OECD Series on Carbon Pricing and Energy Taxation

Effective Carbon Rates 2025

Recent Trends in Taxes on Energy Use and Carbon Pricing

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Please cite this publication as:
OECD (2025), *Effective Carbon Rates 2025: Recent Trends in Taxes on Energy Use and Carbon Pricing*, OECD Series on Carbon Pricing and Energy Taxation, OECD Publishing, Paris, https://doi.org/10.1787/a5a5d71f-en.

ISBN 978-92-64-84181-9 (print)
ISBN 978-92-64-93740-6 (PDF)
ISBN 978-92-64-81305-2 (HTML)

OECD Series on Carbon Pricing and Energy Taxation
ISSN 2958-0161 (print)
ISSN 2957-9899 (online)

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Foreword

This report was prepared by the Tax Policy and Statistics division of the OECD's Centre for Tax Policy and Administration. It is unique in its comprehensive take on carbon pricing and energy taxation, integrating price signals that result from fuel excise taxes, carbon taxes and emissions trading systems into a single "Effective Carbon Rates" metric.

The report is part of the OECD series on Carbon Pricing and Energy Taxation. It covers 79 countries accounting for 82% of global greenhouse emissions in 2023. It provides descriptive evidence on Effective Carbon Rates (ECRs) in 2023 and discusses recent developments in the carbon pricing space in 2024 and 2025, focussing on emissions trading systems and elaborating on built-in flexibility mechanisms in this instrument.

Detailed data on Effective Carbon Rates broken down by country, sector and fuel as well as by ECR instrument (fuel excise taxes, carbon taxes and emissions trading systems) are available in the Carbon Pricing and Energy Taxation database on the OECD's Data Explorer.

The Report is structured as follows:

- Chapter 1 provides context and briefly describes the OECD Effective Carbon Rates as well as the scope of the report.
- Chapter 2 describes Effective Carbon Rates in 2023 with a deep dive on emissions trading systems and the impact of free allowances on ECRs.
- Chapter 3 reviews recent and upcoming changes in the carbon pricing area and the impact of main changes in emissions trading systems on Effective Carbon Rates in 2024 and 2025.
- Chapter 4 provides a special feature on emissions trading systems: the design of their cap, the free allowance allocation methods and the different compliance options they offer (including the use of carbon credits).
- Annex A provides a description of the Effective Carbon Rates definitions of sectors and fuels and briefly goes over its underlying methodology.
- Annex B provides information on the estimation of coverage of and permit prices for the thirty-four emissions trading systems which are included in the analysis of this edition of Effective Carbon Rates.

Acknowledgments

The project was led by Anasuya Raj under the responsibility of Assia Elgouacem and Kurt Van Dender. The report was drafted by Anasuya Raj, with critical inputs from Konstantinos Theodoropoulos. Clara Kögel and Maria Tsiranidou were instrumental in bringing the report to the finish line. Database design (GHG emissions data and taxes) is by Konstantinos Theodoropoulos and the Effective Carbon Rates model was updated and implemented by Anasuya Raj. Information on 2023 carbon taxes and fuel excise taxes was obtained from the OECD's Carbon Pricing and Energy Taxation database. Information on emissions trading systems was collected and processed by Mark Matteo, Anasuya Raj and Konstantinos Theodoropoulos. Konstantinos Theodoropoulos and Maria Tsiranidou provided the statistical support.

The authors would like to thank OECD colleagues Luisa Dressler, Assia Elgouacem and Kurt Van Dender for their feedback and advice at different stages of the production of the report, and Klas Wetterberg for his in-depth review of certain parts of the report. Mael Emonides, Vincent Finat-Duclos, Karena Garnier, Natalie Lagorce, Alexandra Le Cam, Ria Sandilands, Ingrid Theuninck and Carrie Tyler were key in improving the presentation and dissemination of the work, working along with the drafting team, Clara Kögel, Anasuya Raj, Konstantinos Theodoropoulos and Maria Tsiranidou.

The OECD Secretariat would like to thank the delegates of the Joint Working Party on Tax and Environment, and their colleagues in national government administrations for their assistance with the provision of data, for their feedback on the data, underlying emissions trading systems modelling and the report, and for their support for the area of work. The OECD is grateful to the Kingdom of Belgium Federal Public Service, Foreign Affairs, Foreign Trade and Development Cooperation for a voluntary contribution that has supported this work.

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Executive summary

Countries deploy taxes on energy use, carbon taxes and greenhouse gas emissions trading systems in view of policy objectives related to climate change, public revenue raising, energy affordability and cost of living, energy security and competitiveness. This report takes stock of 79 countries' use of these policy instruments. The policy space covered by the report is highly dynamic with strong attention for the impact of energy costs on technology choices, production costs and consumption patterns. By taking stock of recent developments, the report and its underlying database provide policymakers, stakeholders and analysts with a point of reference and a basis for policy reform enquiries.

Two key observations emerge from the data. First, carbon pricing instruments, and especially emissions trading systems (ETSs), are being adopted in several countries and their sectoral scope tends to broaden – an evolution related to considerations on climate change, revenue raising and emerging border carbon adjustment policies. In 2023, 27% of the 79 countries' greenhouse gas emissions faced a carbon tax or were under an ETS; including fuel excise taxes broadens coverage to 44% of emissions. This is a significant increase in coverage compared to 2018, when these shares stood respectively at 15% and 33%.

Second, ETSs are increasingly diverse and flexible. Examples of flexibility include openness towards the use of carbon credits for compliance and placing targets on the carbon intensity of production – instead of emission levels – thus easing constraints on output. Such flexibility suggests efforts to balance climate change, affordability, competitiveness, growth and energy security objectives. The observed diversity of policies reflects differences in national circumstances and priorities and provides space for a variety of approaches to innovation. It can also create a need for interoperability across emission trading systems, where there may be a role for international coordination.

The ECR combines the price signals from ETSs, carbon taxes and fuel excise taxes. The *Effective Carbon Rates 2025* report is part of the Carbon Pricing and Energy Taxation (CPET) series and is based on detailed data from 2023 – with selected updates on key developments through mid-2025 – across 79 countries accounting for approximately 82% of global greenhouse gas (GHG) emissions.

The report compares the level and the structure of ECRs, including the impact of free allowances on ETS price signals, across countries, economic sectors, and fuels. Detailed data on ECRs, by instrument (carbon taxes, ETSs and fuel excise taxes) and broken down by country, sector and fuel category, is available in the OECD Data Explorer's Carbon Pricing and Energy Taxation database. In addition to the overall discussion of ECRs, the report includes a deep dive on evolving design choices in ETSs.

Carbon taxes and ETSs are currently in place in over 50 countries and their reach continues to expand – an evolution mostly driven by ETSs. Since 2023, carbon pricing instruments have been introduced or are being considered in a dozen countries in Asia, Europe and Latin America and the Caribbean. Sectoral coverage is increasing within historically covered sectors such as industry and electricity, buildings and domestic transport, but is also broadening to other sectors including waste incineration, international shipping and agriculture. The expansion of the Chinese national ETS to the aluminium, cement and steel sectors is estimated to increase coverage by carbon pricing instruments to 34% in 2025 in the subset of countries analysed in this report.

Design choices for ETSs reflect increased interest in flexibility and in the limitation of compliance costs for firms. There is a move away from systems placing targets on carbon emissions (e.g. cap-and-trade) towards intensity-based systems where targets depend on the carbon intensity of production. Only two out of twenty ETSs were intensity-based in 2018, compared to 12 out of 34 ETSs in 2023. Intensity-based systems now account for 70% of emissions covered by ETSs. This development is linked with the rising practice of accounting for current production levels in free allowance allocation methods, even in cap-and-trade systems. ETSs can also provide sectoral (and in some cases geographical) flexibility by allowing the use of carbon credits for compliance, and temporal flexibility by allowing the banking and borrowing of allowances. More than half of ETSs allow the use of carbon credits for compliance, and almost all allow for banking of permits. These developments illustrate ways in which the balancing of policy objectives plays out, in line with countries' priorities and circumstances.

Key data

In 2023, the 79 countries considered in this report emitted 41.7 billion tonnes of CO_2e emissions, of which 44% were subject to a positive ECR, i.e. a fuel excise tax, a carbon price from an ETS, a carbon tax or a combination of these:

a. Fuel excise taxes remain the most used ECR instrument, covering 24% of emissions, versus 5% for carbon taxes and 22% for ETSs.

b. High fuel excise tax rates on diesel and gasoline result in the road transport sector facing the highest ECRs, of about EUR 96 per tonne of CO_2 on average across the 79 countries covered.

c. Carbon taxes and ETSs often do not overlap, except, notably, in the case where carbon taxes are introduced as price support mechanisms for ETSs. There is significant overlap by design between carbon taxes and fuel excise taxes, consistent with most carbon taxes being fuel-based. ETSs and fuel excise taxes seldom overlap.

d. The evolution of carbon pricing is mainly driven by ETSs. Coverage of carbon taxes hardly evolved between 2018 and 2023 (remaining at around 5%) while that of ETSs more than doubled (from 10% to 22%). Between 2018 and 2023, average carbon tax rates went from EUR 14 to 15 per tonne of CO_2e and average ETS permit prices went from EUR 13 to 20 per tonne of CO_2e.

e. Carbon taxes typically mostly cover buildings and transport sector emissions (respectively 11% and 13% of each sector's CO_2 emissions in 2023) and ETSs electricity and industry sector emissions (resp. 58.5% and 15% of their CO_2 emissions from energy use in 2023). ETS coverage of buildings and transport sector emissions has been increasing, reaching resp. 8% and 7% of their CO_2 emissions in 2023.

f. GHG emissions related to fugitive emissions, waste, industrial processes, agriculture, and energy use resulting in methane and nitrous oxide emissions represent between 9% and 93% of countries' GHG emissions. They face the lowest ECR levels and coverage, with industrial process emissions being the main priced emissions in this category.

g. The availability of free allowances reduces the average price paid for each tonne of CO_2e emissions compared to the marginal price signal, i.e. the cost of buying an additional emission allowance. Free allowance shares in ETSs range from 0% to 100%, affecting in particular the electricity and industry sectors, where the marginal price signals on ETS-priced emissions are ca. EUR 14 and 37 per tonne of CO_2 respectively and the average ETS price signals after accounting for free permits are ca. EUR 1.26 and 5.2 per tonne of CO_2e.

Some of the main changes since 2023 or in the pipeline are as follows:

a. In 2024 and 2025, three ETSs and five carbon taxes were launched, most of them at subnational levels of government. While most of these new schemes did not increase global coverage by much, and while permit prices have hardly increased since 2023, one major change came through the expansion of the Chinese national ETS to the aluminium, cement and steel sectors. Estimations suggest that this increased coverage of emissions by carbon pricing instruments (i.e. ETSs or carbon taxes) by 7 percentage points in 2025, to ca. 34%, which continues outstripping coverage by fuel excise taxes in the 79 countries analysed.

b. Carbon pricing is being considered in an increasing number of countries, including in large emerging economies, with Brazil, India and Türkiye and several countries in Latin America and the Caribbean (e.g. Chile, Colombia) as well as in Asia (e.g. Malaysia, the Philippines, Thailand, Vietnam) developing or considering the introduction of emissions trading or carbon taxes. In Japan, the voluntary GX ETS is to transition to a mandatory ETS from 2026.

c. Countries are increasingly working towards the coverage of sectors not typically covered by carbon pricing, with recent initiatives in the agriculture sector (e.g. Denmark). Coverage of international aviation (through CORSIA) and shipping emissions (through the expansion of the EU ETS to international maritime emissions in 2024) is also increasing.

d. Policy action in connected spheres could also influence the evolution of carbon pricing. For example, countries are increasingly exploring strategies to address carbon leakage, including through Border Carbon Adjustments (BCAs). Moreover, at the 2024 United Nations (UN) Climate Change Conference, Parties agreed decisions regarding Article 6.2 and Article 6.4, which contained the final agreements necessary for the Article 6 carbon markets to become operational.

The introduction of new and expansion of existing ETSs is gaining momentum, with a variety of design options regarding caps, free allowances allocation methods and compliance possibilities (including the use of carbon credits):

a. Since 2019, most new ETSs have been intensity-based and in 2023, intensity-based systems apply to more than two-thirds of emissions covered by ETSs. These target firms' carbon intensity of production rather than carbon emissions. These systems do not have a pre-determined cap (since total emissions covered by the ETS can vary with output) and present a shift away from the traditional design of cap-and-trade systems. Relatedly, free allowances allocation increasingly accounts for current year's production levels (output-based benchmarking), even in cap-and-trade systems. These developments can ease constraints on production.

b. Entities covered by an ETS have a variety of compliance options to cover their verified emissions, which can help provide temporal flexibility (e.g. banking and borrowing) or sectoral and geographical flexibility (e.g. offsetting through the use of carbon credits). While banking is allowed in all but two ETSs covered in this report, borrowing is allowed in just 6 out of the 34 systems. More than 60% of systems allow for the use of carbon credits.

c. When included as a compliance option, the use of carbon credits often comes with quantitative limits (only five systems place no limit and most limits are below 10% of compliance obligations) and the credits should fulfil qualitative criteria, related to the projects' location, the nature of the projects or the types of credits allowed. Quantitative limits on carbon credit use are easing in some systems, and qualitative criteria are regularly revised.

1 Context, Concepts and Scope

1.1. Policy context

Countries deploy taxes on energy use, carbon taxes and emissions trading systems in view of a range of policy objectives including climate change mitigation, public revenue raising, energy affordability and cost of living, energy security and competitiveness. This report takes stock of 79 countries' use of these policy instruments in 2023, with discussions on recent developments in the carbon pricing space in 2024 and 2025. It also provides a focus on emissions trading systems, with a deep dive on certain design features of this instrument.

The simultaneous pursuit of several policy objectives and the complexity of each of them leads countries to use a combination of policy instruments in view of the weights they attach to the separate objectives. In the climate change mitigation context, the typology of the Inclusive Forum on Carbon Mitigation Approaches Climate Policy Database (IFCMA – CPD) (OECD, 2024[1]) distinguishes five types of policy instruments based on the operating mechanism: economic (e.g. carbon pricing or green subsidies), regulatory (e.g. technology or performance standards); government investment and consumption; information; and voluntary approaches.

Where carbon pricing is part of a climate change mitigation policy package, it can help encourage cost-effective abatement and raise public revenue. By decentralising abatement decisions, carbon pricing helps overcomes the asymmetry of information between the government and polluters and encourages emission cuts where the costs are lower. Moreover, carbon pricing creates ongoing mitigation incentives, and it can help avoid rebound effects. It also raises revenue. However, carbon pricing alone cannot address all the externalities and market failures on the path to net zero emissions and it can raise affordability and competitiveness concerns.

In early 2025, carbon pricing instruments (carbon taxes and emissions trading systems – ETSs) are in place in 52 countries. ETSs cover emissions in 43 countries and carbon taxes in 32 countries, with both instruments thus co-existing in 23 countries.[1] There may be many carbon pricing instruments within a country (e.g. 10 subnational carbon taxes in Mexico, 8 province or city-level ETSs in China) or a single supranational ETS can cover many countries at a time (the European Union Emissions Trading System – EU ETS – covers 30 countries).[2]

1.2. What are Effective Carbon Rates?

The Effective Carbon Rates metric summarises the price signals from ETSs, carbon taxes and fuel excise taxes, and is expressed in EUR/tCO_2e. Irrespective of the policy objectives for their introduction, all three instruments apply to a base that is either GHG emissions – in the case of carbon taxes and ETSs – or is directly proportional to them (e.g., litres of diesel or tonnes of coal), in the case of fuel excise taxes. Here, the term "carbon tax" covers the broad range of all taxes that apply to greenhouse gases, including taxes on fluorinated gases (F-gases), for instance.

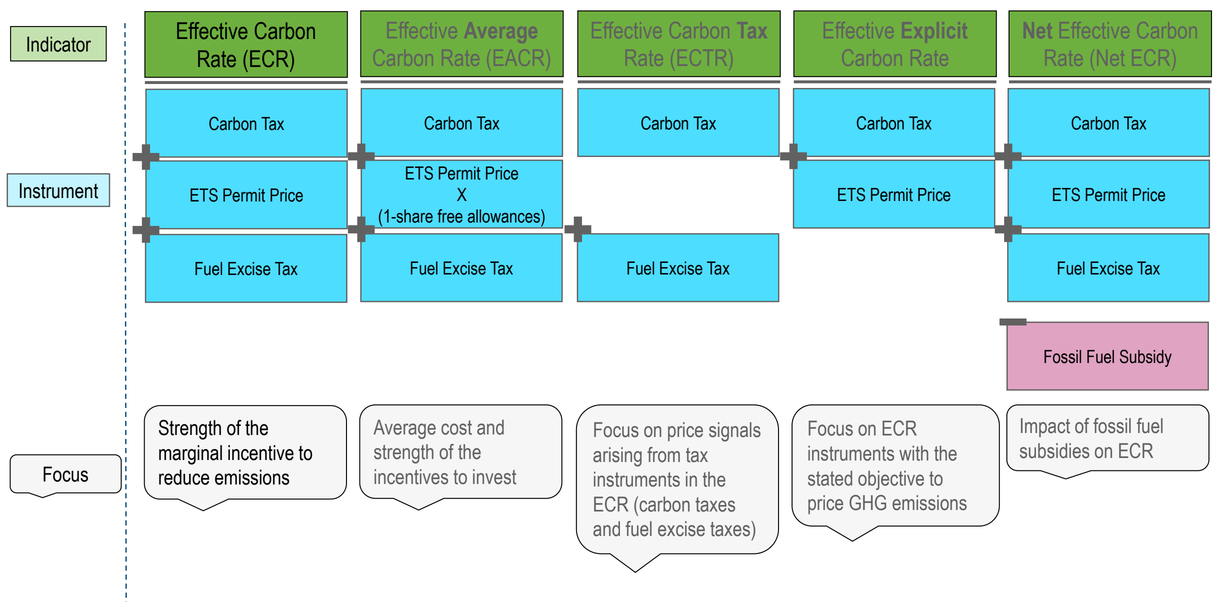
ECRs describe the price levels on GHG emissions but also the coverage of GHG emissions – by instrument and in combination. For each country covered, ECRs are established at a sector, fuel level, by type of instrument. The GHG emissions accounted for are CO_2 emissions from energy use from six sectors that together span all energy use (agriculture and fisheries, buildings, electricity, industry, off-road transport, road transport), as well as other GHG emissions (i.e., emissions from methane (CH_4), nitrous oxide (N_2O), fluorinated gases (F-gases[3]) and CO_2 emissions from industrial processes,[4] excluding Land use change and forestry (LUCF[5])). Annex A presents further detail on the sectors, fuels and underlying databases and also provides some additional information on the modelling assumptions used to build the Effective Carbon Rates.

The three components of Effective Carbon Rates (depicted in Figure 1.1) are as follows:

- Carbon taxes have a statutory rate which is set as a price per tonne of CO_2 or CO_2e. Their administrative implementation can make use of a price per unit of volume or weight of fuel if the tax is fuel-based (this is the case of most carbon taxes – examples include France, Norway, Sweden).
- Fuel excise tax rates are typically set per unit of volume or weight (e.g., litre, kilogram, cubic metre) or per unit of energy (e.g., gigajoule). These rates can be translated into a price per tonne of CO_2, based on the carbon content of each of these fuels. Even though fuel excise taxes are introduced for a variety of policy objectives, that may or may not include a reduction in carbon emissions, they are included in the ECR, since they apply to a base that is directly proportional to CO_2 emissions.
- The carbon price resulting from an ETS is taken to be the price of tradable emission permits issued under the ETS. This price represents the opportunity cost of emitting an extra unit of CO_2 or other GHG. ECRs thus do not account for the impact of (most forms of) free allowances on the ETS-related carbon price signal,[6] and are hence sometimes also referred to as effective *marginal* carbon rates (EMCRs).

The OECD Carbon Pricing and Energy Taxation series (OECD, n.d.[2]) **includes additional metrics beyond the ECR, each with different use cases.** The Effective Average Carbon Rate (EACR) accounts for free allowances received in ETSs, which affect the average carbon price faced by covered entities (Flues and van Dender, 2017[3]; Flues and van Dender, 2020[4]). They inform on the strength of incentives to invest in new technologies as opposed to the strength of marginal incentives to reduce emissions (OECD, 2021[5]; OECD, 2023[6]). Effective Carbon Tax Rates (ECTR) restrict the focus to price signals arising from carbon taxes and fuel excise taxes, i.e. they focus on taxes and leave out ETSs. Effective Explicit Carbon Rates focus on carbon pricing instruments – ETSs and carbon taxes, i.e. instruments whose intended role is to price GHG emissions – and do not consider energy taxation. Net Effective Carbon Rates estimate ECRs net of pre-tax fossil fuel support (Garsous et al., 2023[7]). They document the extent to which direct budgetary transfers that decrease pre-tax energy prices reduce the price signal provided by ETSs, fuel excise, and carbon taxes (OECD, 2022[8]; OECD, 2024[9]).[7] These metrics are depicted in Figure 1.1.

Figure 1.1. Effective Carbon Rates and related metrics



Note: All indicators are expressed in EUR per tCO_2e. Fuel excise taxes rates are typically set per unit of volume or weight (e.g. as a price per kilogram for solid fuels, per litre for liquid fuels, per cubic metre for gaseous fuels). These can be converted into a price per energy unit (e.g. GJ) using calorific factors from the IEA World Energy Statistics and Balances (IEA, 2025[10]) and then into a price per tonne of CO_2 using IPCC emissions conversion factors (Intergovernmental Panel on Climate Change's Guidelines for National Greenhouse Gas Inventories (IPCC, 2006[11]), volume 2). More precisely, such calculations make use of the fact that CO_2 emissions are constant per unit of fuel. See OECD (2019[12]), Chapters 1 and 3, for further details and some examples. The EACR measure could also be augmented to reflect other compliance options used in carbon pricing systems; e.g. carbon credits (see Box 4.2 for a more in-depth discussion). Fossil fuel subsidies accounted for in the Net ECR indicator are budgetary transfers that decrease pre-tax prices for domestic fossil fuel use following the methodology outlined in Garsous et al. (2023[7]).
Source: Authors.

1.3. Scope of the report

The report discusses Effective Carbon Rates and Effective Average Carbon Rates, and their components, with a focus on emissions trading systems. The report presents ECR and EACR data for 2023, relying (i) on fuel excise and carbon tax rates and coverage as of 1 April 2023 gathered and modelled for the OECD *Pricing Greenhouse Gas Emissions* 2024 report (OECD, 2024[9]) and (ii) on ETS coverage and prices for 2023 gathered and modelled for this report.[8] Annex B presents the description of the data used and of the modelling assumptions for the ETSs covered in this report. The taxes covered and their modelling are documented in background notes which are available on the *Pricing Greenhouse Gas Emissions* 2024 support materials page (OECD, 2024[13]).

This edition covers 79 countries which together account for about 82% of global GHG emissions.[9] The 79 countries are made up of all 45 OECD and G20 individual countries other than Saudi Arabia and 34 other countries. Thirteen of these 34 countries are in Africa (Burkina Faso, Côte d'Ivoire, Egypt, Ethiopia, Ghana, Kenya, Madagascar, Mauritius, Morocco, Nigeria, Rwanda, Uganda, Zimbabwe), eight in Latin America and the Caribbean (Dominican Republic, Ecuador, Guatemala, Jamaica, Panama, Paraguay, Peru, Uruguay), seven are in Asia (Bangladesh, Kazakhstan, Kyrgyzstan, Malaysia, Philippines, Singapore, Sri Lanka) and six in Europe (Bulgaria, Croatia, Cyprus, Malta, Romania, Ukraine). The term “total emissions” is used to refer to GHG emissions from the 79 countries considered in this report.

This report is organised as follows. Chapter 2 presents ECRs for 2023, including a focus on carbon pricing through ETSs. It documents free allowances and EACRs in 2023. Chapter 3 provides an update on recent developments and trends in carbon pricing initiatives and design, including estimates of the impact of developments in ETSs on ECRs in 2024 and 2025. Chapter 4 takes a deep dive into key design features of ETSs, including whether they involve the existence of a pre-determined cap and the different compliance options they offer beyond trading (free allowances, purchased permits, banked or borrowed permits, carbon credits).

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Notes

1 Source: https://carbonpricingdashboard.worldbank.org/compliance/instrument-detail, as accessed in May 2025 and own desk research.

2 These figures refer to all countries and not only those covered in this report.

3 HFCs, PFCs, and SF_6.

4 Industrial process emissions are the greenhouse gas emissions released during industrial processes unrelated to energy.

5 Following OECD (2022[8]), this report uses the abbreviation LUCF (as opposed to the term LULUCF, i.e. land use, land-use change, and forestry), to emphasise that the underlying GHG emissions data is sourced from the CAIT dataset (Climate Watch, 2025[14]), which does not rely on countries' official inventories reported to the UNFCCC.

6 In the cases where free allowances may not be traded or are distributed ex-post to be equal to verified emissions, it is considered this affects the base of emissions priced. They are thus implicitly accounted for in the ECR (see Annexe B for more detail).

7 While ECRs are calculated net of relevant exemptions, rate reductions and refunds and hence account for tax expenditures resulting from relevant policy instruments (fuel excise taxes, carbon taxes, and emissions permit prices), they do not account for government measures that decrease pre-tax prices of fossil fuels – as opposed to Net ECRs.

8 Both for taxes and ETSs, modelling is required to assign coverage (i.e. to map the instruments) to their emission base at the country level by sector and fuel.

9 Excluding emissions from LUCF.

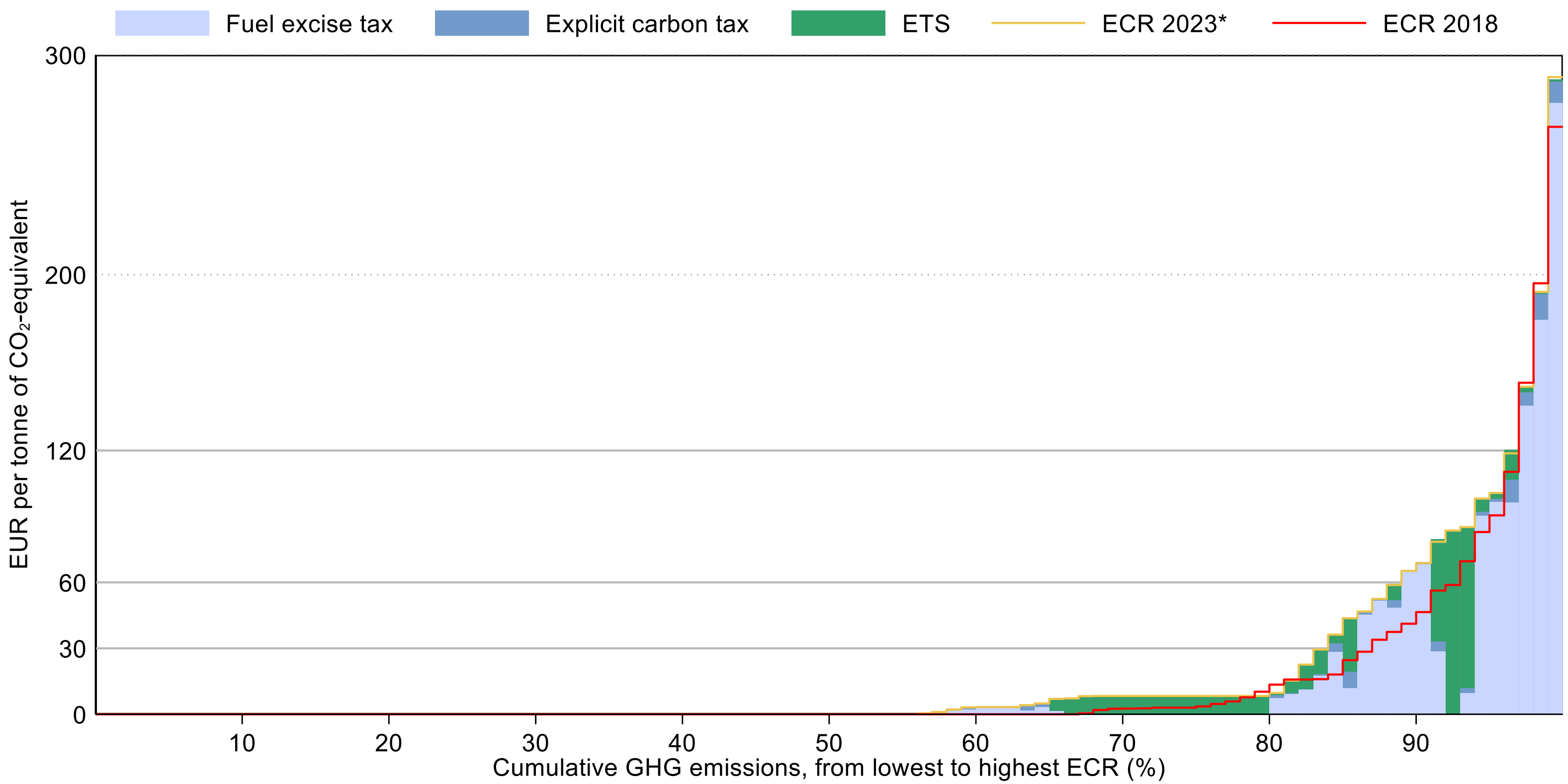
2 Effective Carbon Rates in 2023

In 2023, almost 27% of the 41.7 billion tonnes of CO_2e emissions in the 79 countries considered in this report were subject to a carbon price through ETSs or carbon taxes. Furthermore, 24% were subject to a fuel excise tax, resulting in a positive ECR for 44% of emissions.[1] Figure 2.1 shows that the distribution of ECRs is skewed, with about 16% of GHG emissions subject to an ECR over EUR 30 per tonne of CO_2e (/tCO_2e), ca. 11% of emissions to a rate of EUR 60/tCO_2e or more and 4% to a rate of EUR 120/tCO_2e or more. More emissions are subject to higher ECRs than in 2018, when ECRs were over EUR 30/CO_2e for 13% of GHG emissions, above EUR 60/tCO_2e for 7% and above EUR 120/tCO_2e for 3%.

[1] Carbon prices and energy taxes can overlap (see Figure 2.5, Figure 2.6), which explains why a 27% carbon pricing coverage and a 24% fuel excise tax coverage add up to a 44% ECR coverage.

Figure 2.1. Distribution of Effective Carbon Rates

2023 and 2018, 79 countries



Note: For each percentile bracket, average rates are presented. ECR 2023* is adjusted to the same country coverage as 2018 (from 79 countries to 71). GHG emissions data combines data on CO_2 emissions from energy use, based on the IEA World Energy Balances (IEA, 2025[1]), with "other GHG emissions" data from CAIT (Climate Watch, 2025[2]).

StatLink https://stat.link/c2kxqe

2.1. Sources of GHG emissions

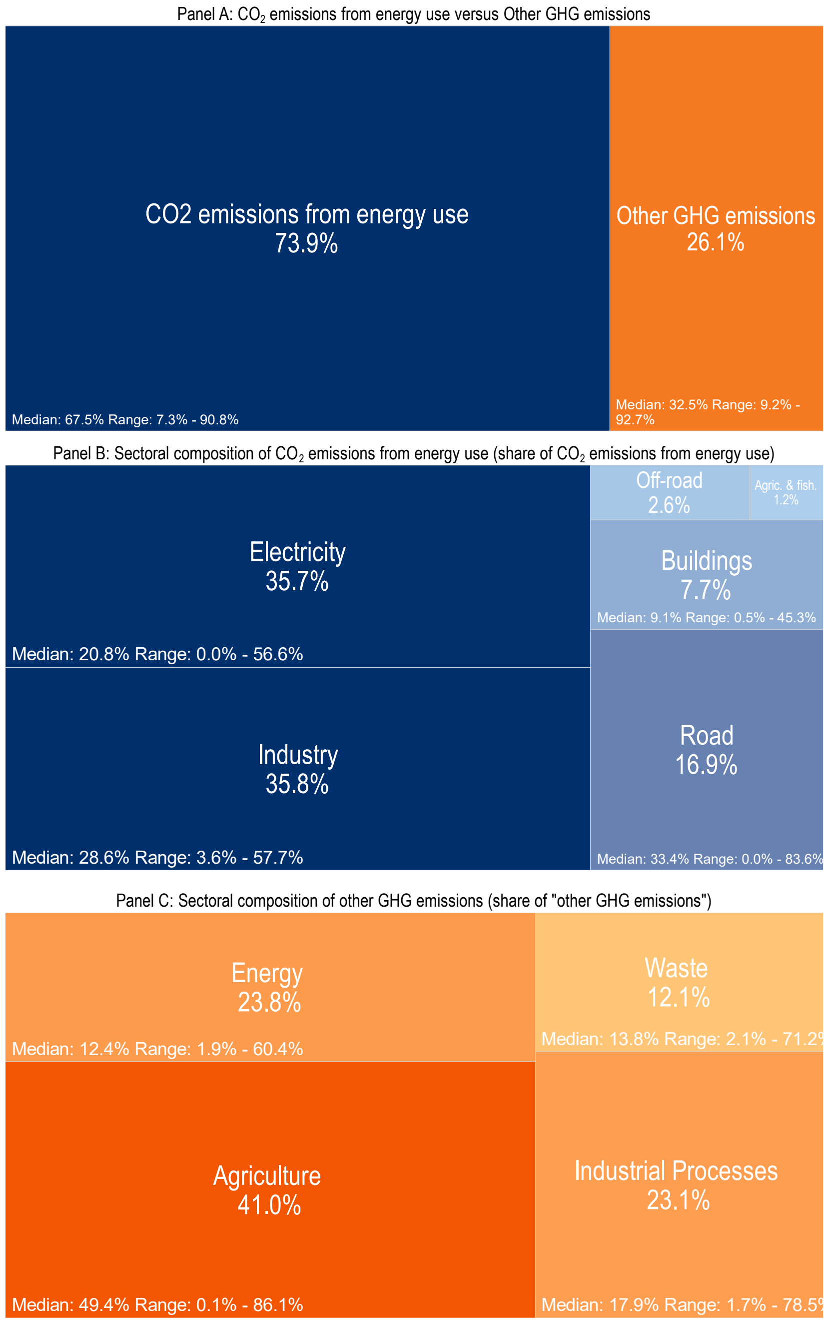
CO_2 emissions from energy use represent about 74% of GHG emissions and this share varies widely across countries, from less than 10% to above 90% (Figure 2.2, Panel A). This depends in part on the importance of the agriculture sector in the economy (OECD, 2023[3]). CO_2 emissions from energy use range from about 7.3% (Ethiopia) to 90.8% (Japan) of a country's total GHG emissions (Figure 2.A.1).

At a global level, the industry and electricity sectors are the most emitting sectors in terms of CO_2 emissions from energy use (Figure 2.2, Panel B). However, inter-country variation is large and in some countries the road transport sector may also account for a large share of emissions. The electricity and industry sectors each account for about 36% of total CO_2 emissions from energy use.[1] Across countries, while these shares vary widely, from 0% to 57% for electricity and 3.6% to 58% for industry, in half of the 79 countries they make up respectively at least 20% and 28% of countries' CO_2 emissions from energy use. While road transport emissions stand at about 17% of total CO_2 emissions from energy use, this sector can represent a substantial share of these emissions in certain countries (up to 83.6%) and its share is at least 33% in half of the countries. The buildings sector represents a little less than 8% of total CO_2 emissions from energy use, and even though it emits less than 9% of CO_2 emissions from energy use in half of the countries, the share is high (up to 45%) in certain countries. The off-road transport sector and agriculture and fisheries sector combined represent less than 4% of total CO_2 emissions from energy use.[2]

Agricultural emissions account for the largest share of "other GHG emissions" (i.e. GHG emissions that are not CO_2 emissions from energy use), at a global level but also in most countries (Figure 2.2, Panel C). Non-energy related agricultural emissions represent 41% of total other GHG emissions, and account for at least 49.4% of other GHG emissions in half of the countries in the sample. This share varies widely, ranging from less than 0.1% (Israel) to about 86% (Uruguay). Industrial processes as well as energy (fugitive emissions and fuel combustion resulting in GHG emissions other than CO_2) make up similar shares of estimated total other GHG emissions, at about 23.1% and 23.8% respectively. These shares can range from close to 2% (1.9% for energy in Uruguay and 1.7% for industrial processes in Uganda) to about 60% for energy (Russia) and 78.5% for industrial processes (Singapore). Countries with high industry-related CO_2 emissions from energy use generally also have high emissions from industrial processes. Waste makes up a smaller share of other GHG emissions globally, and in most countries.

Figure 2.2. Sectoral composition of GHG emissions

79 countries



Note: "Other GHG emissions" refer to methane and nitrous oxide from energy use, fugitive emissions, industrial process emissions (including F-gases), non-fuel based agricultural emissions and waste emissions. They exclude LUCF. GHG emissions data combines data on CO_2 emissions from energy use, based on the IEA World Energy Balances (IEA, 2025[1]), with "other GHG emissions" data from CAIT (Climate Watch, 2025[2]). The "other GHG emissions" data is for 2022, while the data on CO_2 emissions from energy use is for 2023 for OECD and G20 countries as well as Cyprus and Kazakhstan, and 2021 otherwise. Panel B and C sectors are further detailed in Tables A.A.1 and A.A.2. respectively.

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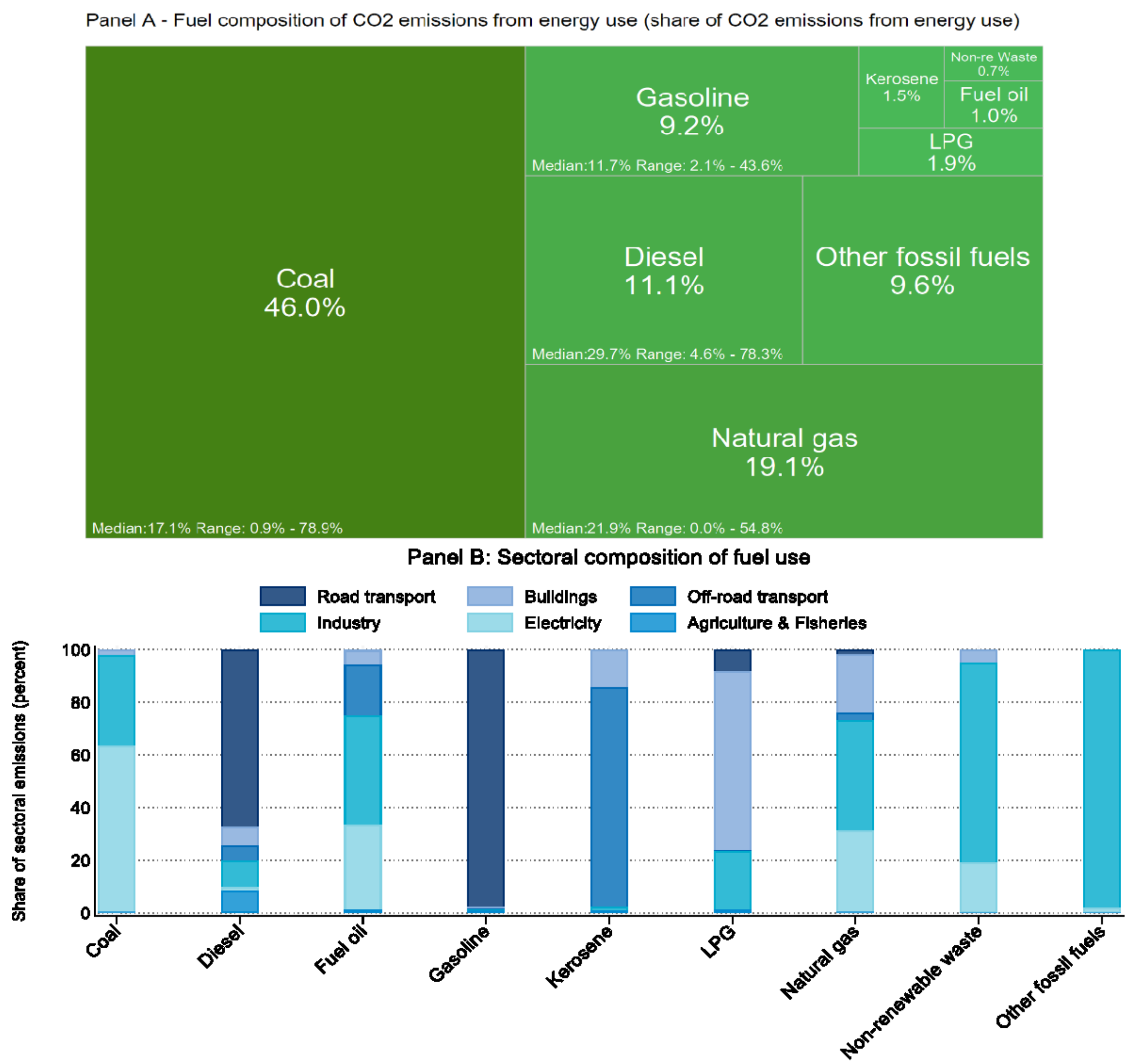
The share of emissions from different fuels substantially varies across countries; globally, most emissions are from coal (46%) and natural gas (19.1%) (Figure 2.3 – Panel A). Emissions from coal range from 0.9% to 79% across countries, as coal use has been almost phased out in certain countries but remains important in others, especially in the electricity sector. Natural gas is used in all stationary sectors (electricity, industry, buildings; Figure 2.3 – Panel B) and hence is more important in countries where these sectors are relatively large. Diesel and gasoline are mostly used in the road transport sector, and kerosene in the off-road transport sector, so their shares in total CO_2 emissions from energy use are linked to the importance of those sectors, globally and at the country level. Currently, non-renewable waste used for energy plays a limited role.

Figure 2.3. Fuel emissions by fuel category

79 countries, CO_2 emissions from energy use.



Note: “Coal” stands for “Coal and other solid fossil fuels” and “Non-re Waste” stands for “Non-renewable Waste”. Other fossil fuels include petroleum coke, residual fuel oil and other refinery gases / bitumen / lubricants. CO_2 emissions from energy use are based on the IEA World Energy Balances (IEA, 2025[1]) and the data is for 2023 for OECD and G20 countries as well as Cyprus and Kazakhstan, and 2021 otherwise.

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2.2. Effective Carbon Rates in 2023

The distribution of ECRs is heterogenous across sectors, with CO_2 emissions from energy use facing the highest ECRs in the road transport sector (Figure 2.4). After the road transport sector, the highest rates are found in the electricity and off-road transport sectors. In 2023, only 6% of CO_2 emissions in the road transport sector face a zero ECR and rates above EUR 60 and EUR 120/tCO_2 mostly occur in this sector.[3] More than three quarters (77%) of electricity sector CO_2 emissions face a positive ECR, with half of ECRs in the sector between EUR 5 and 30/tCO_2 and a little over 4 % above EUR 30/tCO_2. The ECR is zero for 44% of emissions in the off-road transport sector but more than 20% face rates above EUR 30/tCO_2. CO_2 emissions from the industry sector contribute more than a quarter of total GHG emissions (section 2.1) and 29% of emissions in that sector face a positive ECR in 2023. 9% of these emissions in the industry sector face an ECR above EUR 30. Over one-third of the buildings sector CO_2 emissions face a positive ECR, with about 18% of emissions covered by ECRs over EUR 30/tCO_2. Other GHGs face the lowest ECRs, with 97% of emissions unpriced. Effective carbon rates may significantly vary within sectors (Figure 2.4), including because different instruments may be used (Figure 2.5), different fuels used in one sector may be taxed at different rates (Figure 2.6) and because of differences in the rates and coverage of instruments across countries (Figure 2.A.2 and Figure 2.A.3).

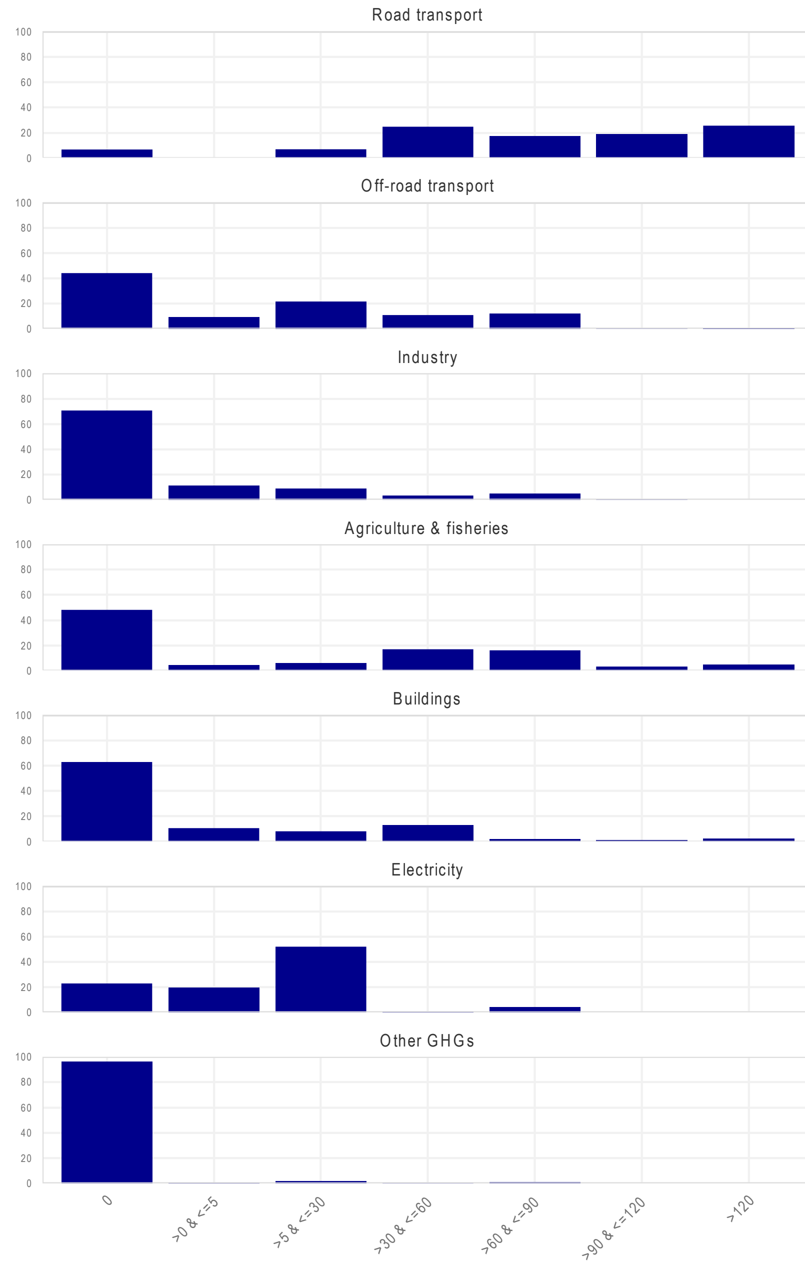
In 2023, fuel excise taxes cover nearly 24% of emissions, ETSs 22% and carbon taxes 5% (Figure 2.5). The base of carbon taxes generally coincides with that of fuel excise taxes as many carbon taxes are fuel-based (as opposed to directly levied on reported CO_2e emissions). ETSs and carbon taxes generally do not overlap though, notably, in some cases carbon taxes are used to complement the ETS price (e.g. the UK carbon price floor, the Netherlands carbon levy[4] or the recently introduced Hungarian carbon tax[5]). The overlap of ETSs with fuel excise taxes is also limited. In many cases, when tax and ETS coverage overlap, covered entities face reduced tax rates. In 2023, out of the 79 countries covered in this report, fuel excise taxes are present in 75 countries, ETSs in 41 countries and carbon taxes in 27 countries (see Figure 2.A.2 and Figure 2.A.3).

Carbon pricing instruments are used in all sectors, with more use of ETSs in the electricity and industry sectors and of carbon taxes in the buildings and road transport sectors (Figure 2.5). Where CO_2 emissions from energy use in the electricity and industry sectors face a positive ECR, respectively 76% and 53% of coverage stems from ETSs. Where CO_2 emissions from the buildings and road transport sectors are covered, respectively 29% and 15% stems from carbon taxes. In total, ETSs (respectively carbon taxes) cover about 8% (resp. 11%) of the buildings sector's CO_2 emissions, 59% (resp. 5%) of CO_2 emissions in the electricity sector, 15% (resp. 4%) of CO_2 emissions from energy use in the industry sector, 7% (resp. 13%) of transport CO_2 emissions and 3.1% (resp. 0.4%) of the "other GHG" emissions category.

Fuel excise taxes and ECRs are on average highest in road transport. Overall, the highest ECR levels arise from fuel excise tax rates (Figure 2.1), though this is not the case in all sectors (Figure 2.5). While fuel excise tax rates are highest in the road transport sector (at an average of EUR 97/tCO_2 for emissions priced by fuel excise taxes), they are much lower than ETS permit prices in the electricity and industry sectors (EUR 4 vs 14/tCO_2 for electricity and EUR 11 vs 37/tCO_2 for industry) – where these prices do not account for free allowances (see section 2.4). Moreover, in the electricity sector, fuel excise taxes cover less emissions than ETSs, and in the industry sector they cover a similar share of emissions. Carbon taxes cover less emissions than the two other instruments, but when applied, carbon taxes are set at non-negligeable rates (e.g. EUR 27/tCO_2 in the buildings sector and EUR 22/tCO_2 in the road transport sector for emissions priced by carbon taxes).

Figure 2.4. Proportion of CO_2e emissions priced at different ECR levels by sector

2023, 79 countries



Note: Within each sector, ECR values are grouped into seven ranges (0, >0–≤5, …, >120). For each sector, coverage in each range is summed and divided by the sector's total coverage; bars display the resulting percentage shares (summing to 100). Empty ranges are shown as zero-height bars.

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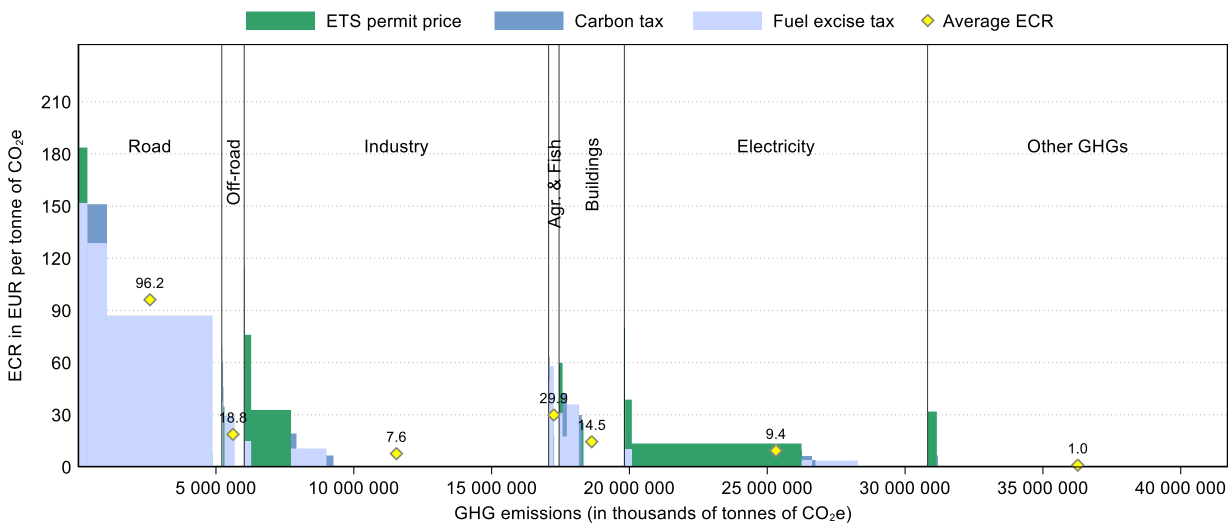
Emissions related to industrial processes are the main "other GHG emissions" which are priced, while non-CO_2 agricultural emissions face no carbon price in 2023. ETSs are the main instrument that covers other GHG emissions (90% of covered emissions - Figure 2.5) mostly through the pricing of emissions from industrial processes. Some ETSs also cover CH_4 and N_2O emissions from energy use (e.g. the Australian Safeguard Mechanism). Carbon taxes cover about 10% of priced emissions from other GHGs, mostly through taxes on F-gas emissions (e.g. in Denmark, Iceland, Norway, Poland, Spain). The pricing of agricultural emissions is currently being discussed in certain countries (section 3.1).

Figure 2.5. ECR levels and coverage by sector

2023, 79 countries



Note: The figure shows both the level of pricing of and the share of emissions covered by fuel excise taxes, carbon taxes and emissions trading systems – by sector. It thus also highlights the variation in carbon pricing instruments across sectors. In the Carbon Pricing and Energy Taxation database, sectors corresponding to agriculture and fisheries, buildings, electricity, industry, off-road transport and road transport 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; they exclude LUCF.GHG emissions data combines data on CO_2 emissions from energy use, based on the IEA World Energy Balances (IEA, 2025[1]), with "other GHG emissions" data from CAIT (Climate Watch, 2025[2]). Fuel excise tax rates are typically set per unit of volume or weight (e.g., litre, kilogram, cubic metre) or per unit of energy (e.g., gigajoule) and these rates have been translated into a price per tonne of CO_2, based on the carbon content of these fuels, relying on calorific factors from the IEA World Energy Statistics and Balances (IEA, 2025[1]) and IPCC emissions conversion factors (IPCC, 2006[4]). All rates are expressed in real 2023 EUR using the latest available OECD exchange rate and inflation data.

Reading note: The horizontal axis of shows total GHG emissions (expressed in thousands of tonnes of CO_2) for each sector across the 79 countries. The width of each sector along the horizontal axis therefore represents the total CO_2e from each sector. The vertical axis shows different levels of ECRs. Within each of the six sectors, the width of the shaded rectangles shows the amount of CO_2e emissions in that sector subject to each type of instrument. The height of each shaded rectangle represents the average ECR level from the corresponding instrument conditional on instrument applicability (i.e. zeros are excluded). This Figure allows the components of the average ECR in each sector to be identified. Carbon taxes are shown in darker blue, fuel excise taxes are shown in lighter blue, while ETSs are shown in green. A tonne of CO_2e emissions can face a positive ECR in different ways: only via carbon taxes (corresponding to a darker blue rectangle), only via fuel excise taxes (corresponding to a lighter blue rectangle), only via a tradable emissions permit price (corresponding to a green rectangle), or via a combination of these (i.e. when rectangles are stacked). Emissions that are not priced are shown with no rectangle. The yellow diamonds show the unconditional average ECR for each sector (i.e. averaged including over zero-ECR emissions).

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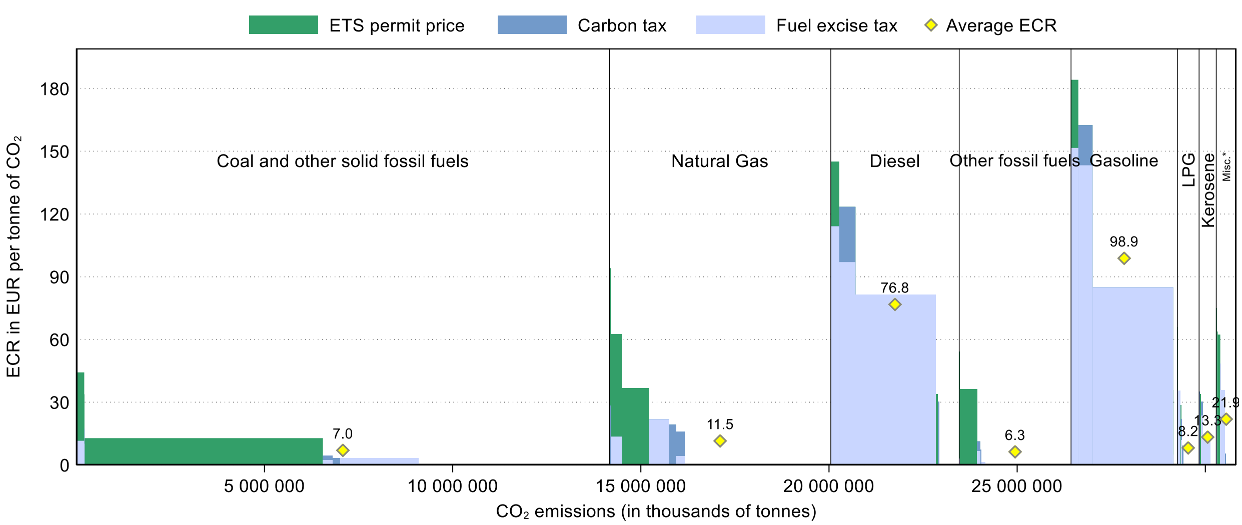
Effective carbon rates vary across fuels and are highest for road transport fuels (diesel and gasoline) (Figure 2.6). On one end of the spectrum, diesel and gasoline, which are primarily used in the road transport sector, are subject to the highest ECRs (respectively EUR 77 and EUR 99/tCO_2 on average) – this also relates to their historically broad tax base and the revenue raising objective of their taxation in many countries. Their ECR mainly stems from fuel excise taxes, i.e. the price on carbon is implicit. On the other end of the spectrum, coal and other solid fossil fuels, which are mostly used in the industry and electricity sectors (Figure 2.3, Panel B) face relatively low ECRs (at an average of almost EUR 4/tCO_2 for taxes and EUR 13/tCO_2 for ETSs when priced by the respective instruments) and are mainly priced through ETSs even though they still have one third of their emissions unpriced. Natural gas which is used in the buildings, electricity and industry sectors also has a large share of its emissions unpriced, resulting in an average ECR of EUR 11.5/tCO_2. Fuels such as natural gas and LPG, which are important in the buildings sector often face reduced tax rates or exemptions, particularly when applying in the residential sector. Fuels used in industry may also face reduced rates when their industrial users are also subject to an ETS.

Figure 2.6. ECR levels and coverage by fuel category

2023, 79 countries, CO_2 emissions from energy use.



Note: The figure shows both the level of pricing of and the share of emissions covered by fuel excise taxes, carbon taxes and emissions trading systems – by fuel category. It thus also highlights the variation in carbon pricing instruments across fuel categories. CO_2 emissions from energy use are based on the IEA World Energy Balances (IEA, 2025[1]). The smallest fuel category ("Misc.*") not legible in the figure includes fuel oil & non-renewable waste. Fuel excise tax rates are typically set per unit of volume or weight (e.g., litre, kilogram, cubic metre) or per unit of energy (e.g., gigajoule) and these rates have been translated into a price per tonne of CO_2, based on the carbon content of these fuels, relying on calorific factors from the IEA World Energy Statistics and Balances (IEA, 2025[1]) and IPCC emissions conversion factors (IPCC, 2006[4]). All rates are expressed in real 2023 EUR using the latest available OECD exchange rate and inflation data.
Reading note: cf. reading note for Figure 2.5.

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2.3. Evolutions between 2018 and 2023

Between 2021 and 2023, global coverage of emissions by carbon pricing instruments changed little (Table 2.2). ETSs have gone from covering about 20% of GHG emissions in 2021 to 22% in 2023. This increase in coverage stems from reforms to existing systems, as well as the introduction of trading in the Australian Safeguard Mechanism and of new ETSs such as the Indonesia Economic Value of Carbon Trading Scheme, the Austria national ETS and the Washington Cap-and-Invest Program. New carbon taxes were introduced in Hungary and Uruguay as well as five States in Mexico (Durango, Guanajuato, Queretaro, State of Mexico, Yucatan)[6] between 2021 and 2023, but they hardly increased total emissions coverage. While carbon pricing coverage did not significantly evolve on a global scale, some of these new initiatives did have an important impact on individual countries' coverage of emissions (Table 2.1).

Table 2.1. Carbon pricing instruments included in ECR vintages

2018, 2021, 2023

	In 2018	In 2021	In 2023
Carbon Taxes	Argentina, Canada (Alberta, British Columbia), Chile, Colombia, Denmark, Estonia, Finland, France, Iceland, Ireland, Japan, Latvia, Mexico (national and Zacatecas state), Norway, Poland, Portugal, Slovenia, Spain, Sweden, Switzerland, Ukraine, United Kingdom Carbon Price Support	**New since 2018:** - Canada federal fuel charge - Canada (New Brunswick Newfoundland and Labrador Northwest Territories Prince Edward Island) - Luxembourg - Mexico (Baja California, Tamaulipas) - Netherlands - Singapore - South Africa **Abolished since 2018:** - Alberta carbon tax (transitioned to federal fuel charge in 2021)	**New since 2021:** - Hungary* (did not increase coverage, as coincides with EU ETS coverage) - Mexican States of Durango, Guanajuato**, Queretaro, State of Mexico, Yucatan. - Uruguay **Abolished since 2021:** - Mexican States of Baja California, Tamaulipas (suspended).
Emissions Trading Systems	Canada (Alberta, Québec), China (Pilot ETSs: Beijing, Chongqing, Fujian, Guangdong, Hubei, Shanghai, Shenzhen, Tianjin), EU ETS, Japan (Saitama, Tokyo), Kazakhstan, Korea, New Zealand, Switzerland, United States (California, Massachusetts, RGGI)	**New since 2018:** - Canada (FOBPS, New Brunswick, Newfoundland and Labrador, Nova Scotia, Saskatchewan) - China (national) - Germany (national ETS) - United Kingdom (UK ETS) - Mexico Pilot ETS***	**New since 2021:** - Australia (Safeguard Mechanism) - Austria (national ETS) - Canada (Ontario) - Indonesia (Economic Value of Carbon Trading Scheme) - United States (Washington Cap-and-Invest Program)

Note: The table captures novel ETS systems or carbon taxes, and thus includes system evolution and transitions within the same jurisdiction even though they may not involve geographical expansion (e.g the UK ETS established following Brexit, or successive system changes in Canada).

* Due to data limitations, the Hungarian carbon tax has not yet been modelled.

** Since the Guanajuato carbon tax was implemented in July 2023, it has not been modelled yet (since taxes are as of 1 April 2023 - see Annex A).

*** Due to data limitations, the Mexico national ETS is generally not accounted for in ETS coverage or price estimates and not displayed in Figures.

ETSs prices are generally higher than carbon taxes and have increased more than carbon tax rates between 2021 and 2023 (Table 2.2). While the average permit price was almost the same as the average carbon tax rate in 2018, the gap between ETS prices and carbon taxes widened in 2021, with a slower divergence between 2021 and 2023 (see also OECD (2023[3]; 2024[5])).[7] In 2023, the average carbon tax rate is of EUR 15.1/tCO_2e and the average permit price is of EUR 20.2/tCO_2e. Note that ETS permit prices represent marginal ETS price signals, i.e. the cost of buying an additional emission allowance. The availability of free allowances reduces the average price paid for each tonne of CO_2e emissions, i.e. affects average ETS price signals, which are further discussed in section 2.4.

ETSs have been the main driver of changes in coverage and levels of ECRs between 2018 and 2023 – as compared to both carbon taxes and fuel excise taxes. Between 2018 and 2023, coverage of carbon taxes hardly evolved, remaining at around 5%, while that of ETSs more than doubled, from 10% to almost 22%. The evolution in ETS coverage is also in contrast with fuel excise taxes, the coverage of which has remained around 24% over the same period. One possible explanation for this trend in coverage may be the following: fuel excise taxes and carbon taxes are primarily used in the buildings and transport sectors, which represent less emissions than electricity and industry (Figure 2.2), where ETSs are mostly used (Figure 2.5) and are expanding. Over the 2018 – 2023 period, average carbon tax rates increased from EUR 14 to 15/tCO_2e and average ETS permit prices rose from EUR 13 to 20/tCO_2e. In contrast, fuel excise tax rates declined during this period. Nevertheless, in 2023, the average fuel excise tax rate when expressed in EUR per tonne of CO_2 remained significantly higher than carbon tax rates and ETSs prices, at EUR 55/tCO_2.

Table 2.2. Evolution of coverage and rates of ECR instruments between 2021 and 2023

71 countries

	Coverage by component (percentage of total GHG emissions in CO_2e)			Average tax rate or permit price by instrument (in constant 2023 EUR/tCO_2e)		
	2018	2021	2023	2018	2021	2023
Carbon Tax	5%	5.1%	4.9%	13.9	14.1	15.1
Emissions Trading System	10.1%	20.1%	21.6%	13.1	18.1	20.2
Fuel Excise Tax	24.3%	22.8%	23.6%	68.5	62.8	55.3

Note: Permit prices and tax rates were converted into (constant) 2023 EUR using the latest available OECD exchange rate and inflation data. The average ECR level by instrument is equal to the emissions-weighted conditional average of carbon tax rates for emissions priced by carbon taxes, of permit prices for emissions priced by ETSs and of fuel excise tax rates for emissions priced by fuel excise taxes. Fuel excise tax rates are typically set per unit of volume or weight (e.g., litre, kilogram, cubic metre) or per unit of energy (e.g., gigajoule) and these rates have been translated into a price per tonne of CO_2, based on the carbon content of these fuels, relying on calorific factors from the IEA World Energy Statistics and Balances (IEA, 2025[1]) and IPCC emissions conversion factors (IPCC, 2006[4]). The table presents figures across the 71 countries covered in the Carbon Pricing and Energy Taxation database in 2018 (see Annex A of OECD (2024[5]) for a list of countries covered in the different CPET vintages), in order for comparisons to be possible.
Differences with previous editions: Similar data points were presented in OECD (2022[6]), OECD (2023[3]) and OECD (2024[5]), though exact values across reports may not be equal because of e.g. changes in the emissions base or of the base year of EUR values. Coverage is equal to the share of the corresponding year's emissions covered by the respective instruments – and hence is not based on the same emissions base, as is the case in OECD (2022[6]) and OECD (2024[5]). OECD (2023[3]) presents coverage based on CO_2 emissions from energy use.

2.4. ETSs, free allowances and EACRs in 2023

In 2023, in the 79 countries considered in this report, there are 34 ETSs covering emissions in 41 countries. The emissions of the 41 countries account for 70.5% of the sample's GHG emissions, and these countries have 32% of their GHG emissions covered by an ETS. ETSs apply at the supranational level in one instance, the national level in eleven instances and the subnational level in twenty-two instances (Table 2.1).

This report covers the following ETSs in place in 2023: the Australia Safeguard Mechanism, the Austria national ETS (NEHG), the Canadian systems (Alberta Technology Innovation and Emissions Reduction (TIER) Regulation, Canada Federal Output-Based Pricing System (FOBPS),[8] New Brunswick Output-Based Pricing System, Newfoundland and Labrador Performance Standards System (PSS), Nova Scotia

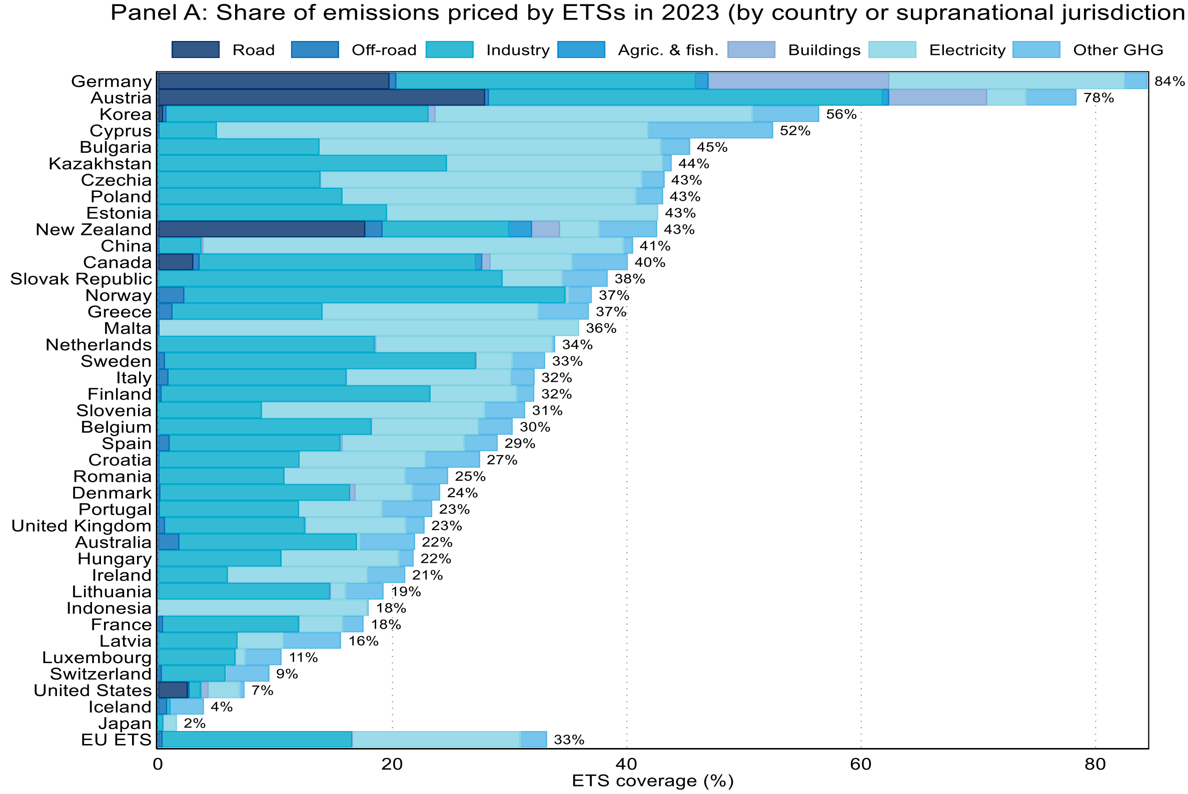
Output-Based Pricing System for Industry, Ontario Emissions Performance Standards (EPS), Québec Cap-and-Trade System, Saskatchewan Output-Based Performance Standards), the Chinese national ETS, the Chinese Pilot ETSs (Beijing, Chongqing, Fujian, Guangdong, Hubei, Shanghai, Shenzhen, Tianjin), the European Union (EU) ETS, the German national ETS (nEHS), Indonesia's Economic Value of Carbon (Nilai Ekonomi Karbon) Trading Scheme, the Japanese subnational ETSs (Saitama Target Setting ETS and Tokyo Cap-and-Trade System), the Kazakhstan ETS, the Korean Emissions Trading System, the Mexico National ETS,[9] the New Zealand ETS, the Swiss ETS, the United Kingdom (UK) ETS, all United States (US) subnational ETSs (California Cap-and-Trade, the Regional Greenhouse Gas initiative (RGGI), Massachusetts Limits on Emissions from Electricity Generators, Washington Cap-and-Invest).

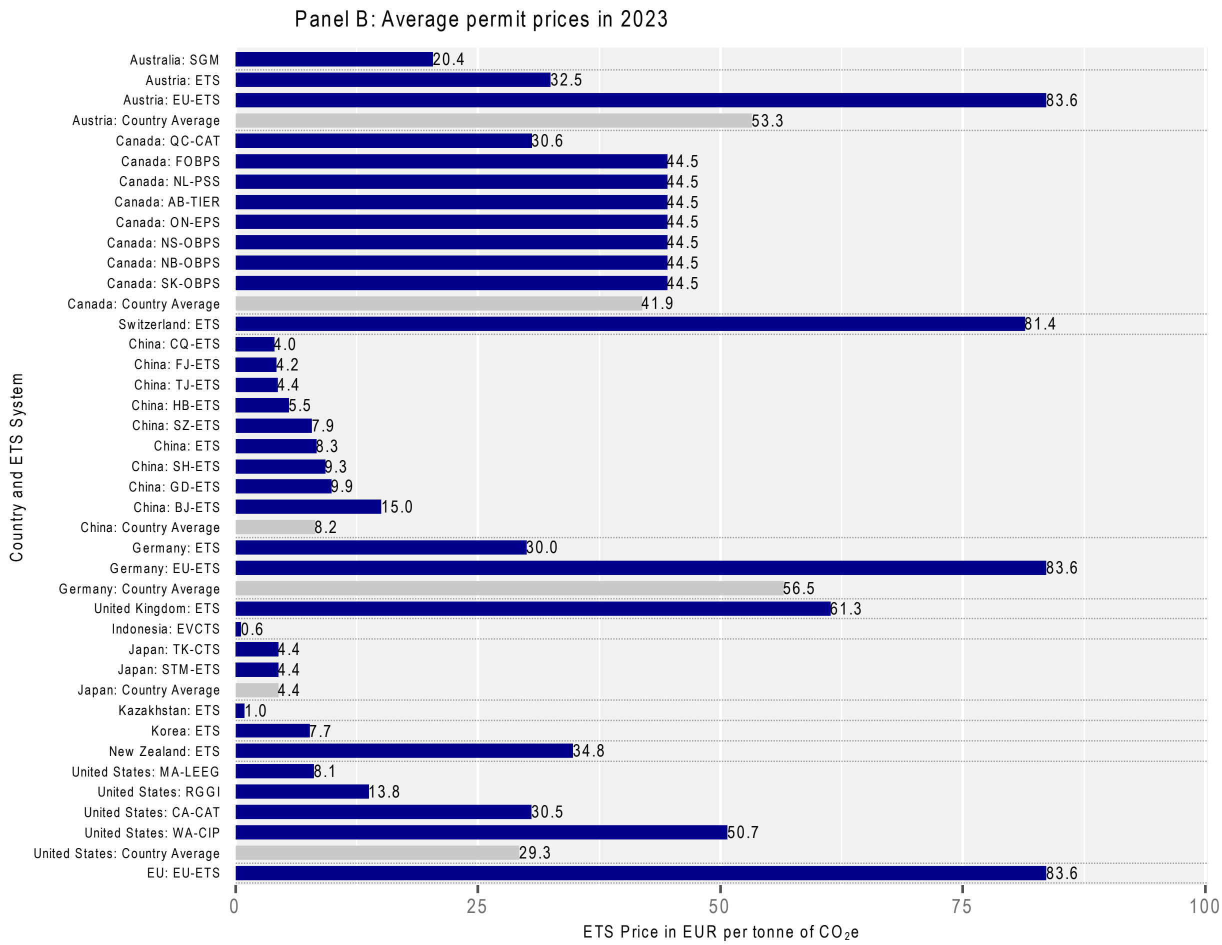
In 2023, the share of GHG emissions covered by ETSs in different countries varies substantially, ranging from about 2% in Japan to 84% in Germany (Figure 2.7, Panel A).[10] The share of a country's emissions covered by ETSs depends on various factors, including sectoral coverage, the level of application of the ETS (supranational, national, subnational), and whether in the case of subnational ETSs, these span an important share of the country's emissions (e.g. the Canadian Province or Territory-level ETSs) or not (e.g. the two Japanese city-level ETS).

Average 2023 permit prices range from EUR 0.6/CO_2e to EUR 84/CO_2e across systems (Figure 2.7, Panel B).[11] 16 systems had an average 2023 permit price equal to or above EUR 30/tCO_2e, and 3 above EUR 60/tCO_2e. It should be noted, however, that these yearly average permit prices can hide important volatility within the year (OECD, 2023[3]). For instance, in 2023, EU ETS permit prices ranged between about EUR 66/tCO_2e and EUR 97/tCO_2e, resulting in an average permit price over 2023 of EUR 84/tCO_2e.

Figure 2.7. Shares of GHG emissions priced by ETSs and average permit prices

Panel A: Share of emissions priced by ETSs in 2023 (by country or supranational jurisdiction)





Note: Panel A: Countries are presented first with data sorted by share of emissions priced (descending), followed by supranational systems. GHG emissions expressed in CO_2e. In the Carbon Pricing and Energy Taxation database, sectors corresponding to agriculture and fisheries, buildings, electricity, industry, off-road transport and road transport 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; they exclude LUCF. Panel B: Average permit price over 2023. Permit prices from the primary market when available, else from the secondary market (see Annex B for more detail on permit price sources). Country averages are emissions-weighted averages of the 2023 permit prices of applicable schemes, conditional on ETS coverage. Data are sorted by country alphabetical order, price (ascending) with the country average appearing last, supranational systems. EU ETS countries feature only in the case where national systems are also in operation, which is the case in Austria and Germany. Note that average permit prices refer to permit prices averaged over the year 2023. This does not refer to the EACR concept, where the ETS-related price signal weights permit prices by the share of allowances not received for free.

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In 2023, all ETSs include the electricity or industry sector in their scope (Figure 2.7, Panel A and Table 2.A.1). Electricity sector emissions are partly covered by all ETSs with the exception of the German and Austrian national ETSs as well as some Chinese Pilot ETSs since the inception of the Chinese national ETS in 2021. Almost all ETSs (with the exception of the Indonesian ETS) cover a part of the industry sector (Annex B), as in most cases even ETSs covering only emissions from power plants extend in part to the industry sector through their coverage of captive power plants.[12]

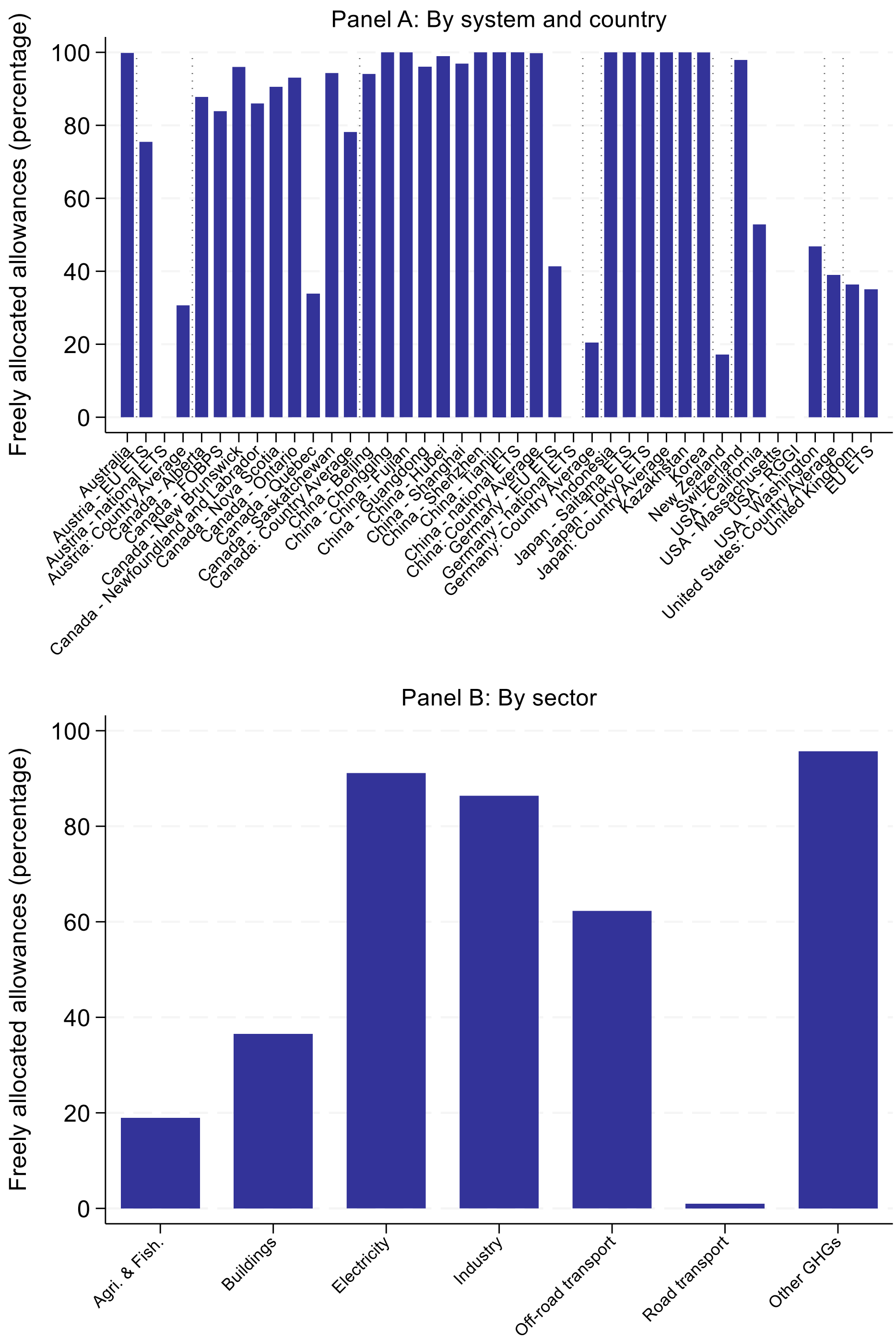
All sectors have part of their emissions covered by ETSs. In 2023, about 58.5% of the 79-country sample's electricity sector CO_2 emissions are covered by an ETS. This stems in large part from (i) the Chinese national ETS, which covers China's power sector emissions and the EU ETS, which covers almost all of EU countries' as well as Iceland, Liechtenstein and Norway's power sector emissions, combined with

(ii) the Chinese electricity sector's CO_2 emissions accounting for about 48% of total emissions from the electricity sector and the EU ETS countries' for about 4%. The industry sector's CO_2 emissions from energy use come next, with about 15.4% of total emissions covered by an ETS. Almost 8% of the buildings' sector CO_2 emissions are covered by an ETS, and this mostly comes from the introduction of the German national ETS. Indeed, the German buildings sector makes up 4% of total buildings CO_2 emissions. The most targeted off-road transport emissions are from aviation (67% of covered emissions from off-road transport) and pipeline transport (11%). Other GHG emissions covered are mostly from industrial process emissions: even when ETSs cover only CO_2 emissions, if they cover industry, they generally include both energy-related and industrial process-related emissions (see Annex B for more details). The road transport sector is mostly covered upstream through systems such as the New Zealand's ETS or the Austrian and German national ETSs (Annex B).

In most ETSs, covered entities receive emission allowances for free, with wide variations in the share of free allowances across systems. The shares of free allocation of allowances in total verified emissions are presented by system in Figure 2.8, Panel A. Free allowances can ease the transition for industries with carbon-intensive processes into an ETS and can be used to protect firms against competitiveness losses and to reduce carbon leakage risks. The decision to allocate allowances for free thus depends on many factors, including the maturity of the ETS, the market structure and the energy (or emission) intensiveness and trade exposure of sectors targeted. In 2023, the share of free allocation of allowances varies widely across systems, ranging from 100% in Japanese ETSs or the Chinese national ETS, for instance, to almost 0% in RGGI and the Massachusetts Limits on Emissions from Electricity Generators (310 CMR 7.74). Some systems have a provision for auctions to take place even when in practice most allowances are allocated for free. For instance, all Chinese pilot ETSs have the possibility of organising auctions, but only 3 of them held auctions in 2023 (Beijing, Hubei and Shanghai)[13] (ICAP, 2025[7]).

The shares of free allowances differ across sectors, with the highest shares in the electricity and industry sectors as well as the "other GHG" category (Figure 2.8, Panel B). In 2023, in the electricity and industry sectors, whose emissions are predominantly priced through ETSs (Figure 2.5), respectively 91% and 87% of allowances are allocated for free. The off-road transport sector receives 62% of allowances for free, consistent with emissions from aviation generally receiving high shares of free allowances. Since other GHG emissions covered are mostly from industrial process emissions, the share of free allowances received for this category is comparable to that received for industry CO_2 emissions from energy use, though slightly higher (96%). These global sectoral shares, however, hide variations across systems (Table 2.A.1): for instance, the electricity sector receives negligeable shares of free allowances in the EU ETS, the RGGI, the Swiss ETS and the UK ETS.

Figure 2.8. Share of free allowances at a system, country and sector level



Note: Panel A: The EU ETS applies to all EU countries as well as Iceland, Liechtenstein and Norway. The individual EU countries are not presented in Panel A, unless they have a national ETS in place as well, which is the case in Austria and Germany. Mexico's ETS is not presented here due to lack of information. Canada, China, Japan and the United States each have sub-national ETSs (along with the national ETS for China), and the ETS-level as well as the resulting country-level shares of free allocation of allowances in total verified emissions are presented here. Agri. & Fish. stands for Agriculture and Fisheries (fuel combustion-related emission).

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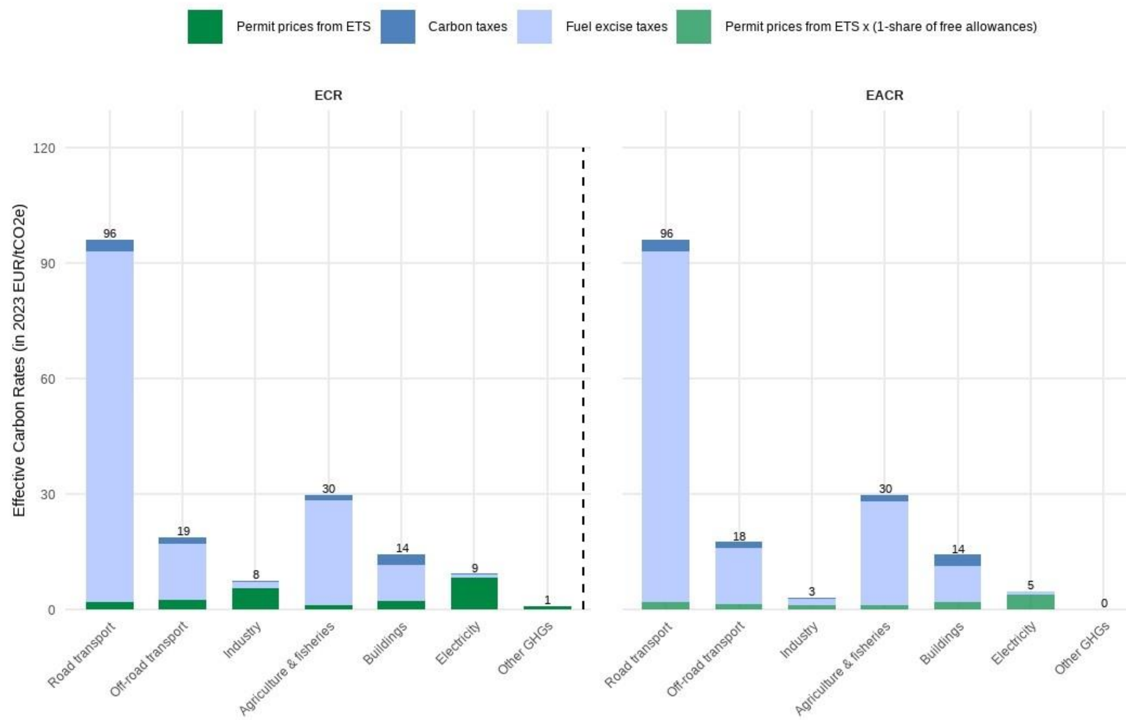
While free allocation of allowances generally maintains marginal price signals, it affects average price signals. When free allowances may be traded, they maintain the marginal price signal faced by firms because even if entities receive free allowances, reducing their emissions (or emission intensity) allows them to sell extra permits while emitting more (or being more emission-intensive) requires them to buy additional permits. And even if they emit exactly what they have been allocated, they face an opportunity cost as they forgo the income they would have gotten from reducing their emissions and selling those extra permits. However, the average price paid by entities for permits does depend on the level of free allowance received (OECD, 2023[3]).

The wedge between the marginal and average carbon prices arising from ETSs is captured by the difference between Effective Average Carbon Rates (EACR) and Effective Marginal Carbon Rates (EMCR). The EMCR or ECR is the main indicator used in this report: it summarises the *marginal* carbon rates faced by subsectors, sectors or countries. The EACR, on the other hand, summarises the *average* carbon rates they face.[14] The EMCR measures the strength of the marginal incentive to reduce emissions provided by carbon prices and fuel excise taxes while the EACR represents the strength of the incentives to invest in longer-term decarbonisation and provides an estimate of the carbon pricing and fuel excise tax-related costs faced by firms (see section 1.2 of this report and Box 4.1 of OECD (2021[8])).

The difference between EMCRs and EACRs is largest in the electricity and industry sectors (Figure 2.9). Figure 2.9 presents results at the sector level and Table 2.A.1 presents results by sector for each country or group of countries with an ETS. The discrepancy between EMCR and EACR varies with the share of free allocation in the ETS systems as well as the share of the sector's emissions priced through ETSs. For instance, in off-road transport there can be a non-negligeable gap between marginal and average carbon prices hence EMCRs and EACRs in certain countries, but this is less evident at the global level since a relatively small share of this sector's emissions is priced by ETSs (Figure 2.5). Another example is that of Japan, where even though allowances are allocated at 100% for free in the Tokyo Cap-and-Trade System and the Saitama Target Setting Emissions Trading System, given that these two systems price about 1.6% of the country's emissions (Figure 2.7), the high share of free allocation hardly lowers the country's EACR, since in Japan ECRs are mostly driven by fuel excise and carbon taxes (Figure 2.A.2). In most countries with ETSs, however, the EACR is at least halved as compared to the EMCR in the industry sector and (in less cases) in the electricity sector (Table 2.A.1). At the sector level, the EMCR is of EUR 9/tCO_2e in the electricity sector and of EUR 8/tCO_2e in the industry sector whereas the EACR is of respectively EUR 5/tCO_2e and 3/tCO_2e.

Figure 2.9. ECRs and EACRs at a sector level

2023, 79 countries.



Note: The EACR is a metric that accounts for free allowances received by entities when calculating the ETS price signal in different sectors – it does not account for the impact of different compliance options provided in carbon taxes and ETSs which could also drive a wedge between the marginal price signal and the average price signal (see example in Box 4.2 for ETSs).

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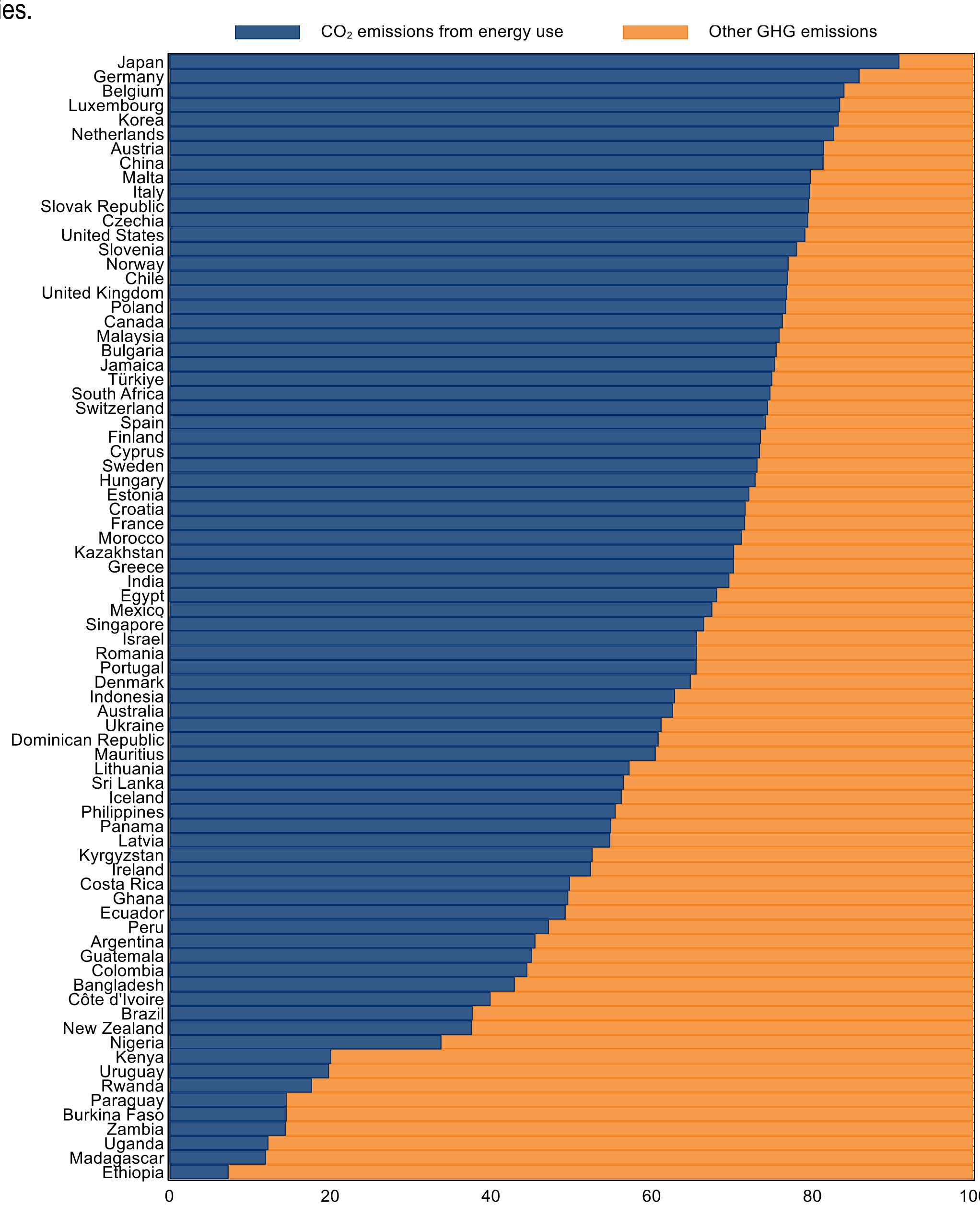
Annexe 2.A. Country-level results

This Annex presents some of the data at the country-level to complement the data presented at the sector or global level in Chapter 2. The figures highlight significant cross-country variations in composition of GHG emissions, ECRs and ECR instruments, levels and coverage.[15]

Figure 2.A.1. Share of CO_2 emissions from energy use in total GHG emissions

78 countries.



Note: Other GHG emissions refer to methane and nitrous oxide from energy use, fugitive emissions, industrial process emissions (including F-gases), non-fuel based agricultural emissions and waste emissions. GHG emissions data combines data on CO_2 emissions from energy use, based on the IEA World Energy Balances (IEA, 2025[1]), with "other GHG emissions" data from CAIT (Climate Watch, 2025[2]). . The "other GHG emissions" data is for 2022, while the data on CO_2 emissions from energy use is for 2023 for OECD and G20 countries as well as Cyprus and Kazakhstan, and 2021 otherwise.

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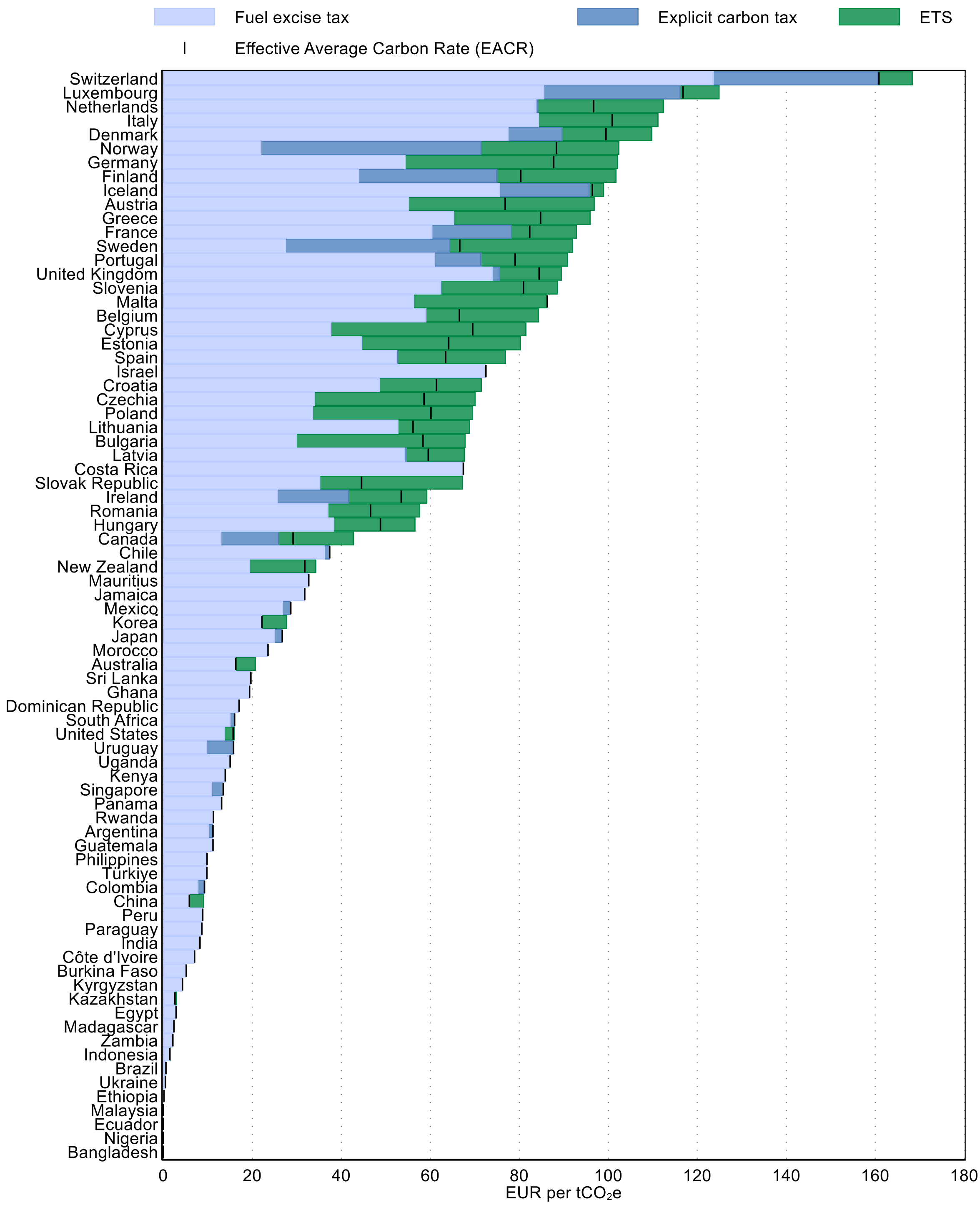
Figure 2.A.2. Average Effective (Marginal and Average) Carbon Rates by country

2023, 78 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 78 countries. Effective Average Carbon Rates account for free allocation of allowances in emissions trading systems (see section 2.4). All rates are expressed in 2023 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, 2025[2]), while the data on CO_2 emissions from energy use are based on the IEA World Energy Balances (IEA, 2025[1]).

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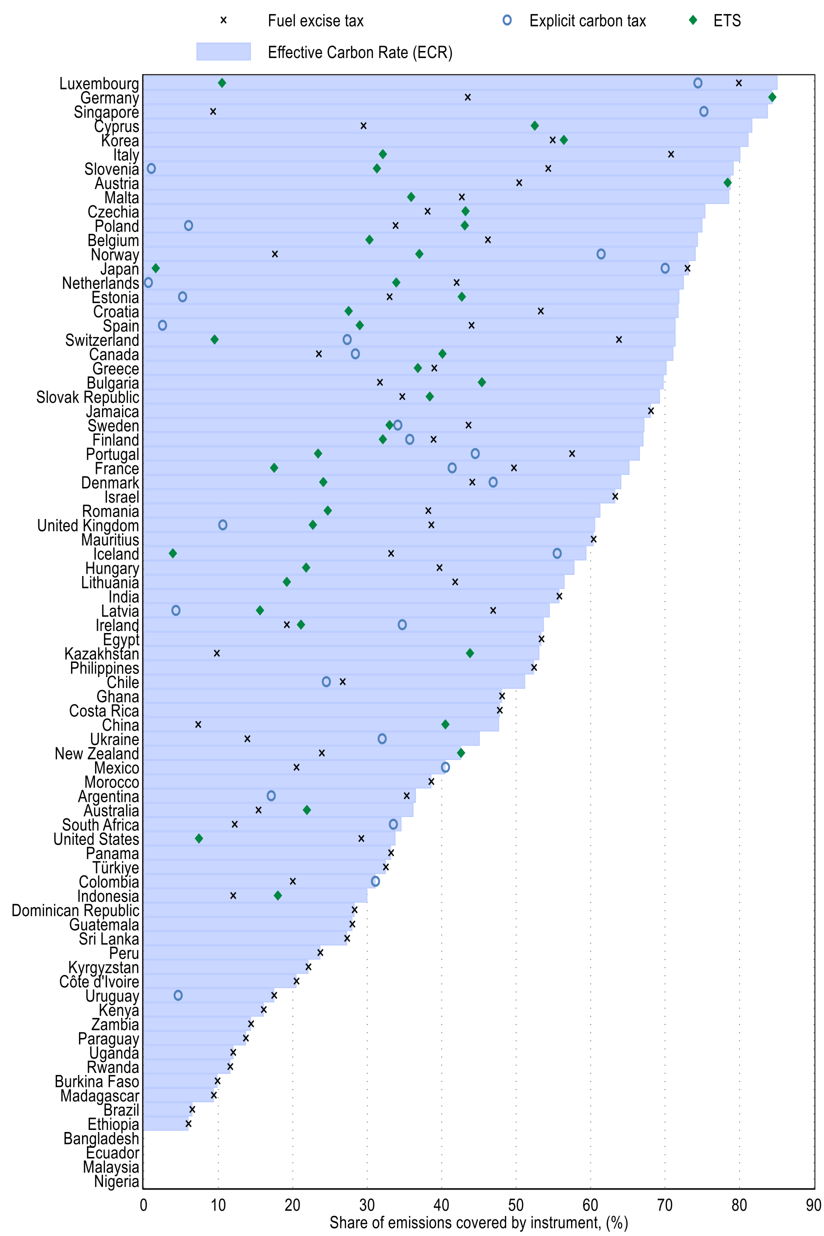
Effective carbon rates vary across countries (Figure 2.A.2), depending on the kinds of instruments used, their coverage (Figure 2.A.3) and rates. ECRs are generally higher in countries with carbon pricing instruments. Many countries combine carbon taxes and emissions trading systems. EACRs and EMCRs differ more when ETSs cover more emissions and when the share of free allowances is high. Sectoral differences within countries are presented in Table 2.A.1.

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

2023, 78 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, 2025[2]), while the data on CO_2 emissions from energy use are based on the IEA World Energy Balances (IEA, 2025[1]).

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Annex Table 2.A.1. EMCRs and EACRs in countries or supranational jurisdictions with an ETS

2023, in EUR

Country or supranational jurisdiction	Sector	ETS permit price	ETS permit price x (1-share free allowances)	ETS coverage in the sector	Share of free allocation in the ETS	EMCR	EACR
Austria	Agriculture	32.50	32.50	53.5%	0.0%	105.10	105.10
	Buildings	32.50	32.50	100.0%	0.0%	52.37	52.37
	Electricity	83.60	76.27	100.0%	8.8%	83.66	76.34
	Industry	71.76	19.36	83.1%	73.0%	63.71	20.19
	Off-road transport	49.36	21.78	100.0%	55.9%	105.50	77.92
	Road transport	32.50	32.50	99.9%	0.0%	214.34	214.34
Australia	Agriculture	n.a.	n.a.	n.a.	n.a.	0.00	0.00
	Buildings	20.39	0.00	0.1%	100.0%	0.03	0.01
	Electricity	20.39	0.00	1.0%	100.0%	0.21	0.00
	Industry	20.39	0.00	88.2%	100.0%	17.98	0.00
	Off-road transport	20.39	0.38	59.8%	98.1%	17.46	5.49
	Road transport	20.39	0.00	0.1%	100.0%	116.97	116.94
Canada	Agriculture	33.75	24.76	20.0%	26.6%	24.75	22.96
	Buildings	33.26	25.69	7.6%	22.8%	42.03	41.45
	Electricity	44.28	8.67	85.9%	80.4%	38.68	8.07
	Industry	43.29	4.43	71.1%	89.8%	33.94	6.32
	Off-road transport	33.70	24.86	14.1%	26.2%	43.68	42.43
	Road transport	30.62	30.62	15.7%	0.0%	105.35	105.35
China	Agriculture	n.a.	n.a.	n.a.	n.a.	45.42	45.42
	Buildings	10.13	0.20	5.4%	98.1%	6.29	5.75
	Electricity	8.34	0.00	100.0%	100.0%	8.35	0.01
	Industry	7.02	0.14	10.3%	98.1%	1.75	1.04
	Off-road transport	8.88	0.17	9.4%	98.1%	33.26	32.44
	Road transport	n.a.	n.a.	n.a.	n.a.	78.55	78.55
Germany	Agriculture	30.00	30.00	100.0%	0.0%	128.99	128.99
	Buildings	30.15	30.06	100.0%	0.3%	59.71	59.61
	Electricity	83.60	81.17	100.0%	2.9%	83.60	81.17
	Industry	70.78	22.74	88.5%	67.9%	67.18	24.66
	Off-road transport	51.93	39.96	99.2%	23.1%	108.13	96.25
	Road transport	30.00	30.00	100.0%	0.0%	269.05	269.05
EU ETS*	Agriculture	83.60	28.39	0.0%	66.0%	50.20	50.18
	Buildings	83.60	61.21	0.6%	26.8%	56.33	56.19
	Electricity	83.60	81.65	99.2%	2.3%	83.60	81.67
	Industry	83.60	18.65	65.8%	77.7%	65.06	22.35
	Off-road transport	83.60	46.22	27.5%	44.7%	41.12	30.83
	Road transport	n.a.	n.a.	n.a.	n.a.	206.76	206.76
Indonesia	Agriculture	n.a.	n.a.	n.a.	n.a.	0.00	0.00

	Buildings	n.a.	n.a.	n.a.	n.a.	0.00	0.00
	Electricity	0.61	0.00	81.6%	100.0%	0.50	0.00
	Industry	n.a.	n.a.	n.a.	n.a.	0.00	0.00
	Off-road transport	n.a.	n.a.	n.a.	n.a.	0.38	0.38
	Road transport	n.a.	n.a.	n.a.	n.a.	12.35	12.35
Japan	Agriculture	n.a.	n.a.	n.a.	n.a.	0.00	0.00
	Buildings	4.44	0.00	0.9%	100.0%	18.23	18.19
	Electricity	4.44	0.00	3.1%	100.0%	4.94	4.81
	Industry	4.44	0.00	1.4%	100.0%	3.39	3.33
	Off-road transport	n.a.	n.a.	n.a.	n.a.	25.28	25.28
	Road transport	n.a.	n.a.	n.a.	n.a.	147.08	147.08
Kazakhstan	Agriculture	n.a.	n.a.	n.a.	n.a.	15.90	15.90
	Buildings	n.a.	n.a.	n.a.	n.a.	2.29	2.29
	Electricity	0.96	0.00	100.0%	100.0%	0.96	0.00
	Industry	0.96	0.00	75.4%	100.0%	1.37	0.64
	Off-road transport	n.a.	n.a.	n.a.	n.a.	18.84	18.84
	Road transport	n.a.	n.a.	n.a.	n.a.	25.82	25.82
Korea	Agriculture	n.a.	n.a.	n.a.	n.a.	0.00	0.00
	Buildings	7.56	0.17	9.8%	97.8%	14.09	13.36
	Electricity	12.27	0.00	84.6%	100.0%	21.52	11.14
	Industry	8.03	0.00	73.4%	100.0%	7.88	1.98
	Off-road transport	7.56	0.00	50.7%	100.0%	17.53	13.70
	Road transport	7.56	0.00	3.1%	100.0%	124.36	124.13
New Zealand	Agriculture	34.82	32.70	100.0%	6.1%	36.88	34.76
	Buildings	34.82	34.82	100.0%	0.0%	35.14	35.14
	Electricity	34.82	34.82	100.0%	0.0%	34.82	34.82
	Industry	34.82	15.07	100.0%	56.7%	35.01	15.26
	Off-road transport	34.82	34.82	100.0%	0.0%	34.82	34.82
	Road transport	34.82	34.82	100.0%	0.0%	144.82	144.82
Switzerland	Agriculture	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	Buildings	81.42	65.71	0.2%	19.3%	135.41	135.38
	Electricity	81.42	80.02	8.0%	1.7%	69.40	69.29
	Industry	81.42	0.44	33.9%	99.5%	64.55	37.12
	Off-road transport	81.42	28.77	47.3%	64.7%	375.18	350.30
	Road transport	n.a.	n.a.	n.a.	n.a.	352.41	352.41
	Agriculture	n.a.	n.a.	n.a.	n.a.	40.52	40.52
	Buildings	61.33	51.76	0.4%	15.6%	11.12	11.08
	Electricity	61.33	61.28	100.0%	0.1%	79.37	79.32
	Industry	61.33	27.62	55.3%	55.0%	46.21	27.57
	Off-road transport	61.33	31.66	36.2%	48.4%	35.18	24.46
	Road transport	n.a.	n.a.	n.a.	n.a.	269.35	269.35
United States	Agriculture	30.55	30.55	5.5%	0.0%	1.68	1.68

	Buildings	32.18	31.16	7.1%	3.2%	2.28	2.20
	Electricity	21.07	21.07	10.8%	0.0%	2.27	2.27
	Industry	31.60	17.74	6.1%	43.9%	1.99	1.15
	Off-road transport	45.66	45.66	2.9%	0.0%	9.56	9.56
	Road transport	33.81	33.81	10.5%	0.0%	59.16	59.16

Note: n.a. not applicable. Free allocation shares greater than 1 were normalised to 1. The EACR is also calculated following this standardisation. EMCR and EACR are averaged across all emissions in a sector, including those emissions that are not covered by any carbon pricing instrument. ETS prices are conditional averages weighted by the emissions covered by the operational systems identified in a given sector. *The EU ETS here is considered without Austria and Germany, which have their own ETS. Austrian and German ETS coverage in this table is meant as coverage by the EU ETS and their national ETSs.

Notes

1 This results in CO_2 emissions from energy use in these sectors each representing above 26% of total GHG emissions.

2 However, for both sectors, other emissions which can be larger are not accounted for in these estimates. Emissions from the off-road transport sector presented here restrict to domestic emissions. International maritime and aviation emissions respectively make up 3% and 2.5% of global CO_2 emissions from energy use (IMO, 2021[10]; IEA, 2023[11]). GHG emissions from fuel use in the agriculture, forestry and fisheries sector only represents a small share of GHG emissions from this sector (less than 8%, according to data from Flammini et al. (2022[12]) and IPCC (2023[13])).

3 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, or can reflect revenue raising objectives.

4 Both of which are classified as carbon taxes, see Background Notes on taxes (OECD, 2024[9]). It is to be noted that in June 2025, the Dutch Parliament voted to abolish the national carbon levy, see Box 3.1.

5 See https://njt.hu/jogszabaly/2023-320-20-22#SZ1, as accessed on 30/06/2025.

6 However, the carbon tax in the Mexican State of Baja California was also abolished between 2021 and 2023.

7 More recent evolutions (i.e. to 2024 and 2025) are covered in Chapter 3.

8 Over the course of 2023, the federal OBPS was operational in Manitoba, Nunavut, Prince Edward Island and Yukon.

9 Due to data limitations, the Mexico national ETS is generally not accounted for in ETS coverage or price estimates and not displayed in Figures.

10 Due to different underlying databases and methodologies, ECR instrument coverage estimates may differ from those computed by individual governments.

[11] Note that average permit prices refer to permit prices averaged over a year or across multiple countries. This does not refer to the EACR concept, where the ETS-related price signal weights permit prices by the share of allowances not received for free. Average 2023 permit prices refer to permit prices averaged over year 2023.

[12] See CPET sector definitions in Annexe A, Table A A.1, with autogeneration of electricity included in the industry sector.

[13] And in 2023, in the Guangdong Pilot ETS, the quota was distributed partially free of charge and partially for a fee (DEE of Guangdong Province, 2024[15]).

[14] The EACR component related to ETSs is equal to: $EACR_{ETS} = EMCR_{ETS}$ x (1-share of (tradeable) free allowances). This gives an indication of the average price signal implied by ETSs and differs from the split of the ETS base into the base covered by (tradeable) free allowances and that not covered by free allowances.

[15] Due to different underlying databases and methodologies, ECR instrument coverage estimates may differ from those computed by individual governments.

3 Developments in carbon pricing in 2024 and 2025

This chapter discusses recent developments in carbon pricing and presents the impacts of emissions trading system (ETS) developments on ETS coverage and prices in 2024 and 2025. Section 3.1 discusses recent developments in carbon pricing and related initiatives. While it aims at describing the trends recently observed, this section does not aim at being exhaustive. Section 3.2 discusses introductions and reforms of carbon pricing instruments in 2024 and 2025, and presents the evolution of ETS permit prices in 2024 and 2025 as well as the impacts of the developments in ETSs on ETS coverage over this same period. The cut-off date for 2025 reforms discussed and included in the figures is 30 June 2025.

3.1. Recent and upcoming developments

3.1.1. Carbon pricing initiatives

Carbon pricing is being considered in an increasing number of countries, including in large emerging economies. The geographical coverage of carbon pricing is set to expand, with countries such as Brazil, India and Türkiye currently developing ETSs (World Bank, 2025[1]), and additional countries in Latin America and the Caribbean (e.g. Chile, Colombia) as well as in Asia (e.g. Malaysia, the Philippines, Thailand, Vietnam) developing or considering the introduction of ETSs or carbon taxes (ICAP, 2025[2]). In Japan, the voluntary GX-ETS has been operational since October 2023 and is to transition to a mandatory ETS from 2026 (ICAP, 2025[2]). Brazil's ETS would span a broad range of sectors and include links to domestic carbon credits, India's ETS would tackle emissions in the industry sector, and Türkiye's ETS would cover electricity and industry emissions.

Expansion of coverage is expected in sectors typically covered (electricity, industry, buildings, transport) as well as sectors not typically covered by carbon pricing (e.g. agriculture). This is set to take place through the expanded coverage of existing policies or through the introduction of new policies. China expanded its national ETS to the cement, steel and aluminium sectors in March 2025 (ICAP, 2025[3]). The European Union (EU) ETS 2, which will apply upstream to fuels used for transport, heating, and some smaller industrial installations is due to start in 2027 (European Commission, 2025[4]). Domestic emissions in the maritime sector are currently covered in four ETSs (through upstream or point source coverage, see ICAP (2025[2])) and are being considered for inclusion in the Tianjin Pilot ETS and the UK ETS. A tripartite agreement was reached in Denmark in 2024 on a package of measures – "A Green Denmark" – which would include a tax on agricultural GHG emissions to take effect in 2030 (Ministry of Food, Agriculture and Fisheries, 2025[5]). This would be the first carbon pricing instrument to be implemented on non-energy related emissions in the agricultural sector. The New Zealand government plans to price agricultural emissions (through a mechanism other than the New Zealand ETS) by no later than 2030 (ICAP, 2025[2]).

Coverage of international aviation and shipping emissions is increasing. In 2023, aviation accounted for 2.5% of global energy-related CO_2 emissions (IEA, 2023[6]). International aviation is covered through the Carbon Offsetting Reduction Scheme for International Aviation (CORSIA), a compliance system involving the use of carbon credits: international flights between participating jurisdictions have been required to report their annual CO_2 emissions since 2019 (IATA, n.d.[7]) and many flights could face offsetting obligations by 2028. The international maritime sector carries over 80% of global trade by volume (UNCTAD, 2025[8]) and contributes to around 2% of global GHG emissions (IMO, 2021[9]). In 2024, the EU ETS expanded its coverage to maritime emissions and became the first carbon pricing instrument to apply to international shipping emissions: it applies to emissions from all large ships (above 5 000 gross tonnage) entering EU ports (ICAP, 2025[2]). Discussions are ongoing at the International Maritime Organization (IMO) on global regulations for the shipping industry (OECD, 2025[10]).

3.1.2. Carbon pricing design

GHG removals are increasingly being considered for inclusion in ETSs. By the end of July 2026, the European Commission is set to assess how removals could be accounted for and covered under the EU ETS (ERCST, 2025[11]; ICAP, 2025[2]). The first EU-wide voluntary framework for certifying carbon removals, carbon farming and carbon storage in products was created in December 2024[1] (European Commission, 2025[12]). While the certified carbon removals could not be used for compliance with the EU Emission Trading System so far, a recent proposal by the European Commission for an amendment to the European Climate Law includes the use of domestic permanent removals in the EU ETS (European Commission (press corner), 2025[13]). In 2024, the United Kingdom (UK) ETS Authority followed up on its commitment to integrate engineered greenhouse gas removals (GGRs) in the scheme by proposing policy options for how this could be done (Department for Energy Security and Net Zero, 2024[14]). Emission removals could compensate for emissions in hard-to-abate sectors (e.g. Swiss Federal Council (2022[15])) and these developments may indicate the narrowing of abatement opportunities in some jurisdictions or sectors. GHG removals are further discussed in section 4.2.

The role of auctioning in ETSs could increase, either through its introduction in systems where it is not in place or through its expansion in systems where it already operates. The EU Carbon Border Adjustment Mechanism (CBAM) entered its transitional phase in October 2023, during which only reporting is required – the gradual phase-in of the scheme, to commence in 2026, will require surrendering payments as well and will be accompanied by a gradual phase-out of free permits for EU CBAM covered-sectors (European Parliament, 2023[16]). While the Swiss government decided against introducing a parallel CBAM to the EU's (Confédération Suisse, 2023[17]), the Swiss ETS is set to gradually phase out free allocations in the industry sector, mirroring the EU ETS approach for sectors covered by CBAM (ICAP, 2025[18]).[2] In Korea, in December 2024, the fourth "Basic Plan for the Emissions Trading System" adopted in 2024 addresses the period from 2026 to 2035 and includes measures for auctioning to increase significantly in the electricity and other high-emitting sectors. In the Chinese national ETS, where allowances are currently exclusively distributed for free, the Interim Regulations clarify that auctioning is to be introduced and gradually expanded. The introduction of auctioning is currently under development in Kazakhstan (ICAP, 2025[2]).

New linking initiatives are being considered. Linking of ETSs already exists between the California and Québec Cap-and-Trade programs and between the EU ETS and the Swiss ETS. New linking agreements could be underway. In March and September 2024, joint statements from the governments of Washington, California and Québec affirmed their commitment to explore potential linkage (ICAP, 2025[2]). On 19 May 2025, the EU and the UK agreed to negotiate the linkage of their ETSs (Tax Notes, 2025[19]). Linking could induce a convergence in carbon prices across the linked ETSs (Verde et al., 2022[20]). In practice, the linking of ETSs raises issues of interoperability of systems on many dimensions – e.g. on the monitoring, reporting and verification systems that underly them (OECD, 2025[21]) as well as on their carbon leakage prevention measures (Verde et al., 2022[20]) or compliance options (Galdi et al., 2022[22]).

The use of carbon pricing revenues for climate change mitigation, consumer and businesses protection, and technological innovation is increasing (ICAP, 2025[2])**.** The targeted use of auction revenues is a component of ETS policy in many jurisdictions, as can be seen in the EU, various US States, Canada, Alberta and Québec, New Zealand or Korea (Cárdenas Monar, 2024[23]) and is common in new systems. For instance, the establishment of the EU's Social Climate Fund is meant to complement the new EU ETS2[3] by pooling revenues from the auctioning of allowances from the ETS2 as well as 50 million allowances from the existing EU ETS to support the most vulnerable groups (European Commission, 2025[24]). Similar to the California Cap-and-Trade program, the Washington Cap-and-Invest program requires some consignment of the allowances distributed to certain electric utilities and to natural gas (NG) suppliers: the entities are required to consign a share (in 2023, 100% for investor-owned electric utilities and 65% for NG suppliers in California, and 65% for both in Washington) of their free allowances to auctioning and use the proceeds for ratepayer benefit or for GHG emissions reductions (California Air Resources Board, n.d.[25]; State of Washington Department of Ecology, n.d.[26]). Many carbon taxes also come with earmarking of revenues, e.g. in Colombia, Japan, Mexican States or Switzerland (Cárdenas Monar, 2024[23]; Marten and van Dender, 2019[27]).

3.1.3. Related policy developments

Countries are increasingly exploring strategies to address carbon leakage, including through Border Carbon Adjustments (BCAs) (OECD, 2025[21]). Carbon leakage occurs when foreign emissions increase because of the introduction or intensification of domestic climate mitigation policies (OECD/Climate Club, 2024[28]). Examples of measures aimed at directly or indirectly responding to this risk include the Australian Guarantee of Origin (GO) Scheme as well as the EU and the UK Carbon Border Adjustment Mechanisms (CBAM). The Australian Guarantee of Origin (GO) Scheme (Australian Government DCCEEW, 2025[29]) tracks and verifies emissions and other attributes across the value chain of Australian clean energy products. It is adopted on a voluntary basis and aims at increasing transparency for consumers. The EU (resp. the UK) CBAM is a mechanism designed to price carbon emissions embedded in selected carbon-intensive goods imported into the EU (resp. the UK), based on the difference between the carbon price paid in the country of origin and the price of EU ETS (resp. UK) allowances. The EU CBAM is currently in its transitional phase, which started in 2023, and is meant to enter its definitive phase in 2026 (European Commission, 2025[30]) and the UK CBAM is meant to start in 2027 (HM Treasury, 2025[31]) with no transitional phase foreseen. The Norwegian government has advocated introducing CBAM in Norway from 2027 (Ministry of Climate and Environment and Ministry of Finance, 2025[32]). The introduction of these CBAMs goes hand in hand with the decrease of free allowance shares in the respective ETSs (section 3.1.2).

Several countries are pursuing co-operation under Article 6 of the Paris Agreement, following recent outcomes from UNFCCC negotiations on international carbon trading. Article 6 provides a framework for countries to use international carbon trading to achieve their NDCs (Wetterberg, Ellis and Schneider, 2024[33]). Article 6.2 provides a flexible framework for bilateral carbon trading, with limited multilateral oversight, while Article 6.4 establishes a UN-supervised mechanism for generating carbon credits – the Paris Agreement Crediting Mechanism (PACM) (Figure 3.1). At the 29th UN Climate Change Conference in Baku in 2024, Parties adopted key decisions for market-based co-operation under both Articles 6.2 and 6.4 to become operational (UNFCCC, 2024[34]; Clyde&Co, 2024[35]).[4] International market-based co-operation could, for example, allow a developed country to support GHG mitigation in a developing country, and account for some of the mitigation outcomes towards its own climate goals (so called internationally transferred mitigation outcomes, or ITMOs). Countries can use carbon pricing instruments to obtain ITMOs, by allowing entities covered by a carbon price to purchase ITMOs and use these for compliance. Currently, ITMOs can be used towards Singapore's carbon tax and Korea's ETS. With the adoption of Article 6 rules in Baku, both developed and developing countries have signalled interest in international carbon trading. For example, the European Commission has proposed that ITMOs could make a limited contribution towards the EU's climate target for 2040 (European Commission (press corner), 2025[13]).

Figure 3.1. Article 6.2 and Article 6.4 of the Paris Agreement

Article 6.2
Decentralised framework for cooperation

- makes cooperative approaches that involve the **international transfer of mitigation outcomes** (ITMOs) possible **between participating parties and other entities**;
- can allow parties to **voluntarily cooperate** to achieve their nationally determined contributions (NDCs);
- should **align with high-level multilateral guidance**, but participating entities have considerable flexibility with respect to the detailed terms for co-operation (e.g. the methodologies used to quantify GHG impacts).

Article 6.4
Centralised mechanism for trading carbon credits

- now officially named the **Paris Agreement Crediting Mechanism** (PACM);
- a centralised mechanism supervised by a UN body,;
- provides for a **standardised, internationally governed framework for generating and transacting carbon credits**.

Note: Both Article 6.2 and 6.4 enable public and private entities to generate credits that can be also used for compliance with NDCs or other international mitigation purposes.
Source: Figure based on text drawing from Doda et al. (2025[36]),Johnstone (2024[37]) and Granziera, Hamrick Malvar and Verdieck (2024[38]).

3.2. Changes in carbon pricing in 2024 and early 2025

In 2024 and 2025, several new ETSs and carbon taxes were introduced, the scope of some existing instruments broadened, and the rates of certain carbon taxes increased, while some instruments were also put on hold or canceled (Box 3.1). Three subnational ETSs were introduced and several expansions in scope took place in existing ETSs, through their extension to new sectors or through the decrease in the inclusion threshold. Carbon taxes were introduced in 2024 and 2025 or are being planned for 2025. Carbon tax rate increases took place in a number of countries. One ETS and a few carbon taxes have been cancelled or put on hold.

A move away from temporary fuel tax relief offered during the energy crisis towards higher fuel excise tax rates was also observed in 2024 (OECD, 2025[10]). While in 2022 and 2023 several temporary cuts to excise taxes were introduced on road transport fuels (OECD, 2023[39]) and residential electricity consumption to alleviate cost-of-living pressures (OECD, 2024[40]), fuel excise tax rates have started to rise again in 2024. Some countries have scheduled a predetermined upward trajectory over the coming years, e.g. in Latvia, Lithuania and New Zealand. Some countries have reduced fuel excise taxes in 2025 (OECD, 2025[10]).

Box 3.1. Introductions and reforms of carbon pricing instruments in 2024 and 2025

- **Three subnational ETSs were introduced** – two in the United States and one in Canada:

  - the **British Columbia** Output-Based Pricing System (B.C. OBPS) began in April 2024, replacing the CleanBC Industrial Incentive Program (CIIP) (ICAP, 2025[2]);

  - the **Colorado** Greenhouse Gas Emissions and Energy Management for Manufacturing Regulation in 2024 (Colorado Department of Public Health & Environment, 2025[41]);

  - the **Oregon** Climate Protection Program (CPP) in 2025 (Oregon DEQ, n.d.[42]).

- **Several extensions in scope took place in existing ETSs, including:**

  - in early 2025, the **Chinese national ETS** went from solely covering the power sector to also **including the cement, iron and steel and aluminium smelting sectors** (China Ministry of Ecology and Environment, 2025[43]) – this extension retroactively applies in 2024 (though effectively only through reporting obligations in 2024);

  - in 2024, the **EU ETS** extended its scope to include **international maritime emissions** (European Commission, 2024[44]) and emissions **from most flights to and from the EU's nine outermost regions** as well as from departing flights from these regions to Switzerland and the UK;

  - in 2024, **Germany's national ETS** expanded to include **waste incineration** (DEHSt, 2025[45]);

  - in 2024, the **Indonesian ETS's inclusion threshold was lowered** from a production capacity for coal-fired power generation plants connected to the Perusahaan Listrik Negara (PLN) grid exceeding 100 MW to 25 MW. Coverage could expand in 2025 to include more types of power plants (ICAP, 2025[2]).

- **Carbon taxes were introduced (2024, 2025) or are being planned for 2025:**

  - the **Indonesian** carbon tax, complementing the Indonesian ETS is expected in 2025 (ICAP, 2025[2]);

  - **Israel** introduced a fuel-based carbon tax in 2024;

  - **Lithuania** plans the introduction of a carbon tax on fuels in 2025 (OECD, 2025[46]);

  - **Mexico** introduced four new carbon taxes at the subnational level: in **San Luis Potosí** in 2024 and in **Colima**, **Mexico City** and **Morelos** in 2025 (World Bank Carbon Pricing Dashboard, 2025[47]).

- **Carbon tax rate increases took place in a number of countries, including:**

  - **Denmark** is strengthening its carbon tax on industry from 2025 by adding a new carbon tax to apply to EU ETS-covered installations. It has also planned to increase its existing carbon tax rate on fuels by 400%;[1]

  - in 2025, **Iceland** raised its carbon tax rate by 59% (OECD, 2025[10]);

  - in **Ireland** the carbon tax rate on natural gas and solid fuels is legislated to increase from EUR 56 to EUR 63.50/tCO_2 in May 2025 (Houses of the Oireachtas, 2025[48]);

  - in **Norway**, carbon taxes on emissions from non-ETS sectors and the offshore petroleum industry increased by 16% (OECD, 2025[10]);

- in **Slovenia** the headline carbon tax rate rose from EUR 17.3 to EUR 30.85/tCO_2 in September 2024 (OECD, 2025[49]);

- following its pre-determined trajectory, the carbon tax rate in **South Africa** increased from ZAR 159 to ZAR 190 in 2024 and ZAR 236/tCO_2e in 2025 (National Treasury Republic of South Africa, 2024[50]);

- **One ETS and a few carbon taxes have been cancelled or put on hold in Canada and the Dutch Parliament voted to abolish Netherland's national CO_2 levy:**

- In April 2025, Saskatchewan's Output-Based Performance Standards program was paused[2] and the British Columbia government cancelled the carbon tax[3] by introducing legislation to drop the rate to CAD 0. The Northwest Territories took steps to effectively remove its territorial carbon tax on most users as of April 2025.[4] In Canada, the government has made regulations that cease the application of the federal fuel charge effective 1 April 2025 and introduced legislation in June 2025 which would formally remove the federal fuel charge (Department of Finance Canada, 2025[51]) (Parliament of Canada, 2025).

- In June 2025, a majority of the Dutch Parliament voted in favour of a motion to abolish the national CO_2 levy (Carbon Pulse, 2025[52]).

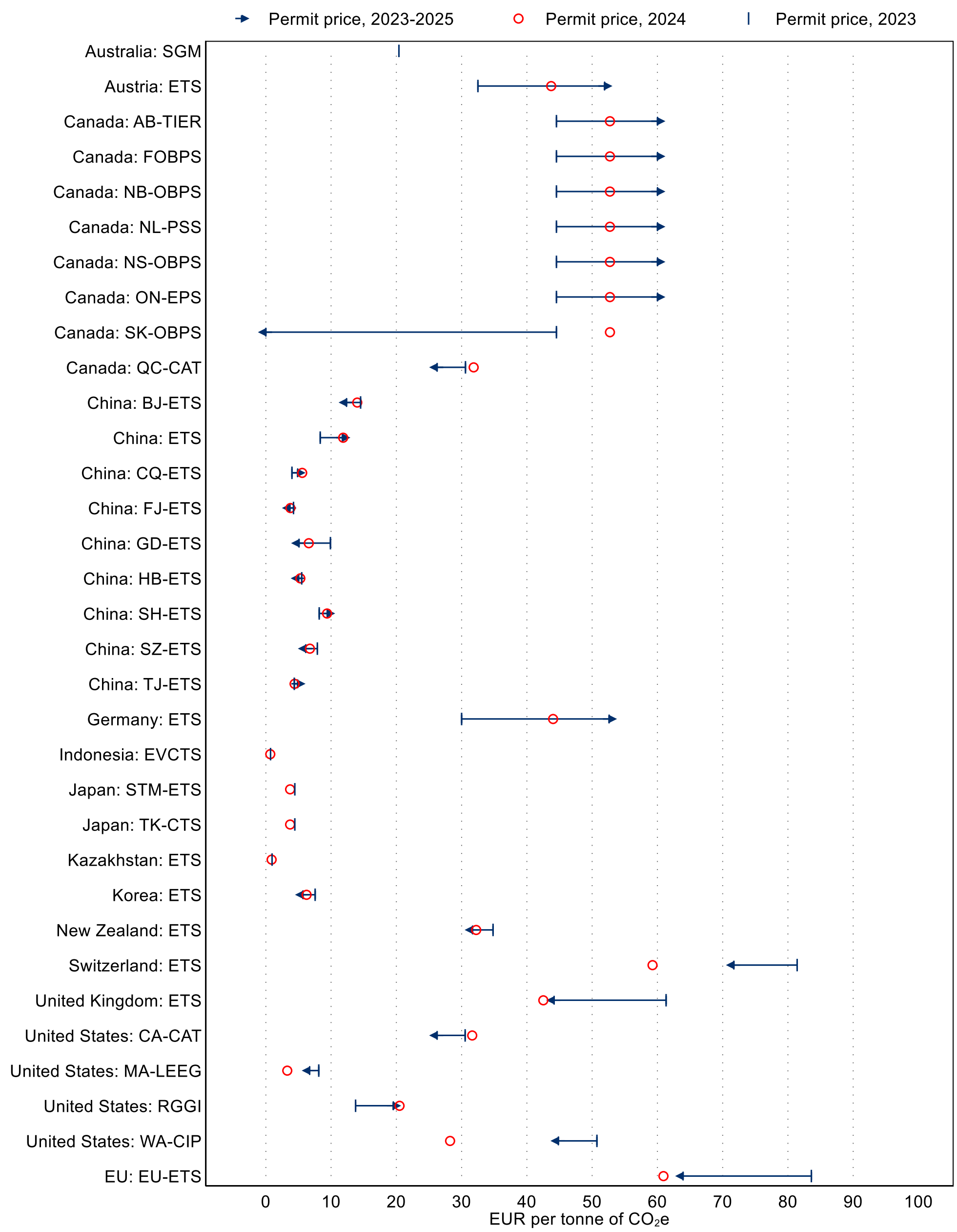
Notes: Introductions and changes presented amongst the 79 countries covered in the report.
1. "Danish Parliament introduces CO2 tax on fuels and CO2-emission tax on industry from 2025" (6 August 2024), https://www.ey.com/en_gl/technical/tax-alerts/danish-parliament-introduces-co2-tax-on-fuels-and-co2-emission-tax-on-industry-from-2025, as accessed on 22/06/2025.
2. "Saskatchewan is the First Province in Canada to be Carbon Tax Free" (27 March 2025), https://www.saskatchewan.ca/government/news-and-media/2025/march/27/saskatchewan-is-the-first-province-in-canada-to-be-carbon-tax-free, as accessed on 22 June 2025.
3. "B.C. eliminates carbon tax" (31 March 2025), https://news.gov.bc.ca/releases/2025FIN0014-000280, as accessed on 22 June 2025.
4. https://www.gov.nt.ca/en/newsroom/gnwt-ending-nwt-carbon-tax-most-users-april-1, as accessed on 23 October 2025.

While ETS reforms generally directly translate into changes in Effective Carbon Rates, carbon tax reforms (e.g. their introduction or a change in rate) should generally be considered simultaneously with fuel excise tax changes to understand their impact on Effective Carbon Rates. Indeed, reforms in carbon taxes are often accompanied by simultaneous changes in fuel excise tax rates, especially in the cases where the carbon taxes are fuel-based (i.e. in a majority of cases). For instance, in Slovenia, the increase in the headline carbon tax rate in 2024 came along with a decrease in fuel excise tax rates.[5] In Denmark, the planned reform to increase the existing carbon tax rate on fuels by 400% would also include cutting the existing excise duty on fuels in half.[6] In France, when the carbon component was introduced to fuel excise taxes in 2014, it initially did not affect the total rate[7] (i.e. fuel excise tax rates decreased) – in subsequent years, when the carbon component rate increased the total tax rate did however increase. Hence, the estimates below only consider the impact of the main ETS changes in permit prices up until June 2025 and expected main changes in coverage (those listed in Box 3.1).

Over the 2023-2025 period, prices (expressed in constant 2023 EUR/tCO_2) have increased in about half of ETSs (Figure 3.2). There are three cases where permit prices follow a pre-determined increasing price path: in all Canadian systems other than Québec, in Austria and in Germany. In Canada, the price went from CAD 65 in 2023 to 80 in 2024 to 95/tCO_2e in 2025. In Austria and Germany, it went from EUR 32.5 (resp. 30) in 2023 to 45 in 2024 to 55/tCO_2 in 2025. However, due to inflation, this does not necessarily imply increased permit prices when expressed in constant 2023 EUR/tCO_2. In the rest, year-on-year changes in average permit prices were positive in less than half of the systems for which information is available. Overall, when accounting for inflation and exchange rates, the average permit price across all ETSs in place in 2023 was stable, from 20.2 in 2023 to 20.7 in 2025, all in 2023 EUR/tCO_2 (Table 3.1).

Figure 3.2. Evolution of permit prices across ETSs between 2023 and 2025

In 2023 EUR/tCO_2e.



Note: Permit prices from the primary market when available, else from the secondary market (see Annex B for more detail on permit price sources). Permit prices do not account for free allocation. Data are sorted by country and system alphabetical order, with supranational systems appearing last.

StatLink https://stat.link/tvl5fq

Table 3.1. Estimated evolution of coverage and average permit prices in ETSs between 2023 and 2025

79 countries

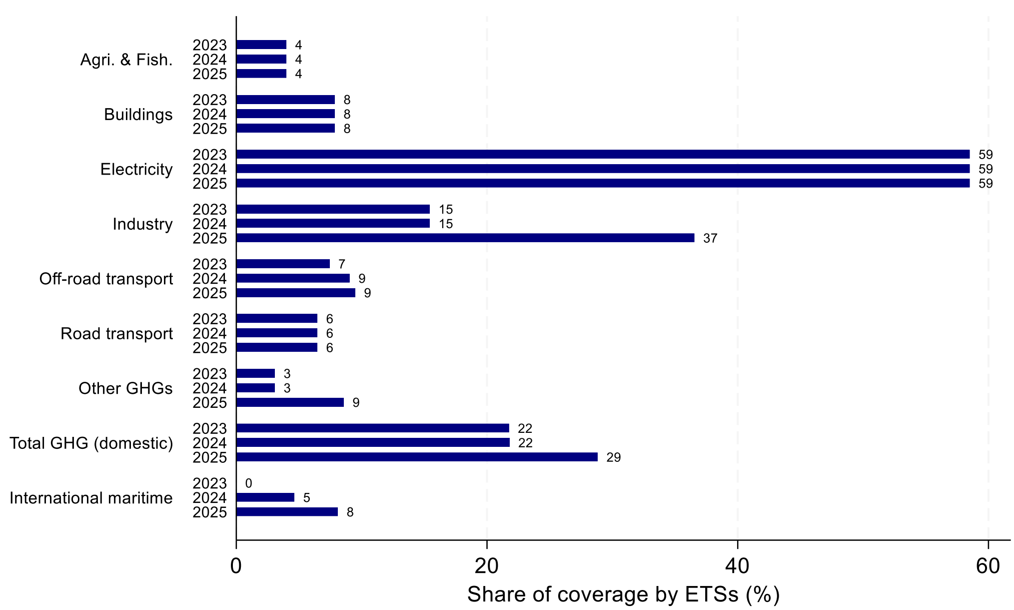
	Coverage by component (percentage of total GHG emissions in CO_2e)			Average permit price (in constant 2023 EUR/tCO_2e)		
	2023	2024	2025	2023	2024	2025
Emissions Trading System	21.8%	21.82%	29%	20.19	20.22	20.70

Note: Permit prices and tax rates were converted into (constant) 2023 EUR using the latest available OECD exchange rate and inflation data. The share of emissions covered are all calculated with respect to the same GHG emissions base (that for 2023 used in this report).

Between 2023 and 2025, ETS coverage has increased most in industry. For the Chinese national ETS, newly covered industrial facilities received free allowances equal to their verified emissions in 2024 (ICAP, 2025[3]), so for 2024 the extension is modelled as a reporting obligation with no carbon pricing coverage. From 2025, free allowances were allocated based on output-based benchmarking (hence providing a marginal incentive to reduce emissions), so it is assumed that the aluminium, cement and iron and steel sectors started being priced in 2025 by the Chinese national ETS, potentially inducing a change in coverage of CO_2 emissions from energy use in industry from 15% to 37%. This change, combined with the extension of the EU ETS to cover maritime emissions (both domestic and international), could induce a change in coverage by ETSs of domestic GHG emissions in the 79 countries studied in this report from 22% to 29%. International maritime emissions could see their coverage by ETS pricing increase by 8 percentage points.

Figure 3.3. Evolution in coverage from ETSs across sectors between 2023 and 2025

International maritime emissions and 79 countries' territorial emissions



Note: Modelling based on changes in coverage of the Chinese national ETS and the EU ETS, keeping the GHG emissions base constant. Agri. & Fish.: agriculture and fisheries.

StatLink https://stat.link/prg362

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Notes

[1] Carbon Removals and Carbon Farming (CRCF) Regulation (EU/2024/3012).

[2] The revision of the Swiss CO2 Act partially provides the legal framework for this gradual phase-out (Swiss Federal Authorities, 2025[53]).

[3] The EU ETS2 will cover buildings, road transport and additional sectors and is to become fully operational in become fully operational in 2027 (European Commission, n.d.[54]).

[4] Parties also adopted decisions related to non-market-based co-operation under Article 6.8, which are not further discussed in this paper.

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4 Emissions trading systems: A variety of designs

ETSs are gaining momentum, and design choices vary regarding the nature of the cap, the method of free allowance allocation (section 4.1) and the compliance possibilities (including the use of carbon credits) (section 4.2). Some design choices provide more flexibility to firms and can help ease competitiveness and affordability issues. For instance, output-based free allowance allocation methods provide flexibility on production levels; the use of carbon credits for compliance provides sectoral and geographical flexibility, while the possibility to borrow or bank permits provides temporal flexibility. Different designs could reflect national circumstances and priorities but may require coordination to ensure interoperability for linking (Verde et al., 2022[1]; Galdi et al., 2022[2]) or for recognition of carbon pricing policies or prices.[1]

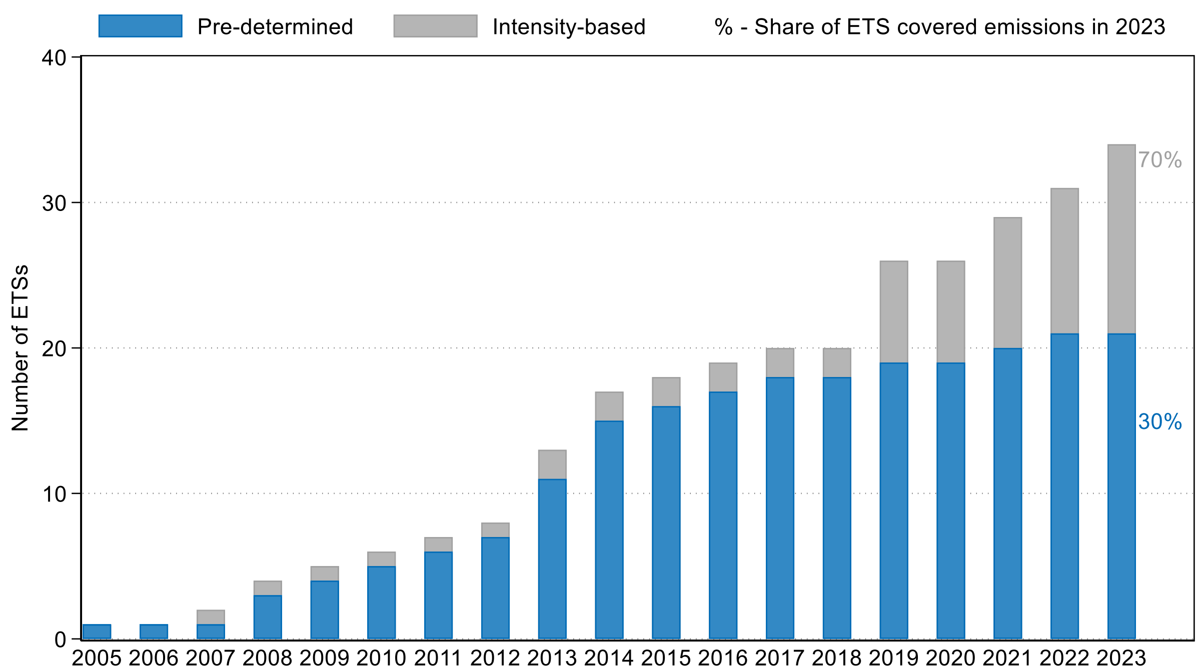
4.1. ETS caps and free allowance allocation setting

ETSs may be distinguished according to whether they set a pre-determined cap on covered emissions (as in cap-and-trade systems) or not (as in intensity-based systems). When the cap is pre-determined[2] the total quantity of allowable emissions for each compliance period is fixed.[3] This is the case of cap-and-trade systems, in which case the cap is set as an overall emission limit at the system level – e.g. the EU ETS. It can also be the case of baseline-and-credit systems with pre-determined baselines, in which case the cap may be calculated as the sum of installation-level emissions limits across covered facilities – e.g. the Tokyo Cap-and-Trade system. Intensity-based systems[4] do not set a limit on emissions; rather, covered emissions are allowed to vary with production and the limit implicitly applies to emission intensities. Intensity-based systems are baseline-and-credit systems where the main allocation of allowances[5] method depends on output-based benchmarking. This implies the reliance on emission intensity factors (a benchmark which may be country-, sector- or emitter-specific) and entities' current year's production (Fischer, Qu and Goulder, 2024[3]): hence, to reduce their average carbon costs, covered entities need not adjust their production as long as the emission intensity of their production is below that set by the benchmark. By, in effect, easing constraints on production (Fischer, 2001[4]), this design can help support the competitiveness of industry. However, intensity-based systems generally do not provide certainty on the total level of emissions covered by the system.

The emissions trading systems introduced in recent years have shifted away from having a pre-determined cap and are now increasingly intensity-based (Figure 4.1). Starting in 2005 with the introduction of the EU ETS, there has been a steady increase in the number of ETSs. Up until 2018, the majority of new ETSs have a pre-determined cap. The year 2019 marks the introduction of several Canadian province or territory-level ETSs, all intensity-based. The majority of ETSs introduced since then have been intensity-based – these include the Chinese national ETS, the Australian Safeguard Mechanism and the Indonesian Economic Value of Carbon Trading Scheme (Figure 4.1). In 2023, the majority (70%) of GHG emissions covered by an ETS are covered by intensity-based ETSs (Figure 4.1) – an effect mainly driven by the Chinese national ETS being intensity-based.

Figure 4.1. Evolution of cap setting in ETSs

Number of ETSs with pre-determined caps and intensity-based ETSs over the years



Note: In 2023, systems with pre-determined caps include: most Chinese Pilot ETSs (Fujian, Guangdong, Hubei, Shanghai, Shenzhen, Tianjin), the EU ETS, the German national ETS, the Japanese subnational ETSs (Saitama Target Setting ETS and Tokyo Cap-and-Trade System), the Kazakhstan ETS, the Korean Emissions Trading System, the Mexico national ETS, the New Zealand ETS, the Québec Cap-and-Trade system, the Swiss ETS, the UK ETS, all US subnational ETSs (California Cap-and-Trade, RGGI, Massachusetts Limits on Emissions from Electricity Generators, Washington Cap-and-Invest). The Austrian national ETS is also classified in this category: while it currently operates as a hybrid system, it is in the process of transitioning to the EU ETS2, at which point it would be classified as a cap-and-trade system (i.e. an ETS with a pre-determined cap).
Intensity-based systems include: the Australia Safeguard Mechanism, the Canada Alberta Technology Innovation and Emissions Reduction (TIER) Regulation, the Canada Federal Output-Based Pricing System (FOBPS), the Canada New Brunswick Output-Based Pricing System, the Canada Newfoundland and Labrador Performance Standards System (PSS), the Canada Nova Scotia Output-Based Pricing System for Industry, the Canada Ontario Emissions Performance Standards (EPS), the Canada Saskatchewan Output-Based Performance Standards, the China National Emissions Trading System, the Beijing and Chongqing Pilot ETSs and Indonesia's Economic Value of Carbon (Nilai Ekonomi Karbon) Trading Scheme.
Source: International Carbon Action Partnership Status Reports (ICAP, n.d.[5]), complemented by authors' desk research.

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Systems may transition from one regime to another. For example, the Chinese national ETS is expected to include non-binding control targets on total covered emissions and eventually transition to a cap-and-trade system by 2030 (Carbon Pulse, 2024[6]; General Office of the State Council, 2024[7]; Carbon Pulse, 2025[8]). The Chongqing Pilot ETS, on the other hand, transitioned to an intensity-based system in 2021 (from a cap-and-trade system from 2014 to 2020).

Emission allowances may be freely allocated following different methods, with grandparenting or benchmarking being the most common. In many cases, ETSs may use a mix of methods. The first approach relies on historical emission levels, while the second depends on production levels and emission intensity factors. With cap-and-trade systems, grandparenting tends to be found more frequently in earlier phases of ETSs, with a move to benchmarking as the system evolves (Kuneman et al., 2022[9]). Moreover, some ETSs use both – for instance, the California Cap-and-Trade Program uses output-based benchmarking for industrial facilities, while it uses grandparenting for natural gas suppliers. Annex B provides more details on free allowance allocation methods across ETSs.

Box 4.1. Free allowance allocation setting

Emissions allowances may be freely allocated using grandparenting or benchmarking – with benchmarking being based on either past production or production in the current year (output-based benchmarking). There are a few cases where free allowances are allocated ex-post and are set equal to verified emissions (see examples in Annex B – this can be interpreted as these emissions facing reporting obligations but no carbon price.

Grandparenting and benchmarking approaches

The formulas for free allowance allocation under the grandparenting and benchmarking methods are of the following form:

Grandfathering: past emissions x adjustment factors

Benchmarking: production x emissions intensity [benchmark] x adjustment factors

Historically, free allowances based on benchmarking have been calculated using production in previous years, but output-based benchmarking now uses current year production data.

Adjustment factors

Adjustment factors may be included in the above formulas for various purposes:

- Factors related to the risk of carbon leakage: this risk is generally assessed using the emission-intensity and trade-exposure (EITE) of sectors. The factor may be based on a binary assessment with all activities above a threshold of leakage risk having a factor of a 100% (e.g. the EU ETS in Phase 3) or based on a tiered assessment, with the application of what is commonly referred to as an assistance factor for different levels of emissions intensity and trade exposure (e.g. New Zealand, Québec).
- Factors related to the decrease in the cap: such factors are used to bring allowance allocation in line with the general cap decline trajectory (e.g. in California).
- Factors related to the decrease in the benchmark: such factors are used to bring allowance allocation in line with the general emissions intensity decline trajectory (e.g. in many Canadian systems).
- Adjustment factors may also be used to stick with a pre-determined cap when multiple allocation methods are used. This is the case in California for instance, where allocations for the industry are output-based and are adjusted if the total sum of freely allocated allowances exceeds the pre-determined cap.

Incentives provided by different approaches

Free allowances can affect economic rents and thus influence investment decisions, but the different methods also have different impacts on the channels through which marginal abatement incentives operate. Grandparenting and benchmarking based on past production levels provide marginal abatement incentives both to reduce the emission intensity of production as well as production (the product of both being equal to covered entities' emissions). Output-based benchmarking, however, only provides an incentive to reduce the emission intensity of production.

In terms of investment, regarding grandparenting, setting the base year not too far back in time enables emissions estimations used to calculate allocation amounts to be more in line with current technologies and abatement opportunities. At the same time, setting the base year or period sufficiently back in time can avoid providing incentives to firms to increase emissions before the implementation of the ETS so as to increase the allocation they receive (OECD, 2023[10]).

The benchmarks used in benchmarking methods can impact investment incentives (Flues and van Dender, 2017[11]; Kuneman et al., 2022[9]). In particular, the more granular benchmarks are, the narrower the range of abatement options they promote: tying them to specific fuels, processes, or technologies can distort incentives to adopt the most cost-efficient means of achieving emissions reductions.

Finally, there are also cases where free allowances may not be traded. If they can then be used for compliance, this can be interpreted as the marginal price signal not being maintained, since there is no incentive to reduce emissions below the allowance allocation (since they cannot be sold). If they should be used for other purposes than compliance (e.g. redistribution) then this can be interpretated as both the marginal and average price signals being equal (the free allowance allocation does not directly reduce the ETS-related costs for firms).

Source: Authors based on ICAP (2025[12]), ETS legislations and announcements, and Kuneman et al. (2022[9]).

Intensity-based systems may also require total covered emissions to decline and may not entirely rely on output-based benchmarking. This is the case for instance of the Australia Safeguard Mechanism[6] (Australian Government DCCEEW, n.d.[13]). Intensity-based systems also do not necessarily entirely rely on output-based benchmarking: for instance, the Beijing and Chongqing Pilot ETSs, which are intensity-based, partly distribute allowances according to grandparenting and benchmarking based on past years' production values.

There is a rising practice of accounting for current production levels in free allowance allocation methods, even in cap-and-trade systems. Output-based benchmarking is not exclusively used in intensity-based systems as it also appears in some cap-and-trade systems. This was historically the case in the California cap-and-trade system for covered entities in the industry sector (see example in Box 4.1). More recently the Kazakhstan ETS has started relying on this method as well (operating a shift from free allowance allocation based on grandparenting). Free allowance allocation in the EU ETS now also accounts to some extent for current production levels: revised rules applying from Phase 4 onwards include adjustments to free allocation when an installation makes a significant change to its production (at least a 15% increase or decrease in production) (European Commission, n.d.[14]). Such a provision has also been included in the UK ETS.

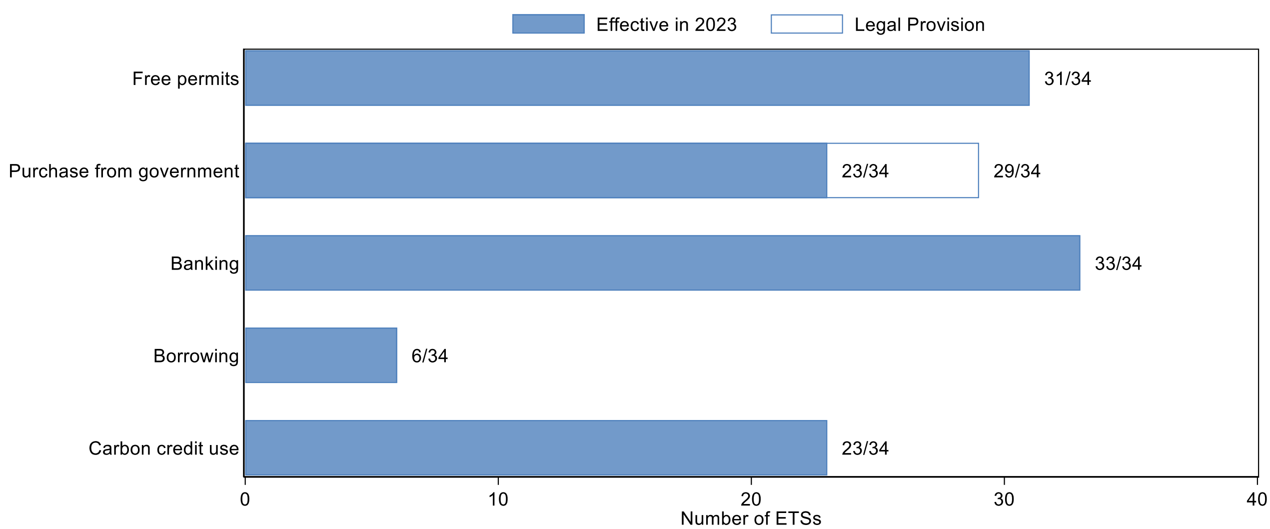
Auctioning or fixed price selling of allowances may complement the allocation of free permits, both in systems with pre-determined caps and intensity-based systems. Cap-and-trade systems generally sell allowances at auctions, while intensity-based systems, when they sell allowances, do so at a fixed price in many cases.[7] As the adjustment factors used in the allocation of free allowances across systems decline (Box 4.1), entities covered by ETSs may need to increasingly rely on the purchase of permits for compliance. Section 4.2 delves deeper into the use of auctioning or fixed price funds as one of the compliance options across systems.

4.2. Compliance options

4.2.1. Different compliance options

Entities covered by an ETS have a variety of compliance options to cover their verified emissions, which can help provide flexibility.[8] These include the use of permits received for free, of permits purchased from other entities (trading) and of permits purchased from the government, the use of banking and borrowing and the use of carbon credits (Figure 4.2).

Figure 4.2. Compliance options in ETSs



Note: Some systems may allow for auctioning to take place in the legislation, but in effect no auction may take place in a given year. This is the case, for instance, of some Chinese Pilot ETSs, where auctioning takes place on an ad-hoc basis.
Source: ICAP (2025[12]) complemented by authors' own desk research.

StatLink https://stat.link/984n6o

The possibility of trading is what defines an ETS. For instance, the Australian Safeguard Mechanism, which had been in place since 2016, introduced tradeable permits in its system in July 2023, which has thus classified it as an ETS. Allowing trade, however, does not necessarily entail that it takes place on a large scale. In many systems, trade is limited.

Free permits are available in almost all ETSs. Only four ETSs do not allocate permits for free (see Annex B for more detail) – these concern ETSs covering the power sector or ETSs applying exclusively upstream (mainly to the road and heating sectors).[9] Permits may be distributed according to different rules (section 4.1), and while they may not impact marginal abatement incentives, they can impact rents and investment incentives (OECD, 2023[10]; Flues and van Dender, 2017[11]).

Permits may be purchased from government auctions or from fixed price funds in a majority of ETSs. While there are provisions for auctions in 28 systems, these are not systematically offered – in 2023, auctions were offered in only 22 systems. Alternatively, the government can also sell permits at a fixed price (instead of prices being determined by the outcome of auctions). For instance, the purchase of permits at a fixed price from government funds is an option for all Canadian intensity-based ETSs.

Banking and borrowing enable temporal flexibility within ETSs – and while banking is typically allowed in ETSs, borrowing is seldom an option (ICAP, 2023[15]). Banking refers to an entity using permits from previous compliance periods (i.e. banked permits), while borrowing refers to borrowing permits that the entity expects to receive for free in future periods. Banking unused permits from one compliance period for use in future periods can be used to meet own compliance obligations or to sell to other market participants. By allowing entities to carry forward unused allowances, banking can incentivise early emissions reductions. Banking is allowed in most ETSs, albeit with limits in time and quantity. Borrowing could help facilitate investment choices by providing flexibility in timing, but could also be seen as delaying the emission reductions needed to achieve the ETS's objectives. Most ETSs do not allow borrowing, and when they do, they only allow it to a limited extent.

Offsetting through the use of carbon credits[10] offers entities covered by ETSs the possibility to cover their compliance obligations by purchasing credits generated by emission reduction and GHG removal projects undertaken outside the scope of the ETS – and present a widespread compliance option among ETSs (La Hoz Theuer et al., 2023[16]). Carbon credit use is allowed in more than 60% of ETSs, generally with restrictions on quantity (what share of compliance obligations can be met through carbon credits) as well as on quality (which criteria these credits should fulfil). This is further discussed in section 4.2.2. Reduction and removal credits generated within an ETS's scope are not considered carbon credits in this report (in line with the definition provided in e.g. La Hoz Theuer et al. (2023[16])). For instance, the New Zealand ETS includes forestry and some other removal activities[11] within the scope of the ETS, so that entities generating emissions can trade with entities removing emissions within the scope of the ETS. As discussed in section 3.1.2, the interaction of GHG removal credits with ETSs is increasingly being considered by jurisdictions – and different options are available for that (see extensive discussion in La Hoz Theuer et al. (2021[17])).

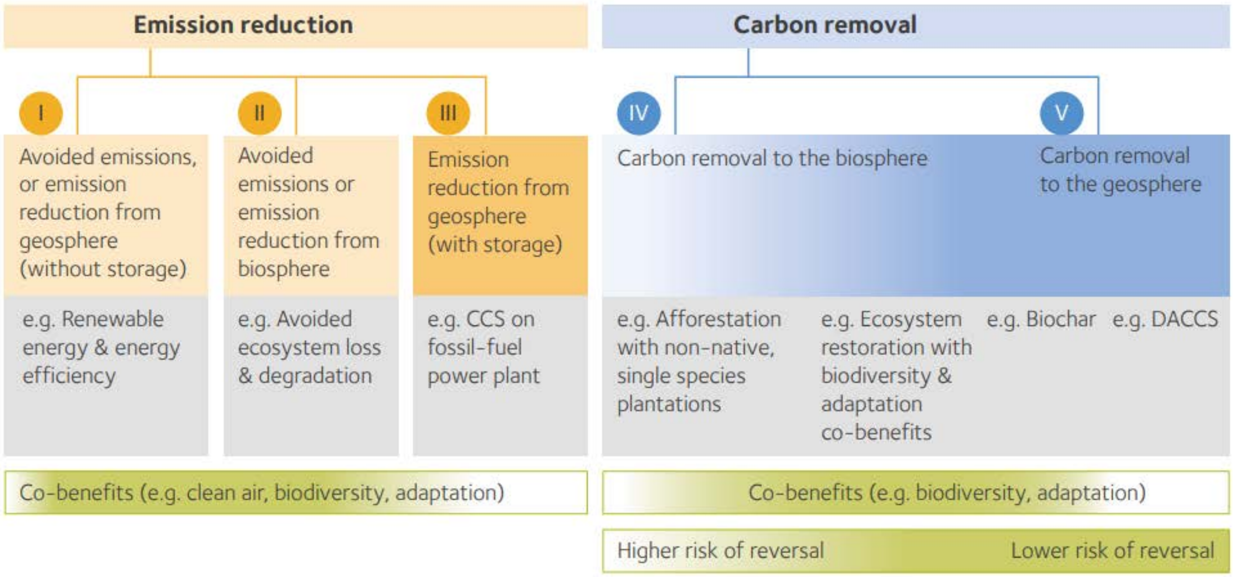
4.2.2. Carbon credit use in ETSs[12]

Carbon credits can be generated from emissions reduction and GHG removal projects (Figure 4.3, Allen et al. (2024[18]), La Hoz Theuer et al. (2023[16])). GHG emission reduction credits are generated by activities that reduce the amount of GHG emissions that enter the atmosphere, compared to a baseline scenario of how large emissions would have been in the absence of the credit-generating activity. This includes the deployment of renewable energy (e.g. solar, wind), programmes to deploy energy-efficient cookstoves, the capture and utilisation of methane from landfills and the destruction of ozone depleting substances with very high global warming potential.

GHG removal relates to taking GHGs from the atmosphere. This includes nature-based solutions (e.g. sequestering carbon through afforestation or reforestation) and technology-based solutions (e.g. bioenergy with carbon capture and storage (BECCS), direct air capture with geological storage (DACCS), converting atmospheric carbon back into rock through remineralisation). These latter negative emissions technologies (NET) have an important role to play in reaching net zero emissions, both by removing residual emissions (e.g. emissions that may be too difficult, too costly, or impossible to abate in the time required) and in scenarios with an overshoot in emissions – i.e. scenarios where the GHG emissions consistent with the 1.5°C or 2°C goals of the Paris Agreement are exceeded (La Hoz Theuer et al., 2021[17]; Intergovernmental Panel on Climate Change, 2021[19]). This may help explain their increasing consideration for inclusion in carbon pricing schemes, either through carbon credit use or through the inclusion of removal activities within the scope of the schemes.

The use of carbon credits for compliance diversifies the sources of ETS compliance. Diversifying the sources of compliance can be especially important in jurisdictions or sectors where abatement opportunities are narrowing, with implications for compliance costs and ETS functioning, due to declining liquidity. Moreover, allowing for the purchase of credits from emission reduction or GHG removal projects can provide incentives for their development. This can help also stimulate mitigation in sectors that may be harder to price – e.g. Agriculture, forestry and other land use, AFOLU, especially in countries where a large share of domestic emissions come from those sectors.

Figure 4.3. A taxonomy of carbon credits



Note: CCS: Carbon Capture and Storage
DACCS: Direct Air Capture with Geological Storage
Source: The Oxford Principles for Net Zero Aligned Carbon Offsetting (revised 2024) (Allen et al., 2024[18]).

To help ensure effective emission abatement incentives and environmental integrity, carbon credit use for compliance in ETSs is typically subject to both quantitative and qualitative limits. Since the use of carbon credits reduces the requirement on regulated entities to reduce their own emissions, careful attention should be paid by regulators to the (i) quantity of credits that can be used and (ii) qualitative criteria for eligible carbon credits. In particular, quantitative limits can be placed to ensure regulated entities' incentives to reduce on-site emissions are maintained.

Qualitative criteria may be introduced to ensure the environmental integrity of carbon credits.[13] Environmental integrity encompasses several elements, such as additionality, permanence and quantification of impacts (La Hoz Theuer et al., 2023[16]; Wetterberg, Ellis and Schneider, 2024[20]). Additionality refers to the requirement that mitigation activities should only generate credits if they would not have occurred in the absence of the added incentive created by such credits.[14] Permanence refers to ensuring that emission reductions or GHG removals of the project will not be reversed (e.g. in the case of forest-related projects) or that the project is accompanied with a way to mitigate and compensate for potential reversals. Finally, emission reductions should be conservatively quantified – i.e. more likely to be underestimated than overestimated.

In most ETSs, carbon credits used for compliance should fulfil qualitative criteria, related to the projects' location. Most ETSs allow for "domestic carbon credits" – referring to credits generated from projects within the geographical boundaries of the country in which the ETS operates (or that of a linked ETS) – while the use of "international carbon credits" originating from projects outside of the ETS is currently only allowed in the Korean ETS[15] (ICAP, 2025[12]). In the case of Korea, a restricted set of international carbon credits may be used for compliance (with criteria related *inter alia* to the type of projects and their ownership). Criteria related to the location of projects may go beyond the domestic versus international dichotomy: for instance, in the Chongqing Pilot ETS, at least 80% of the credits used must be generated by projects within Chongqing city. The Alberta TIER only allows Alberta-based emissions carbon credits.

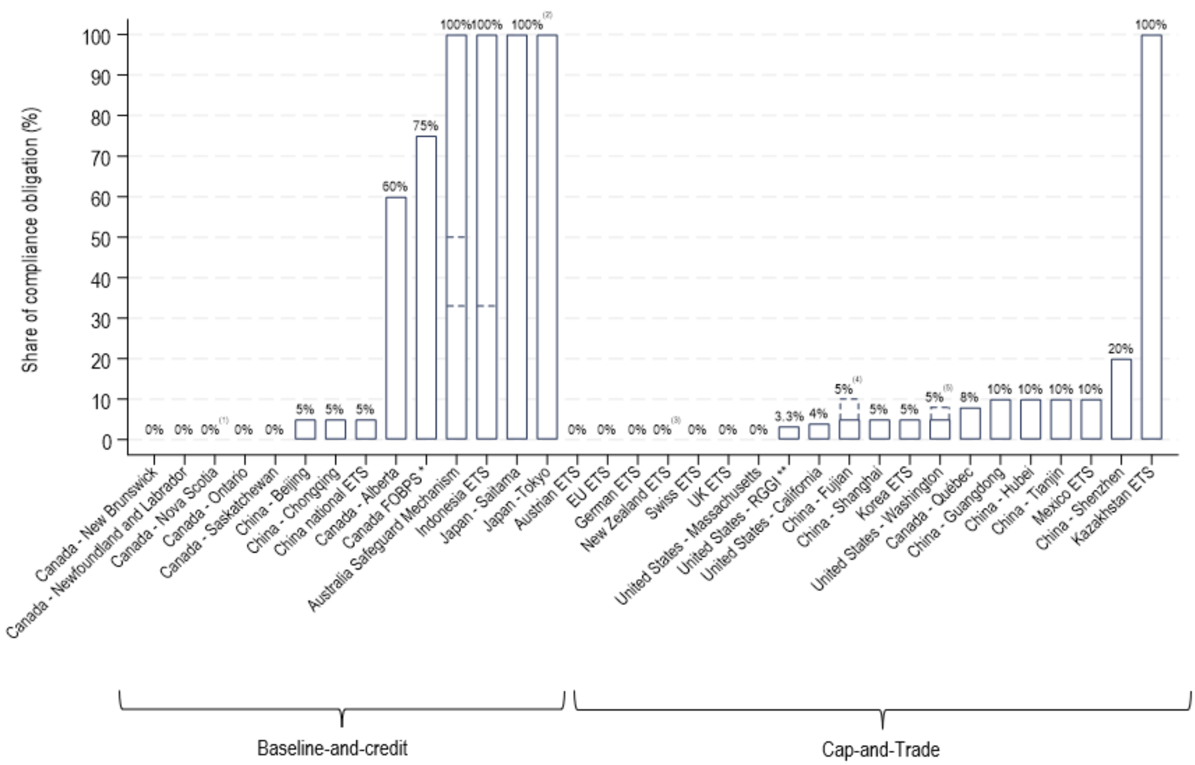
Many ETSs place other qualitative restrictions, including on the nature of the projects generating credits or the types of credits allowed for. For example, for the Québec Cap-and-Trade System, a new regulatory framework allows four carbon credit-generating activities: reclamation and destruction of methane from landfill sites, destruction of certain halocarbons contained in insulating foam from refrigeration, freezer or air-conditioning equipment,[16] carbon sequestration through afforestation or reforestation on private lands and anaerobic digestion of manure. Finally, many ETSs only allow the use of credits from specific crediting mechanisms – e.g. Australian Carbon Credit Units (ACCUs) for the Australian Safeguard Mechanism, credits from the Chinese Certified Emissions Reduction scheme (CCER) for the Chinese national ETS – these are generally governmental crediting mechanisms (Wetterberg, Lanzi and Gómez, 2025[21]).[17]

Almost all ETSs that allow for the use of carbon credits for compliance place a limit on the quantity which can be used. Across ETSs, when allowed, carbon credits can be used in a range between 3.3% and 100% of compliance obligations[18] (Figure 4.4), though compliance obligations may be defined differently for baseline-and-credit systems and for cap-and-trade systems. Even in systems where no limit is placed on the quantity of carbon credits that may be used for compliance, their use beyond a limit may need to be justified. For instance, in the Australian Safeguard Mechanism, entities surrendering ACCUs equivalent to 30% or more of their baselines are required to provide a statement explaining why they have not undertaken more on-site abatement activities (Australian Government Clean Energy Regulator, 2025[22]). In some ETSs, a limit on the share of carbon credits used for compliance by entities is complemented by a cap on the total quantity of carbon credits which can be used at the system-level. This is for instance the case of the Guangdong Pilot ETS, where 10% of covered entities' annual emissions can be covered by carbon credits and where a limit is also set on the total amount of carbon credits which can be used for compliance in a year: in 2021 and 2022, this amounted to one million carbon credits (ICAP, 2025[12]).

In some ETSs, the quantitative limit is linked with the qualitative criteria carbon credits should fulfil. This may relate to the type of credits used. For instance, in the Fujian Pilot ETS, the use of both domestic (Chinese) project-based carbon credits (CCERs) and Fujian Forestry Certified Emission Reduction credits (FFCERs) is allowed. 5% of the annual compliance obligation may be met through CCERs, while this limit is increased to 10% for entities that use both CCERs and FFCER. This may also relate to the type of project which generated the credit or the location of the project. Both the Saitama Prefecture Target Setting ETS and the Tokyo Cap-and-Trade Program place limits on carbon credits not generated within the respective prefectures: for instance, for Saitama, outside Saitama credits can be used for compliance for up to one-third of offices' reduction obligations and to 50% for factories. For instance, the Washington Cap-and-Invest Program places a limit of 5% of an entity's compliance obligations for projects not located on federally recognised tribal land and an additional 3% from projects located on federally recognised tribal land.

Figure 4.4. Shares of carbon credits allowed for compliance in ETSs

2023



Note: This figure aims at highlighting that most systems place quantitative limits on the use of carbon credits, but the shares displayed may not be comparable since the limits relate to "compliance obligations" defined in different ways. This may either relate to an entity's total verified emissions (e.g. the Québec Cap-and-Trade system) or to an entity's difference between verified emissions and free allowance allocation (e.g. the Canada FOBPS). In some restricted cases, these are shares of an entity's free allowance volume (e.g. the Hubei Pilot ETS).

(1) In Nova Scotia, regulations contain provisions for the potential use of carbon credits, but carbon credits are currently not enabled in the system.

(2) For the Saitama Prefecture Target Setting ETS (resp. Tokyo Cap-and-Trade Program), quantitative limits apply only for outside Saitama (resp. Tokyo) credits. These credits can be used for compliance for up to one-third of offices' compliance obligations (and in Saitama factories can use up to 50%).

(3) Note that while carbon credits generated from activities undertaken outside the scope of the ETS are not allowed in the New Zealand ETS (NZ ETS), New Zealand Units (NZUs) generated from NZ ETS removal activities can be used for compliance. No limit applies on their use and they can be banked indefinitely.

(4) For the Fujian Pilot ETS, the 5% limit applies if using only CCERs; the limit is increased to 10% for companies that use both FFCER and CCER carbon credits.

(5) For the Washington Cap-and-Invest Program, the 5% limit applies to projects not located on federally recognised tribal land and an additional 3% can be used for projects located on federally recognised tribal land.

* Over the course of 2023, the federal OBPS was operational in Manitoba, Nunavut, Prince Edward Island and Yukon.

** RGGI (Regional Greenhouse Gas Initiative): in 2023, it operates with ten the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, Vermont and Virginia.

Source: ICAP (2025[12]) complemented by authors' own desk research.

StatLink https://stat.link/pq6x5z

In many ETSs, the quantitative limit on the use of carbon credits is, in effect, not reached. This can relate to many factors, including free allowance overallocation (Dechezleprêtre, Nachtigall and Venmans, 2018[23]) implying a reduced need for further compliance options, low supply of eligible credits or carbon credit prices being higher than primary and secondary ETS market prices (e.g. in Kazakhstan where secondary market prices are currently lower than EUR 1/tCO_2). While data is not always available, where it is, it displays a lower use of carbon credits than what is allowed for (Table 4.1).

Table 4.1. Carbon credit use and prices in a selection of ETSs

Emissions Trading System	Share of compliance obligation met through the use of carbon credits	Price
Alberta TIER	2023: 35.8%	N/A
Australia Safeguard Mechanism	2023-2024: 83.5%	Volume-weighted average spot prices: AUD 25 - 40 in 2023, and AUD 32 - 40 in 2024
California Cap-and-Trade Program	2021-2023 compliance period: 3.1%	N/A
Canada FOBPS	2021: 0.33%	N/A
Kazakhstan ETS	2023: 0%	N/A
Korea ETS	2022: 1.3%; 2023: 0.1%	In July 2025: KCU24 and KCU25 prices are of KRW 9000
Québec Cap-and-Trade System	2021-2023 compliance period: 7.7%	CAD 28.19
RGGI	To date, only one project has been approved under RGGI (in 2017)	N/A
Tokyo Cap-and-Trade Program	2023: Very limited	JPY 5 600 - 5 650 (for renewable energy credits)
Washington Cap-and-Invest Program	2023: 0.13%	N/A

Note: RGGI: Regional Greenhouse Gas Initiative; KCU: Korean Credit Unit.
Source: Canada FOBPS: Table 10 in Government of Canada (2022[24]); Alberta TIER: Alberta Government (2024[25]); Québec Cap-and-Trade: Québec Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs (2025[26]); Tokyo Cap-and-Trade: Mizuho Research & Technologies, Ltd. (2024[27]); Kazakhstan ETS: ICAP (2025[12]); Korea ETS: ICAP (2024[28]; 2025[12]), KRX (2025[29]); California Cap-and-Trade: California Air Resources Board (California Air Resources Board, 2025[30]); RGGI: ICAP (2025[12]); Washington Cap-and-Invest: Department of Ecology - State of Washington (2024[31]); Australia Safeguard Mechanism: Australian Government Clean Energy Regulator (2025[32]).

Carbon credit prices typically depend on the type of projects they come from. While price data on ETS-eligible carbon credits is limited, prices in other market segments suggest that carbon credit prices differ by project type. Exchange-traded prices differ by project type; they are higher for removal projects as compared to reduction projects – and within reduction projects they are highest for nature-based projects. In April 2025, reduction projects traded between USD 1/tCO_2e for renewable energy projects and USD 5.3/tCO_2e for nature-based projects (World Bank, 2025[33]). Estimated over-the-counter prices of carbon credits related to carbon dioxide removal (CDR) projects are higher than those of reduction projects: for technology-based removals they have averaged at about USD 180/tCO_2 over the 2022-2025 period and for nature-based removals, prices are on the rise, with an increase from USD 17 to USD 35/tCO_2 from the end of 2024 to mid-2025 (AlliedOffsets, 2025[34]).[19] Moreover, the World Bank (2025[33]) finds a price premium for credits eligible to be used for NDC achievement (Article 6.2) and international compliance markets (e.g. CORSIA) relative to voluntary markets.

The price of carbon credits used for compliance in ETSs is not readily observable. Since credits may be bought and sold directly between entities, in many cases price estimates are not available. Survey evidence can provide such data, but due to confidentiality constraints, detailed information by project and mechanism is lacking. Hence, the average price of credits relating to GHG removal and reduction projects, as outlined in the previous paragraph, are not necessarily representative of the prices of credits allowed for compliance in ETSs, since as seen above carbon credits generally come with qualitative restrictions. Some initiatives seek to provide project-specific estimates for these prices through modelling, though these price models are uncertain and have limited coverage of many compliance-eligible mechanisms, and may be less reliable than survey evidence (Wetterberg, Lanzi and Gómez, 2025[21]).

When ETS compliance related carbon credit price data is available, it does not necessarily show lower prices than primary and secondary market ETS permit prices (Table 4.1). For Tokyo, the trading prices of renewable energy credits averaged at JPY 5 625/tCO_2 in 2023 – much higher than excess emission reductions credits trading between JPY 650 and 700/tCO_2 (secondary market prices) in the same year. In Korea, in July 2025, Korean Credit Units (KCU) prices for 2024 and 2025 are of KRW 9000/tCO_2, similar to recent auction clearing prices (e.g. KRW 9070/tCO2 in July 2025). In Québec, the weighted average price of carbon credit transactions in 2023 was of CAD 28.19/tCO2, 37% lower than the primary market price in 44.65. In 2025, similar differences are found in California, between the prices of California Carbon Allowances and California Carbon Offsets (Carbon Pulse, 2025[35]).

4.2.3. Evolutions and implications of the variety compliance options on emissions covered by ETSs and covered entities' compliance costs

Free allowance shares are decreasing in many systems. Relatedly, auctioning is taking on a greater role. For instance, for the Chinese national ETS, Interim Regulations state that auctioning is to be introduced and gradually expanded. With the introduction of the many intensity-based Canadian ETSs, the sale of allowances at a fixed price as opposed as through auctions has also taken on a greater role in ETSs. The German and Austrian ETSs have also been selling allowances at a fixed price during their initial transition period. Auctioning should be introduced in the German ETS from 2026, with a price corridor. Indonesia is considering the introduction of a carbon tax through which entities may fulfil part of their compliance obligations (through a hybrid "cap-tax-and-trade" system) (ICAP, 2025[12]).

Carbon credit use for compliance has evolved and is set to continue evolving. The use of carbon credits for compliance has been an option since the onset of ETSs, with domestic carbon credits taking on a greater role than international carbon credits. While the use of international carbon credits used to be a compliance option in the EU ETS and the New Zealand ETS, these became ineligible in, respectively, 2021 and 2015. The Korean ETS, on the other hand, initially only allowed for domestic credits, and introduced the possibility to use international credits three years after its introduction (2018). The qualitative criteria and quantitative limits for carbon credit use are subject to evolutions as well. For instance, qualitative criteria have recently been updated in Québec, California and China. The share of compliance obligations that can be met with carbon credits is set to increase in some systems – e.g. from 4% per year for 2021 to 2025 to 6% for 2026 to 2030 in the California Cap-and-Trade Program; from 60% in 2023 to 90% in 2026 in the Alberta TIER[20] Regulation.

By increasing temporal, spatial and sectoral flexibility, banking, borrowing and carbon credit use directly affect the total amount of emissions covered by ETSs. Borrowing and banking allow for the use of permits from a different period. Hence, these options along with the use of carbon credits affect the total amount of emissions which can occur within the ETS in a given year, potentially making them higher than the cap, even in cap-and-trade systems. Moreover, the surrender of carbon credits for compliance leads to a potential increase of emissions of covered entities (La Hoz Theuer et al., 2023[16]), since they can compensate by abatement taking place in other sectors, other locations or at any rate, outside of the ETS scope. This provides more flexibility to covered entities but also reduces the incentive to reduce emissions on-site.

The different compliance options affect compliance costs for covered entities (in other words, the average price paid per tonne of CO_2e). The prices corresponding to permits borrowed or banked and to carbon credits can substantially differ from primary and secondary market ETS prices, adding to the already existing heterogeneity in prices within systems and across jurisdictions. Box 4.2 presents a conceptual example of an EACR profile that would account for all compliance options – since these options ultimately affect the average price faced by entities.

Borrowing, banking and carbon credit use can also impact primary and secondary market prices in an ETS by (i) increasing the supply of emissions permits within an ETS and by (ii) introducing potentially cheaper compliance options. The first channel refers to the increase in the supply of permits through a variety of compliance options beyond using free permits, trading permits and buying permits from government, which can then drive prices down. The second channel occurs when compliance options with different (and potentially lower) prices directly interact with primary and secondary market prices. This could especially be the case with carbon credits, particularly when their use has no or loose quantitative limits. For instance, evidence was found for the New Zealand ETS (NZ ETS), that when it was operating with an unconstrained international linkage, the decline of international carbon credit prices from 2011 was accompanied by a decline permit prices in the NZ ETS (Leining, 2022[36]).

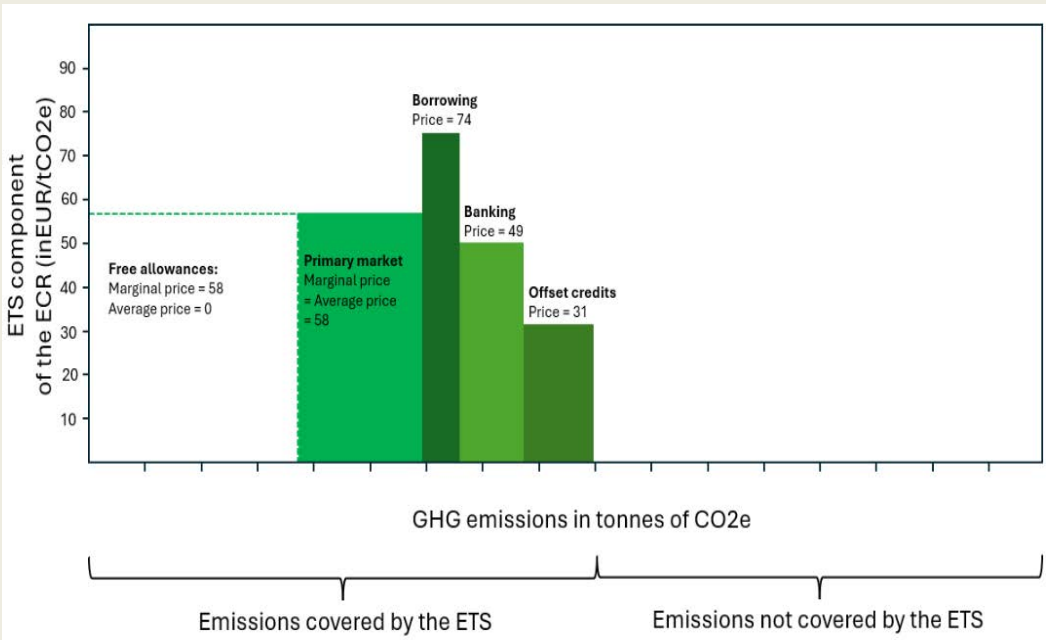
Box 4.2. An ECR mapping of different compliance options

The Effective Average Carbon Rate (EACR) accounts for how free allowances affect the costs faced by entities covered by an ETS. This indicator could be augmented by integrating the other compliance options offered to covered entities, which also affect the average carbon price:

- Prices corresponding to banked permits will either be equal to 0 if these correspond to permits that had been received for free or will be equal to the price on the secondary or primary market in an earlier year (if they were purchased from the government or another trading entity). Over the long term, permit prices have tended to increase (ICAP, n.d.[37]), but this is not always the case (e.g. the Korean ETS) nor is it necessarily the case in the shorter term (e.g. average permit prices have declined in the California Cap-and-Trade Program between 2024 and 2025, and in the EU ETS between 2023 and 2024 – Figure 3.2).
- Borrowing can raise the cost since it generally comes with an interest (e.g. 2 to 10% in the Australian Safeguard Mechanism (Australian Government CER, 2025[38])). Moreover, since it implicitly applies the forthcoming prices in the ETS, it can tend to increase prices through this way also, though not necessarily (e.g. in the past years prices have decreased in certain systems – see Figure 3.2).
- Where carbon credits are used for compliance, the prices at which they are purchased tend to be lower than secondary and primary market ETS prices, though going forward this could also depend on the type of credits available in the market and allowed for compliance (section 4.2.24.2.2).

Integrating these compliance options into an augmented EACR indicator is not straightforward. First, information on the types of permits used for compliance is generally not available. Second, even when they are available, tying them to a price may not be straightforward, as this would require information on the year from which they date for banked permits or on the price at which carbon credits were purchased. Regarding this latter point, the price of credits used for compliance with government-mandated policies is not readily available (Wetterberg, Lanzi and Gómez, 2025[21]).

Figure 4.5. Conceptual example of an EACR profile that would account for more compliance options



Source: Authors' own elaboration.

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Notes

[1] A number of other aspects contributing to increased flexibility and also impacting interoperability of systems are not discussed here. Many of them are documented in ICAP (2025[12]), e.g. price stability mechanisms (see also OECD (2023[10]), Flues and Van Dender (2020[40])), the use of revenues (see also OECD (2024[39]), Cárdenas Monar (2024[41])), auction design, underlying Monitoring, Reporting and Verification systems (OECD, 2025[43]) or fines for non-compliance.

[2] Also referred to as an “absolute cap”, e.g. ICAP (2024[28]).

[3] With some flexibility for adjustment mechanisms at the margin in many cases.

[4] Intensity-based systems (e.g. ICAP (2025[12])) are also referred to as “rate-based systems” (Fischer, Qu and Goulder, 2024[3]) or “output-based systems” (e.g. the Canadian Federal OBPS).

[5] While these are referred to as “baselines” and not free allowances, they are in practice the same as free allowances.

[6] “Total emissions from all Safeguard facilities are also required to reduce over time, measured on a 5-year rolling average. From the financial year commencing on 1 July 2024, the rolling average of Safeguard covered emissions over the previous 5 years is required to be lower than the 5-year rolling average from three years earlier, and from 1 July 2027, the 5-year rolling average of Safeguard covered emissions is required to be lower than the 5-year rolling average from two years earlier.”

[7] This may not always be the case. For instance, both the Chinese national ETS and the Beijing Pilot ETS are output-based systems. The introduction of auctioning is being considered for the Chinese national ETS, and up to 5% of allowances for irregular auctions may be set aside in the Beijing Pilot ETS.

[8] This section discusses options to meet compliance obligations on verified emissions, i.e. once reductions in emissions have already been achieved.

[9] These are sectors where international competition and carbon leakage risks may be limited and where free allowances could result in economic rents (see discussion in section 3.4 of OECD (2023[10])).

[10] Also referred to as offsets in certain jurisdictions or publications (e.g. ICAP (2025[12])).

[11] Entities can opt to receive units for embedding emissions in products or for destroying or exporting synthetic GHGs (Leining and Kerr, 2018[42])

[12] This section discusses carbon credits used for compliance in ETSs, but it should be noted that some carbon taxes allow for this compliance option as well – e.g. the Colombia, Singapore and South Africa carbon taxes.

[13] Environmental integrity requires several conditions to be in place for the generation of carbon credits, their trading environment, and their use (Wetterberg, Ellis and Schneider, 2024[20]). The discussion here focuses on integrity elements related to the generation of carbon credits (‘supply-side integrity’).

[14] Further supply-side integrity considerations are described in (Wetterberg, Ellis and Schneider, 2024[20]).

[15] This may evolve with the rules for Article 6 finalised in 2024, providing regulatory certainty for other countries to consider the potential inclusion of international carbon credits in their ETSs (see section 3.1).

[16] https://www.environnement.gouv.qc.ca/changements/carbone/credits-compensatoires/destruction-halocarbures-en.htm#1, as accessed on 29 August 2025.

[17] While most ETSs recognise that environmental integrity is essential for the inclusion of carbon credits, their environmental integrity guardrails differ considerably (Wetterberg, Lanzi and Gómez, 2025[21]), and the difference in standards followed can affect interoperability across systems but also with other policies (e.g. cross-border policies). Many ETSs only recognise carbon credits from specific crediting mechanisms. These crediting mechanisms, in turn, have different standards, methodologies and tools that guide the development of carbon credit supply. Most crediting mechanisms include provisions to assess additionality, ensure conservative quantification and permanence, but the standards differ: the stringency of such provisions vary greatly. In response to these integrity issues, several initiatives have sought to create international benchmarks for carbon credit quality. These include the UNFCCC-supervised Paris Agreement Crediting Mechanism, ICAO's Eligible Emission Units, and the ICVCM's Core Carbon Principles. The alignment of ETS-eligible carbon credit supply with these international quality benchmarks could help foster interoperability.

[18] Compliance obligations generally refer to verified emissions in cap-and-trade systems and the difference between verified emissions and free allowances in baseline-and-credit systems.

[19] These carbon credit prices are largely driven by the demand from voluntary corporate buyers, who have diverse preferences for carbon credits, compared to ETS-regulated buyers, whose primary motivation is to use credits for compliance.

[20] Technology Innovation and Emissions Reduction.

Annexe A. Effective Carbon Rates methodology

The CPET database presents the Effective Carbon Rates measure of prices arising from carbon pricing instruments (carbon taxes and ETSs) as well as from fuel excise taxes and their mapping to the GHG emissions they cover for each country by sector and fuel, as well as by instrument (i.e. the measure can also be broken down by the ETS, carbon tax and fuel excise tax components). The term “carbon tax” is used to cover the broad range of all taxes that apply to greenhouse gases (including taxes on fluorinated gases (F-gases), for instance). The pricing instruments covered by ECRs either set an explicit price per unit of GHG (e.g., tonnes) or set a price per unit of fuel, which is then proportional to resulting CO_2 emissions.

Sectors and fuels

The CPET database covers CO_2 emissions from energy use from six sectors that together span all energy uses and also covers other GHG emissions (i.e. emissions from methane (CH_4), nitrous oxide (N_2O), fluorinated gases (F-gases) and CO_2 from industrial processes) excluding Land use change and Forestry (LUCF). Due to data limitations[1] and to facilitate comparisons with previous ECR vintages, other GHG emissions are not allocated to the six economic sectors but are considered as a separate category. All sectors’ emissions are their Scope 1 emissions (Greenhouse Gas Protocol, 2011[1]). The six economic sectors and the other GHG category are further detailed in Table A A.1 and Table A A.2.

Table A A.1. CPET sectors and energy users responsible for CO_2 emissions from energy use and other GHG emissions category

Sector	Definition	Subsectors (energy users)
	CO_2 emissions from energy use	
Road transport	Fossil fuel CO_2 emissions from all primary energy used in road transport.	Road
Electricity	Fossil fuel CO_2 emissions from primary energy used to generate electricity (excl. autoproducer electricity plants which are assigned to industry), including for electricity exports. Electricity imports are excluded.	Main activity producer electricity plants
Industry	Fossil fuel CO_2 emissions from primary energy used in industrial facilities (incl. district heating and auto-producer electricity plants).	Adjusted losses in energy distribution, transmission and transport; Adjusted energy industry own use; Adjusted transformation processes; Auto-generation of electricity; Chemical and petrochemical; Construction; Food and tobacco; Industry not elsewhere specified; Iron and steel; Machinery; Mining and quarrying; Non-ferrous metals; Non-metallic minerals; Paper, pulp and print; Sold heat; Textile and leather; Transport equipment; Wood and wood products
Buildings	Fossil fuel CO_2 emissions from primary energy used by households, commercial and public services for activities other than electricity generation and transport.	Commercial and public services; Final consumption not elsewhere specified; Residential

Off-road transport	Fossil fuel CO_2 emissions from all primary energy used in off-road transport (incl. pipelines, rail transport, aviation and maritime transport). Fuels used in international aviation and maritime transport are not included.	Domestic aviation; Domestic navigation; Pipeline transport; Rail; Transport not elsewhere specified
Agriculture & fisheries	Fossil fuel CO_2 emissions from primary energy used in agriculture, fisheries and forestry for activities other than electricity generation and transport.	Agriculture; Fishing
GHG emissions other than CO_2 from energy use		
Other GHG (excl. LUCF)	All other GHG emissions include methane, nitrous oxide from agriculture; fugitive emissions from oil, gas and coal mining activities; waste; non-fuel combustion CO2 emissions from industrial processes (mainly cement production), N20 and CH4 emissions from industrial processes and F-gas emissions. Excludes LUCF emissions. Excludes CO_2 emissions from fuel combustion which are already reported in the agriculture & fisheries sector (since these are from energy use).	n.a.

Note: Estimates of primary energy use are based on the territoriality principle, and include energy sold in the territory of a country but potentially used elsewhere (e.g. because of fuel tourism in road transport). Own classification based on information on energy flows contained in the IEA's extended world energy balances (IEA, 2025[2]) and "other GHG" reported in the Climate Watch dataset (Climate Watch, 2025[3]).
Source: OECD (2016[4]; 2022[5]).

Table A A.2. Climate Watch "Other GHG" data

Description of the data used for the CPET database: sectors, content, gases, sources

Climate Watch Sector	Sector Contents	IPCC Category	Greenhouse Gases	Source
Energy				
Electricity / Heat	Electricity & heat plants (fossil fuels) – Public plants & Auto-producers (electricity, heat, CHP)	1A1a	(CO_2,) CH_4, N_2O	IEA*
	Other Energy Industries (fossil fuels)	1A1b,c	(CO_2,) CH_4, N_2O	IEA*
Manufacturing / Construction	Manufacturing & construction (fossil fuels)	1A2	(CO_2,) CH_4, N_2O	IEA*
Transportation	Transportation (fossil fuels)	1A3	(CO_2,) CH_4, N_2O	IEA*
Buildings	Residential, Commercial and Public Services	1A4a, b	(CO_2,) CH_4, N_2O	IEA*
Other fuel combustion	Agriculture, Fishing, and Other Fuel Use	1A4c, 1A5	(CO_2,) CH_4, N_2O	IEA*
Fugitive emissions	Coal Mining	1B1	CH_4	IEA*, U.S. EPA
	Natural Gas and Oil Systems	1B2	(CO_2,) CH_4	IEA*
	Other Emissions Sources	1B2, 1A6	(CO_2,) CH_4, N_2O	U.S. EPA
Industrial Processes				
	Cement	2A1	CO_2	Andrew R.M.
	Adipic and Nitric Acid Production	2B2, 3	N_2O	U.S. EPA
	Electronics Manufacturing	2E1, 2, 3	Aggregated F-Gases	U.S. EPA
	Electric Power Systems	2G1	SF_6	U.S. EPA
	Metals (Aluminum, Magnesium)	2C3, 4	PFCs, SF_6	U.S. EPA
	Use of Substitutes for ODS	2F1-6	HFCs	U.S. EPA
	HCFC-22 Production	2B9a	HFCs	U.S. EPA
	Other Industrial Process Sources	2A, B, C	CH_4, N_2O	U.S. EPA

Agriculture				
	Enteric Fermentation	3A1	CH_4	FAOSTAT
	Manure Management	3B2	CH_4, N_2O	FAOSTAT
	Rice Cultivation	3C7	CH_4	FAOSTAT
Waste				
	Landfills (Solid Waste)	4A	CH_4	U.S. EPA
	Wastewater Treatment	4D	CH_4, N_2O	U.S. EPA
	Other Non-Agricultural Sources (Waste and Other)	4E	CH_4, N_2O	U.S. EPA

Note: The description of the Bunker Fuels and LUCF sectors is not included in this table as these sectors are not part of the emissions base of the CPET database.
* GCP (GCP, 2025[6]) data is used in energy sectors to fill gaps where IEA data is not available.
Source: World Resources Institute (2024[7]).

The CPET data may also be broken down by fuel. Fuels are grouped into nine categories, described in Table A A.3.

Table A A.3. Fuel category breakdown

Energy type	Fuel category	Energy Products
Fossil fuels	Coal and other solid fossil fuels	Anthracite; Bitumen; Bituminous coal; Brown coal briquettes; Oven coke; Coking coal; Gas coke; Lignite; Oil shale; Patent fuel; Peat; Peat products; Petroleum coke; Sub-bituminous coal
	Fuel oil	Fuel oil
	Diesel	Gas/diesel oil excluding biofuels
	Kerosene	Jet kerosene; Other kerosene
	Gasoline	Aviation gasoline; Jet gasoline; Motor gasoline
	LPG	Liquefied Petroleum Gas
	Natural gas	Natural gas
	Other fossil fuels and non-renewable waste	Additives; Blast furnace gas; Coal tar; Coke oven gas; Converter gas; Crude oil; Ethane; Gas works gas; Lubricants; Naphtha; Natural gas liquids; Other hydrocarbons; Other oil products; Paraffin waxes; Refinery feedstocks; Refinery gas; White and industrial spirit; Industrial waste; Non-renewable municipal waste
Biofuels	Biofuels	Bio jet kerosene; Biodiesels; Biogases; Biogasoline; Charcoal; Municipal waste (renewable); non-specified primary biofuels and waste; Other liquid biofuels; Primary solid biofuels

Note: Energy products are defined as in IEA (IEA, 2025[8]). Emissions from the combustion of biofuels are not included in this edition.
Source: OECD (2019[9])

Instrument choice

The ECR indicator covers pricing instruments that apply to a base that is directly proportional to energy use or GHG emissions. It therefore excludes taxes and fees that are only partially correlated with energy use or GHG emissions – e.g. vehicle purchase taxes, registration or circulation taxes, and taxes that are directly levied on air pollution emissions (e.g. the Danish tax on SO_X or the Swedish NO_x fee). Production taxes on the extraction or exploitation of energy resources (e.g. severance taxes on oil extraction) are not within the scope of instruments covered either, as supply-side measures are not directly linked to domestic energy use or emissions.

The database covers specific taxes and instruments that encourage a switch away from carbon-intensive fuels by changing relative prices. In line with these two criteria, value added taxes (VAT) or sales taxes are not accounted for. Indeed, in principle VAT applies equally to a wide range of goods, so does not change the relative prices of products and services (i.e. it does not make carbon-intensive goods and services more expensive relative to cleaner alternatives). In practice, differential VAT treatment and concessionary rates may target certain forms of energy use, thereby changing their relative price (OECD, 2015[10]). However, quantifying the effects of differential VAT treatment is beyond the scope of the database as it is not a specific tax. Moreover, such an exercise would entail extensive price information, which is generally not available for all energy products. Also, electricity excise taxes do not treat fossil fuels in a differential manner as compared to clean sources and are therefore not part of the ECR indicator.

The ECR indicator includes support measures for fossil fuel consumption that are delivered through the tax code, such as excise or carbon tax exemptions, rate reductions and refunds, which are pervasive in energy tax and carbon pricing systems. This is different from the Net ECR (nECR) database, which includes also fossil fuel subsidies that lower pre-tax prices (budgetary transfers). Indeed, the availability of preferential treatment varies substantially across countries, and even within a country such preferential treatment frequently changes over time. As a result, simply comparing statutory rates (also sometimes referred to as standard or advertised rates) across countries and time would be misleading. More precisely, certain energy users or GHG emitters frequently enjoy preferential treatment that effectively reduces prices on energy or emissions. Therefore, effective carbon tax rates measured by the database are adjusted accordingly irrespective of whether countries report such policy measures as tax expenditures (OECD, 2022[5]).[2]

General ECR methodology, data cycles and content of current report

Once data on ETS permit prices and coverage is gathered, the Effective Carbon Rates (resp. Net ECR) indicator then builds on the fuel excise tax and carbon tax data (resp. and fossil fuel subsidies budgetary transfers data). The first publication of Effective Carbon Rates describes the methodology for matching ETS permit prices and coverage with taxes (OECD, 2016[4]). In particular, carbon taxes are often entirely or partially alleviated if the energy user is subject to an ETS. This is reflected once the tax data is merged with the ETS information to generate the Effective Carbon Rates. The ECR calculation process entails two data gathering cycles: a first cycle that gathers data on taxes and fossil fuel subsidies for a given year (e.g. 2023), and a second cycle that gathers data on ETS coverage and permit prices for the previous year (still 2023) as well as maps these instruments to the same year emissions base data.

Effective carbon rates in 2023 consist of tax rates as of 1 April 2023 and permit prices from ETSs averaged over 2023. Where available, the coverage of emissions trading systems is estimated based on data by the authorities governing the respective systems (see Annexe B). The fuel excise and carbon taxes data is described in the background notes available at OECD (2024[11]). In this publication, CO_2 emissions from energy use data is for 2023 when available, namely OECD and G20 countries plus Cyprus and Kazakhstan and for 2021 elsewhere.[3] It is based on energy use data from the International Energy Agency's World Energy Statistics and Balances (IEA, 2025[2]). Other GHG emissions data is for 2022 and is from the CAIT database (Climate Watch, 2025[3]). Official exchange rate and inflation data are used to express prices in constant terms when required and noted.

Annexe B. Data sources and methodology for Emissions Trading Systems modelling

This Annex provides the main assumptions for the modelling of ETS coverage and free allowance shares. It also details the data sources for ETS-covered emissions, free allowances and permit prices.

General methodology: Permit prices, coverage and free allowance shares

Permit prices

Permit prices are calculated as the average auction prices (primary market prices) across the year under consideration (e.g. 2023 for ECR 2023), if the data is available. The average is taken to smooth price fluctuations, as permit prices experience volatility throughout the year. For some emissions trading systems, price information is only available for part of the year, in which case an average across the available dates is calculated, or for a single auction or date, in which case this price is used. Due to data availability, secondary market prices rather than auction prices are used in the calculation for certain systems.

Coverage

For most systems, ETS coverage is estimated by reference to verified emissions data at facility level or at aggregated facility level (e.g. firm). This emission data is then matched where possible at a subsector-level, and if not at a sector-level (e.g. using ISIC classification). Where this data is not available, broader measures are used such as the total emissions covered or the share of sectoral emissions covered. Data availability and sources are exposed below. It is not possible however, to distinguish coverage by fuels: the implicit assumption is thus that at the subsector level, the composition of fuel use is the same for ETS-covered entities and entities not subject to an ETS.

Free allowance shares

Where verified emissions data is available, it may be the case that free allowance data also is (see below, Table A B.1). In this case, the share of freely allocated allowances in total verified emissions is calculated at the subsector and sector level according to the following formula (where i is an entity, FA are the free allowances and VE are the verified emissions):

$$\sum_{i \in sector\ or\ subsector} FA_i \Big/ \sum_{i \in sector\ or\ subsector} VE_i$$

If no free allowance data is available, other methodologies are used, e.g. relying on the quantity of allowances auctioned or the free allowance allocation formula. The share may generally then only be calculated at the system-level and used as an approximation for sector-level shares (if many sectors are covered by the ETS).

In a few cases, free allowances are modelled as decreasing the share of emissions covered or as not impacting the average price signal (i.e. the EACR). If free allowances are not tradable but may be used for compliance, then this is modelled as decreasing the share of emissions effectively covered. If free allowances are adjusted ex-post to equal verified emissions, then this is also modelled as decreasing emissions effectively covered (in effect, this is modelled as equivalent to reporting emissions without pricing them). In both of these cases, the free allowance allocation rules do not maintain the marginal price signal: there is no opportunity cost of emitting as much as the free allowance allocation received. If free allowances should be consigned to auctions and their revenues used for programs to reduce GHG emissions or to return to ratepayers as non-volumetric credits (as in the California Cap-and-Trade Program and in the Washington Cap-and-Invest Program), then these are modelled as not affecting EACRs (consistent with Flues and Van Dender (2017[12])). Table A B.3 presents more details on free allowance allocation methods.

Country-level data sources and information

This report covers 34 ETSs in 2023 and this section provides information on the sources and information used for the modelling of these ETSs in 2023. It starts by presenting the data source used for permit prices in each ETS, the availability or not of verified emissions data (and if not available the alternative sources used for the modelling of ETS coverage) and of free allowance allocation data (Table A B.1). It also presents the sectors covered by each ETS (according to the CPET classification of sectors – see Table A A.1) and the greenhouse gases covered (Table A B.2). Finally, it also presents the free allowance allocation methods in each system (Table A B.3)

The following table presents free allowance allocation methods across the 34 ETSs analysed in this report, and takes note of instances where additional restrictions or flexibilities apply. In particular, it highlights where traditional benchmarking methods are complemented with considerations accounting for changes in production.

Table A B.1. Sources for permit prices, verified emissions and free allowance amounts

34 ETSs, 2023

System	Permit Price		Verified Emissions		Free allowances
	Source	Primary or secondary market	Source	Level of information***	Source
Australia Safeguard Mechanism	Safeguard Mechanism default prescribed unit price for 2023-24 (https://www.dcceew.gov.au/climate-change/emissions-reporting/national-greenhouse-energy-reporting-scheme/safeguard-mechanism#toc_8)	Secondary	Clean Energy Regulator website	Entity-level	Clean Energy Regulator website
Austrian ETS	Legislation (https://www.bmf.gv.at/themen/klimapolitik/carbon-markets/nationales-emissionszertifikatehandelsgesetz-2022-(NEHG-2022)/entwicklung-und-handelsphasen.html)	Primary	Data provided by the Austrian Ministry of Finance	Total	n.a.
Canada - Alberta	ICAP (factsheet), as accessed in January 2025.	Primary	Alberta Government website	Sector-level	Alberta Government website

Canada - New Brunswick	ICAP (factsheet), as accessed in January 2025.	Primary	Modelled using information in ICAP (2025)	Total	Modelled
Canada - Newfoundland and Labrador	ECCC (2021), Update to the Pan-Canadian Approach to Carbon Pollution Pricing 2023-2030	Primary	Newfoundland and Labrador Department of Environment and Climate Change	Entity-level	Modelled
Canada - Nova Scotia	ICAP (factsheet), as accessed in January 2025.	Primary	Modelled by matching the list of regulated facilities (Climate Change in Nova Scotia website) with emissions data from the GHG Reporting Program (GHGRP)	Entity-level	Modelled
Canada - Ontario	ECCC (2021), Update to the Pan-Canadian Approach to Carbon Pollution Pricing 2023-2030	Primary	Ministry of the Environment, Conservation and Park website	Entity-level	Modelled
Canada - Québec	ICAP Allowance Price Explorer (retrieved from the Ministry for the Fight Against Climate Change website)	Primary	Québec Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs website	Entity-level	Data provided by Direction du marché du carbone
Canada - Saskatchewan	ECCC (2021), Update to the Pan-Canadian Approach to Carbon Pollution Pricing 2023-2030	Primary	Modelled using information in ICAP (2025)	Total	Modelled
Canada FOBPS *	ECCC (2021), Update to the Pan-Canadian Approach to Carbon Pollution Pricing 2023-2030	Primary	Modelled using coverage shares from the Pan-Canadian Approach to Pricing Carbon Pollution report combined with the latest provincial GHG inventories	Total	Modelled
China - Beijing	ICAP Allowance Price Explorer (retrieved from the China Beijing Environmental Exchange)	Primary	Modelled based on ECR (2016), updated using changes in regulation and list of covered entities	Total	Modelled
China - Chongqing	ICAP Allowance Price Explorer (retrieved from the Chongqing Carbon Emissions Trading Centre)	Secondary	Modelled based on ECR (2016), updated using changes in regulation and list of covered entities	Total	Modelled
China - Fujian	ICAP Allowance Price Explorer (retrieved from the Haixia Equity Exchange)	Secondary	Modelled based on ECR (2016), updated using changes in regulation and list of covered entities	Total	Modelled
China - Guangdong	ICAP Allowance Price Explorer (retrieved from the China Emissions Exchange (Guangzhou))	Secondary	Modelled based on ECR (2016), updated using changes in regulation and list of covered entities	Total	Modelled
China - Hubei	ICAP Allowance Price Explorer (retrieved from the China Hubei Emission Exchange)	Primary	Modelled based on ECR (2016), updated using changes in regulation and list of covered entities	Total	Modelled
China - Shanghai	ICAP Allowance Price Explorer (retrieved from the Shanghai Environmental and Energy Exchange)	Primary	Modelled based on ECR (2016), updated using changes in regulation and list of covered entities	Total	Modelled
					Modelled

China - Shenzhen	ICAP Allowance Price Explorer (retrieved from the China Emissions Exchange (Shenzhen))	Secondary	Modelled based on ECR (2016), updated using changes in regulation and list of covered entities	Total	
China - Tianjin	ICAP Allowance Price Explorer (retrieved from the Tianjin Climate Exchange)	Secondary	Modelled based on ECR (2016), updated using changes in regulation and list of covered entities	Total	Modelled
China national ETS	ICAP Allowance Price Explorer (retrieved from the Shanghai Environmental and Energy Exchange)	Secondary	Modelled using legislation	Total	Modelled
EU ETS	ICAP Allowance Price Explorer (EUA auction price and revenue data provided by the EEX Group)	Primary	European Union Registry	Entity-level	European Union Registry
German ETS	Legislation (https://www.bundesumweltministerium.de/en/law/fuel-emissions-trading-act)	Primary	German Emissions Trading Authority (DEHSt) website	Total	n.a.
Indonesia ETS	ICAP Status Report (2025)	Secondary	Data provided by the Ministry of Energy and Mineral Resources	Total	Modelled
Japan - Saitama	Tokyo Metropolitan Government (https://www.kankyo.metro.tokyo.lg.jp/documents/d/kankyo/2024_05)	Secondary	Saitama Prefecture website	Total	Modelled
Japan -Tokyo	Tokyo Metropolitan Government (https://www.kankyo.metro.tokyo.lg.jp/documents/d/kankyo/2024_05)	Secondary	Tokyo Metropolitan Government website	Total	Modelled
Kazakhstan ETS	ICAP Status Report (2025)	Secondary	Modelled using information in ICAP (2025)	Total	National Carbon Quota Plan for 2022-2025
Korea ETS	ICAP Allowance Price Explorer (retrieved from the Korea Exchange)	Secondary	Emissions Trading Registry System, Greenhouse Gas inventory and Research Center of Korea (GIR) website	Entity-level	Emissions Trading Registry System, Greenhouse Gas inventory and Research Center of Korea (GIR) website
Mexico ETS	n.a.	n.a.	Modelled using information in ICAP (2025)	Total	n.a.
New Zealand ETS	ICAP Allowance Price Explorer (supplied by Jarden)	Secondary	New Zealand Environmental Protection Authority (EPA) website	Entity-level	New Zealand Environmental Protection Authority (EPA) website
Swiss ETS	ICAP Allowance Price Explorer (retrieved from the Swiss Emissions Registry)	Primary	Swiss emissions registry (stationary sources), Federal Office for the Environment FOEN website (aviation)	Entity-level	Swiss emissions registry (stationary sources), Federal Office for the Environment FOEN website (aviation)
UK ETS	ICAP Allowance Price Explorer (retrieved from the Intercontinental Exchange (ICE) platform)(1)	Primary	UK Emissions Trading Registry(2)	Entity-level	UK Emissions Trading Registry1
United States - California	ICAP Allowance Price Explorer (retrieved from the Air Resources Board website)	Primary	Californian Air Resource Board (ARB) website	Entity-level	

United States - Massachusetts	Massachusetts auction reports (https://www.mass.gov/lists/massachusetts-carbon-allowance-registry-document-repository)	Primary	Modelled using RGGI information	Entity-level	n.a.
United States - RGGI **	ICAP Allowance Price Explorer (retrieved from the RGGI website)	Primary	RGGI CO_2 Allowance Tracking System (RGGI COATS)	Entity-level	n.a.
United States - Washington	ICAP Allowance Price Explorer (end-of-day and weekly average data is provided by ICE)(1)	Primary	Department of Ecology, State of Washington website	Entity-level	Clean Energy Regulator website

Note: * Over the course of 2023, the federal OBPS was operational in Manitoba, Nunavut, Prince Edward Island and Yukon.
** RGGI (Regional Greenhouse Gas Initiative): in 2023, it operates with ten the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, Vermont and Virginia.
*** Depending on the system, the term "entity" is used to refer to installations, firms, aviation operators or fuel distributors.
n.a.: not available or not applicable.
(1) Disclaimer on use or reference to ICE Data: intercontinental exchange, inc., ice data llp, and/or any of its affiliates ("ice group"), makes no warranty, express or implied, either as to the results to be obtained from the use of ice futures data and/or the figure at which ice futures data stands at any particular time on any particular day or otherwise. The use of ice futures data is provided on an 'as is' basis and ice group disclaims all liability for any loss or damage whatsoever incurred by the use of ice futures data herein, even if ice group has been advised of the possibility of such losses, damages or expenses. Any distribution or commercial use of ice futures data is prohibited without the prior written consent of ice data llp.
(2) Complemented by European Union Registry for Northern Ireland power plants still under the EU ETS.
Source: ICAP (2025[13]) and Authors.

The following table presents coverage of sectors (according to the CPET classification) and GHGs by ETS. Coverage can in some cases be minimal and does not indicate that the whole of the sector's emissions are covered.

Table A B.2. Sectors and GHGs covered by ETSs

34 ETSs, 2023

System	CPET sectors	"Other GHGs" covered	GHG emissions
Australia Safeguard Mechanism	Buildings, Electricity, Industry, Off-road and Road transport (point source)	Yes	CO2 from energy use and from industrial processes; CH4 from energy use, from industrial processes, from fugitive emissions and from waste treatment, disposal and remediation and wastewater handling; N2O from energy use, from industrial processes and from wastewater handling; F-gases from industrial processes
Austrian ETS	Agriculture and fisheries, Buildings, Industry, Off-road and Road transport (upstream)	Yes	CO2, CH4 and N2O from energy use
Canada - Alberta	Electricity, Industry (point source)	Yes	CO2, CH_4, N_2O, NF3, SF_6, HFCs, PFCs from energy extraction and use and from industrial processes
Canada - New Brunswick	Electricity, Industry (point source)	Yes	CO2, CH_4, N_2O, NF3, SF_6, HFCs, PFCs from energy extraction and use and from industrial processes
Canada - Newfoundland and Labrador	Electricity, Industry (point source)	Yes	CO2, CH_4, N_2O, NF3, SF_6, HFCs, PFCs from energy extraction and use and from industrial processes
Canada - Nova Scotia	Electricity, Industry (point source)	Yes	CO2, CH_4, N_2O, SF_6, HFCs, PFCs from energy use and industrial processes

Canada - Ontario	Electricity, Industry (point source)	Yes	CO2, CH_4, N_2O, SF_6, HFCs, PFCs from energy use and industrial processes
Canada - Québec	Electricity (point source and downstream), Buildings, Industry, Off-road transport (point source and upstream), Agriculture and fisheries and Off-road and Road transport (upstream)	Yes	CO2, CH_4, N_2O, NF3, SF_6, HFCs, PFCs from energy use and industrial processes
Canada - Saskatchewan	Electricity, Industry (point source)	Yes	CO2, CH_4, N_2O, NF3, SF_6, HFCs, PFCs from energy extraction and use and from industrial processes
Canada FOBPS *	Electricity, Industry (point source)	Yes	CO2, CH_4, N_2O, SF_6, HFCs, PFCs from energy use and industrial processes
China - Beijing	Buildings, Industry, Road transport (point source)[(1),(2)]	Yes	CO2 from energy use and from industrial processes
China - Chongqing	Industry (point source)[(1),(2)]	Yes	CO2, CH4, N_2O, HFCs, PFCs, SF6 from energy use and from industrial processes
China - Fujian	Industry, Offroad transport (point source)[(1),(2)]	Yes	CO2 from energy use and from industrial processes
China - Guangdong	Buildings, Industry, Off-road transport (point source)[(1),(2)]	Yes	CO2 from energy use and from industrial processes
China - Hubei	Buildings, Industry (point source) [(1),(2)]	Yes	CO2 from energy use and from industrial processes
China - Shanghai	Buildings, Industry, Off-road transport (point source) [(1),(2)]	Yes	CO2 from energy use and from industrial processes
China - Shenzhen	Buildings, Industry, Off-road and Road transport (point source) [(1),(2)]	Yes	CO2 from energy use and from industrial processes
China - Tianjin	Buildings, Industry (point source) [(1),(2)]	Yes	CO2 from energy use and from industrial processes
China national ETS	Electricity[(3)]	Yes	CO2 (from energy use)
EU ETS	Agriculture and fisheries,[(4)] Buildings,[(4)] Electricity, Industry, Off-road transport (point source)	Yes	CO2 from energy use, CO2 from industrial processes, N2O from adipic acid, nitric acid and glyoxylic acid production, PFCs from aluminium production
German ETS	Agriculture and fisheries, Buildings, Industry, Off-road and Road transport (upstream)	No	CO2 (from energy use)
Indonesia ETS	Electricity (point source)	Yes	CO2, N2O and CH4 (from energy use)
Japan - Saitama	Buildings, Industry (point source), Electricity (downstream)	No	CO2 from energy use
Japan -Tokyo	Buildings, Industry (point source), Electricity (downstream)	No	CO2 from energy use
Kazakhstan ETS	Electricity, Industry (point source)	Yes	CO2 emissions from energy use and industrial processes
Korea ETS	Buildings, Electricity, Industry, Off-road and road transport (point source), Electricity and Heat (downstream)	Yes	CO_2, CH4, N_2O, HFCs, PFCs, SF6 from energy use and industrial processes
Mexico ETS	Electricity, Industry (point source)	Yes	CO2 from energy use and industrial processes
New Zealand ETS	All CPET sectors (upstream for all energy-related emissions, as fuel distributors are covered, and point source for sectors such as industry and waste)	Yes	CO2, CH_4, N_2O from energy, waste and industrial processes and SF_6, HFCs, PFCs from industrial processes.
Swiss ETS	Electricity, Industry, Off-road transport (point source)	Yes	CO2 from energy use and industrial processes; N2O, CH4 and F-gases from industrial processes
UK ETS	Buildings,[(5)] Electricity, Industry, Off-road transport (point source)	Yes	CO2 from energy use, CO2 from industrial processes, N2O from adipic acid, nitric acid and glyoxylic acid production, PFCs from aluminium production

United States - California	Electricity (point source and downstream), Buildings, Industry, Off-road transport (point source and upstream), Agriculture and fisheries and Off-road and Road transport (upstream)	Yes	CO_2, CH_4, N_2O from energy use and industrial processes
United States - Massachusetts	Electricity (point source)	No	CO_2 (from energy use)
United States - RGGI **	Electricity (point source)	No	CO_2 (from energy use)
United States - Washington	Electricity (point source), Buildings, Industry, Off-road transport (point source and upstream), Off-road and Road transport (upstream)	Yes	CO_2, CH_4, N_2O from energy and industrial processes, HFCs, PFCs, SF_6, NF_3, other fluorinated GHGs from industrial processes

Note: * Over the course of 2023, the federal OBPS was operational in Manitoba, Nunavut, Prince Edward Island and Yukon.
** RGGI (Regional Greenhouse Gas Initiative): in 2023, it operates with ten the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, Vermont and Virginia.
(1) Due to data limitations or negligeable estimated coverage, the coverage methodology only applies only to: (i) Industry for Chongqing, Fujian, Hubei, Shenzhen and Tianjin; (ii) Industry and buildings for Beijing, Guangdong and Shanghai.
(2) Sold heat and electricity may also be covered downstream in Chinese Pilot ETSs.
(3) The Chinese national ETS may also cover certain electricity autoproduction installations, though not modelled here.
(4) Agricuture and fisheries as well as Buildings (commercial and public services installations) are covered through stationary combustion (with >20 MW thermal rated input). This does not refer to upstream system that would cover fuels used in these sectors. In the majority of countries covered by the EU ETS, this concerns less than 10 installations.
(5) This refers to the coverage of certain commercial and public services installations' emissions at point source (combustion of fuels in installations with a total rated thermal input exceeding 20 MW) and this coverage represents a limited share of emissions in the UK buildings sector (less than 1% of the sector's emissions in the UK). This does not refer to upstream system that would cover fuels used in the buildings sector.
Source: ICAP (2025[13]) and Authors.

The following table presents free allowance allocation methods across the 34 ETSs analysed in this report, and takes note of instances where additional restrictions or flexibilities apply. In particular, it highlights where traditional benchmarking methods are complemented with considerations accounting for changes in production.

Table A B.3. Free allowance allocation methods in ETSs

34 ETSs, 2023

System	Method	Note
Australia Safeguard Mechanism	output-based benchmarking	Unless the baseline is of less than 100,000 tCO_2e (in which case a default of 100,000 tCO_2e is applied).
Austrian ETS	n.a.	
Canada - Alberta	output-based benchmarking	
Canada - New Brunswick	output-based benchmarking	
Canada - Newfoundland and Labrador	output-based benchmarking	
Canada - Nova Scotia	output-based benchmarking	
Canada - Ontario	output-based benchmarking	
Canada - Québec	benchmarking	
Canada - Saskatchewan	output-based benchmarking	
Canada FOBPS *	output-based benchmarking	
China - Beijing	output-based benchmarking and grandparenting	Upper- (120%) and lower-bounds (80%) for the share of free allowances in entities' verified emissions for the 2022 and 2023 compliance years.
China - Chongqing	output-based benchmarking, grandparenting and "equivalence method" (free allowances are adjusted ex-post to equal verified emissions)	
China - Fujian	output-based benchmarking and grandparenting	For sectors using the benchmarking method allocation has upper and lower bound (resp. 120% and 80% of verified emissions). For sectors using historical intensity methods, the surplus or shortfall is limited to 3 to 10% of verified emissions.
China - Guangdong	output-based benchmarking and grandparenting	The quota for 2023 was distributed partially free of charge and partially for a fee.
China - Hubei	output-based benchmarking and grandparenting	
China - Shanghai	output-based benchmarking and grandparenting	
China - Shenzhen	output-based benchmarking and grandparenting	
China - Tianjin	output-based benchmarking and grandparenting	
China national ETS	output-based benchmarking	
EU ETS	benchmarking	There are revised rules applying from Phase 4 covering adjustments to free allocation when an installation makes a significant change to its production. The threshold for adjustments is a 15% increase or decrease in production. Adjustments to free allocation are issued based on yearly activity data reports that operators submit to national competent authorities.
German ETS	n.a.	
Indonesia ETS	output-based benchmarking	
Japan - Saitama	grandparenting	
Japan -Tokyo	grandparenting	
Kazakhstan ETS	output-based benchmarking	
Korea ETS	benchmarking and grandparenting	
Mexico ETS	equal to verified emissions	

New Zealand ETS	benchmarking	
Swiss ETS	benchmarking	Free allocation levels may be updated annually if production levels deviate at least 15 percentage points from the 2014 to 2018 base years.
UK ETS	benchmarking	Installations eligible for free allowances must submit a verified Activity Level Report. If the data in the Activity Level Report shows an increase or decrease in activity of 15% or more from historical activity levels (calculated based on the previous two years' activity levels), their free allocation will be recalculated.
United States - California	output-based benchmarking for industrial facilities,(1)(2) grandparenting for natural gas facilities, forecast methodology for electrical distribution utilities (fixed amount of the cap is distributed to the utilities according to each utility's demand forecast, their supply forecast, and additional information)	Allowances receive by electricity distributors and natural gas suppliers may not be traded. Part can be used for compliance and part should be consigned to auctions, and the resulting auction proceeds used for programs to reduce GHG emissions or return the proceeds to ratepayers as non-volumetric credits.
United States - Massachusetts	n.a.	
United States - RGGI **	n.a.	
United States - Washington	output-based benchmarking for industrial facilities,(1)(2) grandparenting for natural gas facilities, forecast methodology for electrical distribution utilities (fixed amount of the cap is distributed to the utilities according to each utility's demand forecast, their supply forecast, and additional information)	Allowances receive by electricity distributors and natural gas suppliers may not be traded. Part can be used for compliance and part should be consigned to auctions, and the resulting auction proceeds used for programs to reduce GHG emissions or return the proceeds to ratepayers as non-volumetric credits.

Note: * Over the course of 2023, the federal OBPS was operational in Manitoba, Nunavut, Prince Edward Island and Yukon.
** RGGI (Regional Greenhouse Gas Initiative): in 2023, it operates with ten the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, Vermont and Virginia.
(1) Industrial allocations are adjusted if the total sum of freely allocated allowances exceeds the cap.
(2) A small number of facilities may receive free allowances based on grandparenting.
n.a.: not applicable (since no free allowances).
Source: ICAP (2025[13]) and Authors.

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Notes

[1] In particular the energy-related non-CO_2 emissions of heat and electricity may not be disentangled and attributed to the respective CPET sectors/subsectors.

[2] This represents a different approach from the OECD’s Inventory of Fossil Fuel Support. See Box 1.2 of (OECD, 2022[5]) for additional details on the difference in approaches.

[3] In the accompanying database to be published later this year on the OECD Data Explorer, the CO_2 emissions from energy use base data will be updated to 2023 for all 79 countries.

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KINGDOM OF BELGIUM
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PRINT ISBN 978-92-64-84181-9
PDF ISBN 978-92-64-93740-6

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