European Climate Foundation

Exploring the trade-offs in different paths to reduce transport and heating emissions in Europe

cambridge econometrics
clarity from complexity

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UPDATE:
Due to errors in price calculations, relative price changes have been overestimated in the original report published in 2021 May.
In this 2022 February version, updated relative price increase estimates are provided. However, please note that these estimates also take new announced legislation (FF55) into account in the baseline. Therefore, the updated estimates represent our expectations, considering the passing of the non-ETS2 FF55 measures.

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Executive Summary

European Member States agreed in December 2020 to an increased climate target for 2030 of -55% net emissions reductions. In July, the European Commission will propose an update of the EU's key climate and energy legislation to turn that climate target into concrete policy. This report looks into the impact of an increase in ambition in the road transport and buildings sector on the European economy and on household purchasing power. Our analysis shows that, if well designed, more rapid decarbonisation in these two sectors leads to very positive macroeconomic impacts in Europe.

According to the European Commission impact assessment, a cost-efficient contribution by the non-ETS sectors to the EU's new 2030 target of -55% (compared to 1990) would be to reduce emissions in these sectors by around -40% (compared to 2005). The non-ETS sectors consist of road transport, buildings, agriculture, waste and small industries. Note that the current target for these sectors is -30% (compared to 2005), so efforts would need to increase by 10 percentage points. The report looks at two different scenarios to achieve a -40% emissions reduction in the non-ETS sectors. According to our modelling, the contribution of road transport to this target could be to reduce emissions by 33% and in buildings by 41%.

The first scenario modelled to achieve these reductions is with policy measures (both at the EU and national level) where road transport and buildings remain covered under the national climate targets, as regulated by the EU's Effort Sharing Regulation (ESR). Analysis shows that such an approach would deliver substantial economic benefits, while encouraging the take-up of low-carbon technologies and avoiding some of the potential regressive distributional impacts associated with the introduction of an emissions trading system (ETS) for these sectors (which taxes marginal fuel use but does not necessarily help consumers to afford new low-carbon technologies).

The second scenario modelled transfers the responsibility of emissions reductions in the road transport and buildings sectors to a new EU-wide ETS, starting in 2025. Analysis shows that the introduction of such an EU-wide carbon price would require very high allowance permit prices to deliver equally rapid decarbonisation of these sectors by 2030, reaching €180 per ton (in 2015 prices) by 2030. Without any revenue recycling, the parallel ETS has a negative impact on output (measured through GDP) and employment across Europe.

With 100% revenue recycling, the ETS scenario could have the potential to increase economic activity in Europe while delivering the same emissions reductions. But even with revenues recycled, the macroeconomic benefits (in terms of jobs and GDP) are slightly smaller than if the policy measures from our first scenario were deployed to meet the same aim. The extent of revenue recycling, and how such revenues are used, substantially alter the socioeconomic outcomes from an ETS. It also influences the resultant ETS price. The analysis examines two extremes; either all revenues are used to pay down government debt, or recycling of all revenues back into the economy. In reality, revenues will be used in a variety of different ways. The positive economic impact of the policy measures scenario on the other hand does not rely on effective recycling of revenues. The analysis shows that if a share of the revenues are used for low-carbon technologies and building energy efficiency, then this does not only lead to lower resultant low-carbon technology costs for all consumers, but also lower carbon prices. Conversely, if revenues are recycled back to consumers (through either tax cuts or lump sum transfers) the rebound effect leads to higher levels of consumer expenditure and economic activity, which puts upwards pressure on ETS allowance permit prices across the period to 2030.

There are substantial concerns around the distributional impacts of an ETS. There is the potential to leave low-income households ‘stranded’ using heavily-taxed fossil fuel technologies (as a result of the high up front costs of low-carbon alternatives or energy renovations, and other barriers to take-up such as the lack of incentives for landlords to invest in these technologies). The analysis suggests that, in the countries studied in depth closely (France, Germany and Poland) the cost of gas for heating would increase substantially in 2030 as a result of the application of the EU-wide ETS price. Such impacts have a major impact on poorer households; both because they spend a greater proportion of their incomes on heating, but also because reductions in demand by these households are more likely to lead to underheating and resultant detrimental social and health outcomes.

This highlights the need for careful policy design, particularly in respect of use of the revenues that accrue from the ETS. The modelling shows that these choices have a major impact on the distributional impact of the ETS; for example, lump sum transfers lead to better outcomes for lower income households, as the lump sum is a greater proportion of their expenditure.

1 Background

1.1 The policy context

Following on from the legislation which committed the EU to ‘climate neutrality’ by 2050, the European Commission’s (EC) proposal to increase the 2030 GHG reduction target to -55% was endorsed by the European Council in December 2020. As part of the “Fit for 55 Package”, a wide range of climate and energy policies are to be revised, including the EU Emissions Trading System (ETS) and the Effort Sharing Regulation (ESR).

Since its inception in 2005, the EU ETS has helped to drive decarbonisation of the power sector but further measures are needed to drive similar changes in industry too according to the 2021 State of the EU ETS Report[1]. The European Commission is considering establishing a separate parallel ETS for road transport and building heating, outside of the existing EU ETS, in order to impose an additional price on emissions in these sectors without negatively impacting the operation of the existing ETS. They are currently evaluating whether and how such a system would interact with the existing (and presumably, in the future, tightened) targets set under the ESR. One key uncertainty is how to manage the competing responsibilities under the two sets of regulations; while the ETS is the responsibility of the European Commission, it is Member States that currently are responsible for ensuring compliance with the ESR targets.

The 2021 State of the EU ETS Report concludes that a carbon price signal on its own will not be sufficient to deliver the emissions reductions needed and to enable the needed development and deployment of low carbon technologies. It emphasises that additional policies will be needed to support the ETS as well as the non-ETS sectors in achieving decarbonisation in Europe by 2050. In addition, it is clear that a -55% economy-wide emissions reduction target will require greater reductions in both ETS and non-ETS sectors, and relevant supporting policy.

1.2 The aims of the analysis

This report seeks to deliver emissions reductions in the non-ETS sectors in line with the European Commission’s target of the 55% reduction in European GHG emissions compared to 1990 levels. This would mean around 40% reductions compared to 2005 for current non-ETS sectors, as outlined in the EC's Climate target plan impact assessment as the ESR’s cost-efficient share.

The study explores two different illustrative pathways to achieve the same level of emissions reduction in non-ETS sectors:

- First, with policy measures focussed on regulating fossil fuel-based technologies and encouraging the take-up of low-carbon alternatives, specifically targeting the transport and building heating sectors. In this scenario these sectors would remain covered under the ESR.

[1] https://secureservercdn.net/160.153.137.163/z7r.689.myftpupload.com/wp-content/uploads/2021/04/20210414-2021-State-of-the-EU-ETS-Report-vfinal-1.pdf

- Second, with the introduction of a separate parallel EU-wide ETS with a single price for current non-ETS sectors from 2025 onwards (but with no explicit links or convergence to the existing ETS). For this scenario, we have also analysed different revenue recycling options through a sensitivity analysis to evaluate the different economic impacts of recycling options.

The analysis explores the implications in terms of macroeconomic indicators, including distributional impacts, and presents results at the EU27 level, and in three chosen Member States: Germany, Poland and France.

1.3 The structure of this report

After this introduction, the second chapter presents our analytical approach, including the scenario design (2.1), the macroeconometric model used in the analysis (2.2) and the method used to calculate further distributional impacts at the member state level (2.3). Chapter 3 shows the level of emission reductions in the non-ETS sectors. The fourth chapter discusses the impacts of the scenarios on GDP and sectoral output (4.1) and employment (4.2), then EU-wide distributional impacts are detailed. (4.3). Chapter 5 looks in more detail at outcomes from the policy scenarios in three Member States; Germany, Poland and France. The final chapter draws out key conclusions from the analysis.

2 The analytical approach

The overall approach

To assess the research questions posed in Chapter 1, we designed two potential policy scenarios, with different input assumptions and policies to achieve the same level of emissions reductions. The E3ME macroeconomic model was used to assess the impacts of the scenarios and sensitivities and results were compared to a business-as-usual baseline.

2.1 Designing the scenarios to be modelled

The scenarios were developed to achieve a specific goal: to demonstrate, compared to a 'baseline' case, the socioeconomic implications of two alternative policy pathways to deliver decarbonisation consistent with an economy-wide target of -55% GHG emissions in 2030 in the transport and buildings sectors. The first scenario modelled policies in these two sectors to reach the required emission reduction targets. and the second established a separate parallel ETS for current non-ETS sectors.

GHG emissions reductions

The interim target towards economy-wide decarbonisation at the EU27 level is to achieve a 55% cut in GHG emissions in 2030 compared to 1990 levels. However, there is some debate regarding how much ETS versus non-ETS sectors should be expected to contribute to this target, and indeed within non-ETS sectors how much road transport and buildings specifically should reduce emissions (compared to other non-ETS sectors such as agriculture and waste).

In the scenario modelling, we adopted a target for emissions reductions of 40% -compared to 2005 levels- for non-ETS sectors at the EU27 level, based upon the EC's Climate target plan impact assessment which had -39%. This is a 10 pp increase on the 30% reduction currently enshrined in the ESR, however, the target is at the more conservative end of the relative contribution of the ESR sectors (45.6%) to the 2030 target and (41.8%) to the potential new 2030 target[2].

Below we briefly describe key aspects of the baseline and the scenarios, how different measures are implemented, and the implications of our approach.

The model baseline

The baseline used in our analysis is constructed to be broadly consistent with the National Energy and Climate Plans (NECPs). Building on the E3ME baseline, we have added a number of elements to reflect the latest economic, environmental and technology trends, to ensure that the modelling reflects the latest understanding of the costs and benefits of decarbonisation. Specifically, the baseline has been updated to:

- Include short term impacts of COVID-19

[2] The relative contribution of the non-ETS sectors would need to be 45.6% to achieve the current 2030 target, while 41.8% to achieve the increased EU GHG emissions reductions target.

- Allow for the latest developments in renewable deployment: reductions in wind and solar costs in the power sector and recent data on the take-up of EVs
- Include revised ETS prices to reflect the same assumptions as in the European Commission's 55% Impact Assessment reference case

Scenario 1 Policies are introduced to the road transport and buildings sectors

In the first scenario, policy measures are introduced into the two sectors to deliver the same emissions reduction in each year to 2030, without the introduction of an ETS or carbon price in these sectors. This scenario is subsequently described as the 'Policy Measures' or in the charts as ''Policies' scenario.

The starting point for the construction of this scenario was to reflect key elements of existing and anticipated future policy to deliver ESR emissions reduction targets; for transport, this is tightening emissions standards (and ultimately bans on the sale of combustion engine vehicles), subsidies for low carbon vehicles and demand reduction/management policies; for heating the phase-out of fossil fuel boilers and improved building energy efficiency.

However, these policies are implemented only to the extent required to meet the emissions reductions delivered by the ETS-based mechanism in the ETS scenario (Scenario 2) in transport and heating. Ultimately, although all measures are introduced in the Policy Measures scenario (Scenario 1), the phase-outs do most of the work in delivering the required emissions reductions, and only minor reductions are required from supporting measures.

The following specific policies – subsidies, regulations and investment – have been incorporated into our analysis:

Transport policies:

- Tightening emissions standards for new passenger cars, on a trajectory towards a ban on the sale of new petrol and diesel car sales from 2035
- A small amount of subsidy on the purchase of new battery electric cars of €1000 per vehicle[3]
- Tightening emissions standards for vans and heavy goods vehicles, reducing total emissions from the fleet by 2.5% in 2030 compared to baseline
- A small reduction in car transport demand (by up to 2% in 2030), substituted by a combination of walking, cycling and public transport.

Building heating policies:

- The phase out of new sales of fossil fuel (coal, gas and oil) boilers from 2025 onwards
- A subsidy on the purchase of low carbon heating technologies equivalent to 15% of the purchase cost
- Public sector investment in household energy efficiency to reduce heat demand by up to 3% compared to the baseline in 2030[4].

[3] To close the remaining emissions gap

[4] About 23% vs 2005 but this includes also declining trends in the baseline and COVID impacts

Scenario 2 parallel ETS introduced for the road transport and building sectors

In this scenario, a single ETS is introduced to achieve the 40% emissions reduction in the non-ETS sectors (compared to 2005 levels) by 2030. The price is introduced in 2025[5] and set equal to the ETS-price in this year - coming from the E3ME model- then the model calculates the prices required to meet the emissions reduction target in each of the following years.

This scenario is denoted as "the ETS scenario" throughout the report. However, it should be noted that the E3ME model does not include a representation of a true ETS with transferability of permits between years within a single phase of the scheme. As outlined above, instead emissions reduction targets for each year are used as inputs, and prices calculated endogenously within the model for each year to deliver that specific emissions reduction.

The role of revenue recycling

Different revenue recycling options have been explored through a sensitivity analysis applied to this ETS scenario, to evaluate the different economic impacts of recycling options. Revenues can be recycled through a number of different channels in E3ME, and will lead to different economic and distribution outcomes:

- Through income tax – increases disposable income, with greater benefits to households with higher wage incomes
- Through lump sum transfers – increases disposable income, with greater impacts (in percentage terms) on lower income households
- Through employers' social security contributions – reduces labour costs for firms, therefore increases demand for labour, with the greatest benefits to those earning wages
- Through VAT – reduces product prices seen by consumers, with benefits relatively balanced across household groups.

The main case and sensitivities that were then explored were as follows;

- **No recycling (used in the main ETS scenario)**
  This sensitivity assumes that revenues are used by governments to pay down debt. This has the net effect of removing money from the economy, and reducing overall economic activity. This is likely to lead to worse economic outcomes, but will prevent rebound effects from increasing demand for emissions-intensive goods or services.
- **Recycling through tax reductions**
  In this sensitivity revenues are used to cut existing taxes, leaving overall government balances unaffected by policy. This increases consumer expenditure compared to the 'no recycling' case, leading to more positive macroeconomic outcomes.

  In this 'tax recycling' sensitivity, we have split government revenues into three and used equal one-third shares to reduce income taxes, employers' social security contributions, and VAT.

[5] Effectively as carbon tax in the E3ME model

- **Recycling by support low carbon technologies**
  In this sensitivity 25% of government revenues are used for policies which support the transition to low carbon technologies, including government investment in technologies (to help to accelerate cost reductions and emission reductions) and building efficiency investment, while the rest of the revenues (75%) are recycled through tax reductions as in the 'tax recycling sensitivity: a split of government revenues into one-third on direct taxes, one-third on employers' social security contributions, and one-third on VAT reductions.

  This sensitivity reduces the cost of low-carbon technologies, and is likely to increase the take-up of such products by consumers. This can be expected to lead to some rebound effects in terms of economic activity and emissions, although since much of the investment is in low-carbon technologies the emissions rebound would be expected to be minimal.

- **Recycling through lump sum transfers**
  In this sensitivity 25% of government revenues are used for lump sum transfers to consumers, while the rest of the revenues (75%) is recycled through tax reductions as in the 'tax recycling' sensitivity: a split of government revenues into one-third on direct taxes, one-third on employers' social security contributions, and one-third on VAT reductions.

  This sensitivity leads to an increase in disposable income and benefits lower income households more in relative term, as the lump sum transfer is a greater proportion of their total income. It would be expected to lead to rebounds in economic activity and emissions, with consumers spending additional income on a range of goods and services.

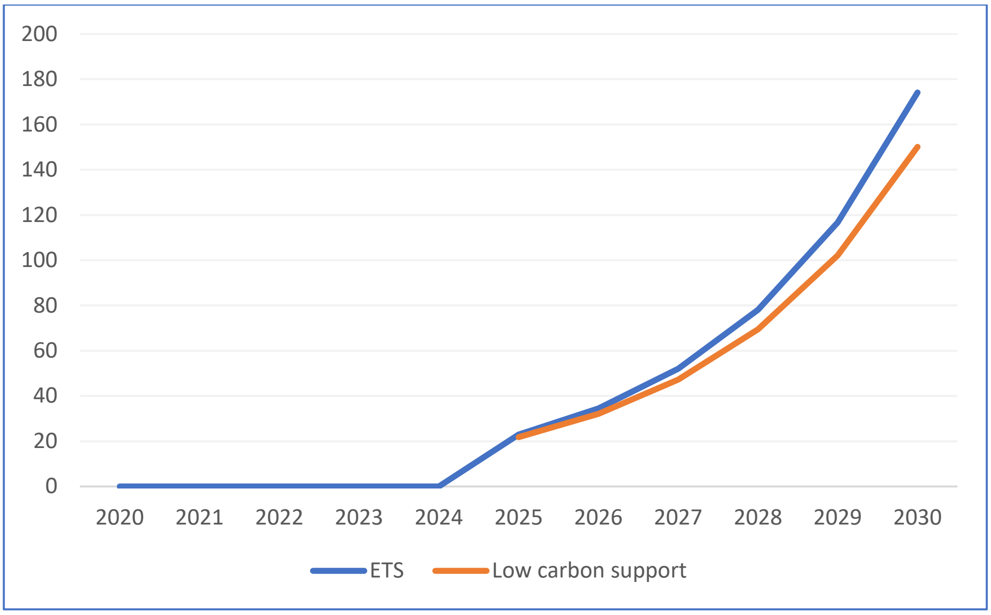
Carbon permit price

In the ETS scenario, the ETS for current non-ETS sectors is introduced in 2025 and set equal to the main ETS price in this year. The chart below shows the price trajectory as calculated by the E3ME model to meet the emissions reduction targets in the following years. A very high permit price for non-ETS sectors is required to meet the -40% target in 2030: €180 per ton of CO_2 by 2030 (2015 prices)[6].

The impact of the different revenue recycling options on the permit price has also been evaluated. The largest impact is seen when one quarter of the revenues are used to encourage the take-up of low carbon technologies and energy efficiency; permit prices needed for the emissions reductions are still high, at €150 per ton of CO_2 in 2030[7], but less than in the main ETS scenario where no revenue recycling takes place.

The other revenue recycling options would lead to slightly higher ETS prices because there will be rebound effects in consumer spending from higher disposable incomes resulting from tax reductions and lump sum payments. However, these rebound effects in spending are likely to be in consumer goods and services such as restaurants and entertainments rather than in heating and road transport.

Figure 2.1 Carbon prices in the ETS scenario (2015euro/tCO2)



[6] €180 per ton in 2015 prices would translate to €236 euro in 2030 prices.

[7] €150 per ton in 2015 prices would translate to €199 euro in 2030 prices.

2.2 The E3ME model

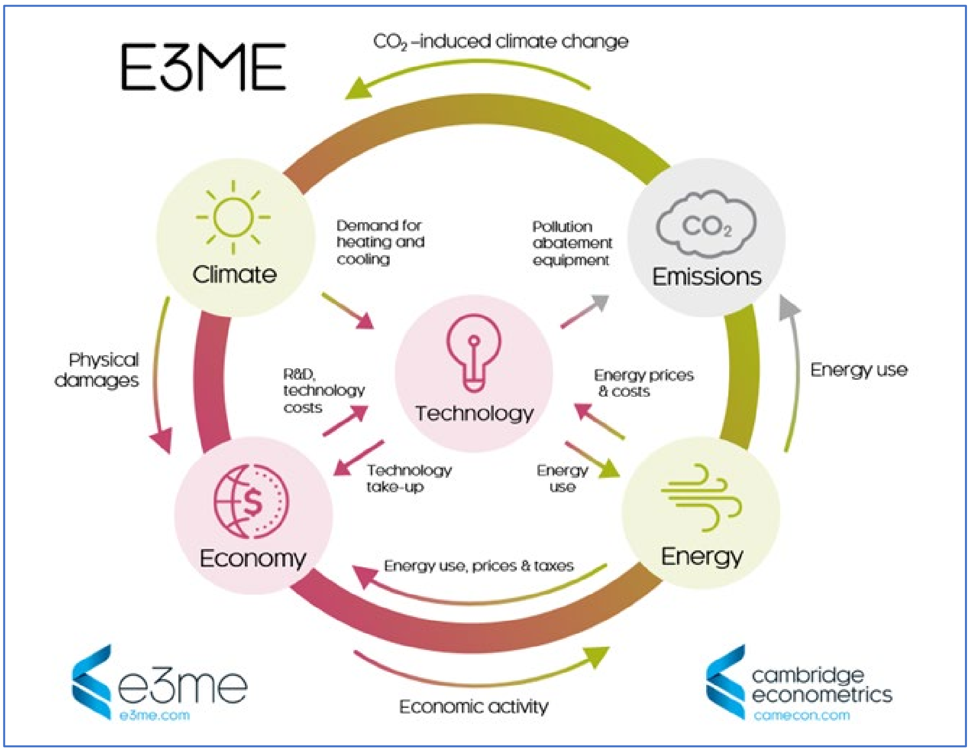
Overview

E3ME is a computer-based model of the world's economic and energy systems and the environment. It was originally developed through the European Commission's research framework programmes and is now widely used in Europe and beyond for policy assessment, for forecasting and for research purposes.

E3ME as an E3 model

Figure 2.2 shows how the three components (modules) of the model - energy, environment and economy - fit together. The economy module provides measures of economic activity and general price levels to the energy module; the energy module provides measures of emissions of the main air pollutants to the environment module, which in turn can give measures of damage to health and buildings. The energy module provides detailed price levels for energy carriers distinguished in the economy module and the overall price of energy as well as energy use in the economy.

Figure 2.2 E3 linkages in the E3ME model



Technological progress plays an important role in the E3ME model, affecting all three E's: economy, energy and environment. The model's endogenous technical progress indicators (TPIs), a function of R&D and gross investment, appear in nine of E3ME's econometric equation sets including trade, the labour market and prices. Investment and R&D in new technologies also appears in the E3ME's energy and material demand equations to capture energy/resource savings technologies as well as pollution abatement equipment.

The FTT models

In addition to the treatment of technology through TPIs, E3ME also captures low carbon technologies in the power, transport and residential heating sector through its interactions with the Future Technology Transformation (FTT) models which measure the substitution of technologies in response to changes in costs (both purchase and operational). These models can better assess shifts in technology, and the impact upon energy demand/emissions, than a simple (linear) elasticity of demand, as found in many macro models.

The FTT models have a number of important characteristics:

- Households are modelled according to a distributed curve of preferences (i.e. investors are heterogenous, with different willingness to adopt new technologies)
- The models do not model specific non-market barriers (i.e. split incentives in rented properties which dramatically reduce the take-up of new technologies, even when they have cheaper levelized costs)
- The models assume that technologies are perfect substitutes (e.g. that a heat pump can be 'dropped in' as a replacement to a gas boiler in all circumstances, and without considering the need for energy efficiency to reduce peak heating need)
- The responsiveness to changes in technology costs is calibrated based upon historical data

Some of the assumptions (e.g. perfect substitution, lack of non-market barriers) have the potential to lead to over-estimates of the responsiveness to price changes. Therefore, the baseline rates of decarbonisation in these industries are adjusted to ensure that the model is producing results in line with other studies.

The implications of using this modelling framework for this analysis

The use of these modelling tools, and in particular the FTT models to assess changes in demand for specific technologies in response to changes in fuel costs, has specific implications for the analysis. Using these models, we can better assess the long-term responsiveness of these sectors to changes in the costs of specific technologies, since we are able to capture changes in purchasing decisions, rather than simply assessing the short-term elasticity (which is dominated by a change in demand for the final output in response to price changes, rather than changes in the technology used). This approach also allows for non-linear responses, i.e. for elasticities to change, which is a key critique of the standard approach, where a single coefficient is estimated based on historical data.

However, these models also make some simplifying assumptions which could conversely lead to the over-estimation of elasticities. In particular, the models assume that technologies are perfect substitutes (e.g. a heat pump can be 'dropped in' to replace a gas boiler, while in most cases substantial energy efficiency improvements are required to a property in order to shift to a heat pump for heating) and a lack of non-market barriers (e.g. split incentives in rented properties which severely depress the take-up of low-carbon heating technologies in this type of building).

The approach taken through the combination of E3ME and FTT models is a more detailed top-down approach; but while the FTT models do not treat consumers as a homogeneous mass (a typical shortcoming of macro models), they fail to take into account the full details of specific individual investment decisions in the way that a bottom-up stock model might. This modelling should not be interpreted as a perfect representation of these sectors, but as a less simple representation than is typically included in macro models.

2.3 Assessing the distributional impacts

The introduction of a carbon price onto transport and heating fuels affects households differently depending upon their individual circumstances, such as their demand for these fuels and their household incomes. A key policy consideration is the distributional effects of such policy; specifically, whether policy has an unduly large impact upon the worst off in society.

For the EU-wide impacts we assumed a uniform demand response across all households. The impact of achieving the emissions reductions in heating and transport on households differs across scenarios and income levels. Section 4.3 discusses the results.

Method for country studies

We have carried out an additional analysis for the three country examples: Germany, France and Poland. We have used a combination of E3ME results for changes in fuel prices and historical data on household income by decile to assess potential impacts on households in the lower half of the income decile. Results are presented in Section 5.

First, we take changes in the price of transport and heating fossil fuels from the macroeconomic modelling work described previously. We then map these fuel price changes to historical data on household expenditure by income to assess potential impacts on households whose income is below the national average, taking into account demand elasticities (i.e. changes in demand in response to price changes) drawn from the literature. National level data on price elasticities was used for both Transport and Household heating, with the exception of the Household energy price elasticity in Poland where national data was not available and therefore EU average data was used instead.

The heating fuel price increase is incorporated in the gas, liquid fuel and solid fuels consumption categories, while the road transport price increase is incorporated in the diesel, petrol and other fuels and lubricants for personal transport equipment consumption categories.

Assumptions

We make a number of assumptions to assess these impacts:

- The passthrough rate of fuel price changes from industry to consumers is 100% in both the road transport and heating sectors.
- In both transport and buildings, price elasticities increase as income increases; this behaviour can be attributed to the reduced role of ‘essential’ consumption as incomes increase, i.e. a smaller proportion of total usage is to meet essential needs, and therefore a larger proportion is discretionary and can be cut in response to price changes.
- The granularity of price elasticities differs across the three observed countries – Germany, Poland and France – due to limited availability of data.

Germany

- The price elasticity of demand of households to changes in heating costs is between -0.21 and -0.32 in the 1st income quartile and between -0.29

and -0.46 in the 2nd income quartile across the household types [1], i.e. a 1% increase in the price of gas for heating leads to a decrease of between 0.21-0.32% and 0.29-0.46% in demand. For the calculations we used the price elasticities representing the households with a single adult without children, being -0.21 and 0.31 for the 1st and 2nd income quartile, respectively.

- The elasticity of demand of households to changes in road transport costs in the lower quartiles ranges from -0.30 to -0. 32 in the 1st income quartile and between -0.41 and -0.51 in the 2nd income quartile across the household types [2]. For the calculations we used the price elasticities representing the households with a single adult without children, being -0.30 and 0.42 for the 1st and 2nd income quartile, respectively.

France

- The price elasticity of demand of households to changes in heating fuel costs is between -0.19 and -0.46[3], i.e. a 1% increase in the price of gas for heating leads to a decrease of between 0.19% and 0.46% in demand. For the calculations we used an average price elasticity across the income groups representing an average household, being -0.35.
- The price elasticity of demand of households to changes in road transport costs in the lower income groups ranges from -0.016 to -0.236[4]. Similar to the approach taken for Germany, separate price elasticity of -0.016 was used for the lowest income group - the 1st income decile - and the average price elasticity of the 3rd, 4th and 5th income deciles was taken to represent the lower income groups.

Poland

- For Poland, EU average figure for median, or 5th decile, income level households was used for the price elasticity of demand for household heating fuels in lack of national level data on the same. The price elasticity of demand of households to changes in heating fuel costs is -0.37[5], i.e. a 1% increase in the price of gas for heating leads to a decrease of 0.37% in demand.
- The price elasticity of demand to changes in road transport costs used for Polish households represents the average in the whole population in Poland, being -0.225[6].

[1] Schulte, I. and Heindl, P. (2016) Price and Income Elasticities of Residential Energy Demand in Germany. ZEW Discussion Paper No. 16-052.

[2] ibid.

[3] Berry, A. (2019). The distributional effects of a carbon tax and its impact on fuel poverty: A microsimulation study in the French context. Energy Policy, 124, 81-94.

[4] ibid.

[5] Borozan, D. (2019). Unveiling the heterogeneous effect of energy taxes and income on residential energy consumption. Energy policy, 129, 13-22.

[6] Dahl, C. A. (2012). Measuring global gasoline and diesel price and income elasticities. Energy Policy, 41, 2-13.

For the purposes of this analysis, we examine the impact in 2030, and take an example household which has not shifted their heating or road transport technology. The aim of this exercise is to consider impacts on those who might be worst affected by the policy; it is well understood that the lowest income households are, in the absence of specific mitigating policy, unlikely to have the financial means to change technologies (for either heating or road transport) before the end of the natural life of their current assets, and therefore are less likely to be able to respond to changes in fuel prices through adopting new low-carbon technologies, and it is precisely these kinds of consumers that we seek to examine through this analysis. Our analysis focuses on 2030 because this is when the distributional effects are likely to be most pronounced. In the case of road transport, there are unlikely to be large volumes of second-hand electric vehicles available to purchase for low-income households, and the price-competitiveness of low-carbon heating and transport technologies will still be evolving, meaning that not all low-income households that need replacement technology by 2030 will be able to choose the low-carbon option.

However, it is important to note that the ability of households to shift to low carbon technologies is endogenous to the scenarios that are being modelled; which is to say, particular policies can provide specific support to consumers which will make the example case (of a household in 2030 which has not switched to low carbon technologies) more or less likely. Most obviously, large subsidies for these technologies could encourage their take-up, but also regulations such as mandates to force rental properties to take-up low carbon technologies could substantially affect how likely this ‘worst case’ outcome is to arise in a given scenario.

3 Environmental impacts

3.1 Emissions trends

In the baseline, emissions in non-ETS sectors are calibrated to the latest Member State-level NECPs. The baseline projection therefore represents the Member State expectations for emissions, including existing and planned policy commitments.

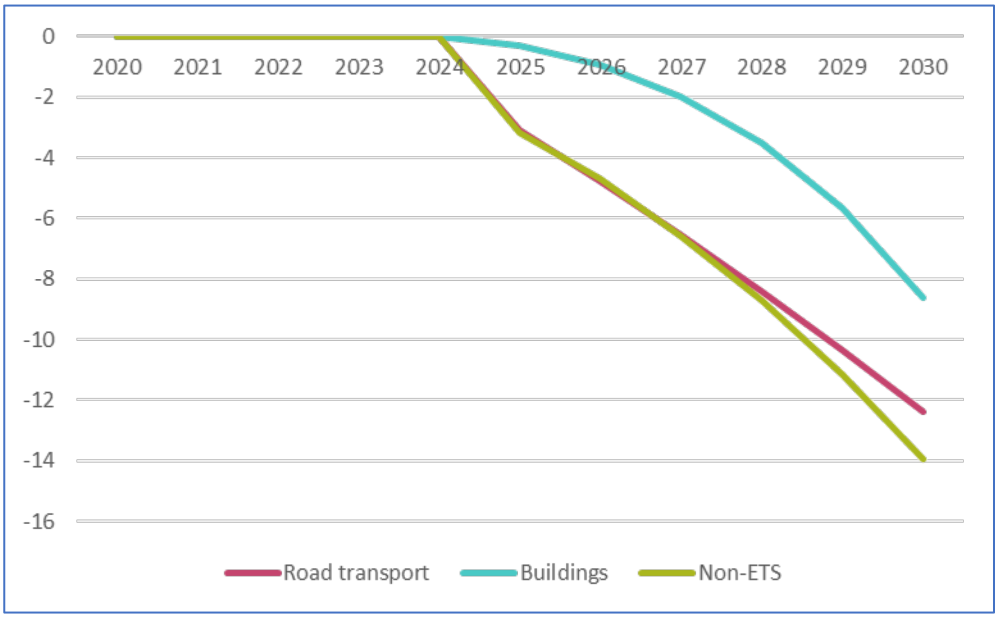
The scenarios, by design, have the same level of emissions reduction achieved in the ETS and Policies scenarios, decided by the breakdown of emissions reduction (by sector and country) delivered by the implementation of the ETS in the current non-ETS sectors. The overall non-ETS target was set by the design, while the E3ME model leads to the road transport and building emissions pathways consistent with meeting the EU27 non-ETS target.

Table 3.1 Proposed scenario targets for 2030 vs 2005

Non-ETS sectors	-40%	Set by the scenario design
Road transport	-33%	As a result of E3ME modelling
Buildings	-41%	As a result of E3ME modelling

As Figure 3.1 shows, in both scenarios a considerably greater CO_2 emission reduction is visible compared to the baseline. There is a greater reduction in emissions from road transport than heating vs the baseline, explained by the faster turnover of the car fleet vs boilers but also by the ability of consumers to change mode of transport more easily than is the case for heating.

Figure 3.1 Carbon dioxide emission by fuel users - EU27 (% difference from baseline)

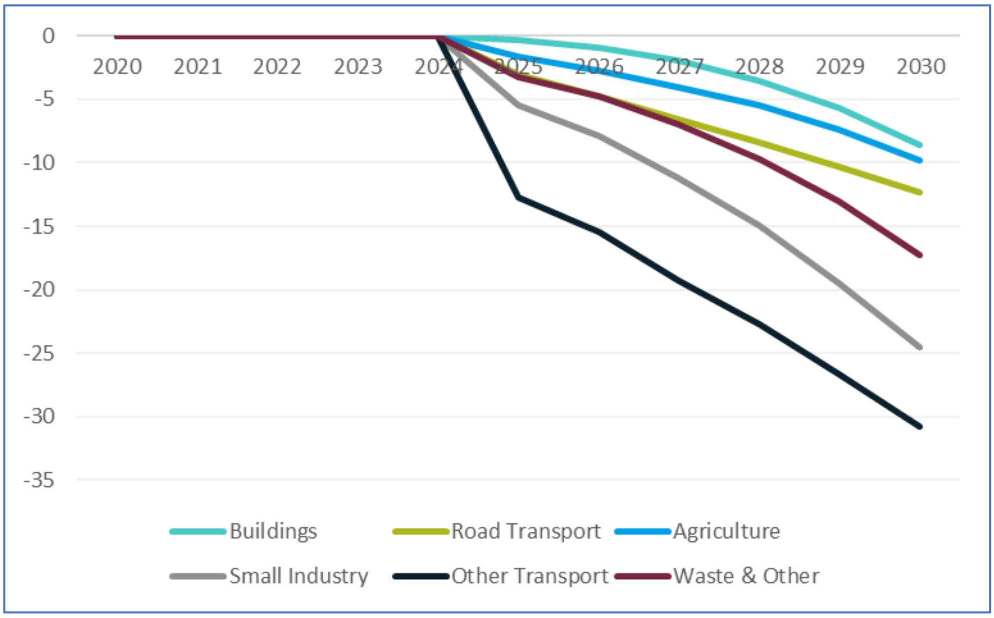


Across the non-ETS sectors as a whole, CO_2 emissions are over 3% lower compared to the baseline already by 2025; by 2030 emissions are reduced by 14% across these sectors as a whole (again relative to baseline).

Emissions reductions are initially much slower to take place in the heating sector, and although they accelerate through the period to 2030, by 2030 emissions are only around 9% lower than baseline. There is a quicker, and ultimately larger (in percentage terms) reduction in emissions from road transport.

In the ETS scenario, the new emissions trading system covers all non-ETS sectors; the impact on these is shown below. Because both road transport and household heating are reducing emissions by less (in percentage terms) than the overall cap implies, other non-ETS sectors are required to do more (see Figure 3.2).

Figure 3.2 Carbon dioxide emission by selected key sectors in the ETS scenario - EU27 (% difference from baseline)



4 Socioeconomic impacts

As highlighted in the previous chapter, through the process of scenario design the environmental impacts of the scenarios are the same; it is in terms of macroeconomic impact where differences emerge. In the analysis that follows, the outcomes for the scenarios and sensitivities are compared to the baseline, to address the question of which potential tool to reduce emissions in these sectors may yield better socioeconomic outcomes.

4.1 The impacts on Gross Domestic Product (GDP)

Previous macroeconomic analysis of the impact of decarbonisation has shown the potential for positive economic impacts from such policy[8]. Our analysis of the impacts of more rapid emissions reductions in transport and buildings shows the same trend – although it highlights the importance of how revenues (from any price-based mechanism, but specifically here from the introduction of an ETS to current non-ETS sectors) are recycled in determining what that economic outcome looks like.

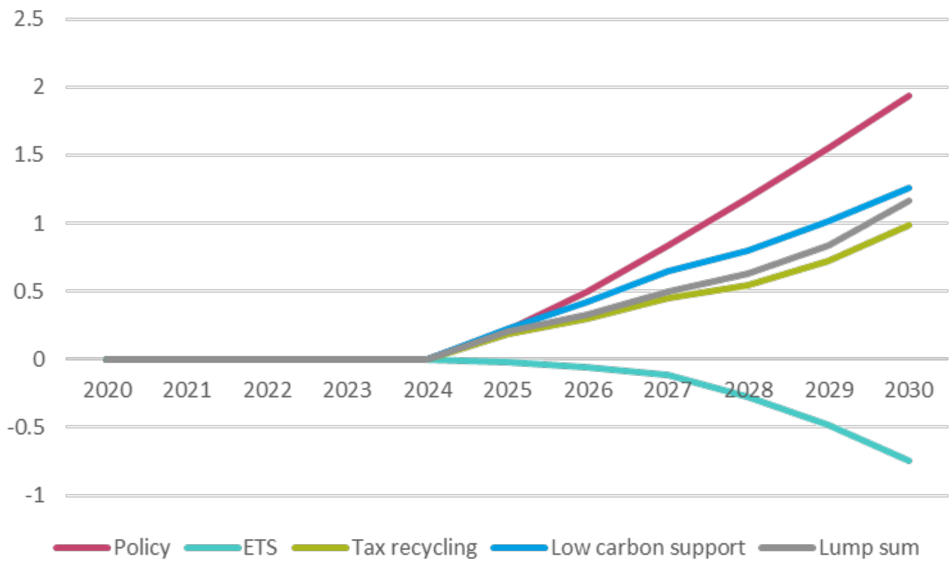
In the Policies scenario and when revenues are recycled in the ETS scenario, positive macroeconomic impacts are observed relative to the NECP baseline. However, when revenues are held onto by governments, the overall outcome (in terms of GDP) is worse than in the baseline, as a result of money being taken out of the economy.

In the ETS scenario, with the introduction of a carbon price for the road transport and household heating sectors, makes fossil fuel-based technologies more expensive, therefore creating incentives for consumers to do some combination of reducing demand and switching to low-carbon technologies, reducing emissions in these sectors.

In the Policies scenario, a policy mix is introduced into the two sectors analysed, in order to deliver the same emissions pathway towards 2030. In the absence of an EU-level ETS price, any national government can choose to implement a price on emissions to achieve their ESR target – as seen for Germany on Figure 4.1.

[8] https://www.nature.com/articles/s41558-018-0182-1; https://newclimateeconomy.report/

Figure 4.1 GDP expenditure measure at market prices (% difference from baseline) in EU27



The main ETS scenario yields negative GDP outcomes, resulting in lower GDP than in the baseline in all years from 2025 to 2030. The high non-ETS sector ETS price under the scenario increases the cost of transport and heating fuels, causing negative GDP impacts as households have less disposable income, and increasing prices in industries which face higher heating and transportation costs. This ultimately leads to a loss of competitiveness for affected firms.

However, when ETS revenues are recycled, the direction of impact switches; because the higher cost of emitting CO2 is compensated by revenues used for tax reductions and other supporting measures, meaning that the revenues ultimately end up back with consumers, who can spend them on goods and services across the economy. The 'rebound' effect in consumer spending, and ultimately GDP, leads also to upward pressure on the ETS price, as higher economic activity is forced to contend with a fixed emissions cap in both existing ETS sectors and current non-ETS sectors.

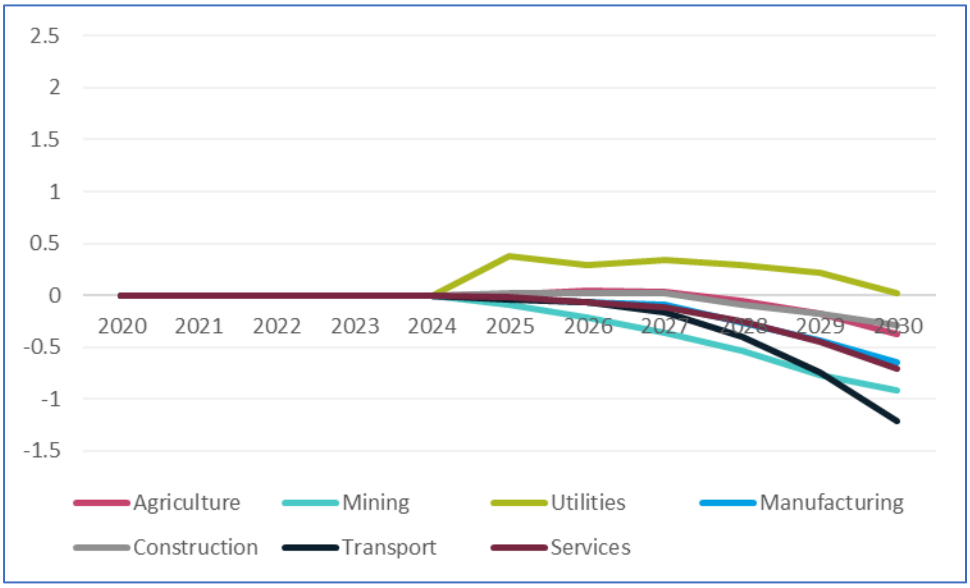
The dynamics are somewhat different when the revenues are recycled through measures supporting the take-up of low-carbon technologies. The revenues are used for investment in energy efficiency, and government procurement of low-carbon technologies to reduce their costs. This effectively reduces the costs to households of reducing their emissions, and therefore leads to more rapid take-up of these technologies. The ultimate impact is two-fold; economic outcomes are improved (relative to other uses of the revenues), since heating and transport costs are lower, and there is downward pressure on the non-ETS ETS price, as carbon emissions can be reduced more cheaply.

The largest positive GDP impact is found in the Policies scenario, 2% above baseline in 2030. Under this scenario, the target is met via a combination of regulations, subsidies and investment leading to GDP increases, driven primarily by i) low carbon technology costs decrease, leading to higher technology take-up, ii) household savings on energy bills and iii) higher investments (providing a form of economic stimulus).

The impacts on sectoral output

The main ETS scenario is expected to result in negative impacts across most sectors, resulting from higher prices, leading to a loss of competitiveness, and lower real consumer spending (since prices increase, consumers with the same income can afford to purchase less). The largest reductions in output (with no revenue recycling) is the transport sector, where the higher price, and depressed economic conditions, lead to lower demand. By contrast, the utilities sector will see small increases in output, linked to increased demand for electricity in the scenario.

Figure 4.2 Output by sectors in the ETS scenario (% difference from baseline) in EU27



When revenues are recycled, long-term negative impacts on output are restricted to the mining industry, as a result of lower demand for fossil fuels. However, the other sectors see increased output benefitting from higher consumer demand (and associated multiplier effects) as a result of the rebound effect from revenue recycling. The sensitivity where revenues are used for government procurement of low-carbon technologies and energy efficiency, show strong gains in the construction sector linked to the deployment of these measures.

Figure 4.3 Output by sectors in the ETS scenario, with RR via tax reduction (% difference from baseline) in EU27

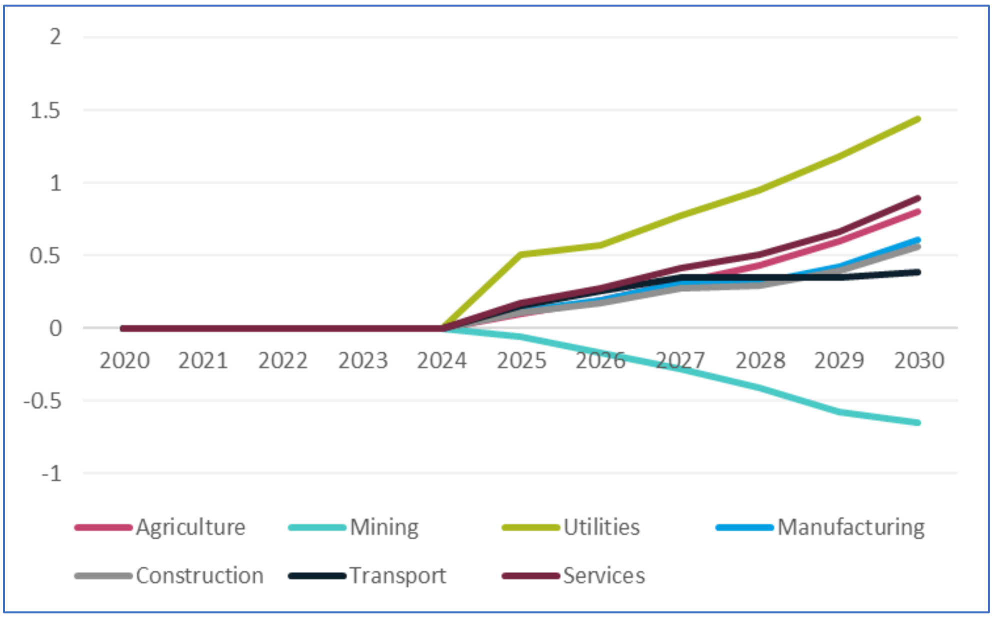


Figure 4.4 Output by sectors in the ETS scenario, with RR via investment and tax reduction (% difference from baseline) in EU27

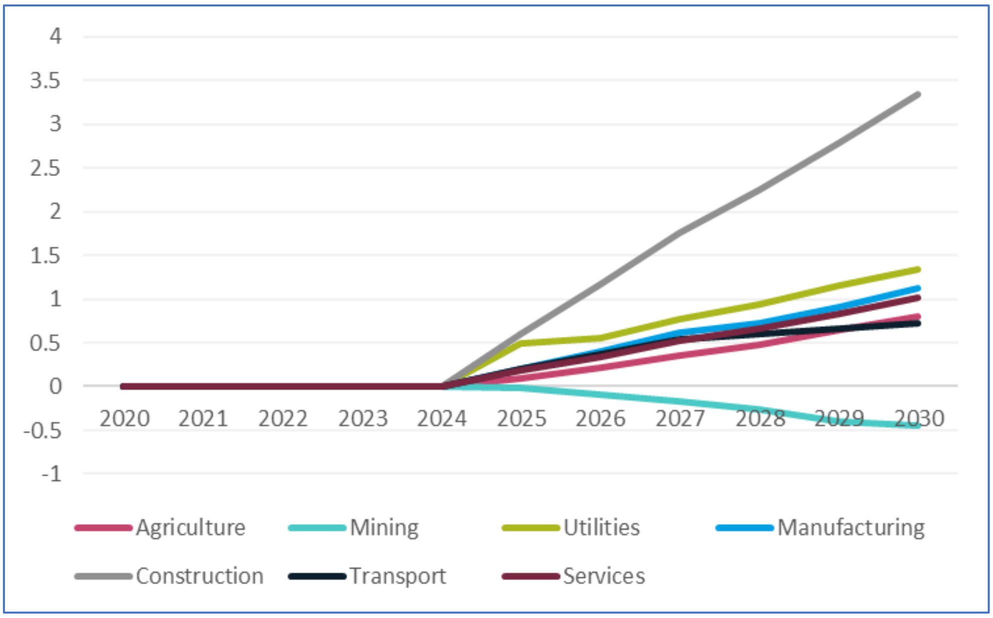
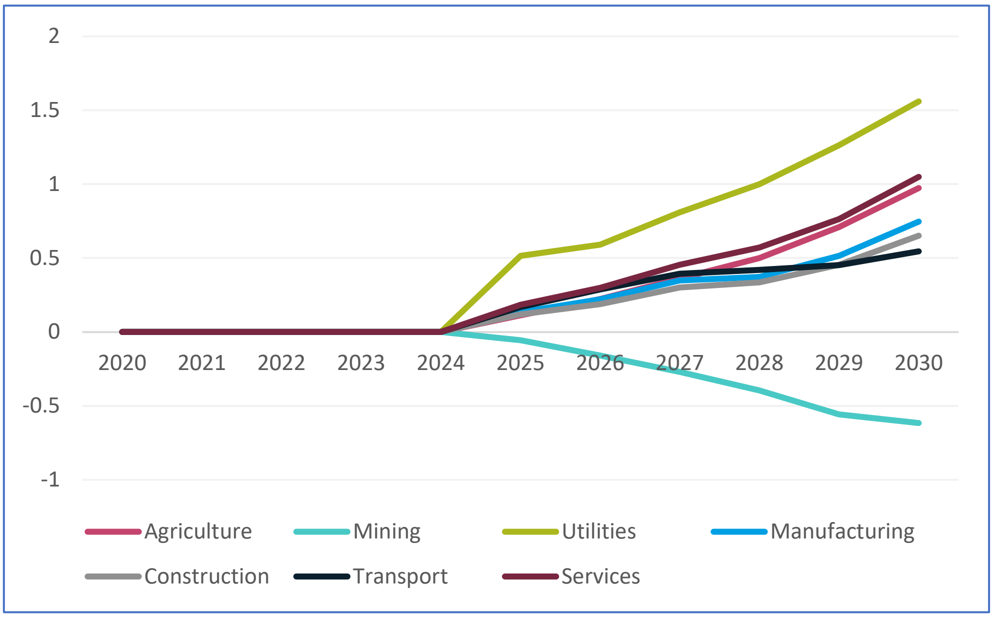
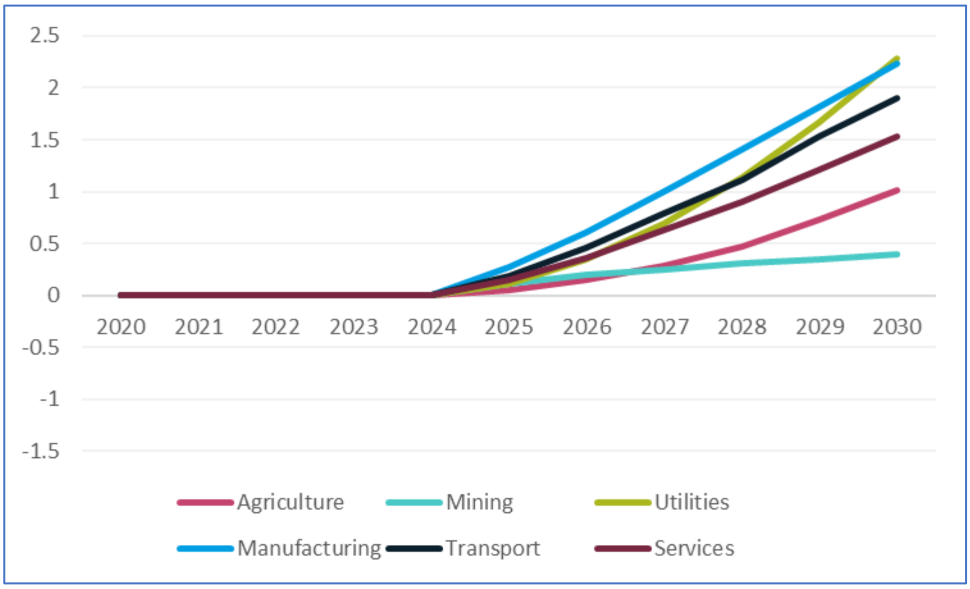


Figure 4.5 Output by sectors in the ETS scenario, with RR via tax reduction and lump sum payment (% difference from baseline) in EU27



In the Policies scenario, sectoral output increases for all sectors as all sectors benefit from additional investment, subsidies and higher technology adoption. The strong take-up of low-carbon technologies provides a strong boost to the manufacturing sector, while even the mining sector sees overall output increasing (although fuel extraction and supply output is falling, there is more extraction of other raw materials).

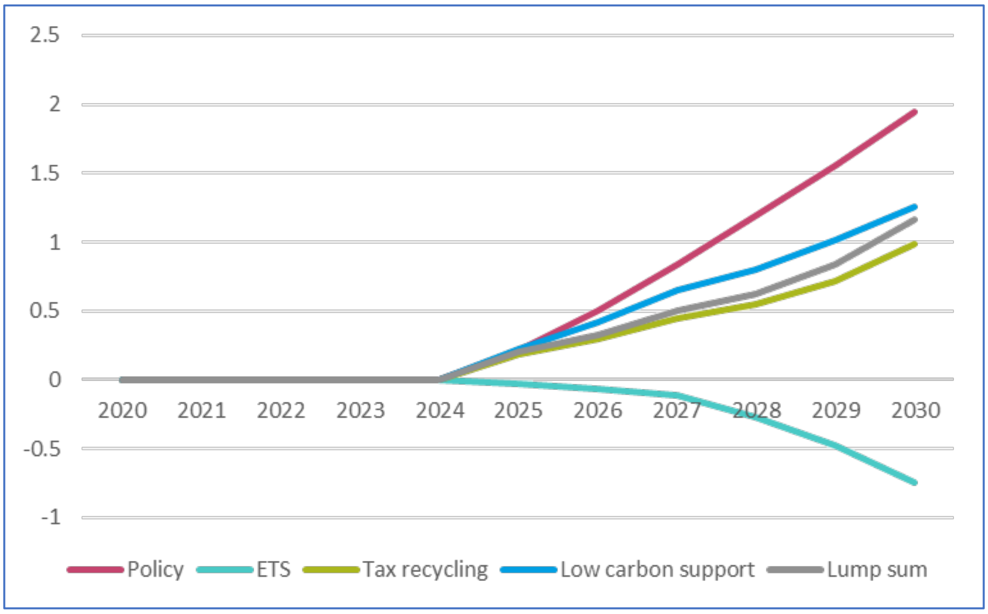
Figure 4.6 Output by sectors in the Policy Measures scenario (% difference from baseline) in EU27



4.2 The impacts on employment

At the EU27 level, total employment impacts largely mirror GDP impacts in both the ETS and the Policies scenarios. The main ETS scenario (no recycling) shows employment lower than in the baseline in 2030, by 0.3%. When ETS permit revenues are recycled, however, there are considerable employment gains, with the largest difference from baseline resulting from the R&D recycling option. The logic underpinning this is as outlined above for output; that lower costs for low-carbon technologies reduce costs for consumers and lead to better economic outcomes, ultimately increasing demand across the economy and leading to increased employment.

Figure 4.7 Total employment (% difference from baseline) in EU27



The impacts on sectoral employment

Key differences in the sectoral breakdown of employment outcomes, as compared to output, relate to one of two areas. The first is the changing nature of the jobs *within* each of the sectors. For example, across the scenarios employment outcomes for the utilities sector are much poorer than the output outcomes, and this is because in all of the scenarios, due to lower demand for fossil fuels, jobs are being lost in supply of these fuels, but are being gained in electricity generation and supply. Because jobs in electricity generation are higher productivity than the fossil fuel supply jobs, the higher output can in fact be met by fewer works across the sector as a whole, so employment falls.

The second factor which affects employment performance is the relative productivity of the different sectors. In employment terms, Construction gains the most jobs (in percentage terms) in most of the scenarios, whereas a number of sectors saw larger percentage increases in output in the same scenarios. However, because construction jobs are typically low productivity, a given increase in output will generate more jobs than the same increase in another sector where productivity is higher.

4.3 EU-wide distributional effects

The impact on households of achieving the emissions reductions in heating and road transport differs across scenarios and income levels. Based on our analysis, introducing an ETS for the non-ETS sectors, assuming the revenues are retained by national governments for paying down debt, will unfavourably impact all income groups (see Figure 4.8) with the largest impacts in the lowest income groups. Carbon pricing adversely affects lower income groups most severely because the additional cost represents a higher proportion of their income. In addition, they typically have a smaller demand response, i.e. they reduce their demand by less in response to price changes, because a greater proportion of their consumption is ‘essential’. They also face barriers to the take-up of low carbon technologies, including limited access to finance (to pay for the higher upfront costs of technologies), and residing in rented properties where owners have little incentive to invest in new technologies with higher up-front costs.

At the same time, revenue recycling can alter the impacts across income groups. In the ‘tax recycling’ sensitivity, real disposable income growth in 2030 is highest in the richer income groups, since these groups pay more taxes - in particular income taxes.

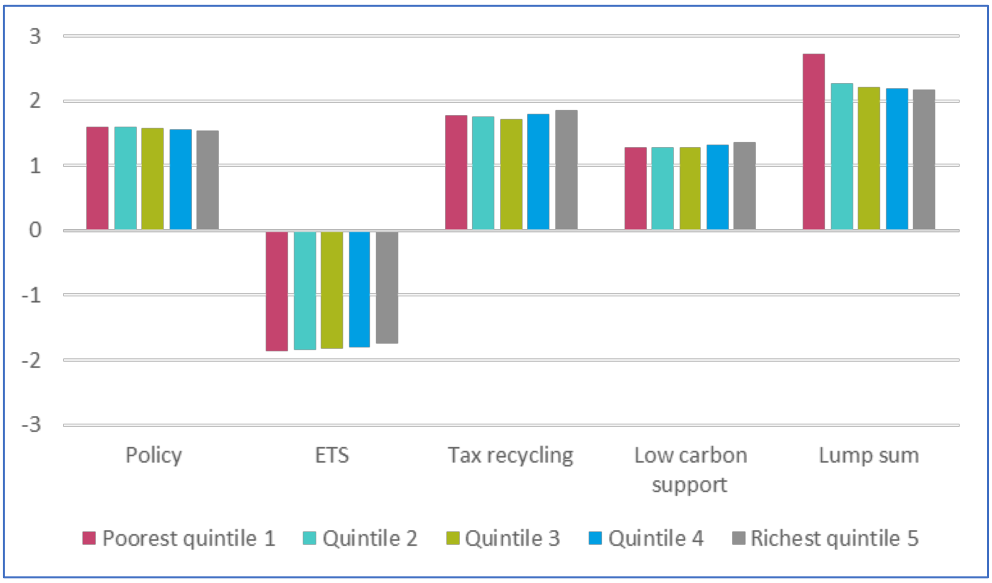
Similarly, if 25% of the revenues are recycled in the form of support for low carbon technologies and building efficiency investment, higher income groups benefit slightly more, as they still benefit from the 75% tax reductions. On the other hand, real disposable incomes are slightly less for all income groups.

In these two sensitivities, medium quintiles experience the least positive impact, explained by the fact that they spend more on transport then the poorest quintiles.

By contrast, in the ‘lump sum recycling’ scenario, the lowest income quintile benefits the most, as these transfers represent a larger proportion of their incomes.

In the Policy Measures scenario, benefits are similar across all income groups, as there are no major impacts on fuel prices. They all benefit from subsidies, investments and efficiency gains.

Figure 4.8 Real disposable income impact in 2030 in EU27, % difference from the baseline, 2030



5 Country impacts

In this chapter, we explain why and how the results are different in the selected country cases from the EU average. Essentially, the changes are likely to be driven by certain countries already having existing schemes for putting a price in carbon (e.g. the recently introduced German ETS).

UPDATE: Due to errors in price calculations, relative price changes have been overestimated in the original report published in 2021 May. In this 2022 February version, we are providing updated relative price increase estimates. However, please note that these estimates also take new announced legislation (FF55) into account in the baseline. Therefore, the updated estimates represent our expectations, considering the passing of the non-ETS2 FF55 measures.

The scenarios, by design, have the same level of emissions reduction achieved in both scenarios. The overall non-ETS EU-level target was set by the design, while the E3ME model leads to the road transport and building emissions pathways in the countries analysed, consistent with the overall target.

Table 5.1 Emissions reduction targets

E3ME result targets	Germany	Poland	France
Non-ETS sectors	-46%	-29%	-42%
Road transport	-50%	+4%	-37%
Buildings	-36%	-43%	-52%

Note: Targets are the result of E3ME modelling to reach the EU-27 non-ETS target

The main scenarios are expected to yield different distributional impacts with regards to household heating and road transport expenditure. The impacts on expenditure occur through two mechanisms; first, the price of carbon (through an ETS price) increases the costs of household heating and vehicle refuelling. Then, there is a demand response to the higher price. As a result, the final impact is a balance of change in cost and demand response. Since the Policies scenario by design does not influence neither the heating nor the road transport prices, its impact is not included in the distributional impacts analysis. While not modelled explicitly, it is key to note that the various sensitivities of the ETS scenario (with different forms of revenue recycling) are anticipated to yield positive benefits for the negatively impacted groups of carbon pricing through redistributing certain part of the revenues in one or the other form. This further underscores that getting the recycling right is also very important from a distributional perspective. The recycling can also benefit some quintile(s) more than others, as illustrated in chapter 4.3.

5.1 Germany

Germany is expected to achieve greater emissions reductions than the EU average. This is primarily linked to their relatively high level of household income, which means that they are (on average) less financially constrained in terms of the take-up of more expensive low carbon technologies.

At the same time, there are structural factors which influence the overall level of impact. The German population drives more than the average EU citizen, as a cultural difference, meaning that greater changes in emissions can be achieved from influencing behaviour in the transport sector – through both demand reduction and shifting to low-carbon technologies.

The ETS also poses risks to the German economy; there is a large motor vehicle industry, which could be adversely affected by lower demand for passenger cars across Europe, as well as the shift to electric vehicles. However, due to the larger emissions reductions seen in the country, an ETS would also accrue substantial revenues; the redistribution of these gives the potential for substantial economic benefits, if well targeted and not creamed off by a European redistribution scheme.

A key uncertainty is in the interaction of an EU-wide parallel ETS with the domestic ETS recently established in Germany.

5.1.1 Emissions reductions in the non-ETS sectors

Current commitments under the Effort Sharing Regulation

In January 2021, Germany introduced a separate German ETS covering the use of fuels across the economy, including in the transport and heating sectors, as a means of supporting them in complying with their effort-sharing targets[9]. The system currently works with a price ceiling of €25/tonne of CO_2 and is expected to rise to €55/tonne by 2025. From 2026 onwards, allowances are planned to be auctioned within a price corridor (of €55-€65)[10], which practically means there would be no 'hard cap' on emissions. If prices reach the upper level of the price corridor, the foreseen emissions cap will be loosened and the climate target will be missed. Germany would then compensate by buying emission reductions from another Member State. Supporting measures are outlined in the Climate Protection Program 2030[11] to ensure existing ESR targets are met. These measures, however, will not be sufficient to achieve the new European climate targets or the new national sectoral targets which resulted from a recent reform of the German Climate Law.

A key uncertainty in the analysis is the substitutability between the domestic ETS and the parallel European system modelled here. Our analysis assumes that the Europe-wide system is in addition to the domestic one; the domestic system is required to ensure that Germany achieves its current target under the Effort Sharing Regulation, and the EU-level ETS drives the further change

[9] https://www.transportenvironment.org/sites/te/files/publications/2021_04_TE_Briefing_Why_increasing_ambition_in_ESR_is_unavoidable.pdf

[10] Bruegel (2021) A whole-economy carbon price for Europe and how to get there

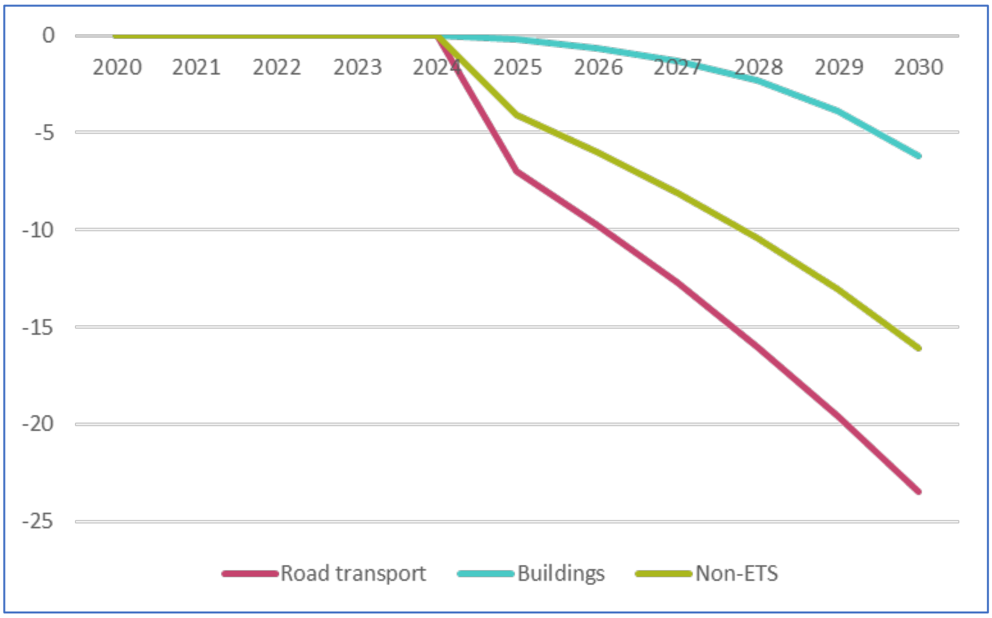
[11] https://www.bundesregierung.de/resource/blob/975226/1679914/e01d6bd855f09bf05cf7498e06d0a3ff/2019-10-09-klima-massnahmen-data.pdf?download=1

required to achieve the higher emissions reductions in our scenarios. If the European system was a substitute for the domestic German ETS, i.e. the German system was removed upon the introduction of the European scheme, emissions reductions and economic impacts in Germany would be smaller than those discussed below, though still following the same trend.

Increased ambition under the modelled scenarios

The emission reduction is expected to be substantially larger in the German road transport sector (~23% difference from the German NECP baseline[12] by 2030) than in the EU-27 on average (~12% difference by 2030). In turn, heating emissions are expected to fall by more than the European average in terms of difference from the baseline case by 2030 (6% compared to 8.5% in EU-27).

Figure 5.1 Carbon dioxide emission by fuel users - Germany (% difference from baseline)



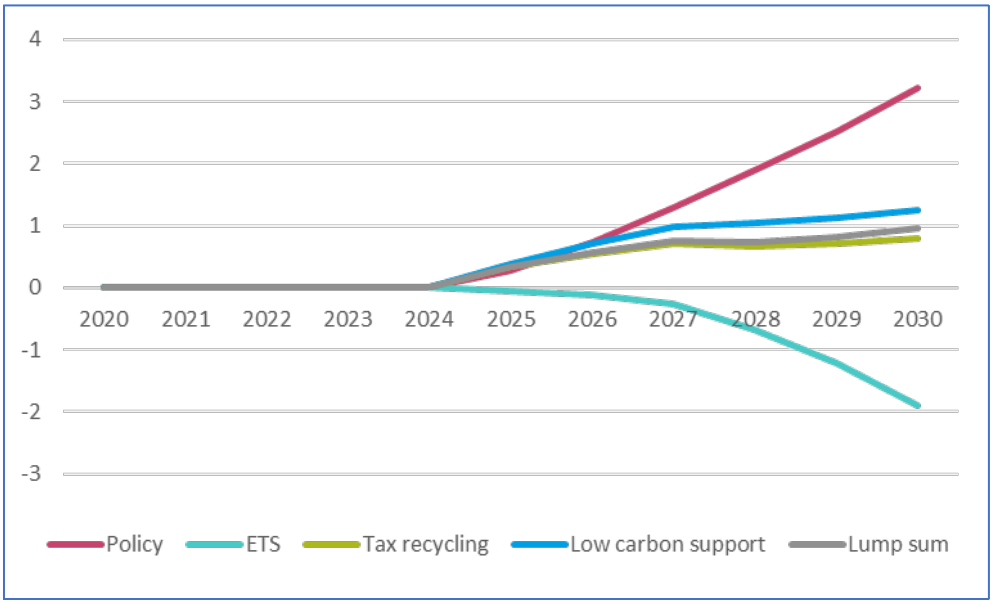
5.1.2 The economic impacts of larger emissions reductions in non-ETS sectors

Impacts on economic output

Germany is anticipated to see more pronounced GDP impacts under both the main ETS and the Policies scenario than the EU-average: the ETS scenario being associated with larger negative impacts (1.9% lower than the baseline by 2030 vs. 0.7% lower in the EU-27), the Policies scenario with larger positive impacts (3.2% higher than the baseline by 2030 vs. 1.9% higher than the baseline in the EU-27). The modelled sensitivities (ETS with various revenue recycling options) yield slightly less positive GDP outcomes for Germany as for the European average: about one-third of the GDP growth of the Policies scenario.

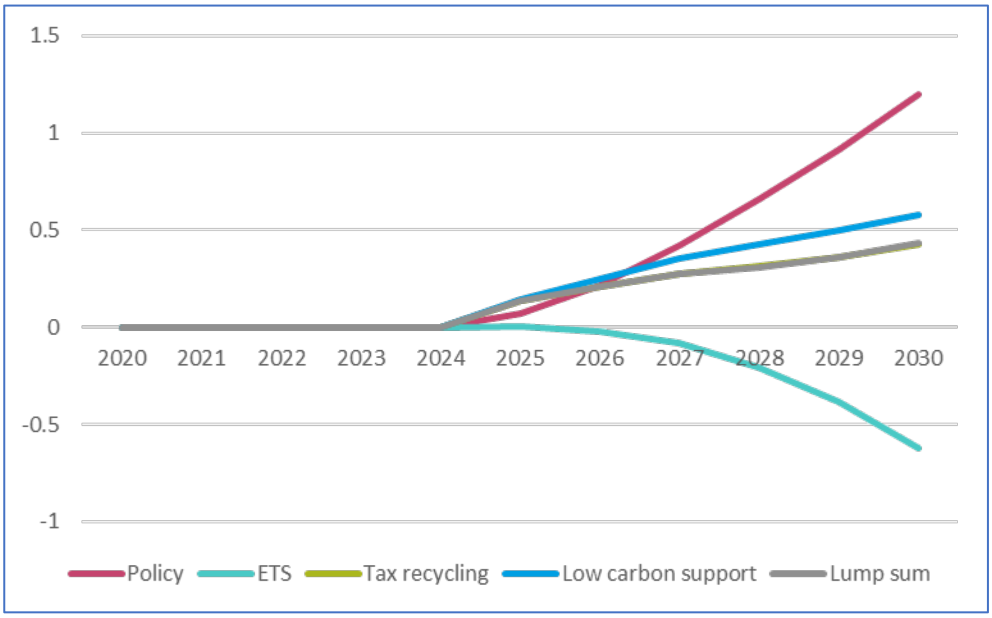
[12] Please see the section 2.1 describing the baseline we used for the modelling

Figure 5.2 GDP expenditure measure at market prices (% difference from baseline) in Germany



Impacts on employment

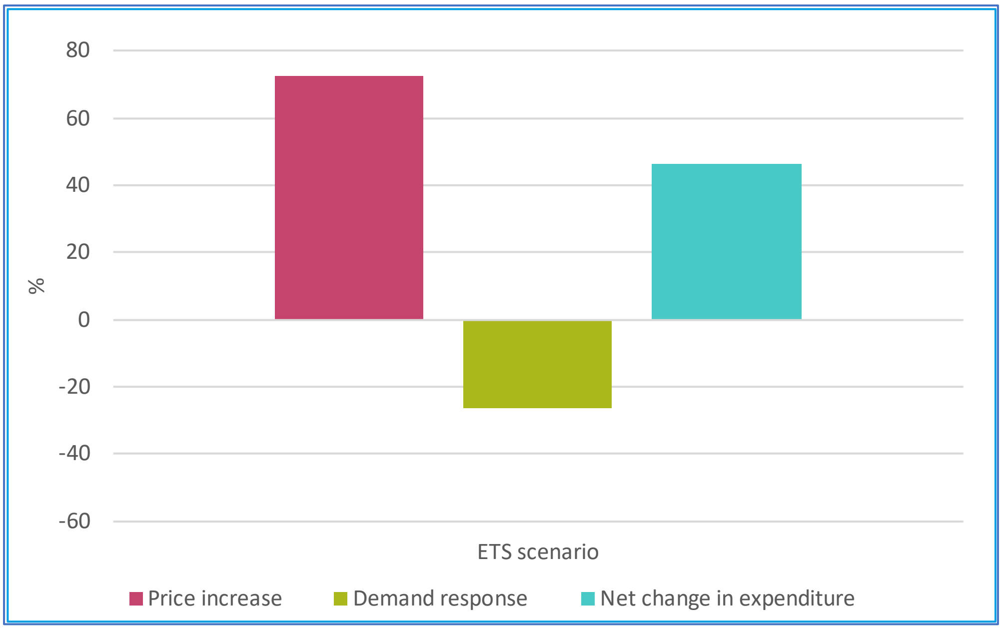
Figure 5.3 Total employment (% difference from baseline) in Germany



5.1.3 Distributional impacts

Looking first to impacts on household expenditure on heating: in the ETS scenario, the price of gas for household heating increases in 2030 by 73%; without a demand response, this would be the increase in household bills. Note that this price increase due to the introduction of an EU-wide ETS is modelled to come on top of the impacts associated with the existing national ETS. However, assuming a price elasticity of 0.21 and 0.31[13] taken from the literature for the 1st and the 2nd quartile of income groups respectively, demand reduces such that the total increase in household heating expenditure in the lowest-income quartile is reduced to 6% and to 36% in case of the 2nd income quartile (see Figure 5.4 and 5.5).

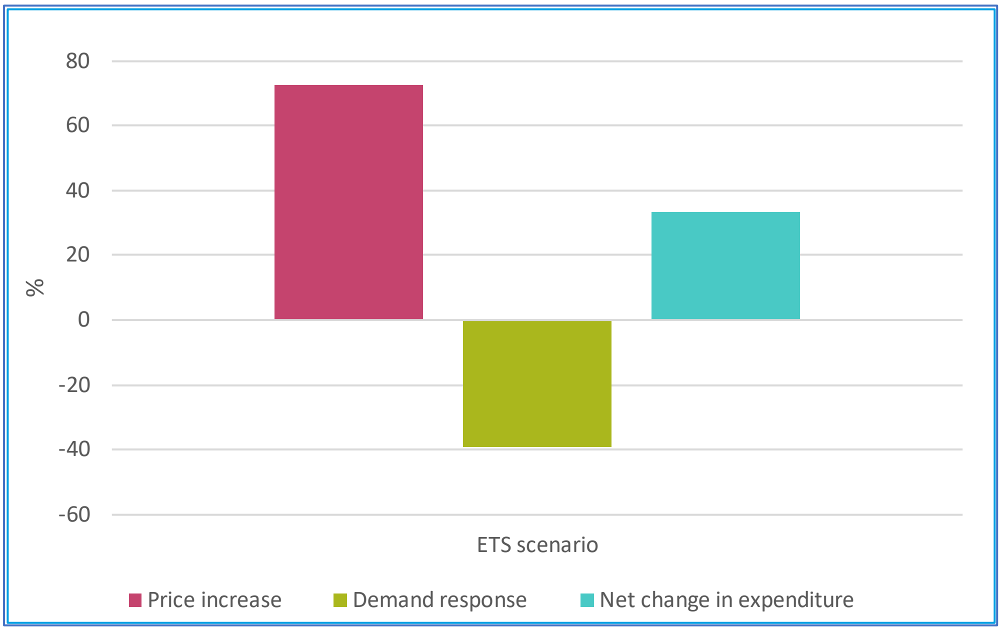
Figure 5.4 Decomposition of impacts on 1st income quartile households heating expenditure, % difference from baseline expenditure, Germany, 2030



The gap between the demand response of the income quartiles is due to the difference in the proportion of 'essential' use of heating. Ultimately there are minimal uses of heating which a typical household will require (e.g. during the coldest nights), and the price elasticity of consumers at this point is very low(i.e. there would have to be a very substantial price increase for them to forego this heating use, since the welfare impacts are likely to be substantial). In addition, any demand responses in these situations would lead to underheating, with associated social and health implications. Across different household income levels and types, the proportion of discretionary usage above this minimum differs, and therefore their overall sensitivity to price increases.

13 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/532539/Annex_D_Gas_price_elasticities.pdf

Figure 5.5 Decomposition of impacts on 2nd income quartile households heating expenditure, % difference from baseline expenditure, Germany, 2030



In our analysis of the road transport expenditures in Germany, we modelled a price elasticity of 0.3 and 0.42 to represent the lower income deciles[14] - taking elasticities applicable to the 1st and 2nd income quartile, respectively. In both income quartiles, the addition of an EU-wide ETS price (on top of the existing German ETS price) to diesel and petrol increases the costs of refuelling by an average of 20% in the ETS scenario. Taking the demand response into account, this results in a net increase in transport fuel expenditure of 13% in the 1st income quartile and 10% in the 2nd income quartile (see Figure 5.6 and Figure 5.7). The demand response of the 1st income quartile households is lower as their demand is less sensitive to price changes.

In all cases, this is explained through the proportion of use which is ‘essential’. The trips being taken by the lowest-income households will already be limited, and therefore a high portion of their trips will be for ‘essential’ purposes, such as commuting, which are difficult for households to reduce.

[14] From Schulte, I. and Heindl, P. (2016) Price and Income Elasticities of Residential Energy Demand in Germany. ZEW Discussion Paper No. 16-052.

Figure 5.6 Decomposition of impacts on 1st income quartile households road transport expenditure, % difference from baseline expenditure, Germany, 2030

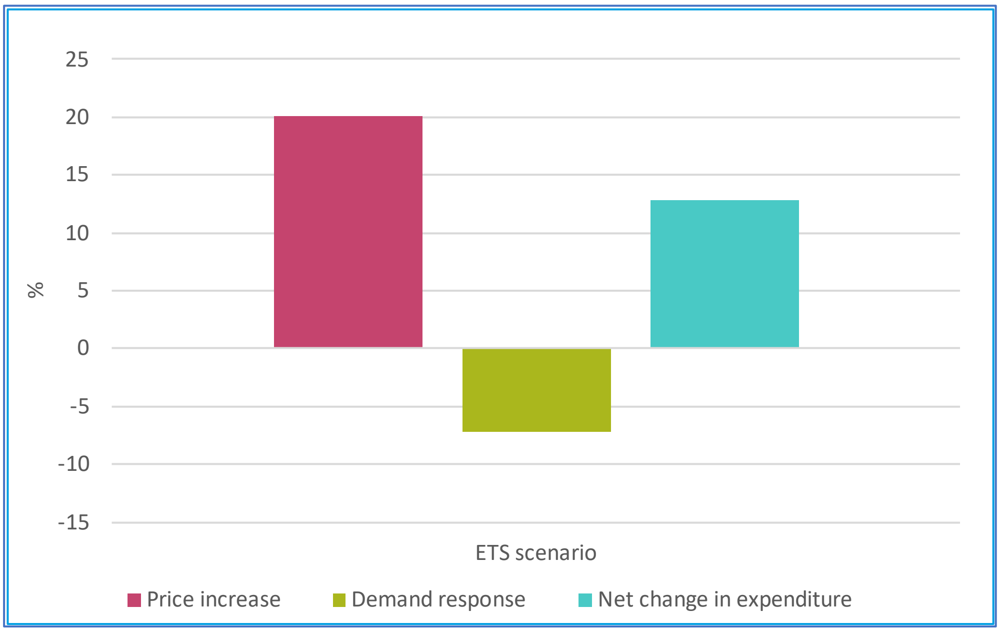
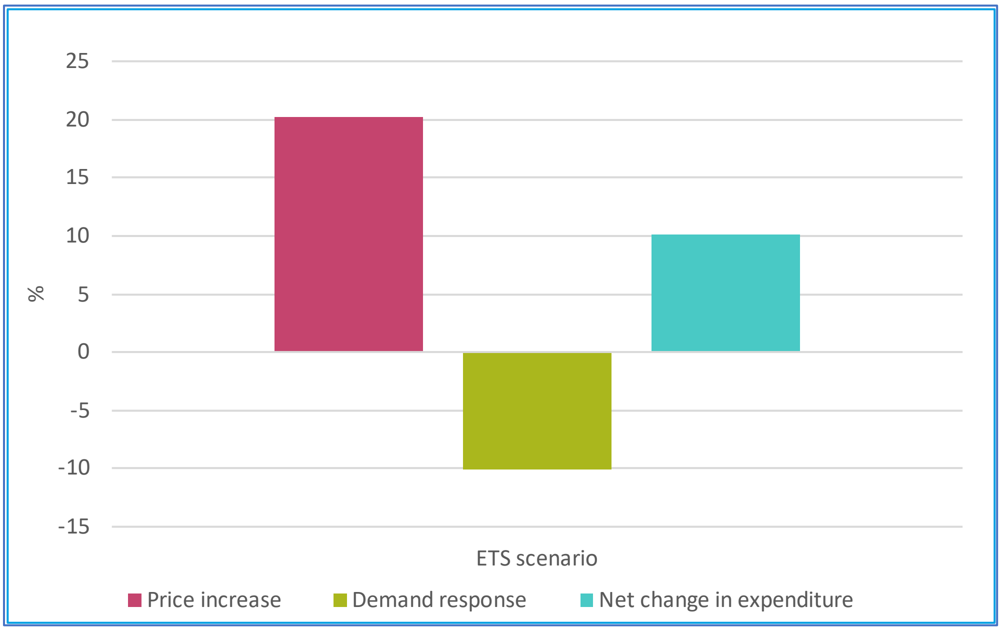


Figure 5.7 Decomposition of impacts on 2nd income quartile households road transport expenditure, % difference from baseline expenditure, Germany, 2030



5.2 Poland

Poland's greenhouse gas emissions decreased by less (13%) than the EU average (20%) since 1990. While since 2005 -the base year for ETS and non-ETS targets- emissions have stayed at the same level, as for most countries in the CEE region. Poland is a coal region, dependent on a high share of fossil fuels in its energy mix. Also, a less wealthy country so facing more challenges with its decarbonisation.

Heating systems in Poland are inefficient, and there are high costs of changing to better systems. Heat is relatively expensive and burning coal for heating is the main pollutant in most Polish cities. Furthermore, 17% of Polish population lives in energy poverty.[15]

As for transport, electromobility is high on the agenda, which would not only reduce emissions from this sector but could add to the country's competitiveness under the increased EU ambitions.

5.2.1 Emissions reductions in the non-ETS sectors

Current commitments under the Effort Sharing Regulation

Under the Effort Sharing Regulation, Poland currently has to reduce its non-ETS greenhouse gas emissions by 7% in 2030 vs 2005.[16] The Polish draft NECP for 2021-2030 describes some climate policies and measures to achieve this, mostly in the transport sector. Actions focusing on energy efficiency, the promotion of the use of less energy-intensive products as well as making heating cleaner and increasing traffic electrification could improve the country's emission reductions.

Increased ambition under the modelled scenarios

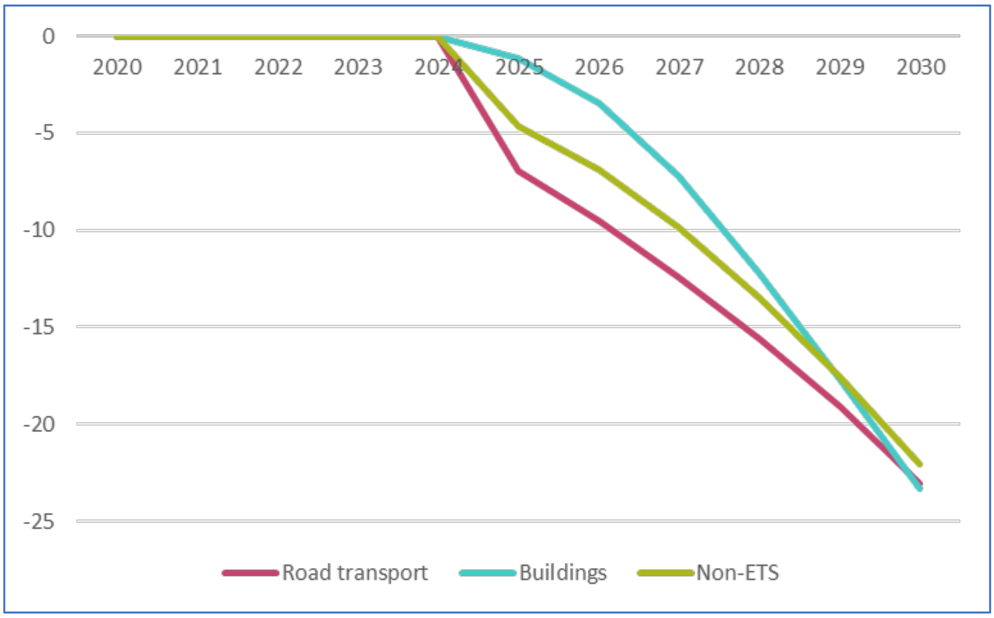
With the 'common but differentiated responsibilities' principle, the Polish emission cuts will not have to be -55%(-40% for the non-ETS sectors) under the new EU climate architecture. Our ETS scenario modelled that a -29%[17] cut in the non-ETS sectors is feasible for Poland compared to 2005, which translates into a 4% increase for the transport sector and -43% cut in the buildings sector. Note that this is a more substantial emissions target as Poland would likely get under the forthcoming revision of the Effort Sharing Regulation, even if the spread between countries is reduced.[18]

The chart below shows that Poland actually achieves the greatest emissions reductions compared to the EU average with the increased ambitions modelled compared to a baseline with no additional policies (but including all the plans in the current Polish NECP) and no carbon price for the road transport and buildings sectors. The emission reduction is expected to be

[15] https://www.energypoverty.eu/publication/its-cold-inside-energy-poverty-poland
[16] Regulation (EU) 2018/842 of the European Parliament and of the Council of 30 May 2018 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No 525/2013.
[17] Our modelling and how we derived at these targets are described in section 2.1
[18] This study shows the new PL target to be between -19% and -26%, depending on the spread between countries, https://www.stefanscheuer.eu/wp-content/uploads/2021/01/20210201-Synergies-between-ESR-EED.pdf)

similar for all non-ETS sectors (~23% difference from the baseline by 2030 compared to 14% for the EU-27).

Figure 5.8 Carbon dioxide emission by fuel users (000s tonnes carbon) - Poland (% difference from baseline)

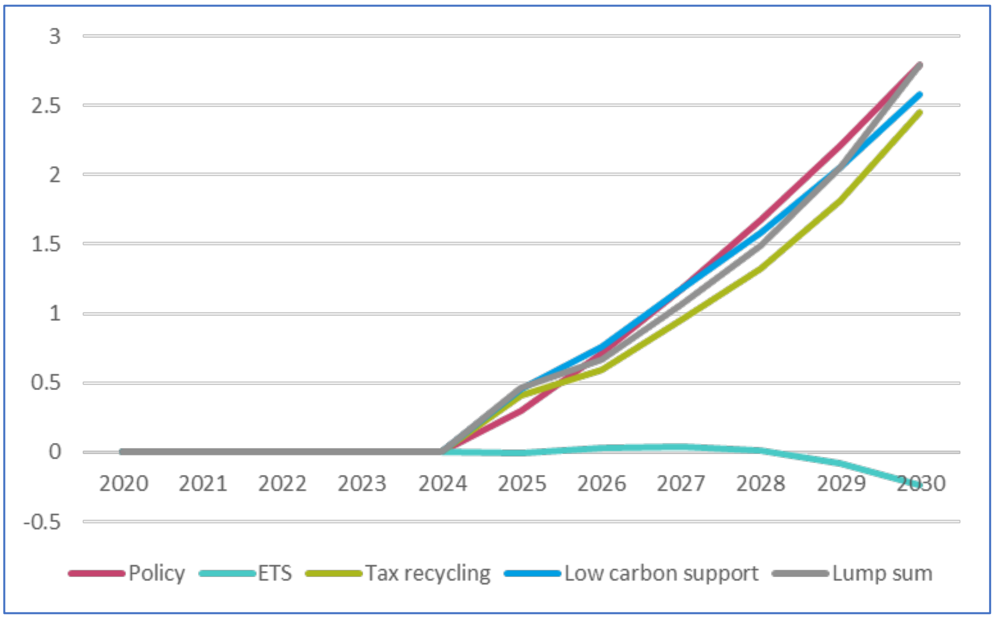


5.2.2 The economic impacts of larger emissions reductions in non-ETS sectors

Impacts on economic output

Poland is less negatively impacted by the main ETS scenario then the EU-average, with the GDP impacts of increasing ambition in the non-ETS sectors by 2030 being only 0.2% lower than the current NECP plans.. While as in all countries, the Policies scenario results in the most beneficial outcome for the Polish economy, the ETS scenario can come close to these impacts if the revenues are recycled 100% and in the most effective way possible. In reality revenues will be used in a variety of different ways. The positive economic impact of the policy measures scenario on the other hand does not rely on effective recycling of revenues.

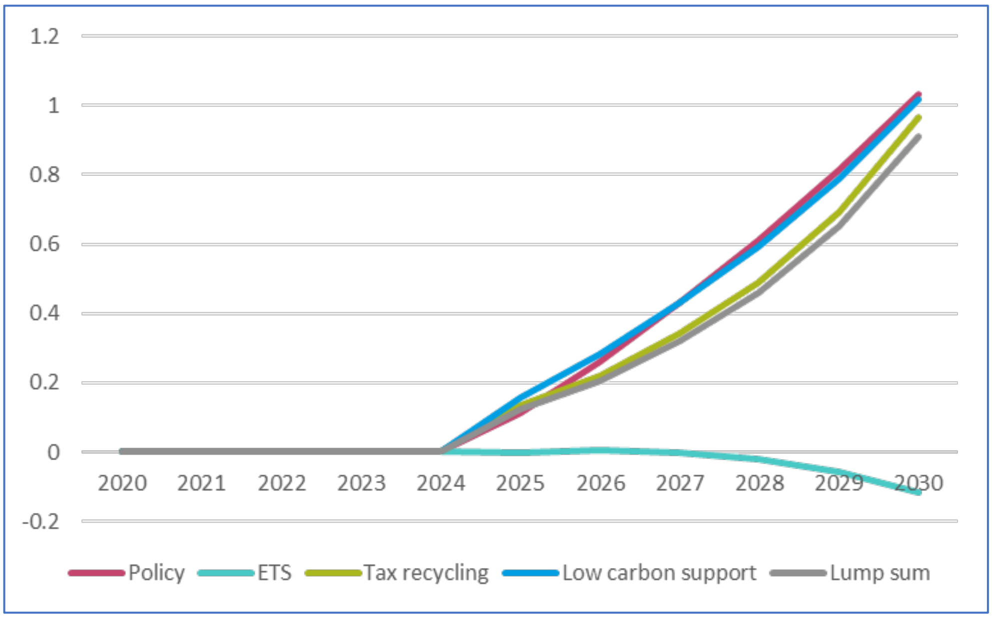
Figure 5.9 GDP expenditure measure at market prices (% difference from baseline) in Poland



Impacts on employment

Employment impacts are foreseen to show the same trajectory as for GDP under the analysed scenarios and sensitivities, with the largest employment gains in the Policies scenario and the low carbon recycling sensitivity driven primarily by the construction sector in both cases.

Figure 5.10 Total employment (% difference from baseline) in Poland

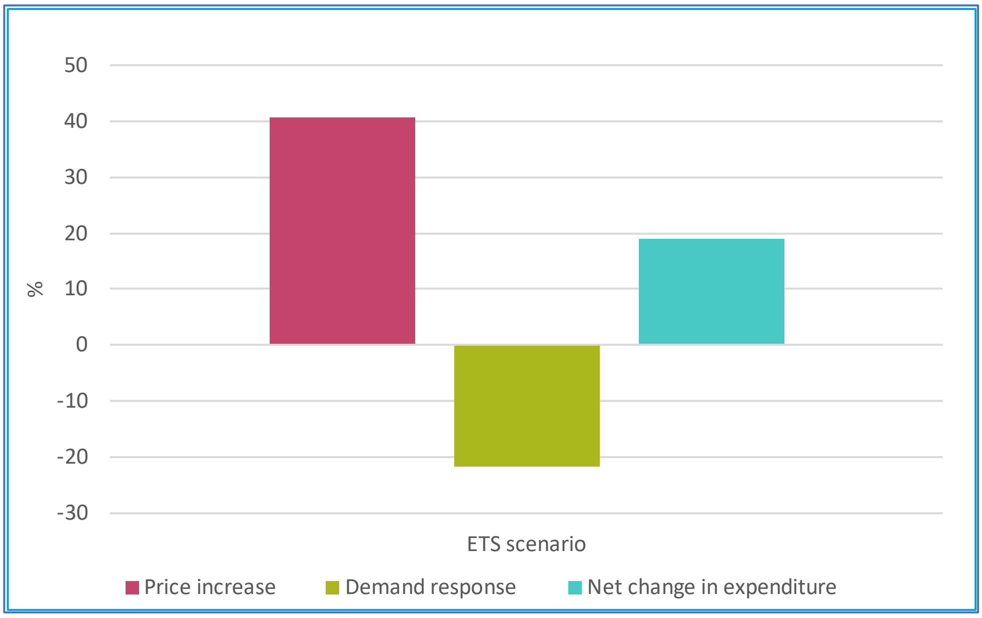


5.2.3 Distributional impacts

In the ETS scenario, both heating and road transport prices substantially increase. The price of household natural gas heating in Poland increases by 41% in 2030. The coal price increases for heating could be as high as 188%. As noted earlier, heating is already relatively expensive in Poland, therefore the relative price increase is lower than in most EU countries. Since the main energy source in Poland is not natural gas but coal, this analysis reveals that a transition towards gas heating from coal under an ETS would be costly. Moving towards cleaner energy sources with zero carbon emission is more beneficial as they are not affected by carbon pricing.

Assuming a price elasticity of 0.38[19], again taken from the literature, the two lower income quartiles reduce demand by over 21%, so the net impact is an increase on expenditure on heating of around 19% (see Figure 5.11).

Figure 5.11 Decomposition of impacts on low-income households heating expenditure, % difference from baseline expenditure, Poland, 2030

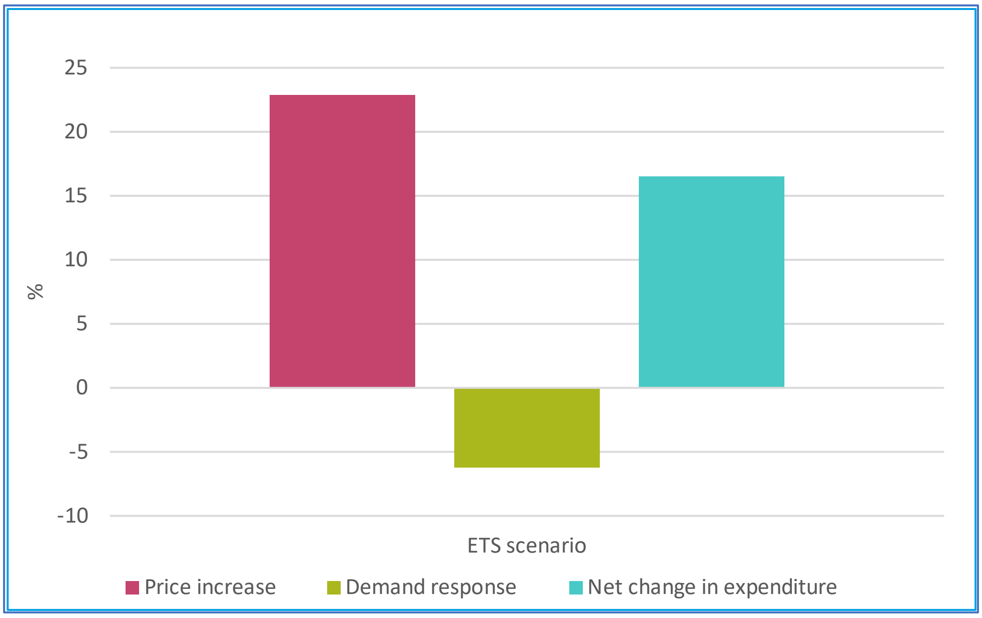


Regarding the road transport expenditure in Poland, we take a price elasticity of 0.23[20], an average elasticity that represents the whole population of the country. The addition of carbon pricing to diesel and petrol increases the costs of refuelling by an average of 23% in the ETS scenario. In response to the higher prices demand is expected to decrease by 6% leading to a 17% total increase in the lower income household expenditure linked to road transport (see Figure 5.12).

[19] From Borozan, D. (2019). Unveiling the heterogeneous effect of energy taxes and income on residential energy consumption. Energy policy, 129, 13-22.

[20] From Dahl, C. A. (2012). Measuring global gasoline and diesel price and income elasticities. Energy Policy, 41, 2-13.

Figure 5.12 Decomposition of impacts on low-income households road transport expenditure, % difference from baseline expenditure, Poland, 2030



5.3 France

Overall, in terms of GDP and employment outcomes, France is expected to see substantial positive impacts across all the investigated scenarios. With regards to emission reduction, on average it falls somewhat below the EU average reductions in the key fuel user non-ETS sectors.

5.3.1 Emissions reductions in the non-ETS sectors

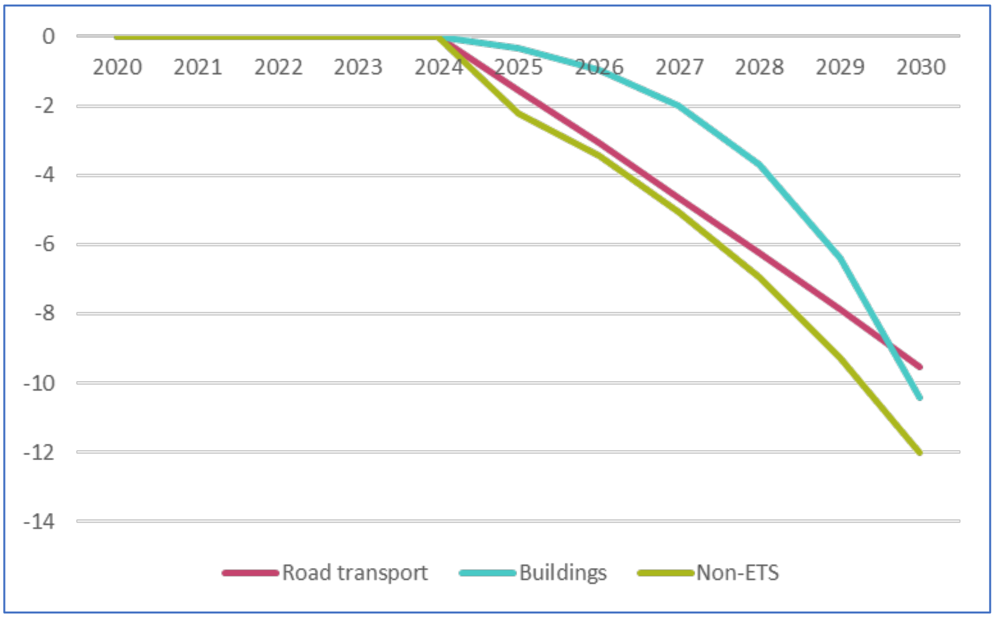
Current commitments under the Effort Sharing Regulation

In November 2018, France was faced with mass demonstrations dubbed the 'Yellow vests movement', motivated by rising fuel prices and a high cost of living. The issue on which the French movement centred at first was the projected 2019 increase in fuel taxes, particularly on diesel fuel. Therefore, higher fuel prices might lead to increased frustration and demonstrations again. Under our ETS scenario, France would however also accrue ETS revenues that can be used to balance the impacts when those are recycled. The difference between a national carbon price and the EU-wide ETS modelled in this study however would be that within an EU-wide system, part of the French revenues might be creamed off by a European redistribution scheme.

Increased ambition under the modelled scenarios

[21], which explains why the relative reduction by 2030, compared to the French NECP baseline[22], falls below the EU average.

Figure 5.13 Carbon dioxide emission by fuel users (000s tonnes carbon) - France (% difference from baseline)



[21] https://static.agora-energiewende.de/fileadmin/Projekte/2020/2020_07_Raising-EU-Ambition/185_A-AW-EU_Ambition_WEB.pdf

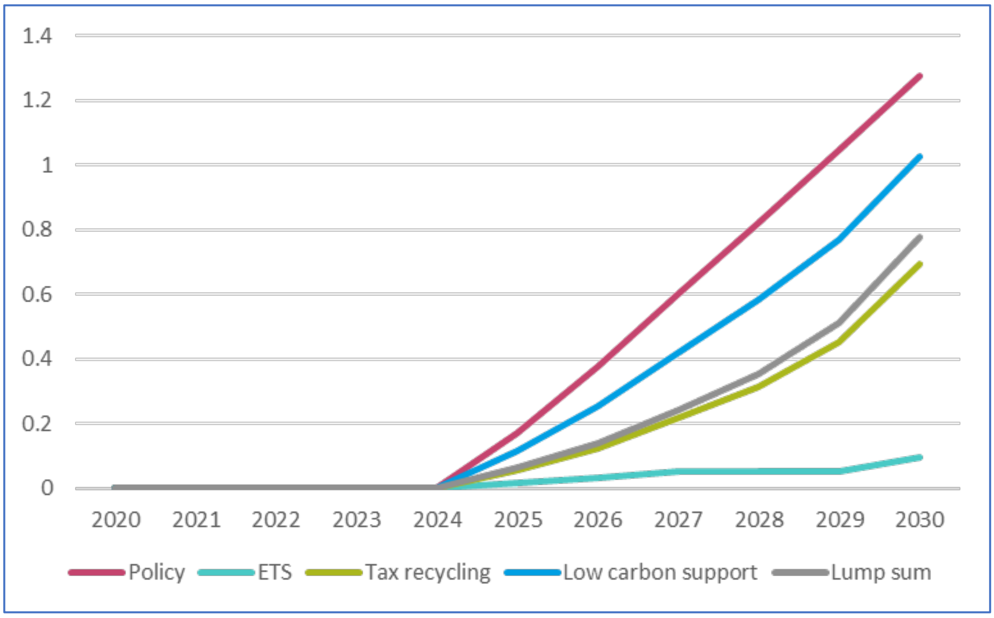
[22] [22] Our modelling and the baseline is described in section 2.1

5.3.2 The economic impacts of larger emissions reductions in non-ETS sectors

Impacts on economic output

The expected GDP outcome is positive for France under each of the assessed scenarios; even the ETS scenario yields slightly higher than baseline GDP impacts. At the same time, all scenarios yield relatively smaller positive impacts on the French economy than the EU-27 average. As in all countries, the Policies scenario has the most potential to improve the economy.

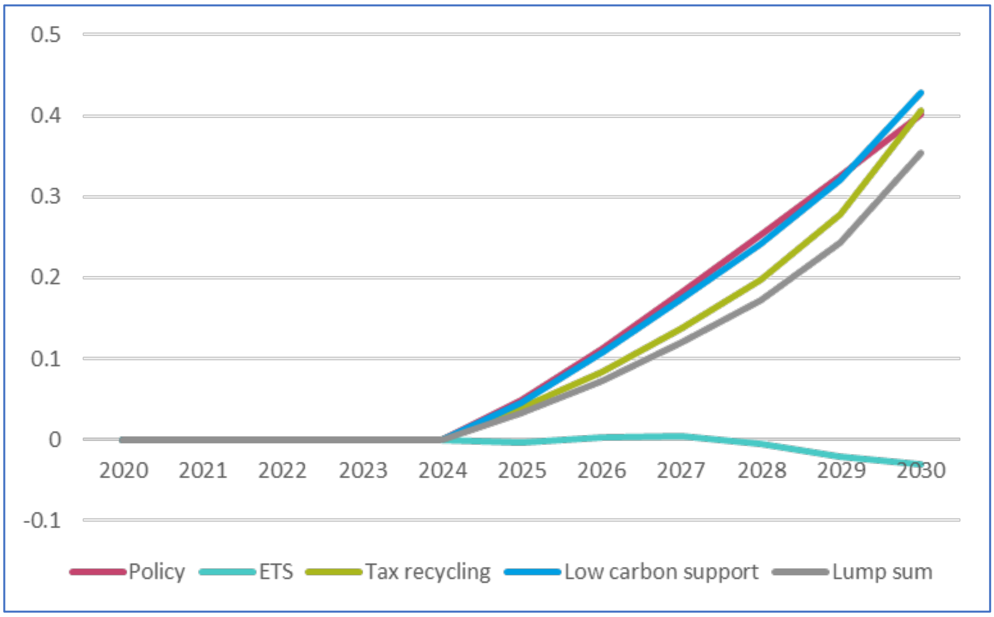
Figure 5.14 GDP expenditure measure at market prices (% difference from baseline) in France



Impacts on employment

Employment in France is expected to see the highest difference from the baseline case in the low-carbon technology support sensitivity (which yields similar results as the Policies scenario), closely followed by the other recycling options for ETS revenues. The lower-than-baseline employment results under the ETS scenario are driven primarily by a reallocation of activity away from low productivity sectors (notably construction) and towards other sectors, which results in lower employment across the economy as a whole even though total output is higher above baseline.

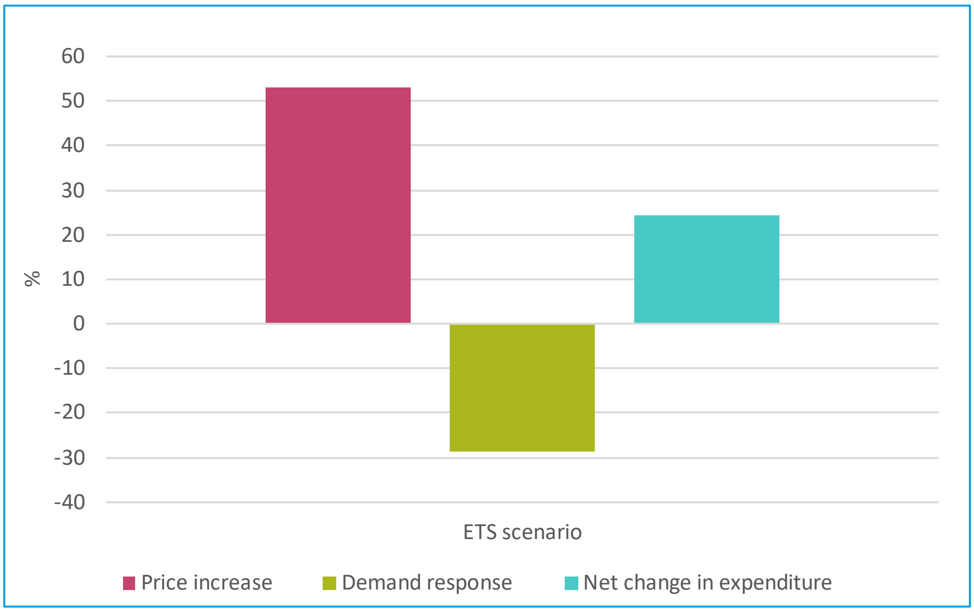
Figure 5.15 Total employment (% difference from baseline) in France



5.3.3 Distributional impacts

Addressing first the impacts of the ETS allowance prices on heating household expenditures, in 2030 the price of household gas heating in France is 53% higher compared to the baseline. While demand response to the higher price, considering an average price elasticity of 0.35 for the whole population[23], reduces expenditure by almost 29%, the net impact of carbon pricing on heating expenditure is 24% (see Figure 5.16).

Figure 5.16 Decomposition of impacts on low-income households heating expenditure, % difference from baseline expenditure, France, 2030

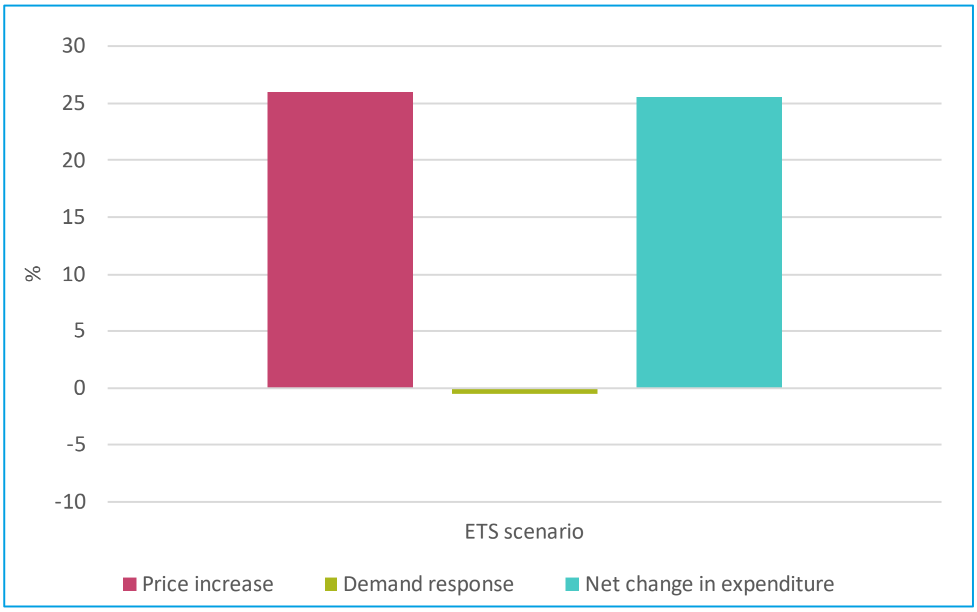


[23] From Berry, A. (2019). The distributional effects of a carbon tax and its impact on fuel poverty: A microsimulation study in the French context. Energy Policy, 124, 81-94.

Then, we analyse the impacts on road transport expenditure in two income groups, in the 1st income decile and in the 3rd-5th income deciles. The distributional impacts in the ETS scenario differ across different household income levels and types. The trips being taken by the lowest-income households will already be limited, as a higher portion of their trips will be for 'essential' purposes, such as commuting. Therefore, the elasticity of the 1st income decile is considerably lower than the 3rd-5th income deciles'[24]. In our analysis we assume a price elasticity of 0.16 for the 1st income decile and an average price elasticity of 0.2 for the 3rd-5th income deciles.

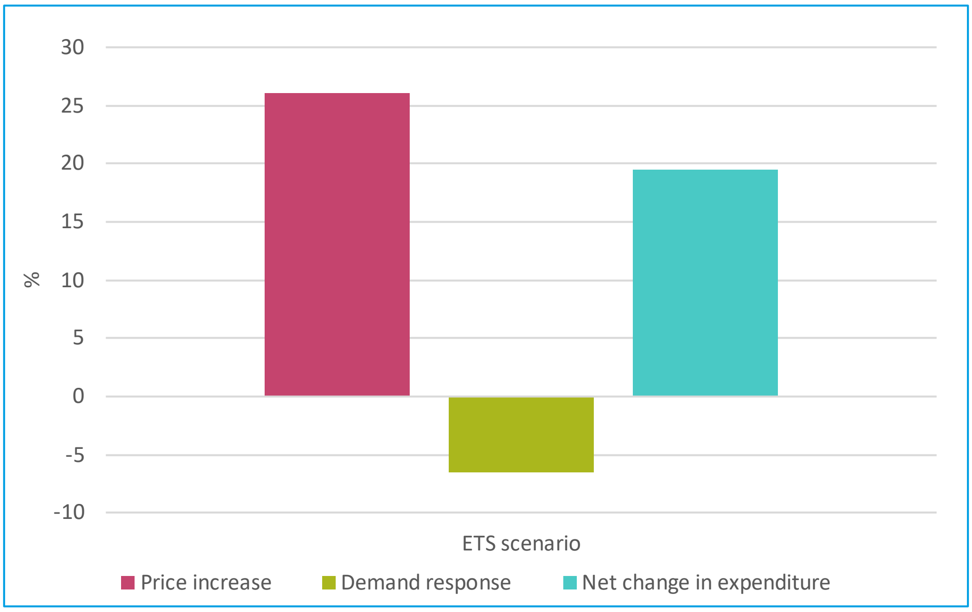
In both cases above, the costs of refuelling increases by 26%. The demand response of the 1st income decile is moderate, the reduction in demand is only 0.5%, thus the total increase in road transport expenditure in the lowest income decile is more than 25%. In the 3rd-5th income deciles demand reduces such that the net impact is an increase in transport fuel expenditure of almost 20% (see Figure 5.17 and Figure 5.18).

Figure 5.17 Decomposition of impacts on 1st income decile households road transport expenditure, % difference from baseline expenditure, France, 2030



[24] From Berry, A. (2019). The distributional effects of a carbon tax and its impact on fuel poverty: A microsimulation study in the French context. Energy Policy, 124, 81-94.

Figure 5.18 Decomposition of impacts on 3rd-5th income deciles households road transport expenditure, % difference from baseline expenditure, France, 2030



6 Conclusions

The analysis in this report highlights a number of key messages which are summarised below.

Raising ambition in the current non-ETS sectors to contribute to the agreed -55% economy-wide emissions reduction target can provide substantial benefits to the European economy, but the policy design and implementation is important; all paths are not equal.

GDP could be up to 2% higher across the EU by 2030 as a result of delivering a -40% reduction in emissions in non-ETS sectors, and employment could be around 0.7% higher – both compared to a baseline consistent with delivering the NECPs.

Introducing a mix of policies with a greater focus on regulation (and with no explicit pricing of carbon in the non-ETS sectors) delivers these economic benefits outlined above – through a combination of phase-outs of high carbon technologies, subsidies for low-carbon alternatives and measures to promote energy efficiency.

In contrast, creating a parallel ETS for current non-ETS sectors delivers smaller economic benefits for the European economy, but the outcome is heavily dependent upon how the revenues from the ETS are recycled. In addition, these revenue recycling options have implications for the resultant ETS price. Recycling revenues back to consumers -via tax reductions or lump sum transfers- leads to better economic outcomes, but also puts upwards pressure on ETS prices – in both the main and parallel ETS, as more economic activity is forced to conform to fixed emission caps. Conversely, using a portion of ETS revenues for public procurement of low carbon technologies and investment in energy efficiency reduces technology costs, and therefore makes the shift to low-carbon alternatives cheaper for consumers and industries, leading to lower costs in both the main and parallel ETS.

Without any revenue recycling, the parallel ETS has a negative impact on output measured through GDP and employment across Europe.

Without explicit mitigation, there are regressive distributional impacts from the introduction of a parallel ETS, as fuel consumption is typically a larger share of expenditure in low income households, while also, expenditure on heating is greatest in the lowest income bands. At the same time, technology turnover rates are also low in this sector as boilers have a longer operational lifetime than cars for example, and there are other barriers to take-up, such as the split incentives faced by landlords and tenants. In sum, increasing the cost of fossil fuel heating, without doing anything to increase the take-up and availability of low-carbon alternatives is likely to lead to poor outcomes for low income households.

Outcomes across the Member States from these policies vary, based on their economic structure and emissions/technology trajectories. For example, Poland sees the largest change in economic activity as a result of the policies introduced, as there is substantial opportunity for decarbonisation of their vehicle and heating stock. In the German case, a shift away from conventional combustion engine vehicles could lead to employment losses in the motor vehicle industry and supply chains, although if revenues are recycled into the economy then there remains the potential for substantive economic gains.