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Reference Details

CWPE	2152
Published	9 February 2024
Key Words	Climate policy, emissions trading, EU, net zero
JEL Codes	Q52, Q54, Q58
Website	www.econ.cam.ac.uk/cwpe

EPRG WORKING PAPER

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EPRG Working Paper 2119

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Contact gd396@cam.ac.uk
Publication July 2021
Financial Support This paper is based on the Centre on Regulation in Europe's report on *Feasibility and impacts of EU ETS scope extension: Road transport and buildings*. Financial support from the European Climate Foundation is acknowledged for the CERRE project.

Should the EU ETS be extended

to road transport and heating fuels?

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Abstract

This paper considers the current proposal to extend the EU ETS to cover CO_2 emissions from the combustion of heating and road transport fuels. We argue that increased coverage of the EU ETS, together with a binding cap consistent with a net zero trajectory, would be a powerful dynamic incentive to efficient emissions reduction. In addition, it would complement standards-based policies currently enacted in these sectors in several ways. Distributional implications remain a serious challenge to such an extension but several mechanisms are available to alleviate them.

1. Introduction

In December 2019, the European Commission (EC) set out its vision for a European Green Deal, detailing its objectives and providing an initial roadmap of the key policies and measures needed to achieve them (European Commission, 2019). This communication reset the Commission's commitment to tackling climate change and, specifically, to continue to reduce EU-wide emissions compared to 1990 levels and achieve no net emissions of greenhouse gases in 2050. It has since proposed to write this goal into law as part of its proposal for a European Climate Law (European Commission, 2020).

The European Climate Target Plan sets out a revised emissions reduction target for 2030 of 55% compared to 1990 levels. Achieving these additional emissions reduction targets will require a revision and strengthening of existing European Union (EU) and national climate policy instruments. It is in this context that an extension of the EU Emissions Trading System (ETS) to road transport and heating fuels is being considered. This would be an institutional adjustment of unprecedented scale in the lifetime of the mechanism as it would raise the coverage of EU GHG emissions to 74% (based on 2018 emissions), up from about 43%[1].

The inevitable increase in stringency of climate policy instruments (required to meet the target of the Paris Agreement) comes at a challenging time. First, it has become increasingly clear that the window of opportunity that would allow the EU (and the rest of the world) to remain within the bounds of a carbon budget compatible with the Paris Agreement (PA) is closing fast.[2] Second, the necessity of a rapid transition to a CO_2-free techno-economic system and the stated aim to do so comes when we face daunting economic conditions. It is therefore essential to design climate policies that (i) offer a credible and binding commitment to achieving the climate target, (ii) achieve it at least cost for society and (iii) adequately address the distributional consequences of the implemented policies.

The existing mix of climate policies implemented within the EU, which is comprised of (sometimes overlapping) national and EU level policies, needs to be strengthened with regard to each of these dimensions. First, attaining the revised EU targets will require cutting emissions on an unprecedented scale and speed in the history of EU climate policy.[3] There is currently no pan-European policy instrument able to ensure that the aggregate, EU-wide, target will be met. This undermines the credibility of the EU target, especially in light of the coordination challenge that aligning individual Member States' policies with the EU target might represent.

Second, the existing policy-mix induces inefficiencies raising the overall policy cost. At the EU level, inefficiencies arise mainly from (i) poorly targeted policies, (ii) lack of harmonization of incentives across countries and sectors[4], (iii) exclusive reliance on standards-based policies in some sectors.[5] A greater reliance on EU-wide carbon pricing, in addition to targeted complementary policies, could reduce the overall policy cost (Dimanchev and Knittel, 2020; Parry, 2020).

Third, the distributional consequences of the policies (price or non-price) implemented to achieve the EU climate objectives will be commensurate with the stringency of the objectives themselves. The scale and nature of existing mechanisms of redistribution between and within EU member states

[1] These figures are for EU-27 (i.e. excluding the UK) and are based on the 2018 EU GHG inventory data available from Eurostat (Eurostat, 2020a).
[2] Notwithstanding the potential deployment of carbon removal technologies at scale later in the century, which might allow this window to remain open for a little longer, the presence of tipping points in the Earth's climate system (Lenton, et al., 2008) means that there are significant benefits in reducing emissions today and avoid crossing GHG concentration thresholds that would irreversibly alter the Earth's climate.
[3]Since 1990, the EU has reduced its greenhouse gas emissions (GHG) at an average pace of 1% per year. By contrast, to achieve the 2030 target, the annual rate of reduction should reach about 4.3%.
[4] For instance, in virtually all EU member states (MSs), fossil fuels used for transport and heating are subject to excise and value added taxes. Significant variation in the tax rates across member states, and in the case of excise and value added taxes, across fuels, exists. Moreover, while high excise duties on (primarily road transportation) fuels have contributed to reductions in fuel consumption – and thereby in GHG emissions, their current levels and design make them poor proxy climate policy instruments (see Pollitt and Dolphin, 2020).
[5] Yet standards have a complementary role to play. The `climate issue` (i.e. excessive GHG emissions) is the result of multiple market failures (e.g. technology learning spillovers, consumer myopia) which are not all adequately addressed by a carbon price alone and which must be addressed before or in parallel to the GHG emissions externality.

are unlikely to be adequate to address the consequences of raised EU-wide emissions reduction objectives.

The objective of this paper is twofold. First, to highlight the value of an extension of the EU ETS to road transport and heating fuels with regard to the credibility of the EU climate target and the overall policy cost.[6] Second, to highlight the economic and distributional implications that such a policy change might have, alongside their political economy implications and possible mechanisms to alleviate them.

The remainder of this paper is organised as follows. Section 2 discusses the theoretical impacts of EU ETS extension and its role within the mix EU climate policies. Section 3 assesses what the price dynamics around implementation would be and the question of whether other policies would be undermined by EU ETS extension. Section 4 reviews the likely distributional effects of an extension, while Section 5 discusses how the political economy of an EU ETS extension might be managed in the light of these effects. Section 6 concludes.

2. Extending the EU ETS

2.1 Why: theoretical effects of an ETS extension

The extension of the EU ETS to road transport and heating fuels would lead to a number of improvements on the existing policy mix.

First, in the case of flow pollutants such as SO_2 or uniformly mixing stock pollutants such as GHGs, tradeable permit systems (or equivalent emissions tax or abatement subsidy) can help achieve any given emissions target at least cost. That is, pricing mechanisms are statically efficient (Montgomery D. , 1972). On the contrary, standards-based regulatory instruments may, but will not usually, be cost-efficient (Perman, Ma, Common, Maddison, & McGilvray, 2011; Schmalensee & Stavins, 2017). In theory, then, extending the scope of the EU ETS to these fuels would improve the cost efficiency of the system and reduce the cost of achieving a given emissions reduction target.[7]

Second, unlike the emission of pollutants creating short-lived and/or local externalities, the social cost of carbon emissions is the same across space (i.e. the localisation of the source)[8] which calls for homogenous policy intervention across economic sectors. As such, expanding the EU ETS to them would constitute the first occurrence of an EU-wide price-based instrument to reduce their GHG emissions in these sectors. It would create a more homogenous carbon pricing regime across countries and economic sectors of the EU ETS participating countries and reduce the potential for sectoral and geographical distortions arising from differentiated pricing.

Third, the price signal arising from the creation of a cap-and-trade system can be expected to have certain properties. First, it is expected to rise at the rate of interest on equivalent financial assets (Rubin, 1996). Second, it is expected to go down when new information emerges suggesting demand is lower than expected or the cost of compliance is lower, and vice versa. Third, prices will rise on expectations of increased policy commitment to targets and fall on expectations of reduced commitment (Fan, Jia, Wang, & Xu, 2017). Fourth, it is common to all participants and all countries, and all are faced with the same changes in price. This harmonisation of area wide price dynamics is in contrast with other policies which, as we have seen, exhibit wide variation in (implicit) carbon price movements across time and space.

[6] We are aware that there is currently consideration being given in the EU to a parallel emissions trading scheme for buildings and transport to sit alongside the existing EU ETS. We are not considering this option in this paper.
[7] Equalisation of marginal abatement cost of emissions across a larger set of sectors reduces total abatement cost (Montgomery W. , 1972; Öko-Institut and Agora Energiewende, 2020). It does, however, have distributional consequences.
[8] And across longer time frames, in the sense that it is keeping the global temperature down that matters, while local pollution varies in effects by the time of day it is emitted.

Fourth, it will provide further clarity as to the environmental effectiveness of the EU climate policy regime, i.e. whether, to what extent and in what timeframe CO_2 emissions reduction in these sectors will be achieved. This is especially important for many periphery EU countries. Standards and technology specific targets have been successful in promoting roll out and innovation, but less so in terms of adding up to the GHG budget constraint and in terms of promoting aggregate and relative policy efficiency. Monitoring, reporting and verification of the enforcement of standards has been a major issue in both the buildings and transport sectors.[9]

Fifth, this extension would indirectly shift pricing of the externality from inputs (excise taxes on fuels) to environmental outputs (EUA price on implied and calculated CO_2 emissions), which in itself present efficiency properties that taxes only indirectly targeting the source of the externality do not (Diamond & Mirrlees, 1971). Knittel & Sandler (2018) argue that fuel taxes that are not set based on the carbon content of fuels only partially correct the deadweight loss of the externality.

2.2 What role for an extended ETS in the EU climate policy mix?

In the EU context, an ETS extended to road transport and heating fuels would overlap with EU and individual member state (MS) standards-based policies which have so far been used to promote GHG emissions reduction in these sectors. In such case, the "value added" of the ETS would be delivered primarily by its role as a quantity-based backstop policy ensuring that the EU as a whole does not overshoot the combined 1.5-2C-compatible carbon budget of all sectors included in it.

Specifically, when combined with existing policies, a price signal arising from such a scheme will achieve this in two ways. First, it will provide incentives to stick to long-term commitments. An ETS whose lifetime credibly extends to 2050 would create a commitment device (Kydland & Prescott, 1977) incentivising the EU and MS to stick to long term commitments such as those enshrined in the CO_2 standards and EPBD. Indeed, the (short-term) price signal created within the ETS will reflect expectations about emissions reduction delivered by these standards-based policies. A rise in the price might indicate lower emissions reduction delivered by other policies and, given that (very) high explicit carbon prices are politically unpalatable (Bang, Victor, & Andresen, 2017), incentivise 'corrective' (i.e. more stringent) actions to meet long term commitments. Put differently, the presence of the EU ETS at the EU level might provide an incentive for the EU and MSs to be serious about complementary policies.[10] These properties and dynamics are self-adjusting and self-enforcing to a high degree. A system of national (excise or carbon) taxes would not guarantee any of these properties.

Second, the EU ETS could help deliver additional (and potentially less costly) emission reductions needed to meet the EU's 1.5-2C compatible carbon budget and not currently mandated by any of the existing policies or deliver emissions reduction instead of these policies, should they fail (European Environment Agency, 2020b). The net-zero emissions by 2050 objective could require an almost tripling of the EU-wide, cross-sectoral, mitigation efforts achieved between 1990-2018. Given that we are now reaching a point where large reductions in power sector emissions have been or will soon be achieved – in 2018, EU-28 CO_2 emissions from the power sector were 35% lower than in 1990 (European Environment Agency, 2020) – the relative mitigation effort required from ESD sectors will increase. In light of recent emissions trends in these sectors, this is a significant ask (European Environment Agency, 2020).

[9] Actual performance of both buildings and cars has involved significantly more emissions in practice than in theory (Fontaras, Zacharof, & Ciuffo, 2017; Triantafyllopoulos, et al., 2019). By contrast EU ETS type emissions monitoring has been much more straightforward because it can focus on upstream point sources of emissions (such as oil refinery deliveries and gas system injections).

[10] A good analogy would be with electrical equipment, where even though electricity is fully in the EU ETS, that has not led to any reduction in pressure to improved product standards in energy efficiency for electricity consuming appliances.

3. Price and market performance implications under current EU ETS design

Institutional adjustments (and market design choices) brought about by an extension of the EU ETS to transport and heating fuels can be expected to affect the ETS in at least two ways. First, through an impact on EUA price dynamics and how it reacts to new information. Second, through its interaction with existing policies.

3.1 Price dynamics and expectations

At any point in time, the price of a commodity in an intertemporal market will be driven by two conditions: an intertemporal arbitrage condition and a long-run market equilibrium condition (Borenstein, Bushnell, Wolak, & Zaragoza-Watkins, 2019). The first condition implies that the *expected* nominal price change over time is equal to the nominal interest rate (or cost of capital).[11] The second condition ensures that the price *level* will be determined by the condition that the resulting expected price path, rising at the nominal interest rate through the end of 2030 (or 2050), would in expectation equilibrate the total supply and demand for the commodity over the entire trading period.

This implies that the *expected* price of allowances is sensitive to (i) the market design choices that are made (e.g. total allowance cap, banking and borrowing rules)[12], (ii) complementary policies in place in these sectors (which affect 'non price-responsive' abatement), (iii) price elasticity of emissions in covered sectors; and that an extension of the EU ETS to road transport and heating fuels need not, in itself, lead to an increase in the price of EUAs.

Given car fleet turnover rates and the housing stock retrofit rate, prices might, in expectation, rise sharply if these sectors are sluggish to adjust to carbon pricing. Yet, empirically, this has not been the case, as the California CaT experience demonstrates. Either because of the presence of a price collar triggering the intake or release of allowances or, as noted by Borenstein, Bushnell, Wolak, & Zaragoza-Watkins (2019), due to the many "complementary" policies in place. As evidenced by modelling calibrated to the California economy, the presence of these policies does reduce the level of the expected equilibrium price of CaT allowances, when compared to scenarios with 'limited complementary policies' (Brattle, 2017). Borenstein et al. (2019) provide further empirical evidence and estimate a probability-weighted price of USD 50/tCO2e in 2030 in the California CaT.[13] Closer to home, the sectors in the EU ETS have overachieved their 2020 emissions reduction targets (albeit at a time of low demand growth), reducing emissions by almost 30% compared to 2005 (European Environment Agency, 2019). These experiences show that there is scope for positive (for the cost of climate policy) surprises which would lower allowance price and have positive welfare impacts.

In addition, in the EU ETS scheme out to and beyond 2030 there would only be a discontinuity in modelled price rises if there were anticipated to be borrowing from after 2030 to before 2030 in a situation where borrowing was not allowed, in which case real prices would rise to 2030 at the real rate of interest from a level consistent with exhausting all of the allowances issued out to 2030. Then the real price would fall between 2030 and 2031 (as borrowing became possible within the next phase) and rise again at the real rate of interest. However given the current surplus of permits it seems unlikely that borrowing will be optimal prior to 2030 in which case no discontinuity would occur. It seems entirely plausible – and to be recommended - that at the time of any agreed extension of the EU ETS to transport and buildings two things also happen in parallel: the extension

[11] With unlimited borrowing and banking, the price of an EUA should be equalized (in present value terms) across periods of time. A necessary condition for this to hold is that the markets for allowances at different points in time are competitive and well integrated, with a sufficient number of risk-neutral participants (Borenstein, Bushnell, Wolak, & Zaragoza-Watkins, 2019).

[12] EU ETS rules allow banking and borrowing. See Bocklet et al. (2019) and https://www.emissions-euets.com/borrowing

[13] It is important to note that a price of Euro 60/tCO2e (in 2020 money) in 2030 is consistent with Euro 36/tCO2e in 2021, as the emissions price of 2030 is linked to 2020 by the real rate of interest of say 6%. Hence care must be taken to properly index expected future prices back to the present day. For a discussion of the appropriate real interest rate to use in the EU ETS, see Lewis (2021).

of the EU ETS to 2050 and - hence - that banking and borrowing out to 2050 are allowed. This would smooth the price dynamics and ensure that there was not a sharp immediate rise in prices.

Finally, the introduction of new sectors might alter the way the EUA prices react to new information. For instance, the role of fossil fuel prices in determining prices in an ETS extended to road transport and heating fuels might be different than in an ETS limited to power and industry. This is because while there have been periods where prices of EUAs have moved in step with natural gas prices (as EUA prices have provided a link between coal and natural gas prices), this has not always been the case. Extension of the EU ETS would set up a potential EUA price linkage between the oil price and/or other low carbon fuels which have not been relevant for the electricity sector. In addition, climate policy ambition announcements have affected and will continue to affect EU ETS prices (see Lepone et al., 2011).

3.2 Interaction with other EU and national-level policies

A concern is that extension of the EU ETS will lead to a weakening of existing complementary environmental policies in road transport and buildings sectors. If this were to happen this might have the effect of pushing off emissions reduction into the longer term as allowed by the intertemporal nature of EU ETS.

This view sees the EU ETS and 'environmental standards' as substitute policies. Yet environmental standards for buildings and transport are about more than the GHG externality as they address local pollutants and customer myopia. As such, they also pre-date modern climate policies. Extension of the EU ETS may in fact strengthen the joint effect of standards and carbon pricing by enhancing efficiency incentives and focussing attention on how to target standards on environmental objectives which are not achieved by carbon pricing.

The potential for enhanced environmental effectiveness

The current Effort Sharing Regulation (EU, 2018) requires emissions reduction of 30% in the transport and buildings sectors, respectively, by 2030. While the overall cap in the ETS would be adjusted to reflect the overall emissions reduction objective agreed by the EC and Member States as well as the expanded scope of the System, placing the transport and buildings sectors within the scope of the ETS will de facto remove them from the scope of Effort Sharing Regulation and its associated emissions reduction targets. As a result, while the overall cap would be met, *when* the transport and heating sector start reducing emissions will depend on the cost of abatement options in these sectors relative to those in other sectors.

It seems unlikely however that fuel efficiency standards will be reduced given that these target other policy objectives such as local pollution and reduction in oil import dependence. In addition, none of the regulations in these sectors currently place a hard cap on their emissions. Passenger cars performance regulation reduce emissions per vehicle mile travelled (VMT) but are ineffective to cap overall road transport emissions if, as has been the case in several EU countries (Eurostat, 2020a), total VMT increases. Similarly, the Energy Performance in Buildings and Energy Efficiency Directives do not place a hard cap on actual total emissions.

The potential for enhanced economic efficiency

Throughout the existence of the ETS, a major concern of analysts has been the existence of other policies aiming at reducing GHG emissions in the sectors covered by the ETS and how their joint effectiveness can be enhanced. For instance, it has been well documented that the renewable electricity generation objectives mandated by the Renewable Energy Directive have put downward pressure on EUA prices and have undermined the efficiency of the ETS by displacing less costly abatement options (Fischer & Preonas, 2017). Renewable subsidies have proved valuable in promoting learning and attention to the relative cost-effectiveness of different renewable support schemes in reducing carbon emissions has led to a focussing of subsidies on renewables with the largest potential for cheaper emissions reduction (i.e. wind and solar) (see Newbery, 2018).

4. Channels of inequality: economic and distributional impacts

Pricing CO_2 emissions from road transport and heating fuels will have an immediate economic impact on the end-users of these fuels. Its magnitude will depend on (i) the size of the increase in retail fuel prices triggered by the newly imposed carbon price, which in turn depends on the level of pass through of carbon prices to fuel prices by fuel retailers (ii); (iii) it will be determined by the own price elasticity of demand for the fuels for different end-user categories.

4.1 Within country impacts

4.1.1 Impact of carbon pricing on the price of energy vectors

An extensive literature studies the relationship between (environmental) duties and retail fuel prices, both from a theoretical and empirical perspective. Unless the demand for a fuel is highly (perfectly) elastic, economic theory predicts that an increase in the price of the carbon content of a fuel will trigger a rise in its (retail) price.

Pass-through rate and fuel price elasticity of demand

There are few (*ex post*) empirical studies about the pass through of carbon prices per se to transport and heating fuels. This is mostly due to existing carbon pricing mechanisms not covering these fuels and those that do have done so only for relatively short periods of time. One exception is Andersson (2019), which finds evidence of full pass-through in the case of the Swedish carbon tax. There is, however, substantial evidence on the relationship between gasoline taxes and retail prices (for the US, see Marion and Muehlegger (2011); Davis and Kilian (2011); and Li, Linn, & Muehlegger (2014) ; for Europe, see Meyler (2009)). These studies find evidence of full pass-through.

With regard to own-price elasticity, estimates for transport and heating fuels vary significantly and there is substantial evidence that short-term price elasticity for transport (Hochman & Timilsina, 2017; Knittel & Tanaka, 2019) and heating (Labandeira et al., 2017) fuels is low, even though the long term elasticity is much higher (Sterner, 2007). However, there is evidence that the carbon tax elasticity of demand for gasoline is up to three times higher than the price elasticity (see Andersson, 2019; Li, Linn & Muehlegger, 2014). This suggests that consumers react more to changes in fuel duty rates (i.e. tax) than fuel prices.

Fuel price elasticity of demand across income quantiles

Carbon taxes (or equivalent cap-and-trade) are often thought to be regressive and, as such, more politically difficult to implement than, say, fuel efficiency standards. Several studies document this effect. In particular, several studies have shown this to be true for the UK (see references in Burke, et al., 2020) and other European countries (Sterner, 2012). A recent study by Eurelectric (2020) finds that, among the policies considered, carbon pricing presents the largest regressive impact. The main reasons for regressivity are (Burke, et al., 2020):

- Carbon-intensive spending as a share of income is higher for poorer households;
- Cost pass through and lower own price elasticity of demand for poorer households;
- The extent of fuel poverty.

However, three observations should be noted. First, it is not clear that fuel efficiency standards are progressive in all circumstances given that they do raise overall compliance costs and, in the transport sector, effect second hand car prices. The issue here being that higher new car prices reduce new car sales and cause higher prices of second hand cars and longer use of older (less energy efficient) vehicles[14].

Second, carbon taxes or cap-and-trade programs can be designed to alleviate their regressive effects (e.g. through uniform transfers, see section 5.1.3) (Davis & Knittel, 2019). This is because, unlike standards, they also raise revenue and the revenue can be used to turn the overall policy progressive.

Third, at the sectoral level, the picture is more nuanced. In the transport sector, Burke et al. (2020) finds that a carbon tax in the UK is progressive, as the share of income spent on transport increases with income.[15] Transport energy taxes can still have negative distributional implications *within* income groups (horizontally), even if they are progressive *between* income groups (vertically). For example, significant variation has been found within income octiles in Sweden (Eliasson et al., 2016).

The tax on heating fuel is the most regressive, relative to transport. For instance, evidence for Germany suggests that heat and transport are both necessities but that the mean expenditure (long-term) elasticity is lower for heating than for transport (Schulte & Heindl, 2017). In addition, both expenditure and price elasticities rise with expenditure level (in absolute value), with the elasticity values in transport strictly above those in heating for each of the expenditure level quantiles considered. The observation on expenditure elasticities implies that heating fuel expenditures as a share of total expenditures are more homogeneous across expenditure levels than road fuel expenditures. The observation on price elasticities indicates that a given increase in the price of fuel would induce less adjustment in heating fuel consumption than in transport fuel consumption. Taken together, it points to a more regressive impact of carbon pricing on heating fuels than on road transport fuels. These observed long-term price and expenditure elasticities seem to have remained relatively stable since the late 1970s, at least in the UK (Fouquet, 2014).

4.2 Between country impacts

Due to differences in the technological and compositional structure of European economies, the sectors to which the ETS would be extended do not represent the same share of total GHG emissions across countries. This, in turn, would lead to different increases in the economy-wide average prices across MSs and result in heterogeneous economic impacts across the continent. Table 2-2**Error! Reference source not found.** shows this for the EU-27 and a number of selected countries, given current EUA price.[16]

Table 4-1 ETS coverage (share of total country GHG emissions) and average CO_2 price, by sector

	Current ETS scope	***GHG emissions – sectoral shares of total 2018 CO_2 emissions***			**Extended ETS scope - 2018 CO_2 emissions**
		Road transport	*Residential Heating*	*Commercial Heating*	
EU-27	43% - 17.96 EUR/tCO₂e	20% - 8.41 EUR/tCO₂e	8% - 3.3 EUR/tCO₂e	3.5% - 1.49 EUR/tCO₂e	74.1% - 31.16 EUR/tCO₂e
France	25.4% - 10.62 EUR/tCO₂e	26.6% - 11.22 EUR/tCO₂e	9% - 3.79 EUR/tCO₂e	6.1% - 2.56 EUR/tCO₂e	67.1% - 28.19 EUR/tCO₂e
Germany	52% - 21.79 EUR/tCO₂e	17.5% - 7.39 EUR/tCO₂e	9.3% - 3.92 EUR/tCO₂e	3.6% - 1.52 EUR/tCO₂e	82.4% - 34.62 EUR/tCO₂e

[14] See Berkovec (1985) for a discussion of car market dynamics.
[15] Burke, et al. (2020), p.10, note that "households in the highest income decile emit seven to eight times the amount that the lowest income decile emits (poorer households are less likely to own a car)". See also references therein. In addition, in the UK in 2018 only 35% of households in the lowest income decile own a car, while it is 93% in the highest income decile (see ONS, 2019, Table A47). For the top decile, 26% own 3 cars.
[16] The countries presented in this paper were selected based on their importance with regard to two dimensions: 2018 GHG emissions and 2018 GDP (chain linked volumes, at market prices), both as share of total EU-27 total. Together, these countries represent 70% of EU-27 emissions and 73% of EU-27 GDP (Eurostat, 2020a, 2020b).

Italy	36.5% - 15.36 EUR/tCO2e	21.8% - 9.19 EUR/tCO2e	10.5% - 4.43 EUR/tCO2e	5.6% - 2.38 EUR/tCO2e	74.4% - 31.35 EUR/tCO2e
Poland	50.8% - 21.34 EUR/tCO2e	15.2% - 6.39 EUR/tCO2e	8.5% - 3.56 EUR/tCO2e	1.7% - 0.7 EUR/tCO2e	76.1% - 31.99 EUR/tCO2e
Romania	39% - 16.33 EUR/tCO2e	15.1% - 6.36 EUR/tCO2e	5.8% - 2.45 EUR/tCO2e	1.9% - 0.8 EUR/tCO2e	61.8 - 25.93 EUR/tCO2e
Spain	39.6% - 16.62 EUR/tCO2e	23.5% - 9.89 EUR/tCO2e	3.5% - 1.49 EUR/tCO2e	4.2% - 1.76 EUR/tCO2e	70.8% - 29.76 EUR/tCO2e
Sweden	40.5% - 16.97 EUR/tCO2e	27.2% - 11.44 EUR/tCO2e	0.9% - 0.36 EUR/tCO2e	1.3% - 0.54 EUR/tCO2e	69.7% - 29.31 EUR/tCO2e

Source: Authors' calculations based on EU GHG emissions inventory available from Eurostat (2020a) and the EUA price of EUR 42.13/tCO2e, as of 31/03/2021 (from https://ember-climate.org/carbon-price-viewer/). Emissions shares are as of total emissions excluding LULUCF and memo items, including international aviation. Note: These sectoral emissions shares might change over time. However, under a scenario where MSs stick to current climate policies, these shares are not expected to change much (as per projected GHG emissions under the "With Existing Measures (WEM)" scenario as communicated by Member States to the European Environment Agency in December 2019). Additional measures might alter the distribution of GHG across the economy.

Looking forward, we can assess the relative impact of more stringent emissions targets – whether enforced through an ETS cap or mandated reductions – in the road transport and heating sectors is by looking at fuel consumption per capita in these sectors across EU MSs. In that regard, the transport and buildings sectors differ. While per capita consumption of fossil fuels for road transportation is relatively homogeneous across EU countries, a much more heterogeneous picture emerges when looking at consumption for heating purposes, both commercial and residential. The fairly homogeneous picture across MSs for the transport sector is unsurprising since the car fleet composition and efficiencies are roughly similar.[17] By contrast the more heterogeneous situation in the buildings sector is due to different geographic (and hence climate) conditions, as well as the differing energy performance of buildings.

These differences in fuel consumption are particularly important given that EU countries also face different economic conditions, which will affect their respective capacity to bear the cost of more stringent climate policies. In transport, Poland might be facing a steep cost, relative to its level of GDP per capita, given that in recent years its level of road transportation fuel consumption has caught up with that of wealthier EU countries. More generally, Öko-Institut and Agora Energiewende (2020) note that by 2030, low income EU countries (i.e. with GDP per capita below 60% of EU average) are expected to be the ones with higher than average emissions in the Effort Sharing sectors. This constitutes a reversal compared to the situation that prevailed when the Emissions Sharing Decision (ESD) was first introduced. Given the lack of flexibility to alleviate wealth impacts by distributing the burden heterogeneously across MSs, it calls for mechanisms to alleviate that burden that are extraneous to the design of the ESD.

5. Managing an EU ETS extension

5.1 Managing the political economy

5.1.1 Fiscal revenue

From the perspective of MSs, the impact of an extension of the EU ETS and adjustment to other policies on fiscal revenue might be a significant issue. In 2018, revenue from energy taxes (i.e. taxes on energy products for transport purposes, for stationary purposes and on greenhouse gases) represented 1.85% of gross domestic product across EU-28 countries, with a minimum of 0.97% in Ireland and a maximum of 2.96% in Slovenia. When expressed as a share of total revenues from

[17] One exception might be Norway, which has a significantly larger share (around 16% in 2020) of all electric and hybrid vehicles in its fleet (Transport and Environment, 2020).

taxes and social contributions (excluding imputed social contributions), the EU-28 average is 4.72%, the minimum is 3.35% (Austria) and the maximum is 9.25% (Latvia) (Eurostat, 2020c).

However, only a few (relatively better-off) EU countries would face a situation where a downward adjustment to their national schemes would be warranted. The problem of `double taxation` would only arise in MSs where a carbon component of energy taxation or a separate carbon tax has already been implemented. In most countries with carbon content-based taxes their level is set below present EUA prices; in countries where only energy duties are in force, the fact that these cover a range of environmental externalities, road usage and congestion costs would limit the magnitude of any downward adjustment grounded in efficiency considerations.

5.1.2 Neutralising the initial impact of the policy change

Much of the benefit of EU ETS extension is in the future and arises due to its dynamic impacts. From this perspective, smoothing the short to medium term impact by an initial tax reduction *upon introduction* could be warranted in the case of some particularly sensitive prices, in order to increase social acceptance and avoid opposition such as that expressed through the Yellow Vest movement in France (Douenne, 2020). This will depend on (i) country-specific externalities and road usage costs, (ii) current excise duty levels.

We have noted that the starting point of fuel taxation is very different in transport and heating in different countries. While in most countries the current excise duty rate on diesel (and transport fuels more generally) would allow for the sterilisation of the introduction of a carbon price, the level of duties on natural gas provide much less scope for such direct sterilisation. This is in particular the case in Eastern European countries. Table 3-2 shows that the rise in the price of heating from the introduction of €25 carbon price is significant across the EU and cannot be sterilised in most countries. Sterilising the initial impact of carbon pricing in these countries might therefore need to be achieved via other means than a reduction of the rate of existing duties (see section 5).

Table 5-1 Effect on retail price of natural gas in selected countries of a €25/tonne carbon price

	Percentage increase in retail price (incl. VAT)	**Can it be offset/sterilised?**
France	8	Yes
Germany	9	No
Italy	7.4	Yes
Poland	14	No
Slovak Republic	12.5	No
Spain	7.5	No
Sweden	5	Yes

Derived from data in Pollitt and Dolphin (2020).

5.1.3 Alleviating distributional impacts

Those impacts require effective instruments and governance to alleviate unintended consequences among the most vulnerable segments of the society. There are two important avenues to potentially alleviate distributional impacts: (targeted) direct financial compensation mechanisms or the implementation of distinct counterbalancing policies.

Direct financial compensation

Direct financial compensation within the EU ETS would have to address adverse distributional impacts arising across and within MSs. One possibility to address the former is to allocate allowances disproportionately to poorer and/or more CO_2 intensive MSs. This would allow to compensate those MSs that are expected to be harder hit by the introduction of carbon pricing. This principle is already accepted. Currently, 10% of the auctioned permits 'are divided between Member States with low per capita income receiving a larger share compared to those with high per capita income' (European Union, 2015, p.31). Alternatively, direct financial compensation of MSs could be organised via other direct transfer mechanisms, at the scale required.

While EU-level direct financial compensation mechanisms can be set up to address between MS impacts, addressing within country distributional impacts through such mechanisms is ultimately the responsibility of MSs themselves.[18] A number of carbon pricing jurisdictions have implemented direct financial compensation arising from the redistribution of carbon price revenue (see Burke, et al., 2020). This can be done via a per-household payment, or by a per-meter payment. It would be possible for instance to give every gas heated household a direct payment from the carbon permit revenue, in the form of a lump sum credit on their energy bill[19]. This would in theory leave most poor households better off.

In California, redistribution of carbon emissions revenue happens in two distinct ways. First, the California Legislature appropriates the proceeds of allowances allocated to the State of California under the program, and invests them in a number of state-wide initiatives aiming at improving environmental outcomes. 57% of the cumulative proceeds since the start of the program have been invested in initiatives benefitting "priority populations" (California Air Resources Board, 2020a). In fiscal year 2019-2020, these proceeds totalled $2.1 billion (California Air Resources Board, 2020b). Second, the proceeds of the sale of allowances that are allocated to utilities are returned to households and small businesses ratepayers in the form of 'carbon credits'. It would be possible to think of doing something along these lines especially for households negatively affected by an extension of the EU ETS to heating.

Counterbalancing policies

Counterbalancing policies could seek to use other policies to offset the distributional impacts of an extension of carbon pricing and could be designed to be progressive. First, there are many existing payment support schemes which can be adjusted easily (or indeed will adjust automatically) to any bill impact as a result of the extension of the EU ETS to heating.[20] Thus households whose heating bills are already paid by the state or subject to low income price adjustments can be assisted relatively easily.

Second, energy efficiency investment have been extensively used in electricity and in industry to support the reduction in energy bills in the face of rising unit prices. There remains a lot of scope for continuing to alleviate the direct impacts of carbon pricing via investments in low energy equipment, particularly related to heating.

6. Conclusion

Achieving climate neutrality in 2050, and a 55% GHG emissions reduction (compared to 1990) in 2030 requires a substantial strengthening of the existing climate policy regime of the European Union (both at the EU and national-level). Extending the EU ETS to road transport and heating fuels could be a key component of a more stringent EU climate policy mix, so the basic answer to the question we ask in this paper is yes.

[18] The EU could however take more responsibility for direct compensation payments. EU ETS legislative reform would however need to define clear governance rules to transfer 'carbon credits' or carbon pricing revenue to individual EU consumers.

[19] In Germany, electricity charges will be reduced when its carbon tax on heating and transport is introduced in 2021, meaning that while gas bills will rise, electricity bills will fall.

[20] For instance, in Germany, commuter taxes will be reduced when its new carbon tax on heating and transport is introduced in 2021.

While existing EU and MS policies targeting transport and heating fuels have certainly delivered some emission reduction (or avoided potential increases) over the past decade, their record with regard to effective aggregate reductions in emissions compared to 1990 levels is mixed. Emissions from fuel burning by households and in the commercial and institutional sector is down 26% in the EU-27 compared to 1990 levels, with significant disparities between EU countries. In the road transport sector, emissions in the EU-27 are 27% higher in 2018 than in 1990, and have recently been on an upward trend.

Successfully implementing an EU ETS extension raises significant distributional challenges that must be addressed by design. Thus the extension must be done in a way that is consistent with Europe's climate goals, does not undermine its existing standards based policies *and* adequately mitigates potentially severe distributional effects. An extension which does not take due account of each of these elements will fail, either to be implemented in the first place, or at some point along the way to 2050. That said, we have argued that extension of the EU ETS could be an effective dynamic commitment device that sets a long-term signal shaping market participants' expectations about the stringency and credibility of EU climate policy. It represents, perhaps uniquely, a policy which could actually ensure delivery of the EU's overall carbon budget over the set time horizon.

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