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REPORT

December 2020

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FEASIBILITY AND IMPACTS OF EU ETS SCOPE EXTENSION

ROAD TRANSPORT AND BUILDINGS

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FEASIBILITY AND IMPACTS OF EU ETS SCOPE EXTENSION
(Road transport and buildings)
Michael Pollitt
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EXECUTIVE SUMMARY

Executive summary

- We consider the current proposal to extend the EU ETS to cover buildings (heat) and transport emissions. This would be a **significant extension** (almost doubling the coverage of the EU ETS to around 80% of GHG emissions in the EU).
- In line with economic theory, we argue that increased coverage of the EU ETS together with a binding cap consistent with a net zero trajectory could be a **powerful dynamic incentive to efficient emissions reduction**.
- The discussion in this report assumes that the extension of the EU ETS to include road transport and heating fuels is ***in addition* to existing policies** targeting the road transport and buildings sectors.
- Existing policies such as vehicle emissions and building energy efficiency standards have **other – complementary – benefits** such as the targeting of local externalities, promoting learning benefits and overcoming buyer myopia.
- We find that the evidence to date is consistent with a view that a **credible net zero consistent extension of the EU ETS** to 2050 would lead to **more incentive to introduce complementary policies** in heating and transport, in part to mitigate the consumer impact of higher carbon prices.
- An extension of the EU ETS would affect allowance (EUA) prices. In theory real EUA prices should rise at the real rate of interest and the initial price at time of extension depends on the tightness of the cap and expected effects of complementary policies in transport and heating.
- Richer member states (MSs) are still likely to undertake complementary policies to promote emissions reduction and this will benefit poorer MSs, through lower emissions allowance prices.
- The inclusion of heating fuels in the EU ETS would level the playing field across fuel vectors and remove the distortion arising from the fact that 30% of emissions related to buildings heating are already included in the EU ETS (via covered CHP plants and electric heating systems).
- **Distributional concerns remain a serious challenge for any extension of the EU ETS to both transport and buildings (heating). Potential policy options to mitigate distributional effects are described in this report** (e.g. adjustment of existing fuel taxes or targeted use of the revenue from additional permit sales to support poorer consumers who might be adversely affected by the extension). In theory, the extension with revenue recycling could be net progressive, relative to any alternative policies that would achieve the same overall emissions reduction.
- **Overall, we conclude that extending the EU ETS to buildings and transport, if done in a way that does not undermine existing standards, adequately mitigates potentially severe distributional effects** and is consistent with the 2050 net zero target, **would be a substantial contribution to the achievement Europe's climate goals.**

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INTRODUCTION

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.[1] 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 transport and heating fuels is being considered.

Such an extension was contemplated multiple times since the very early stages of development of the EU ETS (Convery, 2009). So far, however, concerns around the Monitoring, Reporting and Verification (MRV) of emissions, as well as political opposition, tilted the balance against it. Yet, the new EU 2030 and 2050 climate policy goals, the explicit mention of a possible extension of the EU ETS as means to achieve them, as well as the changing institutional and political context, raise new questions and demand an updated answer to older ones.

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. At the start of 2020 - more than a decade after the Great Financial Crisis - some European economies had not returned to pre-crisis levels of GDP per capita (e.g. Italy) and pre-transfer income inequality has risen in most of them (OECD, 2020).[3] Since then, the global economy has been hit by a sharp economic shock ensuing from the outbreak of the COVID-19 pandemic.

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 (ii) adequately address the distributional consequences of the implemented policies.

It is in light of these principles and with the current economic and political reality in mind that this report will assess the potential impacts and feasibility of an extension of the EU ETS to road transport and heating fuels. Reflecting the European Commission's stated aim to make a *fair* transition a key driver of its policy developments (EC, 2020), a key focus of the report will be the economic and distributional implications that such a policy change might have (see section 5). Mechanisms to alleviate the distributional impacts of such an extension will be discussed in section 6, alongside

[1] The 2030 target is being legislated on. This EU-wide, cross-sectoral, target translates into different targets for sectors falling under the scope of the EU ETS Directive and those falling under the scope of the Effort Sharing Decision. For the former sectors, at least 52% (and up to 57%) would be required compared to 2005 levels; for the latter, it amounts at least 42% (and up to 48%) emissions reduction target (CAKE, 2020).
[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] Note, however, that in several countries, inequality calculated based on disposable income (i.e. income after taxes and transfers) has remained relatively stable (OECD, 2020).

aspects of its practical feasibility. We also consider whether transport and heating fuels should be introduced in the EU ETS at the same time or whether the sectors could be introduced sequentially.

However, such a discussion *cannot* happen without considering the effect of an extension on the performance of the existing EU ETS sectors and the EU ETS as a whole. These impacts are considered in section 4. Specifically, the section will review impacts on EUA prices, since the magnitude of the economic and distributional implications will in large part depend on it, and effects on emission abatement. It will also consider the interaction between an extended ETS and existing policies.

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.[4] We are not considering this option in this paper. What we are examining is an open emissions trading scheme with full emission allowance tradability between existing EU ETS sectors and EU buildings and transport sectors. We use the term 'extension of the EU ETS' as a shorthand for any future EU emissions trading arrangements in which there are aggregate emissions limits for existing EU ETS sectors plus buildings and transport sectors *and* unrestricted allowance trading between all of the covered sectors.

Finally, extension of the EU ETS *should not* happen without due regard to the pre-existing policy context and motivations driving the policy change (section 3), as well as the resulting outcome (section 2). Any major policy change inevitably involves policy compromises and it will be important to be aware of how parallel energy and climate policies might be adjusted positively or negatively in the face of what would be a major EU ETS extension.

The present report will draw on existing literature to address the issues at hand. In particular, it will rely on both theoretical and empirical literature as well as some previous modelling studies and historical experiences with carbon pricing.

[4] This is partly inspired by the German decision to extend carbon taxation to buildings and transport from January 2021. See https://www.euractiv.com/section/energy-environment/news/german-cabinet-agrees-to-a-co2-price-of-e25-from-january-2021/

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WHAT IF: COVERAGE AND AVERAGE CARBON PRICE IMPACTS OF AN EXTENDED EU ETS

2. What if: coverage and average carbon price impacts of an extended EU ETS

Extending the coverage to transport and heating fuels across all countries participating in the EU ETS would be an institutional adjustment of unprecedented scale in the lifetime of the mechanism. It would raise the coverage of GHG emissions to 79%, up from 45%[5], an almost doubling of the scope of the System.

The EU ETS has been extended before. However, the previous geographical, sectoral or gas extensions were much more modest in comparison. The inclusion of Liechtenstein, Iceland and Norway at the start of Phase II increased the System's coverage by 0.1% as a share of the GHG emissions of the 31 EU ETS (ETS-31) participating countries while the introduction of aviation emissions in 2013 (European Union, 2014) added 3.4% of ETS-31 GHG emissions to the scope of the EU ETS (European Environment Agency, 2020).[6] Directive 2009/29/EC extended the EU ETS to nitrous oxide and perfluorocarbons (PFCs) for the third phase. This added 0.2% of GHG emissions of the ETS-31 participating countries to its scope (Eurostat, 2020).

Importantly, the effect across EU ETS countries would be uneven. 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. Hence, the absolute percentage jump in coverage as well as the new coverage resulting from this extension will differ across Member States (MSs). 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.

[5] These figures are calculated based on an EU-28 assumption (i.e. including the UK).

[6] This figure includes International aviation. However, international aviation emissions were temporarily excluded from the scope of the EU ETS under Regulation (EU) 2017/2392. As a share of the total GHG emissions of the ETS-31 participating countries, the addition of emissions from domestic air transport represented only 0.36%.

Table 2-1 shows this for the EU-28 and a number of selected countries, given current EUA price.[7]

Table 2-1 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-28	45% - 11.73 EUR/tCO_2e	21% - 5.61 EUR/tCO_2e	9% - 2.35 EUR/tCO_2e	4% - 1 EUR/tCO_2e	79% - 20.68 EUR/tCO_2e
France	26.9% - 7.18 EUR/tCO_2e	27.7% - 7.39 EUR/tCO_2e	9.4% - 2.5 EUR/tCO_2e	6.3% - 1.69 EUR/tCO_2e	69% - 18.41 EUR/tCO_2e
Germany	55% - 14.59 EUR/tCO_2e	18% - 4.84 EUR/tCO_2e	9.6% - 2.57 EUR/tCO_2e	3.7% - 1 EUR/tCO_2e	86% - 23 EUR/tCO_2e
Italy	38.8% - 10.35 EUR/tCO_2e	22.4% - 5.98 EUR/tCO_2e	10.8% - 2.88 EUR/tCO_2e	5.8% - 1.55 EUR/tCO_2e	77.7% - 20.75 EUR/tCO_2e
Poland	51.7% - 13.81 EUR/tCO_2e	15.3% - 4.07 EUR/tCO_2e	8.5% - 2.27 EUR/tCO_2e	1.7% - 0.45 EUR/tCO_2e	76% - 20.28 EUR/tCO_2e
Romania	40.7% - 10.86 EUR/tCO_2e	15% - 4.05 EUR/tCO_2e	5.8% - 1.55 EUR/tCO_2e	1.9% - 0.51 EUR/tCO_2e	63.6 - 16.97 EUR/tCO_2e
Spain	42% - 11.18 EUR/tCO_2e	24.7% - 6.6 EUR/tCO_2e	3.7% - 1 EUR/tCO_2e	4.4% - 1.17 EUR/tCO_2e	74.7% - 19.94 EUR/tCO_2e
Sweden	43.2% - 11.52 EUR/tCO_2e	28.6% - 7.64 EUR/tCO_2e	0.9% - 0.24 EUR/tCO_2e	1.3% - 0.36 EUR/tCO_2e	74% - 19.76 EUR/tCO_2e
United Kingdom	34.6% - 9.22 EUR/tCO_2e	24.1% - 6.44 EUR/tCO_2e	14.4% - 3.83 EUR/tCO_2e	4.3% - 1.14 EUR/tCO_2e	77.3%- 20.63 EUR/tCO_2e

Source: Authors' calculations based on European Environment Agency GHG emissions data and the EUA price of EUR 26.68/tCO_2e, as of 10/08/2020 (from https://ember-climate.org/carbon-price-viewer/). 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.

The price of EUAs in an extended ETS is unlikely to remain at current levels. In particular, two lines of argument suggesting that it might increase have developed. First, it has been argued that, given existing – or upward revised – emissions reduction objectives and low short-term carbon price elasticities in the road transport and heating sectors, an extension to these sectors could lead to an increase in the price of emission allowances, at least in the run up to 2030 – see, for example, Cambridge Econometrics (2020). Second, some studies also have shown that in order to deliver emissions reductions *equivalent* to currently enshrined GHG emission reduction objectives and policies in these sectors, a very high carbon price is required (Oko-Institut and Agora Energiewende, 2020).

In theory, then, given the high upfront cost of substantial GHG abatement options in road transport and heating as well as low price elasticity of emissions for road transport and heating fuels, a high EUA price is a plausible outcome. This is because EUA price induced emissions reduction in these sectors would likely initially come from reduced use (and associated behavioural change), switching

[7] The countries presented in this report 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-28 total. Together, these countries represent 74% of EU-28 emissions and 77% of EU-28 GDP (Eurostat, 2020).

between transport modes and building energy efficiency investments, prior to substantial investment in new zero carbon transport and building technologies. These abatement options have low price elasticity and hence require large proportionate price rises (and even larger proportionate EUA price rises) to reduce emissions by a given percentage in these sectors.

However, most studies investigating the price impacts of an extension consider policy contexts where a pricing mechanism is substituted for all existing policies and becomes the sole policy instrument to deliver emissions reduction (Oko-Institut and Agora Energiewende, 2020; Cambridge Econometrics, 2020). Hence they do not consider a case where the EU ETS co-exists with other ‘complementary’ policies that would put downward pressure on equilibrium EUA prices, in the same way that the Renewable Energy Directive did in the second and third phases of the EU ETS. Yet it is such a situation that is most likely to prevail, not only because these complementary policies address market failures that a carbon pricing mechanism is unlikely to alleviate on its own but also because having those in place might actually help keep the carbon price to politically acceptable levels.

Recent experience from California provides some empirical evidence supporting that view. Before the EU announced its intention to revise upwards its emissions reduction objectives as part of its Green Deal, the California Cap-and-Trade (CaT) programme had identical overall 2030 GHG emission reduction targets (-40% compared to 1990 levels) and required similar reductions from their CaT covered sectors.[8] GHG emissions from California CaT sectors, which include road transport and heating fuels, would be capped at 200 Mt in 2030, a 47% reduction compared to their 1990 levels (California Air Resources Board, 2019; California Air Resources Board, 2019b). California’s emissions structure is similar to that of the EU-28, albeit with a larger share of emissions in road transport. In 2017, GHG emissions from its road transport and residential and commercial heating represented 37%, 7%, and 5% of its total GHG emissions, respectively.

Most notably, California also has a very similar set of ‘complementary’ policies to the EU, including renewable portfolio standards for renewable electricity generation capacity deployment in the power sector and vehicle performance standards targeting the road transport sector. 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.[9]

It is also likely that the presence of these policies has played a role in keeping past prices low[10] which, together with the above insights from Borenstein et al. (2019), implies that removing policies such as the Energy Efficiency Directive and the passenger cars and light commercial vehicle CO_2 performance standards Regulation is most likely a recipe for the price of allowances to shoot up in the EU ETS. These policies secure long term emissions reduction (and associated investment), which in turn reduces the demand for allowances in the market and puts downward pressure on allowance price. That alone would be one strong motivation to keep them as part of the EU climate policy mix.

The evidence thus points towards a likely rise in allowance prices in the run up to 2030, and further rise after as the emissions cap for EU ETS sectors is tightened, if road transportation and heating

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[8] One notable difference was that California’s intermediary target (2020) was to return emissions to 1990 levels, whereas the EU’s one was to reduce them by 20%.

[9] It is important to note that a price of USD 50/tCO2e in 2030 is consistent with a real price of, say, USD 30/tCO2e in 2020, as the emissions price of 2030 is linked to 2020 by the real rate of interest of say 5%. Hence care must be taken to properly index expected future prices back to the present day.

[10] Since the launch of the California CaT Program, the price of allowances in the secondary market oscillated between USD 12/tCO2e and USD 18.5/tCO2e over the period Nov 2014 – today. In the EU, there seems to be little evidence from the history of the EU ETS that prices would be allowed to rise to very high levels in a short time period without intervention occurring and indeed the Market Stability Reserve explicitly allows for the introduction of extra permits to bring the price down.

fuels are included are included in its scope.[11] Yet a rise that could be reduced through a careful design – and strengthening – of complementary policies as well as the implementation of price-based or quantity-based market stability mechanisms.

[11] This would induce a shift in the sectoral burden sharing of the abatement, to which we return in section 4.2. The exact nature of the shift depends on the cross-sector short-run and long-run Marginal Abatement Cost Curves and whether abatement options in other sectors are cheaper than those in road transport and buildings.

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POLICY CONTEXT AND RATIONALES FOR EXTENSION

3. Policy context and rationales for extension

3.1 Existing institutional and policy environment

Following agreement by all MSs (except Poland), the EU has set itself an objective of net zero emissions by 2050.[12] While EU-wide emissions reduction objectives are agreed by MSs at the EU-level, the set of instruments constituting the EU climate policy mix is comprised of instruments adopted by the EU and national MSs. Hence a potential extension of the EU ETS to transport and heating fuels – and implications thereof, should be assessed in light of the pre-existing EU and national (climate) policies (or any proposed change thereto).

3.1.1 The EU-level

The EU ETS: current design

The design of the EU ETS has evolved significantly over time, so that the scheme currently operated bears little resemblance to the one that was introduced in 2005.

In theory, it is not the purpose of a quantity-based mechanism such as the EU ETS to lead to the emergence of a particular price signal.[13] However, the provision of a credible long term price signal to incentivise the development of new technologies has long been part of the discussion around ETS reform (Grosjean, Acworth, Flaschland, & Marshinski, 2014). Over time, these concerns have led to EU- and national-level institutional developments that have effectively introduced some price management features into what was, at first, a pure quantity-based scheme. The most significant change has been enhanced policy stringency through an increase in the linear reduction factor – from 1.74% to 2.2% - and the introduction of the Market Stability Reserve (MSR) to manage long term market imbalances through flexible management of unused allowances banked by participants in the system.[14]

The MSR has the potential to substantially affect market dynamics, especially through its allowances invalidation mechanism, which enters into force in 2023. From 2023, the MSR may alter the long-term allowance supply in the EU ETS by invalidating allowances held in the MSR in excess of the previous year's auction volume. This will affect the overall emissions budget available to ETS sectors, and therefore the total level of emissions within the EU.[15]

The EU ETS allows borrowing of future allowances within phases and banking of accumulated allowances across phases[16]. This is important because it suggests how modelled prices are connected between years. With free banking and borrowing EU ETS prices are expected to rise at the real rate of interest across all modelled periods of the scheme, no matter when changes to the scheme are introduced. This connection between years is only broken when unanticipated changes are introduced.

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[12] It is assumed that this objective implies a set *carbon budget* and is eventually achieved following a path of `steadily' decreasing aggregate emissions. A configuration where EU emissions remain at current level until 2049 and are brought down to net zero in 2050 is inconsistent with a 2C maximum increase target in Global Mean Temperature by 2100.

[13] "Two market-based mechanisms (and hybrid combinations) have emerged: carbon taxes and emissions trading schemes (ETSs). The former places a set price on each unit of CO_2 emitted into the atmosphere, leaving an uncertainty about the resulting level of emissions; the latter sets an emissions cap and leaves to the market the creation of the price signal. Even though both mechanisms share the same underlying motivation and, under complete knowledge and perfect certainty, are theoretically equivalent and deliver the same environmental outcome, they relate to two slightly different views about carbon pricing. The first view emphasizes the use of carbon pricing mechanisms to internalize the externality associated with GHG emissions and hence is more sympathetic to carbon taxes. In that case, the price of carbon should closely track the Social Cost of Carbon (SCC). The second stresses the achievement of a set carbon budget over a given planning horizon in a cost-effective way, in which case the price will follow the dynamically cost-effective price path (Rubin, 1996)." (Dolphin et al., 2020)

[14] See Vivid Economics (2020) for further details about recent and future changes the EU ETS design.

[15] For estimates of the number of allowances that could be invalidated, see Vivid Economics (2020) and references therein.

[16] See Bocklet et al. (2019) and https://www.emissions-euets.com/borrowing

Other EU policies

Despite being an instrumental component of the EU climate policy regime, the EU ETS is not the sole instrument in force to bring down GHG emissions. A number of other EU policies exist that either (i) serve as a complement in sectors falling under the scope of the EU ETS, (ii) are the main instrument of emissions reduction in sectors currently under the scope of the Effort Sharing Decision, or (iii) are not climate policies per se but bear implications for the EU climate objective.

Salient instances of the first category are the Renewable Energy Directive and (some aspects) of the Large Combustion Plant Directive. Both of these regulations have contributed to GHG emissions reduction in the power sector and some industrial sectors, respectively. The former by mandating the addition of CO_2 free power generation capacity, the latter by mandating reductions in emission of air pollutants (such as SO_2) that are correlated with CO_2 emissions.

In the second category, specifically focusing on the road transport and buildings sector, are the regulations setting CO_2 emission performance standards for new passenger cars and for new light commercial vehicles (EU, 2019) and the Energy Performance in Buildings Directive (EPBD) (EU, 2019). These are supported in the buildings sector by the Ecodesign Directive (EU, 2009) which sets the framework for the energy efficient design of 31 product groups and the Energy Labelling Directive which specifies energy consumption labelling requirements for 15 product groups (EU, 2017). These regulations have been the main EU-level instruments enacted to drive down emissions in the road transport and buildings sectors, respectively.

Finally, perhaps the most significant of policies falling in the third category is the Energy Taxation Directive (ETD). Its current design and implications for climate policy is well summarised by Agora (2020). "Currently, the EU ETD of 2003, which is designed to harmonize energy taxes in the EU, only stipulates minimum tax rates for each fuel, but without a link to carbon content. As a general pattern, all Member States levy higher taxes on transport fuels than on fuels used for power or heat generation. This disparity in implicit carbon prices across the economy distorts incentives to invest in the most cost-effective emission reduction options. Moreover, some EU countries – Germany and Italy, say – have high taxes and surcharges on electricity that serve as a barrier to sector coupling and the provision of flexibility." (Agora, 2020, p.42-43). Further details pertaining to this point are provided in the next section.

3.1.2 Member States' policies

Two categories of domestic policies are likely to play a decisive role in a potential process of EU ETS extension: (i) fuel duties, (ii) carbon pricing mechanisms.

Excise duties and VAT on transport and heating fuels

In most MSs, fossil fuels used for transport and heating are already subject to (sometimes substantial) excise taxes and, in some cases, are also covered by targeted carbon taxes. While some degree of harmonization of the former across EU Member States exists through the Energy Taxation Directive (EU, 2003), this only provides a floor for the taxation of energy products. Therefore, for any given product, significant variation in the tax rates across member states remains (see Oko-Institut and Agora Energiewende, 2020).

In addition, these fuels are subject to a Value-Added-Tax (VAT). While VAT rates are relatively homogeneous across fuels (and countries), there is one notable exception: the application of reduced

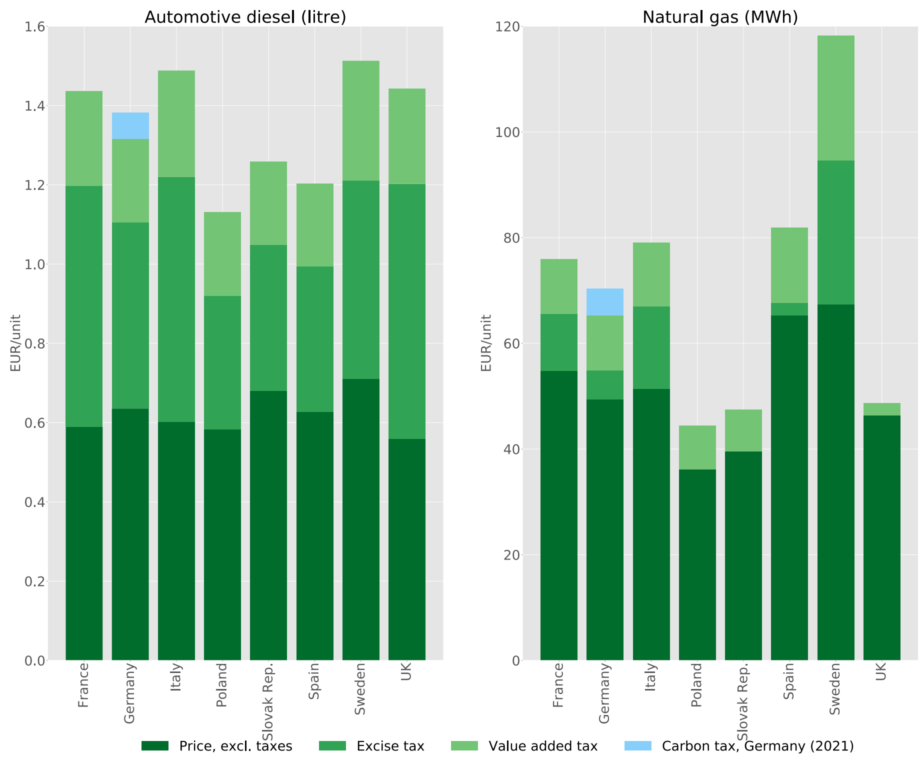
VAT rates to natural gas by several EU countries. For instance, the UK applies a 5% VAT rate, while Ireland and Luxemburg apply a rate of 13.5% and 8%, respectively. As highlighted by Burke et al. (2020), this comes at an environmental cost.

3-1 below presents the breakdown of the total retail price for automotive diesel (road transportation) and natural gas (heating) for households. In the case of the former, excise duties sometimes represent more than half of the total retail price of a fuel.

Box 1 – Excise duties in the UK

The UK excise duties on road transport fuel are currently set at levels that are among the highest among OECD countries. Current levels are the result of significant real increases in the 1990s and the establishment of fuel duties as an important source of overall tax revenue (c. 3.5% of all tax revenue)[17]. However, this is in stark contrast to the level of excise duties applied to heating fuels, particularly natural gas. The UK applies a zero duty (and domestic carbon tax) rate on natural gas used for heating purposes in residential dwellings and a very low (5%) VAT rate.

Figure 3-1 Taxes and charges applied to transport and heating fuels in 2018, by Member State and tax type



Source: IEA Energy Prices and Taxes (2020)

[17]2019-20 forecast. https://obr.uk/forecasts-in-depth/tax-by-tax-spend-by-spend/fuel-duties/

While road fuel excise duties tend to be high across Europe, heating fuels, by contrast, face much lower excise duties (European Commission, 2020; International Energy Agency, 2020), which compounds the (environmentally detrimental) effect of lower VAT rates on these fuels. Specifically, there is for instance no excise tax – and hence no carbon price – on direct burning of natural gas in the United Kingdom and Poland (see

Figure 3-2).

While high excise duties[18] on (primarily road transportation) fuels have contributed to reductions in fuel consumption – and thereby in GHG emissions[19], the current levels and design of fuel duties suffer from at least three shortcomings. First, in addition to the global GHG externality, the combustion of fossil fuels in Internal Combustion Engines (ICEs) or heating boilers leads to (a number of) local negative externalities (from local air pollution to road congestion). Hence only a fraction of existing duty rates should be associated with the GHG emission externality.[20] In some national contexts (i.e. prevailing level of taxation for a given fuel and total value of all externalities), that remaining fraction of the price tag created by excise duties may fall short of the cost of these externalities, especially when excise duties can be seen as a universal road user charge which also needs to cover road costs and congestion externalities.[21]

Second, perhaps more importantly, existing excise duties are not set according to the carbon content of the fuel. As a result, the implicit carbon price that they imply varies across fuels, even for the same end-use (Heine, Norregaard, & Parry, 2012). Equivalently, this means that fuels with the highest carbon content are not more heavily taxed than those with lower carbon content. This runs against the very principle of carbon pricing and is, as such, distorting with regard to the environmental goal. Carbon taxes (or excise duty with a carbon component) that would be based on the carbon content of fuels and hence more directly target CO_2 emissions would (i) ensure that fuels with the largest carbon content face a heavier penalty and (ii) guarantee a more efficient and comprehensive internalisation of the externality. While the heterogeneity of current excise duty levels across member states is a source of inefficiencies, it also means that there is ample scope for harmonization as part of a broader tax reform aiming at pricing environmental externalities more efficiently (Heine, Norregaard, & Parry, 2012).

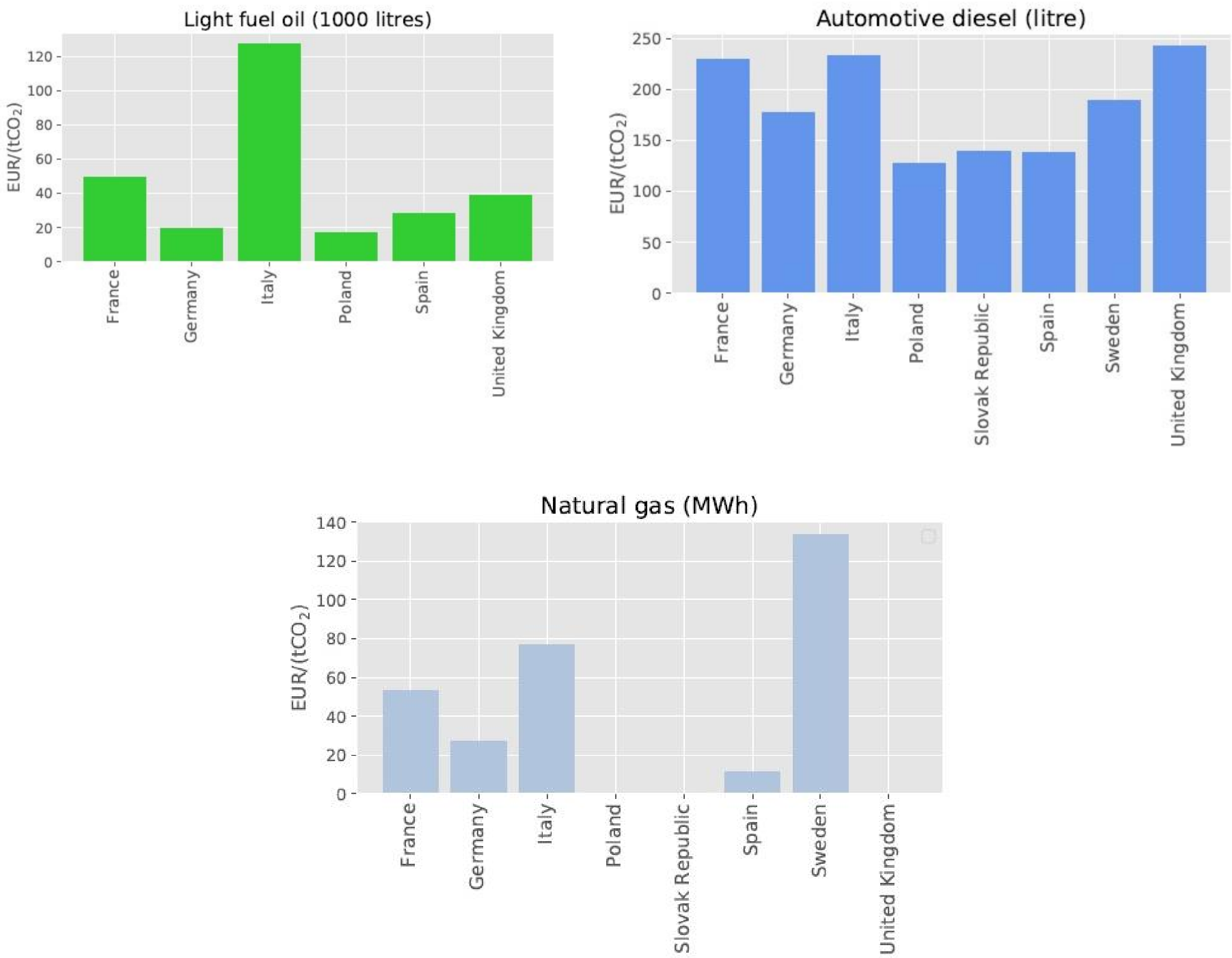
[18] This has been interpreted, incorrectly, as a high implicit carbon price. A recent Öko-Institut and Agora Energiewende (2020) calculation puts the range of implicit carbon prices from indirect taxes on diesel and petrol (Euro Super 95) at €150-€350 across EU-28 MSs, with implicit carbon prices consistently higher for petrol than for diesel. This ignores the fact that there are other externalities which should be priced into the cost of transport fuel.

[19] Sterner (2007) discusses how if Europe had US levels of gasoline taxation fuel consumption would be twice as high. Coady et al. (2019) estimate that efficient higher fuel prices - resulting from removing the implicit fossil fuel subsidies caused by low taxation - would have reduced global emissions by 28% (from coal, petroleum and gas) in 2015.

[20] Parry et al. (2015) estimate that the efficient level of CO_2 price due to co-benefits is around 2010USD 50/tCO_2 across a number of European countries. Importantly, this study only considers health benefits as co-benefits and does not consider other externalities such as road congestion.

[21] In some extreme cases, even if one attributed 100% of the excise rate to the CO_2 externality, the carbon price implied by current excise duty levels (and carbon taxes, where applicable) would remain below carbon prices consistent with the EU's climate objective. For a discussion of the multiple justifications for fuel duty, see Newbery (1988). Recently, Santos (2017) found that diesel excise duties did not cover all the *external* costs – carbon, congestion, noise and accidents - for all 22 European countries she looked at in 2008, while petrol taxation was below the optimal level in several of them.

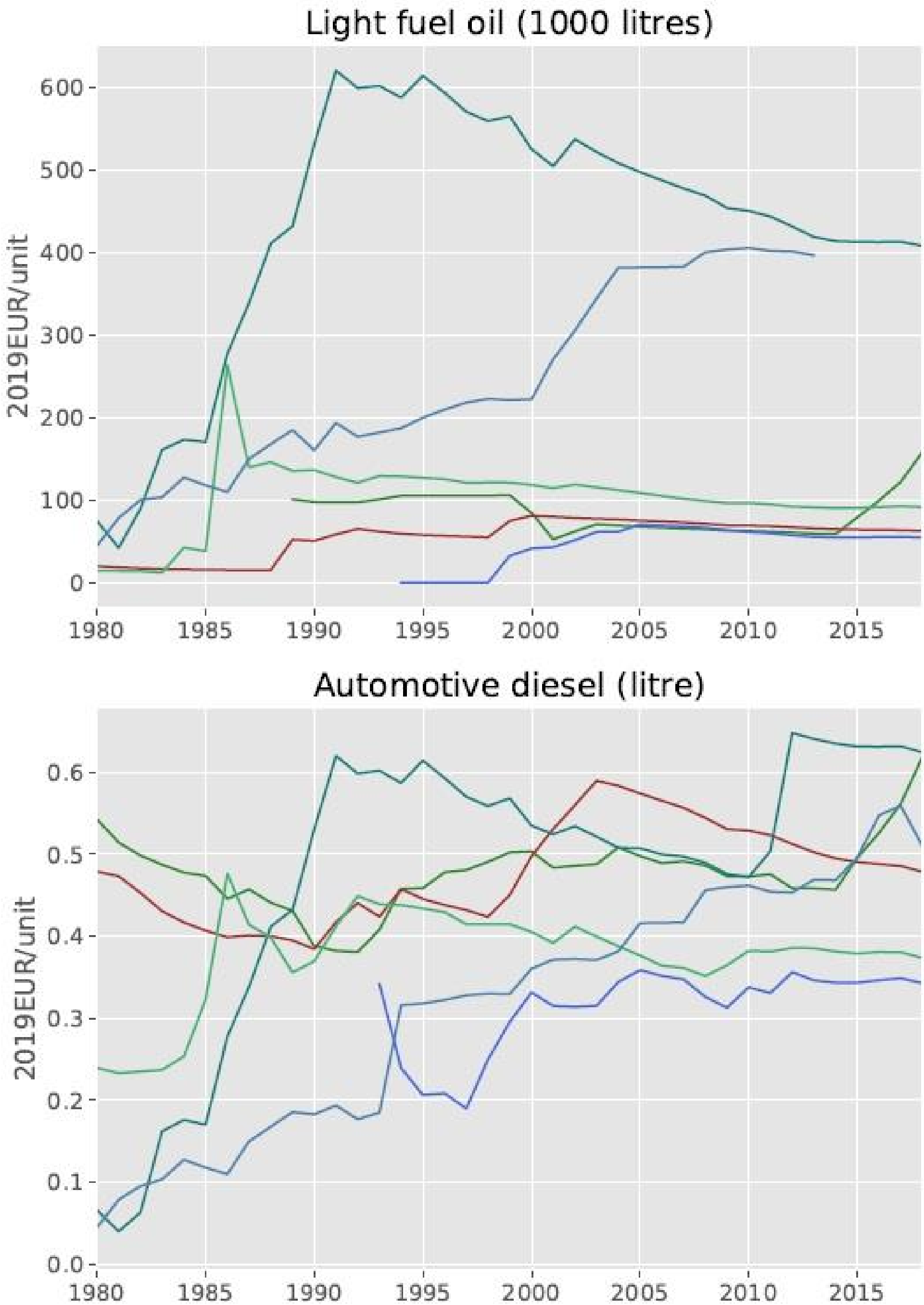
Figure 3-2 – Fuel duties indexed by carbon content (households)

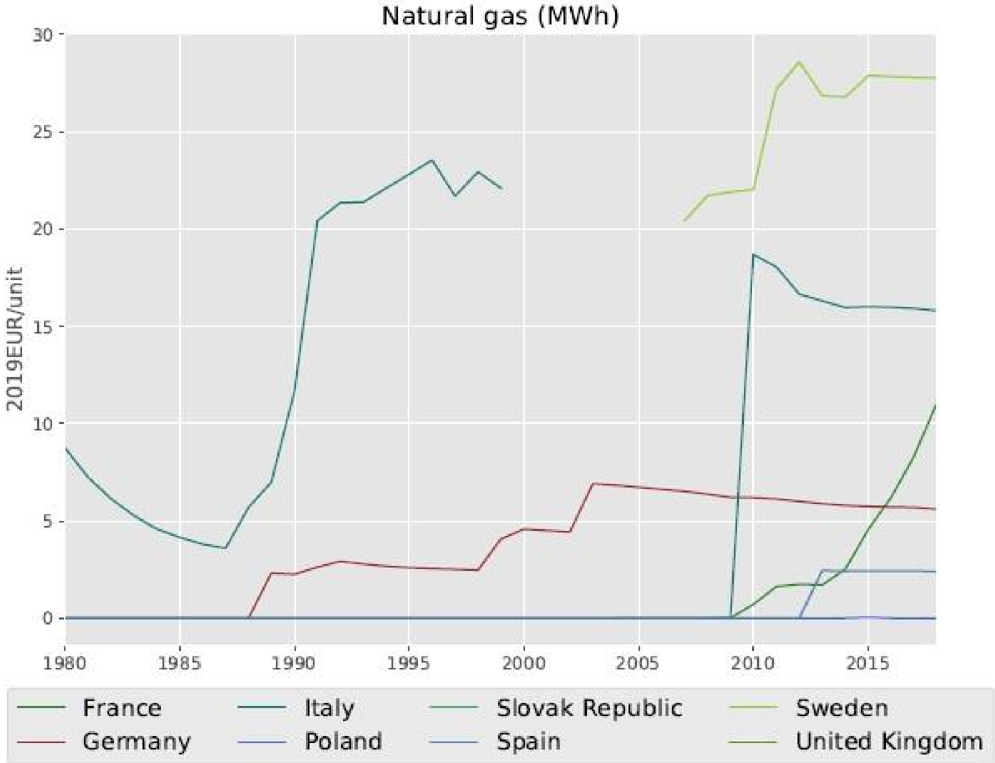


Source: IEA Energy Prices and Taxes (2020)

Third, it is worth noting that the implicit penalty on GHG emissions created by the presence of excise duties has in some cases been weakened over time as their rate has been falling in real terms. This is unlike the price dynamics arising from multi-period ETSs where, by design, the real price of the commodity (i.e. allowance) is expected to increase at the real rate of interest.

Figure 3-3 – Excise duties over time (2019 EUR/unit)





Source: IEA Energy Prices and Taxes (2020)

Carbon pricing

Several EU Member States have, in addition to energy duties, introduced carbon pricing mechanisms. Virtually all of them have introduced carbon taxes, either in the form of a carbon component within their existing regime of energy duties (as in the case of France) or as a separate tax (as in, e.g., Sweden).[22] Some of these mechanisms cover road transport and heating fuels and hence create a carbon content-based price signal on these fuels. Table 3-1 below shows the price signal created.

[22] One upcoming exception is the Emissions Trading System soon to be implemented by Germany and to cover these fuels.

Table 3-1 Carbon taxes on road transport and heating fuels in EU ETS participating countries (as of 2017), 2015USD/tCO$_2$e

	Road transport	Residential heating	Commercial heating
Denmark	35	35	33.4
Finland	88	87	87
France	0	40.5	40
Iceland	10.5	10.5	10.5
Ireland	26.5	26.5	26.5
Liechtenstein	96	96	96
Norway	82	75.5	69.5
Portugal	9	9	9
Slovenia	23	23	23
Sweden	191	133.5	133.5

Source: Authors' dataset.

Only 9 out of the 31 ETS participating countries have (as of late 2020) a carbon pricing mechanism targeting road transport and heating fuels. Five of them have prices significantly above current EUA prices (Denmark, Finland, France, Norway, Sweden), Ireland is around the EUA level and three of them are pricing CO_2 emissions from these fuels below current EUA prices (Iceland, Portugal, Slovenia).

In 2021, Germany will start applying a price on emissions from the combustion of road transport and heating fuels. The rate will initially be €25/tCO$_2$ and rise to €55/tCO$_2$ in 2025. This will add about 6.5 cents to the retail price of one litre of diesel and about €5 to a MWh of natural gas (see Figure 3-1). This represents a 5% (10% at 2025 rate) in the retail price of diesel and 7.5% (15% at 2025 rate) in the retail price of natural gas.

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 at similar rates as those enacted in Germany, the level of duties on natural gas provide much less scope for such sterilisation. This is in particular the case in Eastern European countries. Table 3-2 shows that the rise is the price of heating from the introduction of €25 carbon price is significant in 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 3-2 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
UK	10.5	No

Derived from data in Figure 3-1

It must also be noted that carbon pricing is already indirectly applied to fuels used for heating purposes as well as to rail transport. The former, through the inclusion of Combined Heat and Power plants in the EU ETS in some EU countries. The latter through the inclusion of the power sector in the EU ETS and the fact in many EU Member States, parts of the railway network is electrified.[23] Currently, about 30% of CO_2 emissions from heating are included in the EU ETS (EU, 2020). This is an already substantial share, which currently creates a significant distortion with respect to the remaining 70% of emissions that are not priced. Applying the same price signal to these remaining emissions would ensure that all heating fuels face a homogenous externality charge.

Box 2 – District heating and the EU ETS in Denmark and Sweden

In several Northern and Eastern European countries, home heating is substantially provided through district heating networks to which heat (or combined heat and power, CHP) providing plants are connected[24]. In both Denmark and Sweden, district heating plants are subject to both the national carbon tax and the EU ETS. The price to which their CO_2 emissions are subject is therefore the sum of the national tax rate and the EU ETS price. In addition, Sweden has opted-in plants below 20MW to avoid a situation where several small plants would be connected to the network instead of a single large unit.

The introduction of the EU ETS would have put district heating at a disadvantage with respect to home heating, had the Swedish tax not covered heating fuels. In many other countries, where no carbon tax exists, home heating appliances (most of which are < 20MW of rated capacity) are therefore sheltered from current schemes such as the EU ETS, putting heat providing and CHP plants at a disadvantage.

3.2 Extending the EU ETS

3.2.1 Why: theoretical effects of an ETS extension

To constitute a valid policy development, an extension of the EU ETS (and associated potential adjustments to other policies) to transport and heating fuels must improve on the existing policy

[23] The share of electrified railway lines in total network length varies significantly across Member States, from as low as 0.05% in Estonia to 96% in Luxembourg. The median electrification rate is 53%. Source: Eurostat (2020).

[24] For most European countries with substantial shares of households with access to district heating, most of this is provided by CHP. See http://www.euroheat.org/wp-content/uploads/2016/03/2015-Country-by-country-Statistics-Overview.pdf

mix.[25] In particular, it must make a contribution toward economically efficient and credibly binding emissions reductions.[26] From that perspective, the extension of the EU ETS to road transport and heating fuels may present a number of potential benefits.

First, a well-established and widely accepted result of environmental economics is that, 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 achieve any given emissions target at least cost. That is, pricing mechanisms are statically efficient[27], i.e. they can drive down emissions of the targeted pollutants at least cost by equalising marginal abatement cost across emission sources (Montgomery D. , 1972). This has been one of the driving forces behind the establishment of markets to tackle GHG and local pollutant emissions, such as the U.S. SO_2 program (Chan, Stavins, Stowe, & Sweeney, 2012). 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.[28] Importantly, it would create a level playing field between sectors and across energy vectors for incentivising carbon emissions reductions.

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)[29] which calls for homogenous policy intervention across economic sectors. As such, expanding the EU ETS to them 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. As we saw in section 3.1.2, there is currently not only significant variation in the tax rates across fuels but across end-uses as well.

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.

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

[25] Whether or not an extension would achieve such contribution is especially important given that it would not take place in a policy vacuum and that it might, in part, depend on adjustments brought to the design of existing policies, such as the Energy Efficiency or the Energy Taxation Directives. It must also be noted that an ETS is not the only policy tool that could efficiently achieve a given climate target. In theory, other mechanisms with such property could be designed. As Fischer (2019) points out, tradeable performance standards is one example.

[26] One must also be able to demonstrate that any distributional impact from the policy (change) can be addressed either through policy design choices or "compensatory" policies (Eurelectric, 2020). This aspect is discussed in section 6.

[27] Whether such schemes have also delivered dynamic efficiency by providing incentives to invest in the development of abatement technologies is much less clear. In the case of the EU ETS, several studies have pointed to some impact on patenting (Calel & Dechezlepretre, 2016) but the overall evidence is inconclusive. One reason why the dynamic efficiency attribute of the ETS may have been hampered is the significant uncertainty surrounding future prices (Hintermann, Peterson, & Rickels, 2016). The price of EUAs since the inception of the EU ETS has been very volatile at times, though it is important to point out that daily volatility can be significantly managed by hedging strategies.

[28] 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.

[29] 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.

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. 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).[30]

Fifth, distributional effects are a serious concern. An extension of the EU ETS to heating and transport must adequately address distributional issues by design (a point we discuss in section 6). It is, however, important to point out that existing policies have distributional impacts and that in theory an ETS which lowers total cost and gives rise to revenue that can be recycled (either directly or indirectly) can be progressive and have less impact than alternative polices (see Davis and Knittel, 2019). Non-price environmental policies also have serious distributional impacts, which are often hidden. It is the poor that are disproportionately affected by the effects of climate change, and the associated local pollution impacts of private transport such as congestion, noise and accidents (see Santos, 2017). While failure to charge sufficiently for externalities may come at the cost of reduced public health and education provision (Coady et al., 2019).[31]

Sixth, there is a risk that a significant extension will cause individual countries to leave the EU ETS if an MS feels that it has been particularly adversely affected by the extension. Indeed, in theory this might in the limit cause the scheme to be abandoned. Individual US and Canadian states have left regional ETSs (e.g. New Jersey and Ontario). However this has not been – it would appear – because of price changes within the scheme, but because of ideological objections to the principle of carbon pricing. The ETSs effected by departures (RGGI and California-Quebec) have continued. In the case of the EU, leaving the EU ETS is only possible if a country leaves the EU, which substantially reduces the risk that any country might leave the EU ETS per se as a result of adverse carbon price impacts.

Finally, 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).[32] This argument is similar to that of Knittel & Sandler, (2018), who argue that fuel taxes that are not set based on the carbon content of fuels constitute second-best optimal taxes and, ultimately, only partially correct the deadweight loss of the externality.

3.2.2 How: consistency and compliance with the climate target

While the extension of the EU ETS may provide a number of economic benefits, it is important to stress that it must be done in a way that is consistent with the climate target. That is, the total budget for emissions occurring between the time of extension and 2050 must be compatible with the target increase in global temperature. In addition, it is important that the exhaustion of the budget and the path to net zero emissions in 2050 be happening along a trajectory of linearly declining intermediate allowance allocations. This would ensure that sectors included in the EU ETS are prompted to take early decarbonisation actions, rather than delay emissions abatement and subsequently reduce emissions following a much steeper trajectory.

[30] The EU has mandated fuel consumption meters on new cars and light commercial vehicles from 2020 to address this issue in road transport (European Commission, 2019 - Regulation (EU) 2019/631). However this only addresses the issue of an individual car reaching the emissions standard, not aggregate emissions from the transport sector.
[31] For a comment on the relationship between environmental policy and inequality, see Tirole (2012, p.223).
[32] Input taxes or performance standards should only be used if outputs are unobservable.

The design of the EU ETS must also ensure that compliance with the set carbon budget is achieved. The EU ETS Directive requires MSs to adopt "effective, proportionate and dissuasive" rules on penalties for breaches of the Directive's requirements (EU, 2015). In addition, entities that fail to surrender a number of allowances commensurate with the quantity of GHG emitted will face a liability of €100/tCO_2 (2013 euros). A substantial strengthening of the EU ETS might call for a revision of compliance rules to ensure that they continue to provide covered entities with the incentive to comply. In particular, the penalty fee on emissions for which no allowance has been surrendered might need to be revised upward, if the price of allowances is eventually expected to rise above the current penalty fee.

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

The suitability of an extension must be assessed in light of the role an ETS plays and would play in the climate policy regime of the EU and its member states. The ETS has long played a central role in the EU's climate policy mix but its sectoral coverage has been limited to power generation and industrial sectors. GHG emissions reduction in the road transport and buildings sectors have been promoted through standards-based policies, namely the Passenger cars and light commercial vehicles CO_2 standards and the Energy Performance in Buildings Directive.

An ETS extended to transport and heating fuels would overlap with these policies. This raises the question of the complementarity (i.e. additionality in terms of emissions reduction) of the EU ETS with other existing EU or national policies. The "value added" of the ETS in sectors such as road transport and buildings where other EU and MS regulations remain in place would be delivered primarily by its role as a quantity-based backstop policy ensuring that the EU does not overshoot the combined 1.5-2C-compatible carbon budget of all sectors included in it.

When combined with existing policies, a price signal arising from such a scheme will provide:

1. **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), incentivises 'corrective' (i.e. more stringent) actions to meet long term commitments.

2. **Additional emissions reduction, if they are required (as is likely).** The EU ETS could help deliver additional 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 whole point of the EU ETS is that it is a technology neutral policy which allows for both positive and negative surprises arising from technology based policies. Moreover, while numerous (standards-based) policies addressing emissions in the road transport and buildings heating sectors currently exist at the EU and MS level (EIONET, 2019) and have helped to keep emissions in check(European Environment Agency, 2020b), they do not take

advantage of all the emissions reducing opportunities that exist in these sectors (Friedman, 2010)[33] and cannot ensure that a set carbon budget is satisfied.

With regard to 1., we should remember that the key issue is not one of legal accountability but one of (self-)enforcement of the environmental target. If a MS breaches standards or fails to deliver on EU-defined emissions reduction objectives it is likely to be brought before the ECJ and fined. However, this does little to improve the environmental outcome per se.[34] The introduction of an ETS in the transport and heating sectors might thus introduce additional incentives to deliver on emissions reduction commitments embedded in existing policies and to commit to the broader climate policy objective. Existing policies would continue to address economic agents' myopia and other market failures (European Environment Agency, 2020b). Importantly, such an institutional setting could create both an internal and external commitment devices (Brunner, Flachsland, & Marschinski, 2012). As an internal device, it would ensure the EU is bound by commitments currently enshrined in non-ETS climate policies; as an external device, it would bind MSs to their commitments taken *vis-à-vis* the EU.

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 – as the more stringent these complementary policies are, the lower the EUA price and its consumer impact *ex post.* 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. Indeed, one of the primary mitigation impacts for electricity price rises induced by carbon pricing (and other GHG policies) has been to push harder on energy efficiency (as EU climate policy to date demonstrates). Another illustration of these dynamics might be found in the recent announcement by Poland to speed up the transition of its power sector away from CO_2 emitting technologies.[35]

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. In addition, there is a theoretical possibility that the ETS would be more credible than existing national climate policies (e.g. carbon taxes or fuel duties) in the transport and heating sectors because it creates 'countervailing constituencies' with an interest in its continuation (Brunner, Flachsland, & Marschinski, 2012). This is because once investors adjust to the presence of an extended EU ETS, they then have a vested interest in the mechanism continuing as planned and will oppose attempts to undermine it, as has happened in the power sector under the existing EU ETS.

With regard to 2., 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 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. In the road transport sector, GHG emissions stand 172 $MtCO_2e$ higher than in 1990, driven by increases in both passenger

[33] For instance, in the transport sector, these include: (1) the response of vehicle manufacturers in making more carbon-efficient vehicles (e.g. plug-in hybrids, fuel-cell vehicles, flex-fuel vehicles, more fuel-efficient conventional vehicles); (2) the response of fuel manufacturers and distributors in making more carbon-efficient fuels competitively available (e.g. biodiesels, hydrogen, natural gas, electricity), and (3) the response of vehicle drivers in choosing more carbon-efficient alternatives (e.g. buying more carbon-efficient vehicles, using more carbon-efficient fuels, and reducing carbon-emitting vehicle usage switching to alternative transits and work-life arrangements).

[34] The UK and France have been repeatedly brought before the Courts (either national or EU) for breaching the provisions of the Directive on Ambient Air Quality (Directive 2008/50/EC) but to relatively little (environmental) avail.

[35] See https://www.euractiv.com/section/energy/news/poland-to-accelerate-coal-phase-out-spend-billions-on-renewable-and-nuclear-energy/?utm_term=Autofeed&utm_medium=social&utm_source=Twitter - Echobox=1599679472

and freight transport (European Environment Agency, 2020).[36] While the car and LCV performance standards have contributed to reductions in fleet-wide emissions (European Environment Agency, 2020), a study by Transport & Environment (2017) estimates that with current performance standards targets, road transport would contribute only between 35%-39% of its fair share of emissions reduction under the ESR framework. There is also recent evidence that some types of vehicles (such as Plug-in Hybrid) whose certified emissions reduce car manufacturers average fleet-wide emissions and helps them meet the more stringent standards in force since January 2020, exhibit much higher emissions when in actual use; one reason for this being that owners of such vehicles do not actually plug them in to recharge the battery (Transport & Environment, 2020). In addition, emissions from heating fuel combustion have decreased for the EU as a whole, but there is substantial variation across EU countries. It has been driven by a mix of fuel switching (heating fuel to natural gas), reduced winter demand for heating fuel due to warmer winters, (policy-induced) insulation improvements and retrofitting in buildings (European Environment Agency, 2020b).

Therefore, a strengthening of the EU's climate policy regime targeting these sectors is needed. Additional emissions reduction brought about by an explicit carbon pricing mechanism in the road transport and buildings sectors could help deliver part of the additional mitigation effort. Interaction between an extended ETS and existing policies could enhance the efficiency and environmental effectiveness of the EU's climate policy mix.[37]

An EU-wide price on CO_2 emissions could in principle also be imposed via a revision of the Energy Taxation Directive. Such a revision could entail a minimum price on the carbon content of fossil fuels, rising at an agreed rate over time to 2050. However, there are few (if any) precedents of agreement among Member States on rates of environmental (or other) taxes, let alone on the specification of a trajectory for their level over a long time span. The EU ETS itself arose from the failure to agree on an EU-wide carbon tax.

Box 3 – Fuel-economy standards, Energy Efficiency standards and Cap-and-Trade in California

The California CaT programme that came into effect in 2013 now covers most of the State's GHG emissions (85%, as of 2017). This programme came into being well after the implementation of other (targeted) policies aiming at reducing GHG emissions from the State's power sector (Renewable Portfolio Standards), buildings' sector (Energy Efficiency) or transport sector (Car Average Fuel Efficiency - CAFE). These policies effectively mandate emissions reductions in sectors that are now covered by the CaT programme. As a result, some emissions reductions achieved within it are in effect non-responsive to the price of allowances.

These "complementary" policies may force emission reductions that would not have otherwise occurred in a decentralised carbon pricing mechanism and might have an impact on the efficiency of the CaT itself. However, the existence of the CaT as an economy-wide umbrella policy serves as a backstop and ensures that emissions reductions in line with the environmental objective of California Assembly Bill 32 will be achieved.

Overall, we can think of a comprehensive emissions trading scheme and an equivalent set of standards as both having a carbon quantity and carbon price dimension. The difference being that while individual standards can represent long term price commitments, they cannot guarantee that

[36] "[T]he CO_2 emissions per km for newly registered vehicles has increased in the last two years [2017 and 2018] in the EU. This was because of more sales of gasoline cars relative to diesel, as well as bigger cars being sold on average in the EU" (European Environment Agency, 2020b, p.14). Emissions per km rose again in 2019 (see https://www.aecc.eu/wp-content/uploads/2020/07/AECC-Newsletter-June-2020.pdf).
[37] It would be possible to attempt to harmonise energy taxes across Europe, but as we have pointed out these reflect many externalities and other costs and this would be a very indirect (and politically difficult) route to achieving consistency of carbon pricing across Europe.

the overall carbon quantity is controlled or that implicit carbon prices are consistent between standards. By contrast emissions trading can guarantee the achievement of the overall quantity target and does achieve consistency, albeit with a variable carbon price. A combination of both a comprehensive emissions trading scheme and a set of standards on buildings and transport would in theory allow the shortcomings of both schemes on their own to be addressed – guaranteeing the achievement of overall emissions targets and the reduction of total realised carbon price volatility.

04

IMPLICATIONS FOR MARKET PERFORMANCE UNDER CURRENT EU ETS DESIGN

4. Implications for market performance 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 three ways. First, through an impact on EUA price dynamics and how it reacts to new information. Second, by altering the distribution of abatement across both economic sectors and time. Third, through its interaction with existing policies.

4.1 Price dynamics and expectations

4.1.1 Drivers of EUA prices in an extended EU ETS

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).[38] 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 is true for EUA prices in an intertemporal environmental market such as the EU ETS and is independent of the (geographical or sectoral) scope of the market. Rather, 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) and (ii) complementary policies in place in these sectors (which affect 'non price-responsive' abatement). Crucially, this means 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. It depends on design choices and policy interactions, as well as the number of new allowances created upon extension.

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. 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. They also show that if EUA permits are expected to be valid after the end of the current trading period, they can advance emissions reductions (i.e. a 2050 emissions target actually could provide incentives to bank emissions reductions prior to 2050 in the hope of selling surplus EUAs post-2050).

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

[38] As discussed earlier, with unlimited borrowing and banking, the price of an EUA should be equalized (in present value terms) across periods of time. Note that 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).

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.[39] 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 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.[40]

4.1.2 Market design and stability mechanisms in an extended EU ETS

A prolonged period of low EUA prices over the period 2012-2017 caused by weak demand for and inflexible supply of EUAs prompted several stakeholders to call for the implementation of a market (price) stabilisation mechanism. In 2015, the EU enacted legislation (EU, 2015) creating a quantity based stability mechanism, the Market Stability Reserve (MSR), to manage long-term supply-demand imbalances.[41]

The MSR has two components, an allowance allocation smoothing component and, as from 2023, a cancellation component. The first component works as follows. Every year, the European Commission determines the Total Number of Allowances in Circulation (TNAC).[42] If this number is strictly above 833 million, then the number of allowances is reduced by 24% (between 2019 and 2022) or 12% (from 2023 onward). If it is below 400 million, then 100 million allowances will be released. Any TNAC between these two bounds will not trigger any MSR action. The second component effectively implies a cancellation (or invalidation) of some allowances. From 2023, allowances held in the MSR in excess of the previous year's total volume of allowances auctioned will be cancelled.

By introducing a link between the market outcome and the long-term allowance supply in the EU ETS, the MSR has altered the system in a non-trivial way. The cap on ETS sectors emissions over the entire period effectively becomes an upper bound with downward adjustment flexibility. In addition, this means that any 'complementary' policy that reduces GHG emissions in ETS-covered sectors *in the near term* has the potential to alter the total cap on emissions in the system (the 'punctured waterbed' effect, see section 4.3).

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[39] Some of the previous modelling of the price impact of the EU ETS extension to transport and buildings exhibits incorrectly modelled price dynamics. For instance, Cambridge Econometrics (2020) show real annual prices actually falling – year on year - post 2030 and an assumption that prices rise sharply at faster than the real rate of interest in the period up to 2030. Thus banking is – wrongly - ignored within periods and borrowing is assumed to be necessary between the pre-2030 and post-2030 periods.

[40] See Lepone et al. (2011).

[41] A distinction can be made between quantity-based and price-based market stability mechanisms (Vivid Economics, 2020). The former are triggered by allowance quantities conditions whereas the trigger of the latter is contingent on some price based condition.

[42] "The TNAC in a given year is defined as 'the **cumulative** number of allowances issued in the period since 1 January 2008, including the number issued pursuant to Article 13(2) of Directive 2003/87/EC in that period and entitlements to use international credits exercised by installations under the EU ETS in respect of emissions up to 31 December of that given year, minus the cumulative tonnes of verified emissions from installations under the EU ETS between 1 January 2008 and 31 December of that same given year, any allowances invalidated in accordance with Article 12(4) of Directive 2003/87/EC and the number of allowances in the reserve' (European Commission, 2015a, p. 3)." (Vivid Economics, 2020, p.16).

Market participants' expectations about implications of these changes will be reflected into both present and future EUA prices. A "high EUA price world" and a "low EUA price world" would have very different economic and political implications.

With extension, it will be important to think again about (price smoothing) mechanisms and EU ETS design. It would be possible to introduce formal price collars and or minimum and maximum prices. This is done in other schemes such as California and RGGI. The MSR would be a mechanism which could be used to do this explicitly. Fischer, et al. (2019) makes the case that the existence of "complementary" policies requires the introduction of an auction reserve price (i.e. a form of market stability mechanism) in the EU ETS.

One might also need to consider formally introducing borrowing from future phases. It might be needed if you have sectors that can only deliver over the (very) long term. Banking and borrowing smoothens any anticipated price impact. The question is whether borrowing is necessary in the near term given that there is a huge overhang of permits at the moment, which could be helpful in smoothing the rise in the EUA price.

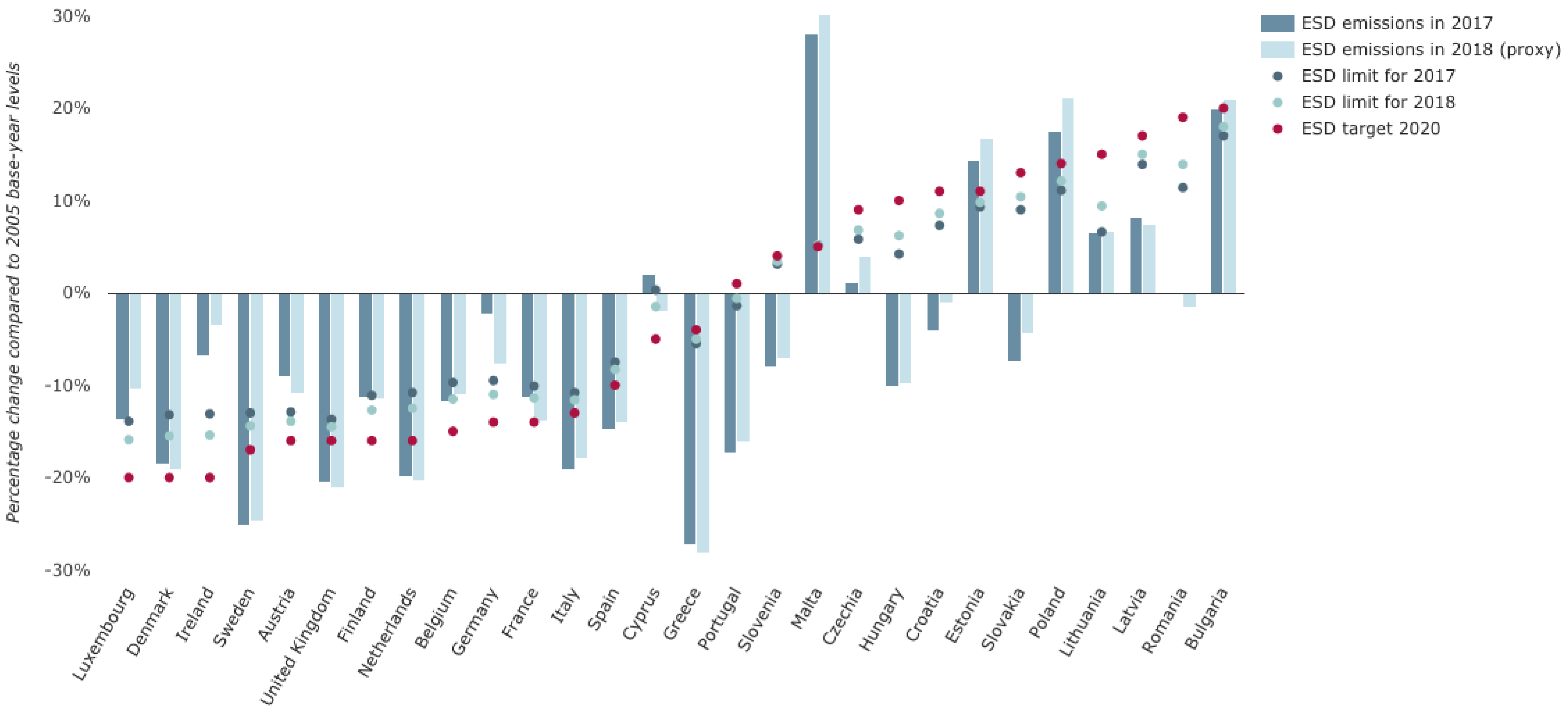
4.2 Sectoral burden sharing

It is very likely that including emissions from road transport and buildings in the ETS will result in a different sectoral distribution of abatement across sectors than under the current policy framework. Specifically, given the relatively higher cost of emissions reduction in these sectors (compared to incumbent ETS sectors), one can expect, all else equal, that for a given equilibrium EUA price more emissions reductions would occur in sectors currently included in the scope of the EU ETS and relatively few emissions reductions in the road transport and heating sectors, at least in the short to medium term (i.e. to 2030). Several modelling exercises have provided support to that view (e.g. Cambridge Econometrics, 2020).

This sectoral shift in emissions reduction might also mean that sectors currently falling under the scope of the Effort Sharing Decision (ESD) (EU, 2018) would reduce their emissions more slowly than currently prescribed by the Decision. The Decision currently requires the EU-28 to achieve 10% reduction (compared to 2005) in the non-ETS sectors by 2020 and a 30% reduction by 2030. This EU-wide objective is, however, translated into MS-specific targets that some of them have struggled to achieve. It is all but uncertain that they would be able to meet more stringent ESD objectives based only on existing EU or national policies.

Shifting the burden from transport and buildings to other sectors means that they might deliver reductions later than under their respective ESD trajectories. This is not to say, however, that no emissions reduction would happen in these sectors in the short to medium term. In addition, the inclusion of these sectors in an ETS whose emissions budget is consistent with the climate target might actually provide incentives for complementary policies to support investment in hydrogen, zero carbon new buildings, etc. As alluded to above, what matters for the trajectory of EUA prices is that GHG emissions buildings heating could be reduced within the time horizon (i.e. by 2050), not that they respond immediately.

Figure 4-1 Current progress of Member States towards their 2017 and 2018 Effort Sharing targets



Source: EEA - https://www.eea.europa.eu/data-and-maps/indicators/greenhouse-gas-emission-trends-6/assessment-3

4.3 Interaction with other EU and national-level policies

A significant concern is that extension of the EU ETS will lead to a weakening of existing complementary environmental policies. An argument might be made on the grounds that the EU ETS extension reduces the need for efficiency standards in transport and buildings. 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. This however is only partially true. Environmental standards for buildings and transport are about more than GHGs, they importantly address local pollutants and customer myopia. Indeed, it is important to note that these policies – and their regular tightening – 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 alone. It would also highlight the role of complementary policies in keeping EUA prices down.

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, emissions reduction in these sectors could eventually be less than those that would have been observed under the current institutional arrangements. In other words, inclusion of these sectors in the EU ETS does not imply emissions reduction, at least in the short run. *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.

However, 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, 2020), 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

Given the existence of "complementary" policies in transport and buildings, such policy overlap and interaction between the ETS and other policies will be extended. In particular, the EU ETS would come to interact directly with the Passenger cars performance regulation and the Energy Performance in Buildings Directive, Energy Efficiency Directive, Ecodesign Directive and Energy Labelling Directive.

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).

Box 4 – Punctured waterbed (adjustments to overall cap)

Perino et al. (2019) highlight that the current design of the EU ETS Market Stability Reserve makes the presence of 'complementary' policies very consequential for the EU ETS itself. Indeed, as highlighted in section 3.1.1, the cancellation mechanism of the MSR that starts operating in 2023 would reduce the number of available allowances in the EU ETS and reduce the overall cap. This means that complementary policies leading to substantial emissions reduction in the near term and increasing the number of allowances placed in the MSR would have the potential to affect the overall EU ETS cap. Bruninx et al. (2019) also note that the presence of this mechanism introduces significant uncertainty as to the overall emissions reduction and make the price of EUA allowances sensitive to the timing of emissions reduction implied by complementary policies.

When considering an extension of the EU ETS to road transport and heating fuels, one must keep this mechanism in mind. The exact outcome, however, depends on a number of factors: (i) the stringency of the (scope) adjusted EU ETS cap, (ii) the stringency of complementary policies, (iii) the response of emissions to the new policy package.

The potential for additional supportive policies among MSs

In spite of the existence of the EU ETS, richer MSs have introduced additional policies to promote CO_2 emissions reduction (further emissions reduction schemes in electricity and inclusion of electricity fuels in carbon tax schemes). This suggests a desire for complementary rather than substitute policies in the face of EU carbon pricing.

Moreover, (ambitious) complementary policies introduced by richer MSs would lower EU ETS allowance prices, creating a wealth benefit for all other countries in the system. This is likely positive for other countries in heating and transport because these are sectors where welfare due to energy is wholly about price, rather than in electricity where there have been concerns about negative effects on producers of price lowering measures, who may have past investments written off.

05

CHANNELS OF INEQUALITY: ECONOMIC AND DISTRIBUTIONAL IMPACTS

5. 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 a number of factors, which are reviewed in this section. First, it will be affected by the size of the increase in retail fuel prices triggered by the newly imposed carbon price.[43] This, in turn, depends on the level of pass through of carbon prices to fuel prices by fuel retailers (5.1.1). Second, it will be determined by the own price elasticity of demand for the fuels for different end-user categories (5.1.2). In this respect, we make a distinction between commercial/industrial users and households. While the former might have the possibility to pass the increase in fuel prices to their customers, households cannot and hence assume the burden of any retail price increase in full.

5.1 Within country impacts

5.1.1 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.

The crucial question is *by how much?* Given that fossil fuels are (in most European countries) a necessity and that price elasticity is quite low, the pass-through rate of increases in the carbon price would very likely be high. That is, most of the increase in the price of carbon would be reflected in higher retail fuel prices. This is especially important since, in a system where the point of regulation is upstream fuel retailers, the magnitude of the pass-through to end-users of fuels will largely determine the burden sharing of the new carbon price between retailers and end-users (consumers). It matters also because the level of pass-through will affect consumers' response to carbon pricing as it will affect the price change that they're eventually exposed to – *tax incidence* (Andersson, 2019).

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.[44] These studies find evidence of full pass-through.

In addition, ex-ante studies aiming at estimating the impact of carbon pricing mechanisms on emissions when applied to transport and heating fuels have often assumed full pass through. In the case of the California ETS, for instance, Borenstein, Bushnell, Wolak, & Zaragoza-Watkins (2019) assume full pass through of GHG emission price to end-use consumers.[45]

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[43] This note focuses on the impacts on the transport and buildings sectors. It therefore abstracts from any general equilibrium effects.

[44] Evidence for the US: Marion and Muehlegger (2011); Davis and Kilian (2011); and Li, Linn, & Muehlegger (2014) . Evidence for Europe:Meyler (2009).

[45] "For transportation fuels, we assume full pass-through of the GHG cost of tailpipe emissions, but no pass-through of GHG cost from refinery emissions due to output-based free allocation. Moreover, they acknowledge that "output-based allocation of emissions allowances reduce firms' marginal cost of production and, thus, reduces the pass through of allowance price to consumers, and the associated reduction in consumption of these goods" (Borenstein, Bushnell, Wolak, & Zaragoza-Watkins, 2019), p. 17.

5.1.2 Effect of higher energy prices on households and industries

Fuel price elasticity of demand

Estimates of own-price elasticity 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. Two possible explanations for this being that they perceive tax changes as either more permanent or more salient. Either way, this means that a carbon price signal is perceived as more credible than a 'market' induced rise in 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):[46]

- 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[47].

Second, carbon taxes or cap-and-trade programs can be designed to alleviate their regressive effects (e.g. through uniform transfers, see section 6.2.2) (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.[48] 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, particularly between those living in rural and urban areas or between central cities and suburbs in lower income octiles (Eliasson et al., 2016). Earlier work reported in Sterner (2007) makes it clear that car ownership is a major driver of the regressive effect in transport. If the poor disproportionately own and use cars (especially for commuting) this can cause regressivity, but this by definition can only be true in relatively rich countries where lower income deciles can afford a car[49], so for poorer and middle income countries transport fuel taxation is progressive.

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[46] (Burke, et al., 2020) also note that there can be differences in impact between households of similar income.
[47] See Berkovec (1985) for a discussion of car market dynamics.
[48] 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.
[49] 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.

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).

Current and projected (baseline) fuel consumption

Current and projected consumption of fossil fuels (per capita) for road transport and heating purposes constitute another key determinant of the impact of an extension of the EU ETS to these fuels, on both end-users of these fuels and the economy as a whole. The higher the underlying increase in demand for fossil fuels, the higher the carbon price impact will be.

5.2 Between country impacts

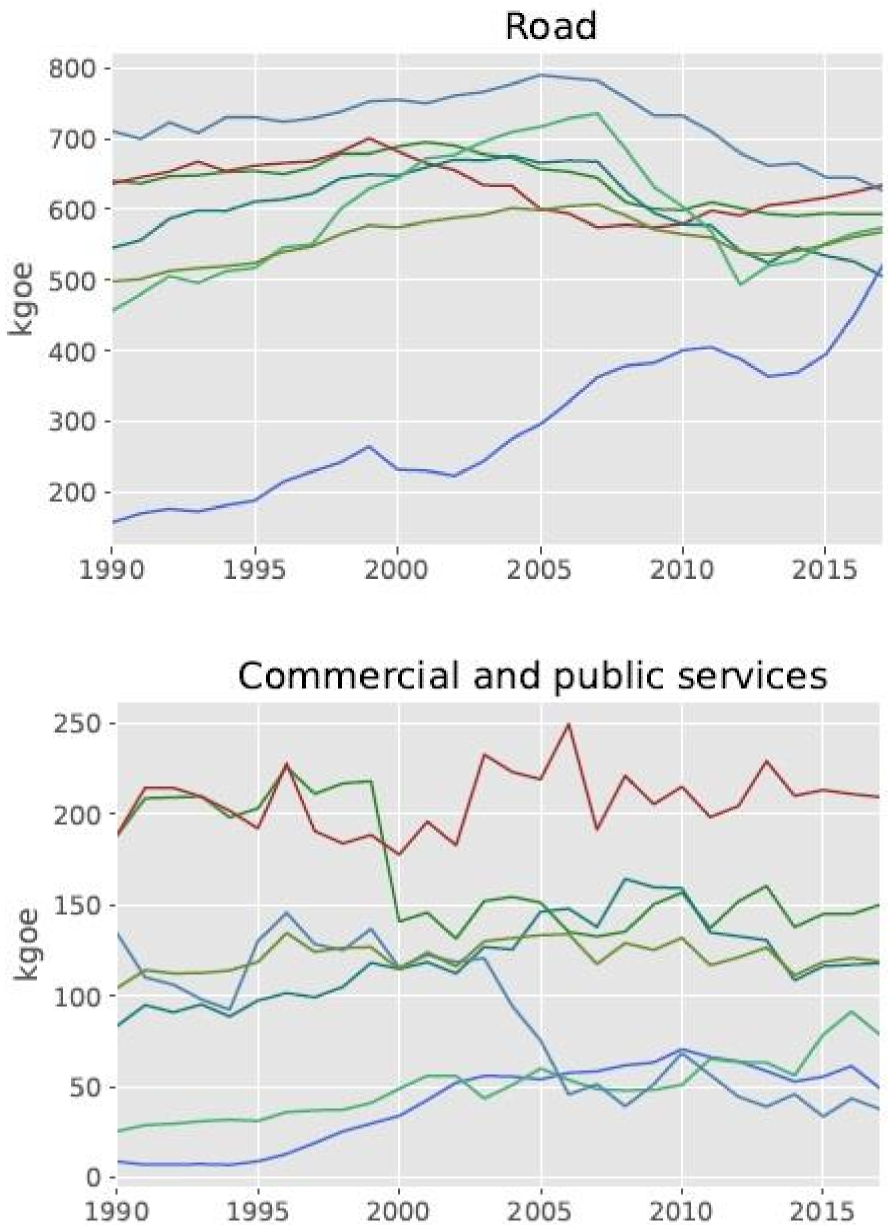
The strengthening of EU climate policy required to achieve net zero emissions by 2050 will also have heterogeneous wealth/income effects across MSs. This is particularly important as climate neutrality will require efforts by all MSs, including the poorer ones (Oko-Institut and Agora Energiewende, 2020). This removes the possibility to assign different ESR reduction targets to MSs according to their GDP per capita, which had been the practice thus far and provided a key flexibility to alleviate the burden on poorer MSs.

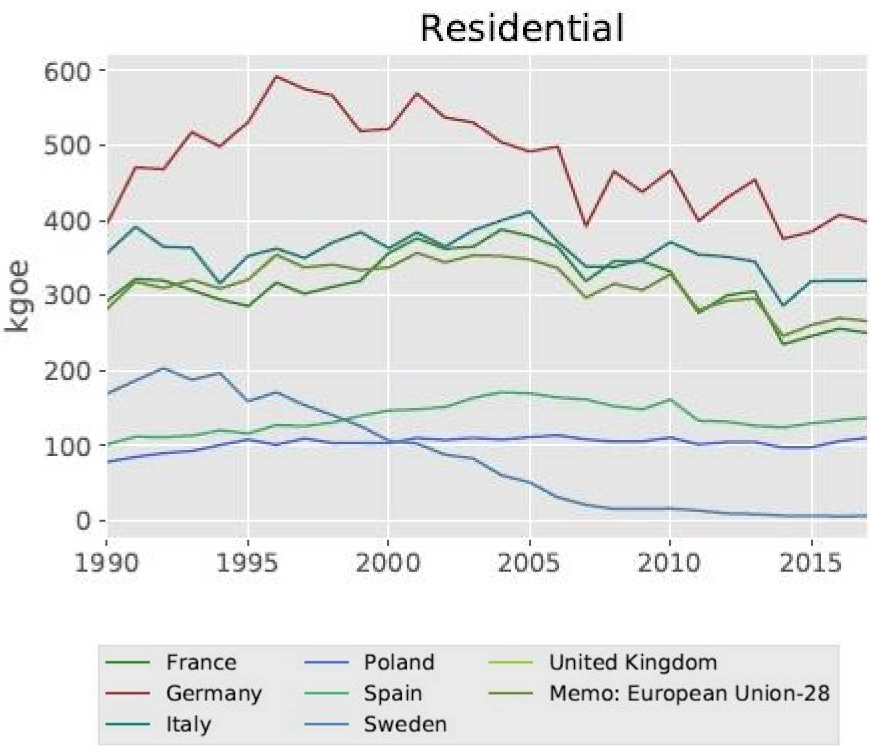
One way to assess the relative impact of more stringent emissions targets – whether enforced through an ETS cap or mandated reductions – in the road transport and heating sectors is to look at fuel consumption per capita in these sectors across EU MSs. In that regard, the transport and buildings sectors differ. While per capita consumption of fossil fuels for road transportation is relatively homogeneous across EU countries (see Figure 5-1), a much more heterogeneous picture emerges when looking at consumption for heating purposes, both commercial and residential.[50] The fairly homogeneous picture across MSs for the transport sector is unsurprising since the car fleet composition and efficiencies are roughly similar.[51] 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.

[50] Given that no technology currently exists to abate emissions at the tailpipe of vehicles equipped with internal combustion engines or at the chimneys of building's heating boilers, there is an almost one to one relationship between fuel consumption and CO_2 emissions in these sectors. Hence the patterns identified based on fuel consumption also apply to CO_2 emissions.

[51] One exception might be Norway, which has a significantly larger share of all electric and hybrid vehicles in its fleet (around 15%).

Figure 5-1 – Road transportation and heating fuel consumption per capita, 1990-2017





We note that these inter-country differences in the consumption of transport and heating fuels have been relatively stable over time, with no country significantly reducing or increasing transport or heating fuel consumption compared to 1990 levels. Two notable exceptions are Sweden, which reduced consumption per capita across all sectors, and Poland, whose road transport fuel consumption (per capita) increased dramatically since 1990 and now compares to that of richer EU countries and is close to the EU-28 average.

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 particular, a legitimate question is whether the least well-off Member States also happen to be the ones with high consumption of fossil fuels in transport and heating? The picture is contrasting. 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, Ӧko-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 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.

06

FEASIBILITY OF AN EU ETS EXTENSION

6. Feasibility of an EU ETS extension

6.1 Legal process and institutional considerations

The legal processes by which the scope of the EU ETS can be extended are reasonably straightforward (Bragadóttir, Magnusson, Seppänen, Sundén, & Yliheljo, 2015; Öko-Institut and Agora Energiewende, 2020). First, an amendment to the EU ETS directive, which would extend the scope in all EU ETS participating states. Second, application of the `opt-in' clause, which would extend the scope within individual member states. Both approaches have been used before. The former for an extension to domestic aviation; the latter for an extension to specific point sources or gases in countries like Sweden, which included district heating plants below the 20MW threshold, and Norway, when it chose to include N_2O.

Aside from clearing the legal process, an extension of the EU ETS will have to account for – and overcome – a number of institutional and political hurdles.[52] From the EU perspective, a primary concern will be to preserve the integrity and credibility of the ETS. A key to this credibility is the MRV framework. At its inception, the ETS did not include road transport and heating sectors because starting with sectors comprised of large stationary sources for which monitoring and verification of emissions was feasible seems to have been the prevailing thinking at the time (Bragadóttir, Magnusson, Seppänen, Sundén, & Yliheljo, 2015).[53]

Under a scenario of an upstream point of regulation in these sectors (e.g. fuel supplier), emissions would be estimated based on the carbon content of fuels and the total quantity of fuel supplied. Yet emissions from fuel combustion could be reliably estimated based on fuel-specific emissions factors, as is currently the case for emissions from fuel combustion in air transportation.[54]

In addition, inclusion of the aviation industry in the scheme means that stakeholders would be familiar with the method. In short, there is no major technical difficulty that would stand in the way of an accurate and relatively inexpensive MRV framework for these sectors. The main sticking point is likely to lie in the interaction with other EU climate policies – see section 4.3. The European Commission might consider reviewing some aspects of the policies that would interact with an extended scheme, i.e. Energy Taxation Directive, Passenger cars performance Directive, as well as Energy Performance in Building Directive and Energy Efficiency Directive.

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 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, 2020).

[52] Exactly how it will play out will depend on initial EU- and national-level conditions (see previous section).
[53] "The MRV rules lay the foundation for the selection of which sectors can be included (CEC, 2008a, pp. 32–33). In connection with the revision of the scope of the EU ETS for Phase 3, the Commission stated that the ETS should cover emissions which can be monitored, reported and verified with the same level of accuracy as the emissions covered by the Directive already included in the EU ETS (CEC, 2008b, p. 4)." (Bragadóttir, Magnusson, Seppänen, Sundén, & Yliheljo, 2015, p.22). The intention was, however, for the system to be open for gradual geographical, sectoral and gas coverage extension (CEC, 2000, p. 10). Other considerations such as transaction and compliance costs as well as the present and projected share of the emission source in total EU GHG emissions were part of the decision-making process. In addition, (Convery, 2009) notes that "implicit in the focus on the power sector and heavy industry was the decision to go downstream."
[54] These are calculated based on emission factors presented in Table 2 of Annex III of the Commission Regulation on the monitoring and reporting of greenhouse gas emissions (EU 601/2012).

However, as was pointed out in section 3.1.2, 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. This in turn would force only few countries to forego – in relative terms – fiscal revenue upon expansion of the ETS.

6.2 Managing the political economy

Although extending the EU ETS to road transport and heating fuels is in essence a binary decision, EU policy makers retain some discretion over the process by which it would occur.[55] Given the existing policies and institutional arrangements highlighted above, decisions made about this process might bear consequences for both the environmental effectiveness of the policy change and its political acceptability.

6.2.1 Neutralising the initial impact of the policy change

The desire to make an extension of the EU ETS appealing to voters in some constituencies might lead some member states to consider downward adjustments to the current level of their existing fuel duties. This could neutralise/sterilise the effect of the policy change *upon introduction* and allow for a smoother transition into the new policy regime. This will depend on (i) country-specific externalities and road usage costs, (ii) current excise duty levels. As we saw, a few countries are clearly in a situation where adjustments to their national (tax) schemes may be warranted and where there is scope for sterilisation.

Box 5 – The cases of France and Sweden

Several Member States changed the scope (or adjusted the effective rate) of their national excise duty in parallel to the introduction of national carbon taxes or the introduction EU ETS in 2005.

France: in 2014, France introduced a 'carbon tax' or, rather, a carbon content-based component into the "taxe interieure de consommation sur les produits energetiques (TICPE)". Upon introduction, it fully sterilised the effect of this introduction by reducing the other components of the tax.[56]

Sweden: in 2005, it removed industry (but not power and heating) stationary sources covered by the EU ETS from the scope of its national carbon tax.

Policy responsibility and environmental race to the bottom?

One concern raised during past discussions of EU ETS extension to road transport and heating fuels is that it might have provided an opportunity for MSs to lower the stringency of national policies, in particular substantially reduce excise fuel duties. Indeed, an interesting consequence of this institutional development would be that, by removing the road transport and heating sectors from the scope of the Effort Sharing Decision, the responsibility to introduce policies to achieve mandated emissions reduction in these sectors will no longer lie with MSs.

[55] Policy makers also have ample discretion with regard to the design of the market. However, a detailed discussion of market design adjustments is beyond the scope of this report.
[56] The Gilets jaune (Yellow Vests) movement in France of 2018 had rising fuel taxes as one of its motivations. 2017-18 saw a very large rise in fuel taxes (partly due to carbon prices) combined with higher commodity and distribution costs. This shows the importance to timing and framing of carbon price induced rises in price. It also shows the difficulty of EU countries going it alone on raising carbon prices.

However, we see limited scope for such dynamics to take place. The risk that EU countries take advantage of this policy change to significantly reduce excise duties seems limited in light of the substantial fiscal impact that this would have. If anything, there is ample evidence that MSs have over the last decade enacted GHG-reducing policies that go beyond current EU targets (Öko-Institut and Agora Energiewende, 2020), either to avoid collateral local pollution damages or because they do bear a substantial share of the global cost of a changing climate (Tirole, 2012).

More importantly though, is that the existence of a (steadily declining) carbon budget encompassing road transport and heating fuels would now ensure emission reduction in these sectors across all MSs, regardless of their national policies.

6.2.2 Alleviating distributional impacts

As described in section 5, pricing CO_2 emissions resulting from the combustion of road transport and heating fuels will have serious distributional impacts, both within and between EU MSs. Those impacts require effective instruments and governance to alleviate unintended consequences among the most vulnerable segments of the society. In line with European Commission's intention to include distributional effects' evaluation in its legislative impact assessment process, 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 mechanisms (e.g. the Just Transition Fund).

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. 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 bill[57]. This would in theory leave most poor households better off. However, it is important to acknowledge that the extra revenue which extension of the EU ETS to buildings and transport would raise would have many calls on it and that direct compensation, compensation for indirect carbon costs via State Aid Guidelines, and expenditure on innovation and energy efficiency investments, not to mention other fiscal priorities, will compete with each other for the available revenue.

[57] 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.

In California, redistribution of this 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.

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. This would constitute a new mechanism devoted to limit distributional effects and could be further explored in order to ensure that such a measure would have the expected impact.

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.

Existing countervailing mechanisms

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.[58] Thus households whose heating bills are already paid by the state or subject to low income price adjustments can be assisted relatively easily.

Energy efficiency investment

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

Final price sterilisation

It is possible in many cases to reduce other energy taxes to accommodate the initial impact of the extension of carbon pricing. Much of the benefit of EU ETS extension is in the future and arises due to its dynamic impacts. Smoothing the short to medium term impact by an initial tax reduction could make a lot of sense in some particularly sensitive prices. One of the interesting observations that can be made about this is that it can be left to individual MSs to make these decisions as these taxes are not wholly specified by the EU. As we have noted the starting point of fuel taxation is very different in transport and heating in different countries.

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

6.3 Timing and sequencing

6.3.1 Timing it right

The timing and sequencing of the extension (i.e. the possibility of introducing one sector after the other) will affect the ability of Member States to "cope" with it and hence the political economy of such an extension. A key issue is the initial expected price impact at time of introduction, given that the real price is then expected to rise at the real rate of interest.

There may be a risk that a large extension could end up being the Trojan horse of the ETS, i.e. that its implications (e.g. in terms of EUA price) become so unpalatable to some sectors that the scheme gets scrapped entirely. This might happen if the EU ETS price effect and its distributional impacts were so large as to provoke a political backlash. The expected changes in EUA price might indeed have substantial wealth effects on both the new and incumbent sectors. Understanding / quantifying these would allow foreseeing these sectors' reaction to institutional adjustments. Hence, from a political point of view, the extension should leave the EUA price unchanged *in expected terms*.

Ideally also, the introduction should happen at a point where underlying commodity prices about to fall because it would soften the shock created, yet anticipating these commodity price changes is very difficult.

6.3.2 Extending to heating and transport fuels: a differentiated case?

Notwithstanding the theoretical grounds for the introduction of a mechanism pricing the carbon content of both of road transport and heating fuels, the practical case for it could be materially different.

In the transport sector, the carbon price would come on top of already high road transport fuel duties. Introducing a carbon price at, say, €25/tCO_2e would raise the price of a litre of petrol by about 5.75 cents, which is not small. This would most likely have to be sterilised upon introduction. Given currently high road transport fuel duties (see section 3.1.2), this might be relatively straightforward (at least compared to the lower duty levels on heating fuels). In light of the reduced excise duty (and VAT) rates on heating fuels, sterilising or alleviating the initial impact on consumers of heating fuels would require more elaborate policies.

The case for either sector should also take into account current trends in coupling with the power sector, where carbon is already priced. In the buildings sector, where electricity and natural gas compete for use for space heating purposes, pricing the carbon content of natural gas would ensure a harmonized carbon pricing across the power and natural gas provision sectors.[59] In the transport sector, although at an earlier stage of development than power and gas, increased coupling of transport and energy networks make the case for extension of the EU ETS to the former grow stronger.

Total transaction costs for firms included in the EU ETS following its extension are likely to be the same regardless of whether the extension is to both heating and road transport fuels or only one of these fuel categories. Indeed, under a system where the point of regulation is at the level of upstream fuel suppliers, including either of these fuel categories in the EU ETS would require to set up a monitoring, reporting and verification framework that would be virtually identical and involve the same participating actors. Hence there could be substantial economies of scale in including both road transport and heating fuels in the system at once. Past evidence suggests that firms with larger

[59] Note that for some countries, e.g. Finland and Sweden, the extension of the ETS to heating fuels would not alter their respective coverage of national GHG emissions by the ETS since a large share of heating is supplied by district heating networks, the combustion installations of which are already covered by the ETS either by default or because these countries chose to opt-in several of their district heating installations below 20MW.

pollution levels regulated under the EU ETS faced lower transaction costs *per tonne of CO_2* (Jaraite, Convery, & Di Maria, 2010).

From a dynamic perspective, long term signals and policy credibility are very important for private investment (Dixit & Pindyck, 1994). A strengthening of climate policy brought about by the introduction of a stringent pricing mechanism would strengthen investment incentives for emissions reduction in both road transport and buildings sectors. It is particularly interesting to include road transport fuels because underlying demand for road transport fuel is growing but such a signal, possibly combined with additional measures, could also provide a strong signal to further reduce heating fuel emissions – and hence CO_2 emissions.

Finally, the theoretical case for extension of the EU ETS in both buildings and transport is the same. It is about setting carbon reduction targets within a tight overall trading cap consistent with climate policy goals. We have seen that either separately or together extension to transport and/or buildings would be a major extension in the history of the EU ETS. Given that the economic theory behind the extension is stronger if both sectors are taken together, it would seem to be sensible to make the argument for a major extension only once between now and 2050 – give the length of time it might take to agree and implement - if such a policy is to play a major role in meeting EU climate targets.

The above provides little support for a separate introduction of road transport and heating fuels in the EU ETS. Although an extension to the road transport fuels might be more easily sterilised and hence easier to implement, several other considerations lend support to a joint inclusion of these fuels in the EU ETS.

07

CONCLUSION

7. 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.

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 28% in the EU-28 compared to 1990 levels, with significant disparities between EU countries. In the road transport sector, emissions in the EU-28 are 23% 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. 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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