2 Pricing greenhouse gas emissions: What has changed? What needs to change?

This chapter introduces carbon pricing and the current energy policy context. It then analyses changes in the pricing of greenhouse gas (GHG) emissions between 2018 and 2021 in 71 countries. The chapter takes a broad view of carbon pricing, considering both explicit forms of carbon pricing (emissions trading systems and carbon taxation) and implicit carbon pricing instruments that directly change fossil fuel prices (fuel excise taxes and negative carbon prices resulting from subsidies that lower pre-tax fossil fuel prices). Results are broken down by instrument, sector (road transport, off-road transport, industry, agriculture & fisheries and buildings, and other GHG emissions), country, fossil fuel, and GHG emissions percentile. The chapter presents estimates of the revenue potential of policy options for fossil fuel subsidy and carbon price reform, explains the link between carbon pricing and the sustainable development goals, and discusses how governments could unlock further mitigation efforts.

Carbon pricing works

Carbon pricing can help countries to reach their climate objectives and raise government revenues to meet social, environmental and development objectives. Carbon pricing means putting a positive price on CO_2 and the CO_2 equivalent (CO_2e) of other greenhouse gas (GHG) emissions through taxes or emissions trading systems (see Chapter 1 for definitions of the relevant policy instruments and an overview of related policy instruments that are out of scope of this Chapter). It encourages households and businesses to make cleaner choices, while mobilising government revenue (Box 2.1). Carbon pricing therefore both reinforces and enables public spending as long as emissions remain significant (OECD, 2020[1]).

Box 2.1. Strengths of carbon pricing

Carbon pricing:

- Provides across-the-board incentives for firms and households to reduce carbon-intensive energy use and shift to cleaner fuels. This occurs as carbon pricing increases the price of carbon-intensive fuels, electricity, and consumer goods produced with such fuels and electricity.
- Provides the essential price signal for mobilising private investment in clean technologies. Pricing levels the playing field for emissions-saving technologies and helps to avoid lock-in of fossil fuel intensive investments (e.g. coal generation plants), contributing to cost-effective abatement.
- Is more flexible than regulatory approaches. Unlike energy efficiency standards and other regulations, prices leave households and businesses a range of choices on how to cut emissions. This greater flexibility reduces costs because the government is generally less well informed about the options available to emitters, particularly where different emitters would prefer different responses.
- Provides ongoing mitigation incentives. With some policy tools (e.g. standards), the pressure to reduce emissions disappears once compliance is achieved, whereas prices continue to induce mitigation effort as long as emissions are positive.
- Reduces rebound effects. Some instruments, such as energy efficiency standards, can lead to increased energy usage. For example, improving the energy efficiency of an air-conditioning unit makes it cheaper to run and may therefore result in it being used more often, undoing some of the energy savings from the efficiency improvement, unless the price of energy use or of the emissions from energy use increase simultaneously.
- Mobilises government revenue. Unlike most other mitigation instruments, carbon pricing raises government revenues, and administrative costs of revenue collection can be lower than for many other fiscal instruments.
- Generates domestic environmental co-benefits, including reductions in the rates of mortality and morbidity from local air pollution. Pricing carbon, like other mitigation instruments, results in cleaner air, which is a tangible and immediate benefit of reduced combustion of coal and motor fuels, especially in metropolitan areas.

Source: Based on (IMF/OECD, 2021[2]).

Carbon pricing works in practice. A recent review of the empirical literature confirms that "carbon pricing has significant and relatively large normalized effects (i.e. accounting for the low level of prices so far), in terms of emissions reduction in general (through behavioural change, technology adoption and substitution) as well as pure innovation impacts" (van den Bergh and Savin, 2021[3]). Evidence from the

UK carbon price floor in the power sector shows that even in the short-term, carbon pricing can yield strong emission reductions – 20-26% per year on average (Leroutier, 2022[4]). Recent OECD estimates of the long-run responsiveness of emissions to carbon pricing found that, on average, an increase of effective carbon rates by EUR 10/tCO_2 reduces emissions by 3.7% in the long run, under prevailing technological conditions (see also Box 2.5).[1] Accordingly, carbon pricing is among the frequently cited mitigation options in countries' NDCs (UNFCCC, 2021[5]).

Carbon pricing is not the only important component needed to successfully accelerate the transition to net-zero GHG emissions. A combination of other price-based and non-price based policy instruments will play a critical role in countries' net zero toolbox (see Chapter 1). This includes standards and regulations, as well as enabling policies – including innovation support mechanisms, infrastructure investment, and policies that help people in transition (D'Arcangelo et al., 2022[6]). (IMF/OECD, 2021[2]) emphasises that a "key challenge at the domestic level is to balance explicit carbon pricing and other reinforcing sectoral instruments, like feebates and regulations, which can be less efficient but likely have greater public acceptability due to their smaller or less direct impact on energy prices". Sometimes governments take measures that in effect reduce the price of carbon, which increases GHG emissions and reduces government revenues or requires additional government expenditure. Fossil fuel support may be introduced to protect vulnerable households or energy intensive industries, yet they also have the effect of lowering the cost of using fossil fuels (Box 2.2).

Box 2.2. Fossil fuel support and effective carbon rates

The indicators in this chapter account for two common types of fossil fuel support.[2] First, they account for support measures such as tax cuts or tax exemptions, that reduce positive marginal carbon prices provided by any of the three components of the effective carbon rates (ECR) indicator. The ECR is the sum of carbon prices resulting from emissions trading systems, carbon taxes, and fuel excise taxes.

Second, the indicators reflect direct budgetary transfers to fuel suppliers (or fuel end users if the transfer is conditional on fossil fuel use) that decrease pre-tax fossil fuel prices domestically. This includes, for example, budgetary transfers that compensate fuel suppliers for providing fossil fuels at prices that are regulated below market levels. Such transfers are mapped to the domestic fossil fuel use that benefits from the reduced prices. This allows for an estimation of the amount of emissions for which prices effectively decrease, in order to calculate the corresponding rate per tonne of CO_2, building on methods developed in the context of Taxing Energy for Sustainable Development (TEU-SD) (OECD, 2021[7]) and drawing on data on budgetary transfers from the Inventory of Fossil Fuel Support (OECD, 2015[8]). Without prejudice to the use of the term subsidies by countries or in the Inventory of Fossil Fuel Support, this report labels support measures that reduce pre-tax energy prices "subsidies", as was done in TEU-SD.

Fossil fuel subsidies are defined in the same unit and mapped onto the same base as the ECR. Deducting fossil fuel subsidies from the ECR yields the Net ECR, i.e. the ECR net of such fossil fuel subsidies.

The Net ECR integrates a larger amount of fossil fuel support than the standard ECR. Its calculation requires a larger number of assumptions for its calculation. In particular, fossil fuel subsidy rates are generally not directly observed, but need to be estimated. By contrast, the rates of the components of the standard ECR are directly observed. In the case of fuel excise or carbon taxes, rates are specified by the government. In the case of emissions trading systems, rates are observed in the market.

Source: (OECD, Forthcoming[9])

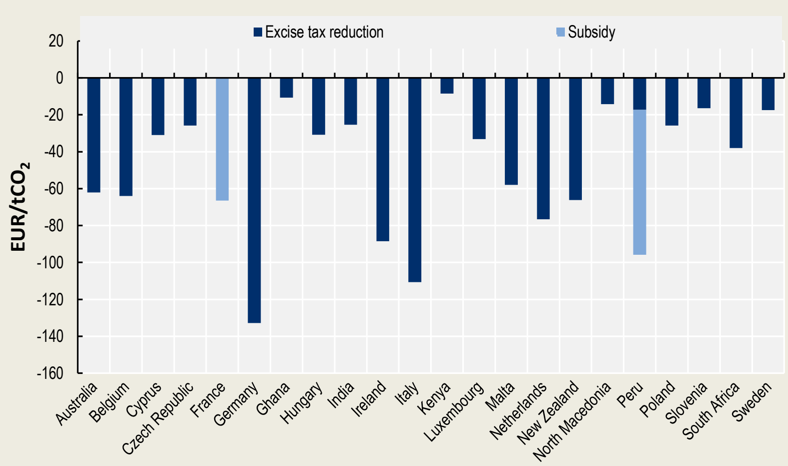
Recent measures taken in response to the energy price hikes starting in the second half of 2021 and amplified during the first half of 2022 are not yet reflected in the data, even though the associated reductions in effective carbon rates are expected to be substantial. France, for instance, introduced a temporary refund of 15 cents per litre for gasoline and diesel fuels used in road transport. This corresponds to a carbon tax cut of approximately EUR 66 per tonne of CO_2 for gasoline. For the purposes of comparison, France's explicit carbon tax (levied as a component of the fuel excise) currently equals EUR 44.6/tCO_2. (see also, Box 2.2).

Box 2.3. Policy responses to recent fuel price increases

Energy tax policy has been a key component of governments' policy responses to rising energy prices. Excise tax cuts, mainly on petroleum products, were the most common measure implemented by governments to shield consumers from price increases. As far back as the middle of 2021, Estonia, decided to maintain the reduced fuel and electricity excise rates implemented in 2020 in the context of the COVID-19 pandemic, at least until the end of 2022, with a gradual increase back to normal by 2026. From March 2022, many other countries have also implemented petroleum excise tax reductions. Rate reductions per litre of gasoline were up to EUR 0.3 in Germany, EUR 0.25 in Italy, and EUR 0.2 in Ireland – which correspond to a reduction per tonne of CO_2 of EUR 133, EUR 111 and EUR 89 respectively. In other countries, reductions were more limited, also because pre-existing rates were lower (e.g. Hungary, Poland).

Several countries also decided to introduce or increase fossil fuel subsidies, either through ad-hoc refund mechanisms (e.g. France) or already established price stabilisation funds (e.g. Chile, Peru).

Figure 2.1. Excise tax reductions and subsidies for automotive gasoline in selected countries, in EUR per tonne of CO_2



Some countries have also implemented VAT reductions (not shown in the figure above), e.g North Macedonia and Kenya. Natural gas used for heating also benefitted from reduced VAT rates starting from the end of 2021, more frequently in EU countries (e.g. Croatia, the Czech Republic, Italy, Poland).

Tax reductions, alongside price controls, can be categorised as price support. In 42 OECD and key partner economies, measures taken since October 2021 and ending by December 2022 to support prices (including for electricity) are estimated to cost more than USD 160 billion, 94% of this support being non-targeted (Van Dender et al., 2022[10]). While this support may be justified in the short-run as part of countries' efforts to shield households and businesses from the sudden and sharp increase in energy prices, these measures are likely to be unsustainable over time if high prices persist and may generate a range of additional negative effects, such as:

- If prices are maintained at artificially low levels, the incentives for households and businesses to adapt by reducing consumption and switching to low-carbon energy sources are reduced.
- Price regulation can cause losses for energy market players discouraging future investments.
- Tax cuts are costly for public finances due to the significant revenues foregone and may be inefficient, as constrained supply is likely to hinder full pass-through to end user prices.
- Finally, non-targeted measures disproportionately benefit high income energy consumers.

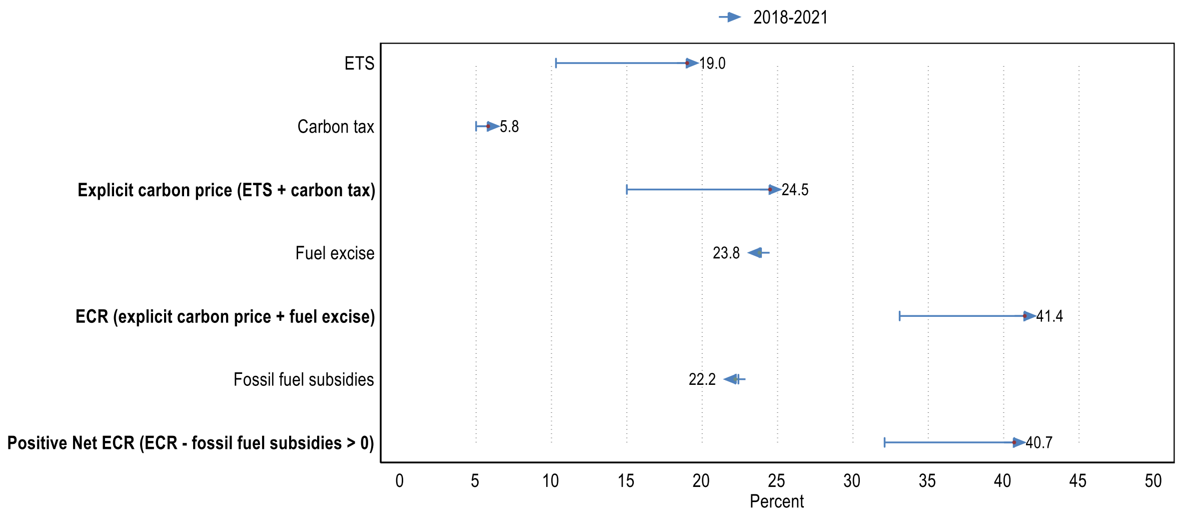
In light of the potential negative effects of tax reductions, other more targeted measures, such as income support (e.g. temporary and targeted cash transfers), would be more appropriate. However, some of these measures may require a relatively sophisticated level of administrative capacity to identify and properly target the beneficiaries in most need, according to various criteria (i.e. income, energy needs).

Note: as of 10 May 2022
Source: (OECD, 2022[11]). (Van Dender et al., 2022[10])

Changes in coverage: more emissions covered by explicit carbon prices in several countries

More than 40% of GHG emissions in the 71 countries covered in this report face a positive net effective carbon rate (Net ECR) – up from 32% in 2018.[3] Figure 2.2 shows the change of emissions coverage between 2018 and 2021 across the 71 countries for each component of the Net ECR indicator (see Chapter 1). With roughly nine percentage points, the coverage increase is largest for emissions trading systems, driven by new systems in Canada, China and Germany.[4] Carbon tax coverage increased by around one percentage point due to the introduction of carbon levies in Canada and Luxembourg, as well as the South African carbon tax in 2019.[5] As a result, 25% of GHG emissions in 2021 are covered by an emissions trading system (ETS), a carbon tax, or both. The share of GHG emissions covered by fuel excise taxes, an implicit form of carbon pricing most common in the road transport sector (but also relevant for heating fuels, especially in Europe), remains at 24%.[6] The share of GHG emissions covered by carbon taxes or emissions trading systems (or both)[7] is now about as large as the share covered by fuel excise taxes. Fossil fuel subsidies that counteract the carbon price signals provided by the other instruments apply to approximately 22% of GHG emissions, as in 2018.

Figure 2.2. Share of GHG emissions subject to a positive price, in %, by instrument, all 71 countries, 2018-2021



Note: ETS coverage estimates are based on the OECD's (2021[12]), *Effective Carbon Rates 2021*, with adjustments to account for recent coverage changes. Fossil fuel subsidy estimates are based on the Inventory of Fossil Fuel Support where available and original research for the other countries (OECD, Forthcoming[9]). Due to data limitations, 2021 Fossil fuel subsidy estimates are based on data for 2020. GHG are the sum of fossil-fuel related CO_2 calculated based on energy use data for 2018 from IEA (2020[13]) and other GHGs from Climate Watch (2020[14]). Percentages are rounded to the first decimal place.

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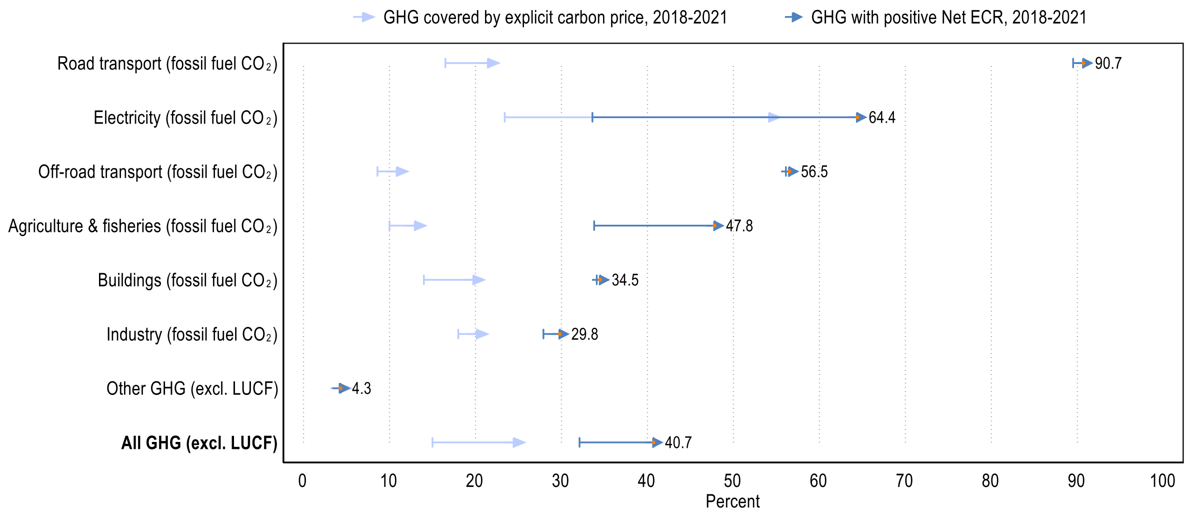
Coverage by carbon pricing instruments continues to vary across sectors, with recent increases concentrated in the electricity sector. Figure 2.3 shows how emissions coverage across the 71 countries covered in this report has evolved by sector between 2018 and 2021. In the electricity sector, coverage is now at 64%, up from 34%. The increase is driven by the introduction of the Chinese national ETS for the power sector, as well as the expansion of carbon pricing in Canada, boosting the share of emissions from the 71 countries covered by an explicit form of carbon pricing from 23% to 54%. In addition, US ETS coverage in the electricity sector goes from around 7% to almost 10% as Virginia joined the Regional Greenhouse Gas Initiative (RGGI) in 2021, and New Jersey rejoined RGGI in 2020. Carbon price reform at the subnational level in Mexico increased electricity sector coverage from 45% to 49%.[8]

In road transport, coverage by excise continues to be near complete at 91%. In this sector, the main change is that Canada, Germany, Luxembourg and South Africa have introduced explicit carbon pricing schemes that apply in addition to pre-existing fuel excise taxes.

The share of fossil fuel CO_2 emissions from agriculture & fisheries with a positive Net ECR increased from 34% to 48%. The main driver behind this increase was a decrease of sectoral diesel subsidies in China (related to lower oil prices), which had previously been responsible for pushing the Net ECR below zero for the users benefitting from the subsidy. Most of the sector's GHG emissions are from methane, which is allocated to "other GHG" and which is not usually covered by carbon pricing instruments (Box 2.4).

Emissions coverage has changed relatively little in off-road transport, buildings, and industry. At 4%, overall coverage is lowest for "other GHG". Note that this category includes non-fossil fuel CO_2 from cement production, which are covered under the EU ETS for example. Some countries also levy specific taxes on F-gases or include them in their emissions trading systems.[9]

Figure 2.3. Share of GHG emissions subject to a positive price, in %, by sector, all 71 countries, 2018-2021



Note: ETS coverage estimates are based on the OECD's (2021[12]), *Effective Carbon Rates 2021*, with ad-hoc adjustments to account for recent coverage changes. Fossil fuel subsidy estimates are based on data on budgetary transfers from the Inventory of Fossil Fuel Support where available and original research for the other countries (OECD, Forthcoming[9]). 2021 Fossil fuel subsidy estimates are for 2020. GHG are the sum of fossil-fuel related CO_2 calculated based on energy use data for 2018 from IEA (2020[13]) and "other GHG" from Climate Watch (2020[14]). Percentages are rounded to the first decimal place.

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Box 2.4. Policies affecting non-CO_2 GHG emissions in AFOLU

The Agriculture Forestry and Other Land Use (AFOLU) Sector is expected to play an increasingly important role in climate change mitigation and countries' pathways to net-zero emissions. AFOLU GHG emissions, which are comprised of methane (CH_4) mostly from livestock and paddy rice production, nitrous oxide (N_2O) from soils, particularly due to fertilisers, and CO_2 mostly from land use change, vary significantly across countries. They have been increasing slowly in OECD countries in recent years, but there has been some partial decoupling from production.[10]

The share of AFOLU in global GHG emissions, which is estimated to be 22% by the IPCC, is expected to grow as emissions from agriculture grow and other sectors reduce emissions or slow down their growth. At the same time, the AFOLU sector can play a key role in sequestering carbon in agricultural soils and forest and plantation biomass, thus contributing to net-zero ambitions.

At present, policy efforts to mitigate GHG emissions in the AFOLU sector are limited, particularly for agriculture (which accounts for more than half of AFOLU emissions). Out of the 54 countries whose agricultural policies are routinely monitored by the OECD, only 16 had some form of mitigation target for their agricultural sector. Where such policy measures exist, they mostly involve voluntary measures, such as payments for farmers to adopt potentially climate-friendly practices, rather than carbon pricing policies based on the polluter-pays principle. Table 2.1 shows the main instruments employed to reduce GHG emissions from the sector focusing on the production side. Changes to consumer diets, particularly the consumption of less red meat could also significantly lower GHG emissions from agriculture. Demand-side instruments, like those aiming to reduce food loss and waste, and change consumer preferences (including through awareness raising), are likely to be more effective in the long-run than in the short-run, and they have not been applied often enough (in either model studies or in practice) to gauge their efficacy.

Policy instrument	Examples of application to AFOLU sector
Emission trading systems (ETS)	New Zealand (horizon 2025): market price applied per farm (CH_4) and fertiliser tax applied to industry (N_2O)
Abatement subsidies	Emission reduction fund (ERF) in Australia (auctioned emission credits)
Carbon offsets	Alberta and Quebec, California
Agricultural support	Agri-environmental payment programmes under the Common Agricultural Policy in the European Union (EU), Canada and other OECD countries
Afforestation programs	Ireland, New Zealand, China (Grains for Green)
Grants	United States (biogas), China (fertilisers), Australia (energy)
Preferential credits	Brazil (ABC program)
REDD+ (payments linked to land use)	Some developing countries are developing their strategies
Deforestation regulation	Brazil (Forest code) and Indonesia (Forest-clearing ban)
Pollution regulations	Nitrates Directive and pollution control (EU)
R&D	Many countries – Global Research Alliance
Knowledge transfer for farmer	Ireland, France, and others

Market-based initiatives that price emissions or result in a competitively achieved emission price include:

- New Zealand's plan to price emissions in agriculture by 2025, at farm-level for livestock (CH4) and industry-led for fertilisers (N2O);
- Australia's emission reduction fund;
- Carbon offset schemes in North America.

An important reason for the relatively slow pace of mitigation efforts is that the sector is called on to contribute to multiple other sustainable development goal (SDG) objectives, from improved global food security and nutrition, poverty reduction, and other environmental and resource objectives, while at the same time withstanding multiple types of climate and market risks.

Governments will therefore need to strengthen their efforts to fulfil their increasingly ambitious targets and ensure that the AFOLU sector effectively contributes to GHG emission mitigation without impeding food security and other stated policy objectives.

This will require, first, adopting effective but balanced mitigation policy packages. A 2021 OECD study (Henderson et al., 2021[15]) shows that a comprehensive policy package, combining taxes for emissions and rewards for sequestration could limit up to 90% of global AFOLU emissions by 2050 at carbon prices consistent with economy-wide efforts to limit global temperature increases to 2ºC.

At the same time, instrument choices and policy design matter. An effective pricing system for agricultural GHG emissions could incentivise the transition to low-emission agriculture. A global carbon tax on AFOLU was found twice as effective in lowering emissions as an equivalently priced emission abatement subsidy "because the latter keeps high emitting producers in business" (Henderson et al., 2021[15]). But the use of emission taxes lowers global agricultural production by 3-8% and per capita consumption by 2-4%, raising concerns around its impact on food security, which emission abatement subsidies avoid. Taxes also raise revenues, while subsidies require government expenditures and may be challenging to scale mitigation over time. Maximising carbon sequestration potential also requires setting contracts that ensure additionality, permanence, and lower transaction costs

Second, governments should also reform potentially environmentally harmful agriculture support both to limit emissions and to help boost innovation, research and development to enhance agricultural productivity sustainably and potentially fund abatement payments referred to above.

Third, the effective use of well-designed environmental regulations and information policy instruments, such as labelling, can play an important role to limit land use change and curb associated emissions, including to reduce food loss and waste, and exploiting synergies between healthier diets and those with lower emissions.

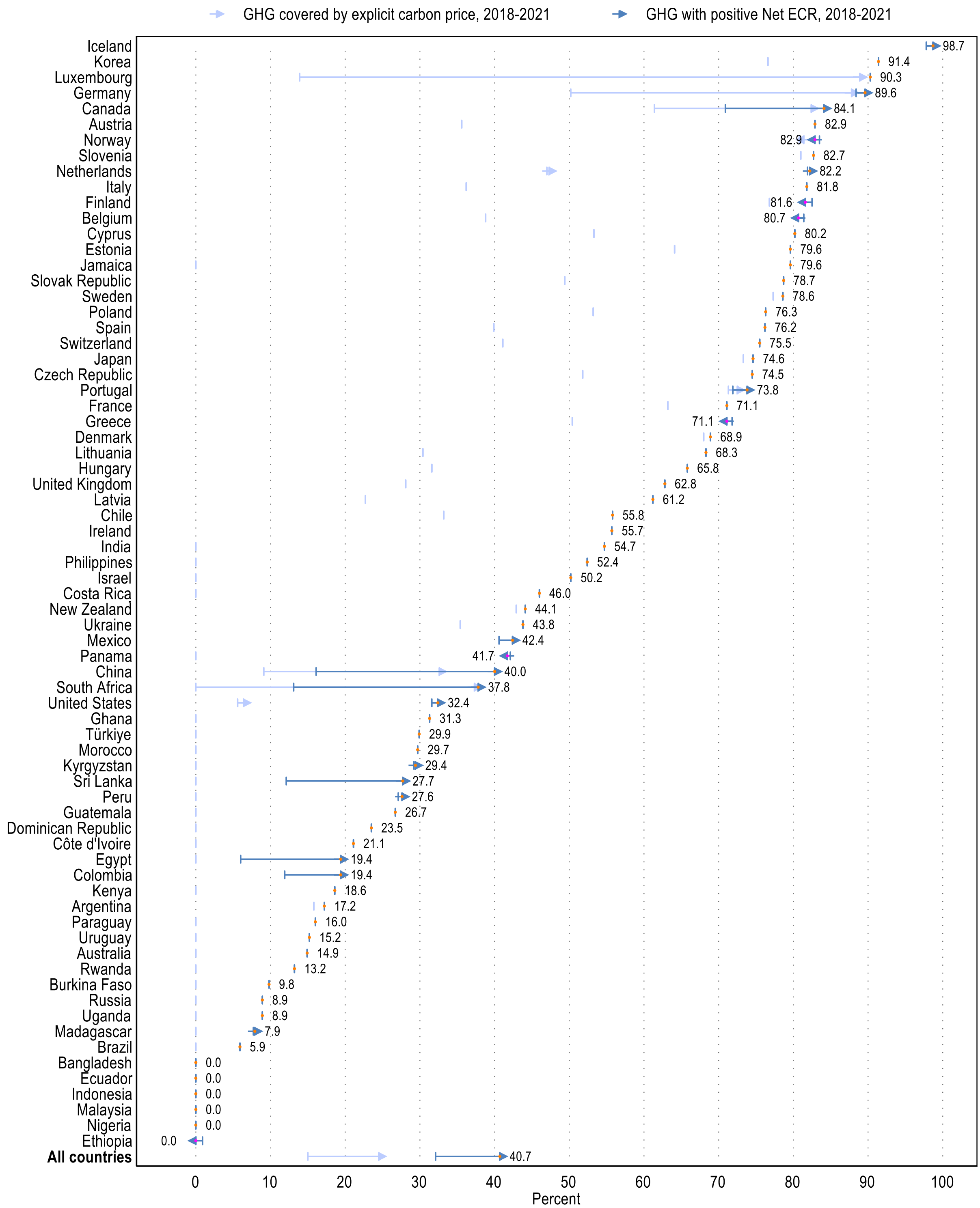
Source: (Henderson, Frezal and Flynn, 2020[16]; Henderson et al., 2021[15]; Henderson et al., 2022[17]; OECD, 2019[18]; Intergovernmental Panel on Climate Change, 2019[19])

The share of GHG emissions that is subject to net positive carbon prices varies substantially across the world. At 99%, Iceland is the country where the largest share of GHG emissions is subject to a positive Net ECR, up one percentage point following the introduction of a new tax on fluorinated greenhouse gases (HFCs, PFCs and SF6) in 2020.

Recent changes in Canada, China, Germany, Luxembourg, Mexico, the Netherlands,[11] and South Africa result from the introduction of new explicit forms of carbon pricing. In total, 39 of the 71 countries covered in this report have explicit carbon pricing instruments in place at either the national or subnational level or participate in the EU's ETS.

Base broadening of pre-existing instruments can also lead to coverage increases. This was the case in Portugal, which in 2018 began to gradually phase out a number of fuel excise and carbon tax exemptions, including for coal, which contributed to its successful phase out of coal power by the end of 2021 (IEA, 2021[20]). Lower levels of fossil fuel subsidies are the main reason for the increase in the share of GHG priced by a positive Net ECR in Colombia and Egypt.

Figure 2.4. Share of GHG emissions subject to a positive price, in %, by country, 2018-2021



Note: ETS coverage estimates are based on the OECD's (2021[12]), *Effective Carbon Rates 2021*, with adjustments to account for recent coverage changes. Due to data constraints, the recent changes of the Korean ETS that have increased coverage by around 2 percentage points (ICAP, 2021[21]) are not modelled. Fossil fuel subsidy estimates are based on the Inventory of Fossil Fuel Support where available and original research for the other countries (OECD, Forthcoming[9]). 2021 Fossil fuel subsidy estimates are based on data for 2020. GHG are the sum of fossil-fuel related CO_2 calculated based on energy use data for 2018 from IEA (2020[13]) and other GHG from Climate Watch (2020[14]). Percentages are rounded to the first decimal place.

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Changes in price levels: uneven progress with carbon prices across instruments, sectors, fuels and countries

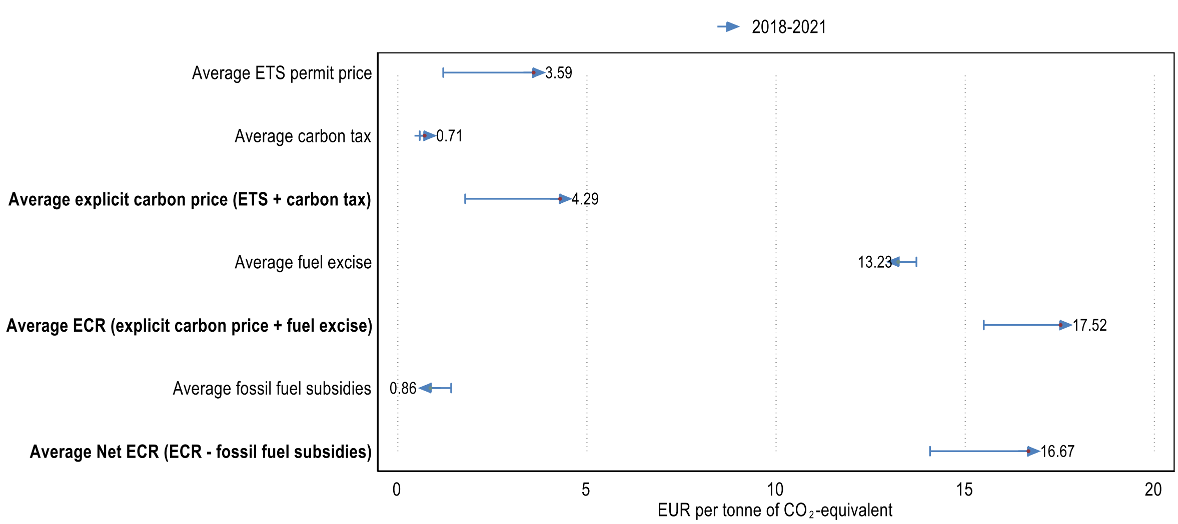
In some countries, explicit carbon prices have increased considerably. EU ETS prices averaged EUR 53 per tonne of CO_2e in 2021, which is more than three times the average EU ETS price of 2018 in real prices (EUR 17).[12] Allowance prices of the newly established UK ETS traded at approximately EUR 56 in 2021. Rates have also increased substantially in Canada, with the backstop carbon price rising to CAD 40 (around EUR 30). The new national ETS in China, initially covering the power sector, traded at CNY 50 (around EUR 6) per tonne of CO_2e on average. Emissions covered by the new German national ETS for emissions not covered by the EU ETS were priced at EUR 25 per tonne of CO_2e.

The change in average explicit carbon prices across all countries is less pronounced. As shown in

Figure 2.5, explicit carbon prices have increased from EUR 1.78 to an average of EUR 4.29, with ETS prices averaging EUR 3.59 in 2021, up from EUR 1.20 in 2018. Carbon taxes in 2021 amounted to EUR 0.71 on average, up 13 eurocents since 2018. The principal reasons for this relatively smaller increase are that only a quarter of GHG emissions in 2021 were covered by an explicit carbon price (see Figure 2.2) and that explicit carbon prices remained relatively low in several large countries.

Despite recent progress with explicit carbon prices, the Net ECR continues to be dominated by fuel excise taxes. Fuel excise taxes amounted to EUR 13 on average in 2021, down slightly relative to 2018 in 2021 in real terms. Across all countries, the average Net ECR – the sum of explicit carbon prices and fuel excise taxes, minus fossil fuel subsidies – increased to EUR 17, up approximately EUR 3 since 2018. Fossil fuel subsidies and carbon taxes are of similar magnitude, meaning their net effect is close to zero on average.

Figure 2.5. Average effective carbon prices in EUR/tCO_2e, by instrument, all countries, 2018-2021



Note: Carbon prices are averaged across all GHG emissions of the 71 countries, including those emissions that are not covered by any carbon pricing instrument. All rates are expressed in real 2021 EUR using the latest available OECD exchange rate and inflation data; change can thus be affected by inflation and exchange rate fluctuations. Prices are rounded to the nearest eurocent. 2021 Fossil fuel subsidy estimates are based on data for 2020.

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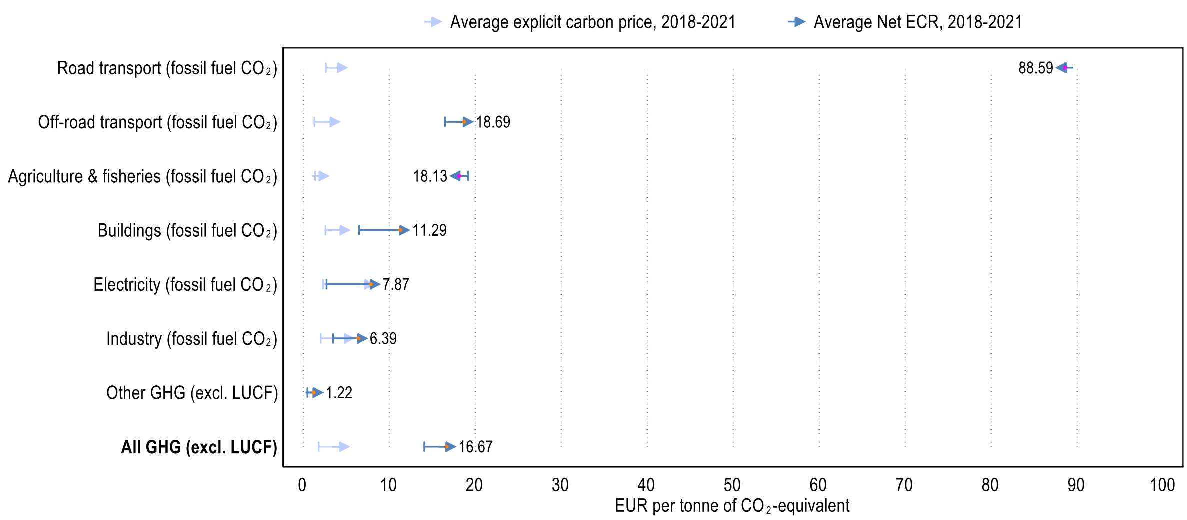
The Net ECR continues to be highest in road transport. As shown in Figure 2.6, the average Net ECR across the 71 countries in road transport is EUR 89 per tonne of CO_2e, almost unchanged since 2018.

This is because of the relatively high rates of excise taxes in this sector (Figure 2.10) and the broad coverage discussed above.

Outside the road sector, the average Net ECRs remain much lower. With EUR 1 per tonne of CO_2e, the Net ECR is lowest for “other GHG”, up from EUR 0.5, followed by industry (EUR 6, up from EUR 3) and electricity (EUR 8, up from EUR 3, where inter-country heterogeneity is large, however, as further discussed below). Explicit carbon prices have been on the rise in all sectors. The increase is largest in electricity where they increased by EUR 5 per tonne of CO_2e between 2018 and 2021 (Figure 2.6).

Figure 2.6. Average effective carbon prices in EUR/tCO_2e, by sector, all countries, 2018-2021



Note: Carbon prices are averaged across all GHG emissions of the 71 countries, including those emissions that are not covered by any carbon pricing instrument. All rates are expressed in real 2021 EUR using the latest available OECD exchange rate and inflation data; change can thus be affected by inflation and exchange rate fluctuations. Prices are rounded to the nearest eurocent. 2021 fossil fuel subsidy estimates are based on data for 2020.

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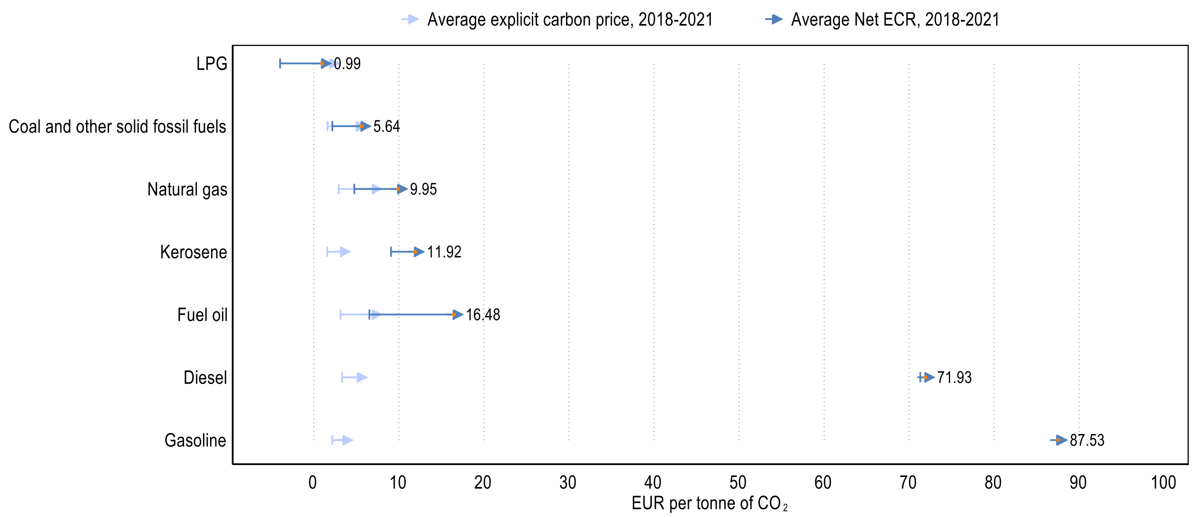
Carbon prices have increased across all fossil fuels, as shown in Figure 2.7. Recent increases are often driven by higher explicit carbon prices. However, the average Net ECR on fuels that are predominantly used in road transport continue to be significantly higher than those on other fuels. With a net ECR of EUR 72 and 88, respectively, diesel and gasoline are both priced more than ten times as much as coal at EUR 6 – often considered the most polluting fossil fuel because of its air pollution impacts that come on top of its climate effects.

Figure 2.7. Average effective carbon prices in EUR/tCO_2e, by fuel, all countries, 2018-2021



Note: Effective carbon prices are averaged across all CO_2 emissions from each of the fossil fuels, including those emissions that are not covered by any carbon pricing instrument. 2021 fossil fuel subsidy estimates (component of Net ECR) are based on data for 2020.

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Carbon price developments since 2018 diverge across countries. Figure 2.7 shows that countries with the highest effective carbon prices in 2018 have seen prices rise further. These changes are mostly driven by the rise of explicit carbon prices, mainly due to higher permit prices related to emissions trading systems, in countries covered by the European Union ETS, but also in Canada, New Zealand and the United Kingdom. In addition to the EU ETS, Germany launched an additional national ETS for heating and transport fuels in 2021. In some countries, carbon tax changes also played a role, with the introduction of new carbon taxes (Luxembourg in 2021, Iceland in 2020 for fluorinated gases), increases in carbon tax rates (e.g. Finland, Iceland, Ireland, Norway) or the phasing out of carbon tax exemptions (e.g. Portugal, Sweden). In Canada, the increase in explicit carbon prices stems from the increasing stringency of the national minimum standards of the federal benchmark, enforceable through the introduction of the federal carbon pollution pricing backstop system.[13]

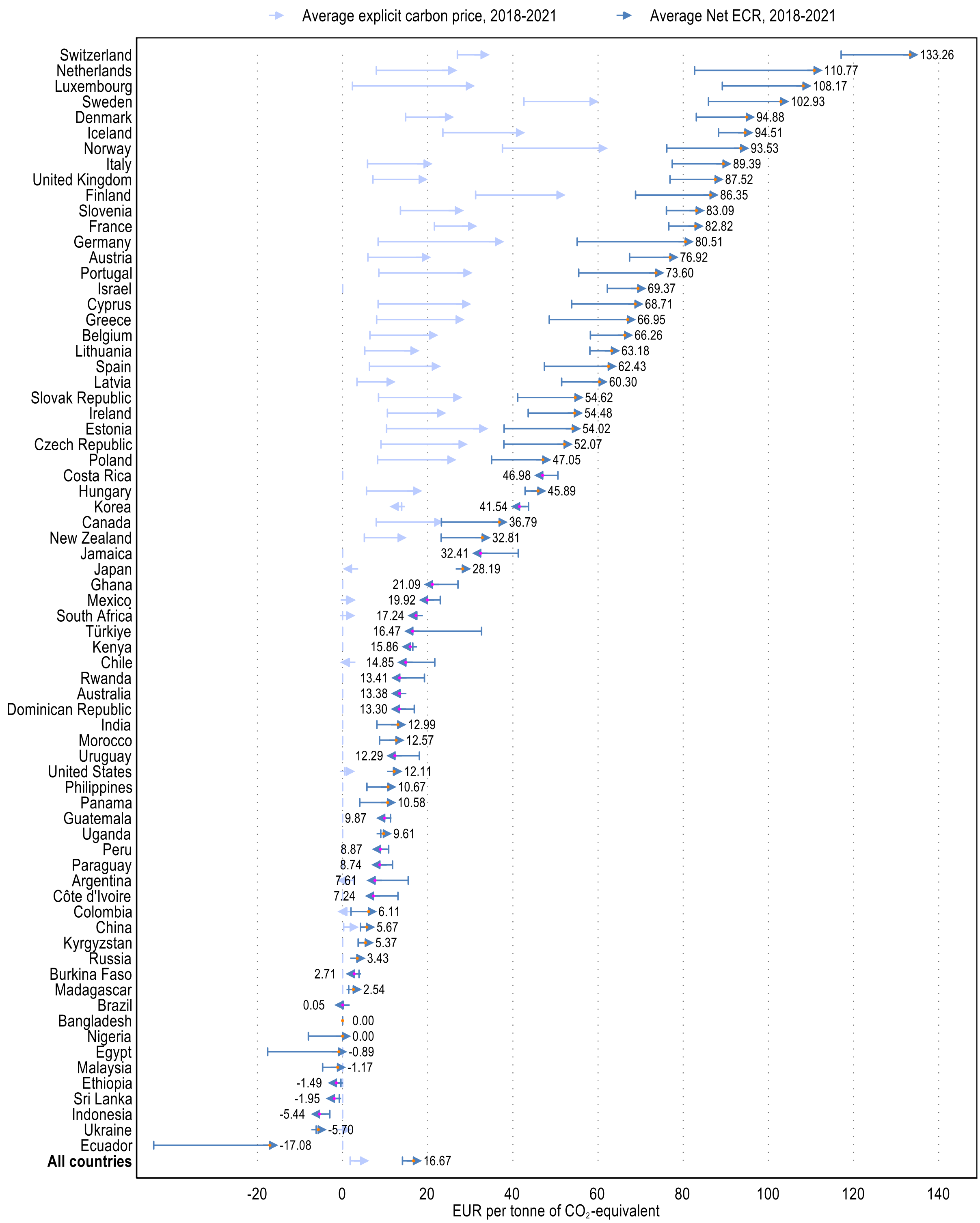
The impact of fuel excise taxes and exchange rate fluctuations on the increase in Net ECRs among countries that already had relatively high Net ECRs to begin with is mixed; inflation exerted some downward pressure on the average Net ECR (which is expressed in real euros). The main noticeable positive contribution of excise taxes in these countries can be observed in the Netherlands, where fuel excise taxes increased for diesel, gasoline and natural gas. Some fuel excise tax rates have also increased in Denmark, Latvia and Switzerland, albeit not to the same extent as in the Netherlands. By contrast, several countries, in particular, Belgium, Cyprus and Estonia, lowered fuel excise tax rates on selected fuels. As fuel excise taxes are often not indexed to inflation, inflation also led to some decreases in real prices. In some cases, upward pressure on Net ECRs from increased carbon taxation was partially offset by excise tax reductions (e.g. for gasoline in Luxemburg and Portugal). Exchange rate appreciation vis-à-vis the EUR explains approximately half of the increase in Switzerland's average Net ECR and almost all of the increase in Israel, where excise tax rates in new Israeli sheqels were almost stable in constant prices. By contrast, the increase in the average Net ECR would have been much higher in Iceland, and to a lesser extent in Hungary and Norway, if their exchange rates had not depreciated relative to the euro.

Overall, increases in the average Net ECR were less common in countries where rates were relatively low in 2018. However, fossil fuel subsidies declined substantially in Colombia, Ecuador, Egypt, Panama, Malaysia, and Nigeria, increasing the average Net ECR of these countries. In Colombia the change was driven by a reduction of automotive fuel subsidies, resulting from low international oil prices in 2020 relative to 2018. Egypt completed a major fossil fuel subsidy reform in 2019 and adopted a fuel price indexation mechanism. Ecuador adopted a new system for monthly adjustments for fuel prices, which partly explains the decrease of subsidies, alongside the reduction of international oil prices. LPG subsidies decreased in Panama. Fossil fuel subsidies declined without any government policy intervention in Malaysia because of lower oil prices. Nigeria temporarily halted petroleum subsidies in 2020 (but they have since been re-introduced). In addition, India, Kyrgyzstan and the Philippines raised fuel excise taxes. India is an interesting case as it increased excise tax rates in 2020 to generate revenues while international oil prices were low.

Where the average Net ECR was already low in 2018, it sometimes declined further. In some cases, this was due to countries decreasing fuel excise tax rates. Chile and Côte d'Ivoire, for instance, both reduced excise tax rates for automotive gasoline. In other cases, it was due to increases in fossil fuel subsidies (e.g. Indonesia).

Lower rates in real euro (as shown in Figure 2.8) do not always mean that countries' Net ECRs have changed in nominal local currency terms. They can also be the result of inflation and exchange rate depreciation relative to the euro, which can temper or even offset increases in nominal domestic prices. Argentina is noteworthy in this regard as a sharp depreciation of the Argentine peso relative to the euro – coupled with domestic inflation – more than offset an increase in nominal tax rates. Both fuel excise and carbon tax rates increased in nominal pesos, and there was also a small decrease in fossil fuel subsidies. Similarly, in South Africa, excises and carbon tax increased slightly above inflation, but the average Net ECR remained essentially unchanged because the rand depreciated vis-à-vis the euro. In Ghana, Kenya and Uruguay, nominal fuel excise tax rates increased broadly in line with domestic inflation, but exchange rate depreciation led to a decrease in the countries' average Net ECR. In Türkiye fuel excise tax rates increased, but inflation and exchange rate depreciation drove the average Net ECR lower.

Figure 2.8. Average effective carbon prices in EUR/tCO2e, by country, 2018-2021



Note: Effective carbon prices are averaged across all GHG emissions, excl. LUCF, of the 71 countries, including those emissions that are not covered by any carbon pricing instrument. 2021 Fossil fuel subsidy estimates (component of Net ECR) are based on data for 2020. All rates are expressed in real 2021 EUR using the latest available OECD exchange rate and inflation data; change can thus be affected by inflation and exchange rate fluctuations. Prices are rounded to the nearest eurocent.

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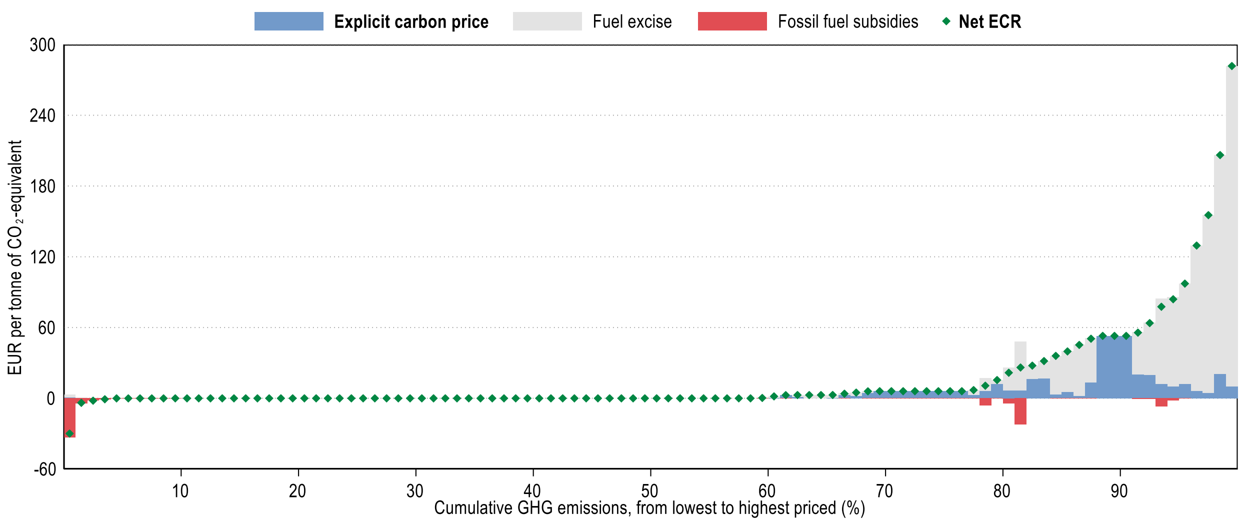
Carbon price heterogeneity persists, also in industry and electricity

Considering the heterogeneous progress with carbon pricing and fossil fuel subsidy reform, it should come as no surprise that the distribution of effective carbon prices across GHG emissions remains highly skewed. Figure 2.9 shows that less than 9 percent of GHG emissions have a Net ECR above EUR 60, a mid-range estimate of current carbon costs (OECD, 2021[22]).

Figure 2.9. The distribution of effective carbon prices across GHG emissions is skewed, 2021



Note: This figure has been simplified for illustration purposes (the average price for each percentile bracket is shown). 2021 Fossil fuel subsidy estimates are based on data for 2020.

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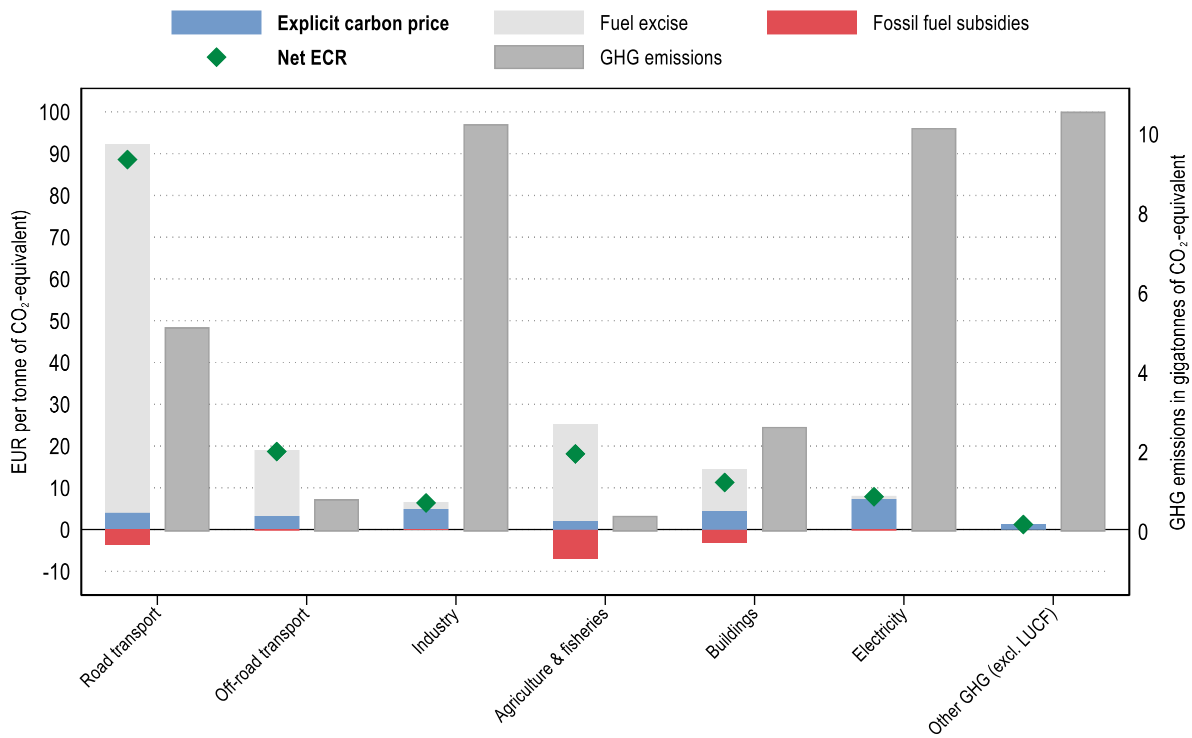
The highest effective carbon prices tend to be the result of relatively high fuel taxes in the road sector. Emissions from industry, power and other GHG are usually mostly priced by emissions trading systems or carbon taxes, at lower rates than road fuels, or remain entirely unpriced. As a result, the average Net ECR for these three sectors is lower than for the other sectors (Figure 2.10). The three sectors with the lowest Net ECRs are also the sectors with the highest GHG emissions. In all other sectors, fuel excise taxes continue to dominate compared to explicit carbon prices and fossil fuel subsidies. Fossil fuel subsidies are largest in the agriculture and fisheries sector, followed by road and the buildings sector.[14]

Figure 2.10. Average effective carbon prices (left axis) and GHG emissions (right axis), by sector, all 71 countries



Note: Net ECRs and its components (LHS) are averaged across all GHG emissions of the 71 countries, including those emissions that are not covered by any carbon pricing instrument. Effective price information is for 2021, with the exception of fossil fuel subsidy estimates that are based on data for 2020. GHG emissions (RHS) are the sum of fossil-fuel related CO_2 calculated based on energy use data for 2018 from IEA (2020[13]) and "other GHG" from Climate Watch (2020[14]).

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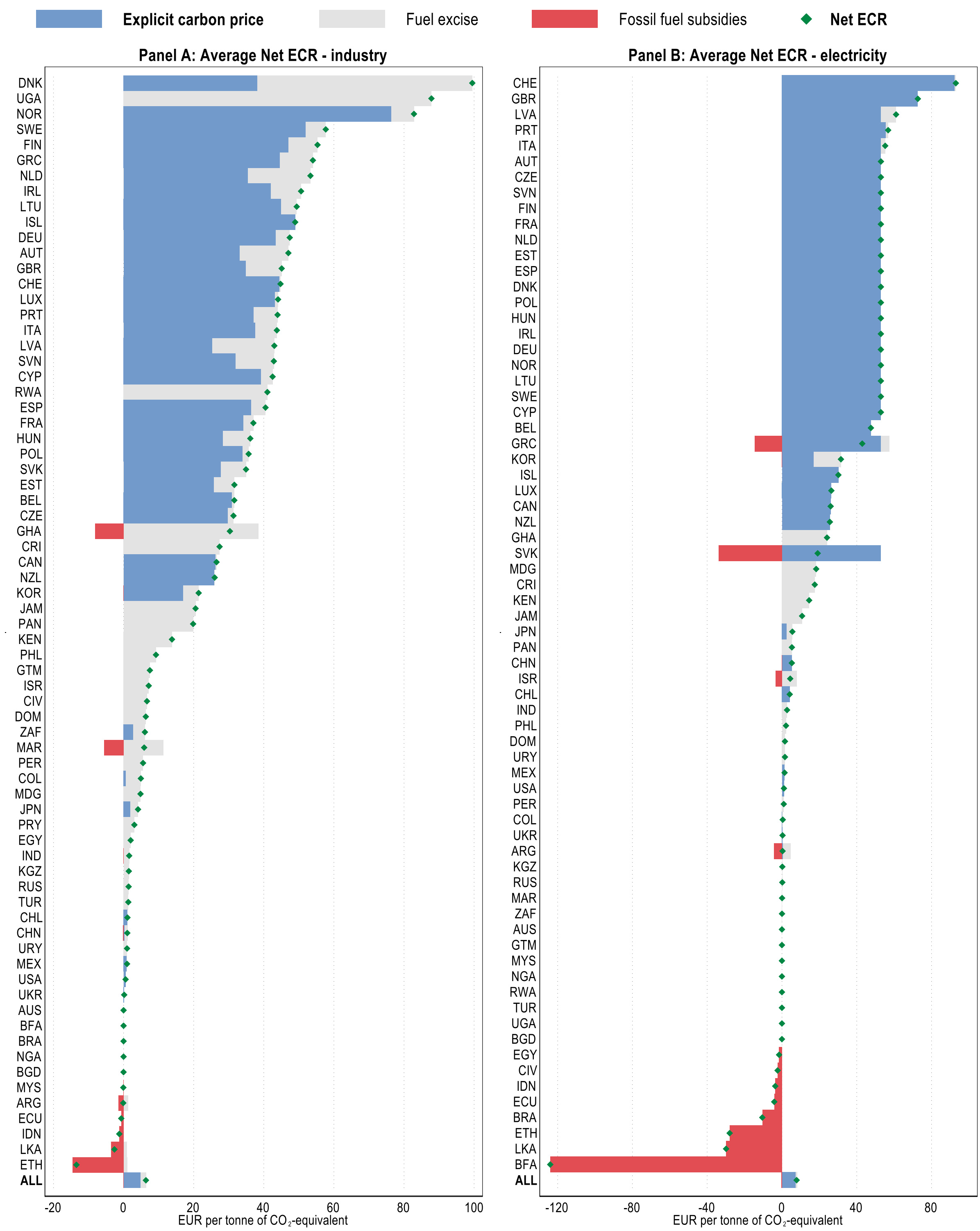
In discussions around carbon leakage and competiveness, industry and electricity sectors take centre stage. Figure 2.11 shows that inter-country heterogeneity in these sectors is indeed large.[15]

Figure 2.11. Effective carbon prices in industry and electricity, by country



Note: Panel B does not include Paraguay as its electricity mix is 100% hydro power, which does not have any CO_2 emissions. Effective carbon prices are averaged across all fossil fuel CO_2 emissions of each sector, including those emissions that are not covered by any carbon pricing instrument. 2021 Fossil fuel subsidy estimates are based on data for 2020. Prices are rounded to the nearest eurocent.

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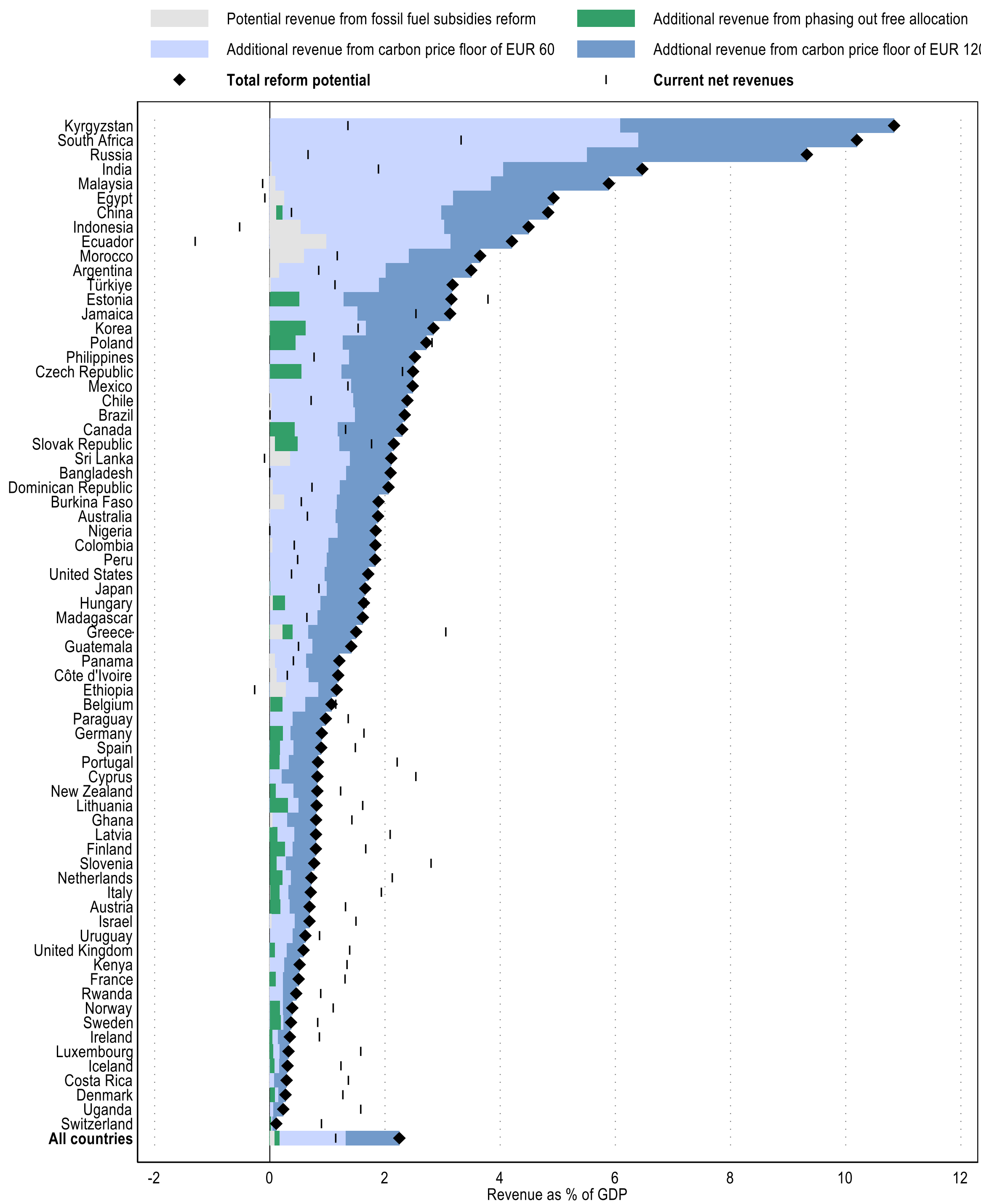
Increasing effective carbon prices could raise substantial revenues, while cutting emissions

Unlike standards and regulation, increasing effective carbon prices can raise revenue. The precise impact of carbon price reforms on public revenue will change over time and will depend on how fast the tax base erodes. Nevertheless, it is useful to provide some indication of how much revenue carbon pricing could raise, at least in the short to medium term. Even if the revenues are not durable over time, they can play an important role in the period of transition where there will be substantial adjustment costs. By how much would revenues increase if Net ECRs were raised to reach a carbon benchmark of EUR 120 per tonne of CO_2 for all fossil fuels? EUR 120 per tonne is a mid-range estimate of carbon prices required by 2030 (OECD, 2021[12]).

The revenue potential from increasing effective carbon prices to the EUR 120 carbon benchmark differs substantially across countries. Figure 2.12 shows that the 71 countries would be able to raise an amount equivalent to approximately 2.2% of GDP on average. This average hides the fact that the revenue potential differs substantially across countries. Some would raise revenues of less than 0.3% of GDP (Costa Rica, Denmark, Switzerland, Uganda), while others could raise revenues in excess of 5% of GDP (e.g. India, Kyrgyzstan, and South Africa). The figure also shows that doing so would increase the net revenues from current carbon pricing instruments by almost 100% on average. There too cross-country differences are considerable.

Figure 2.12. Revenue potential from fossil fuel subsidy and carbon price reform



Note: Revenue estimates use the elasticities described in Box 2.5 and are attributed to the reform components based on the assumption that the reforms are implemented sequentially. Phasing out free allocation is assumed to not lead to behavioural change. Revenue estimates may be considered an upper bound of the actual revenue potential as they were estimated on historical data (fewer and more expensive low-carbon technologies, lower carbon prices, few developing countries in the sample). Estimates are for fossil fuel CO_2 emissions and do not include the revenue potential from reforming the pricing of other GHG or biofuels. Current net revenues are a bottom-up estimate using the Net ECR dataset and may not correspond to the revenues collected in practice. All countries refers to the unweighted average for the 71 countries covered.

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The revenue potential differs among countries for three main reasons. First, there are substantial differences in pre-existing Net ECRs (see Figure 2.8). Higher pre-existing carbon prices (or lower fossil fuel subsidies) reduce the remaining revenue potential from pricing carbon to a given benchmark. Second, some countries price carbon through emissions trading systems, where free allocation remains common in industry and to a lesser extent in electricity. Phasing out such free allocation would generate substantial revenues and could increase the effectiveness of emissions trading systems at reducing emissions (Flues and van Dender, 2017[23]). Third, the carbon intensity of GDP varies across countries.

To provide households and businesses with time to adjust, governments typically raise carbon prices gradually. Figure 2.12 indicates the incremental revenue potential of more modest reform options, starting from reforming fossil fuel subsidies (removing negative carbon prices), followed by phasing out free allocation; and then raising prices to a carbon benchmark of EUR 60. The carbon benchmark of EUR 60 is a low-end estimate of the climate damage caused by each tonne of CO_2 emitted in 2030 and the carbon prices that would be needed by then for consistency with net-zero emissions targets. It is also a mid-range benchmark of current carbon costs (OECD, 2021[12]). In addition to illustrating the revenue impacts of such a sequential reform, the figure also identifies a range of countries where the estimated elasticities imply very large revenue increases. Such large increases are particularly uncertain in that they partly depend on countries' ability to include higher carbon prices in export prices.

Box 2.5. Estimating the CO_2 emission and revenue effects of carbon pricing: new evidence from the first three vintages of the Effective Carbon Rates dataset

The OECD Effective Carbon Rates dataset was used to estimate the long-run responsiveness of CO_2 emissions from fossil fuel use and resulting government revenues to carbon pricing, by D'Arcangelo, Pisu, Raj and Van Dender (Forthcoming[24])

Estimates using the ECR databases for 2012, 2015 and 2018 and exploiting cross-sectional variations over 37 OECD and G20 countries suggest that a EUR 10 increase in effective carbon rates decreases CO_2 emissions from fossil fuels by 3.7% on average in the medium-term.

More precisely, the model used to obtain such estimates regresses the natural logarithm of CO_2 emissions from fossil fuel use on effective carbon rates (as in Sen and Vollebergh (2018[24])) and additionally includes a rich set of fixed effects. The regression equation is as follows:

$$q_{cuft} = \beta \times ECR_{cuft} + \delta_{cut} + \delta_{uft} + \varepsilon_{cuft} \quad (1)$$

where q_{cuft} is the log of CO2 emissions from fossil fuel use for country c, user u and fuel category f in the year t, ECR_{cuft} is the corresponding ECR averaged at the country-user-fuel category level in year t, δ_{cut} and δ_{uft} are fixed effects, and ε_{cuft} is the error term. The large set of fixed effects permitted by the time, sector, user, fuel category and country-span of the ECR dataset enables to account for many confounding factors.

Emission responsiveness varies by sector and fuel category. Table 2.1 presents sector-level semi-elasticity estimates from regression (1) for the whole sample of countries used in D'Arcangelo et al. (Forthcoming[25]).

Table 2.1. Emission responsiveness to ECR by sector

Estimated semi-elasticities and standard errors (multiplied by 100)

	Semi-elasticity
Road	-0.439***
	(0.135)
Electricity	-0.452
	(0.511)
Industry	-0.369***
	(0.112)
Buildings	-0.282
	(0.182)
Off-road	0.017
	(0.207)
Agriculture & fisheries	-0.907***
	(0.238)
Constant	5.585***
	(0.026)
Observations	4899
user×fuel×year fixed effects (δ_{uft})	✓
country×user×year fixed effects (δ_{cut})	✓

Note: *p ≤ 0.1, **p ≤ 0.05, *** p ≤ 0.01. The dependent variable is log-emissions, the independent variable is ECR. Standard errors clustered at user×fuel×time level and country×user×year level are in parenthesis. For the regression, 348 singletons were dropped. Estimates should be interpreted as follows: in the Industry sector, a EUR 1 increase in ECR decreases emissions by 0.37% in the sample of OECD and G20 countries considered for the analysis.
Source: OECD.

Carbon pricing and the sustainable development goals

Carbon pricing and fossil fuel subsidy reform is at the nexus of several UN Sustainable Development Goals (SDGs). While carbon pricing and fossil fuel subsidy reform contributes to responsible production and consumption (SDG 12) and climate action (SDG 13), it also supports good health and well-being (SDG 3) and affordable and clean energy (SDG 7) and, with the right design, leads to reduced inequalities (SDG 10) and more sustainable cities and communities (SDG 11) (OECD, 2021[7]). In addition, carbon pricing has a role to play in domestic resource mobilisation (SDG target 17.1). More broadly, the synergies between mitigation options and the SDGs was also highlighted in the IPCC's third instalment of the Sixth Assessment Report (IPCC, 2022[26])].

The benefits of carbon pricing and fossil fuel subsidy reform extend beyond contributing to good climate policy and are relevant for all countries, not just advanced economies. Against this background, this edition of Effective Carbon Rates and Taxing Energy Use provides data that can help to identity opportunities for carbon pricing and fossil fuel subsidy reform for a larger group of countries than ever before. In addition to 45 OECD and G20 countries, this report covers 26 non-OECD, non-G20 countries at different stages and levels of economic development from across the world. It builds on the initial expansion of the database to 15 developing and emerging economies published in 2021 (OECD, 2021[7]).

The low level of GHG emissions generated by developing and emerging countries can mean that their ability to slow down climate change in the near future through their own actions is limited. However, carbon pricing and fossil fuel subsidy reform enables countries to respond to multiple pressing challenges, including but also extending beyond climate change. Cutting GHG emissions substantially reduces local air pollution, and these co-benefits can counterbalance some of the short-term costs of climate action (e.g. related to higher energy and food prices).

Carbon pricing can also strengthen developing countries' efforts to improve domestic resource mobilisation. While the revenue potential varies across countries, Figure 2.12 shows that it is often substantial. Revenues from carbon pricing could be used to provide targeted support to improve energy access and affordability, enhance social safety nets, and support other economic and social priorities. For example, in Egypt, where a successful fossil fuel subsidies reform generated fiscal savings, the government was able to allocate more funds to education and health and implement an economic stimulus package to recover from the crisis.

The potential use of carbon pricing revenues to support improvements in social safety nets is particularly relevant in developing countries where many citizens do not benefit from an adequate social safety net. Based on a simulation of the impacts of potential carbon price reforms in eight developing and emerging countries (Bangladesh, India, Indonesia, Pakistan, the Philippines, Thailand, Türkiye and Viet Nam), Steckel et al. find that "[e]qually recycling revenues back to all citizens would overcompensate the burden of a carbon price for the poorest households in all countries" (2021[27]). This is because higher-income households tend use more fossil fuels.

It is worth highlighting that carbon taxes are generally harder to avoid than direct taxes on personal or corporate income and can, therefore, be effective taxes in economies facing the challenge of high levels of informality. These challenges are particularly acute in developing countries, where 70% of all employment is informal (OECD/International Labour Organization, 2019[28]).

By committing to gradually increasing carbon prices and investing in low-carbon technologies, developing countries can avoid many of the transition costs that the developed world is facing today, such as stranded assets and stranded jobs in coal regions. The reason is that today there are fewer dirty legacy assets in many developing countries than in the developed world. Sub-Saharan Africa is the region closest to net-zero GHG emissions per capita, with 3.45 tonnes of CO_2e per capita in 2018. For comparison, per capita GHG emissions are 18.03 tonnes in North America.[16] Countries like Burkina Faso, Côte d'Ivoire, Ecuador, Ghana, and Uganda for example, are not currently using coal.[17] Carbon price reform or other environmental instruments such as a ban on coal use, could enable some countries to leapfrog the most polluting fossil fuels altogether.[18]

While interest in carbon price reform is on the rise, as evidenced by the growth in explicit carbon pricing schemes (Box 2.6), carbon prices continue to be relatively low in many developing and emerging economies (Figure 2.8). The barriers to carbon pricing reform are not predominantly administrative: almost all countries have experience with fuel excise taxes, meaning that the implementation of carbon price reform is within reach in administrative terms. Governments could make good progress by aligning excise taxes with the carbon content of the fuels. For example, a carbon tax of EUR 30 per tonne of CO_2 corresponds to a gasoline tax of 7 eurocents per litre of gasoline and to a coal tax of some 6 eurocents per kg. Such fuel-based carbon taxes could be collected from the fuel suppliers in the same way as existing fuel excise taxes.

The principal barriers to carbon pricing lie in making sure that change is equitable and aligned with the country's development objectives, which is also critical to building broad public support for carbon price reform. Egypt's success with fossil fuel subsidy reform is encouraging as it shows that adverse impacts on vulnerable households and businesses can be alleviated. As in advanced economies, carbon pricing needs to be part of a larger portfolio of climate and fiscal policies. Kenya, for instance, is taking steps to ensure that people and businesses will have affordable access to cleaner alternatives. Broader efforts at encouraging electrification are one promising avenue. Kenya does not have a carbon tax, but is considering implementing an emissions trading system and levies fuel excise taxes. Recent energy price increases led to the reintroduction of subsidies starting from 2021, alongside an excise duty and VAT rate cut on petroleum products (see Box 2.3).

A real risk with carbon pricing is that it could lead to more widespread use of locally sourced firewood, which is typically impractical to tax. Apart from blunting the effect of the carbon tax on GHG emissions, the use of traditional biofuels will often also bring about local pollution with substantial environmental and health costs. The issue is of particular relevance in developing countries with less administrative capacity to design, implement and enforce countervailing policies. It is therefore critical that carbon pricing reform be accompanied by measures to avoid such substitution effects (e.g. support for the uptake of clean heating and cooking technologies, see also, Chapter 3).

Box 2.6. Explicit carbon pricing in developing and emerging economies

Since they were first implemented in the early 1990s in Scandinavian countries, explicit carbon pricing mechanisms have spread in Europe (especially with the EU ETS in 2005) and in many other high income countries. Increasingly emerging economies, but also other developing countries, have also implemented or are considering the introduction of carbon pricing mechanisms. Fuel-based carbon taxes are quite straightforward to implement, but rates remain low or are limited to certain fuels or uses. Uruguay's carbon tax, for instance, is only levied on gasoline. Albania's carbon tax doesn't have a uniform rate per tonne of CO2 across fuels. Emissions-based pricing mechanisms, by contrast, require a measuring, reporting and verification (MRV) system, which may create additional implementation challenges but allow for the targeting of a wider range of GHG (OECD, 2019[29]). Emissions trading systems benefit from growing interest in middle income countries, especially in Asia and Eastern Europe. Recently the EU proposal for a carbon border adjustment mechanism (CBAM), has led to an increased interest in explicit carbon pricing systems among many of the EU's trading partners.

Table 2.2. Explicit carbon pricing in developing and emerging economies

	Explicit carbon price in place	Explicit carbon price under consideration
Albania	Carbon tax in place since 2008 with rates per tonne of CO_2 varying by fuel	
Argentina*	Carbon tax implemented since 2018 on liquid fuels of ARS 519 (ca. EUR 4.6) in April 2021	
Bosnia and Herzegovina and other Western Balkans countries		Carbon taxation mechanisms under consideration
Brazil*		Carbon pricing system under consideration
China*	ETS in place since 2021, initially for the power sector, with planned increasing sectoral coverage	
Côte d'Ivoire		Carbon tax under consideration
Indonesia*	Emissions-based carbon tax introduced on 1 July 2022 for coal-fired power plants emissions above a cap, at a rate of IDR 30 per kilogram (ca. EUR 1.9 per tonne), before a larger cap-and-trade system in 2025	
Kazakhstan	ETS since 2013, covering power, heat and some extractive and manufacturing sectors, with an average secondary market price of KZT 504 (ca. EUR 1) per tonne of CO_2 in 2021	Carbon tax under consideration
Kenya*	.	ETS under consideration
Morocco*		Carbon tax concept introduced by a tax law in July 2021, but no concrete timetable for implementation
Pakistan		ETS under consideration
Philippines*		ETS under consideration
Senegal		Carbon tax under consideration
South Africa*	Carbon tax since 2019, rate currently of ZAR 144 (ca. EUR 8.6) per tonne of CO_2e, gradually increasing	
Thailand		ETS under consideration
Ukraine*	Carbon tax since 2011, rate of UAH 30 (ca. EUR 1) per tonne of CO_2	ETS under development
Uruguay*	Carbon tax of more than EUR 100 per tonne of CO_2 on gasoline introduced in 2022	
Viet Nam		ETS under development

Note: Countries covered in this report are marked with an asterisk.
Source: Authors, Carbon pricing dashboard (World Bank), ICAP.

Unlocking further mitigation efforts

Reaching their GHG reduction targets in the medium and long term will require countries to step up their efforts (IMF/OECD, Forthcoming[30]). As discussed in Chapter 1, countries can and should deploy a range of instruments to overcome the various barriers to the transition to net zero, and they should do so in a way that fits their particular circumstances. Progressively increasing carbon prices while phasing out fossil fuel subsidies contributes to more ambitious, effective and efficient climate policy, and will be particularly powerful when combined with policies that support the supply of low and zero carbon technologies and infrastructures.

The share of emissions that is covered by carbon prices has increased in recent years as a number of countries have introduced or extended explicit carbon pricing schemes. Nevertheless, there is a long way to go if carbon pricing is to live up to its potential. For almost 60% of GHG emissions, the Net ECR is zero or even negative. In addition, even for emissions where positive carbon prices dominate, price levels are often not high enough for a successful transition to net zero (Carbon Pricing Leadership Coalition, 2021[31]; OECD, 2021[12]). Making progress requires countries to ensure that the transition to net zero is inclusive and aligns with their growth and development agendas.

The political economy of carbon pricing and fossil fuel subsidy reform can be challenging. Equitable reform packages are critical to ensuring a just transition that does not leave vulnerable groups behind. Embedding carbon price and fossil fuel subsidy reforms in broader policy packages can cushion adverse short-term impacts by delivering immediate benefits to vulnerable groups – whether households, workers, firms or regions. Strategically deploying the revenues from carbon pricing can make climate policy more inclusive and effective. The most productive revenue use will depend on the local circumstances (Marten and van Dender, 2019[32]; OECD, 2021[7]; IMF/OECD, 2021[2]). Political support may be increased by spending revenues on climate projects (Maestre-Andrés et al., 2021[33]) or by targeting revenue use strategies to citizens' fairness preferences (Sommer, Mattauch and Pahle, 2022[34]). However, returning carbon pricing revenues to citizens as targeted lump sum transfers is not a panacea, particularly where climate policy is the subject of a robust partisan and interest group divide (Mildenberger et al., 2022[35]). Of course, these challenges are magnified in a broader economic context of sharply rising energy prices driven by external shocks. While choices on revenue use can contribute to stronger support for climate policy, they will not, on their own, be sufficient to securing broad public support. Instead, there is a need for building trust that the transition to net zero is needed and can be achieved in a socially cohesive way.

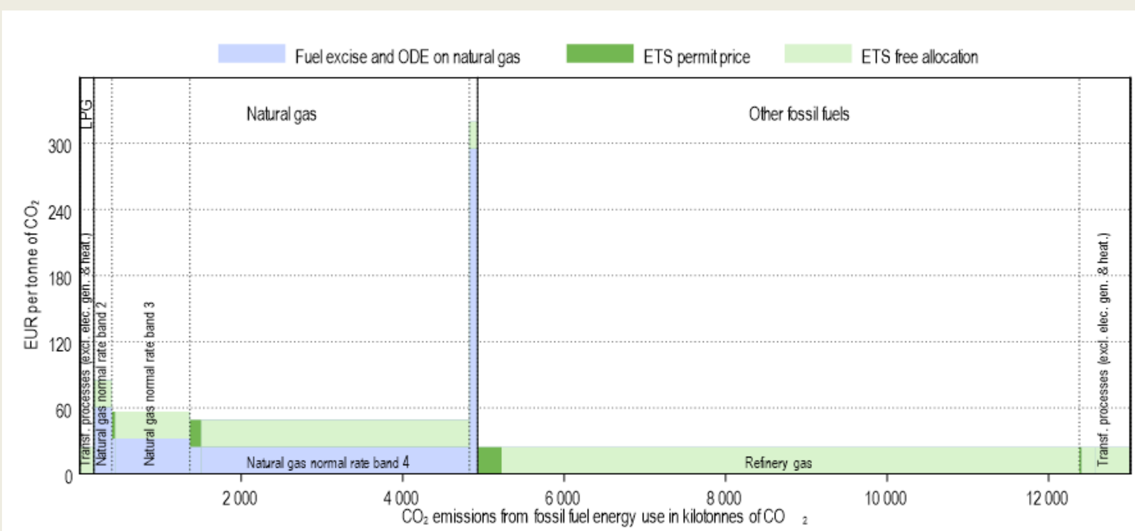
Competiveness and carbon leakage concerns often hold back carbon price reform. The evidence from OECD countries is that at historical price levels with modest carbon price differences across countries there are no discernible effects (Dechezleprêtre et al., 2022[36]; OECD, 2021[37]; Venmans, Ellis and Nachtigall, 2020[38]). However, prices are low and in emissions trading systems permits (allowances) are often allocated for free, especially in the industry (Box 2.7) and electricity sector (OECD, 2021[22]). The rules for free permit allocation can provide an advantage to carbon-intensive technologies, effectively muting carbon price signals (Flues and van Dender, 2017[23]). These and other existing measures to address potential impacts of carbon pricing on competitiveness and leakage are therefore difficult to reconcile with the long-term ambition to reach net zero. Auctioning off more ETS allowances would strengthen abatement incentives, while raising government revenue to support a green and inclusive transition. Yet, where increased policy stringency in some jurisdictions is not matched by similar policies in other countries, competiveness and carbon leakage concerns could amplify, at least for a limited number of carbon-intensive and trade exposed sectors, e.g. cement, steel, and aluminium (OECD, 2020[39]).

Box 2.7. Free allocation of EU ETS allowances: the case of the Dutch chemical sector

The Dutch Climate Act in 2019 sets out ambitious climate goals for the Netherlands, including legally binding greenhouse gas (GHG) emissions reduction targets of 49% by 2030 and 95% by 2050 compared to 1990 levels. The Act is accompanied by a Climate Plan and Climate Agreement that develop the policy package to reach those goals. For the industry sector, the Netherlands' climate policy package combines a commitment to raising carbon prices with ambitious technology support. A new carbon levy in industry sets out a carbon price trajectory that rises to EUR 125 per tonne of CO_2 in 2030 (including the EU ETS price). The carbon levy comes on top of existing carbon pricing instruments: the EU ETS, an energy tax on natural gas and the sustainable energy surcharge on natural gas.[19]

Concerns over competition that domestic energy users may face from firms in countries with less ambitious carbon pricing policies have led the Dutch authorities to grant extensive preferential treatment to energy-intensive users. For example, the levy base phases in only gradually over time. Freely allocated EU ETS allowances and generous energy tax exemptions are available, leaving key energy users entirely unpriced. Finally, a regressive energy tax and surcharge rate applies that decreases with energy consumption. This provides for a very heterogeneous carbon pricing signal across industries, energy users and fuels in the Netherlands and advantages large energy consumers over small ones.

Figure 2.13. Effective carbon rates on CO_2 emissions from fossil fuel energy use in the Dutch chemical sector, 2021



Note: Figures are based on the OECD Taxing Energy Use and Effective Carbon Rates methodology (2019[29]; 2021[22]). They include energy tax ("fuel excise") and ODE rates on natural gas (net of exemptions) and the ETS permit price (accounting for free allocation). The carbon levy is set to zero for 2021 because of the large amount of excess dispensation rights in 2021. CO_2 emissions are calculated based on fossil fuel energy use data adapted from IEA (2020[40]) World Energy Statistics and Balance.
Source: OECD (2021[41]).

The individual industry profile in Figure 2.13 presents the carbon pricing profile for the chemical sector in 2021. Only natural gas is covered by the fuel tax – mainly at the lowest available rate as the majority of consumption falls into the highest consumption bin. The EU ETS covers a large part of other fossil fuels, but extensive free allocation erodes the price signal in the sector. The figure partitions the price signal deriving from the EU ETS (green area) and provides an estimate of how much of the EU ETS emissions are covered by an auctioned (dark green) or freely allocated emissions allowance (light green). This is different from the marginal price approach taken in the remainder of this report that assigns permit prices to the respective emissions base independently of whether allowances are freely allocated. The latter approach is rooted in the idea that freely allocated allowances retain CO_2 abatement incentives at the margin due to the opportunity cost (the allowance price) that they entail.

Accounting for free allocation significantly narrows the base of the ECR. More precisely, the chemicals sector receives freely allocated allowances for 96 percent of emissions. This effectively drives a wedge between the *marginal price* emitters pay for an additional unit of emissions (EMCR) and the *average price* they pay for their entire emissions base (EACR). In 2021, the EMCR is estimated at EUR 37 per tonne on average in the chemicals sectors, reducing to EUR 13 per tonne on average when taking free allocation into account.

Source: Anderson et al. (2021[42]) and OECD (2021[41])

Border carbon adjustments (BCAs) have been proposed as one tool to address competitiveness and leakage concerns. Depending on their design, BCAs create incentives to introduce explicit carbon prices in jurisdictions where they do not yet exist. However, due to limited product coverage, BCAs would only price a fraction of GHG emissions embodied in traded goods. Since BCAs do not address emissions not related to trade, their potential to unlock comprehensive action on climate change mitigation is limited (Parry, Black and Roaf, 2021[43]). By contrast, international co-ordination has the potential to spur more widespread climate action. Co-ordination needs to be fair and should account for countries differentiated responsibilities and respective capabilities. It also needs to be pragmatic and recognise that countries start out from very different economic and political realities, which implies that they will rely on different combinations of mitigation policy instruments (IMF/OECD, 2021[2]). As a consequence, coordination will need to consider a broad range of instruments, which increases complexity significantly.

Improving the measurement of different mitigation policy instruments and approaches could be an important enabler to address negative spill-overs across countries. This will likely require going beyond explicit carbon prices and implicit carbon prices from fuel excise taxes and fossil fuel subsidies – the instruments covered in this chapter. Chapter 3 makes a first attempt at broadening the scope by additionally incorporating electricity taxes and subsidies. However, an even broader assessment of mitigation policies will be needed to advance this dialogue.

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Notes

[1] The long run can be understood as the period in which full adaptation to a price change takes place within the set of technological and behavioural options available in the sample period – this could be a period of 3 to 10 years, depending on sector, fuel and country. It is plausible that technology change, partly as a result of climate policy, will increase the price responsiveness of CO_2 emissions from energy use to carbon prices in the years to come, so that the estimates are lower bounds. The responsiveness differs across sectors. In three of the main sectors – road transport, industry and electricity – an ECR increase of EUR 10 reduces emissions by around 4%, even though the percentage *price* changes differ strongly. The responsiveness is much higher in the agriculture and fisheries sector, a bit lower than 4% for a EUR 10 increase in ECR in the buildings sector and zero in the offroad transport sector (D’Arcangelo et al., Forthcoming[25]).

[2] The OECD Inventory of Support for Fossil Fuels provides complementary information on the nature and magnitude of government support measures that are beyond the scope of the Net ECR indicators. This includes producer subsidies with no direct link to domestic fossil fuel prices, VAT reductions for energy

and "general services" support (e.g. support for industry-specific infrastructure development such as coal or natural gas terminals).

[3] All comparisons included this report are like-for-like comparisons based on the revised specifications and scope of this vintage – 2018 data has been updated retroactively. These figures can, however, not be directly compared to the headline numbers from previous reports. In particular, there are four main differences to the figures presented in the OECD's *Effective Carbon Rates 2021* report (see also, Chapter 1). First, this edition incorporates fossil fuel subsidies resulting from budgetary transfers. Second, this edition includes 27 additional countries. Third, this edition includes "other GHG", in addition to CO_2 emissions from fossil fuel use, while excluding CO_2 emissions from the combustion of biofuels. Fourth, this edition expresses all prices in real 2021 euros, whereas *Effective Carbon Rates 2021* expressed prices in real 2018 Euros.

[4] In addition there is the new UK ETS, but as it replaced the EU ETS that applied previously, this has not led to a change in coverage.

[5] In addition, the Mexican states of Baja California and Tamaulipas introduced carbon taxes between 2018 and 2021. Starting from 2022, Austria, Indonesia and Uruguay also levy carbon taxes.

[6] The overall increase in coverage by the sum of these instruments is lower than the sum of the change in each instrument. The reason is that sometimes several instruments apply to the same emissions. Both the German ETS and the South African carbon tax, for instance, also apply to emissions from the road transport sector that are equally covered by pre-existing fuel excise taxes.

[7] In the UK electricity sector, for instance, the carbon price support, a carbon tax, applies in addition to the ETS.

[8] Coverage alone is insufficient to judge whether a carbon pricing system is aligned with a country's climate targets.

[9] Denmark, Spain, Norway and Poland had in place F-gas taxes in both 2018 and 2021. By 2021 taxes covering F-gases had also been introduced in the Netherlands and Iceland. Among emissions trading systems, the EU ETS covers perfluorocarbons (PFCs) from the production of aluminium. Other systems with coverage of F-gases include the Chongqing pilot ETS, the Korean ETS, the New Zealand ETS, the Swiss ETS, the UK ETS, the California Cap-and-Trade (CaT), the Quebec CaT, and the Nova Scotia CaT.

[10] In the Taxing Energy Use and Effective Carbon rates database, traditionally CO_2 emissions from energy use in the Agriculture & Fisheries sector were the only GHG emissions from Agriculture and Forestry in the scope of the report (see Chapter 1). With the addition of "other GHG" from the CAIT dataset, CH_4 from livestock and rice cultivation and N_2O from agriculture soils are now also covered in the database. On the other hand, GHG from Land Use Change and Forestry (LUCF) are not presently part of the emissions base utilised in this report. While the CAIT dataset includes estimates of GHG emissions from Forestry and Other Land Use (FOLU), it is not presently incorporated into this report as "this data is useful as reference only and may not coincide with LUCF emissions reported by countries to the UNFCCC" where it is also noted "that the errors and uncertainties associated with these (and other LUCF) estimates may be significant."

[11] In the Netherlands, the increased coverage is a result of the introduction of the carbon levy in industry. The instrument largely overlaps with the EU ETS but additionally covers nitrous oxide emissions from facilities and waste incinerators outside the scope of the EU ETS (the EU ETS only covers nitrous oxide from production of nitric, adipic and glyoxylic acids and glyoxal).

[12] Unless otherwise stated, prices are expressed in real 2021 EUR per tonne of CO_2e.

[13] The federal backstop is composed of a regulatory fuel charge on fossil fuels and an output-based pricing system for industrial facilities that applies either in whole or in part in provinces and territories that requested it and in provinces and territories that did not enact their own carbon pricing systems of sufficient stringency.

[14] The skewed distribution and uneven pricing patterns across sectors imply that country-level average carbon price metrics need to be interpreted with caution. Countries with a relatively large share of emissions from road transport, and lower levels of emissions from industry and power where carbon prices tend to be lower (Figure 2.11), usually have relatively high average emissions-weighted Net ECRs at the country level. Luxembourg is a case in point. The country has a large share of road emissions, also because of fuel tourism from neighbouring countries. In addition, Luxembourg has relatively few emissions from industry and power, where it largely relies on imports. The OECD.STAT dataset accompanying the release of this report provides fine-grained fuel and sector-specific Net ECR data that allow comparisons by fuel and sector to avoid composition effects. Luxembourg's sector-level Net ECR, is, for instance, not particularly high for Europe.

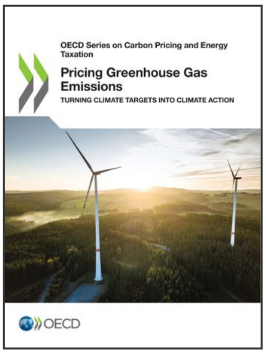
[15] Competitiveness and carbon leakage risks vary across industries. For example, in Chile, studies on climate transition risks identified cement and steel as sectors that would be affected the most (https://4echile.cl/publicaciones/desarrollo-bajo-en-carbono-para-sectores-con-riesgo-de-transicion-climatica-en-chile).

[16]https://www.climatewatchdata.org/ghg-emissions?end_year=2018&regions=EAP%2CECA&start_year=1990.

[17] Similarly, consumption in Paraguay is very low (0.1% of total energy supply).

[18] Carbon prices will need to be sufficiently high and credible to impede investments in coal power. In this respect, it is worth noting that new coal fired power plants are opening in countries that have implemented (China, Indonesia, South Africa) or are considering establishing (Pakistan, Philippines, Thailand) explicit carbon pricing mechanisms (Global Energy Monitor, 2022[44]).

[19] A sustainable energy surcharge and energy tax also applies on electricity consumption. However, these apply on kWh electricity consumed and do not differentiate by type of fuel or their carbon content. They are not considered a carbon-pricing instrument.



From:

Pricing Greenhouse Gas Emissions

Turning Climate Targets into Climate Action

Access the complete publication at:

https://doi.org/10.1787/e9778969-en

Please cite this chapter as:

OECD (2022), “Pricing greenhouse gas emissions: What has changed? What needs to change?”, in *Pricing Greenhouse Gas Emissions: Turning Climate Targets into Climate Action*, OECD Publishing, Paris.

DOI: https://doi.org/10.1787/023747ff-en