OECD Series on Carbon Pricing and Energy Taxation

Pricing Greenhouse Gas Emissions

TURNING CLIMATE TARGETS INTO CLIMATE ACTION

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BETTER POLICIES FOR BETTER LIVES

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Foreword

Containing the risks of climate change requires accelerating the transition to net zero greenhouse gas (GHG) emissions. Countries can employ or reform a wide range of policy instruments to cut GHG emissions, including price-based instruments. This report tracks how carbon taxes, tradeable emission permit prices, energy taxes and subsidies – together an important subset of price-based instruments – have evolved between 2018 and 2021.

This is the first report in the newly established OECD series on Carbon Pricing and Energy Taxation. The series combines the Taxing Energy Use and Effective Carbon Rates database and publication series. The report presents the main findings from the database, tracking governments' evolving use of carbon pricing and energy taxation. The level of detail in the publication is high, yet it does not reflect the full granularity of the database, which is available on OECD.STAT.

The report will inform the work of the Inclusive Forum on Carbon Mitigation Approaches, an OECD project that seeks to take stock of countries' diverse approaches to climate change mitigation and estimate their effectiveness, with a view to strengthening dialogue to scale up combined action to reach net zero emissions by mid-century.

This report is released in a time of turmoil on energy markets. Energy price hikes experienced since 2021 have presented policy makers with even greater challenges in their efforts to use carbon pricing to reduce GHG emissions. Energy taxes have been cut in several countries, as part of governments' emergency responses. Even though the report focusses on long run trends between 2018 and 2021, it provides indications of how tax cuts and fossil fuel subsidies affect effective carbon prices. The need for supporting energy affordability is clear, but its form could change over time, with more emphasis on targeted income support than on broad tax cuts. This will help to reduce the risk that the policy responses to the current energy crisis slow down the transition to net zero, which would also better protect energy users from fossil fuel price shocks in the future.

This report was produced by the Tax Policy and Statistics Division of the OECD's Centre for Tax Policy and Administration. The integration of selected fossil fuel support measures from the OECD Inventory of support measures for fossil fuels into the Taxing Energy Use and Effective Carbon Rates database is the result of a collaboration with the Environmental Performance and Information Division of the OECD's Environment Directorate and the Analysis, Data and Modelling Division in the OECD's Trade and Agriculture Directorate.

The project was led by Jonas Teusch under the guidance of Kurt Van Dender and the overall responsibility of David Bradbury. The report and accompanying online country notes were drafted by Jonas Teusch, Konstantinos Theodoropoulos and Astrid Tricaud. The redesign of the architecture of the Taxing Energy Use and Effective Carbon Rates database was led by Konstantinos Theodoropoulos, who also prepared the data and technical background notes with Kim Lan Mellon and Astrid Tricaud. Anasuya Raj provided inputs on emissions trading systems. Text boxes were contributed by Luisa Dressler, Grégoire Garsous, Guillaume Gruère, and Anasuya Raj. Marie-Aurélie Elkurd, Karena Garnier, Hazel Healy, Natalie Lagorce, Michael Sharratt, and Carrie Tyler improved the presentation and dissemination of the work.

The authors would like to thank OECD colleagues David Bradbury, Luisa Dressler, Jane Ellis, Ben Henderson, Mark Mateo, Justine Garrett, Grégoire Garsous, Anasuya Raj, Hugo Vallin, and Kurt Van Dender for their feedback and advice at different stages of the production of the report.

The report was discussed at and endorsed for declassification by the OECD's Joint Meetings of Tax and Environment Experts, and it was approved by the Committee on Fiscal Affairs and the Environment Policy Committee. The OECD Secretariat would like to thank the delegates to the Joint Meetings and their colleagues in national government administrations for their assistance with the provision of data, for their feedback on the data and the report, and for their support for the area of work.

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Executive summary

The risks of climate change need to be contained and this urgently requires accelerating the transition to net-zero greenhouse gas (GHG) emissions. Pursuing the net-zero transition will also help to reduce dependence on fossil fuels, which can reduce exposure to energy price shocks in the future. A successful transition to net-zero GHG emissions requires policy packages that deliver affordable access to low and zero carbon options for households and businesses.

Pricing Greenhouse Gas Emissions: Turning Climate Targets into Climate Action tracks how explicit carbon prices, energy taxes, and subsidies that lower pre-tax energy prices, have evolved between 2018 and 2021. This is an important subset of the policy instruments that can accelerate the transition to net-zero. All instruments considered either directly change the cost of emitting GHGs or change electricity prices. Reforming these instruments can play an important role in meeting climate targets, leading to cleaner air and water, while improving public finances.

The report covers 71 countries, which together account for approximately 80% of global GHG emissions and energy use. Explicit carbon prices, as well as energy taxes and subsidies, are detailed by country, sector, product and instrument. The use of a common methodology ensures comparability across countries. Summary indicators facilitate cross-country comparisons and help policy makers keep track of progress made and identify opportunities for reform.

The *Taxing Energy Use and Effective Carbon Rates* database underpinning the newly established OECD series on Carbon Pricing and Energy Taxation is designed to track long run developments in energy taxation and carbon pricing. The tax rates for the 2021 stocktake are those applicable on 1 April 2021. Since then, several countries have taken measures to shield consumers and businesses from the impact of the sharp increases in pre-tax energy prices, including through significant reductions in energy tax rates. While the report does not seek to comprehensively cover all of these measures, orders of magnitude are shown and policy options are discussed.

Key findings

As part of their efforts to cut greenhouse gas (GHG) emissions, countries have increased their use of carbon pricing through taxes or emissions trading systems, with coverage increasing across countries and sectors in 2021

In 2021, more than 40% of GHG emissions were covered by carbon prices, up from 32% in 2018, with average carbon prices from emissions trading systems and carbon taxes more than doubling to reach EUR 4 per tonne of CO_2e over the same period. The report finds that countries adapt their emissions reduction strategies to their specific circumstances, with some relying on carbon pricing more than others. Even though not all countries focus on carbon pricing as part of their climate mitigation policies, carbon prices increased in 47 of the 71 countries covered in the report in 2021.

The increasing divergence over the extent that countries rely on carbon pricing highlights the importance of improved data and analysis to obtain a more complete picture of countries' climate mitigation strategies, beyond carbon pricing. This OECD's Inclusive Forum on Carbon Mitigation Approaches seeks to contribute to building the required evidence and analysis..

The report also finds that:

- More than 40% of GHG emissions in the 71 countries covered in the report face net positive carbon prices – up from 32% in 2018. This increase is the result of the introduction or extension of explicit carbon pricing mechanisms in several countries, including Canada, China and Germany.
- Carbon price developments have diverged across countries in 2021, with prices rising further in countries with the highest net carbon prices in 2018. In these countries, changes were mostly driven by the rise of explicit carbon prices (i.e. carbon taxes and permit prices in emissions trading systems). In contrast, in general, increases in net carbon prices were less common in countries where prices were relatively low in 2018.
- Permit prices related to emissions trading systems have increased in countries covered by the European Union ETS (EU ETS), but also in Canada, New Zealand and the United Kingdom. In addition to the EU ETS, Germany launched an additional national ETS for heating and transport fuels in 2021.
- Carbon tax changes also played a role in the carbon price divergence, with the introduction of new carbon taxes (Luxembourg in 2021, Iceland in 2020 for fluorinated gases), increases in carbon tax rates (e.g. Finland, Iceland, Ireland and Norway) or the phasing out of carbon tax exemptions (e.g. Portugal and Sweden).
- In Canada, the increase in explicit carbon prices stems from the increasing stringency of the national minimum standards of the federal benchmark, enforceable through the introduction of the federal carbon pollution pricing backstop system.

Net carbon prices often remain low outside of the transport and building sectors, but inter-country heterogeneity is large. The industry and electricity sectors are no exception in this regard.

- Where emissions from industry and electricity are priced, this is usually through emissions trading systems or carbon taxes. While many emissions remain unpriced, some emitters now face substantial carbon prices, especially in Europe.
- The highest net carbon prices tend to result from relatively high fuel taxes in the road sector.
- Negative carbon prices from fossil fuel subsidies are most common in the agriculture and fisheries sector, followed by road transport and the buildings sector.

Increasing effective carbon prices could raise substantial revenues, while cutting emissions. Revenues from carbon pricing can play an important role during the net-zero transition where there will be substantial adjustment costs.

- This report estimates that countries could be able to raise an amount equivalent to approximately 2.2% of GDP on average if they were to raise carbon prices to EUR 120 per tonne of CO_2 – a mid-range estimate of carbon prices required by 2030.
- The revenue potential from increasing effective carbon prices to the EUR 120 carbon benchmark differs substantially across countries. Some would raise revenues of less than 0.3% of GDP (Costa Rica, Denmark, Switzerland and Uganda), while others could raise revenues in excess of 5% of GDP (e.g. India, Kyrgyzstan and South Africa).

Key insights for policy makers

Drawing upon these key findings, the report provides insights to support policy makers as they grapple with the challenge of transitioning to net-zero GHG emissions.

Countries need to deploy a wide-range of policy instruments to overcome the barriers to the transition to net-zero in ways that fit their circumstances. Progressively increasing carbon prices while phasing out fossil fuel subsidies, can help countries to implement more ambitious, effective and efficient climate policy. These policy approaches will be particularly powerful when combined with policies that support the supply of low and zero-carbon technologies and infrastructures.

While this report shows that countries have been making progress, there is a long way to go if carbon pricing is to live up to its full potential.

- Carbon prices - net of fossil fuel subsidies - are zero or negative for almost 60% of GHG emissions.
- Where carbon prices are net positive, price levels are rarely high enough to drive a successful transition to net-zero.
- Measures taken in response to recent energy price hikes have reduced net carbon prices substantially.

Energy tax cuts in response to the recent energy price shock have been large and widespread, with reductions amounting to EUR 50/tCO_2 or more in many cases. In the long-run, pursuing the net-zero transition will help to reduce dependence on fossil fuels, which can reduce exposure to energy price shocks in the future. In the short and medium run, there is a strong case for shielding the most vulnerable from the impact of higher energy prices as a necessary precondition of building support for the low carbon transition.

While it is understandable that the immediate response of governments has been to provide price support, where further measures are needed they could be better targeted through income support and by making low carbon options more widely available.

Conclusions

Progress is being made with carbon pricing. Climate mitigation policy approaches and levels of stringency nevertheless continue to differ across jurisdictions. Differences in the use of carbon pricing increased between 2018 and 2021. These differences can amplify concerns over competitiveness and carbon leakage for carbon-intensive and trade-exposed sectors.

Regardless of the extent to which countries currently rely on carbon pricing, getting to net-zero GHG emissions by mid-century will require a range of policy instruments that are mutually reinforcing. The policy mix will vary from country to country depending on its specific circumstances.

For all countries, there is a need to build trust that the transition to net zero GHG emissions can be achieved in a socially cohesive way. This challenge is magnified in a context of sharply rising energy prices driven by external shocks. Recent experience has shown that protecting the most vulnerable from high energy prices is a necessary precondition for building climate policy support in the long run. In the face of an energy price shock, policies to moderate prices, e.g. through tax cuts, may be suitable to provide fast relief. However, if such high prices persist, shifting to targeted income support over time will help maintain price signals and help strengthen the incentives to reduce fossil fuel use.

1

Building a systematic stocktaking and mapping of mitigation policies

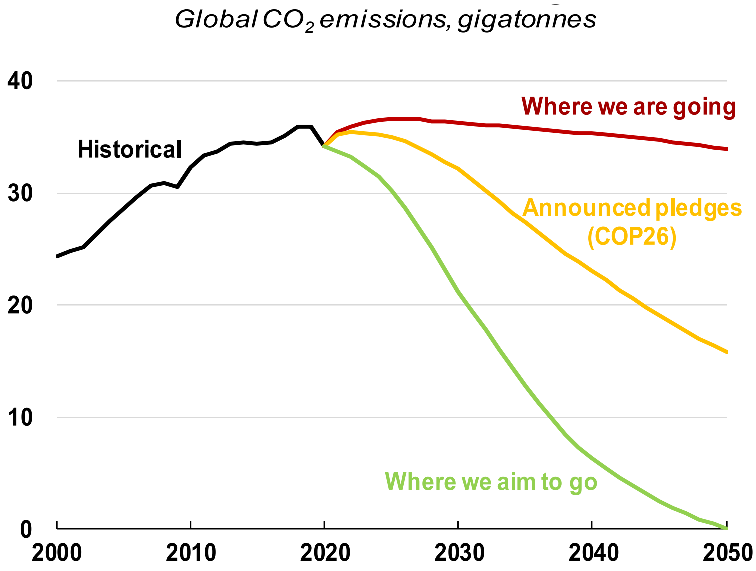
This chapter provides climate policy context and gives an overview of the mitigation policy instruments that governments can deploy or reform to accelerate the transition to net-zero greenhouse gas (GHG) emissions. It then describes the methodology of the Effective Carbon Rates and Taxing Energy Use database, which takes stock of emissions trading systems, carbon taxes, fuel excise taxes, fossil fuel subsidies, electricity excise taxes and electricity subsidies in 71 countries, including all OECD member countries. The database contains several composite indicators, including the Effective Carbon Rate (ECR), which is the sum of permit prices from emissions trading systems, carbon taxes and fuel excise taxes, and the Net ECR, i.e. the ECR minus fossil fuel subsidies that decrease pre-tax fossil fuel prices. The chapter also outlines the effective tax rates framework that is used for the systematic stocktaking, and explains how effective tax rates are mapped to GHG emissions and energy use.

The climate challenge

Accelerating the transition to net zero greenhouse gas (GHG) emissions is urgently required to contain the risks of climate change. The Working Group I contribution to the Sixth Assessment Report by the Intergovernmental Panel on Climate Change (IPCC), released in August 2021, made it clear that "unless there are immediate, rapid and large-scale reductions in GHG emissions, limiting warming to close to 1.5°C or even 2°C will be beyond reach." (IPCC, 2021[1]) The Working Group II contribution, released in February 2022, observed that "human-induced climate change, including more frequent and intense extreme events, has caused widespread adverse impacts and related losses and damages to nature and people" (IPCC, 2022[2]) already. The Working Group III contribution, released on April 2022, concluded that there are "options in all sectors to at least halve emissions by 2030." (IPCC, 2022[3])

While awareness of the urgency to address climate change has increased, an ambition gap persists. Announced pledges, even if fully implemented, are insufficient to reach the objectives of the Paris Agreement. As of 1 March 2022, 88% of global GHG emissions where covered by a net zero target (Net Zero Tracker, 2021[4]). This is because 136 countries, home to 85% of the world's population and accounting for 90% of global GDP (in purchasing power parities) have announced net zero targets of some sort. Nevertheless, the ambition gap between where countries aim to go and where they would end up if the announced pledges were fully implemented remains substantial, as shown in Figure 1.1. In addition, it should not be taken for granted that announced pledges will be implemented in full, and many details of existing net zero targets are still unclear (Jeudy-Hugo, Lo Re and Falduto, 2021[5]).

Figure 1.1. The climate challenge



Source: Adapted from (IEA, 2021[6]).

To avoid an implementation gap, countries now need to translate their long-term climate commitments into concrete policy packages that deliver for the climate and the economy in the short and medium term. Recent analysis by the United Nations Framework Convention on Climate Change (UNFCCC), synthesising the nationally determined contributions (NDCs) submitted by the Parties to the Paris Agreement, concluded that there was an "urgent need for either a significant increase in the level of ambition of NDCs between now and 2030 or a significant overachievement of the latest NDCs, or a combination of both" (UNFCCC, 2021[7]). This analysis is supported by recent bottom-up scenario analysis

(Meinshausen et al., 2022[8]). Similarly, many countries have committed to a "green recovery" from the COVID-19 crisis to take advantage of "a unique window for finance ministers across the world to act fast and put investment in sustainable growth" (Coalition of Finance Ministers for Climate Action, 2020[9]). However, OECD analysis shows "overall, recovery packages are not currently set to deliver the transformational investments needed" (OECD, 2021[10]).

The net-zero toolbox

As countries seek to reduce GHG emissions, they can employ or reform a wide range of policy instruments. Table 1.1 gives a schematic overview of the variety of policy instruments in the net-zero toolbox. It includes climate policy instruments, introduced with the explicit policy motivation of reducing GHG emissions. It also contains non-climate policy instruments, i.e. policy instruments for which the principal policy motivation behind their introduction is not climate, but which are nevertheless highly climate-relevant. Both types of instruments can either be price-based (i.e. they directly change prices of activities or assets and leave it to the market to react to the price signals) or not. Non-price-based instruments (e.g., vehicle emission rate standards, energy efficiency regulations) instead put constraints on producers and consumers to only pursue activities or invest in assets complying with regulatory requirements. Non-price-based instruments leave less flexibility to market participants to reduce emissions.

Table 1.1. A tentative typology of selected mitigation policies

	Price-based instruments		Non-price-based instruments
	Explicit carbon prices	Other price-based instruments	
Climate policy instruments (main policy motivation is to reduce GHG emissions)	Emissions trading systems (1) Carbon taxes (2)	Emissions-based vehicle taxes Feed-in tariffs Feebates Tradable GHG emissions performance standards Corporate tax incentives	GHG emissions intensity standards Technology mandates or bans
Non-climate policy instruments (Other principal policy motivation but highly climate-relevant)		Fuel excise taxes (3) Fossil fuel subsidies (4) Electricity excise taxes (5) Electricity subsidies (6) Some industrial and agricultural and household subsidies	Air pollution standards Fertiliser regulations Fuel efficiency regulations

Note: All instruments followed by a number in parentheses are covered in this report; their definition and scope of coverage in this report is further discussed below. ECR=1+2+3, Net ECR=ECR-4, EER=1+2+3+5, Net EER=EER-(4+6). Corporate tax incentives equally impact emissions whether they are motivated by climate considerations or not (see Box 1.1). Instruments not mentioned in the table, such as biodiversity policies (OECD, 2020[11]) and nature-based solutions (OECD, 2021[12]), can have mitigation benefits as well.

Price-based climate policy instruments include, but are not limited to, explicit carbon prices. Explicit carbon prices either take the form of carbon taxes, first implemented in the Nordic countries in the early 1990s, or tradable GHG emission permits (or allowances), as pioneered by the European Union's (EU) emissions trading system in operation since 2005 (see Chapter 2). Carbon taxes and emissions trading systems directly price GHG emissions as they apply to a base that is proportional to GHG emissions.

Other price-based policy instruments (as well as non-price-based instruments) generally do not induce the same energy demand and supply response as their relationship to GHG emissions is typically only indirect.[1] The public support for such instruments can be stronger and they can complement explicit carbon prices by targeting hurdles to the transition to net zero other than the absence of a price on emissions. Emissions-based vehicle taxes, for example, encourage the uptake of more carbon-efficient vehicles, but do not price the GHG emissions resulting from the use of these vehicles. They strongly affect vehicle choices and therefore can help to drive electrification of the vehicle fleet. Feed-in tariffs promote the use of renewable sources for power generation, such as wind and solar, which can accelerate the transition to a zero-carbon power sector. However, they do not directly discourage the use of fossil sources of power generation. Similarly, while not pricing GHG emissions, corporate income tax incentives can encourage investment in carbon-neutral production processes and consumption of low carbon or carbon-neutral products by providing targeted activities with favourable deviations from a country's standard tax treatment (Box 1.1).

Box 1.1. Corporate income tax incentives and the transition to net zero

Corporate income taxation (CIT) affects the cost of investment, which can have an effect on the take-up of new technologies and input choices, with potentially important implications for the carbon footprint of businesses. In particular, CIT influences business decisions on whether and when to invest, what technology or processes to use and how much investment to provide (Hall and Jorgenson, 1967[13]; 1969[14]; Devereux and Griffith, 2003[15]). While taxation is only one of multiple drivers of investment decisions, businesses take costs from taxation into account when evaluating new projects, including investments in clean industrial technologies or in clean power production. Therefore, standard CIT systems and targeted tax incentives could have a significant effect on the transition towards net-zero GHG emissions and the investments in clean productive assets that it requires.

Tax incentives have the potential to promote investment and create positive spillovers, but they come at the cost of forgone government revenue and can compromise the neutrality of the tax system.

CIT incentives for clean investment come with different designs and targeting strategies

Countries use different instruments, designs and targeting strategies to promote clean investments through the CIT system. For example, some tax incentives reduce the tax costs of acquiring specific clean assets; others favour activities that reduce carbon emissions per unit of output relative to a benchmark; and other incentives apply to entire sectors, such as power production from renewable energies. These varying and complex designs and targeting strategies complicate an evaluation of the benefits and costs from using tax incentives as part of the net-zero toolbox.

Evidence suggests that OECD countries usually apply expenditure-based tax incentives when promoting clean investment through CIT. These include tax credits or favourable tax deductions relating to the acquisition costs of clean assets. For example, (Dressler, Hanappi and Van Dender, 2018[16]) found that 10 out of 36 OECD and selected partner economies provide fiscal depreciation schedules that are more generous for carbon-neutral power generation technologies than for their carbon-intensive alternatives. Denmark recently introduced an accelerated depreciation allowance targeting clean technologies more broadly (OECD, 2021[17]).Germany plans to implement a super depreciation allowance to promote investment in climate protection and digital assets (SPD, Bündnis 90/Die Grünen and FDP, 2021[18]). The United States has a long-standing tradition of supporting clean investment through the corporate tax system, mainly through investment and production tax credits (Metcalf, 2021[19]). The Netherlands provides tax support to clean investment through a combination of targeted CIT incentives, including two investment allowances and a specific accelerated depreciation schedule (Anderson et al., 2021[20]).

Developing and emerging economies equally use CIT incentives to promote climate objectives– through expenditure-based, but also through income-based tax incentives (i.e. reduced CIT rates or CIT exemptions). The OECD Investment Tax Incentives database (Celani, Dressler and Wermelinger, 2022[21]) shows, for example, that investors in the renewable energy sector have access to CIT incentives that specifically target renewables in Madagascar (tax allowance), Rwanda (reduced rate), Senegal (partial tax exemption) and South Africa (accelerated depreciation). Investment in green technologies more broadly is promoted in Viet Nam (tax exemption and reduced rate), as well as in Mauritius, and the Seychelles (accelerated depreciation).

Non-price-based climate policy instruments (e.g. GHG emissions intensity regulations) are motivated by climate considerations. They do not directly change prices of activities or assets but usually involve costly compliance efforts. The CO_2 limits imposed on new fossil fuel-fired appliances, such as utility boilers, as included in the United States' Environmental Protection Agency's (EPA) New Source Performance Standards (NSPS) under the Clean Air Act are an example of an emissions intensity regulation.

Not all policy instruments with an impact on climate change mitigation are motivated by climate considerations. Among price-based instruments, fuel excise taxes are typically introduced principally with revenue raising considerations in mind, but still discourage the use of fossil fuels. Fossil fuel subsidies may be introduced to protect vulnerable households or energy intensive industries; yet they also lower the cost of using fossil fuels, which increases GHG emissions. Air pollution standards, a non-price-based instrument, can come with the co-benefit of reducing GHG emissions from fossil fuel use, which is a major cause of air pollution.

The economics and the politics of the challenge to mitigate climate change call for the use of a combination of policy instruments, including pricing, regulation and subsidies. There are at least two sets of reasons for this. First, there are many market failures, inertia and path dependencies that need to be overcome to move to net-zero. Second, countries have different starting points, economic structures, and political, social and legal constraints, which can lead them to opt for different policy approaches. At the same time, the variety of approaches and overlap between instruments make systematic comparisons of countries' climate change mitigation policies challenging.

Comparing mitigation policies is useful for strengthening mutual learning, comparing policy stringency, and informing decisions on ways to manage international spillovers from domestic policy choices. International spillovers can be negative, for example when domestic action leads to carbon leakage or harms the competitiveness of countries' businesses. But spillovers can equally be positive, in particular when it comes to innovation and the transfer and trade of clean technologies.

This report provides a systematic stocktake and mapping of carbon pricing and energy tax policy instruments, and it accounts for fossil fuel and electricity subsidies that lower pre-tax prices for domestic energy use. This is an important subset of price-based policy instruments listed in Table 1.1. All instruments covered in this report have one thing in common: they either directly change the cost of emitting GHG (emissions trading systems, carbon taxes, fuel taxes, fossil fuel subsidies) or change electricity prices (electricity taxes and subsidies). In addition, reforming these instruments to better align them with climate considerations could contribute to improving public finances, either by raising revenue or reducing expenditure. By contrast, reforming most of the other policy instruments in the mitigation toolbox would typically not directly change the cost of emitting GHG or using electricity, although indirect effects on prices can be significant.

A systematic stocktaking using the OECD's effective tax rates framework

First published in 2013 and 2016 respectively, the OECD's *Taxing Energy Use* (TEU) and *Effective Carbon Rates* (ECR) publication series and database (simply referred to as the database below) take stock of how countries tax energy use and explicitly price GHG emissions.[2] The database systematically integrates all specific taxes on energy use and GHG emissions in a consistent framework that ensures cross-country comparability. It traditionally covers carbon taxes, excise taxes on fuels, taxes on the consumption of electricity, and determines permit prices on emissions that are subject to emissions trading systems (Table 1.2). Starting with Taxing Energy Use for Sustainable Development (OECD, 2021[22]), and drawing on data from the Inventory of Fossil Fuel Support (OECD, 2015[23]; OECD, 2021[24]) where available,[3] fossil fuel subsidies and electricity subsidies that lower pre-tax prices for domestic energy use have also been integrated in the effective tax rates framework used in the database (OECD, Forthcoming[25]).

This vintage of the database provides new and original 2021 data for 71 countries (including, but no longer limited to, all OECD and G20 countries except Saudi Arabia)[4] and all GHG emissions. In addition to the 44 OECD and G20 economies, already covered in *Taxing Energy Use 2019* and *Effective Carbon Rates 2021*, this report includes Costa Rica, a member of the OECD since May 2021, as well as 26 other countries, all members of the Coalition of Finance Ministers for Climate Action. Eleven of these new countries are in Africa (Burkina Faso, Côte d'Ivoire, Egypt, Ethiopia, Ghana, Kenya, Madagascar, Morocco, Nigeria, Rwanda, Uganda), eight in Latin America and the Caribbean (Dominican Republic, Ecuador, Guatemala, Jamaica, Panama, Paraguay, Peru, Uruguay), six are in Asia (Bangladesh, Kyrgyz Republic, Malaysia, Philippines, Sri Lanka) and two in Europe (Cyprus, Ukraine). Fifteen of these countries were covered for the first time in *Taxing Energy Use for Sustainable Development* (OECD, 2021[22]).

As a result of the geographical and base expansion, TEU now accounts for approximately 79% of global GHG emissions (excluding emissions from land use change and forestry (LUCF)[5]). For comparison, *Effective Carbon Rates 2021* (2021[26]) covered 57% of global GHG emissions – GHG emissions coverage has thus increased by 22 percentage points. Throughout this report, 2021 rates are often compared to data for 2018, which has been updated and extended to incorporate the increase in instrument, emissions, and country coverage of this report (see also, next section).[6]

The most widely used composite indicator of the database to date has been the ECR, which is the sum of fuel excise taxes, carbon taxes, and ETS permit prices. The new *Net* ECR indicator additionally accounts for negative carbon prices (i.e. pre-tax price reductions) resulting from fossil fuel subsidies. Fuel excise and fuel-based carbon taxes, which are typically specified in various physical units such as litres or kilogrammes, are converted into tax rates per tonne of CO_2 based on the carbon content of the fuels to which they apply.[7] Emissions-based carbon taxes and emissions permit prices do not need to be converted since they are usually specified per tonne of CO_2-equivalent (CO_2e).[8] Budgetary transfers are mapped to all CO_2 emissions from domestic energy use directly affected by the measure and converted into the corresponding negative tax rate per tonne of CO_2. Official OECD exchange rate and inflation data are used to express all prices in real 2021 Euros.[9]

The other principal composite indicator is the Effective Energy Rate (EER), which adds electricity taxes to the components included in the ECR indicator; the *Net* EER indicator additionally accounts for fossil fuel and electricity subsidies. Electricity excise taxes and subsidies generally do not treat fossil fuels in a differential manner compared to clean sources and are therefore excluded from the Net ECR indicator (OECD, 2019[27]; OECD, 2021[22]). The *Net* EER indicator is expressed per gigajoule (GJ) based on the energy content of the products to which they apply, because electricity taxes and subsidies typically also apply to energy sources that do not emit CO_2, such as hydro, wind and solar, as well as nuclear. This indicator can, for example, be used to estimate energy tax revenues net of fossil fuel and electricity subsidies (see Chapter 3) and break down such revenues by policy instrument.[10]

Table 1.2. Policy instruments covered in this report

	Instrument definition	Instrument examples	Composite indicator	Dataset
ETS permit price	The price of tradable emission permits in mandatory emissions trading and cap-and-trade systems representing the opportunity cost of emitting an extra unit of CO_2e., regardless of the permit allocation method	Emissions trading systems are most commonly used for larger emitters from the power and industry sectors and are in operation in, e.g. California and Québec, China, and the European Union.	Component of Effective Carbon Rate (ECR) and Net ECR (see Chapter 2) as well as Effective Energy Rate (EER) and Net EER (see Chapter 3)	Included in both GHG emissions dataset (expressed per tCO_2e, see (Chapter 2) and energy content dataset (expressed per GJ, see Chapter 3)
Carbon tax	All taxes for which the rate is explicitly linked to the carbon content of the fuel or where the tax is levied directly on GHG emissions (irrespective of whether the resulting carbon price is uniform across fuels and GHGs.) The term carbon tax is thus equally used for taxes that apply to GHGs other than CO_2.	Most countries administer explicit carbon taxes in the same way as fuel excise taxes (e.g. France, Sweden). Countries that follow this fuel-based approach do not actually tax CO_2 directly, but rather calculate the corresponding rate in common commercial units, for instance by reference to kilograms for solid fuels, litres for liquid fuels, and cubic metres for gaseous fuels. Fuel-based carbon taxes are often levied as a component of fuel excise taxes. There are a number of countries that tax GHGs directly. Countries that pursue such an emissions-based approach include Chile, Estonia, Latvia and South Africa.	Component of ECR, Net ECR, EER, and Net EER	Included in both GHG emissions dataset (expressed per tCO_2e) and energy content dataset (expressed per GJ)
Fuel excise tax	All excise taxes that are levied on fuels and that are not carbon taxes.	Almost all countries tax gasoline and diesel used for road transport. The tax rate is typically specified per litre or gallon of fuel.	Component of ECR, Net ECR, EER, and Net EER	Included in both GHG emissions dataset (expressed per tCO_2e) and energy content dataset (expressed per GJ)
Fossil fuel subsidy	Budgetary transfers that decrease pre-tax prices for domestic fossil fuel use.	There are countries that regulate the price of fossil fuels below supply costs and then compensate fuel suppliers for the resulting losses (e.g. LPG in Morocco).	Component of Net ECR and Net EER	Included in both GHG emissions dataset (expressed per tCO_2e) and energy content dataset (expressed per GJ)
Electricity excise tax	All excise taxes that are levied on electricity.	Mandatory for residential and commercial electricity use in the European Union. Often specified per kWh of electricity end use.	Component of EER and Net EER	Only included in energy content dataset (expressed per GJ)
Electricity subsidy	Budgetary transfers that decrease pre-tax prices for domestic electricity use.	In some countries, such as Nigeria, the government provides budgetary transfers to electricity suppliers to finance the shortfall resulting from electricity tariffs that are set below supply costs.	Component of Net EER	Only included in energy content dataset (expressed per GJ)

Note: Data on the tax policy instruments are collected via publicly available official sources; government officials are provided with the opportunity to review and refine the data.. Excises are taxes levied as a product specific tax on a predefined limited range of goods (OECD, 2020[28]). For details on emissions trading systems, see OECD's (2021[26]), *Effective Carbon Rates 2021*. For details on fossil fuel and electricity subsidies, see (OECD, Forthcoming[25]; OECD, 2021[24]).

The database accounts for tax exemptions, rate reductions and refunds, which are pervasive in energy tax and carbon pricing systems. Frequently, certain energy users or GHG emitters enjoy preferential treatment that effectively reduces prices on energy or emissions. Therefore, effective tax rates measured by the database are adjusted accordingly irrespective of whether countries report such policy measures as tax expenditures, which represents a different approach from the OECD's Inventory of Fossil Fuel Support (Box 1.2).[11] 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 nominal rates (also called standard or advertised rates) across countries and time is misleading (Finch and van den Bergh, 2022[29]).

The Net ECR captures carbon price signals (resulting from taxes and emissions trading systems, as well as fossil fuel subsidies), whereas the Net EER measures energy price signals (resulting from the Net ECR components plus electricity taxes and subsidies). The policy instruments included in the Net ECR and Net EER indicators are rarely directly applied to the actual emitters, but typically levied on fuel suppliers.[12] Therefore, final energy users are exposed to price signals captured by the Net ECR and Net EER indicators to the extent that these costs are passed through to them. Evidence on pass-through is fragmented and mixed, but there are indications that pass-through is high when competition is strong and supply is elastic. In addition, pass though tends to be stronger in the case of tax rises than tax cuts (Alm, Sennoga and Skidmore, 2009[30]; Harju et al., 2022[31]; Benzarti et al., 2020[32]; Marion and Muehlegger, 2011[33]).

The database focuses on pricing instruments that specifically 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. Common examples of policy instruments that fall outside the scope of the database include vehicle purchase taxes, registration or circulation taxes, and taxes that are directly levied on non-GHG emissions, such as the Danish tax on SO_X. Some countries also apply production taxes on the extraction or exploitation of energy resources (e.g., severance taxes on oil extraction). Since these supply-side measures are not directly linked to domestic energy use or emissions, the database does not cover them either.

Similarly, the database does not include value added taxes (VAT) or sales taxes. As VAT in principle applies equally to a wide range of goods, they do not change the relative prices of products and services (i.e. they do not make carbon-intensive goods and services more expensive than cleaner alternatives). In practice, differential VAT treatment and concessionary rates may target certain forms of energy use, thereby encouraging their consumption (OECD, 2015[34]). However, quantifying the effects of differential VAT treatment is beyond the scope of the database as such an exercise would entail extensive price information, which is generally not available for all energy products.[13] Reduced VAT rates, zero-ratings or exemptions are noted where relevant and data are available.[14] Sometimes such measures are recorded in the OECD Inventory of Support Measures for Fossil Fuels, which can be used as a complement to this analysis.

Box 1.2. The OECD Inventory of Support Measures for Fossil Fuels

The OECD Inventory of Support Measures for Fossil Fuels (OECD, 2021[24]) identifies, documents, and estimates government measures that encourage fossil-fuel production or consumption relative to alternatives. Its primary objective is to enhance transparency on such public policies, which may result in larger production and consumption of fossil fuels than would be the case absent government intervention. The Inventory should be considered as a tool for policy makers to identify potentially distortive support measures – the first step in a sequential approach to the reform of fossil fuel subsidies (Elgouacem, 2020[35]). It does not provide an analysis of the effects of covered measures on prices and quantities and does not assess whether they are inefficient, encourage wasteful consumption, or are environmentally harmful (OECD, 2015[23]). This is consistent with the notion that “information precedes analysis”. The intent is to cast a wide net in supporting governments identify potential measures for reform. In its latest version, it includes around 1 300 measures in 50 OECD countries and selected partner economies (OECD, 2022[36]).

While support measures for fossil fuels can take many forms depending on their incidence and their transfer mechanism (OECD, 2015[23]), the Inventory covers budgetary transfers and tax expenditures because of data availability. The primary data sources are official government documents such as budget reports and reviews, public accounts, and budget statistics. Such documents typically report budgetary transfers and tax expenditures – with a varying degree of estimation quality and coverage – but generally do not report other forms of support. Budgetary transfers are generally well documented and estimated in budget reports, revised on a budget cycle, and subject to legislative scrutiny (Elgouacem, 2020[35]). Such policies can be readily compiled in an inventory of support measures.

By contrast, the quality of tax expenditure estimations reported in official documents varies, as tax expenditures tend to undergo less scrutiny than direct spending programmes (Elgouacem and Van Dender, 2019[37]; OECD, 2015[23]; OECD, 2021[24]). Some countries report detailed estimates of their support measures through tax expenditures while others provide hardly any information.[15] In addition, cross-country and over-time comparisons of tax expenditures are challenging for several reasons. First, countries estimate tax expenditures from specific tax provisions against their own benchmark tax system. As benchmarks vary across countries and over time, it is difficult to correctly interpret factors driving cross-country and over-time variation in tax expenditures. Second, countries have diverging accounting and budgetary approaches to tax expenditures. Certain countries consider lower tax rates on a subset of fuels – typically lower excise tax rates – as a reduction of tax liability, but others consider them as tax differentiation on different products or economic activities.

Tax expenditures included in the Inventory are typically provided through lower tax rates, exemptions, or rebates on value-added taxes (VAT) and excise taxes. Tax expenditures are generally targeted towards: i) specific groups of consumers; ii) specific types of fuels; iii) specific uses of fuels (OECD, 2015[23]). For instance, residents of regions deemed economically disadvantaged may benefit from lower taxes on their use of fuels, or diesel fuel may benefit from a lower tax rate relative to gasoline in the transport sector. Finally, some tax rebates can also be applied if fuels are used for specific activities such as commercial aviation, farming, fishing, forestry, maritime transport and mining.

Source: (OECD, Forthcoming[25]).

Mapping effective tax rates to energy use and GHG emissions

The database not only takes stock of policy instruments, but also maps them to the corresponding energy use and GHG emissions base in a way that is comparable across countries and over time. Energy base data is adapted from IEA, *World Energy Statistics and Balances* (IEA, 2020[38]), which is also used to calculate CO_2 emissions from energy use. GHG emissions other than CO_2 emissions from energy use are included for the first time, and sourced from Climate Watch (2020[39]). Non-CO_2 emissions are expressed in CO_2e using 100-year global warming potential values from the IPCC's Fourth Assessment Report.[16] Effective tax rates for 2018 and 2021 are both mapped to 2018 base data, which facilitates comparisons between the two points in time, as changes in average rates are not affected by changes in the composition of energy use and GHG emissions.[17]

The mapping accounts for overlap between policy instruments, which is ubiquitous. In countries, such as Finland and the United Kingdom, carbon taxes apply to emissions that are also covered by an ETS, increasing the carbon price applied. In other countries, such as France and Germany, the domestic carbon pricing instruments generally only apply to emissions that are not already covered by the EU ETS.[18] Explicit carbon prices often apply on top of pre-existing excise tax regimes, and excise taxes are sometimes reduced following the introduction of explicit carbon pricing instruments. The very same fuels and users benefiting from fossil fuel subsidies are sometimes still subject to fuel excise taxes (e.g. in Egypt). Ignoring such interactions – which vary across countries, change over time, and often extend over several levels of government (e.g., the EU and its member states, at national and subnational levels in Canada, Mexico, and the United States) – will paint an inaccurate picture of countries' climate actions and policies.

Table 1.3. Sector definitions

Sector	Base definition in GHG emissions dataset (Chapter 2)	Base definition in energy content dataset (Chapter 3)
Road	Fossil fuel CO_2 emissions from all primary energy used in road transport.	Energy content (in joules) of all primary energy used in road transport.
Off-road	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.	Energy content (in joules) of 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.
Industry	Fossil fuel CO_2 emissions from primary energy used in industrial facilities (incl. district heating and auto-producer electricity plants).	Energy content (in joules) of all primary energy used in industrial facilities (incl. district heating and auto-producer electricity plants).
Agriculture & fisheries	Fossil fuel CO_2 emissions from primary energy used in agriculture, fisheries and forestry for activities other than electricity generation and transport.	Energy content (in joules) of all primary energy used in agriculture, fisheries and forestry for activities other than electricity generation and transport.
Buildings	Fossil fuel CO_2 emissions from primary energy used by households, commercial and public services for activities other than electricity generation and transport.	Energy content (in joules) of all primary energy used by households, commercial and public services for activities other than electricity generation and transport.
Electricity	Fossil fuel CO_2 emissions from primary energy used to generate electricity (excl. auto-producer electricity plants which are assigned to industry), including for electricity exports. Electricity imports are excluded.	Energy content (in joules) of all primary energy used to generate electricity (excl. auto-producer electricity plants which are assigned to industry), including for electricity exports. Electricity imports are only used for the calculation of net energy tax revenues (as imported electricity is typically also subject to electricity excise taxes where they exist).
Other GHG (excl. LUCF)	All other GHG emissions include methane, nitrous oxide from agriculture, fugitive emissions from oil, gas and coal mining activities, waste and industrial processes, as well as non-fuel combustion CO_2 emissions from industrial processes (mainly cement production) and F-gas emissions. Excludes LUCF emissions. Excludes CO_2 emissions from fuel combustion which are reported in the agriculture & fisheries sector.	Not applicable.

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).
Source: Own classification based on information on energy flows contained in the IEA's extended world energy balances (IEA, 2020[38]) and "other GHG" reported in the Climate Watch dataset (2020[39]).

To enable like-for-like comparisons across countries, the database uses consistent sector and product definitions for all countries. Table 1.3 provides an overview of the six economic sectors used in the database, and defines the GHG emissions and energy base associated with them. GHG emissions and energy use are allocated to the sector where the primary energy is consumed. The primary energy use associated with electricity generation is, for instance, allocated to the electricity sector, even if the electricity is consumed by households. Due to data limitations and to facilitate comparisons with previous vintages of this database, other GHG emissions are not allocated to the six economic sectors, but introduced as a new, seventh sector, in the GHG pricing dataset (see Chapter 2). Table 1.4 contains more details on how energy products are aggregated in the database, and in which dataset they are included.

Table 1.4. Energy product definitions

Product classification	Product category	Product definition	Included in GHG emissions dataset (Chapter 2)?	Included in energy content dataset (Chapter 3)?
Fossil fuels:	Coal and other solid fossil fuels	Anthracite; bitumen; bituminous coal; brown coal briquettes; coke oven coke; coking coal; gas coke; lignite; oil shale; patent fuel; peat; peat products; petroleum coke; sub-bituminous coal	Yes	Yes
	Fuel oil	Fuel oil	Yes	Yes
	Diesel	Gas/diesel oil excl. biofuels	Yes	Yes
	Kerosene	Jet kerosene; other kerosene	Yes	Yes
	Gasoline	Aviation gasoline; jet gasoline; motor gasoline excl. biofuels	Yes	Yes
	LPG	Liquefied petroleum gas	Yes	Yes
	Natural gas	Natural gas	Yes	Yes
	Other fossil fuels and non-renewable waste	Additives; blast furnace gas; coal tar; coke oven gas; converter gas; crude oil; ethane; gas works gas; industrial waste lubricants; municipal waste (non-renewable); naphtha; natural gas liquids; other hydrocarbons; other oil products; paraffin waxes; refinery feedstocks; refinery gas; white and industrial spirit	Yes	Yes
Biofuels:	Biofuels	Biodiesels; biogases; biogasoline; bio jet kerosene; charcoal; municipal waste (renewable); other liquid biofuels; primary solid biofuels	CO_2 emissions from the combustion of biofuels included as memo item only.	Yes
Non-combustible energy sources:	Hydro	Hydro	No	Yes
	Geothermal	Geothermal	No	Yes
	Solar, wind, ocean	Solar photovoltaics; solar thermal; tide, wave and ocean; wind	No	Yes
	Nuclear	Nuclear	No	Yes
	Other electricity and heating sources	Electricity imports; heating imports; other elec. & heat. sources	No	Yes

Note: Own classification. Energy products are as defined in IEA, *World Energy Statistics and Balances* (2020[38]).

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Notes

[1] Among the other price-based policy instruments, both fuel excise taxes and a subset of fossil fuel support measures also apply to a base that is proportional to CO_2 emissions, and they are therefore included in the Net Effective Carbon Rates indicator. However, as the applicable rates are not linked to a carbon price, they do not provide a consistent carbon price across fuels with different carbon intensities. In addition, they typically only apply narrowly to certain fuels, (e.g., diesel and gasoline used for road transport).

[2] In addition to CO_2 emissions, this dataset covers methane (CH_4), nitrous oxide (N_2O), fluorinated gases (F-gases), which include hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6).

[3] The Inventory of Support Measures for Fossil Fuels is available for OECD and G20 economies and Eastern Partnership countries. For all other countries covered in this report, the OECD Secretariat collected original data on budgetary transfers and related measures.

[4] The report is based on data and information that pre-date the war that began with Russia's offensives into government-held territories in Ukraine in February 2022.

[5] This report uses the abbreviation LUCF (as opposed to the term land use, land-use change, and forestry, or LULUCF), to emphasise that the underlying GHG emissions data is sourced from CAIT dataset (Climate Watch, 2020[39]), which does not rely on countries' official inventories reported to the UNFCCC.

[6] Tax rates are those applicable on 1 April 2021 (for 2021) and 1 July 2018 (for 2018). To account for permit price volatility, ETS permit prices are the average ETS auction (or, if unavailable, spot) prices for all of 2021 and 2018, respectively. 2021 and 2018 fossil fuel and electricity subsidy estimates are based on annual data for 2020 (due to data availability) and 2018, respectively.

[7] The Secretariat first converts all tax rates into effective energy tax rates per gigajoule (GJ) based on the energy content of the taxed products, using conversion factors from the IEA (when IEA conversion factors are not available, the Secretariat uses conversion factors provided by JMTEE delegates, mainly for natural gas, or based on desk research). This approach allows tax rates to be aggregated across all energy products and energy users (as reported in Chapter 3). Fuel excise and fuel-based carbon taxes are then additionally converted into rates per tonne of CO_2 (Chapter 2), using official conversion factors from the Intergovernmental Panel on Climate Change.

[8] Where this is not the case, as for certain F-gas taxes, CO_2-equivalent rates are calculated using the best available information.

[9] Where OECD exchange rate period averages were not available, they were supplemented using IMF International Financial Statistics. Inflation gaps were supplemented using the World Bank's World Development Indicators Consumer Prices. In the case of Argentina, the GDP deflator was used as an approximation for inflation. Remaining missing 2021 values were filled with 2020 values.

[10] It is possible to obtain bottom-up estimates of tax revenues from energy use by multiplying the prevailing effective tax rates with the energy base. Bottom-up estimates do not necessarily correspond to the actual revenue and expenditures, inter alia due to differences between the base year and the rate date. Given that energy use data is available at yearly intervals, mapping the complete evolution of tax rates throughout a full year is not possible.

[11] Tax expenditure data remains highly relevant, however, in identifying and setting out individual subsidy measures, and allowing tracking of what countries themselves consider to be preferential treatment in the form of deviations from domestic tax benchmarks, along with potential revenue gain from reform (OECD, 2021[24]).

[12] This is different for emissions trading systems (and emissions-based carbon taxes), where it is usually the regulated entities who need to remit emission permits (also called allowances) for the GHG emissions of their facilities.

[13] In addition, given that the dataset takes a territorial approach to emissions and energy accounting, adding information on a destination-based tax such as VAT is not straightforward (e.g., for export-based industries).

[14] Import tariffs are not included, but similar to VAT and sales taxes, they may affect relative prices of energy products to the extent that they do not apply widely to other goods.

[15] Nevertheless, the majority of measures the Inventory documents are tax expenditures (60% of total support by USD value); virtually all recorded support takes this form for some countries. The stocktaking of individual government measures also invites assessment of ongoing relevance of support measures, and the extent to which alternative, more efficient, equitable and environmentally-friendly measures could potentially meet intended policy objectives (OECD, 2021[24]).

[16] See http://cait.wri.org/docs/CAIT2.0_CountryGHG_Methods.pdf for details regarding data source and methodology.

[17] At the time of data collection, the latest available energy use, emissions, and ETS coverage data available for all countries was from 2018, which was used as a proxy for the 2021 base. Energy use and GHG emissions declined substantially in the beginning of 2020 due to the COVID-19 pandemic. However, already in December 2020, global emissions were 2% higher than they were in the same month a year earlier (IEA, 2021[40]).

[18] ETS coverage estimates are based on the OECD's (2021[26]) *Effective Carbon Rates 2021*, with adjustments to account for recent coverage changes.

2

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

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

Carbon pricing works

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

Box 2.1. Strengths of carbon pricing

Carbon pricing:

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

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

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

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

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

Box 2.2. Fossil fuel support and effective carbon rates

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

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

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

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

Source: (OECD, Forthcoming[9])

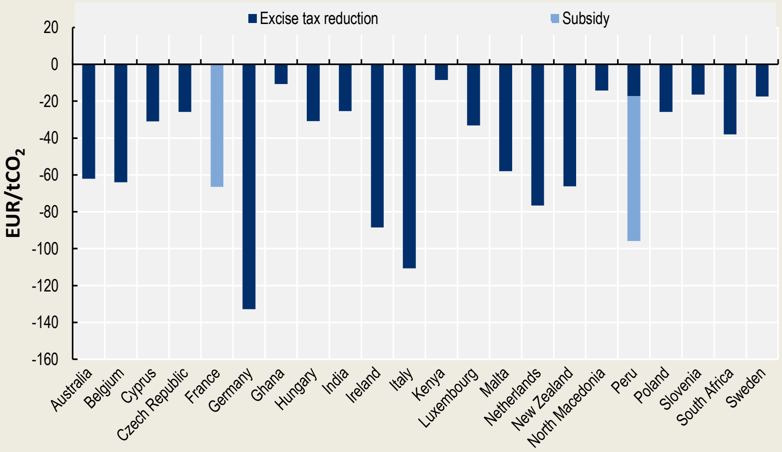
Recent measures taken in response to the energy price hikes starting in the second half of 2021 and amplified during the first half of 2022 are not yet reflected in the data, even though the associated reductions in effective carbon rates are expected to be substantial. France, for instance, introduced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

Box 2.3. Policy responses to recent fuel price increases

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

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

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



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

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

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

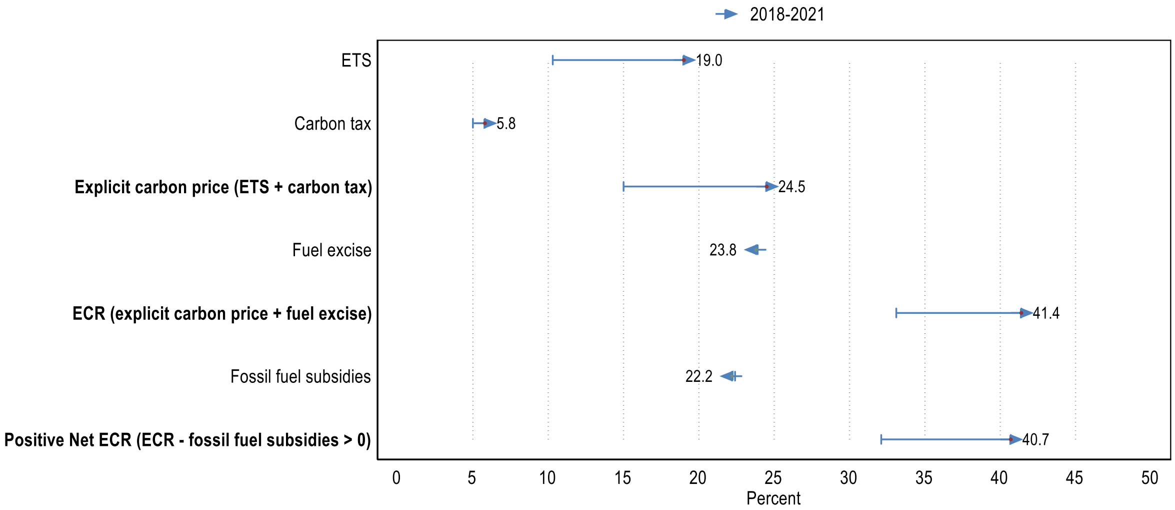
In light of the potential negative effects of tax reductions, other more targeted measures, such as income support (e.g. temporary and targeted cash transfers), would be more appropriate. However, some of these measures may require a relatively sophisticated level of administrative capacity to identify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

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

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

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

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



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

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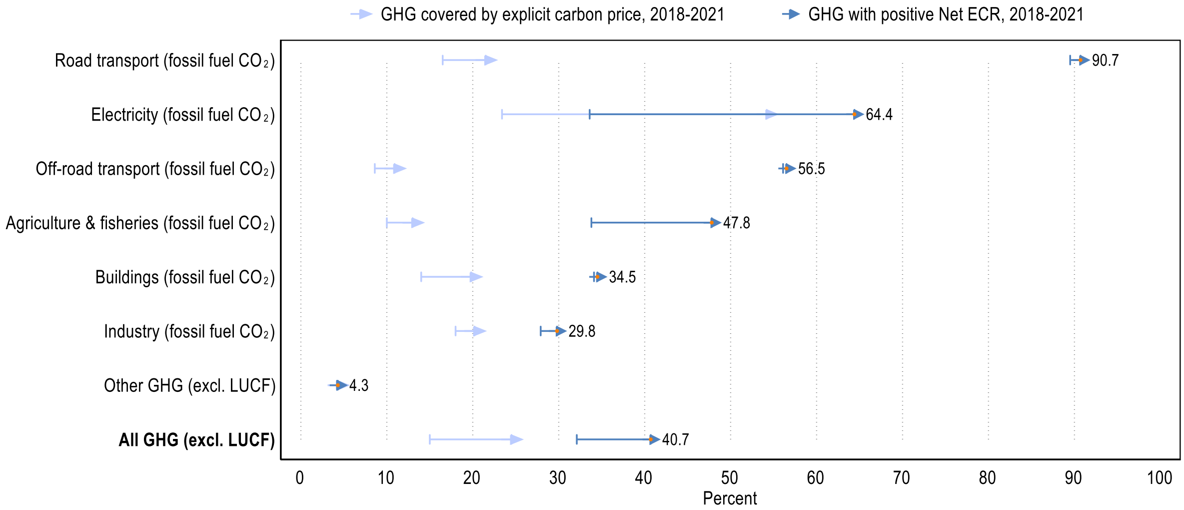
Coverage by carbon pricing instruments continues to vary across sectors, with recent increases concentrated in the electricity sector. Figure 2.3 shows how emissions coverage across the 71 countries covered in this report has evolved by sector between 2018 and 2021. In the electricity sector, coverage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

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

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

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

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



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

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

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

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

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

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

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

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

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

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

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

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

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

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

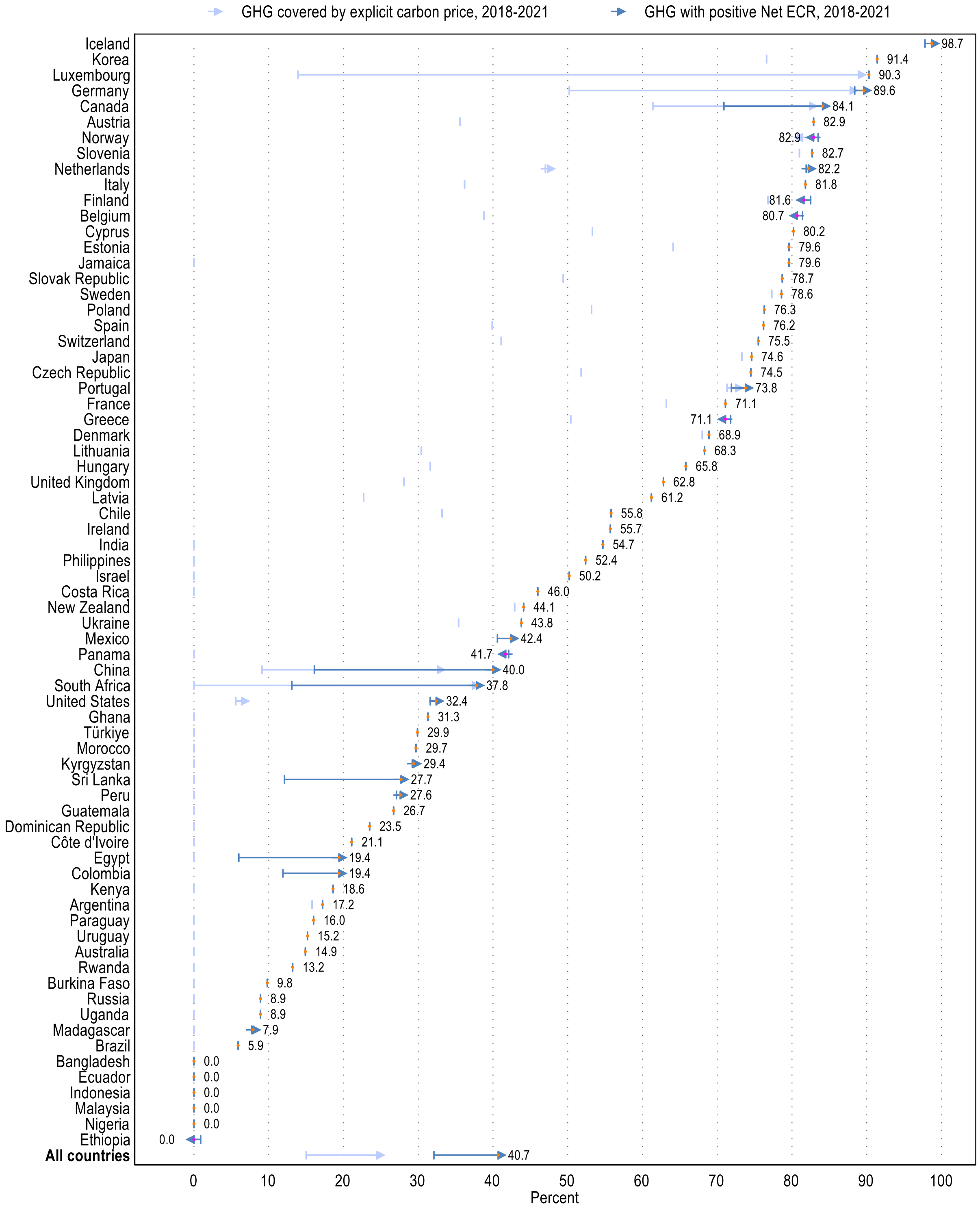
Source: (Henderson, Frezal and Flynn, 2020[16]; Henderson et al., 2021[15]; Henderson et al., 2022[17]; OECD, 2019[18]; Intergovernmental Panel on Climate Change, 2019[19])

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

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

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

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



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

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

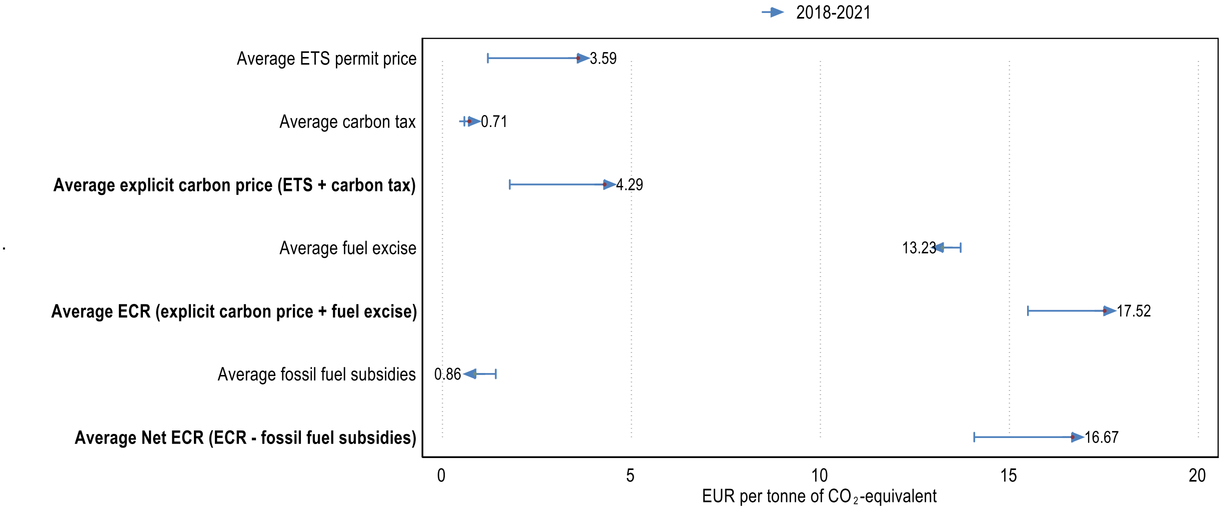
In some countries, explicit carbon prices have increased considerably. EU ETS prices averaged EUR 53 per tonne of CO_2e in 2021, which is more than three times the average EU ETS price of 2018 in real prices (EUR 17).[12] Allowance prices of the newly established UK ETS traded at approximately EUR 56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

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

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

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

Figure 2.5. Average effective carbon prices in EUR/tCO2e, by instrument, all countries, 2018-2021



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

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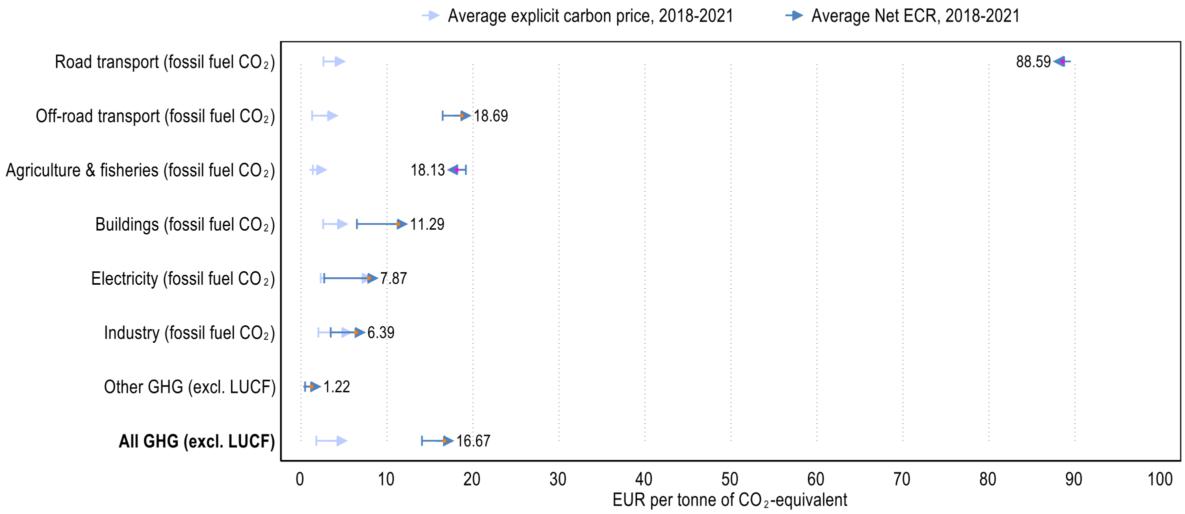
The Net ECR continues to be highest in road transport. As shown in Figure 2.6, the average Net ECR across the 71 countries in road transport is EUR 89 per tonne of CO_2e, almost unchanged since 2018.

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

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

Figure 2.6. Average effective carbon prices in EUR/tCO₂e, by sector, all countries, 2018-2021



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

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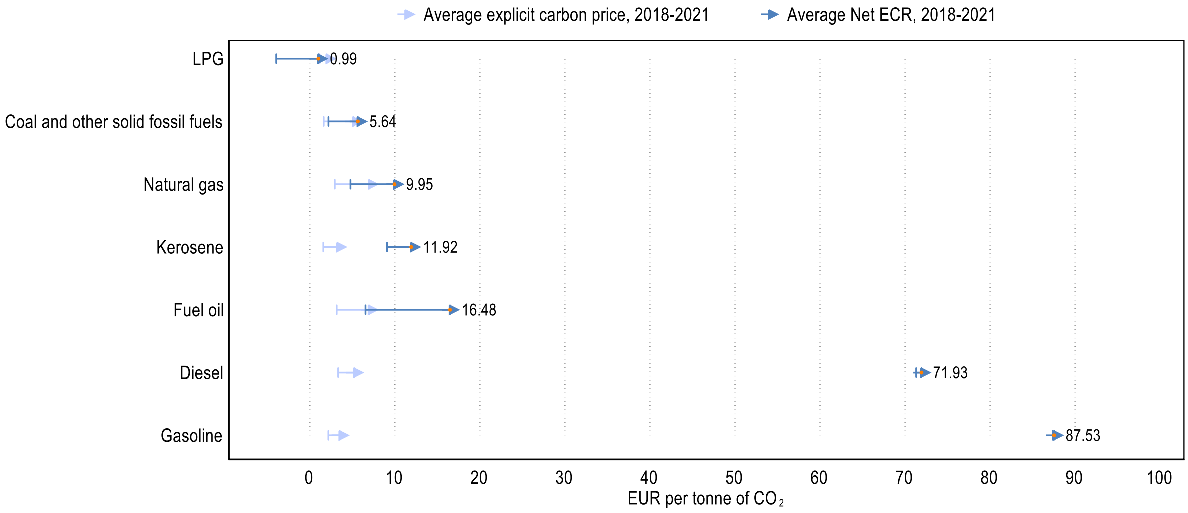
Carbon prices have increased across all fossil fuels, as shown in Figure 2.7. Recent increases are often driven by higher explicit carbon prices. However, the average Net ECR on fuels that are predominantly used in road transport continue to be significantly higher than those on other fuels. With a net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

Figure 2.7. Average effective carbon prices in EUR/tCO2e, by fuel, all countries, 2018-2021



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

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

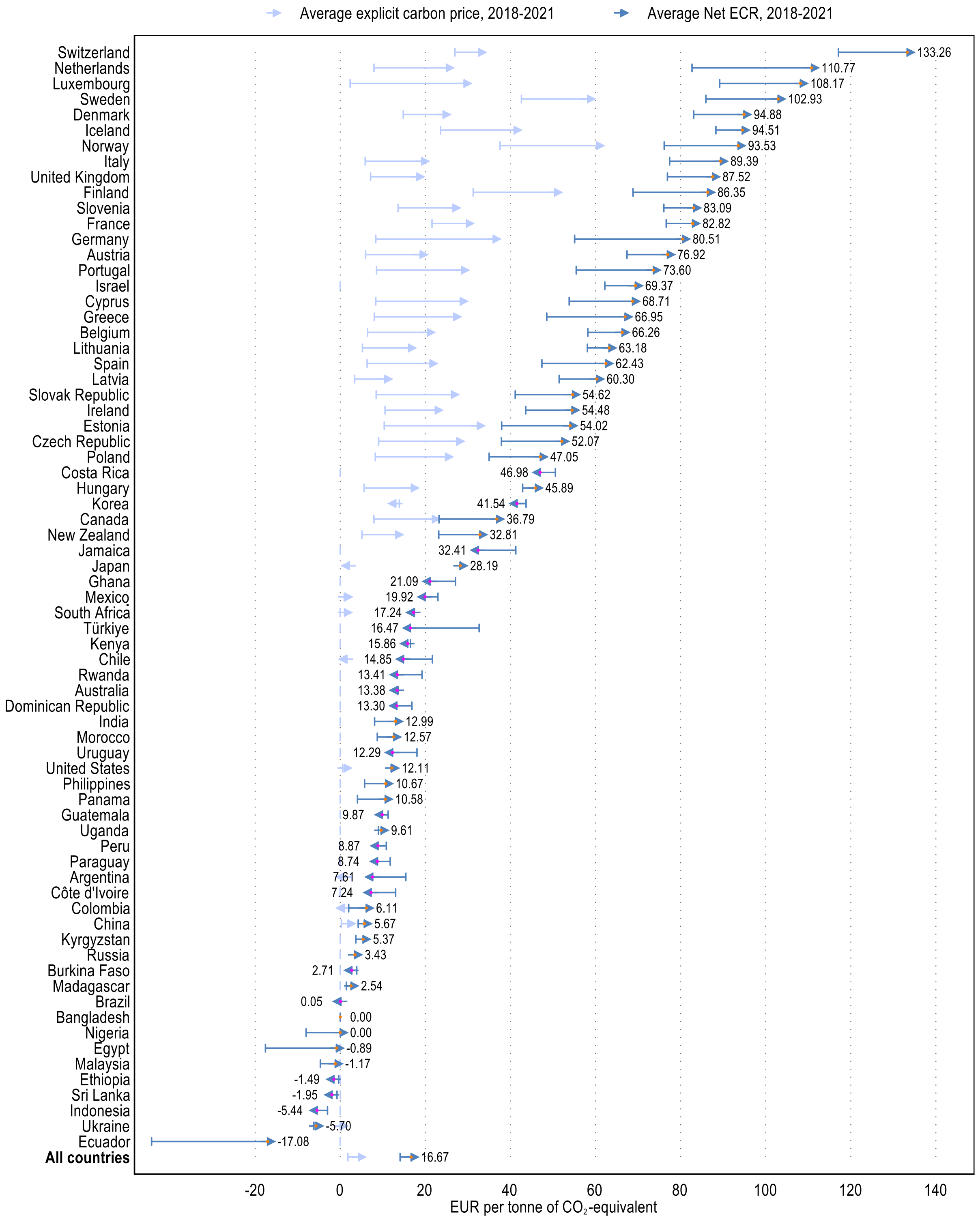
The impact of fuel excise taxes and exchange rate fluctuations on the increase in Net ECRs among countries that already had relatively high Net ECRs to begin with is mixed; inflation exerted some downward pressure on the average Net ECR (which is expressed in real euros). The main noticeable positive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

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

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

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

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



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

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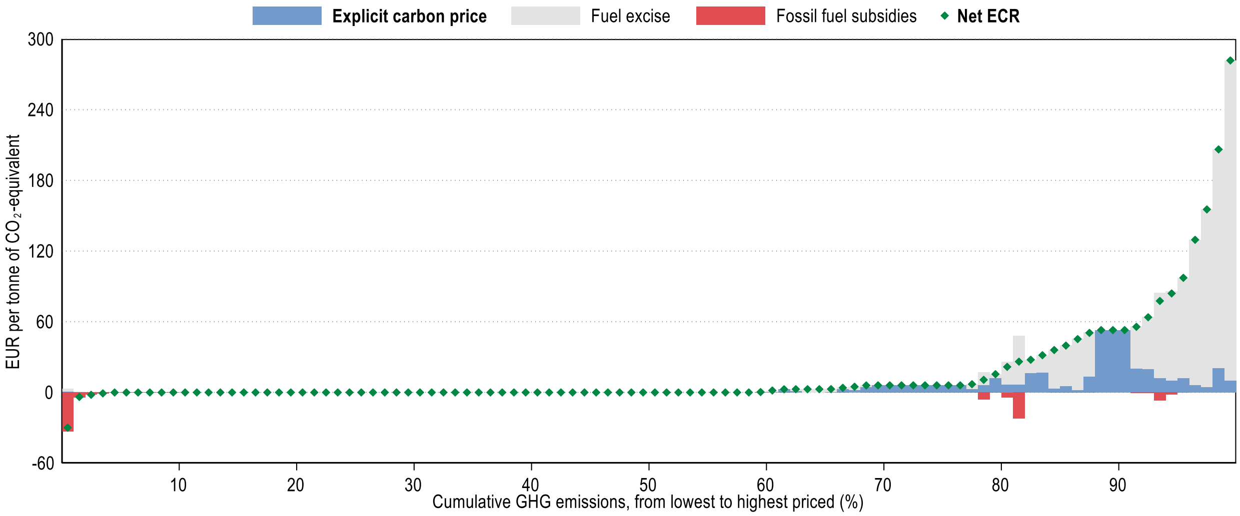
Carbon price heterogeneity persists, also in industry and electricity

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

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



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

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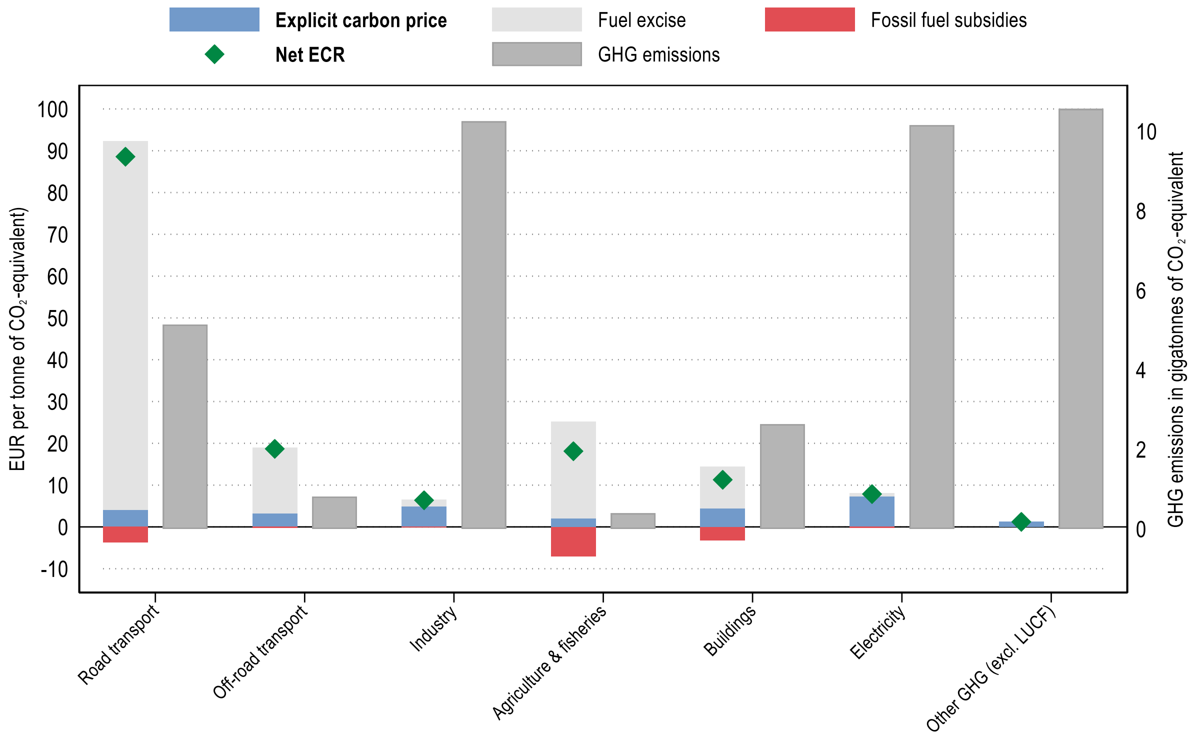
The highest effective carbon prices tend to be the result of relatively high fuel taxes in the road sector. Emissions from industry, power and other GHG are usually mostly priced by emissions trading systems or carbon taxes, at lower rates than road fuels, or remain entirely unpriced. As a result, the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

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



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

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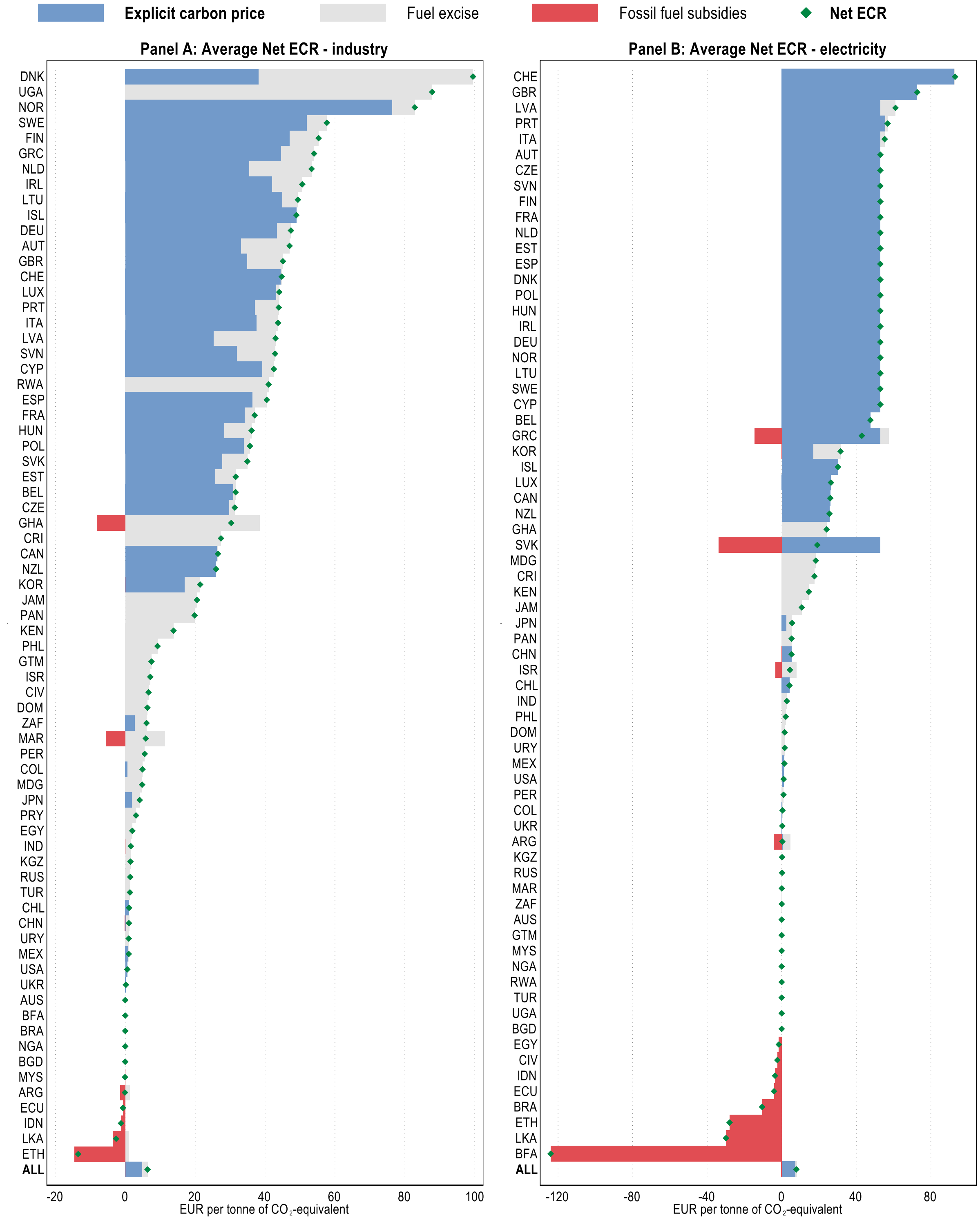
In discussions around carbon leakage and competiveness, industry and electricity sectors take centre stage. Figure 2.11 shows that inter-country heterogeneity in these sectors is indeed large.[15]

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



Note: Panel B does not include Paraguay as its electricity mix is 100% hydro power, which does not have any CO2 emissions. Effective carbon prices are averaged across all fossil fuel CO2 emissions of each sector, including those emissions that are not covered by any carbon pricing instrument. 2021 Fossil fuel subsidy estimates are based on data for 2020. Prices are rounded to the nearest eurocent.

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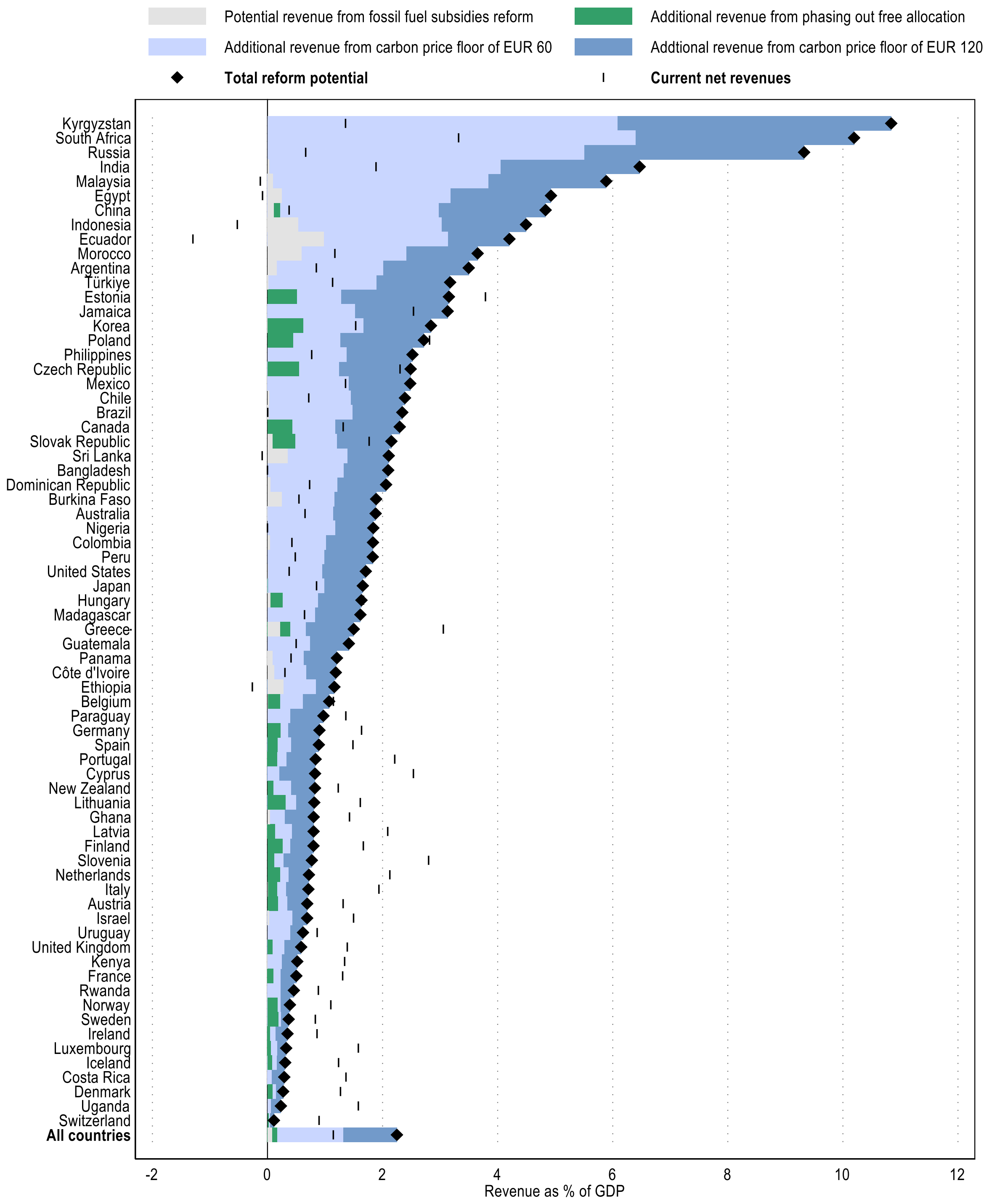
Increasing effective carbon prices could raise substantial revenues, while cutting emissions

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

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

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



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

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

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

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

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

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

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

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

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

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

Table 2.1. Emission responsiveness to ECR by sector

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

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

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

Carbon pricing and the sustainable development goals

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

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

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

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

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

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

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

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

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

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

Box 2.6. Explicit carbon pricing in developing and emerging economies

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

Table 2.2. Explicit carbon pricing in developing and emerging economies

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

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

Unlocking further mitigation efforts

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

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

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

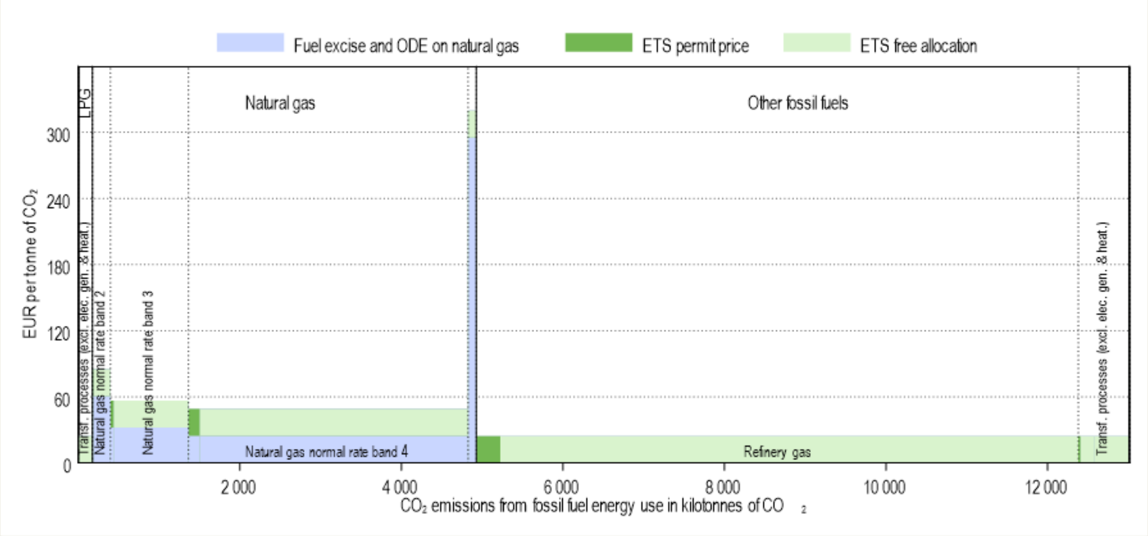
Competiveness and carbon leakage concerns often hold back carbon price reform. The evidence from OECD countries is that at historical price levels with modest carbon price differences across countries there are no discernible effects (Dechezleprêtre et al., 2022[36]; OECD, 2021[37]; Venmans, Ellis and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

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

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

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

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



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

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

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

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

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

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

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Notes

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3 Taxes and subsidies on energy use

This chapter provides an overview of energy tax and subsidy patterns in the 71 countries covered in the report and estimates the net effect of energy taxes and subsidies on public finances. The chapter then compares the Net Effective Energy Rate (Net EER) across all forms of energy use, including fossil fuel use, but also energy sources that do not emit CO_2 when used, such as hydro, wind and solar. The Net EER is the sum of fuel excise and electricity taxes, carbon taxes, and permit prices related to emissions trading systems that apply to CO_2 emissions from energy use, net of fossil fuel and electricity subsidies that reduce pre-tax energy prices. The chapter applies the Net EER to analyse whether fossil fuels are effectively taxed more than other energy sources and to compare effective tax rates on diesel and gasoline.

Energy taxes and subsidies are ubiquitous and extend beyond fossil fuels

Almost all countries covered in this report collect energy taxes (i.e. excise taxes on fuels or on electricity consumption). These taxes raise government revenues and increase energy prices, thereby reducing energy use and the negative side-effects associated with it. However, energy taxes are often poorly aligned with the environmental costs of energy use.

The most common form of energy taxes are fuel excise taxes, but electricity use is sometimes also taxed. Fuel excise taxes, even where they are not explicitly linked to a carbon price, are similar to carbon taxes in that the tax liability increases proportionally to fossil fuel use. However, they typically only apply narrowly to certain fuels (e.g. gasoline used for road transport or specific heating fuels). In addition, tax rates do not align with fuels' carbon content systematically, so they do not provide a consistent carbon price across the economy (see also Chapter 2).

Electricity excise taxes do not apply to the energy sources used to generate it, but rather to tax certain forms of electricity consumption, which is why they are sometimes called output taxes. Electricity taxes are often specified per kWh of electricity use (Chapter 1), and typically do not distinguish between the sources used to generate electricity. As a result, in many countries they tend to make electricity more expensive even when it is produced from clean energy sources and are therefore not included in the effective carbon rates indicator discussed in Chapter 2 (OECD, 2019[1]).

In addition to taxing energy use, several countries also grant subsidies on certain forms of energy use. Subsidies for energy use put a burden on public finances and change incentives for energy use, often in environmentally harmful ways. Fossil fuel subsidies, as defined in Chapter 1, effectively reduce domestic pre-tax fossil fuel prices below supply costs, encouraging fossil fuel use. This is, for example, the case for several liquid fuels in Colombia and Ecuador, heating fuels used by households in Greece and Hungary, and LPG in Morocco. Countries also provide electricity subsidies that reduce pre-tax electricity prices (e.g. in Argentina, Burkina Faso, Dominican Republic).

Governments could use more targeted tools than subsidies or energy tax reductions to achieve the important policy objectives of energy access and energy affordability (OECD, 2021[2]). Fossil fuel and electricity subsidies and energy tax cuts on energy use tend to benefit richer energy users more than poorer ones, especially in absolute terms, and "are generally detrimental to the economic, social, and environmental dimensions of sustainable development" (Rentschler and Bazilian, 2016[3]). Reducing fossil fuel support could free up public funds for higher value uses, including targeted support to low-income groups to ensure that such reform not only provides short-term relief but becomes a fully integrated component in a country's long-term sustainable development strategy (Rentschler and Bazilian, 2017[4]).

The subsidy reform experience of Egypt is an example of where this has happened effectively in recent years. However, as discussed in Chapter 2, many governments both in and beyond the OECD have reacted to recent energy price hikes by introducing new forms of fossil fuel support (Van Dender et al., 2022[5]). Even where this support has been described as temporary, it may be challenging to roll back as prices stabilise.

Not all forms of subsidies or energy tax cuts are equally harmful from an environmental and public health perspective. For instance, LPG subsidies that are in place in number of developing and emerging economies (e.g. Argentina, Côte d'Ivoire, Dominican Republic, Ecuador, India, Indonesia, Kenya, Malaysia, Morocco, Panama), can help to avoid the use of more polluting fuels, such as traditional firewood – an informal market fuel.[1]

In some cases, subsidies on electricity use may be associated with higher fossil fuel use in the short term, but could also play an important role in accelerating electrification. Electrification is a promising decarbonisation option for transport, industry and heating as long the power sector itself transitions to net zero GHG emissions. Despite these considerations, electricity subsidies impose a burden on public budgets, and can discourage private investment in the sector, which could slow down the transition to a clean power sector capable of serving countries' low-carbon energy needs.

Several developing countries intend to reduce electricity subsidies (e.g. the Dominican Republic has planned decrease of electricity subsidies starting from November 2021, with the phase-out to be completed by in 2026) (Superintendencia de Electricidad, 2021[6]). Others, such as Malaysia, have improved the targeting of electricity subsidies to the poorest households (Ministry of Finance Malaysia, 2018[7]).

Where it is not possible to phase out electricity subsidies (e.g. because more targeted support faces administrative obstacles), subsidies for electricity could be made conditional on environmental criteria (e.g. on implementing recommendations from an energy audit, or on investing a portion of the subsidy on emissions reduction projects).

What is the net effect of energy taxes and subsidies on public finances?

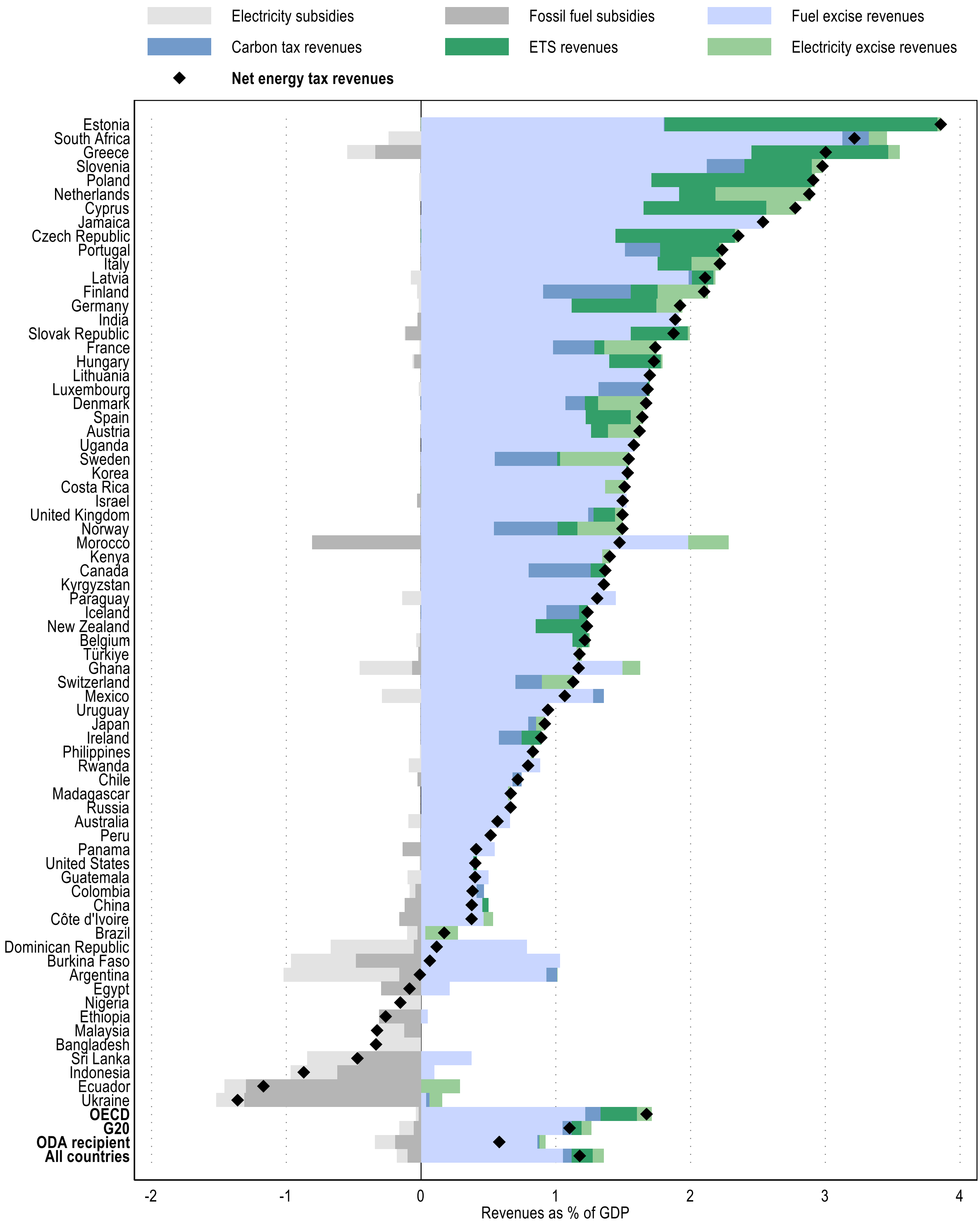
The mix of taxes and subsidies on energy use varies across countries, and so does their net effect on public finances. Figure 3.1 shows that in 61 out of the 71 countries covered in this report, tax revenues exceed the cost of the subsidies within the scope of this report in 2021. This means that the overall contribution of these energy tax and subsidy policies to public finances and domestic resource mobilisation is positive. Tax revenues were estimated based on the Net EER dataset, which maps fuel and electricity excise taxes, carbon taxes and permit prices from emissions trading systems, as well as fossil fuel and electricity subsidies to the corresponding domestic energy use (Chapter 1).

After netting out fossil fuel and electricity subsidies, taxes on energy, as well as revenues resulting from the sale of emission allowances, make a relatively larger contribution to public finances in OECD countries than in other parts of the world. Taking the simple average across all 71 countries covered in this report, net energy tax revenues are in the magnitude of 1.2% of GDP. The contribution exceeds 3% of GDP in Estonia, Greece and South Africa. The OECD average is 1.7%, in G20 countries it is 1.1%, and in low and middle-income countries that are eligible for official development assistance it is 0.6%.

The cost of subsidies on energy use sometimes exceeds the revenues from energy taxes. In this case, the net effect of energy tax and subsidy policies represents a burden on public finances. This is most common in oil producing countries, such as Ecuador, Egypt, and Nigeria. However, reforms have often already reduced these subsidies substantially in recent years, as discussed in more detail in Chapter 2.

The magnitude and composition of energy tax revenues is likely to change in the coming years as the transition to a low-carbon economy accelerates. During the transition, some of the existing tax bases are expected to be eroded over time. In this respect, the road sector is of particular relevance, considering that it is an important source of fuel excise tax revenues (OECD/ITF, 2019[8]). With the rise of electric vehicles and mode shifts to other mobility options this fuel excise tax base is eroding gradually. This suggests the need to anticipate this shift and proactively design policies that take this transition into account (Van Dender, 2019[9]).

Figure 3.1. Net energy tax revenues estimates, 2021



Note: Net energy tax revenues are a bottom-up estimate of the net revenues resulting from taxes and subsidies on energy, and the revenues from auctioning emissions permits for energy-related CO_2 (estimated based on OECD (2021[10])). Bottom-up revenue estimates may not correspond to the actual revenues and expenditures, inter alia due to differences between the base year and the rate date. Subsidy estimates are for 2020 and are based on data on relevant budgetary transfers from the Inventory of Fossil Fuel Support where available and original research for the other countries (OECD, Forthcoming[11]). Country groupings are simple (unweighted) averages. G20 refers to the 18 individual G20 countries covered in this report. ODA recipient refers to all ODA recipient countries covered in this report.

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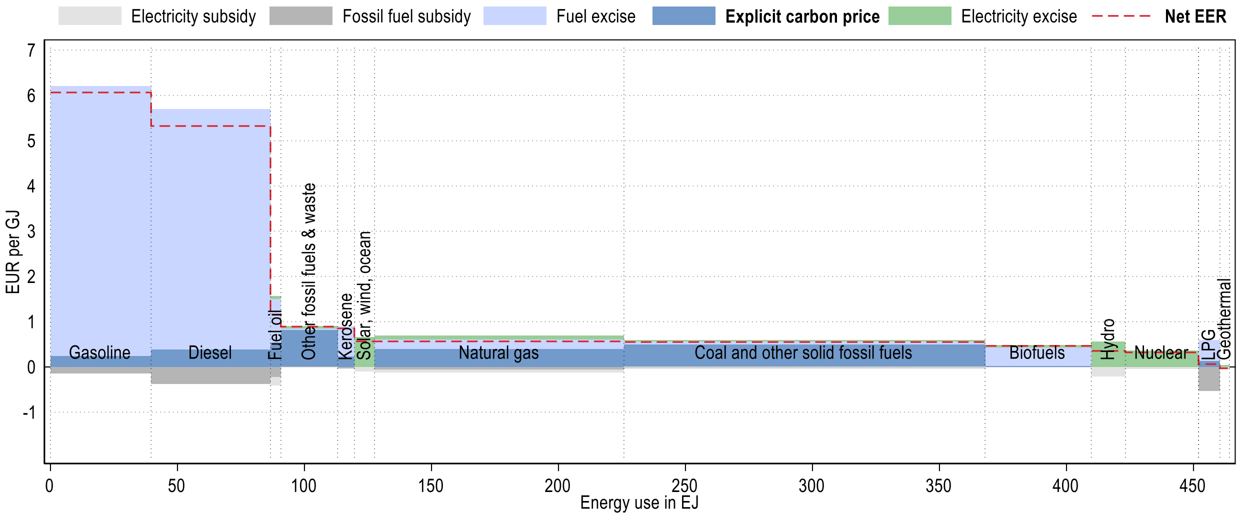
Effective energy rates vary across products, but are generally higher on fossil fuels

Taxing more polluting forms of energy use at higher effective rates, net of subsidies, can shift energy demand towards cleaner energy sources. Chapter 2 already showed that net effective carbon rates are generally poorly aligned with the climate costs of fossil fuel use. However, incentives for reducing fossil fuel use are also affected by the relative tax treatment of fossil fuels vis-à-vis other energy sources that do not emit GHG emissions when used (and are hence beyond the scope of effective carbon rates). A higher relative tax burden on fossil fuels, for instance, strengthens the economic case for switching to electric vehicles in passenger transport. It can also help to improve the business case for decarbonising industrial processes (e.g. in the steel sector). Changing relative prices in favour of cleaner sources can also contribute to directing private and public resources towards the development of new clean technologies. Switching to cleaner sources, such as electricity from hydro power, as well as wind and solar, also comes with important co-benefits, including reduced morbidity and mortality from local air pollution (OECD, 2019[1]).

Effective energy rates are highest for fossil fuels used in road transport. Figure 3.2 shows that the average Net EER varies widely between energy products. The biggest difference in average Net EERs is between fossil fuels primarily used in road transport (gasoline and diesel) and other fossil and non-fossil fuel energy sources. Where coal is priced, it is mainly the result of explicit carbon pricing in the industry and electricity sector. On average, natural gas is priced at similar levels to coal. However, fuel excise taxes are relatively more common for natural gas, which mostly apply to natural gas used for space heating in the buildings sector. For both coal and natural gas, electricity excise taxes practically cancel out electricity subsidies when calculating the average for the 71 countries (Figure 3.2). Fossil fuel subsidies are relatively high for LPG (relevant in Ecuador, Egypt, Morocco, and India), but on average the Net EER for the group of countries considered in this report remains positive, mostly due to fuel excise taxes.

Figure 3.2. Average effective energy rates, by product category, 71 countries, 2021



Note: Subsidy estimates are for 2020. Energy use data is for 2018 (IEA, 2020[12]).

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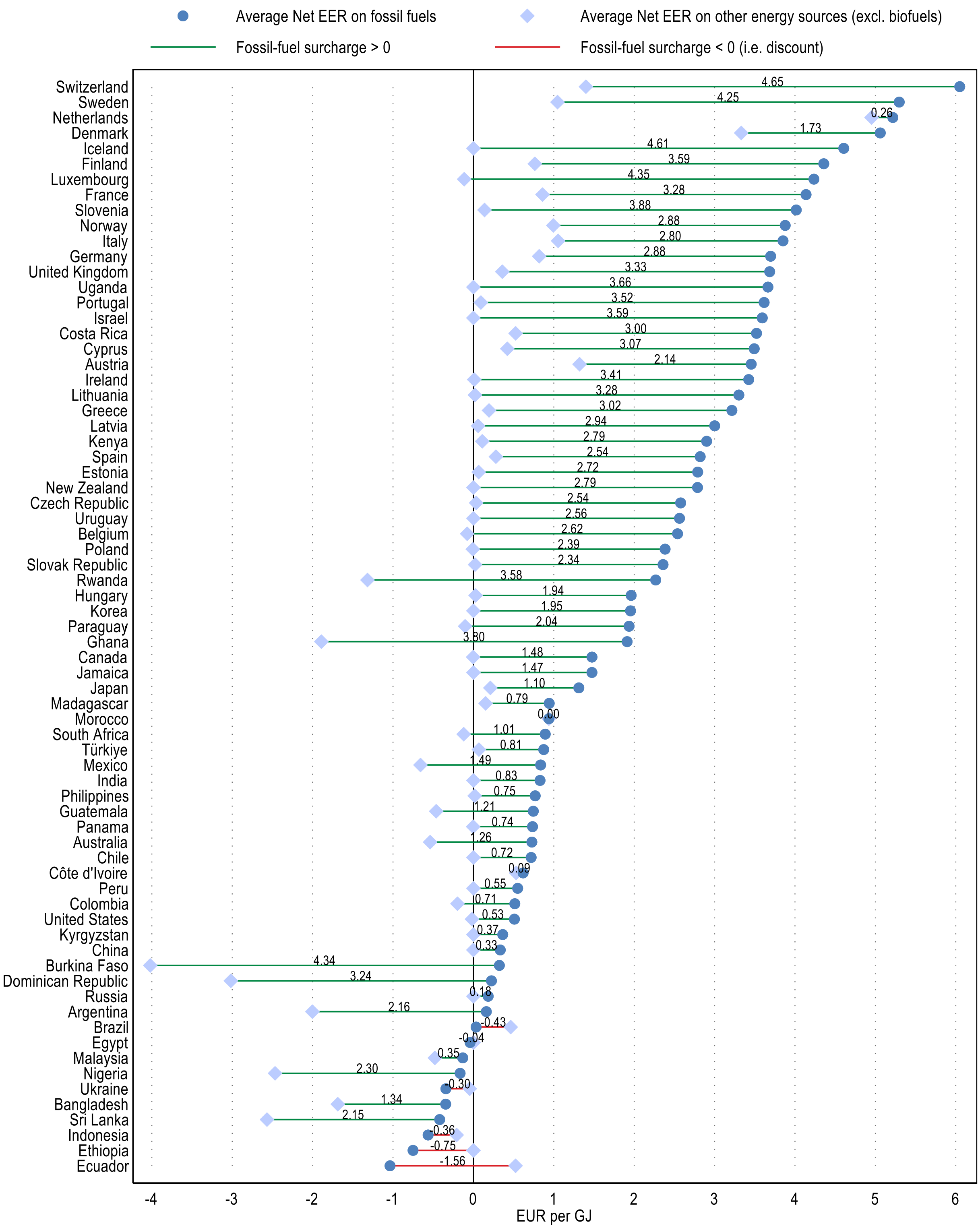
The net effect of energy taxes and subsidies is non-negligible for many non-fossil alternatives, mainly because of electricity taxes. Electricity taxes dominate the Net EER for renewables (with the exception of biofuels) and nuclear. Electricity subsidies also apply to electricity produced from renewable sources, pushing down the Net EER. However, the Net EER remains positive, on average, with the exception of geothermal (which is a major source of electricity produced in the Philippines, where there are electricity subsidies). Note that direct support measures for renewable power production, such as feed-in tariffs, are beyond the scope of the instruments covered in this report (Chapter 1).

Most countries tax fossil fuels at a higher Net EER than other energy sources. Figure 3.3 shows, however, that the difference between the average Net EER on fossil fuels and on other energy sources (excl. biofuels) – the fossil-fuel surcharge – varies substantially across countries. Switzerland has the highest average Net EER on fossil fuels, and also the highest “fossil-fuel surcharge”. There are some countries with a negative fossil combustion surcharge. In countries that tax other energy sources at a higher Net EER on average, this is either because of relatively high taxes on the consumption of electricity (e.g. Brazil) or because of relatively high subsidies on fossil fuels (e.g. Ethiopia), or a combination of the two (e.g. Ecuador). Averages and the fossil fuel surcharge are affected by the composition of energy use and need to be interpreted with caution (see also, Chapter 2). Net EER data disaggregated by energy product categories is available on OECD.STAT.

Figure 3.3. On average, in 2021 fossil fuels are effectively taxed more than other energy sources



Note: Sorted by average Net EER on fossil fuels, starting with the highest at the top of the figure. The labels mark the values of the fossil-fuel surcharge rounded to the nearest eurocent. Subsidy estimates are for 2020.

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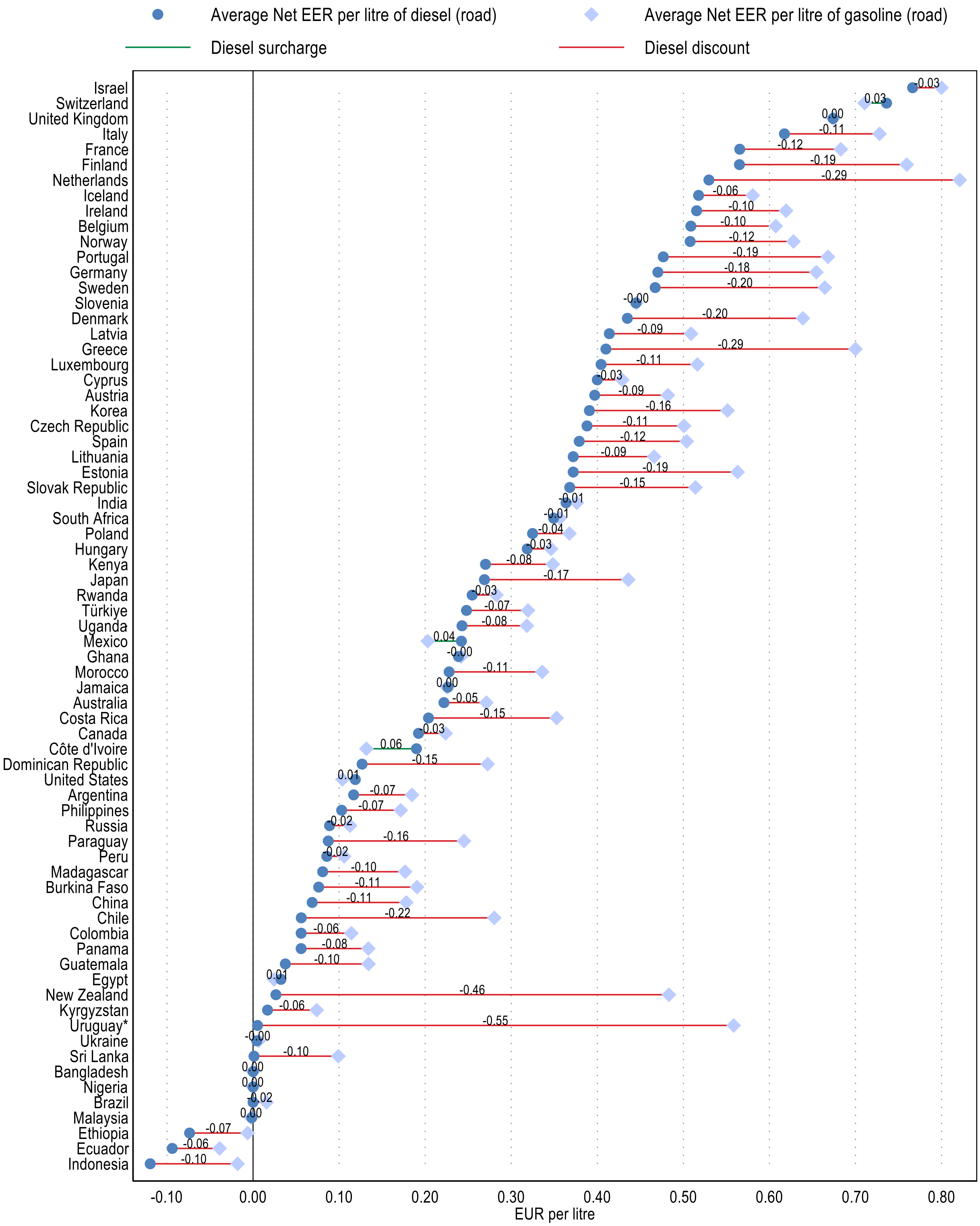
Most countries tax diesel less than gasoline, even though this is not supported by environmental considerations

From an environmental perspective, diesel merits being taxed at higher effective rates per litre than gasoline. Climate considerations suggest taxing diesel at the same effective rate as gasoline per tonne of CO_2, which translates into a higher effective rate per litre because CO_2 emissions per litre of diesel are higher. In addition, non-climate damage per litre of diesel use tends to be higher than for gasoline use, even though regulations and emission control technologies could reduce the difference. This damage includes environmental externalities such as air pollution, as well as congestion (Harding, 2014[13]).

However, diesel for road use only faces a higher average Net EER per litre of fuel than gasoline in seven out of the 71 countries covered in this report (Côte d'Ivoire, Egypt, Jamaica, Malaysia, Mexico, Nigeria, Switzerland and the United States).[2] In Bangladesh and the United Kingdom the average Net EER on diesel and gasoline in road transport is identical per litre. Bangladesh neither taxes nor subsidises diesel and gasoline in the road sector. There has been little change in the tax preference enjoyed by diesel in many countries - the diesel discount - since 2018 (OECD, 2019[1]; OECD, 2021[2]).

Figure 3.4. The diesel discount



Note: Sorted by average Net EER on diesel, starting with the highest at the top of the figure. The labels mark the values of the diesel surcharge, which is negative for countries with a diesel discount, rounded to the nearest eurocent. Uruguay is marked with an asterisk because in Uruguay diesel used in road transport is subject to VAT (outside the scope of this report), but no fuel excise, whereas gasoline is subject to fuel excise, but not VAT. Subsidy estimates are for 2020.

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Notes

[1] Nevertheless, replacing these subsidies with direct support for cleaner alternatives, such as solar, could accelerate the energy transition (Zinecker et al., 2018[14]).

[2] For both Egypt and Jamaica, this is only true on average. In Egypt, some gasoline types do not attract excise and bring the gasoline average below the average for diesel. Otherwise where fuel excise taxes apply, rates tend to be higher for gasoline than for diesel in Egypt. In Jamaica, taxes differ between types of gasoline, one is taxed below diesel, and this dominates the average Net EER. Nigeria subsidises gasoline and does not price diesel. Malaysia subsidises gasoline more than diesel (no energy or carbon taxes apply).

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Accelerating the transition to net zero greenhouse gas (GHG) emissions is urgently required to contain the risks of climate change. As countries seek to reduce GHG emissions, they can employ or reform a wide range of policy instruments. This report tracks how explicit carbon prices, energy taxes and subsidies have evolved between 2018 and 2021. This is an important subset of the policy instruments available to governments. All instruments considered in this report either directly change the cost of emitting GHG or change electricity prices. Reforming these instruments could help to meet climate targets, lead to cleaner air and water, and improve public finances. The report covers 71 countries, which together account for approximately 80% of global GHG emissions and energy use. Explicit carbon prices, as well as energy taxes and subsidies are detailed by country, sector, product and instrument. The use of a common methodology ensures comparability across countries. Summary indicators facilitate cross-country comparisons and allow policy makers and the public to keep track of progress made and identify opportunities for reform.

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