbates this existing trend and is consistent with studies which find that carbon taxes on home energy are more regressive than taxes on road transport fuels.[60]

[60] Buchs et al. (2021). [Fairness, effectiveness, and needs satisfaction: new options for designing climate policies]

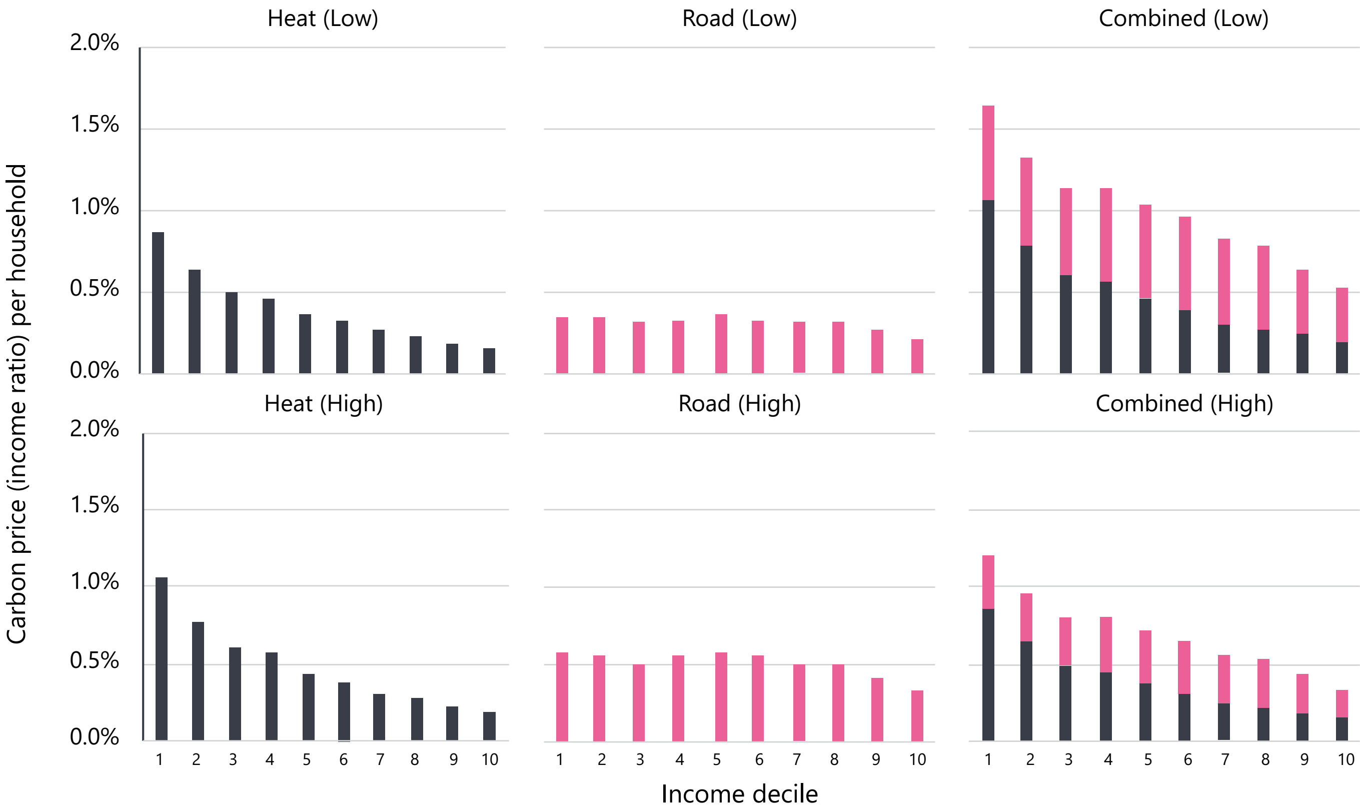


Figure 6 Distributional impact by income decile.

Even though the impact of a carbon price on road transport fuels is still regressive, the distribution is considerably flatter than that observed in heating. The flatter distribution stems from the fact there is higher variation in household road transport emissions across income deciles, where wealthier households have much larger carbon footprints.

This first set of results does not reflect the revenue generated by the carbon price (see Table 1), which can be used to finance public services and/or transfers to households to enhance overall progressivity.

Applying a carbon price to heating fuels only raises marginally more revenue than when applied only to road transport fuels.

Table 1. Share of revenue as a percentage of GDP

Scenario	Carbon price share of GDP
Combined (High)	0.62%
Combined (Low)	0.37%
Heat (High)	0.33%
Heat (Low)	0.19%
Road (High)	0.29%
Road (Low)	0.17%

Figure 7 illustrates how the distributional impacts change when the revenue is redistributed to households. Distributional impacts are expressed as proportion of income. Here, two different revenue redistribution scenarios are modelled.

In the first scenario, a uniform distribution (where all households receive the same amount of money) of all available revenue across all household income groups is modelled. In the second, a distribution of a lump-sum calibrated to offset the average losses in the fourth national income decile is modelled. Where the bars are negative, this represents that households are net beneficiaries from the policy. In other words, they receive more in compensation than they are taxed.

Figure 7. Distributional impact by income decile for different revenue redistribution scenarios.

In both revenue redistribution scenarios, the most vulnerable income groups will be unaffected or gain from the combination of the carbon price and transfer of revenue, although the degree to which households are protected varies between scenarios. A uniform redistribution protects lower-income households the most as this scenario uses all available receipts across all households, so the total amount of money redistributed is much larger. Our second redistribution strategy is less progressive because the amount of revenue redistributed is smaller.

The amount of total revenue raised from the policy that is required to compensate households varies depending on which sectors a carbon price is extended to. As carbon pricing has more regressive impacts in the heating sector than the road transport sector, this requires a greater amount of revenue to compensate households, as illustrated in Figure 8.

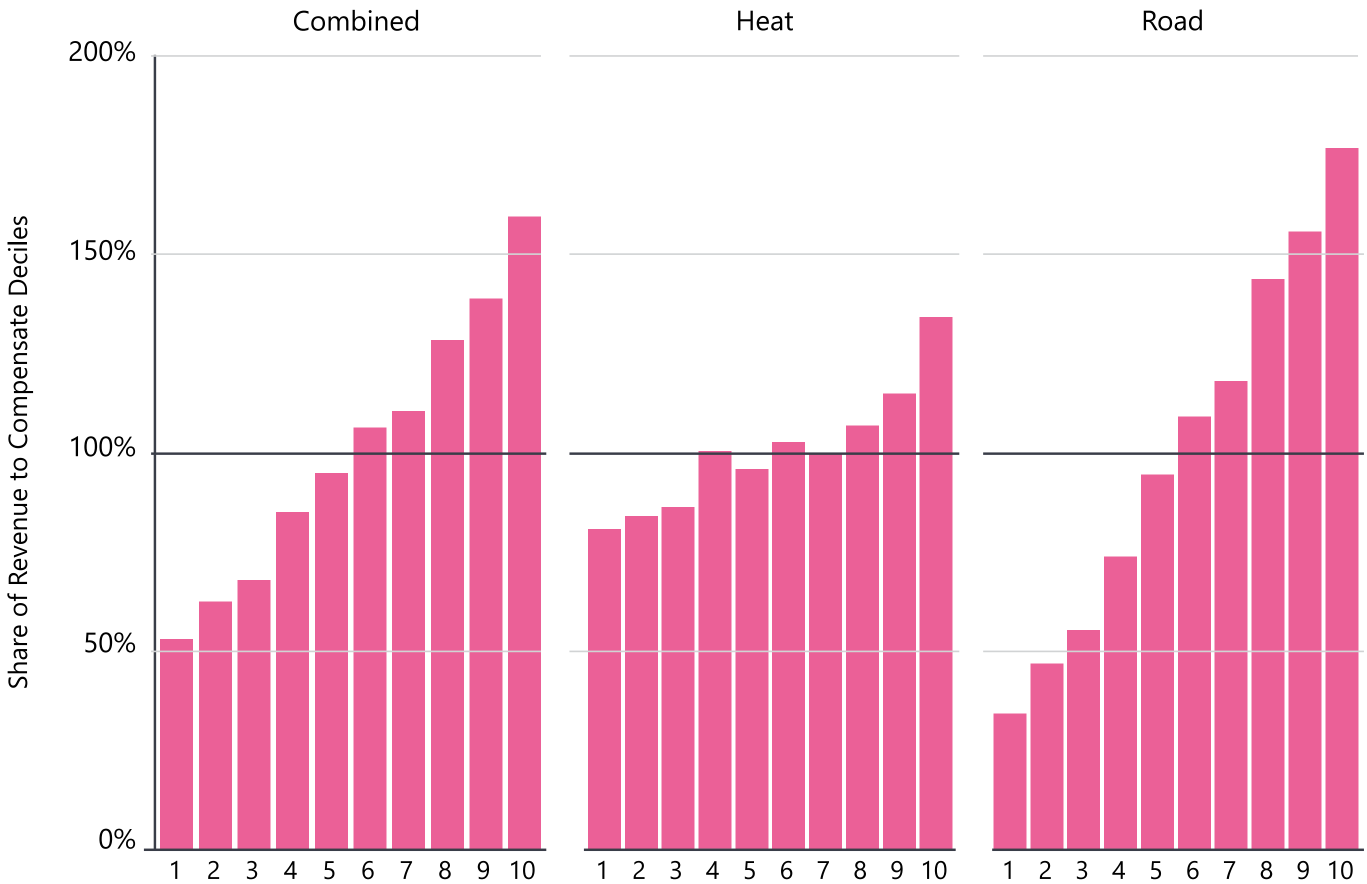


Figure 8. Share of revenue needed to compensate households, where the bars are below the 100% line this indicates which income deciles can be fully compensated with the revenue generated from the carbon price and there is a surplus remains.

For example, to fully compensate income deciles 1–4 in a scenario where carbon pricing is extended to heating fuels requires 100% of the revenue.[61] This stems from non-linearity in spending on home heating fuel as a function of income.

In contrast, if the carbon price were only extended to road transport fuels, 73% of the revenue is needed to compensate the same households. If both sectors were covered by an extended carbon price, then 84% of the revenue would be needed to compensate income deciles 1–4.

[61] In the heating sector, we observe non-linearity in the total amount of revenue that is required to compensate income groups. For example, a smaller proportion of revenue is needed to compensate income decile 5 compared to decile 4.

A key takeaway from these results is that the UK government could implement a carbon price on heating, road transport, or both, and that redistributing revenue would not have an adverse impact on households in at least 50% of all income deciles.

The choice of which households to protect is a political decision, and there will be trade offs between how much surplus revenue policymakers want and the number of households protected from the policy. This analysis provides the basis for thinking through possible combinations.

4.3 Sectoral Insights

We see that when the same carbon price is applied to both sectors, greater emissions are modelled to occur from pricing heating fuels. This suggests that carbon pricing, if implemented as an addition to the current policy mix, has potentially higher salience in the heating sector.

If the higher modelled carbon price of £80/tCO_2e were implemented for heating fuels, it would only reduce emissions by 14.8% compared to the baseline. Our lower carbon price of (£40/tCO_2e), which is similar to current UK ETS prices (£37/tCO_2e as of January 2024), reduces emissions by an even smaller amount of 10% compared to the baseline. This modest contribution to emissions reductions by both our high and low carbon price scenarios illustrates that carbon pricing alone will not be sufficient to reduce emissions in line with the UK's Net Zero target.

Even though carbon pricing has potentially higher salience in the heating sector, it results in higher distributional consequences, where lower-income households are disproportionately affected by the policy. The presence of greater regressive impacts in the heating sector when a carbon price is introduced is not surprising, but this reinforces the case to judiciously use carbon pricing revenue to offset these impacts. Failure to couple carbon pricing with redistribution for low-income households will undermine public and political support for extending carbon pricing to the domestic heating sector.

5 Implementation of Carbon Policies

The placement of a UK ETS obligation should be considered as part of a comprehensive and enduring package of policy measures for decarbonisation. This could include complementary polices; for example, to mitigate distributional impacts or enable the uptake of low carbon technologies. It also has implications for wider system transaction costs resulting from monitoring, reporting and verification (MRV) and allowance surrendering requirements. These can be minimised by placing the obligation upstream in the supply chain,[62] but there are also considerations beyond transaction costs:

- Whether it is likely to elicit the intended response or behaviour change (i.e. reducing emitting activities/ increasing switching to a low carbon alternative) from the targeted party.
- Whether it is likely to distort competition, prevent market entry, or otherwise undermine the functioning of the relevant market(s).

All else being equal, the option chosen should be the lowest cost to implement, administer, and monitor.

The remainder of this section assesses the merits of placing the obligation at different points along the domestic heating and road transport value chains.

5.1 Domestic Heating: UK ETS Obligation Placement in the Value Chain

5.1.1 Consumers

Placing the UK ETS obligation on consumers (i.e. at the point of emissions) follows the 'polluter pays' principle. Consumers, specifically building owners, are in a position to make decisions about investments to improve their building emissions performance (involving complex choices around building fabric improvements and heating/cooling technologies) and to do so in the context of other attributes of the building. This could be supported by a mechanism whereby building owners are rewarded for switching to low carbon heating, rather than penalised for not.

[62] Coria and Jaraitė (2019). Transaction costs of upstream versus downstream pricing of emissions

Such an approach would be best implemented by applying a default requirement on energy retailers to administer the obligation on behalf of their customers. Retailers could be required to monitor the emissions[63] associated with the energy they supply to their customers and to purchase (or trade) any emissions allowances on their behalf.

While this would entail transaction and administrative costs, it would be more efficient to administer the carbon price via retailers instead of requiring millions of households to engage directly with the UK ETS. It would also incentivise retailers to develop consumer-friendly low carbon service propositions (such as retail offerings that make heat pumps attractive, encouraging the switch away from gas boilers).

While it could be considered highly unlikely that individual building owners would actively engage in UK ETS trading, the option of participation may be of value for owners of significant property portfolios. It may also be of interest to energy retailers acting on behalf of significant portfolios of retail customers.

5.1.2 Energy Retailers

Energy retailers are defined as companies that buy energy from producers and importers and sell energy to the end consumer. As of September 2023, there were 21 active energy retailers in the domestic energy market.[64]

Retailers have the benefit of already being registered as licensed Ofgem operators – meaning greater ease of monitoring and accountability. Given their access to data on consumers (e.g. from smart meters), placing the UK ETS obligation on retailers could prove effective in keeping administrative costs down with regards to reporting. In addition, the relevant data that is already available could be used to better target measures to mitigate distributional impacts.

Retailers could generate revenue from selling surplus allowances by increasing the proportion of low carbon heating they supply, such as by providing retail offerings that encourage consumers to switch from gas boilers to heat pumps, which could increase the incentive to decarbonise further down the value chain.

63 Energy Systems Catapult (2021). Accurately tracking carbon in electricity markets

64 Ofgem (2023). Retail market indicators

A UK ETS obligation at the point of the retailer would also help prevent any double counting issues from arising. Electricity generators (including gas-fired generators) are already covered by the UK ETS, before the electricity is sold to consumers via retailers, so the requirement would only apply to supply of natural gas. In addition, heat network operators, heating oil suppliers, and potentially biomass suppliers could be made liable for meeting the same obligation.

5.1.3 Gas Shippers

Gas shippers are defined as companies with a shipper licence from Ofgem, which are able to buy gas from a producer, sell it to an energy retailer, or procure a gas transporter to transport the gas directly to consumers. A list of licensed gas shippers operating in the UK is available through Ofgem.[65]

In addition to this, there are separate licences for gas suppliers and transporters for both domestic and non-domestic end users. While not directly comparable, placement of the UK ETS here would most closely resemble the approach taken in electricity, where the obligation is applied to generators.

Placing a UK ETS obligation on gas shippers may prove beneficial as there are two potential options for pricing emissions, by either imposing it:

1. Upon purchase of gas from fuel producers/importers.
2. At the point at which the gas is injected into the National Transmission System or distribution network.

In either scenario, gas shippers have the benefit of already being registered as licensed Ofgem operators – providing greater ease of monitoring and accountability. Gas shippers operate in a heavily regulated environment, and as such already declare the composition and total volume of fuel purchased and injected.

Over time, this may provide an incentive for gas supply chains to invest in innovations to reduce the carbon content of energy supplied using gas transportation and/or purchase an increasing number of units from low carbon sources, such as low carbon hydrogen. However, we recognise that the

[65] Ofgem (2023). List of all gas licensees including suppliers

transition to hydrogen is likely to be made at a system level, mainly influenced by government decisions rather than by the actions of individual participants.[66]

It will be important to avoid double counting for end users who are already covered by the UK ETS (i.e. electricity generators and heavy industry) and whose gas purchases may come via gas shippers. The number of installations affected in this way are likely to be manageable.

If the obligation is placed at the point of injection into the National Transmission System or distribution network, there may be a demonstratable audit trail of where the fuel is eventually used. Parties selling the fuels onto retailers will require records of volumes and composition of gas sold, and will have existing relationships with buyers. An obligation would also need to be placed on non-gas suppliers (e.g. heat network operators).

5.1.4 Fuel Producers and Importers

Fuel producers and importers are defined as:

- A producer is a company that explores for gas, drills the wells, and extracts the gas from onshore and offshore UK gas fields.
- An importer is a company that is responsible for arranging the transportation of gas to the UK at the point of entry (e.g. liquefied natural gas/terminals or the interconnector terminal at Bacton). Importers are different from physical gas transporters (i.e. the ships and interconnecting pipes that physically move the gas to the UK).

Placing a UK ETS obligation on primary producers/importers of fuel would result in an effective carbon price at the point of production or entry. It may, however, also affect natural gas producers and importers that serve non-combustion users of natural gas. For importers, the obligation could be placed at the point where the fuel passes through UK border control, in a similar way to HMRC's 'excise duty point' for fuel duty. For producers, it could be placed at the point of leaving the production facility.

In terms of energy provided from natural gas, approximately 40% results from production within the UK, while the remaining 60% is imported (see Figure 9), predominately from Qatar, the US, and Peru.[66] Currently, domestic use sees the highest portion of demand.

[66] See, for example: DESNZ (2023). Hydrogen blending into GB gas distribution networks a strategic policy decision

[67] DESNZ (2023). DUKES 2021 Chapter 4: Natural gas

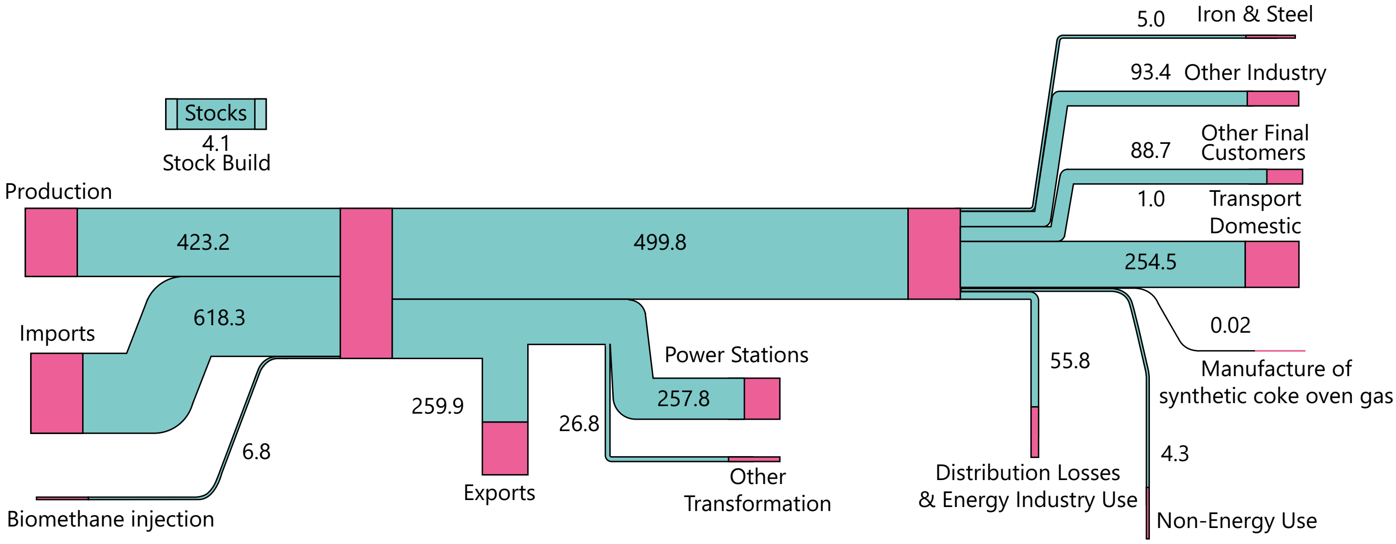


Figure 9. Natural gas flow chart 2022 in TWh.

Given there are likely relatively few primary producers or importers in the supply chain, this could feasibly be monitored with a degree of transparency and simplicity.

There is a double counting risk, however, as it could be difficult to determine the end users. Producers and importers already sell natural gas to existing participants of the UK ETS (i.e. electricity generators and heavy industry). Preventing double counting is key to retaining the correct incentives across the value chain and removing the risk of further increases to electricity prices.

Placing the obligation at the beginning of the supply chain could influence behaviour further down the distribution chain (but the strength of the investment signal may weaken by the time it reaches energy retailers and consumers) and would be greatest on producers, importers, and shippers.

5.2 Road Transport: UK ETS Obligation Placement in the Value Chain

5.2.1 Consumers

Placing the UK ETS obligation on consumers of transport fuels could involve owners of eligible ICE vehicles assuming compliance responsibilities. These responsibilities would include reporting emissions and operating an allowance trading account. While such an approach would follow the 'polluter pays' principle, it would expose consumers to a high administrative burden that may invite pushback. This administrative burden could be limited by provisions to form 'clubs', where compliance responsibilities are shared among a group of vehicles (for instance, a company fleet).

One important advantage of placing the obligation at the point of emission is that consumers are directly exposed to the price signal and incentivised to respond accordingly. Notwithstanding this theoretical advantage, it is highly unlikely that any consumers will be required to participate directly in emissions trading for private ICE usage due to impracticality.

5.2.2 Fuel Retailers

Fuel retailers are defined as companies that purchase fuel from primary producers for sale to consumers. As of 22 December 2022, there were 23 large retailers operating 7,714 sites, alongside 651 sites across an unknown number of minor and unbranded fuel retailers in the UK.[68] Many of these companies are also fuel producers and importers.

The government has well-developed mechanisms to monitor fuel sales through existing fuel excise mechanisms, meaning an obligation at this point should not be overly burdensome in MRV terms.

Imposing the UK ETS obligation at the fuel retailer level would place an effective incentive on fuel retailers to install EV chargers or procure low carbon/biofuels to comply with the cap. Retailers could then generate revenue by selling surplus allowances earnt through this behaviour.

In practice, consumers would also see a strong price signal under this point of obligation, especially if retailers respond to price incentives.

5.2.3 Fuel Producers and Importers

Placing the point of obligation at the fuel producer/importer level aligns with practices in other emission trading systems (e.g. New Zealand's ETS).[69] Proponents of an upstream point of obligation (i.e. fuel importers, refineries, or distributors) assert that it targets a concentrated point in the supply chain, making it easier to monitor and regulate the carbon content of transport fuels, while being less administratively burdensome to comply with for downstream participants – i.e. smaller retailers in the fuel supply chain or consumers. Criticism of an upstream point of obligation relates to a lack of direct incentives for consumers to reduce their emissions.

[68] Petrol Retailers Association (2023). Market review 2023

[69] Ministry for the Environment (2022). Coverage of the New Zealand Emissions Trading Scheme

The Hydrocarbon Oil Duties Act 1979[69] provides a number of definitions for different hydrocarbon and biofuel blends, including derivatives. This could provide the basis for determining which fuel producers and importers are liable, based on the emissions per fuel blend, under an extension of the UK ETS. There are clear mechanisms to monitor quantities of petroleum fuels imported into the UK through the HMRC's 'excise duty point' for fuel duty. For domestic producers, the obligation could be placed at the point of leaving the production facility.

In 2022, total UK crude oil[70] imports were 46 million tonnes (MT) while domestic production was 38 MT. Refinery output was 51 MT of petroleum products (see Figure 10). Some 23% of total UK oil imports came from the US at this date, followed by 20% from Norway, 7% from the Netherlands, and 4% from Belgium.

[70] HMG (1979). Hydrocarbon Oil Duties Act 1979.

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[71] DESNZ (2023). DUKES 2021 Chapter 3: Oil and oil products

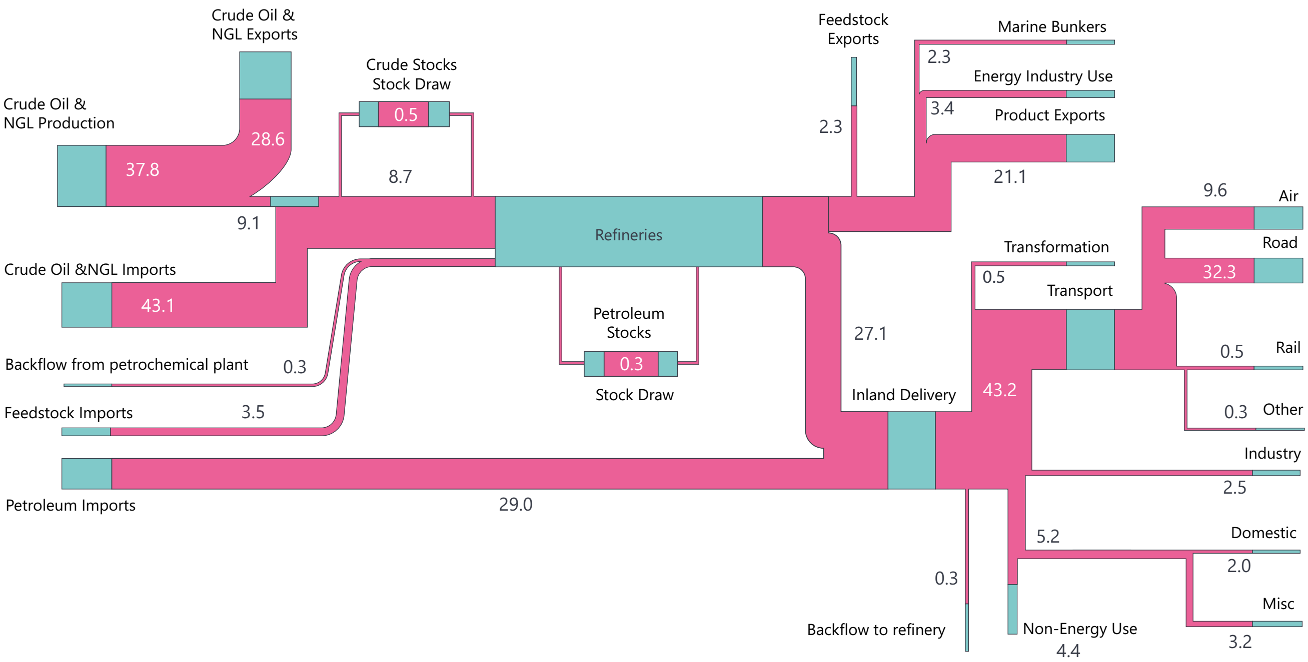


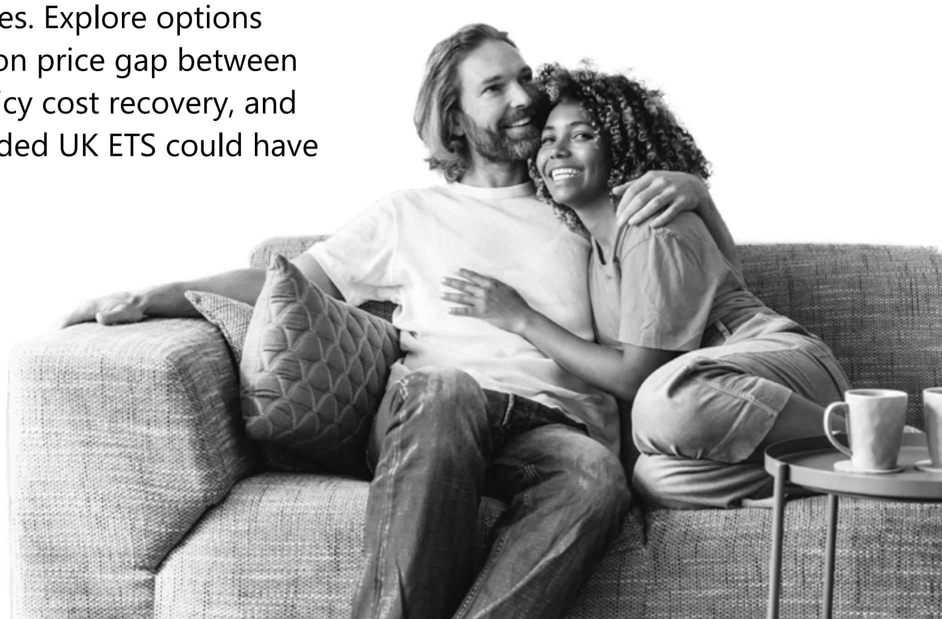
Figure 10. Petroleum flow chart 2022 (million tonnes).[71]

6 Policy Recommendations

6.1 Domestic Heating

Extending the UK ETS to heating fuels could play a meaningful role in decarbonising the buildings sector. The following recommended actions aim to better align incentives across heating technologies for households, while mitigating potential distributional impacts:

- Ensure continued development and delivery of a coherent mix of policies, including investment in grid infrastructure, supply chains, and skills for low carbon heating, and Energy Performance Certificate reform. Carbon pricing alone will not be sufficient to incentivise a complex value chain to provide low carbon heating technologies in a market where there is no 'one-size-fits-all' solution, and where decarbonisation can be disruptive and come with high capital expenditure.
- Over time, phase in extending the UK ETS to cover heating fuels, beginning with natural gas, and eventually extend it to cover other fuels. Alongside this, implement complementary policies that mitigate distributional impacts, which could be funded through redistributed revenue generated from the UK ETS.
- Place the UK ETS obligation on energy retailers. This would mitigate potential double counting issues while maximising the carbon price signal on households. Innovative business models could be developed to support building owners in decarbonising their heating systems, and energy retailers are already well placed to support households.
- Make extending the UK ETS part of an approach to rebalance electricity and gas prices. Explore options for addressing the effective carbon price gap between electricity and gas caused by policy cost recovery, and what role revenue from an extended UK ETS could have in addressing this imbalance.



6.2 Road Transport

Extending the UK ETS to road transport fuels could play a supporting role within a comprehensive policy mix, including funding, regulation, and market-based measures designed to drive low carbon transport choices.
The following recommended actions aim to better align incentives across the road transport sector, while mitigating potential distributional impacts:

- Ensure continued development and delivery of a coherent mix of policies, including support for the development of infrastructure and services (e.g. EV charging infrastructure, cycling lanes, public transport network) to make low carbon transport options more attractive for consumers. This should help to counteract the risk that extending the UK ETS to road transport fuels might impose additional costs on low-income households if existing policies are retained.
- Strengthen existing policies that have started to enable the decarbonisation of road transport as the most effective approach in the near term.
- If the UK ETS is extended to road transport fuels:
    - Consider this in conjunction with targeted support to households to improve their ability to mitigate exposure to higher prices through mode and/or technology switching.
    - Consider placing the obligation upstream at the fuel producer/importer level as this would present the most practical and least cost option.
    - Phase in its introduction and use it as an opportunity to comprehensively reform revenue collection from transport, including by simplifying the myriad of local schemes into a national road pricing system, and by exploring the option to reform fuel duty in light of the substantial revenue shortfalls forecast by the continued electrification of vehicles.

Appendix: Modelling Approach

For the purposes of this analysis, we used ThreeME (Multi-sector Macroeconomic Model for the Evaluation of Environmental and Energy policy), which is a country-generic and open source model that has been in development since 2008 by the French Environment and Energy Management Agency, French Economic Observatory, and Netherlands Economic Observatory. Its main purpose is to evaluate the impact of environmental and energy policy measures on the economy at the macroeconomic and sectoral levels.

The UK baseline scenario we used is based on economic and population growth assumptions to 2050 aligned to that of the counterfactual used in the latest UK Climate Change Committee's Net Zero Strategy assessment. Similarly, the baseline electricity mix is calibrated to reflect the same counterfactual evolution used by the CCC. World oil and European natural gas and coal import prices are calibrated to the International Energy Agency's World Energy Outlook projections to 2050.

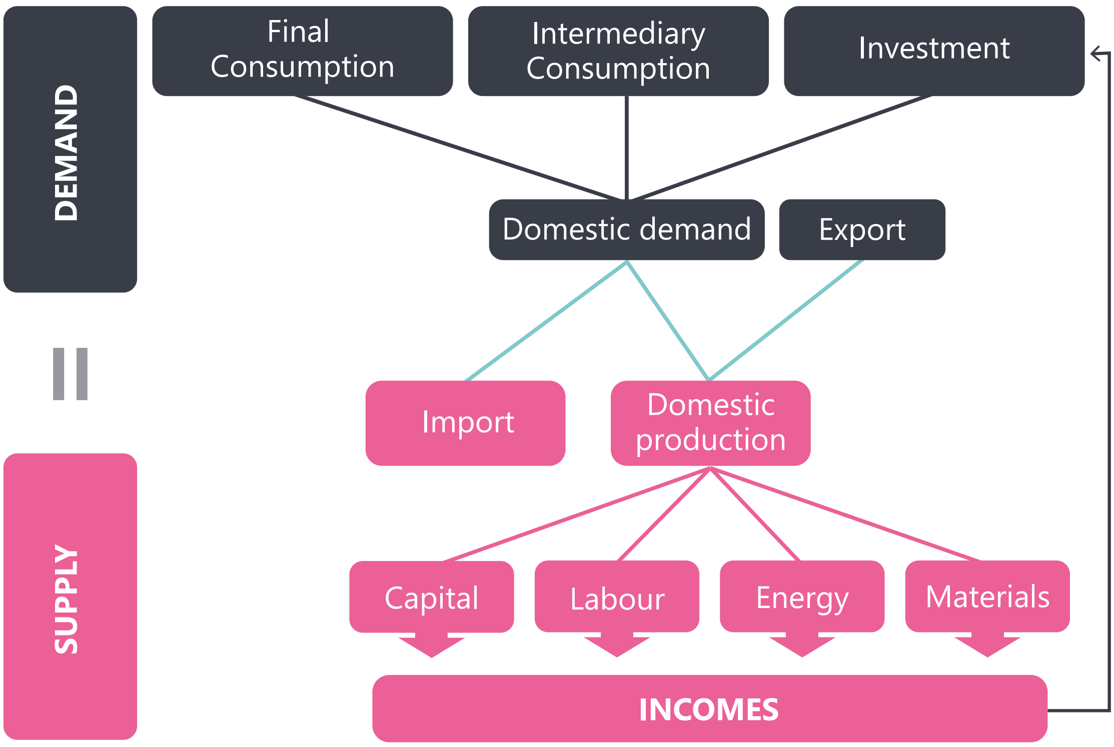


Figure 11. Diagram of the ThreeME model.

Microsimulations built on the Office for National Statistics' Living Costs and Food Survey Households in ThreeME are modelled using a single representative household, as is common in the macroeconomic literature. Carbon pricing affects different households heterogeneously, particularly along the income distribution. To better account for this heterogeneity, an adapted version of ThreeME that is combined with a techno-economic microsimulation model of household carbon footprint has been used.[73] This combination of ThreeME and the microsimulation model is a one-way model: there is no retroaction from the microsimulation towards the macroeconomic model. Distributional considerations have no macroeconomic implications in the results of the simulations presented.

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