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Carbon market spotlight: **Discussing sector extension options for the EU ETS**

Discussing sector extension options for the EU ETS

FLORIAN ROTHENBERG, SEBASTIAN RILLING MARCH 2021

Executive Summary

- With the upcoming review of the EU's 2030 emission reduction target, sectors which are not currently covered by the EU's Emission Trading System (EU ETS) will have to increase their emission reduction efforts.

- This concerns transport, buildings and small industry sectors, currently covered by the Effort Sharing Regulation (ESR). In 2018, these sectors generated 2,204 Mt of emissions.

- To achieve a 55% net reduction target by 2030, as proposed by the European Commission, these emissions need to go down to 1,524 Mt by 2030 (38% below 2005 levels).

- While short-term abatement potential is limited, long-term emission reduction options via electric vehicles and heat pumps are readily available technologies with the potential for large-scale implementation.

- From an investor's perspective, abatement potential through electrification remains economically unattractive in the absence of financial subsidies and a carbon price signal.

- However, if a carbon price of € 100/tCO2e were implemented, 225 Mt of abatement potential would be unlocked across the EU and the named sectors.

- This potential increases to 679 Mt by introducing subsidies which offset investment costs at the same € 100/tCO2e carbon price.

- We conclude that the introduction of a fuel ETS through an upstream coverage of fuel suppliers could help to cost efficiently achieve the EU's emission goals and would allow for the targeted sectors to link with the existing EU ETS.

- However, our analysis highlights that early inclusion of such a system into the EU ETS remains unlikely, as carbon leakage and liquidity concerns could outweigh the economic efficiency argument amid high long-term abatement costs and the lack of short-term flexibility.

- Therefore, a gradual phase-in of a separate fuel ETS with increasing flexibilities with the EU ETS could present a politically viable option in the mid term.

Introduction

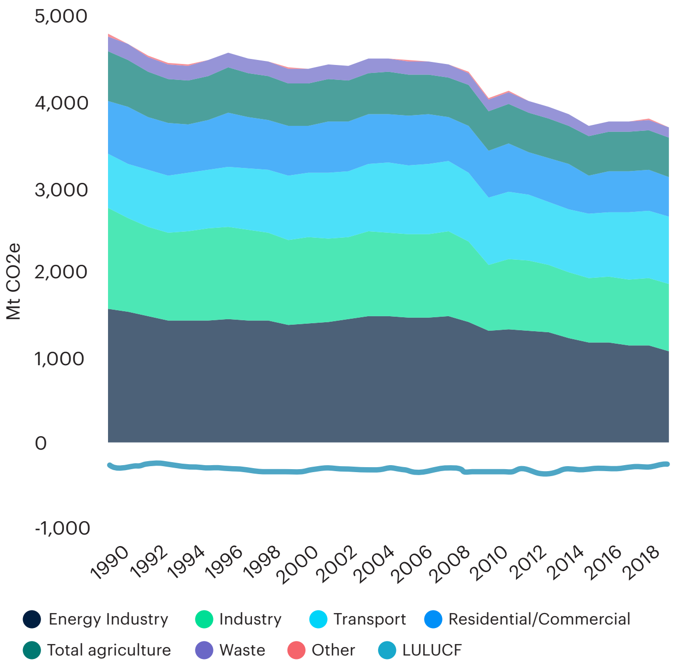
In September 2020, the European Commission published its proposal for a European Climate Law. In the proposal, the Commission suggests raising the 2030 emission reduction target to 55% net (including sinks), up from currently 40% gross (excluding sinks) compared with 1990 emissions[1]. Trilogue negotiations with the Council (in support of 55% net target) and the Parliament (favours a more ambitious 60% gross target) are ongoing. We expect the three institutions to finally land on a 55% net target.

The European Emission Trading System (EU ETS) has been one of Europe's central decarbonisation instruments thus far. However, to achieve the increased 2030 target and reach climate neutrality in the long run, more effort will be required from sectors outside the EU ETS. Those sectors, currently covered by the Effort Sharing Regulation (ESR), include transport, construction, agriculture and small industry, accounting for 2.2 Gt of emissions in 2018.

In the impact assessment (IA) that accompanied the Climate Law presentation last year, the European Commission discusses the option of introducing a carbon pricing scheme for the sectors not currently covered by the EU ETS, such as buildings and road transport. The Commission did not specify how the pricing scheme would be designed; possible options include introducing a carbon tax on fuels, an extension of the EU ETS to cover more sectors, or the creation of a separate trading scheme for these sectors.

This paper assesses the different options being discussed, with a view on the required effort, scope, and implications for the existing ETS. For this paper, we focus on the EU-27 countries, excluding the UK and EEA countries which are currently part of the EU ETS. We do not assess maritime shipping within this paper given this sector is very different to the assessed ones, and will be thoroughly analysed in a separate forthcoming publication.

Figure 1: Historical emissions in EU-27 by sector, 1990 to 2018



Source: ICIS analysis of EEA data

Setting the scene: Emissions by sector

Net emissions in the EU-27 (including carbon sinks but excluding emissions from cross-border shipping and aviation) amounted to 3.47 Gt in 2018, down 1.1 Gt or 24% from 4.56 Gt in 1990 as per figure 1. To reach a 55% net target, this total would have to decrease to 2.05 Gt by 2030.

In 2018, stationary installations covered by the EU ETS emitted 1.53 Gt of CO2 equivalents, a number which has further reduced to 1.33 Gt in 2020 (ICIS estimation), down by 39% compared with 2005 when the ETS was introduced (-26% in 2018). At the same time, emissions covered by the ESR reduced by only 10% compared with 2005, standing at 2.2 Gt in 2018.

In our modelling, we assume that, by 2030, the LULUCF sector will contribute 300 Mt of sinks to the overall target, up from 263 Mt in 2018. While the IA in its base case assumes only 225 Mt of emission removals from LULUCF, we would expect increased effort in this sector should lead to a more ambitious sink scenario in accordance with the IA.

[1] Sinks are mainly represented by land-use, land-use-change and forestry (LULUCF).

Projected emissions would have to be reduced by an additional 437-701 Mt by 2030 to achieve the necessary emission reductions in the ESR sector.

The stationary ETS sector will contribute 35% of total emissions by 2030, leaving the ESR sectors with 1.52 Gt of emissions budget by 2030, 38% below 2005 levels and 31% below the latest figures from 2018[2].

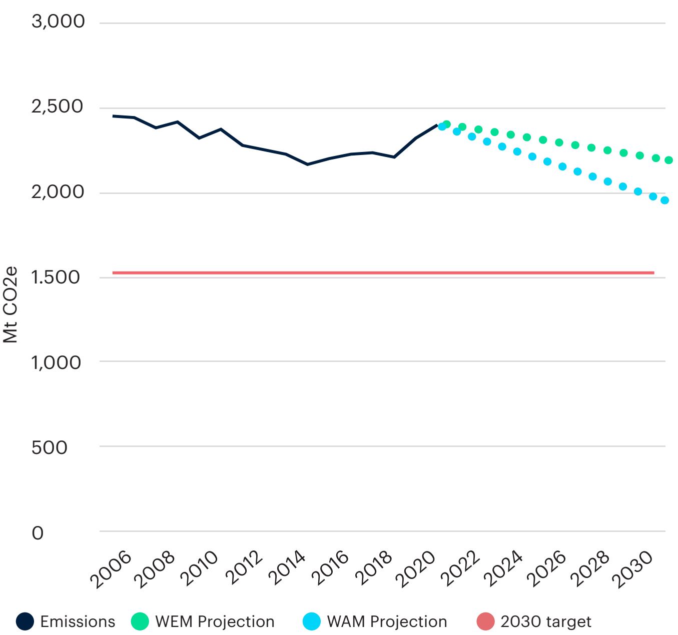
Comparing this target with projected emissions shows that there remains a significant gap to be bridged by 2030 to achieve the assumed emission reduction target for the current ESR sectors. Projected emissions would have to be reduced by an additional 437-701 Mt by 2030, depending on whether only currently existing instruments (with existing measures – WEM scenario[3]) or additional instruments are applied (with additional measures – WAM scenario[4]), see figure 2.

Is the German fuel ETS a role model for the EU?

If either a carbon tax or an emission trading scheme were implemented, the EU would likely opt for an upstream system in which fuel suppliers would be targeted by the measure. The largest part of the emissions in the ESR comes from fuel combustion, especially by construction and transport. Depending on the scheme chosen, fuel suppliers would participate in a trading scheme or pay a fixed carbon tax for the fuels they sell to their customers, who in turn would participate only indirectly, decreasing the bureaucratic burden for private consumers and small businesses.

A similar system entered into force in Germany in 2021. While the system is called “national emission trading scheme”, during the first years of the scheme the price development follows a pre-determined path, starting at € 25/tCO2e in 2021 and increasing to € 55/tCO2e in 2025. In 2026, certificates will be auctioned within a price corridor of € 55-65/tCO2e, aiming to put in place a freely traded cap-and-trade scheme by 2027. The compliance obligations rests with the fuel supplier, who passes on the cost to their customers. The German system accounts for potential double counting within the EU ETS and the national scheme by giving operators the option of either being exempt from the system, or getting an ex-post compensation for their costs under the national scheme. Similar upstream systems are in place in the California-Quebec ETS and the New Zealand ETS.

Figure 2: Historical and projected emissions and 2030 target for the ESR sector



Source: ICIS analysis of EEA data

If the EU were to introduce such a system on the European level, it could opt to define a pre-determined cap for this system. Assuming that the full emission reduction in the ESR sector is to be shouldered by such a scheme targeting fuels only, the scheme would have to reduce emissions by 680 Mt between 2018 and 2030. This compares with an estimated total of 1,501 Mt of fuel-related emissions from the ESR sector in 2019 (source: ICIS analysis of EEA data and Eurostat energy balances).

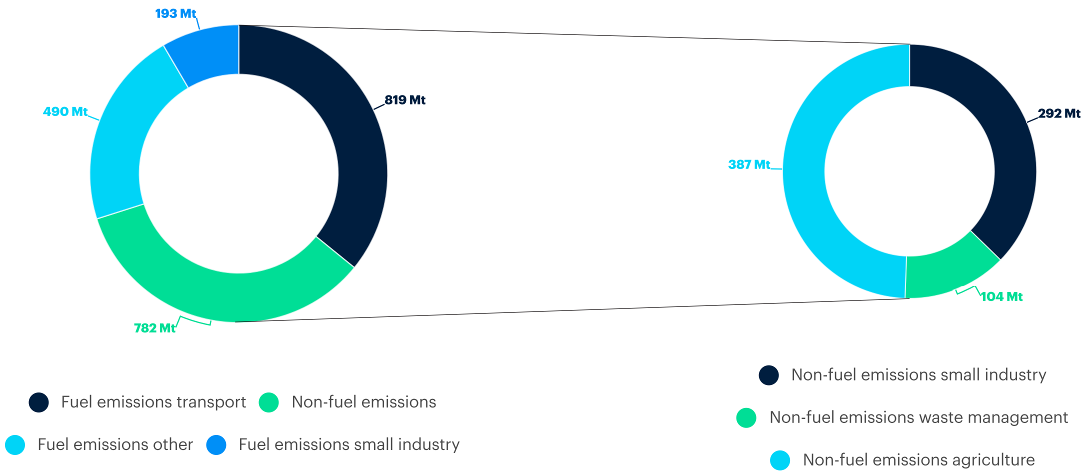
However, as Figure 3 shows, a large proportion of emissions in the non-ETS sectors are not directly attributed to the combustion of fuels. Notably, 394 Mt of CO2e in agriculture are not fuel-related. In the small-industry sector, another 86 Mt in 2018 were attributable to Greenhouse Gas (GHG) emissions from

[2] See tables 27, 51 of the Impact Assessment

[3] Existing measures include, e.g., measures laid out in the EU’s Energy Efficiency Directive, such as energy efficient renovations and efficiency standards for buildings, as well as emission standards for cars.

[4] Additional measures include measures that are currently being discussed or in the legislative process. For example, the German national emission trading scheme would fall into the “additional measures” category, as at the time of the projection the system had not yet been adopted.

Figure 3: Emissions breakdown for ESR sectors, 2019 estimate



Source: ICIS analysis based on EEA and Eurostat

ozone-depleting substance (ODS) substitutes, such as hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs). These emissions would not be subject to a fuel carbon price, so reducing their impact would have to be tackled differently.

How to fill the gap?

The above findings show a significant gap between a 55% ambition and the current measures implemented by member states. To reach the target, additional action would be required to intensify existing regulatory measures, such as vehicle standards, the implementation of carbon pricing or a combination of both. To evaluate the feasibility of a trading scheme, we assess abatement costs for fuel combustion in the non-ETS sectors in this section.

Short-term abatement potential in ESR sectors is limited

One important recent criterion for the success of the EU ETS is its capacity for short-term emission reduction in the power sector via fuel switch. The increasing EUA price since 2017 has acted as an efficient dispatch signal for power generation, which is able to vary emissions by about 400 Mt in a price range between € 0 and € 75/tCO2e, the equivalent of more than a quarter of EU ETS emissions. This important flexibility allows the market to balance and find a price efficiently depending on fuel prices, weather and participants’ risk appetite.

Studies also show a certain short-term price elasticity for fuel consumption in the **transport and buildings** sector. Empirical findings from Germany in 2021 suggest a price elasticity for gasoline of -0.25, whereas diesel price elasticity was absent. Other studies imply a short-term sensitivity of between -0.3 and -0.6 (Frondel and Vance 2018, Gillingham 2019) for the whole EU and all transport fuels. Applying the findings, we estimate a short-term emissions flexibility for the non-freight transport sector of between 20-120 Mt in a CO2 price range of € 0-200/tCO2e.

For the **buildings** sector a 2016 meta study suggests a short-term price elasticity of -0.184 for natural gas, -0.188 for heating oil and -0.175 for all fuels. Applying this to household emissions and average consumer gas prices, we could see another 11% (30 Mt) short-term reduction potential at a CO2 price of € 200/tCO2e. Extending this assumption to the commercial buildings sector, we would extend the potential to about 50 Mt in the same price range.

In the future, additional flexibility could be provided from the **fuel supplier** side by blending biofuels into transport fuels, or green hydrogen/biogas into the gas grid to balance the market. For example, using biofuels contributed to a large part of the transport emission reduction in Sweden. However, sustainability issues surrounding mostly imported biofuels would put a question mark behind a large-scale application in Europe. That said, green hydrogen in particular could play an important role post-2030 for CO_2 reduction in gas consumption, as an H_2 blend-in between 0-20% seems technically feasible using the existing infrastructure.

Viewing this with the theoretically available flexibility pre-2030, we see a short-term reduction potential of 70-170 Mt from **households and passenger transport** combined as a response to increasing fuel prices at a CO_2 price of € 200/tCO_2e. This results in a flexibility of between 4.6% and 11% compared to overall fuel emissions, which is significantly below the EU ETS flexibility via power dispatch. Note that this is a purely theoretical consideration.

4.6-11%

Estimated short-term emission flexibility in €0-200/tCO_2e price range for transport and buildings.

The short-term emission reduction would, to some extent, come in the form of more considered decisions on the use of transport mean and heating behaviour; some of the potential at higher prices, however, could come alongside losing comfort and might increase energy poverty in some countries. To increase acceptance, infrastructure investments in public transport and green hydrogen could help to further increase flexibility in later years. However, in the long term it is important to consider the abatement options at hand that drive emissions towards the 2030 target and towards net-zero in 2050.

Long-term abatement costs – the investor's perspective

While some long-term energy system models assume abatement cost curves from a macroeconomic perspective as a least-cost formulation, in this analysis we look at a 2021 investor's perspective and determine CO_2 price levels that would be required for an investment in a zero-emission alternative to break even, compared to an efficient fuel-combustion alternative.

17-22%
Of all new cars registered between 2021-2030 would need to be fully electric to reach the 2030 ambition.

We do this using 2019 fuel end-user prices across the EU member states (Source: Eurostat). This approach captures the heterogeneity of fuel taxes and existing carbon pricing measures across Europe and gives the perspective of a myopic investor, assuming that fuel prices remain constant over time. Even for the EU ETS, often only the current price of carbon determines investment decisions as investors lack foresight.

Looking at the pathways provided by a recent McKinsey study as well as the EU's 2030 IA, we assume that electrification will be a key factor for decarbonisation in buildings and transport sectors. As the power sector is covered by the EU ETS we consider electricity as a zero-emission abatement option in this analysis. It must be acknowledged, however, that electrification further increases the burden on the EU ETS, but also that with PV and wind the power sector currently has the cheapest abatement options to hand.

In the **transport** sector, by 2030 the IA foresees 11-14% of the vehicle fleet to be electric. Considering that every year about 15m new cars are registered, between 17-22% of all newly registered cars between 2021 and 2030 would need to be fully battery electric vehicles (BEV), whereas the rate of BEV registrations stood at 2.2% in 2019 (Source: EEA). Therefore, we look at the CO2 price needed to make an average BEV cheaper over its lifetime compared to an average diesel or gasoline car. Heavy-duty trucks are not considered in the analysis as the technology seems unlikely to be available large-scale in the coming years.

For the **buildings** sector the EU IA sees a growing electricity demand from households of +24% by 2030 compared with 2015. This comes as electric heat pumps replace fossil fuel-fired boilers as the most significant sources for residential space heating and warm water. Combined, these contributed 94% of the sectors' emissions in 2018. By 2050 fossil fuels are intended to be almost completely phased-out in households. At the moment heat-pump installations, in comparison to hydrogen or e-fuels, are already "zero-emission options" for many buildings. We therefore only consider the CO2 price necessary to make the installation of a heat pump more economic than the installation of an efficient natural gas boiler in residential and commercial buildings considering end-consumer prices for fuels (Source: Eurostat). Costs of necessary renovations are not considered in the analysis, however it should be noted that building renovations are an efficiency measure that has an enormous potential for reduction.

94%
Residential emissions are 94% associated with space heating and warm water providing large potential for use of heat pumps.

The third important sector within the ESR is **small industry**, which is not covered by the EU ETS. Data availability for industry is relatively limited, however, using EEA data on total emissions and those covered by the ETS, we derived an estimate for small industry emissions. Using Eurostat energy balances, we further deducted the usage of different fuel types by small industry. The approach chosen in this paper further distinguishes between small power and heat production, and manufacturing.

For the small **manufacturing** industry, we investigate the theoretical cost of a switch from carbon-intensive fuels to electricity or gas as energy carrier. Note that this approach neglects the specific purpose for which the energy is used, as there is no detailed data available that would distinguish by application. It is unknown whether the fuels are used to provide services for which electricity would be a more valuable energy carrier (e.g. turning a machine), as there are transformation losses to be accounted for when using fossil fuels. We therefore developed two MACCs, one assuming usage as energy only, i.e. without including an efficiency level of transformation, and one assuming electricity usage including efficiency, making electricity more economic. Actual abatement costs can be assumed to move between those two MACCs.

With regards to **power and heat** production, a similar approach was taken as for the service the fuel provides (energy vs. electricity), with the expectation that this sub-sector would tend towards the electricity side of the curve. However, since it cannot be expected that the energy sector would itself use electricity to generate a product (likely electricity), we assume that hard coal and lignite are replaced by gas here to reduce emissions.

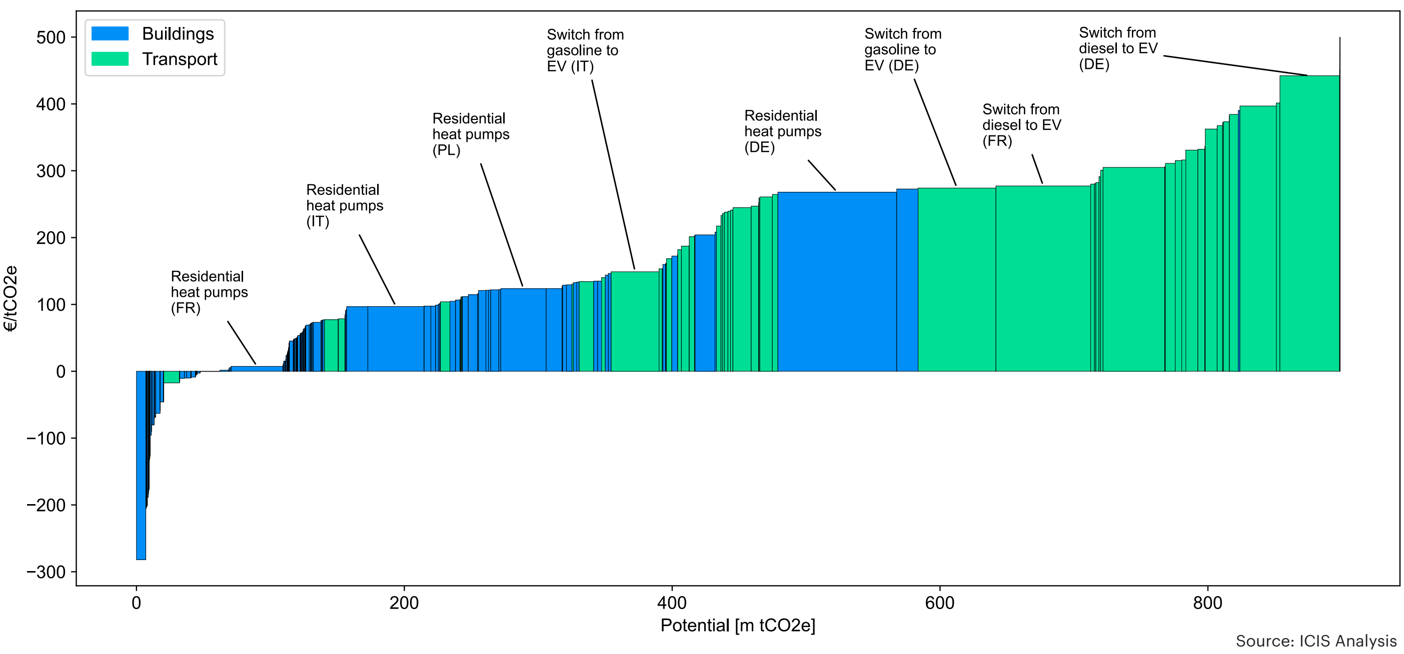
Marginal abatement costs

We determine the potential for all sectors by combining the energy balance (Source: Eurostat) of each country and statistics on car fleets (Eurostat, EEA) as well as building stock (Hotmaps) and fuel consumption (Eurostat). The costs are determined for each country separately due to the heterogeneity of fuel prices for an average dwelling, commercial building, car or industrial installation. The potential is always the full fuel combustion emission resulting from space heating and warm water, transport and industrial end-use (in the case of small power producers, limited to the difference between coal and lignite to gas emission intensity).

Combining all data points, we derive an investor's perspective zero-emission abatement/electrification cost curve for transport and buildings (see Figure 4). The chart shows that, especially in some regions like Germany, the residential end-user costs of electricity make it unprofitable to switch to a heat pump and that CO2 prices of above € 250/tCO2e would likely be necessary to trigger large-scale economic investments in this technology. For the commercial sector, the abatement costs via heat pumps are lower as investment costs are proportionally smaller. For the transport sector, we can see that the currently significantly higher investment costs would need to be balanced by a high carbon price to make an EV economical. In Germany, a CO2 price of about €270/tCO2e would be necessary given the high electricity tariffs in case no investment incentive is provided.

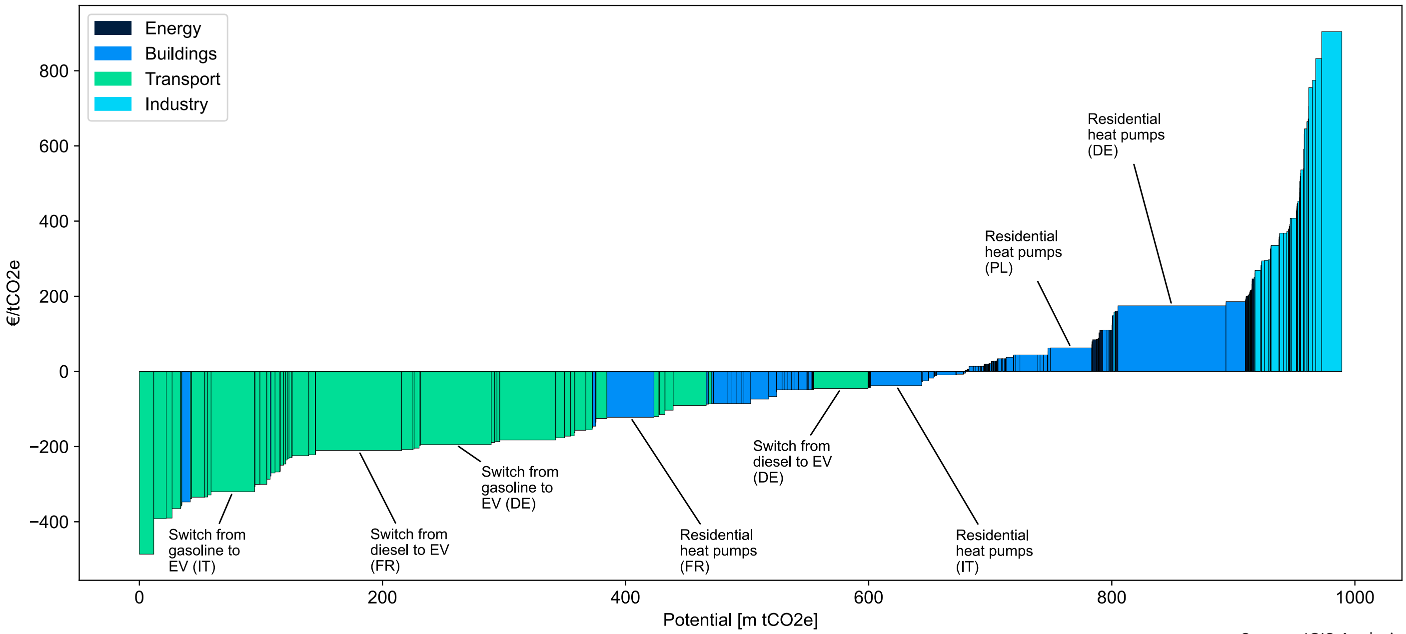
Considering the current still higher investment costs for electrification, investment

Figure 4: Comprehensive MACC for transport and buildings sectors. Data points represent abatement potential for a specific country, sector and fuel type, including investment costs.



Source: ICIS Analysis

Figure 5: Comprehensive MACC for transport, buildings and small industry sectors. Data points represent abatement potential for a specific country, sector and fuel type, assuming all investment costs are offset by subsidies.



Source: ICIS Analysis

subsidies would be a short-term measure to lower the necessary CO2 prices in these sectors and thus limit the effect on the end-consumer's energy bill.

The second curve in Figure 5 shows that offsetting investment costs by subsidies results in a negative CO2 price, only by realising all transport sector electrification technologies in all EU countries. Further, in all countries average heat-pump investments would turn a positive investment case at a CO2 price of below € 200/tCO2e. This curve also includes abatement potentials for small industry. There was no information with regard to the specific application available, and thus no investment costs could be considered. The curve for small industry therefore assumes that all additional investment costs are carried through subsidies.

As the curves show, the single largest abatement potential is the wide application of heat pumps in Germany (89 Mt), with the caveat that it is also one of the least economical (abatement cost of € 175/tCO2e). Switching from diesel-fuelled cars to EVs in France provides another 71 Mt of abatement potential, which would be highly economical if subsidies offset the difference in one-off investment costs due to low electricity prices.

Overall, a switch from diesel to EVs in all 27 countries yields an abatement potential of 266 Mt, all of which becomes economical when subsidies are considered. Switching from gasoline fuels to EVs provides a further 198 Mt of abatement potential. The residential sector provides another 297 Mt of abatement potential, and commercial buildings, 137 Mt. Small industry, apart from being highly uneconomical despite ignoring investment costs, only provides 75 Mt of abatement potential in the manufacturing sector, and 16 Mt in the energy sector. This is once again due to the limited contribution of fuels to overall emissions from the small industry sector.

For small industry, in both the electricity- and energy-equivalents curves, it appears that abatement costs quickly exceed the €100/tCO2e level, achieving only little abatement potential in doing so. To arrive at 50 Mt of abatement potential, carbon prices of €400-600/tCO2e seem necessary. We therefore conclude that, while there is some abatement potential to be tapped with prices similar to current EU ETS prices, incentivising a switch away from emission-intensive fuels towards gas or electricity would require massive support to become economical in the sector. Thus, small industry would contribute little to the necessary overall emission reduction in the non-ETS sectors.

In this context, it should again be pointed out that a significant share of emissions in the small industry sector cannot be directly attributed to burning fuel for energy purposes. Only 193 Mt of the sector's emissions were associated with this, while around 125 Mt were attributable to process emissions, of which an estimated 86 Mt were due to emissions of ODS substitutes (ICIS analysis based on EEA data and Eurostat energy balances). This suggests that targeting only fuel emissions would have a limited effect in the small industry sector. Tackling emissions from the sector is likely most effective when addressing specific emission categories, such as ODS substitutes.

In Germany, which alone had space heating- and warm water-related CO_2 emissions of about 89 Mt in 2018, almost 50% of the population lives in rented dwellings

Can this potential be fully scooped ?

The potential on the x-axis in Figures 4 and 5 has several behavioural limitations beyond technical restrictions like the feasibility of heat pumps in some areas. Household investments are not purely economically driven. For new car purchases safety, quality, comfort and design are important factors that are not captured by looking at the economics. Concerning comfort, further charging infrastructure improvements will be necessary to overcome boundaries in decarbonisation.

The buildings sector faces an investor-user dilemma where property owners have no incentive to invest in efficient heating equipment as they pass on costs to the tenant. On average 30% of the EU population lives in a rented dwelling. In Germany, which alone had space heating- and warm water-related CO_2 emissions of about 89 Mt in 2018, the quota stands at almost 50%. To incentivise retrofits and renovations in rented dwellings, CO_2 pricing alone is unlikely to achieve the desired outcome (Eurostat).

Design considerations: Emission trading on fuel combustion?

Given the current gap between ambition and existing measures, the EU will have to provide member states with guidelines to achieve the bloc's 2030 and 2050 emission reduction targets. The EU ETS has proven an efficient tool, especially in recent years, to bring down emissions in the power sector, and partially in the industry sector. By 2021, it has established acceptance and credibility among polluters in the EU after several years of prices at around € 5/tCO2e. Legislators, however, should bear in mind the lessons learned from the past when designing a carbon trading system for fuel combustion or considering extending the scope of the EU ETS.

From a legal perspective, an extension of the EU ETS to an upstream/mid-stream system for all fuels via the opt-in provision of the EU ETS is disputed.

The German Environment Ministry has published a report which highlights several legal obstacles for such a step. While challenges exist for member states that seek to opt national systems in, an opening of the EU ETS Directive in June as well as a new EU-wide system could remove them.

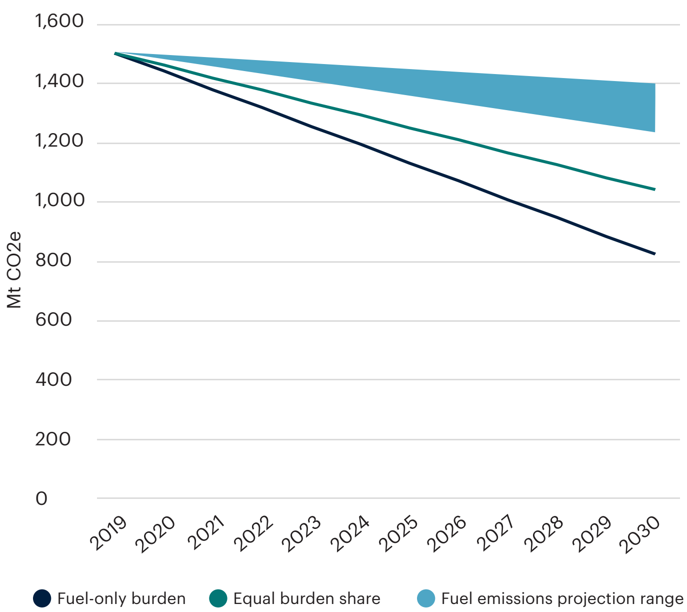
The cap for such a fuel ETS would be equivalent to around 1,501 Mt, decreasing to a level of 821-1,038 Mt by 2030 in view of a 55% emission reduction target.

From a technical perspective, pricing the CO2 content of fuels via the fuel supplier would likely present the most feasible option in terms of implementation. Fuel suppliers would participate in the trading system, even though they themselves offer only limited abatement potential. These players would pass the costs of CO2 on to the end user. The cap for such a system would be equivalent to around 1501 Mt, decreasing to a level of 821 Mt by 2030 in view of a 55% emission reduction target, and assuming the full burden of emission reduction in the ESR sector is placed on fuel emissions. This considerable effort could be mitigated by equally addressing fuel and non-fuel emissions, leaving the 2030 cap at 1,038 Mt. Figure 6 shows the resulting caps as well as the emission range for existing and additional measures. A fuel ETS would therefore have to deliver an additional emission reduction from fuels in ESR sectors of 200-570 Mt by 2030, depending on the implementation of additional measures and the distribution of ambition within the sector.

Other options are the inclusion of large transport companies and large commercial buildings downstream, or the introduction of an EU-wide carbon tax. We neglect the first option, as it would only cover a small share of the emissions of the transport and buildings sector. Neither do we consider the tax option as it would not allow for interacting with the EU ETS at a later stage.

Concerning market design, legislators should keep in mind the need for flexibility to adjust the emission level at least to some extent in the short-term. In the EU ETS, power sector dispatch decisions are continuously adjusted, driven by the current carbon price. ICIS modelling overall identifies significant flexibility of around 410 Mt in a moderate price range of € 0-75/tCO2e in 2021 via fuel switching – 26% of the 2021 EU ETS cap of 1571 Mt. While there is a theoretical short-term flexibility via modal shift in transport, small efficiency measures and lower consumption by households of around 70-170 Mt for a higher price range of € 0-200/tCO2e, this is a significantly smaller fraction of the overall ESR fuel emissions of 1,501 Mt (11% at € 200/tCO2e).

Figure 6: Theoretical fuel ETS cap trajectory to achieve 2030 ESR target



Source: ICIS analysis based on EEA data and Eurostat energy balances

Further, this flexibility would be accompanied by comfort losses in many cases. While demand-side management for electricity is an option for larger industrial installations, we do not expect significant short-term flexibility in the small industry sector – any kind of decarbonisation measure would therefore be long term.

A lack of liquidity and flexibility to adjust emissions level could lead to a market crunch in the case of unexpected shocks such as cold snaps. Significantly, higher CO2 prices would be the result. In the long term, it would therefore be desirable to further support flexibility by providing public transport infrastructure and promoting the use of zero-emission transport in cities.

On the fuel-supplier side, infrastructure for blending-in green hydrogen or biofuels would also provide more flexibility as higher CO2 prices could lead to the immediate adjustment of emission levels and thus extra supply.

Physical flexibilities would have similarities to fuel switching in power markets to support market liquidity and the emergence of an efficient CO2 price signal.

From an ETS design perspective, there are further elements that could help ensure market liquidity. Front-loading of auctions would allow fuel suppliers to build up a stock of allowances that could be used to adjust for weather effects of heating demand by hedging the CO2 content of their supply contracts. A similar effect would be achieved by introducing longer compliance cycles of two-to-five years, which would give more time for fuel suppliers to monitor progress and buy CO2 certificates accordingly.

Another consideration to increase market liquidity would be the introduction of a one-sided, limited EU ETS flexibility, which would also mean a gradual linkage of two separate systems. The amount of flexibility should be defined carefully given the risks we discuss below.

In addition, the use of offsets could be considered. The use of international credits, however, in the past has led to a significant oversupply in the EU ETS and should be treated with caution. Given the envisaged technological transformation, such flexibility would likely be strictly limited by lawmakers. Currently, the absence of a CDM successor mechanism under article 6 of the Paris Agreement also leaves a question mark around this instrument.

€ 250

One element of risk lies in the abatement costs, which are considerably higher in the non-ETS sectors as large-scale electrification would need carbon prices of around € 250/tCO2e by 2030.

Extending or linking the EU ETS?

Many of the options for decarbonising the ESR sectors involve an increased use of electricity. Therefore, the case for having both elements under one cap/pricing regime will increase in the long term as the ESR sectors enforce their obligations to the EU ETS by electrifying transport, heating and industrial processes. From a theoretical economic efficiency perspective, a joined system should thus be the preferred option.

In the short term, however, there are several risks associated with linking a fuel ETS to the EU ETS. Agent behaviour as well as price formation for sectors that are not yet subject to carbon pricing remain key uncertainties. This is also a result of the provision that not the emitter, but the fuel supplier, has a compliance obligation.

Another element of risk lies in the abatement costs, which are considerably higher in the non-ETS sectors as large-scale electrification would need carbon prices of around € 250/tCO2e by 2030. A fully fledged linkage would bring significantly higher carbon prices to the EU ETS, which would foster carbon leakage fears in the industrial sector.

In addition, linkage would lead to lower abatement effort in the buildings and transport sectors and could therefore slow innovation, delay infrastructure investments and harm the economies of scale for EVs and heat pumps that lead to lower abatement costs in the long term. As especially electric mobility is still an emerging trend, a combination of investment incentives and carbon pricing is one possible option to further reduce the investment costs of EVs and boost technology diffusion at the same time as collecting funds for the subsidies.

Overall, we see the short-term risk as well as the political sentiment currently hinting towards a separate trading system for fuels. Such a system could then be gradually linked with one-sided or even two-sided flexibilities allowing the prices to converge eventually.

Discussion

While the carbon content of electricity and (most) industrial production is priced via the EU ETS, there is no Europe-wide streamlined tool for pricing CO2 from fuel combustion. Abatement in the transport and buildings sector often means electrification, but in some member states such as Germany, there is currently a significant disadvantage to investing in electrification, which is a high end-user power price. An EU-wide carbon price on fuel emissions could therefore be an efficient tool to overcome abatement boundaries and reach the EU's 2030 and 2050 emission targets.

If policy makers decide to put a price on carbon, they will have to weigh the introduction of a trading scheme against a carbon levy. The trading scheme option offers certainty with regard to the overall amount of GHGs that can be emitted into the atmosphere and is highly likely to contribute significantly to the EU's emission reduction targets.

The trading scheme option offers certainty with regard to the overall amount of GHGs that can be emitted into the atmosphere and is highly likely to contribute significantly to the EU's emission reduction targets.

However, there remain question marks around the cost of delivering the desired emission reductions, and the liquidity in a market that provides only limited short-term balancing options, making it prone to price volatility. This could hamper setting an efficient carbon price which would constitute an investment signal.

These uncertainties could partly be mitigated by the introduction of one- or two-way flexibility to the existing EU ETS. Compared to current prices in the ETS, such flexibility would very likely result in a significant price increase, the amount of which would depend on the degree of flexibility allowed. The introduction of a linked system is therefore likely to spark opposition from compliance players in the EU ETS.

However, the absence of a linkage would still increase the emission reduction burden on ETS power installations, as electrification measures in other sectors would result in increased power demand, requiring investment in low- to zero-emission generation technologies.

Our investor perspective abatement cost curve shows that, to achieve significant emission reductions in any system, a carbon price would have to start relatively high and increase to at least € 250/tCO2e by 2030.

However, this price signal could be balanced by a combination of subsidies for investments and renovations, lowering the potential carbon price significantly and reducing investors' myopia.

An advantage of an EU-wide minimum CO2 levy on the contrary would be the ability to control end-consumers' energy bills. CO2 prices of over € 200/tCO2e on top of existing energy taxation could mean a significant extra burden for many households and smaller industry. To increase the acceptance of any carbon pricing system in low-GDP and fossil fuel-reliant member states, EU legislators will likely have to earmark large shares of the additional funds to mitigate energy poverty in, and support the energy transition of, these countries. While the controllability and acceptance aspects are important, one should note that a carbon price would not ensure that the EUs 2030 and 2050 net-zero ambition is achieved, nor would it allow the linkage with the EU ETS in the long run which would be the preferable option from an economic efficiency perspective.

The uncertainty and risks associated with emission trading in these sectors could potentially lead policymakers to gradually phase in a separate system with a fixed price regime, blueprinting Germany's approach and maintaining the ESR obligations of member states. This would allow necessary trading infrastructure and acceptance to build up. After the removal of a fixed price phase, a linkage with the existing EU ETS could be envisaged, gradually increasing flexibility across sectors. This could be an option especially once the electricity sector has already achieved a large part of its decarbonisation task, while EU ETS-covered industry sectors likely need a higher carbon price signal for their abatement efforts anyway.

Authors

Florian Rothenberg
Analyst EU Power & Carbon Markets

Sebastian Rilling
Analyst EU Power & Carbon Markets