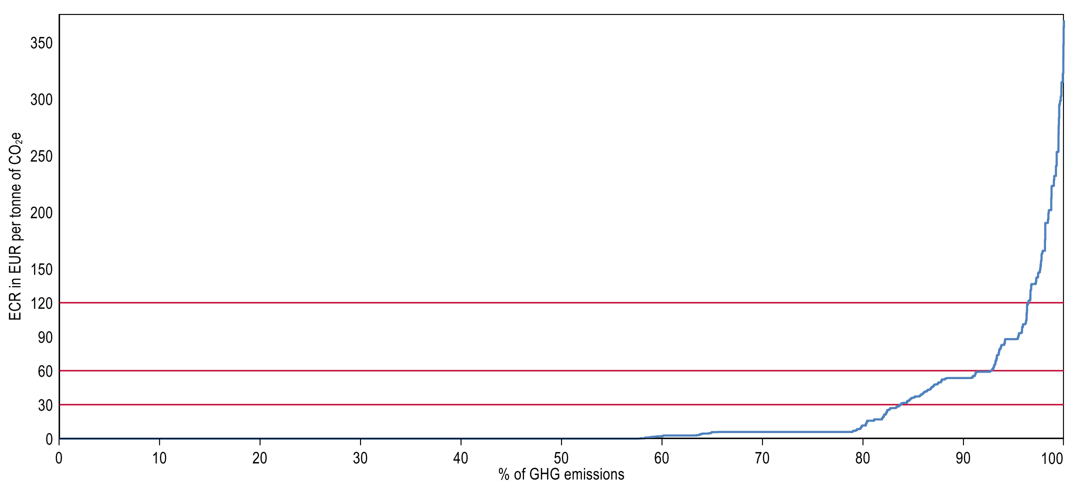
2 Effective Carbon Rates in 2021

2.1. Effectives Carbon Rates in 2021

In 2021, 42% of the little over 40 billion tonnes of GHG emissions were priced in the 72 countries considered in this report (Figure 2.1). The distribution is skewed, with about 16% of GHG emissions priced over the EUR 30 benchmark. About 7% of emissions are priced at EUR 60 or more and almost 4% are priced at EUR 120 or more.

Figure 2.1. Distribution of Effective Carbon Rates

2021, 72 countries



Note: The breakdown of percentiles by type of pricing instrument is presented in Annex 2.A (Annex Figure 2.A.1). The equivalent figure when accounting for CO_2 emissions from biofuel combustion is presented in Annex A.'

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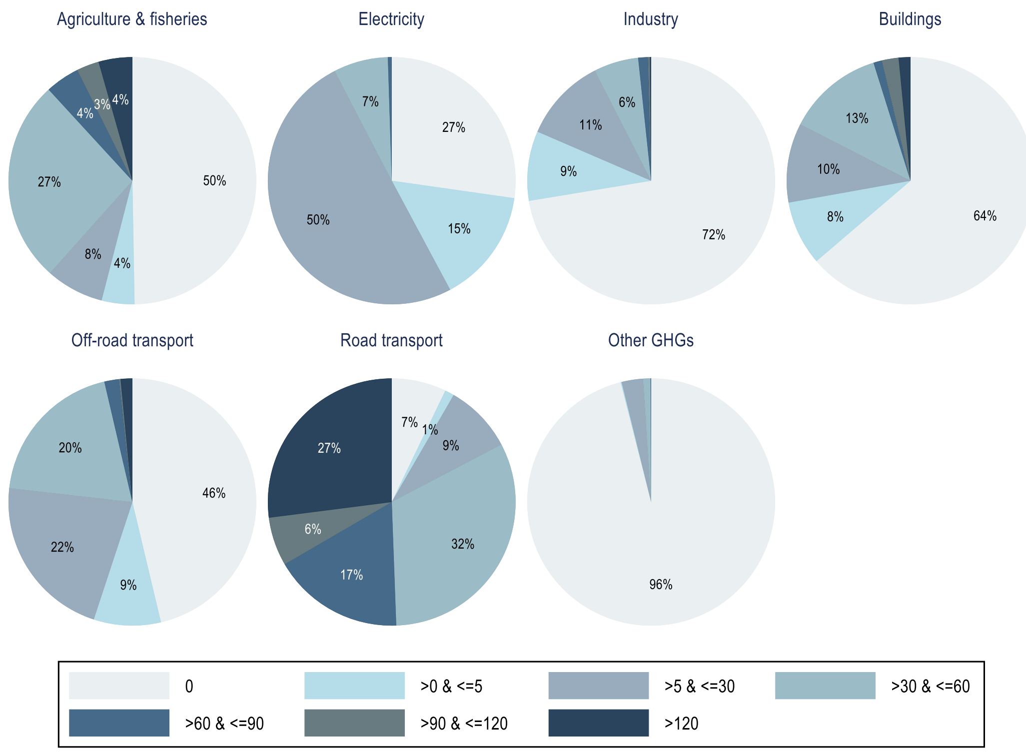
The distribution of ECRs is heterogenous across sectors, with the road transport sector facing the highest rates, followed by the electricity and off-road transport sectors, and the majority of other GHG emissions (methane – CH_4 –, nitrous oxide – N_2O –, fluorinated gases – F-gases – and carbon dioxide – CO_2 from process) facing no carbon price (Figure 2.2). Rates above EUR 60 and EUR 120 per tonne of CO_2 mostly occur in the road transport sector. However, high taxation rates in this sector may also reflect the pricing of other externalities caused by road transport, such as air pollution, accidents, congestion and noise,[1] or can reflect revenue raising objectives. Despite the industry sector contributing more than a quarter of total emissions Figure 2.3), 72% of emissions in that sector remain unpriced. Only 7.5% of emissions in the industry sector are priced above the EUR 30 benchmark. Almost three quarters (73%) of the electricity sector emissions face a positive carbon price, with half of ECRs in the sector between EUR 5 and 30 per tonne of CO_2 and a little over 7% above EUR 30 per tonne of CO_2. About two thirds (64%) of the buildings sector emissions are unpriced, with about 17% of emissions covered by ECRs over EUR 30 per tonne of CO_2. Other GHGs face the lowest ECRs, with 96% of emissions unpriced.

Figure 2.2. Proportion of CO_2e emissions priced at different ECR levels by sector

2021, 72 countries



Note: Other GHG emissions refer to emissions from methane (CH_4), nitrous oxide (N_2O), F-gases and process CO_2 emissions excluding LUCF. The equivalent figure when accounting for CO_2 emissions from biofuel combustion is presented in Annex A.

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Differences in average price levels between sectors can be related to differences in pricing instruments used to cover their emissions (Figure 2.3), to the degree of coverage, and to differences in fuel use across sectors[2] (Figure 2.4). ECRs are highest in sectors where emissions are predominantly covered by fuel excise taxes – that is, in the road transport, and to a lesser extent in the agriculture and fisheries, off-road transport and buildings sectors. In those sectors, average fuel excise tax rates stand at respectively EUR 86, EUR 25, EUR 15 and EUR 10 per tonne of CO_2. The lower ECRs are observed for sectors where emissions are mostly covered by emissions trading systems (ETSs), the electricity and industry sectors (their average ECRs stand at respectively EUR 7.5 and EUR 6 per tonne of CO_2). This is in part because fuel excise taxes are more prevalent than ETSs as a carbon pricing instrument and because when fuel excise taxes are used, they tend to cover a larger proportion of a sector's emissions than ETSs. Chapter 3 shows that average ECRs are higher in the electricity and industry sectors when restricting attention to countries that have an ETS.

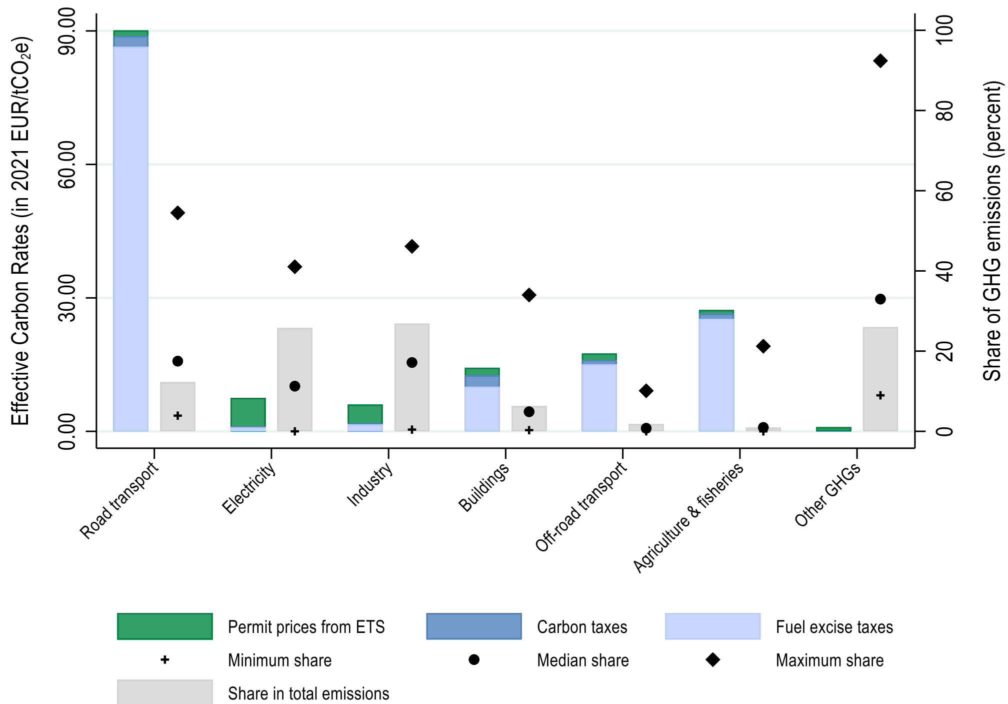
Explicit pricing instruments are being used to price emissions in all sectors (Figure 2.3). Emissions trading systems are mostly used in the electricity and industry sectors, accounting for 86% and 70% of the respective sectors' average ECRs: average permit prices in these sectors stand at respectively EUR 6.5 and EUR 4 per tonne of CO_2. ETSs are the main instrument that covers other GHG emissions (3.8%), mostly through the pricing of industrial process emissions. Average carbon tax rates are highest in the road transport and buildings sectors, at about EUR 2.5 per tonne of CO_2 in both sectors. Carbon taxes cover about 0.14% of emissions from other GHGs; they make up a low share of the base and hence present an average close to 0, but range from EUR 0.46 to about EUR 59 per tonne of CO_2.

The most emitting sectors are not necessarily those that face the highest prices on average (Figure 2.3). Indeed, the industry and electricity sectors as well as other GHGs (emissions from CH_4, N_2O, F-gases and process CO_2 emissions) account for about one quarter each of emissions, but on average face lower ECRs than the agriculture and fisheries and off-road transport sectors which are responsible for much lower shares of total emissions (respectively almost 1% and 2%). Given political constraints facing carbon pricing and different abatement opportunities in different sectors, setting higher prices on larger emissions bases can be more challenging than for narrower emissions bases.

Sectoral shares can substantially vary across countries (Figure 2.3) and this variation influences average ECRs at the country level. Indeed, a low ECR can be due to a low carbon price or a narrow base. Sectoral shares widely vary: off-road transport sector emissions never make up more than 10.2% of a country's GHG emissions, while other GHG emissions can account for up to 92.4% of emissions in a country. This variation then influences country-level average ECRs. For example, a country with a higher share of other greenhouse gas emissions will tend to have a lower average ECR (since these emissions are hardly covered) than one with a higher share of emissions from the road transport sector (where ECRs are on the higher end of the distribution).

Figure 2.3. Carbon pricing instruments and share of GHG emissions by sector

2021, 72 countries



Note: The left-hand side bars of this graph show ECR components by sector. Together, emissions from the road transport, electricity, industry, buildings, off-road transport and agriculture and fisheries sectors make up CO_2 emissions from energy use. Other GHG emissions cover CH_4, N_2O and F-gas emissions as well as CO_2 emissions from industrial process. The right-hand side axis presents shares of emissions from these sectors in total emissions, as well as their country-level variation. “Minimum share” (resp. “Maximum share”) indicates the minimum share this sector may represent in a country’s total GHG emissions. “Median share” is the median of such shares across countries. For instance, the median share in the road transport sector indicates that half of countries in the sample have a road transport sector that accounts for more than 17.5% of national GHG emissions. Other GHG emissions data are from CAIT (Climate Watch, 2022[1]) while the data on CO_2 emissions from energy use are based on the IEA World Energy Balances (IEA, 2023[2]). The equivalent figure when accounting for CO_2 emissions from biofuel combustion is presented in Annex A.

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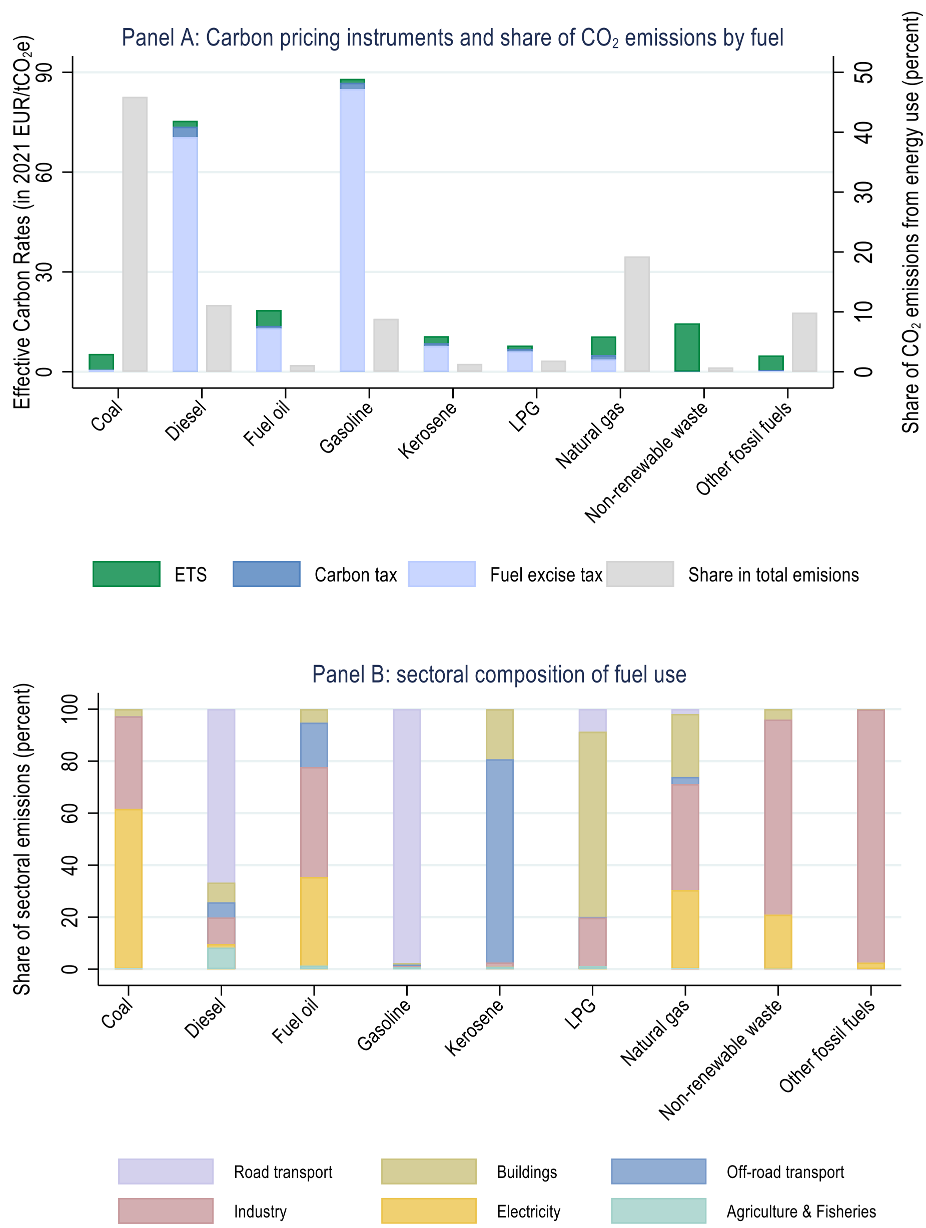
Fuel excise tax rates are relatively high for transport fuels (diesel and gasoline) and some heating fuels, and this translates into higher ECRs in the related sectors (Figure 2.4). On one end of the spectrum, diesel and gasoline, which are primarily used in the road transport sector, are subject to the highest fuel excise tax rates (translating to respectively EUR 70 and EUR 85 per tonne of CO_2 on average), which also relates to their historically broad tax base used by countries to raise revenue. On the other end of the spectrum, coal and other solid fossil fuels, which are mostly used in the industry and electricity sectors face relatively low effective carbon tax rates (at an average of EUR 5.4 per tonne of CO_2). Fuels such as LPG and natural gas, which are used in the buildings sector, stand in the middle, with average ECRs at about EUR 8/tCO_2 and EUR 10.6/tCO_2 respectively. These fuels often face reduced tax rates or exemptions, particularly when applying in the residential sector.

Country-level ECRs presented in Annex 2.A show that countries with the highest ECR levels and shares of emissions priced generally have emissions trading systems (see Annex Figure 2.A.2 and Annex Figure 2.A.3). This is consistent with the industry and electricity sectors presenting large shares of emissions and mostly being priced by ETSs. The highest carbon tax rates can be found in countries with the highest ECRs. Fuel excise taxes still cover most priced emissions in most countries. Country-level average ECRs also depend on sectoral composition: countries with a high share of road transport sector emissions tend to have higher average ECRs (consistent with Figure 2.3).

Figure 2.4. ECR levels by fuel and sectoral composition of fuel emissions

2021, 72 countries



Note: "Coal" stands for "Coal and other solid fossil fuels". Other greenhouse gases are not included here as they are not fuel-based. CO_2 emissions from energy use are based on the IEA World Energy Balances (IEA, 2023[2]). The equivalent figure when accounting for CO_2 emissions from biofuel combustion is presented in Annex A.

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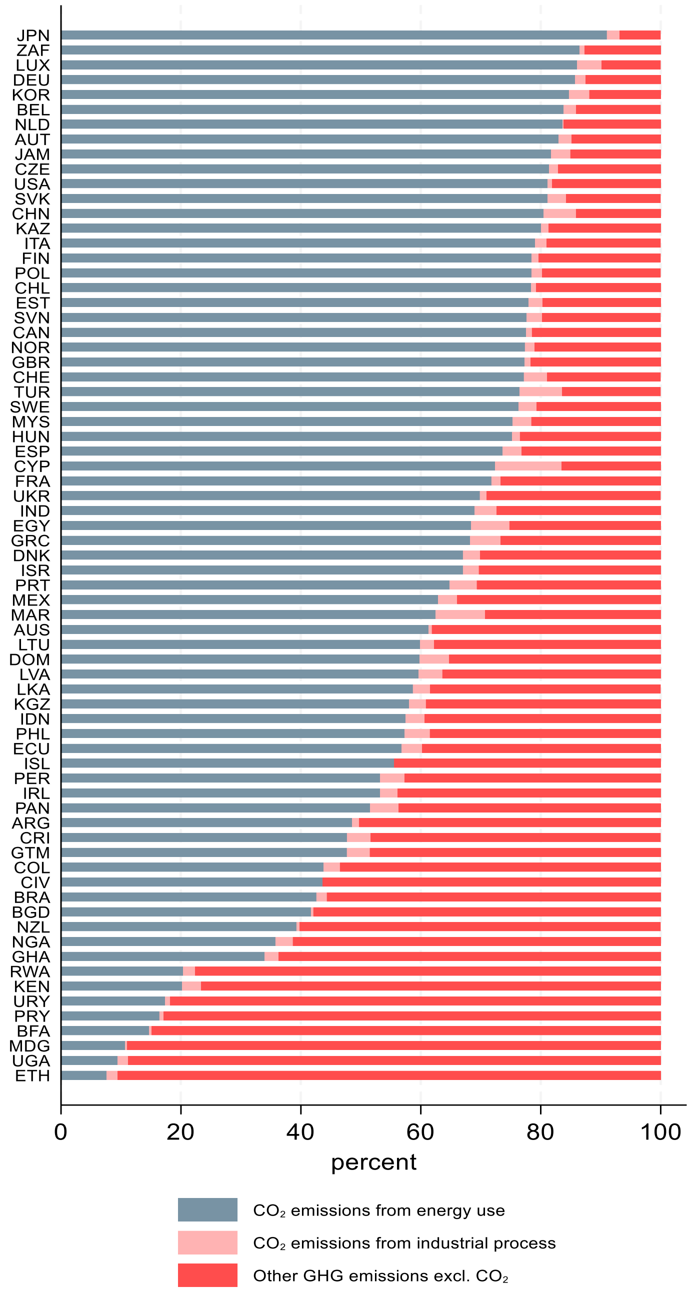
2.2. Other greenhouse gas emissions

Across all countries in the sample, CO_2 emissions from energy use represent a little less than three quarters of greenhouse gas emissions (74%), even though this share varies widely across countries. This depends in part on the importance of the agriculture sector in the economy (Figure 2.6). CO_2 emissions from energy use range from about 8% (Ethiopia) to 92% of total GHG emissions (Japan) (Figure 2.5).

Figure 2.5. Share of CO_2 emissions from energy use in total GHG emissions



Note: Other GHG emissions stand for emissions from CH_4, N_2O, F-gases and process CO_2 emissions. In this figure, this category is split between CO_2 and non-CO_2 emissions. The other GHG emissions data (CAIT (Climate Watch, 2022[1])) is for 2018, while the data on CO_2 emissions from energy use (based on the IEA World Energy Balances (IEA, 2023[2])) is for 2021 for OECD and G20 countries as well as Cyprus and Kazakhstan, and 2018 otherwise.

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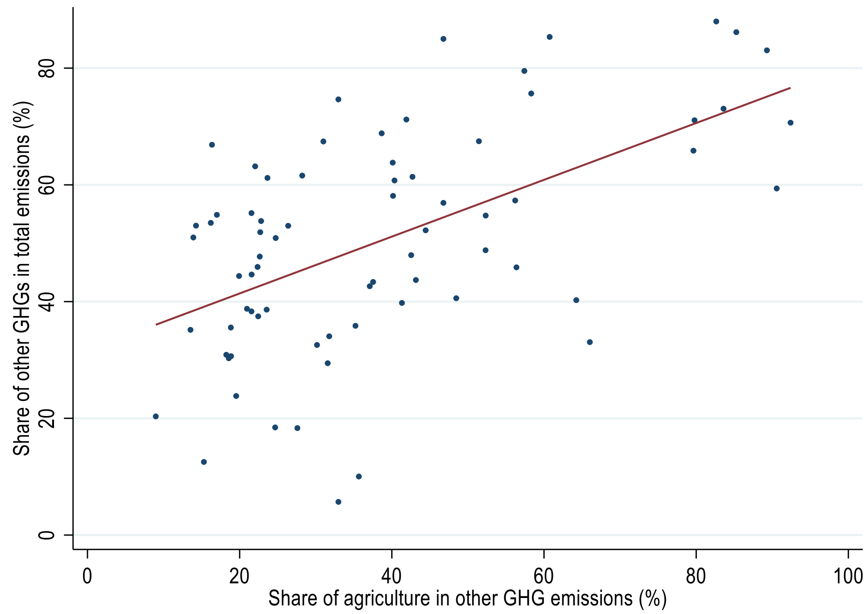
Figure 2.6. Share of other GHGs emissions in total emissions and importance of agricultural emissions in a country



Note: Other GHG emissions stand for emissions from CH_4, N_2O, F-gases and process CO_2 emissions.
Source: CAIT (Climate Watch, 2022[1]).

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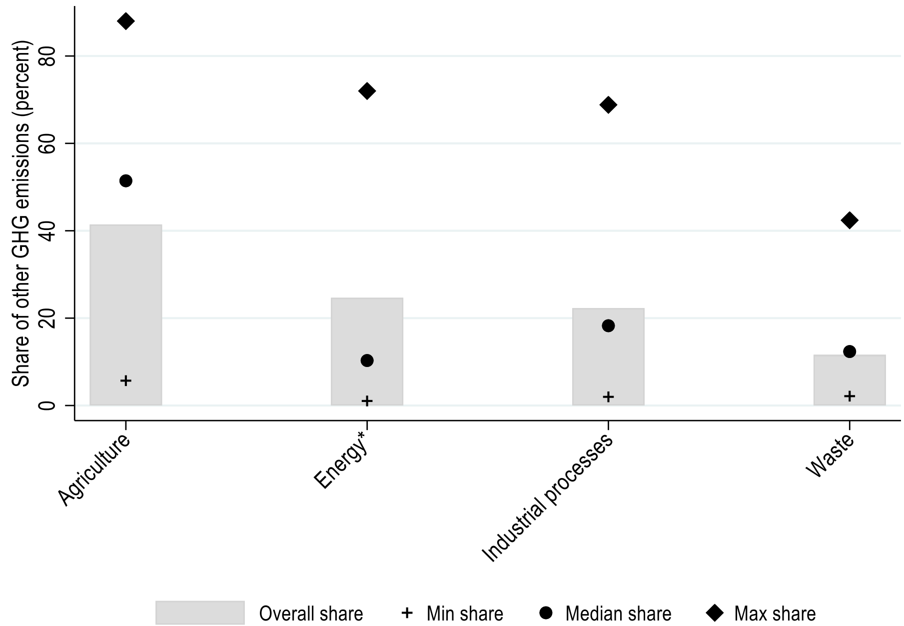
While uncertainties around the estimation of other GHG emissions levels (and the tax base corresponding to pricing instruments) are much higher than on levels of CO_2 emissions from energy use, available information on the GHGs and sectors that make up this category provides some insights into the strategies that may be used to price this non-negligeable source of GHG emissions, which in 2021 remained largely unpriced (Figure 2.3). This may also help assess whether these emissions are tackled through other measures (Errendal, Ellis and Jeudy-Hugo, 2023[3]). Uncertainties relating to methane (CH_4) emissions measurement are large for emissions from fugitive sources, landfills and wastewater. Nitrous oxide (N_2O) emissions from agricultural sources and F-gases emissions are also difficult to estimate accurately; the uncertainty range associated with these estimates can be set at a factor of two.[3]

Agricultural emissions account for the largest share of estimated other GHG emissions, both for the combined total of countries studied but also in most of these countries (Figure 2.7). More than half of the countries in the sample have more than 51.4% of their other GHG emissions stemming from non-energy related agricultural emissions. This share varies widely, ranging from 5.7% (in Israel) to about 88% (in Uruguay). Industrial processes as well as energy (fuel combustion resulting in non-CO_2 emissions and fugitive emissions) make up similar shares of estimated total other GHG emissions, at about 22% and 25% respectively. These shares can range from close to 1% (1.04% for energy in Uruguay and 1.98% for industrial processes in Uganda) to about 72% for energy (Russia) and 69% for industrial processes (Korea). Waste makes up a smaller share of other GHG emissions globally, and in most countries.

Figure 2.7. Sectoral composition of other GHG emissions

2018, 72 countries. Overall share of each sector in total other GHG emissions, minimum, median and maximum.



Note: *The "Energy" category here covers non-CO_2 related emissions from fuel combustion as well as fugitive emissions.
The overall share represents the share of each sector in total other GHGs (excluding LUCF). "Min share" (resp. "Max share") represents the lowest country-level share of each sector in other GHGs (excluding LUCF) in the sample of 72 countries. "Median share" represents the value such that 50% of countries have a share above (or below) this value for that sector. For instance, "Median share" for the waste sector can be interpreted as follows: at the country level, the waste sector represents less than 12.35% of other GHG emissions (excluding LUCF) in 50% of the 72 countries.
Source: CAIT (Climate Watch, 2022[1]).

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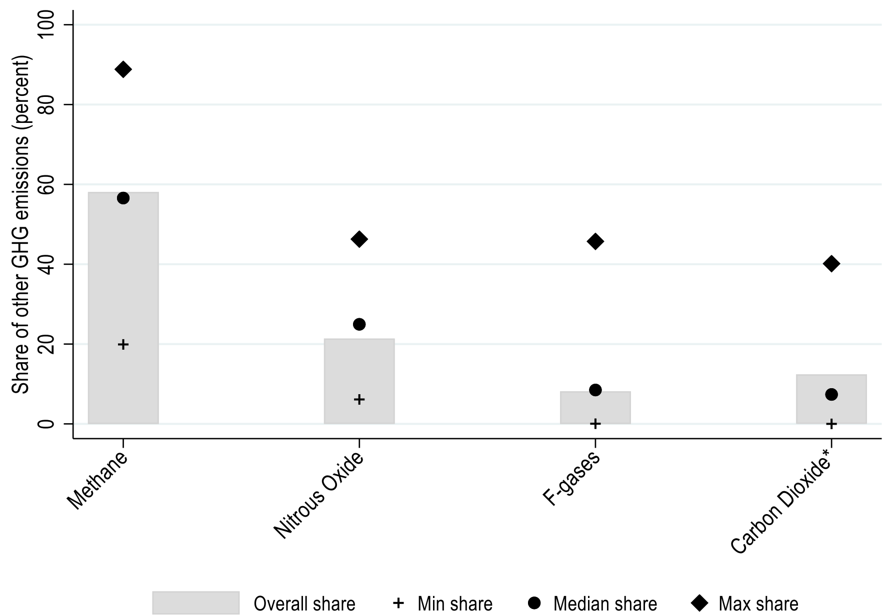
Consistent with the sectoral decomposition of other GHG emissions, methane, which principally occurs in the agricultural sector, makes up the largest share of other GHG emissions (Figure 2.8). Energy, however, is steadily increasing to become a close second for methane emissions.[4] While half the countries in the sample have an estimated share of F-gas emissions in other GHG emissions between 0.04% (Uganda) and 8.5% (Canada), this share can reach up to 45.7% (Korea), similar to the maximum share observed for N_2O (46.3% in Estonia). No country share of CH_4 emissions in other GHG emissions is below 19.9%.

Figure 2.8. GHGs responsible for other GHG emissions

2018, 72 countries. Overall share of each gas in total other GHG emissions, minimum, median and maximum.



Note: *CO_2 emissions here are from industrial process.
The overall share represents the share of each gas in total other GHGs (excluding LUCF). "Min share" (resp. "Max share") represents the lowest country-level share of each gas in other GHGs (excluding LUCF) in the sample of 72 countries. "Median share" represents the value such that 50% of countries have a share above (or below) this value for that gas. For instance, "Median share" for N_2O can be interpreted as follows: at the country level, N_2O represents more than 25% of other GHG emissions (excluding LUCF) in 50% of the 72 countries.
Source: CAIT (Climate Watch, 2022[1]).

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References

Climate Watch (2022), *https://www.climatewatchdata.org*. [1]

Errendal, S., J. Ellis and S. Jeudy-Hugo (2023), "The role of carbon pricing in transforming pathways to reach net zero emissions: Insights from current experiences and potential application to food systems", *OECD Environment Working Papers*, No. 220, OECD Publishing, Paris, https://doi.org/10.1787/5cefdf8c-en. [3]

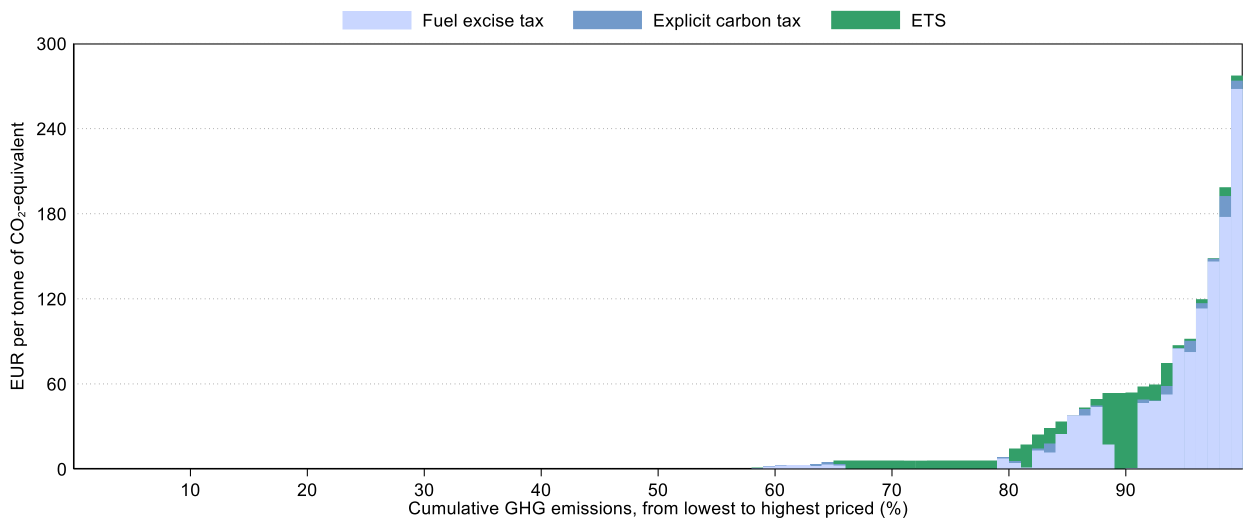
IEA (2023), "Extended world energy balances", *IEA World Energy Statistics and Balances* (database), https://doi.org/10.1787/data-00513-en (accessed on 28 March 2023). [2]

Annex 2.A. Breakdown of Effective Carbon Rates by instrument and country

Breakdown of the distribution of ECRs by instrument

Annex Figure 2.A.1 Distribution of instrument-level ECRs across GHG emissions

2021, ECRs are broken down by instrument for each percentile



Note: For each percentile bracket, average rates are presented. Other GHG emissions data are from CAIT (Climate Watch, 2022[1]) while the data on CO_2 emissions from energy use are based on the IEA World Energy Balances (IEA, 2023[2]).

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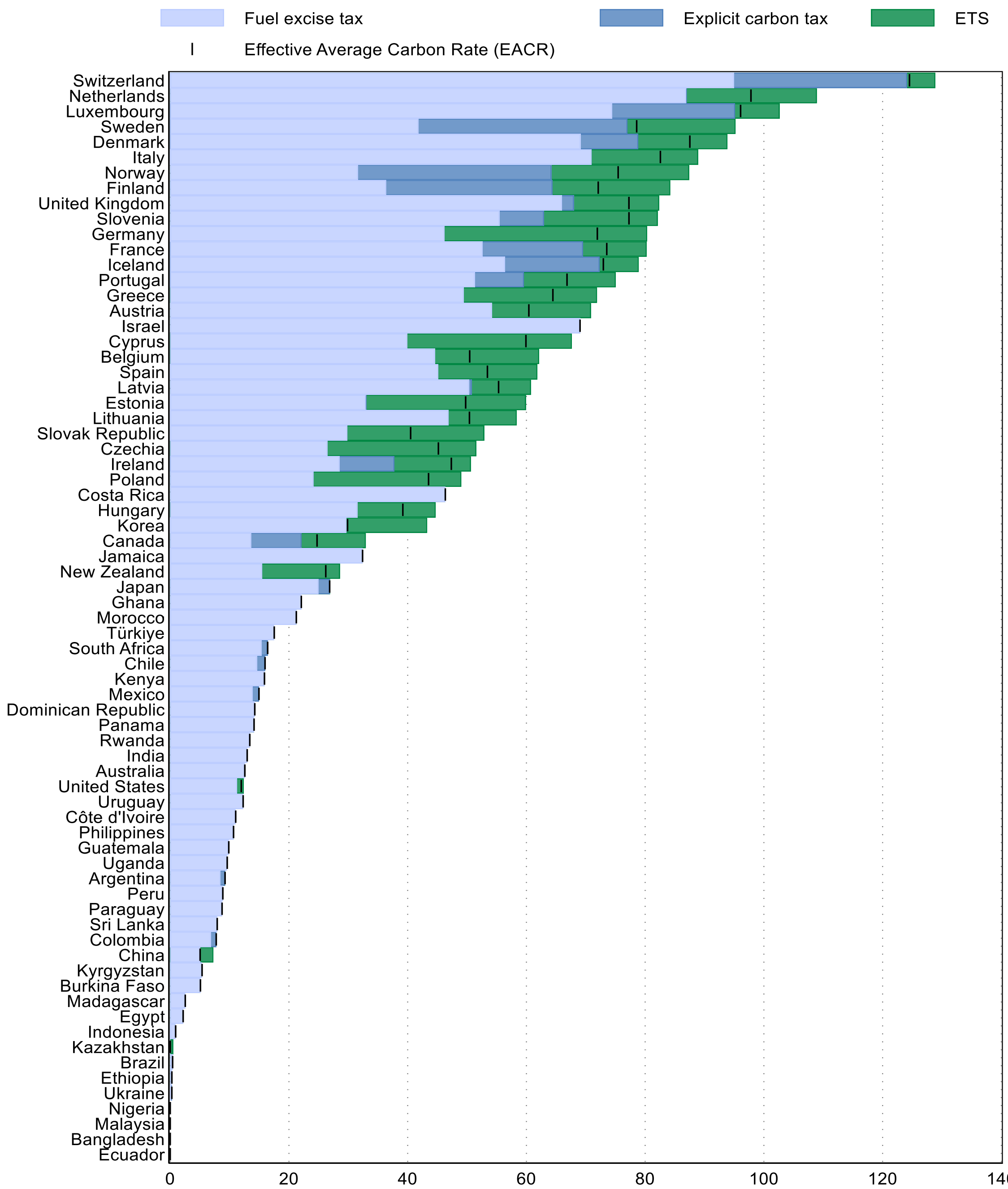
Effective Carbon Rates levels and coverage by country

Annex Figure 2.A.2. Average Effective (Marginal & Average) Carbon Rates by country

2021, 71 countries



Note: Effective carbon rates are averaged across all GHG emissions, excl. LUCF, including those emissions that are not covered by any carbon pricing instrument, for each of the 71 countries. Effective Average Carbon Rates account for free allocation of allowances in emissions trading systems (see section 3.4). All rates are expressed in 2021 EUR using the latest available OECD exchange rate and inflation data. Prices are rounded to the nearest eurocent. Other GHG emissions data are from CAIT (Climate Watch, 2022[1]) while the data on CO_2 emissions from energy use are based on the IEA World Energy Balances (IEA, 2023[2]).

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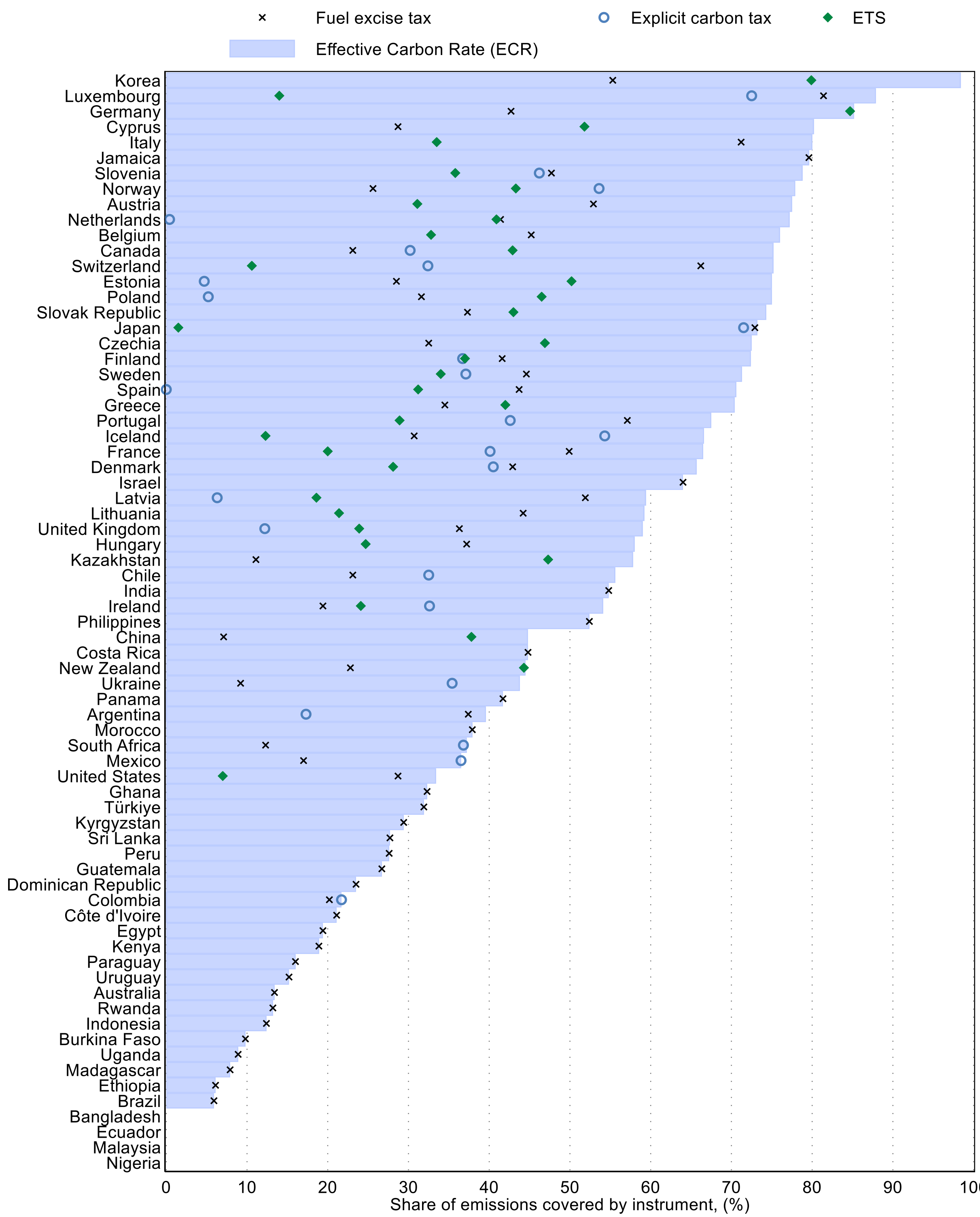
Annex Figure 2.A.3. Country-level share of GHG emissions priced by ECR component

2021, 71 countries. Shares are presented in percent.



Note: Shares covered by ECRs are often less than sum of the shares covered by its components due to overlapping instruments. Percentages are rounded to the first decimal place. Other GHG emissions data are from CAIT (Climate Watch, 2022[1]) while the data on CO_2 emissions from energy use are based on the IEA World Energy Balances (IEA, 2023[2]).

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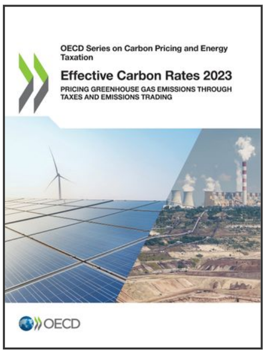
Notes

[1] While the former externality would not be present if a full switch to electric vehicles (EVs) took place, the other three externalities would remain.

[2]This latter point applies to the first six sectors which together are responsible for CO_2 emissions from energy use.

[3] The IEA (2021[4]) documentation on GHG emissions provides additional information on these uncertainties and advises that “figures provided for individual countries should be considered solely as order-of-magnitude estimates”.

[4] At the global level, emissions from methane in agriculture went from about 3.2 Gt in 1990 to about 3.5 Gt today, while in energy, they went from about 2.3 Gt in 1990 to 3.4Gt today (see historical trends from Climate Watch (2022[1])). Moreover, the IEA’s Global Methane Tracker (IEA, 2022[5]) finds that methane emissions from the energy sector are 70% higher than official figures, thus reinforcing this observation.



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