Taxing Energy Use 2019

USING TAXES FOR CLIMATE ACTION

OECD

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Preface

Public pressure is mounting for action on climate change. Keeping climate change at bay in line with the goals of the Paris Agreement will require deep cuts in emissions. In the absence of decisive action, extreme weather events such as storms, floods, droughts and heat waves will become more frequent and severe, and rising sea levels will endanger coastal cities and entire island states. Against this background, it is disconcerting that energy-related CO_2 emissions reached an all time high in 2018.

While not in itself sufficient, taxing polluting fuels is an effective way to help curb emissions that harm the planet and human health. Well-designed systems of energy taxation encourage citizens and investors to favour clean over polluting energy sources. As a result, citizens and businesses will consume fewer carbon-intensive goods and services, and gradually transition to low or zero-carbon activities. Taxes on fuels equally discourage investments in carbon-intensive assets, such as coal-fired power stations, which reduces the risk of high adjustment costs in the future. Unlike most other climate policy instruments, energy and carbon taxes raise government revenues, which can be used to ease the low-carbon transition for vulnerable groups.

Raising the price of energy is a very effective way of reducing emissions but the impacts on households can be large. Some households may find that normal patterns of energy use become unaffordable. Many may find it difficult to cut energy consumption quickly, meaning that spending on other items falls. In general, care must be taken that energy price reform does not become unbearable. The OECD investigates the impacts of energy price reform, and finds that using a part of the revenues from higher energy taxes is often sufficient to ensure that energy affordability is maintained; broader revenue recycling strategies – e.g., revenue transfers, or income tax reductions – allow ensuring that decarbonisation efforts are equitable. The detailed stocktake of energy taxes in this report provides policy-makers with precise information to help identify the most effective and inclusive reform options.

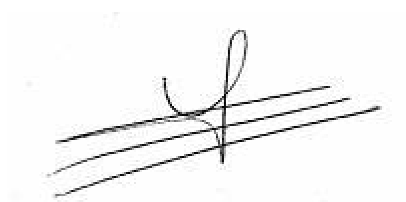
The OECD's *Taxing Energy Use 2019* shows that governments are not deploying energy and carbon taxes to their full potential. The report identifies avenues for policy reforms that will improve environment and climate outcomes while simultaneously boosting the performance of the fiscal system to promote equity, well-being, competitiveness, and efficient tax policy. The report presents new and original data on energy taxes and carbon taxes in OECD and G20 countries, and in international aviation and maritime transport. Tax rates and tax coverage are detailed by country, sector, energy source and tax type. The use of a common methodology ensures full comparability of tax rates and structures across countries. Summary indicators facilitate cross-country comparisons.

Taxes on polluting fuels remain too low to reduce the risks and impacts of climate change and air pollution. Seventy percent of energy-related CO_2 emissions are not taxed at all. While all countries tax road fuel, 85% of energy-related CO_2 emissions take place outside the road sector. Taxes only cover 18% of non-road emissions, leaving a tax of zero for the remaining 82%. Taxes on coal – which is behind half of non-road emissions – are zero or close to zero and lower than taxes on natural gas. For international flights and shipping fuel, taxes are zero. Only 3% of non-road emissions are taxed above EUR 30 per tonne of CO_2, a low-end estimate of the climate damage caused by a tonne of CO_2 emitted at present.

The revenue potential from carbon pricing is considerable: raising effective carbon taxes to EUR 30 per tonne of CO_2 for all energy-related emissions would generate around 1% of GDP worth of additional tax revenues across the 44 countries covered in *Taxing Energy Use*. Apart from providing countries with the means to manage the impacts of decarbonisation on vulnerable groups, revenues from carbon taxes create opportunities for broader fiscal reform. Reform options include modifying the tax mix to foster inclusive growth, e.g. through lowering income taxes or increasing investment in productivity-enhancing areas, such as education, health and infrastructure.

Taxes are not the only policy instruments that can effectively put a price on carbon. Emissions trading systems equally target CO_2 emissions from energy use and can be as effective and efficient as carbon taxes. Emissions trading systems are analysed in the OECD's *Effective Carbon Rates* report. Overall, carbon price signals remain insufficient even when considering the impact of emissions trading systems.

Tax policy can and should play a more important role in levelling the playing field for clean technologies. Better aligning energy taxes with the pollution profile of energy sources would help to reduce investment in carbon-intensive technologies and shift financial flows to greener alternatives. It is time for a comprehensive reform of energy tax systems.



Pascal Saint-Amans

Director

Centre for Tax Policy and Administration

Foreword

This report was produced by the Tax Policy and Statistics Division of the OECD's Centre for Tax Policy and Administration, in collaboration with the Environmental Performance and Information Division of the OECD's Environment Directorate. The report was drafted by Jonas Teusch under the guidance of Kurt Van Dender. The data underlying the report were prepared by Melanie Marten and Jonas Teusch. Richard Juřík contributed research on air pollution indicators. Marie-Aurélie Elkurd, Karena Garnier, Natalie Lagorce, Michael Sharratt, and Konstantinos Theodoropoulos improved the presentation and dissemination of the work.

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The report was discussed 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, in particular, the delegates to the Joint Meetings and their colleagues in national government administrations for their assistance with the provision of data, as well as for their invaluable suggestions, inputs and comments on the data and the report.

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Executive Summary

Global energy consumption rose strongly in 2018, and so did energy-related CO2 emissions, which reached a new all-time high. This is disconcerting as meeting the goals of the Paris Agreement will require deep cuts in emissions.

Well-designed systems of energy taxation encourage citizens and investors to favour clean over polluting energy sources. Fuel excise and carbon taxes are simple and cost-effective tools to limit climate change, but the politics of carbon pricing often prove to be challenging. Taxes on energy use also contribute to limiting health damage from local pollution, which is a pertinent policy concern in an urbanising world.

Taxing Energy Use (TEU) 2019 presents a snapshot of where countries stand in deploying energy and carbon taxes, tracks progress made, and makes actionable recommendations on how governments could do better. The report presents new and original data on energy taxes in OECD and G20 countries, and in international aviation and maritime transport. Tax rates and tax coverage are detailed by country, sector, energy source and tax type. The use of a common methodology ensures full comparability of tax rates and structures across countries. Summary indicators facilitate cross-country comparisons.

Too many energy users do not pay the energy and carbon prices needed to curb dangerous climate change, even when comparing carbon price signals against a low-end carbon benchmark of EUR 30 per tonne of CO_2. This benchmark is unlikely to reflect the climate damage caused by a tonne of CO2 emitted at present, and will not be sufficient to meet the objectives of the Paris Agreement. The evidence shows that tax structures are poorly aligned with the pollution profiles of energy sources. Coal in particular is taxed at comparatively low or zero rates, despite its harmful climate and air pollution impacts.

Fuel excise and carbon taxes are not the only policy instruments that effectively put a price on carbon. Emissions trading systems equally target CO2 emissions from energy use, and sometimes also include other greenhouse gas emissions and different emission sources. Emissions trading systems can be as effective and efficient as carbon taxes. Emissions trading systems that are analysed in the OECD's Effective Carbon Rates report, account for approximately 6% of carbon price signals in OECD and G20 countries.

The extent to which countries choose to price carbon emissions through taxes and emissions trading systems varies substantially. The European Union's emissions trading system, for instance, covers most emissions from electricity generation, industry, and intra-European flights. Allowances were traded at approximately EUR 25 per tonne of CO_2 at the time of writing. Overall, carbon price signals remain insufficient even when considering the impact of emissions trading systems.

Key findings

Carbon price signals are far too weak

- 85% of energy-related CO2 emissions take place outside the road sector. Taxes only price 18% of these emissions. The price signal is at least EUR 30 per tonne of CO_2 for a mere 3% of non-road emissions.
- Only four countries, Denmark, the Netherlands, Norway and Switzerland, tax non-road emissions at more than EUR 30 per tonne of CO2 on average. If emissions trading systems had been included in the analysis, the picture would have been less bleak. However, where emissions trading systems exists, permits typically trade at less than EUR 30 per tonne of CO_2 and cover only a limited share of emissions.
- Little progress has been made in extending tax-based carbon price signals. Specifically, since 2015, average effective carbon tax rates on non-road emissions increased by more than EUR 10 per tonne of CO2 in only three countries: Denmark, the Netherlands and Switzerland.
- Emissions from international aviation and maritime transport are not taxed at all. Fuels used in domestic aviation and domestic navigation are sometimes taxed, but rarely reflect a low-end carbon benchmark. Most of these emissions are not subject to emissions trading systems either.
- Effective carbon price signals are stronger in road transport, mostly because of relatively high fuel excise taxes, but the non-climate related external costs are also relatively high in road transport (e.g. local air pollution impacts). The only two countries that do not tax road emissions at EUR 30 per tonne of CO_2 or more are Brazil and Indonesia.
- Overall, taxes are not being used to provide meaningful carbon prices across fuels, not least coal – the most polluting fossil fuel. The average effective carbon tax rate on coal is close to zero across the 44 OECD countries and Selected Partner Economies. Even if emissions trading systems had been included in the analysis, carbon price signals for coal would still be very low almost everywhere.

Fuel excise taxes continue to dominate explicit carbon taxes

- In all 44 countries, effective carbon prices are driven by fuel excise taxes in the road sector.
- In non-road sectors, explicit carbon taxes tend to play a relatively more important role.

Not all energy taxes encourage deep cuts in emissions

- Electricity taxes, which typically do not differentiate between different energy sources, often fail to favour cleaner power sources, and may discourage deep cuts in emissions through electrification.
- Nevertheless, most countries encourage switching to cleaner sources by taxing combustibles more than less polluting energy sources such as hydro, wind, and solar.
- In countries that tax combustibles at relatively higher rates, energy use tends to be less carbon intensive.

Policy implications

- Strengthening carbon price signals will encourage citizens and businesses to take the climate costs of their actions into account. They would consume fewer carbon-intensive goods and services, and gradually transition to low- or zero carbon activities. In addition, clean technology firms would see their competitive position vis-à-vis polluting firms improve. Discouraging investments in carbon-intensive assets, such as coal-fired power plants, also reduces the risk of high adjustment costs in the future.

- Increasing carbon prices first where they currently are lowest makes sense. Coal is a particularly striking case in point as it is presently taxed at some of the lowest rates across all energy users despite its harmful climate and air pollution impacts. Rates are currently zero in international aviation and shipping, and near zero or very low across all users in several countries.
- Overall, most countries encourage switching to cleaner sources by taxing combustibles more than cleaner energy sources such as hydro, wind, and solar. In some countries, even revenue-neutral electricity tax reforms could strengthen incentives to reduce emissions.

1 Introduction and methodology

This chapter provides the context and motivation for the analysis of energy and carbon taxes. It also contains an overview of the main results for 44 OECD and Selected Partner Economies. In addition, the chapter discusses the methodology used to calculate effective energy tax rates (per GJ) and effective carbon tax rates (per tonne of CO_2).

Introduction

Global energy consumption rose strongly in 2018, and so did energy-related CO_2 emissions, which increased by 1.7% – a new all-time high (IEA, 2019[1]). This is disconcerting as meeting the goals of the Paris Agreement will require deep decarbonisation (UNEP, 2018[2]). The economic tools to prevent the climate crisis from worsening are readily available. Specifically, energy and carbon taxes, as well as other price-based instruments such as emissions trading systems, have what it takes to make polluters pay for the cost energy use imposes on society, and drive deep decarbonisation at the lowest possible cost to society. Regrettably, however, these tools have not yet been deployed to their full potential (OECD, 2018[3]).

Well-designed systems of energy taxation encourage citizens and investors to favour clean over polluting energy sources. Energy and carbon taxes can equally prevent excessive energy use – where the social costs of energy use exceed their private benefits. In particular, fuel excise and carbon taxes are simple and cost-effective tools to curb dangerous climate change – even though the political economy of carbon pricing can be challenging (Jenkins, 2014[4]; Sallee, 2019[5]). Energy and carbon taxes also contribute to limiting health damage from local pollution, which is a pertinent policy concern in an urbanising world. In addition, taxes on energy use are a major source of government revenue, which could increase in importance during the transition to zero-carbon economies.

Taxing Energy Use (TEU) 2019 presents a snapshot of where countries stand in deploying energy and carbon taxes to their full potential, tracks progress made, and makes actionable recommendations on how governments could do better. The report presents new and original data on energy taxes in 44 OECD countries and Selected Partner Economies, and in international aviation and maritime transport. In total, TEU 2019 covers taxes on around 80% of global energy use. TEU 2019 extends and refines the TEU methodology developed in OECD (2013[6]), OECD (2015[7]) and OECD (2018[8]). In line with previous editions of TEU, this publication reports results *including* emissions from the combustion of biofuels Annex 1.C).

TEU 2019 shows that too many polluters do not pay the energy and carbon taxes needed to avoid excessive environmental and health damage. To assess to what extent energy and carbon taxes provide incentives to reduce energy-related carbon emissions, TEU relies on a low-end carbon benchmark of EUR 30 per tonne of CO_2 (OECD, 2018[3]). This benchmark is unlikely to reflect the climate damage caused by a tonne of CO_2 emitted at present, or to be sufficient to meet the objectives of the Paris Agreement. However, even compared against this low-end carbon benchmark, countries fall short of taxing energy use in line with what climate considerations alone would suggest.

The level of carbon prices needed to meet the objectives of the Paris Agreement is generally considered to be higher than the low-end benchmark of EUR 30 used in this study. Notably, the High Level Commission on Carbon Prices has estimated that carbon prices would need to be at least USD 40-80/tCO_2e by 2020 and USD 50-100/tCO_2e by 2030 in order for emissions to decrease in line with the goals of the Paris Agreement, assuming favourable complementary policies (High-Level Commission on Carbon Prices, 2017[9]).

Since the last edition of *Taxing Energy Use*, a number of countries have introduced explicit carbon taxes, which have improved the strength of carbon price signals. Other countries are considering following suit. Against this background, TEU 2019 analyses the design of existing carbon taxes, and provides some guidance on how to move forward with carbon taxes.

A priority area for improved carbon price signals is aviation and maritime transport, where emissions are on the rise. TEU 2019 consequently extends coverage to also include international transport (aviation and maritime). International aviation and maritime transport are included as if they were countries because a universally accepted methodology as to how this energy use should be allocated to individual countries remains to be established.[1] In addition, representing international aviation and maritime transport as virtual countries is a convenient way of showing the relative importance of the sector. This allows progress made in exposing such energy use to carbon price signals and providing incentives for cleaner mobility choices to be monitored.

States and provinces play an increasingly important role in energy taxation. For the first time, this edition therefore also analyses the state of energy taxation at the subnational level, which is particularly relevant for Canada and the United States.

Electrifying final energy consumption could contribute to decarbonising energy use (IEA, 2018[10]) – provided that electricity generation itself is decarbonised. Against this background, the report models electricity taxes with greater granularity than previous releases, enabling a detailed discussion of the promises and perils of electricity taxes in the age of decarbonisation.

TEU 2019 is structured as follows. The remainder of Chapter 1 discusses the methodology. Chapter 2 analyses energy price signals across all forms of energy use, paying special attention to whether energy and carbon taxes favour low- and zero-carbon energy sources over more polluting options. Chapter 3 focuses on combustible energy sources, and establishes the extent to which carbon price signals are aligned with a low-end carbon benchmark. The chapter also discusses the differential tax treatment of coal and natural gas, carbon tax design, and the taxation of aviation and maritime transport.

Methodology

Taxing Energy Use (TEU) 2019 estimates how 43 OECD and G20 countries, as well as Colombia, tax energy use as at 1 July 2018.[2] Together, these countries represent more than 80% of global energy use.

TEU provides information on all specific taxes on energy use.[3] Specific taxes on energy use comprise carbon taxes ("explicit carbon taxes"), as well as excise taxes on fuels ("fuel excise taxes") and on the consumption of electricity ("electricity excise taxes").[4] Table 1.1. provides definitions of these specific taxes

Table 1.1. Tax types

	Definition
Explicit carbon tax	All taxes for which the rate is explicitly linked to the carbon content of the fuel, irrespective of whether the resulting carbon price is uniform across fuels and uses.
Fuel excise tax	All excise taxes that are levied on fuels and that are not carbon taxes.
Electricity excise tax	All excise taxes that are levied on electricity.

Note: Taxes are compulsory, unrequited payments, in cash or in kind, made by institutional units to government units (OECD, 2001[11]). Permit prices that result from emissions trading systems are not covered in TEU, but are included in OECD's *Effective Carbon Rates* (2018[3]) publication.

When certain energy users benefit from a full or partial refund of these taxes (e.g. for excise taxes on fuels used in commercial heavy-duty vehicles), tax rates are adjusted for the refund. Annex 1.A provides further details on which taxes are included in *Taxing Energy Use* and why.

Matching

The OECD Secretariat assigns the 2018 tax rates to the latest available information on energy use that is adapted from IEA (2018[12]), *World Energy Statistics and Balances.* The latest energy use data that were available at the time of production of the present report date from 2016. TEU 2019 thus does not take recent changes in energy use patterns into account. However, energy use tends to change slowly over time – as long as no major price changes or technological shifts take place. In most instances, 2016 data on energy use should be a good approximation of energy use in 2018.

Energy use is split across 59 energy products, and the secretariat assigns applicable tax rates to each of the energy products listed in Table 1.2. Electricity taxes are attributed to the share of the associated primary energy use that is transformed into electricity.

Table 1.2. Energy sources

Energy type	Energy category	Energy product
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
	Fuel oil	Fuel oil
	Diesel	Gas/diesel oil excl. biofuels
	Kerosene	Jet kerosene; other kerosene
	Gasoline	Aviation gasoline; jet gasoline; motor gasoline excl. biofuels
	LPG	Liquefied petroleum gas
	Natural gas	Natural gas
	Other fossil fuels	Additives; blast furnace gas; coal tar; coke oven gas; converter gas; crude oil; ethane; gas works gas; lubricants; naphtha; natural gas liquids; other hydrocarbons; other oil products; paraffin waxes; refinery feedstocks; refinery gas; white and industrial spirit
Other combustible fuels:	Non-renewable waste	Industrial waste; municipal waste (non-renewable)
	Biofuels	Biodiesels; biogases; biogasoline; charcoal; municipal waste (renewable); other liquid biofuels; primary solid biofuels
Non-combustible energy sources:	Hydro	Hydro
	Other renewables	Geothermal; solar photovoltaics; solar thermal; tide, wave and ocean; wind
	Nuclear	Nuclear
	Other electricity and heating sources	Electricity imports; heating imports; other elec. & heat. sources

Note: Own classification. Energy products are defined as in IEA (2018[12]), *World Energy Statistics and Balances*.

Conversion

TEU converts all tax rates into effective energy tax rates per gigajoule (GJ) based on the energy content of the taxed products.[5] This approach allows tax rates to be aggregated across energy sources and energy users (Chapter 2).

TEU additionally converts fuel excise and explicit carbon taxes into effective carbon tax rates per tonne of CO_2 based on the carbon content of these fuels (Chapter 3). In line with previous editions of *Taxing Energy Use* and *Effective Carbon Rates* (OECD, 2018[3]; OECD, 2016[13]) this publication reports results including emissions from the combustion of biofuels. Annex 1.C discusses the implications of the combustion approach and presents graphs excluding emissions from biofuels to facilitate comparisons with inventories reported under the UN Framework Convention on Climate Change (UNFCCC).

Official OECD exchange rates are used to express the all tax rates in euros. When comparing tax rates across time, TEU uses official OECD country-specific annual inflation data to convert 2015 rates into 2018 local prices.

Categorisation and ordering

TEU presents data in a way that is comparable across countries. Therefore, TEU categorises energy products in the same way for all countries (see Table 1.2.). The table also shows how energy categories are ordered throughout the report. Fossil fuel use comes first – ordered by the average carbon content per GJ of each energy category – followed by other combustible fuels (non-renewable waste and biofuels), and non-combustible energy sources.

TEU presents the distribution of taxes across six economic sectors, as tax rates on energy products tend to vary substantially depending on where energy products are used. Table 1.3. shows how TEU defines these economic sectors. Notice that energy use is 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.

Table 1.3. Energy use by sector

Sector	Definition
Road	All primary energy used in road transport.
Off-road	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 covered but not assigned to a specific country.
Industry	All primary energy used in industrial facilities (incl. district heating and auto-producer electricity plants).
Agriculture & fisheries	All primary energy used in agriculture, fisheries and forestry for activities other than electricity generation and transport.
Residential & commercial	All primary energy used by households, commercial and public services for activities other than electricity generation and transport.
Electricity	All primary energy used to generate electricity (excl. auto-producer electricity plants which are assigned to industry). The electricity sector includes exports unless otherwise stated. Country profiles additionally include electricity imported from abroad, for which the primary energy source is, however, not known.

Note: Own classification based on information on energy flows contained in IEA (2018[12]), *World Energy Statistics and Balances*.

Subnational taxes

In most countries, taxes on energy use are set at the national level. However, there are exceptions to this rule, including Canada and the United States, where taxes on energy use are also set at the subnational level. To be able to assign subnational taxes to the corresponding tax base, it is required to split up countries' energy base by subnational jurisdiction, because the IEA's energy balances only report energy use data for the country level. Wherever possible, TEU relies on energy data from official sources. Nevertheless, coverage at the subnational level requires a larger number of simplifying assumptions than at the federal level.

The OECD Secretariat does not necessarily cover those subnational taxes where revenues from subnational taxes on energy use amount to less than 20% of a country's total revenue from taxes on energy use. The secretariat relies on the expert judgement of the delegates to the OECD Joint Meeting of Tax and Environment Exports to decide whether a country's subnational taxes should be included.

Notes

[1] Similarly, under the UNFCCC reporting guidelines on annual inventories, emissions from international aviation and maritime transport are reported separately from the national totals.

[2] This includes all OECD and G20 countries with the exception of Saudi Arabia. Colombia is included because the country was invited to join the OECD in May 2018.

[3] Tax rates are collected from official sources, such as government websites and the European Commission's Taxes in Europe Database (http://ec.europa.eu/taxation_customs/tedb); country-specific information was then validated by the delegates to the OECD's Joint Meeting of Tax and Environment Experts (JMTEE).

[4] Equivalent taxes on heating would be covered as well. However, the only country in the sample that levies such taxes is Denmark, and there the energy use affected by the tax (industrial waste) is small and not reported in the IEA's extended energy balances, and hence excluded from TEU.

[5] TEU generally relies on the standard conversion factors used by the International Energy Agency. When IEA conversion factors are not available, TEU uses conversion factors provided by JMTEE delegates (mainly for natural gas) or based on desk research.

Annex 1.A. Tax details

Where taxes on energy use are quoted as a percentage of the sales price (ad-valorem taxes), publicly available price information is used to translate ad-valorem rates into per-unit rates. Converting ad valorem taxes into per-unit taxes allows the calculation of effective tax rates on energy and carbon terms across different bases, but the calculated unit taxes are contingent upon observed prices.

TEU does not include value added taxes (VAT) or sales taxes. The reason is that VAT and sales taxes generally apply equally to a wide range of goods and do not change relative prices between energy sources or factors of production. Specifically, VAT or sales taxes do not make fossil fuels more expensive than other energy sources as long as they are applied uniformly. However, where an energy product is subject, for example, to a concessionary rate of VAT, the concession does affect relative prices (OECD, 2015[7]).

TEU generally does not cover tax expenditures or subsidies that operate through the income tax system, such as tax credits for alternative fuels or tax-deductible commuting expenses.

Some countries also apply production taxes on the extraction or harnessing of energy resources (e.g. severance taxes on oil extraction). Since such supply-side measures are not directly linked to domestic energy use, TEU does not cover these taxes.

Also excluded are taxes that that may be correlated with energy use but that are not imposed directly on the energy product (such as vehicle taxes and taxes on emissions such as NOX and SOX) unless they have a fixed relationship to fuel volume (emissions-based carbon taxes, see Chapter 3).

Given the scope of the analysis, TEU does not cover certain very small details of tax bases and rates. Country-specific simplifying assumptions are discussed in online country notes.

Annex 1.B. Electricity and heating

Electricity and heating differ from most of the other energy forms in that they are secondary energy products that must be generated by use of some other energy source. Some countries tax the energy products from which electricity and heating are generated, whereas others, especially European countries, tax electricity (and sometimes heating) output – typically electricity consumption by end users. A few countries, notably Japan, tax both inputs and outputs of electricity.[1]

For combustible energy sources (e.g. coal or natural gas), TEU shows the energy content of the primary energy that is used to generate electricity and heating domestically rather than of the electricity or heating itself. For these energy products, a substantial part of primary energy content is lost in the conversion process (thermal waste). TEU reports this thermal waste because it is part of the tax base. A carbon tax, for instance, also "applies" to thermal waste because even though the energy is wasted, it is equally associated with CO_2 emissions.

For non-combustible energy sources, TEU follows the "physical content method" from the IEA's energy balances and works with "primary energy equivalents". The method measures the primary energy equivalent at the first point downstream in the production process for which multiple energy uses are practical. This means that hydro, wind and solar become 'energy products' in the statistical sense at the point of generation of electricity, and that their 'primary energy equivalent' is computed as the electricity generated in the plant, while the kinetic energy of the wind or the water does not enter the 'energy balance', although being 'energy' in a scientific sense. (Millard and Quadrelli, 2017[14])

Specifically, the energy content reported in TEU is thus either based on the heat released in the production process (nuclear, solar thermal, geothermal) or based on the electricity output that is generated after the energy input (solar radiation, the potential and kinetic energy of water) is converted into electricity. In the latter case, the energy content of electricity inputs and outputs is identical – by construction there are no conversion losses.[2]

Notes

[1] Note that part of electricity and heating outputs are consumed by the energy industry own-use or lost during transmission and distribution to end-users. As even broad excise taxes on electricity and heating tend to be levied only on electricity or heating consumption by end users, not the entire output is subject to such taxes.

[2] This also applies to the special case of electricity imports for which the IEA does not report the underlying energy source.

Annex 1.C. CO_2 emissions from the combustion of biofuels

This annex explains why the emission base in *Taxing Energy Use* is different from UNFCCC inventories, and presents alternative results excluding emissions from biofuels from the base.

Combusting biofuels releases CO_2 and other pollutants into the atmosphere. However, if sustainably sourced, biofuels may be carbon-neutral over the lifecycle because the biomass feedstocks have previously absorbed a similar amount of CO_2 from the atmosphere. As discussed in OECD (2018[8]; OECD, 2018[3]), the assumption of carbon neutrality from a lifecycle perspective is increasingly challenged in the scientific literature.

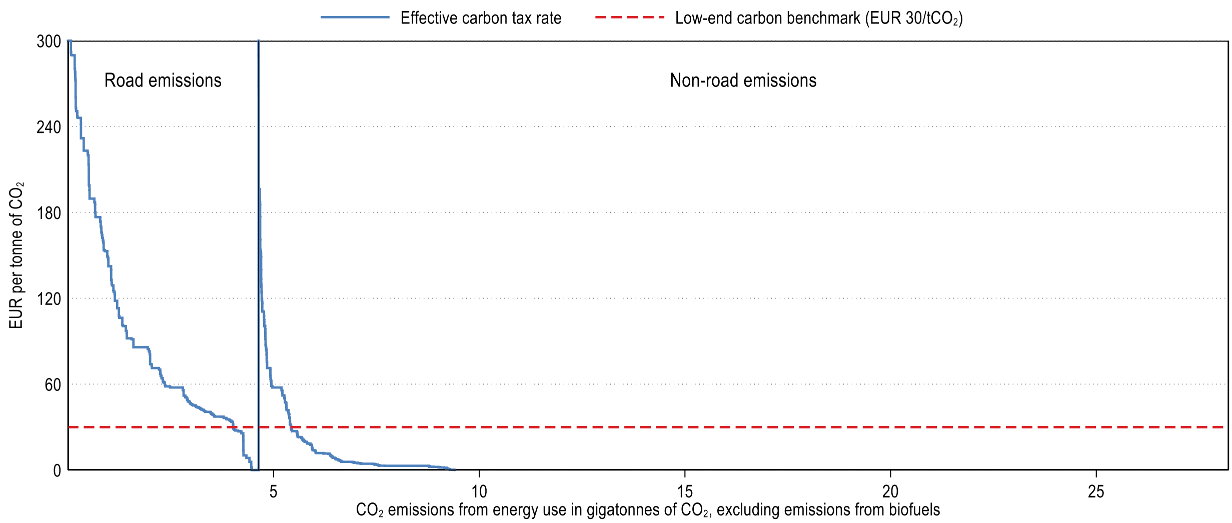
In line with previous editions of *Taxing Energy Use* (OECD, 2013[6]; OECD, 2015[7]) (OECD, 2018[8]) as well as of *Effective Carbon Rates* (OECD, 2016[13]; OECD, 2018[3]), this report uses a combustion approach and includes emissions from the combustion of biofuels in the emissions base (see Chapter 3). This means that CO_2 emissions from the combustion of biofuels are treated in the same way as CO_2 emissions from the combustion of fossil fuels.

By contrast, CO_2 emissions from the combustion of biofuels are considered zero in the greenhouse gas inventories reported under the UN Framework Convention on Climate Change (UNFCCC). The emissions and sinks from biomass are instead accounted for as net changes in carbon stocks included in the annual reporting on Land Use, Land Use Change and Forestry (LULUCF). As *Taxing Energy Use* only considers emissions from energy use, it cannot account for emissions induced by the use of biofuels in a separate category for agriculture, forestry and other land use.

As a result, emission bases from *Taxing Energy Use* and *Effective Carbon Rates* are not directly comparable with the energy-related emissions that are reported in the UNFCCC inventories. To avoid confusion, this report therefore includes a note on the treatment of biofuels under each figure that includes CO_2 emissions from biofuels.

To facilitate comparisons with UNFCCC inventories, the remainder of this Annex reports alternative figures where emissions from biofuels are excluded. This exercise is limited to those figures from the main report where biofuel emissions are relevant and where biofuel emissions are not shown separately from fossil-fuel emissions.

Annex Figure 1.C.1. Distribution of effective fossil carbon tax rates across CO_2 emissions for 44 OECD countries and Selected Partner Economies and international transport



Note: This figure excludes emissions from biofuels, but is otherwise equivalent to Figure 3.1 (Chapter 3). Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), *World Energy Statistics and Balances*. The vertical axis is cut off at EUR 300, but the share of emissions priced higher is negligible.

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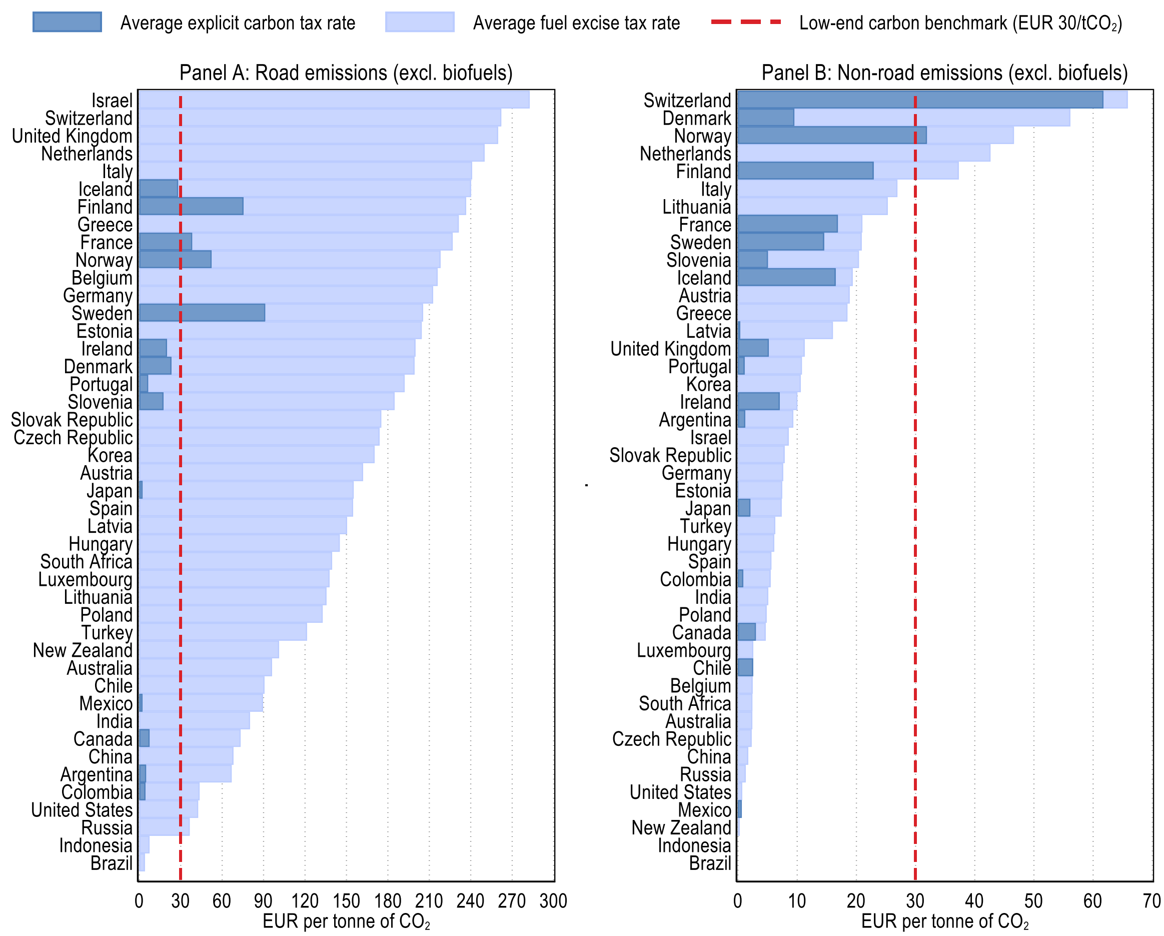
Annex Figure 1.C.2. Effective fossil carbon rates by country



Note: This figure excludes emissions from biofuels, and does not show 2015 rates, but is otherwise equivalent to Figure 3.2 (Chapter 3). 2018 tax rates as applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), *World Energy Statistics and Balances*. The scale of the horizontal axis differs between Panel A and Panel B.

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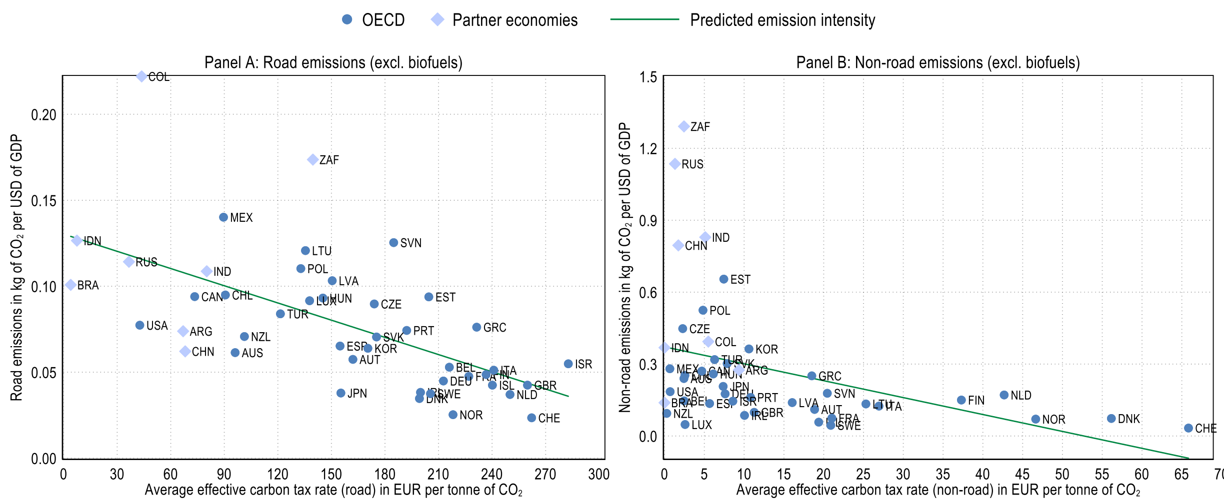
Annex Figure 1.C.3. Countries with higher effective fossil carbon taxes tend to be less emission intensive



Note: This figure excludes emissions from biofuels, but is otherwise equivalent to Figure 3.3 (Chapter 3). 2018 tax rates as applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), *World Energy Statistics and Balances*. The output-based GDP is for 2016 and from the OECD National Accounts database. The scales of both horizontal and vertical axes differ between Panel A and Panel B.

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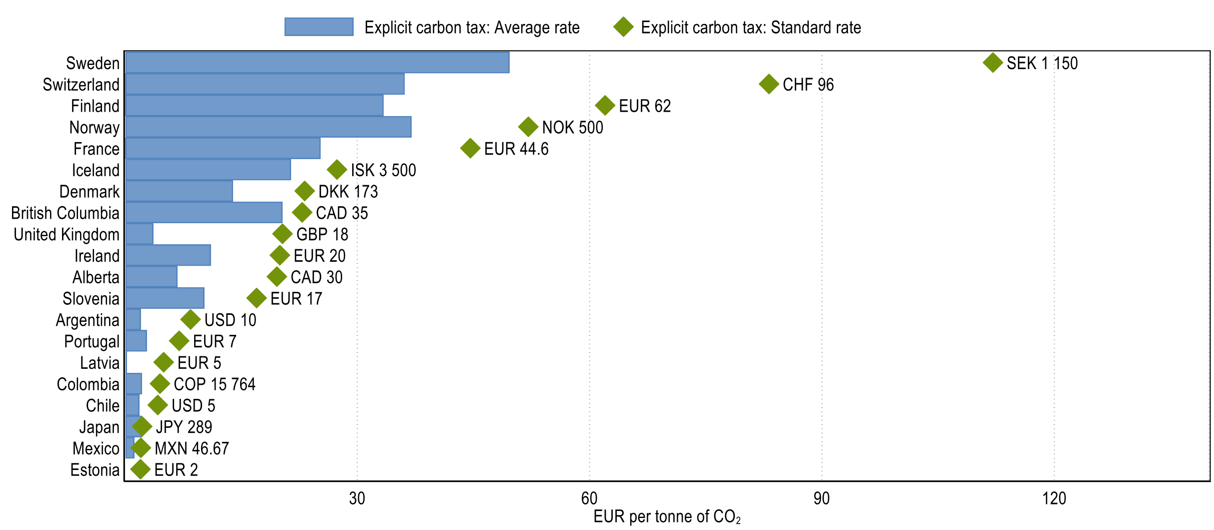
Annex Figure 1.C.4. Explicit carbon taxes do not cover all energy-related emissions from fossil fuels



Note: This figure excludes emissions from biofuels, but is otherwise equivalent to Figure 3.7 (Chapter 3). Tax rates as applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), *World Energy Statistics and Balances*. Carbon tax rates are converted into EUR using official OECD exchange rates.

StatLink https://doi.org/10.1787/888934008019

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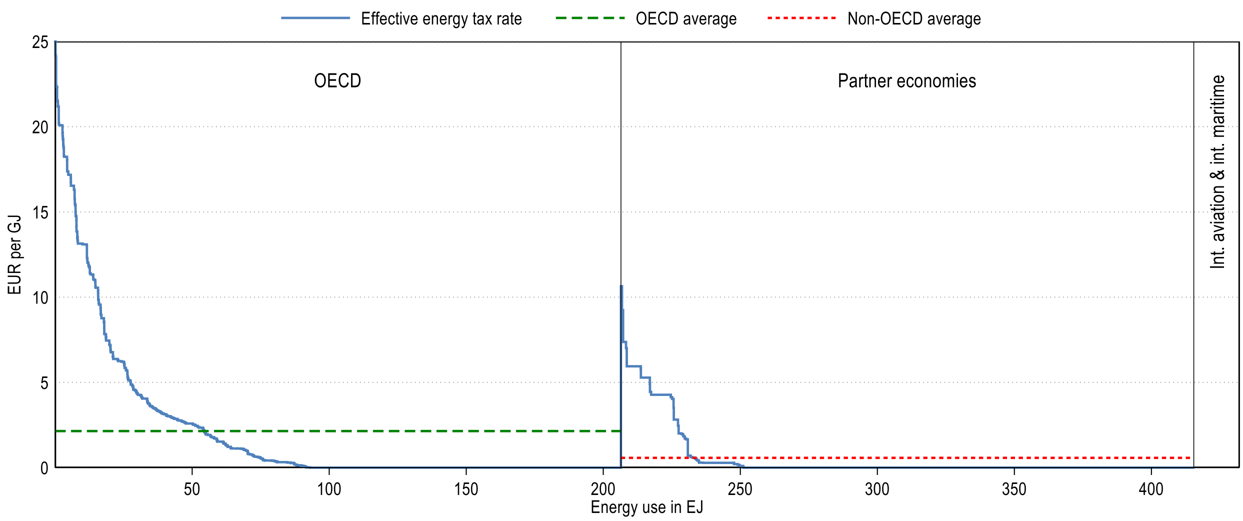
2 Energy price signals through taxes

This chapter analyses tax-based energy price signals across all forms of energy use. The chapter pays special attention to whether energy and carbon taxes favour low- and zero-carbon energy sources over more polluting options. The chapter also discusses the relative tax treatment of gasoline and diesel in road transport. The chapter annex presents energy tax profiles for all 44 OECD and Selected Partner Economies.

The big picture

Effective tax rates on energy use – i.e. the sum of fuel excise taxes, explicit carbon taxes, and electricity excise taxes, net of applicable exemptions, rate reductions, and refunds (see Chapter 1) – vary widely across the world. Figure 2.1 shows the distribution of these effective energy tax rates across two groups of countries (the OECD and the eight selected partner economies covered in this report) and international aviation and maritime transport. Rates tend to be higher in OECD countries than in the partner economies. International aviation and maritime transport are generally not subject to energy and carbon taxes.

Figure 2.1. The distribution of effective energy tax rates across energy use in OECD and Selected Partner Economies and international transport



Note: Tax rates applicable on 1 July 2018. The energy use is for 2016 and adapted from IEA (2018[1]), *World Energy Statistics and Balances*. Electricity and heating imports are not shown as the associated primary energy use is not known, and to avoid the double-counting of this energy use. The vertical axis is cut off at EUR 25, but the share of energy use taxed higher is negligible.

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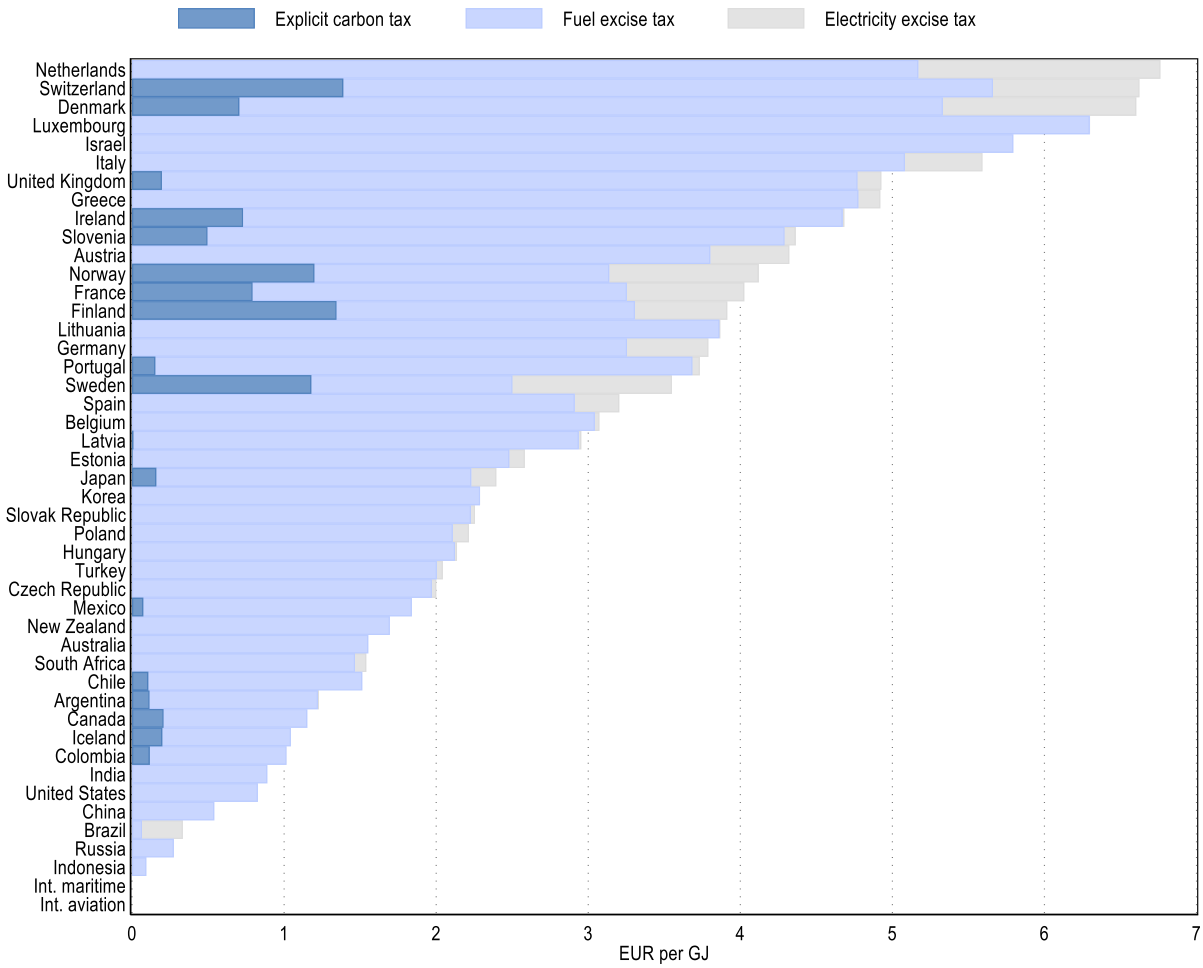
There are good reasons to tax different forms of energy use differently. Not all forms of energy use impose equal external costs on society, and revenue-raising considerations can also justify different rates. The distribution of effective energy tax rates is indeed highly skewed. Figure 2.1 demonstrates that most energy use is untaxed, whereas rates vary widely across the energy use that is taxed. However, the remainder of this chapter also shows that tax rates are poorly aligned with the polluter-pays principle. More generally, the distribution suggests a need and a merit to simultaneously review both tax rates and tax bases when discussing energy and carbon tax reforms.[1]

One reason for the highly skewed distribution is that effective energy tax rates vary widely across countries. Figure 2.2 shows average effective energy tax rates for all countries that are covered in TEU 2019, in addition to energy used in international aviation and maritime transport.

Figure 2.2. Average effective energy tax rates by country



Note: All EU member countries levy electricity taxes, but tax rates are not always discernible in the figure. Tax rates applicable on 1 July 2018. The energy data that is used to calculate the weighted averages is for 2016 and adapted from IEA (2018[1]), *World Energy Statistics and Balances*. Average tax rates do not include electricity and heating imports, in order to avoid the double-counting of this energy use.

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In all countries covered, fuel excise taxes are the largest component in the average effective energy tax rate. In fact, fuel excise is the only specific tax on energy use in several countries, namely Australia, China, Indonesia, Israel, Korea, New Zealand, Russia and the United States. In an increasing number of countries, explicit carbon taxes play an important role as well, as is further discussed in Chapter 3. Electricity excise taxes, levied on electricity consumption by end users, are also relevant, especially in those OECD countries that are also members of the European Union.

Incentives for energy savings

What all specific taxes on energy use have in common is that they increase the final price of the taxed energy products.[2] Higher energy prices encourage citizens and businesses to consume less energy. Energy savings can result from energy conservation, e.g. heating less in the winter, or shifting to less energy-intensive forms of economic activities.

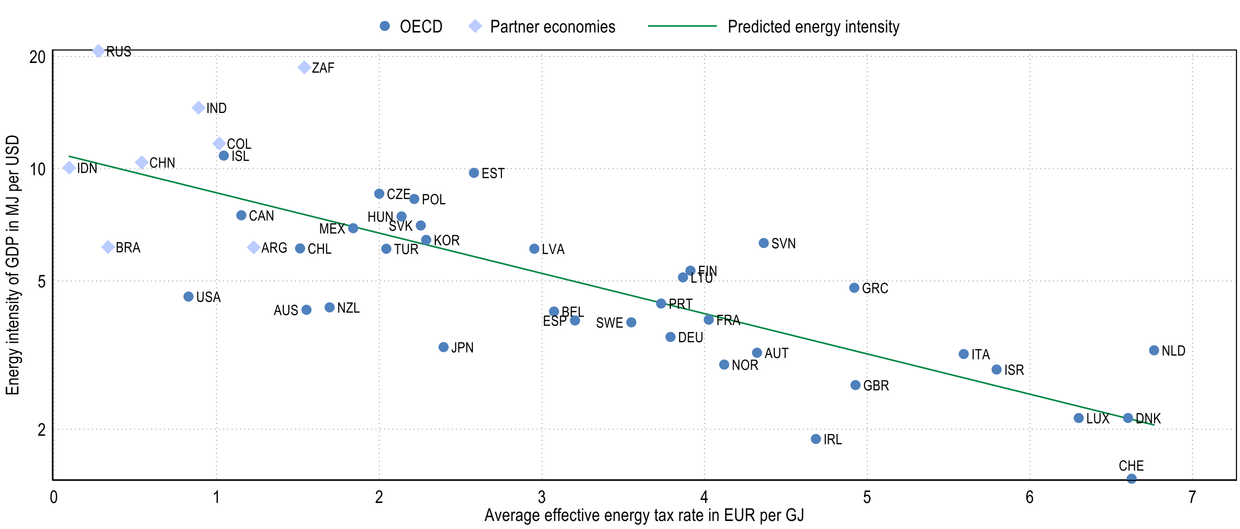
Energy savings may also result from energy-efficiency improvements, which reduce the amount of energy needed for a given output (products, services, comfort, etc.). Citizens faced with higher energy prices, may, for instance, choose to better insulate their homes than they would if tax rates were lower. Similarly, businesses facing or anticipating higher energy prices can be expected to invest in research, development and deployment of more energy-efficient technologies, which can lead to energy savings, e.g. for aluminium smelters.

Energy and carbon taxes avoid direct rebound effects (Linares and Labandeira, 2010[2]). Direct rebound effects occur because energy-efficiency improvements decrease the cost of using energy-related products and services, which in turn increases demand for these products or services (Small and Van Dender, 2007[3]). Given that standards and related policy instruments encourage, or require, the uptake of more efficient technologies, but do not make their use more expensive, not all energy-efficiency improvements result in net energy savings. Rebound effects generate consumer benefits, but also additional external costs, and are detrimental to welfare when the marginal social costs of extra demand exceed the marginal benefits. Energy and carbon taxes, on the other hand, do not only affect investment decisions, but also increase the marginal cost of using energy-related products and services; they therefore avoid the rebound effect.

The empirical literature confirms that the demand for energy products decreases as prices rise (Labandeira, Labeaga and López-Otero, 2017[4]). This meta-study additionally shows that consumers adjust their consumption patterns more strongly in the long-term than in the short term.

As a result, countries with higher taxes on energy use can be expected to have a lower intensity of GDP, everything else being equal. Figure 2.3 shows that there is indeed a negative correlation between energy taxes and energy intensity of GDP. For instance, Denmark and Switzerland not only have some of the highest average effective energy tax rates, they are also among the countries with the lowest energy intensity of GDP.

Figure 2.3. Countries with higher energy taxes tend to have less energy-intensive economies



Note: Average effective energy tax rates are calculated as in Figure 2.2. The output-based GDP is for 2016 and from the OECD National Accounts database. International transport is not shown as no GDP data is available. The vertical axis is log-transformed.

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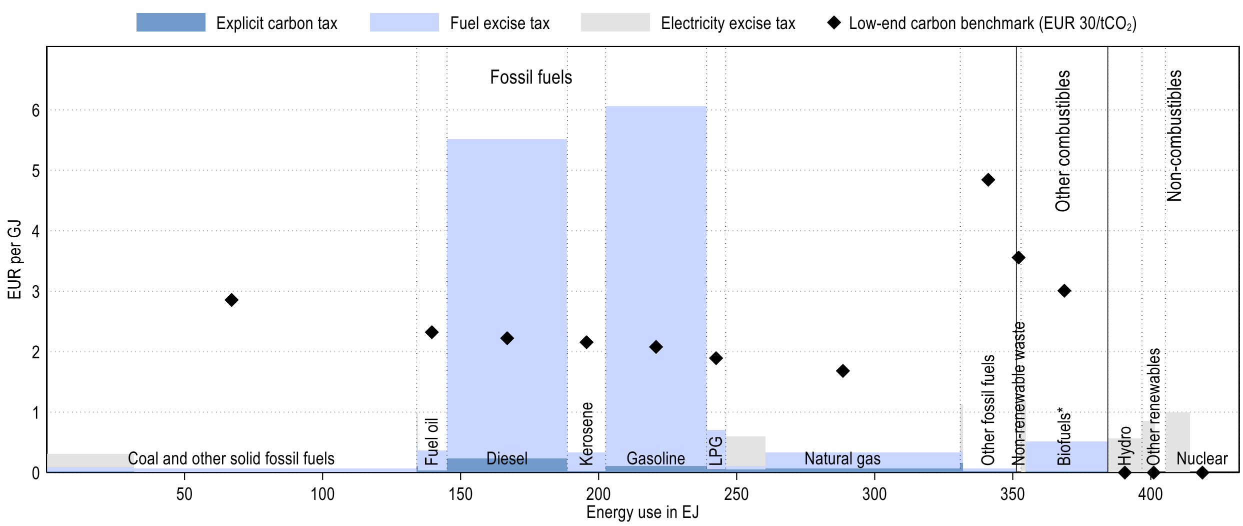
The selected partner economies, on the other hand, tend to have relatively low average effective energy tax rates – and more energy-intensive economies. This correlation is not exclusively driven by differences in energy and carbon taxes. For instance, countries with less energy-intensive economies also tend to have less stringent regulatory mandates. There may also be structural reasons for differences in energy intensity (e.g. Ireland's knowledge-based economy, Norway's hydro power reservoirs, or Russia's oil and gas reserves), which are not necessarily the result of energy and carbon tax levels.

Providing incentives for energy savings through taxes generally improves environmental outcomes if the foregone energy use would have created environmental damage.[3] Environmental damage varies widely by energy source.[4] Figure 2.4 shows, *inter alia,* that countries at the moment still meet most of their energy needs with combustible energy sources (89%), especially coal and other solid fossil fuels, natural gas, as well as oil products, such as diesel and gasoline. Non-combustible energy sources, namely nuclear, hydro and other renewables such as wind, solar and geothermal only represent 11% of primary energy use.[5]

Figure 2.4. Effective energy tax rates and their carbon benchmarks for 44 OECD and Selected Partner Economies and for international transport

Weighted average by energy category and energy end use (electricity or other)



Note: Tax rates applicable on 1 July 2018. The energy use is for 2016 and adapted from IEA (2018[1]), *World Energy Statistics and Balances*. The energy base does not include electricity and heating imports, for which the primary energy source is not known. Biofuels are marked with an asterisk as CO_2 emissions from the combustion of biofuels are considered zero in the greenhouse gas inventories reported under the UNFCCC (see Chapter 1).

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In the absence of carbon pricing policies, final energy prices will not reflect the damage carbon emissions from energy use impose on society, and there is also non-climate damage. Combusting fuels releases CO_2 and other potentially harmful substances into the atmosphere.[6] Typically, consumers use energy products as long as the private benefit of these products is larger than the purchase cost. This results in wasteful consumption of an energy product if consumers' marginal private cost is below the consumers' marginal private benefit – provided that marginal private benefit is lower than the marginal social cost associated with using the energy product.

Differences in effective energy tax rates are generally not proportional to energy products' carbon contents. Specifically, Figure 2.4 shows that for most combustible fuels, effective energy tax rates on average do not reflect even a low-end carbon benchmark of EUR 30 per tonne of CO_2 (OECD, 2018[5]). The figure illustrates this by using a black diamond to indicate the tax rates that would result (in EUR per GJ) if countries were to implement a carbon tax set to EUR 30 per tonne of CO_2.

The discrepancy between the low-end carbon benchmark and the average effective energy tax rate is particularly pronounced for coal and other solid fossil fuels. This is disconcerting as coal represents the largest share of primary energy use (see also, Chapter 3). Figure 2.4 also shows that there are two energy categories – diesel and gasoline – that are, on average, taxed at a higher rate than the selected low-end estimate of the marginal climate damage of fuel use would suggest. The climate damage is, however, likely to be higher than the low-end carbon benchmark (OECD, 2018[5]). In addition, there are important non-climate reasons for higher tax rates in the road transport sector – which is where the bulk of diesel and gasoline is consumed.

Combusting biofuels also releases CO_2 and other pollutants into the atmosphere. However, if sustainably sourced, biofuels may be carbon-neutral over the lifecycle because the biofuels feedstocks have previously absorbed a similar amount of CO_2 from the atmosphere. Unlike in *Taxing Energy Use* (see Chapter 1), CO_2 emissions from the combustion of biofuels are considered zero in the greenhouse gas inventories reported under the UN Framework Convention on Climate Change (UNFCCC). The emissions and sinks from biofuels are there instead accounted for as net changes in carbon stocks included in the annual reporting on Land Use, Land Use Change and Forestry (LULUCF), in accordance with the guidelines of the UN Intergovernmental Panel on Climate Change (IPCC). The figure therefore marks biofuel use with an asterisk.

If countries exclusively relied on the tax system to ensure the sustainability of biofuels, they would tax biofuel use based on the carbon emissions that result from their combustion, and subsidise farmers and foresters that sustainably source biofuels based on the carbon that is absorbed by their activities. However, governments generally favour sustainability standards for this purpose, and do not tax, or exempt, most biofuel use outside the road sector. Explicit carbon pricing through carbon taxes or emissions trading typically do not cover or exempt emissions from the combustion of biofuels.

In sum, tax-induced energy savings or shifts to less polluting energy sources can generally be expected to improve environmental outcomes if the energy not consumed would have come from combustible energy sources. Also, both fossil fuel and biofuel combustion additionally cause non-climate damage.

By contrast, with respect to non-combustible energy sources, it is less clear as to whether tax-induced energy savings improve environmental outcomes.[7] However, such energy sources – mainly hydro, wind and solar, as well as nuclear – are, on average, also taxed. The reason is that many countries levy output taxes on the use of the electricity generated by these energy sources. As these energy sources do not emit CO_2 at the time of use, their carbon benchmark is zero. Local air pollution impacts are equally negligible.

Incentives for switching to cleaner energy sources

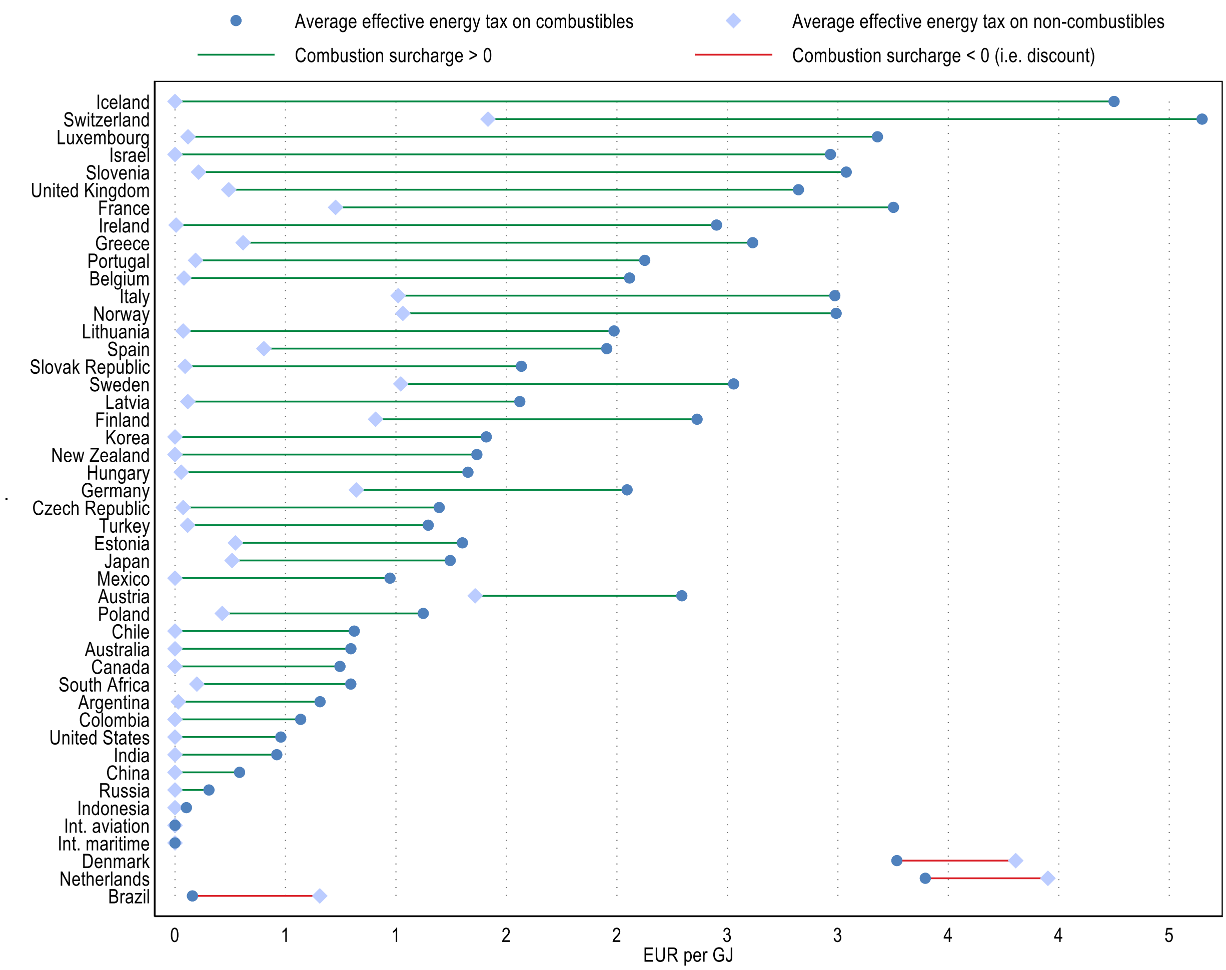
Taxing energy use can shift energy demand towards cleaner energy sources. By taxing combustible sources – which do emit CO_2 when combusted – at higher rates than non-combustible sources, energy tax systems can provide abatement incentives in support of decarbonisation objectives, and provide co-benefits such as reduced local air pollution.

Such differential tax treatment – effectively putting a surcharge on the use of combustible energy sources – does for instance make it relatively more profitable to switch from vehicles based on an internal combustion engine to electric or hydrogen vehicles. It can also contribute to the electrification of industrial processes, e.g. by increasing the competitiveness of electric arc furnaces in steelmaking. Note, however, that the combustion surcharge is mainly driven by relatively high taxes on road fuels. Last but not least, a combustion surcharge can help direct private and public resources towards the development of new clean technologies (Acemoglu et al., 2012[6]).

Most countries do indeed tax combustible fuels at higher average effective tax rates than non-combustible fuels, as shown in Figure 2.5. The difference between these two tax rates does, however, vary substantially across countries. The combustion surcharge is largest in Iceland, closely followed by Switzerland. Notice that Iceland comes before Switzerland in this comparison, even though its average tax rate on combustibles is lower. The reason is that, unlike Switzerland, Iceland does not indirectly tax non-combustible energy sources because the country does not levy an electricity tax.[8]

Figure 2.5. Most countries tax combustibles more than non-combustibles

Countries are sorted by surcharge in descending order



Note: The weighted average tax rates are calculated based on the tax rates applicable on 1 July 2018 and energy use for 2016 that was adapted from IEA (2018[1]), *World Energy Statistics and Balances*. Average tax rates do not include electricity and heating imports to avoid the double-counting of this energy use.

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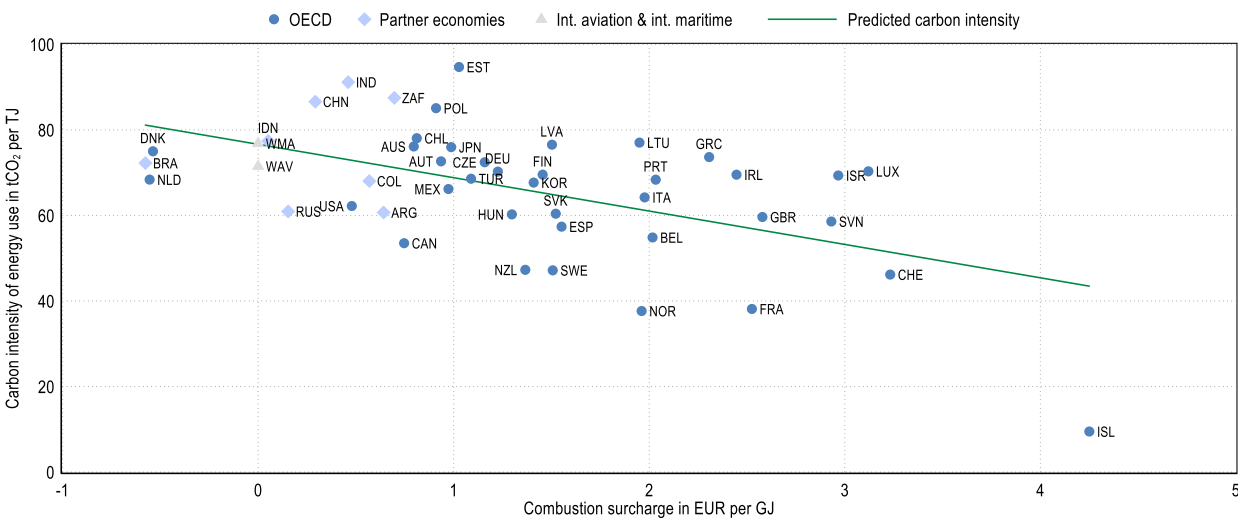
In Denmark and the Netherlands – which have among the highest overall tax rates on energy use (Figure 2.2) – the combustion surcharge is negative on the other hand, which is also the case for Brazil. The main reason for this is that these countries levy relatively high taxes on the consumption of electricity. Given that most non-combustible energy sources are used for electricity generation, this increases the average effective tax rate of these energy sources.

The combustion surcharge is a summary measure indicating the extent to which overall energy tax system provides incentives to move to cleaner, non-combustible energy sources. Everything else being equal, countries that levy a higher surcharge on combustible fuels can be expected to have lower carbon-intensity of energy use. In countries that tax combustible fuels more, energy use tends to be less carbon intensive. Figure 2.6 shows that there is indeed a negative correlation between the surcharge and countries' carbon intensity. Iceland has the lowest carbon intensity, followed by Norway and France.

Figure 2.6. In countries that tax combustible fuels more, energy use tends to be less carbon-intensive



Note: Average tax rates are calculated based on the tax rates applicable on 1 July 2018 and energy use data for 2016 that was adapted from IEA (2018[1]), *World Energy Statistics and Balances*. Energy-related carbon emissions are calculated based on IEA data. Emissions from the combustion of biofuels are included. Average tax rates do not include electricity and heating imports to avoid the double-counting of this energy use. WAV refers to international aviation; WMA to international maritime transport.

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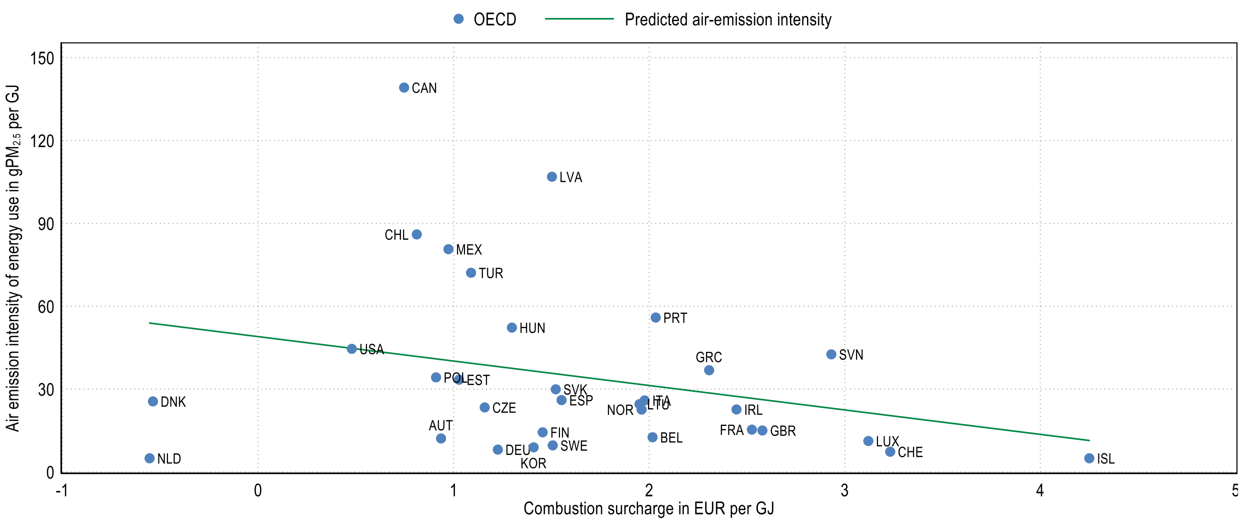
While tax-induced energy price signals partly explain the observed differences in carbon-intensities across economies, energy and carbon taxes are not the only explanatory factors. Against this background, it is worth noting that Iceland and Norway benefit from exceptional endowments with renewable resources (hydropower in both countries and geothermal energy in Iceland).

Combustible energy use is also associated with local air pollution. In this case, however, the link between energy price signals and air emission intensity is not as straightforward as with carbon intensity.[9] On the one hand, reducing combustible energy use also reduces emissions from local pollutants. On the other hand, air emissions are not directly related to the energy use, but also depend on the end-of-pipe technology used and can vary with the specifics of the combustion process.[10] End-of-pipe abatement technologies may, for instance, substantially limit emissions of air pollutants from coal and biomass plants (Portugal-Pereira et al., 2018[7]). Accordingly, Figure 2.7 shows that the linear correlation between the combustion surcharge and air emission intensity is weak (and it is not statistically significant).

Figure 2.7. There is no clear link between the combustion surcharge and air-emission intensity at the country level



Note: Average tax rates are calculated based on the tax rates applicable on 1 July 2018 and energy use data for 2016 that was adapted from IEA (2018[1]), *World Energy Statistics and Balances*. Average tax rates do not include electricity and heating imports to avoid the double-counting of this energy use. Air emissions data as reported as reported on OECD.Stat.

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Electricity taxes and decarbonisation

Electrifying final energy consumption could contribute to decarbonising energy use (IEA, 2018[8]) – provided that electricity generation itself is decarbonised.[11] In the road sector, for instance, which causes approximately 18% of energy-related CO_2 emissions (see Chapter 3), the technological barriers to further electrification are falling rapidly. The technologies to meet residential and commercial demand for heating and cooling by using electricity already exist today. In other areas, such as high-temperature industrial heat demand as well as aviation and maritime transport (see Chapter 3),[12] electrification is more challenging – but not inconceivable (Lechtenböhmer et al., 2016[9]).

Against this background, it is important to note that many countries do not only tax fuels directly, but also tax electricity. This is particularly common in the European Union where at least some form of electricity taxation is mandated by the EU Electricity Tax Directive.[13]

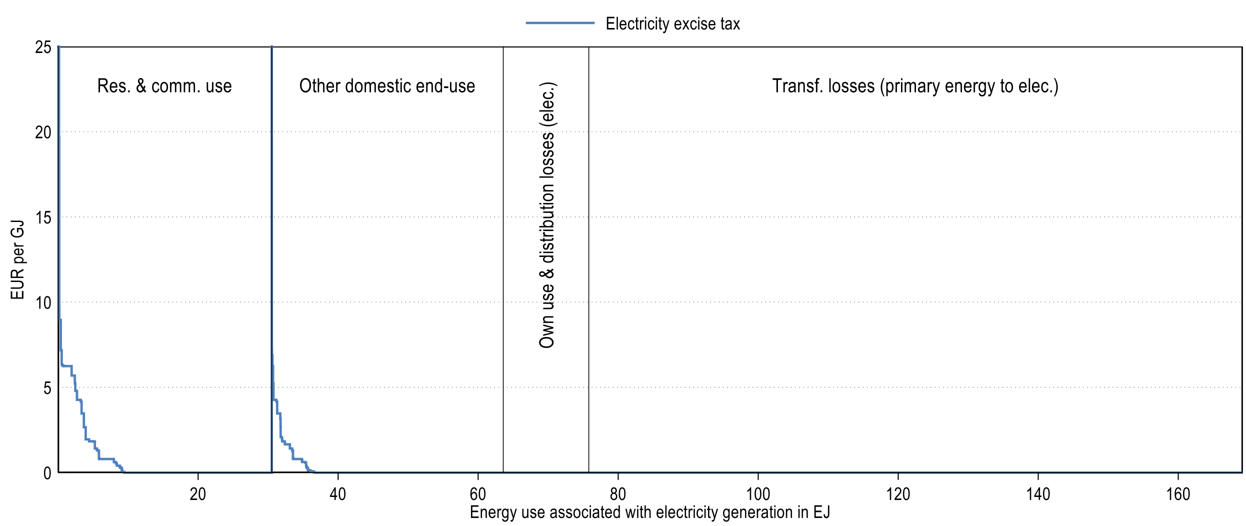
Electricity taxes typically do not directly encourage power producers to shift to cleaner sources, and do not provide direct incentives for the decarbonisation of the power sector. The reason is that most electricity taxes are not differentiated by energy source, and hence make all energy sources more expensive irrespective of the carbon content. There are exceptions to this rule, however, such as electricity taxes in Ireland and South Africa. In addition, many countries exempt certain small-scale installations that produce electricity for own consumption from the obligation to pay electricity taxes. To the extent that such exemptions benefit rooftop solar or other cleaner sources, electricity taxes do provide some direct incentives for decarbonisation. Electricity taxes also incentivise reducing electricity use in general. In liberalised power markets, fossil fuel-powered generators are frequently the marginal electricity producer. Energy savings induced by electricity taxes could thus indirectly decrease emissions.[14]

Electricity taxes may decrease the effectiveness of carbon taxes in achieving emission reductions because taxing electricity use makes switching to electricity less profitable for end users, everything else being equal.[15] As a result, electricity taxes, as well as other levies and charges not modelled in TEU (see Chapter 1),[16] may discourage the electrification of sectors such as road transport and industry.

Fuel excise and explicit carbon taxes, on the other hand, specifically apply to combustible fuels, making fuels more expensive relative to non-combustible energy sources. Given that fuel excise and carbon taxes are directly levied on the energy product, they also provide direct incentives to increase power plant efficiency – unlike electricity taxes.

In fact, most of the primary energy use associated with electricity generation is not subject to electricity taxes, as shown in Figure 2.1. There are three mechanic reasons for this that are generally not driven by environment policy objectives. First, for most energy products, a substantial part of primary energy is lost in the conversion process – it never becomes electricity. Second, electricity taxes typically do not apply to the own use of the electricity industry and electricity that is lost before reaching end users. Finally, not all countries tax electricity use, and those who do, tend to mainly tax residential and commercial use.

Figure 2.8. Electricity taxes fall largely on residential & commercial users



Note: Electricity excise rates are those applicable on 1 July 2018. Energy use data includes all primary energy use associated with electricity generation in 2016, and is adapted from IEA (2018[1]), *World Energy Statistics and Balances*. The figure includes electricity imports, but does not show electricity exports to avoid the double-counting of this energy use. The y-axis is cut off at EUR 25, but the share of energy use taxed at a higher rate is negligible.

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While the environmental case for electricity taxes is arguably decreasing; their relative importance as fiscal policy instruments might be on the rise. Unlike fuel excise and carbon tax revenue, which could eventually disappear, electricity as a potential tax base appears here to stay.

Countries will be reluctant to give up electricity as a tax base, considering that practically feasible tax bases are rare. In fact, there are a number of countries, the Netherlands and Denmark in particular (see Figure 2.2), where electricity tax revenues contribute substantially to government budgets.

One potential strategy to avoid conflicts between environmental and fiscal objectives would be to temporarily replace pre-existing electricity taxes with carbon taxes in such a way that overall energy tax revenues remain constant. At the beginning, the gradual erosion of the carbon tax base could be mitigated by increasing carbon tax rates over time. Eventually, as the energy system is approaching full decarbonisation, electricity taxes could be reintroduced if so desired.

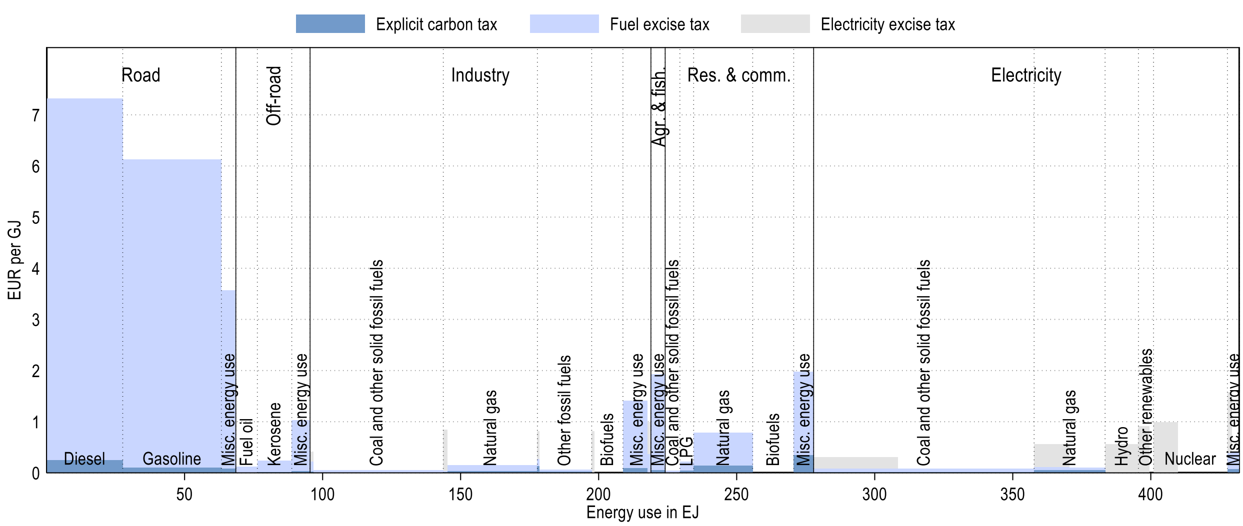
However, the most productive (and politically expedient) use of carbon tax revenue will differ substantially depending on the local circumstances. This suggests a need and a merit to conduct a broader review of domestic tax and spending priorities before deciding on using carbon tax revenues for a specific purpose (Marten and van Dender, 2019[10]). With respect to tax revenues from road transport, recent OECD work suggests, for instance, that gradual tax reforms, shifting from taxes on fuel to taxes on distances driven, can contribute to more sustainable tax policy over the long term (OECD/ITF, 2019[11]).

Sectoral patterns

Tax rates differ depending on the sector where energy sources are used. Figure 2.9 shows that road transport fuels tend to be taxed at far higher rates than energy use in other sectors, which is true for all 44 countries covered in this report (Annex 2.A.). The discrepancy is particularly pronounced when comparing road transport to international aviation and maritime transport (see Figure 2.1), where energy use is not taxed (see also, Chapter 3). In the figure, international transport is grouped under off-road, and is therefore taxed "on average" because domestic aviation and navigation is sometimes taxed, and so are other forms of off-road fuel use, such as use in railways.

Figure 2.9. Effective energy tax rates across sectors

Average by sector, energy category and end-use energy (electricity or other)



Note: Tax rates applicable on 1 July 2018. The energy use is for 2016 and adapted from IEA (2018[1]), *World Energy Statistics and Balances*. The energy base includes all 44 countries as well as energy use in international transport. The energy base does not include electricity and heating imports to avoid double-counting. The figure groups energy categories that represent less than 1% of the horizontal axis into "miscellaneous energy use".

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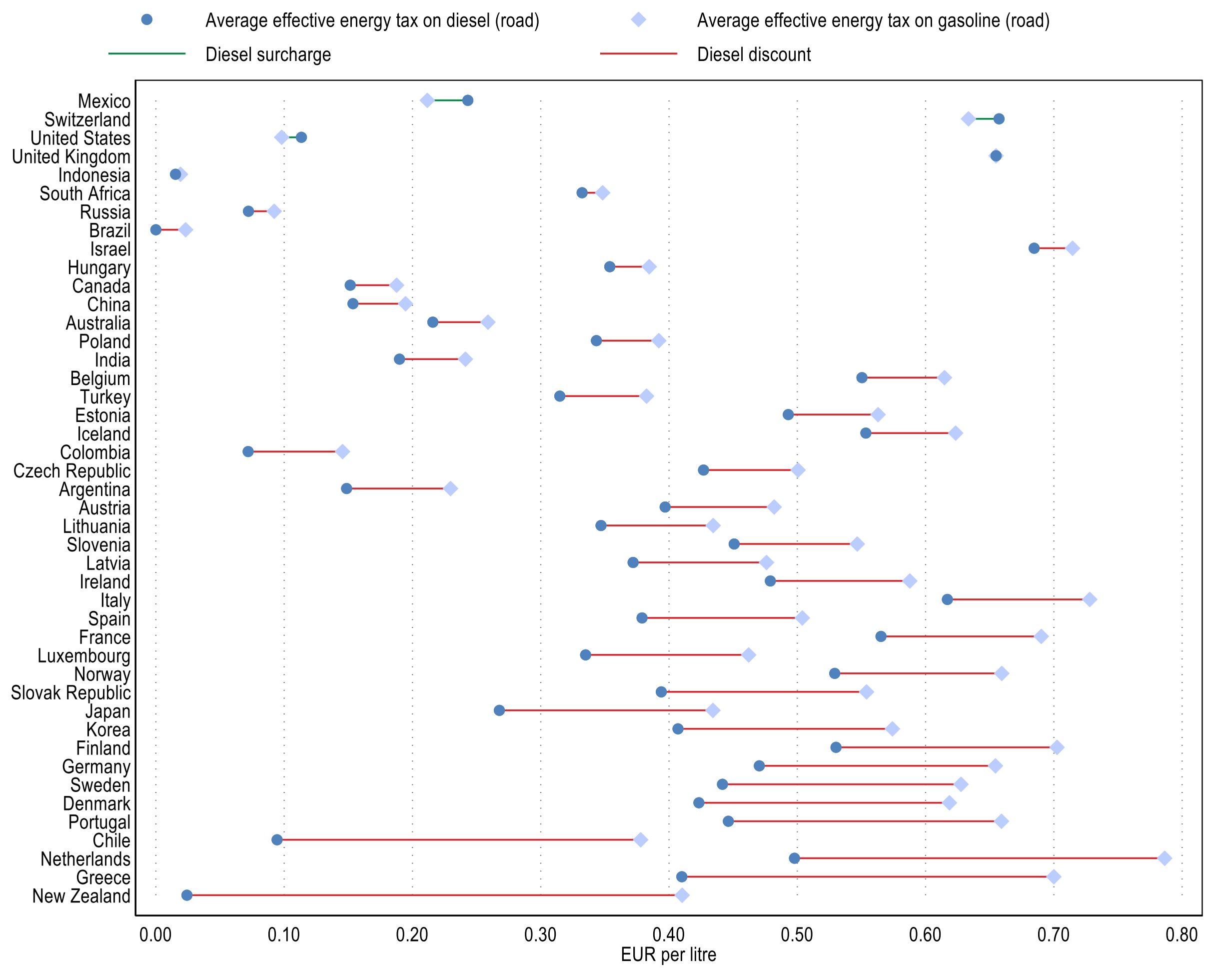
There are good reasons to tax road transport fuels at higher rates than other fuels. Especially in urban road transport, non-climate external costs associated with gasoline and diesel use can be considerable, e.g. because of congestion and local air pollution (Van Dender, (2019[12]); Teusch and Braathen, forthcoming). Fossil fuel combustion in other sectors does, however, also cause air pollution; coal-fired power generation, for instance, can be associated with substantial external costs (Coady et al., 2019[13]). To the extent that more targeted policy instruments are not feasible, excise taxes can be effective policy instruments to make polluters pay for these externalities.

The figure also shows that diesel is, on average, taxed at higher rates than gasoline in road transport. This effect is, however, largely driven by the United States, where this is indeed the case. In fact, Figure 2.10 shows that only three countries tax diesel at higher rates than gasoline, even on a per litre basis. These countries are Mexico, Switzerland and the United States. Further, the United Kingdom taxes diesel and gasoline at the same rate per litre. All other countries effectively tax diesel less than gasoline.

Figure 2.10. Diesel continues to be taxed at lower rates in most countries

Countries are sorted by discount in ascending order



Note: Average tax rates are calculated based on the tax rates applicable on 1 July 2018 and energy use data for 2016 that was adapted from IEA (2018[1]), *World Energy Statistics and Balances*. New Zealand is a special case because diesel vehicles pay distance-based road-user charges, which are not included in TEU because they affect different behavioural margins than energy taxes.

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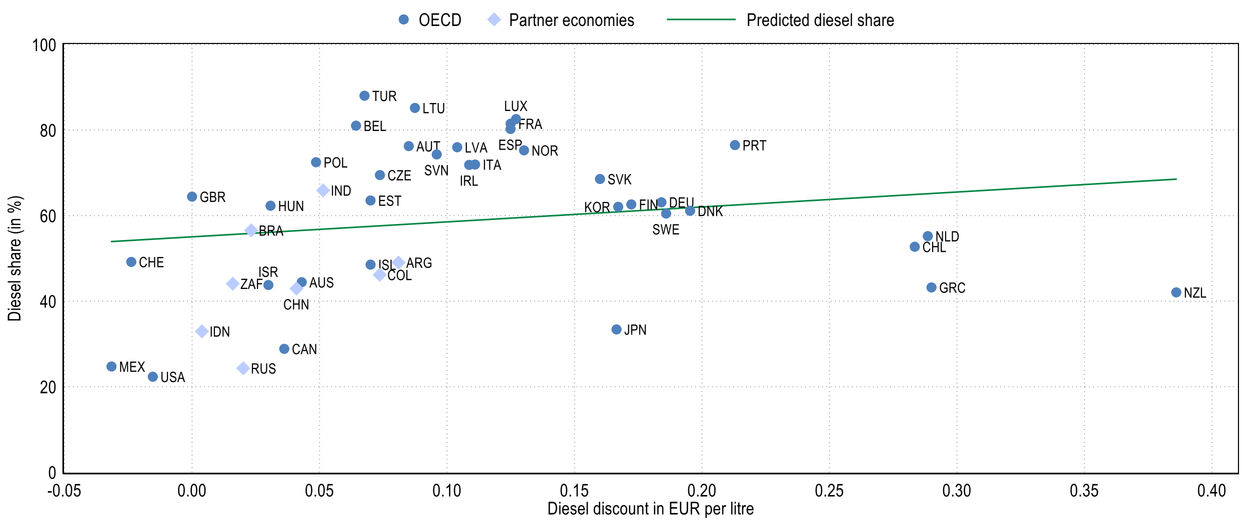
In principle, taxing diesel at higher rates than gasoline is sound environment policy. Effectively putting a surcharge on diesel makes sense from a climate perspective, considering that CO_2 emissions per litre of diesel are higher. In addition, non-climate damage per litre of diesel use tend to be higher than for gasoline use. This damage includes environmental externalities such as air pollution, as well as congestion (Harding, (2014[14]); Teusch and Braathen, forthcoming).

In countries where the diesel discount is higher, diesel consumption tends to be relatively higher as well, as shown in Figure 2.11. The effect is, however, only statistically significant if New Zealand is excluded from the sample. New Zealand is a special case because diesel vehicles pay distance-based road-user charges, which are not included in TEU because they affect different behavioural margins than energy taxes. Notice that consumers' choice for or against diesel vehicles tends to be influenced by regulatory standards[17] as well as vehicle purchase and circulation tax structures, among other factors, which may help explain the relatively weak correlation. The weak correlation is also due to the fact that diesel completely dominates among the heavy goods vehicles – irrespective of whether diesel is taxed at a discount or not.

Figure 2.11. Countries with higher diesel discounts tend to have higher diesel shares

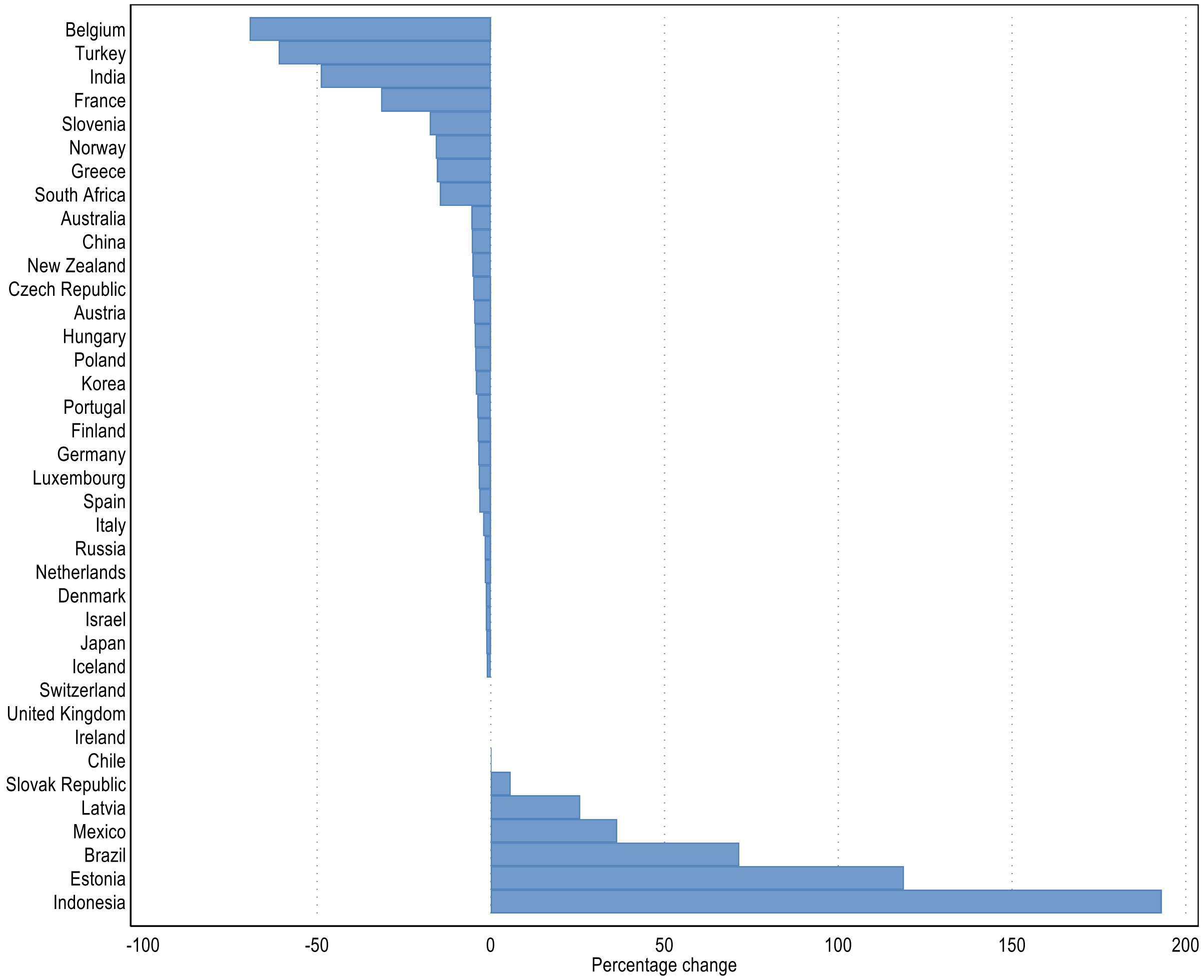


Note: The diesel discount was calculated as in Figure 2.10. The diesel share is calculated as the diesel consumption in the road sector divided by the sum of gasoline and diesel consumption in the road sector, whereby all consumption is expressed in litres.

StatLink https://doi.org/10.1787/888934008228

Compared to the previous edition of *Taxing Energy Use*, some progress has been made in certain countries; Belgium, Turkey and India in particular (Figure 2.12). Such progress is not necessarily driven by rate changes, but in countries where the diesel discount is positive, may simply be the result of inflation that gradually eats away the diesel discount.

Figure 2.12. The diesel discount is diminishing in most countries



Note: Changes are calculated based on constant 2018 local prices. The comparison excludes USA and Canada as data on subnational taxes is not available for 2015. Columbia and Lithuania are missing because they were not yet covered in the previous vintage of TEU. Argentina is missing because no inflation data was available. Sweden is excluded from the chart as the diesel discount is not comparable across time (the tax bases have changed as a result of a new greenhouse gas reduction obligation system that came into force on 1 July 2018).

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In a number of countries, the diesel discount increased, however. In Indonesia both gasoline and diesel are subject to the same ad-valorem tax, i.e. 5%; as in 2015 – the change is driven by pre-tax price changes. Estonia increased taxes on both, but less so on diesel. In Brazil, the main difference is that the effective diesel tax rate was reduced to zero, whereas the gasoline rate remained unchanged. In Mexico, which continues to have the lowest diesel discount (the discount is negative as Mexico taxes diesel at a higher rate than gasoline), both rates increased, but gasoline more so than diesel.

Making progress with the diesel discount is challenging, considering that many governments have long encouraged consumers to buy diesel vehicles. In addition to lower fuel excise taxes, there were also tax purchase-related tax incentives that effectively favoured diesel vehicles, such as those based on CO_2 emissions (OECD (2016[15]); Teusch and Braathen (2019[16])). It would therefore appear important to give consumers time to adapt to changes that reverse the effect of flawed existing policy signals. Complementary policies, such as investing in public transport or electric vehicle charging stations, or providing other forms of support that would allow owners of old polluting diesel vehicles to switch to cleaner mobility options might thus be warranted.

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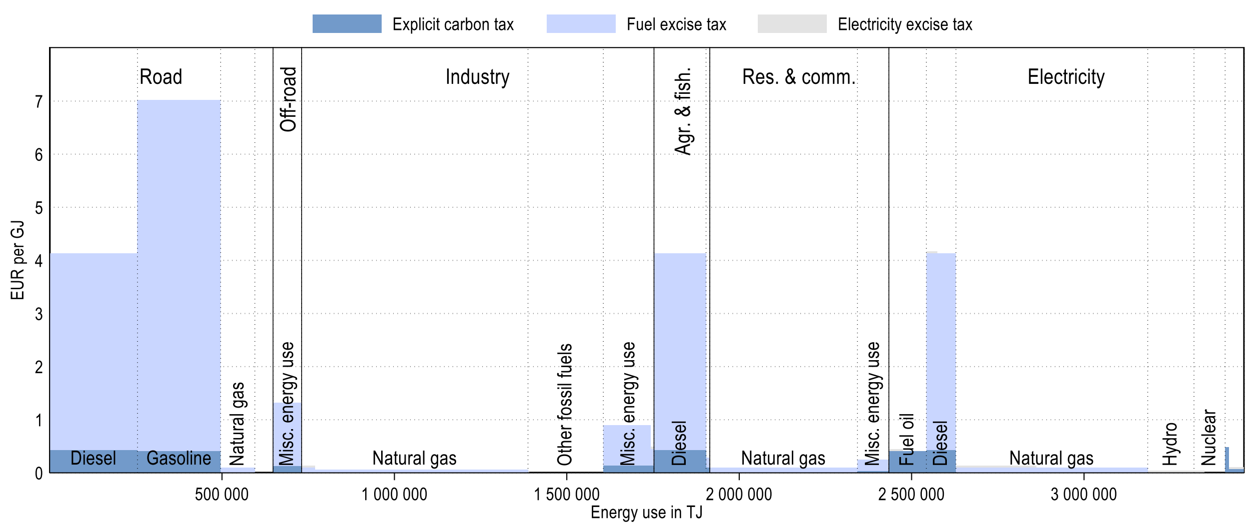
Annex 2.A. Energy tax profiles

This annex provides energy tax profiles for all 44 countries covered in TEU 2019. General assumptions are explained in Chapter 1. For country-specific assumptions and more fine-grained data, please consult the online country notes. Notice that vertical axes vary widely across countries, depending on how high tax rates are.

Annex Figure 2.A.1. Effective energy tax rates in Argentina

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ



Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled.

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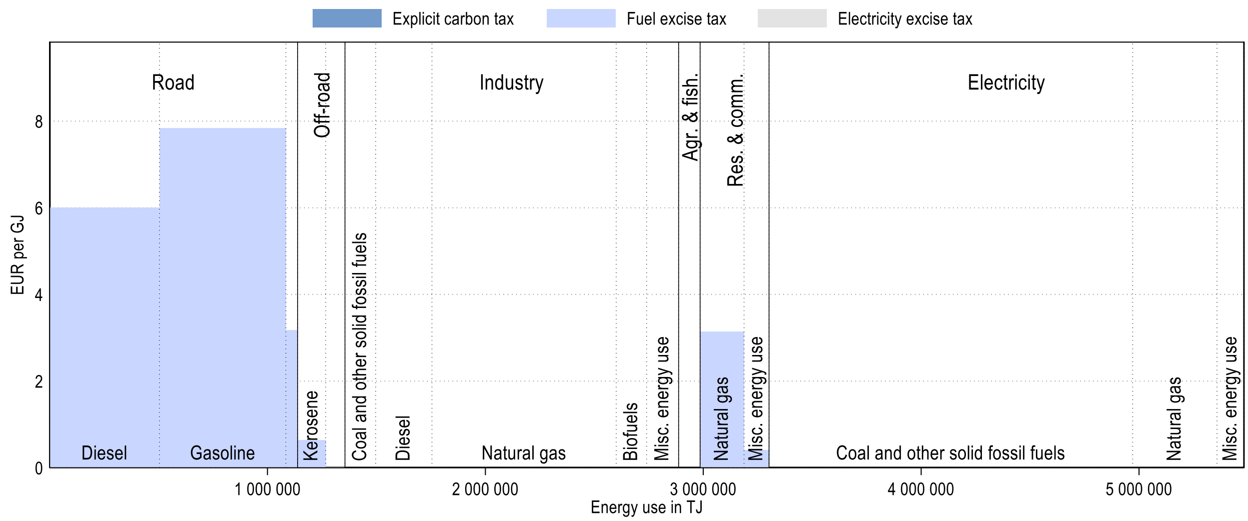
Annex Figure 2.A.2. Effective energy tax rates in Australia

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ



Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled.

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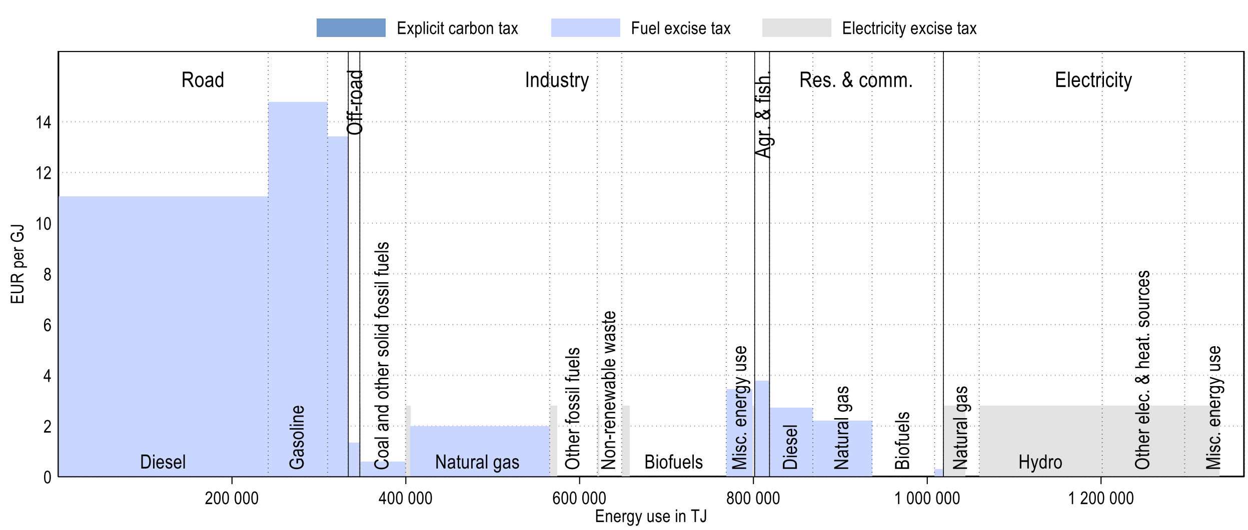
Annex Figure 2.A.3. Effective energy tax rates in Austria

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ



Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled.

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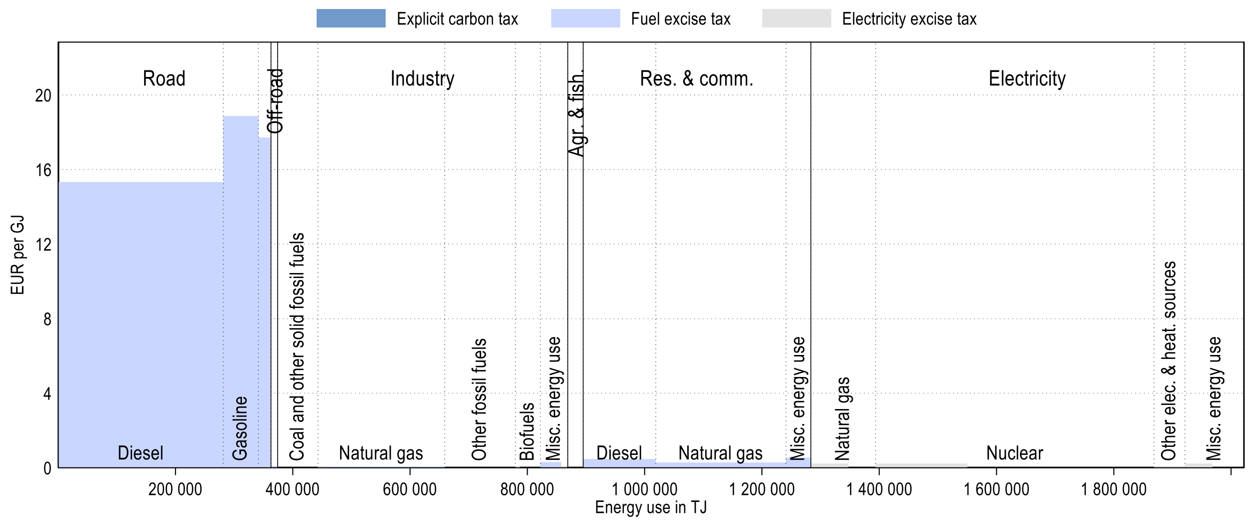
Annex Figure 2.A.4. Effective energy tax rates in Belgium

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ



Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled.

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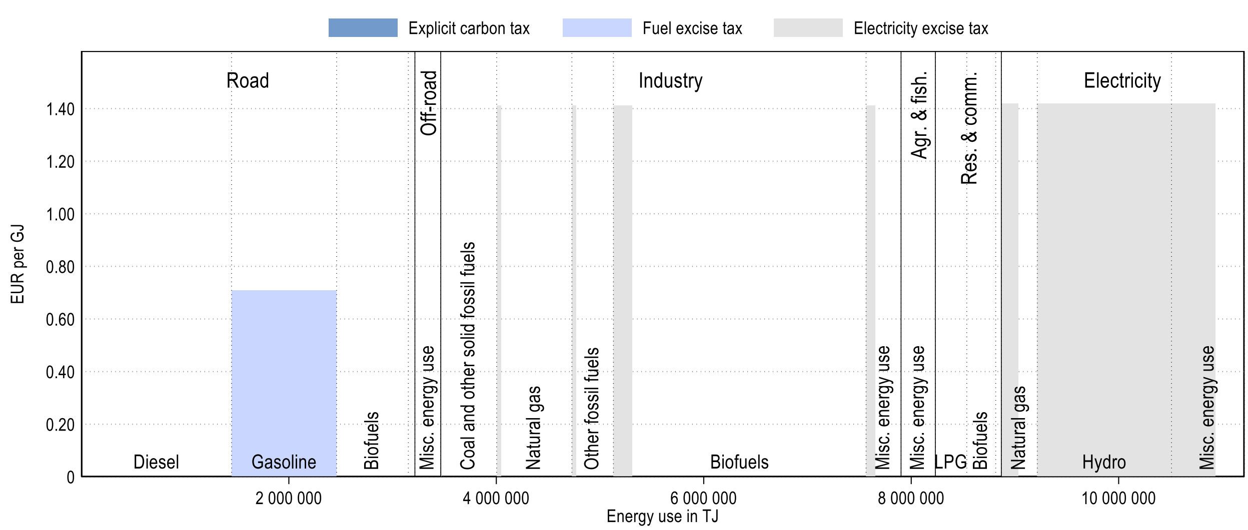
Annex Figure 2.A.5. Effective energy tax rates in Brazil

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ



Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled.

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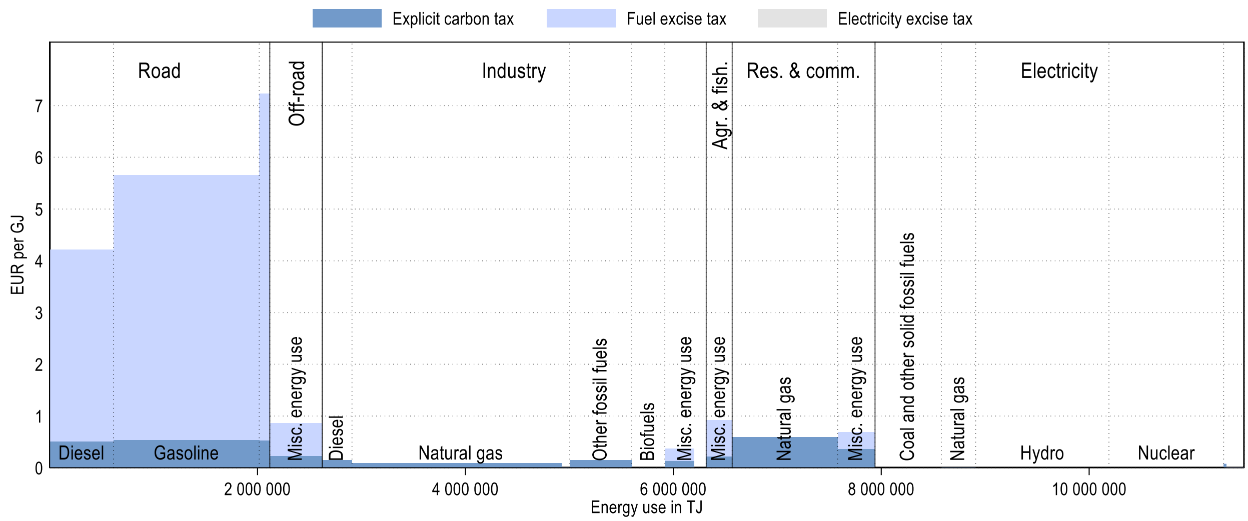
Annex Figure 2.A.6. Effective energy tax rates in Canada

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ



Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled.

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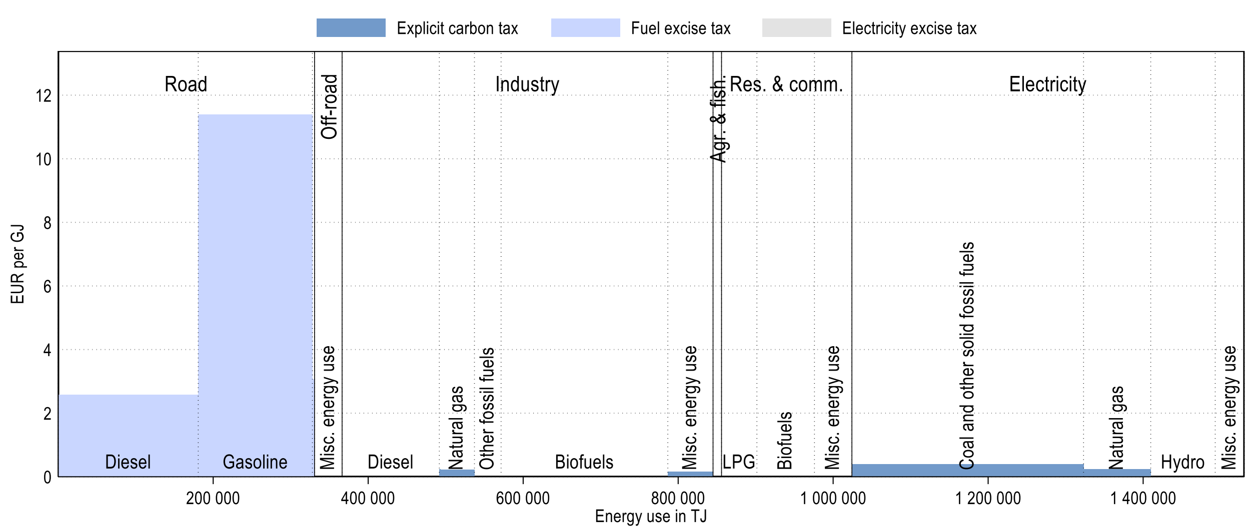
Annex Figure 2.A.7. Effective energy tax rates in Chile

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ



Note: Tax rates applicable on 1 July 2018. The explicit carbon tax shown in dark blue refers to the Green Tax (see online country note for modelling assumptions). Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled.

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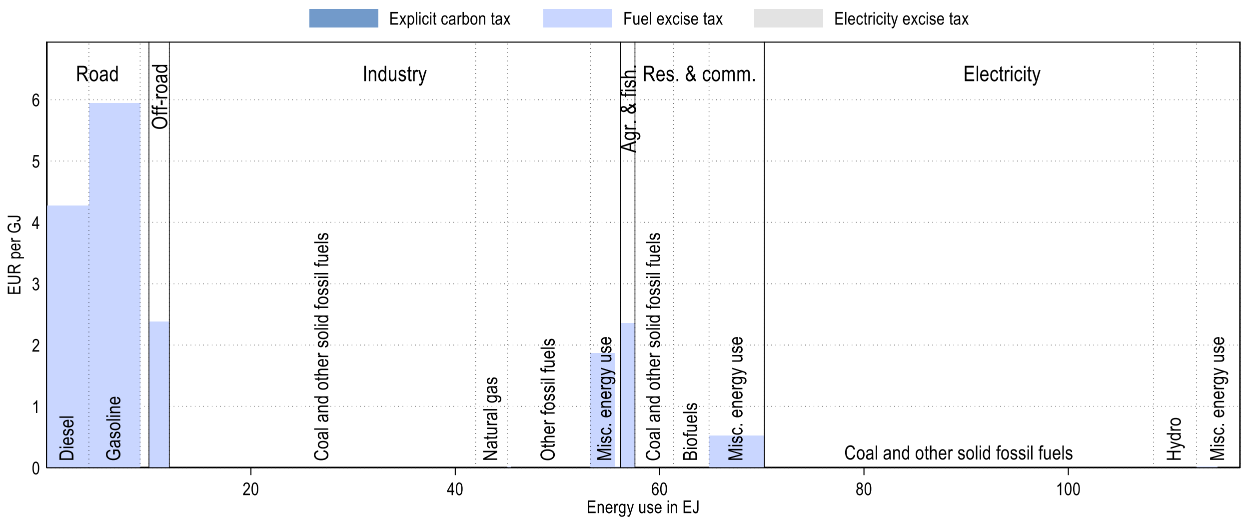
Annex Figure 2.A.8. Effective energy tax rates in China

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ



Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into “miscellaneous energy use”, which is not always labelled.

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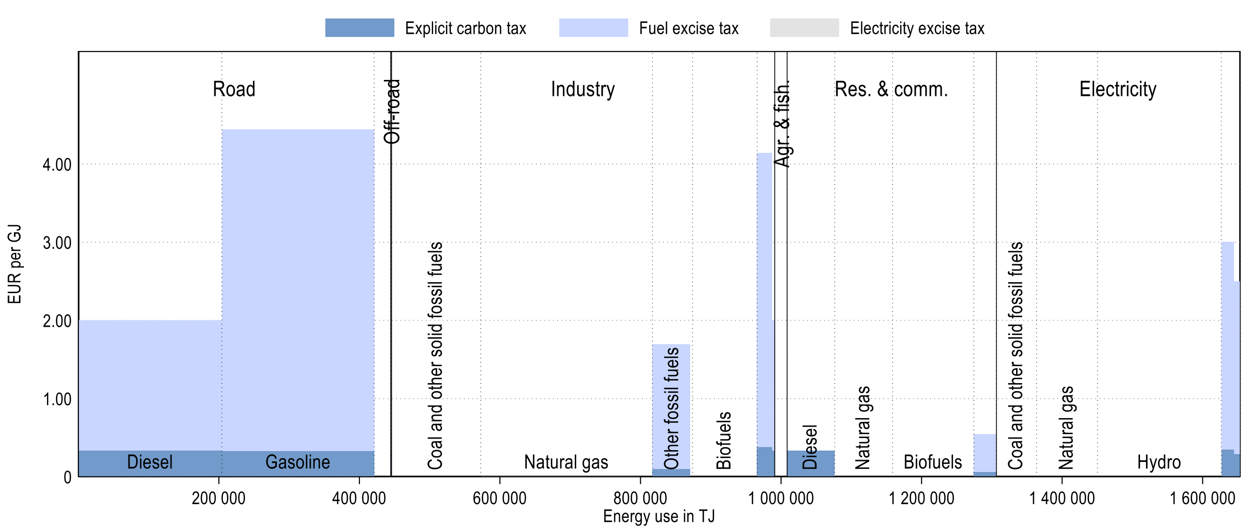
Annex Figure 2.A.9. Effective energy tax rates in Colombia

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ



Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into “miscellaneous energy use”, which is not always labelled.

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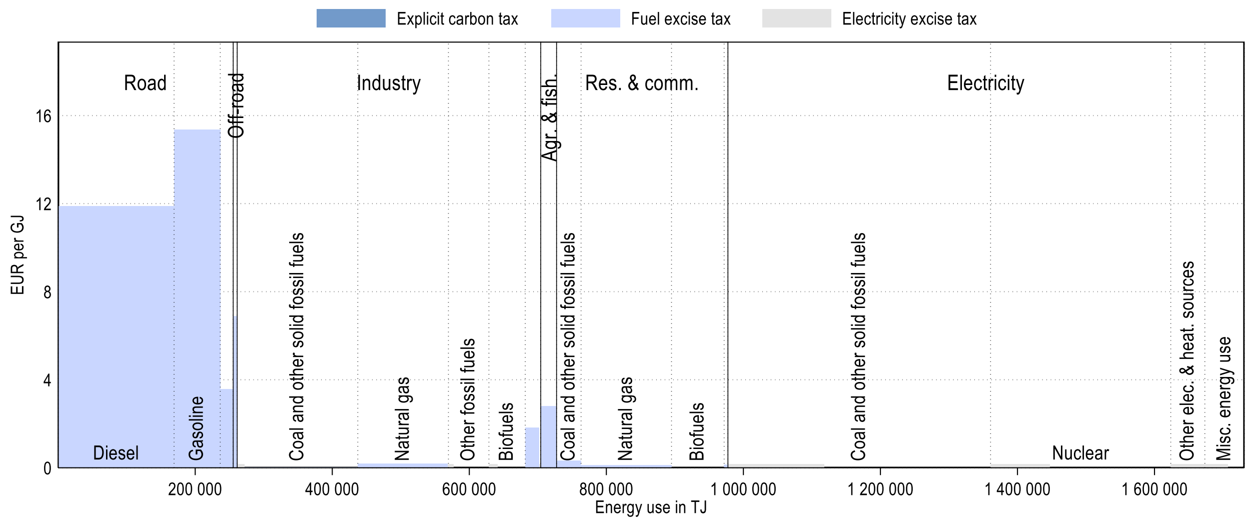
Annex Figure 2.A.10. Effective energy tax rates in Czech Republic

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ



Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled.

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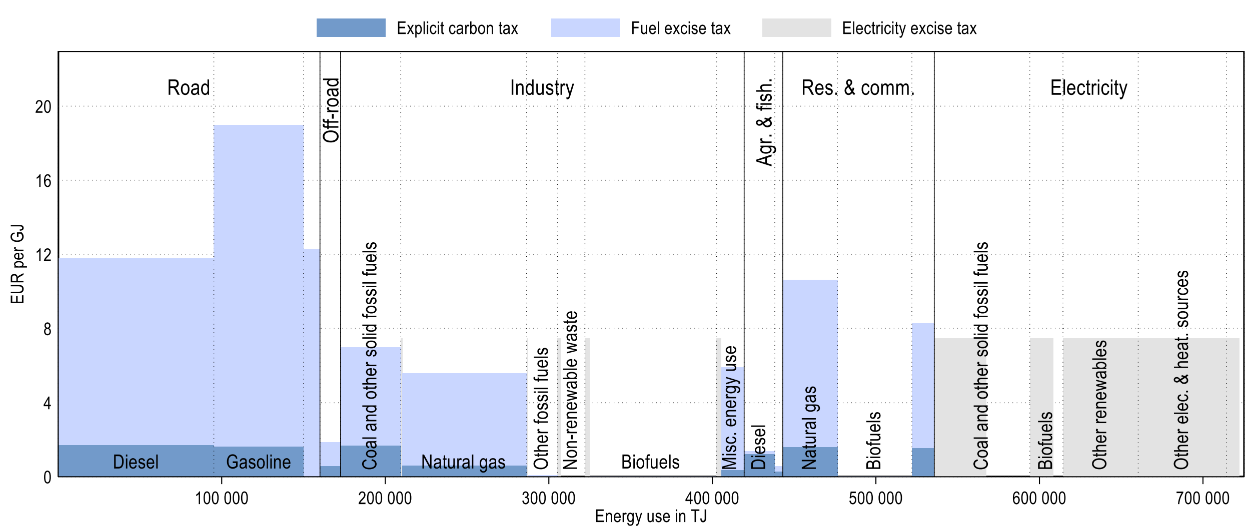
Annex Figure 2.A.11. Effective energy tax rates in Denmark

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ

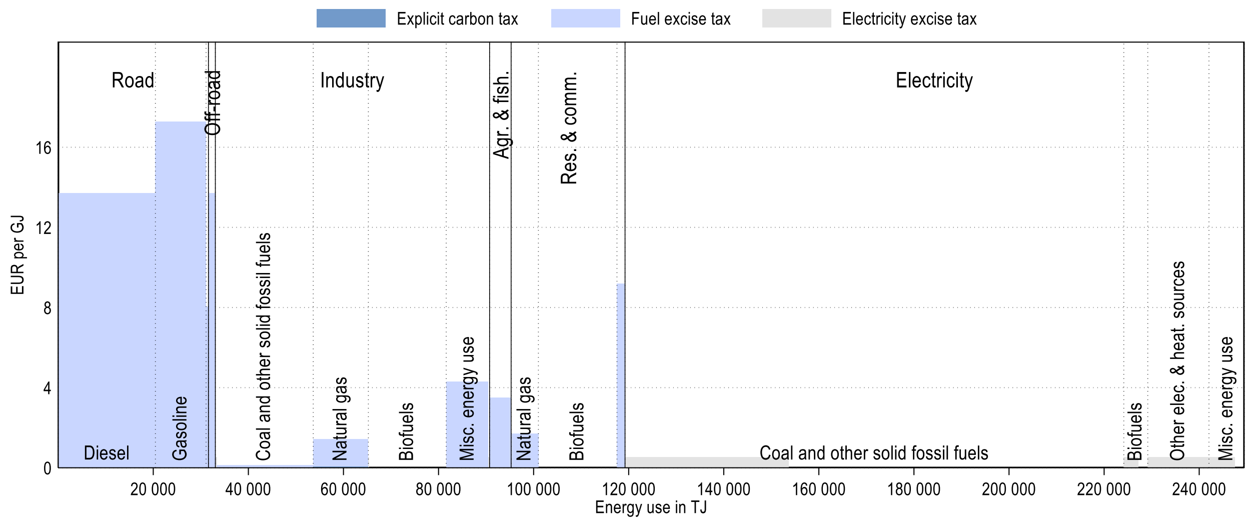


Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled.

StatLink https://doi.org/10.1787/888934008456

Annex Figure 2.A.12. Effective energy tax rates in Estonia

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ

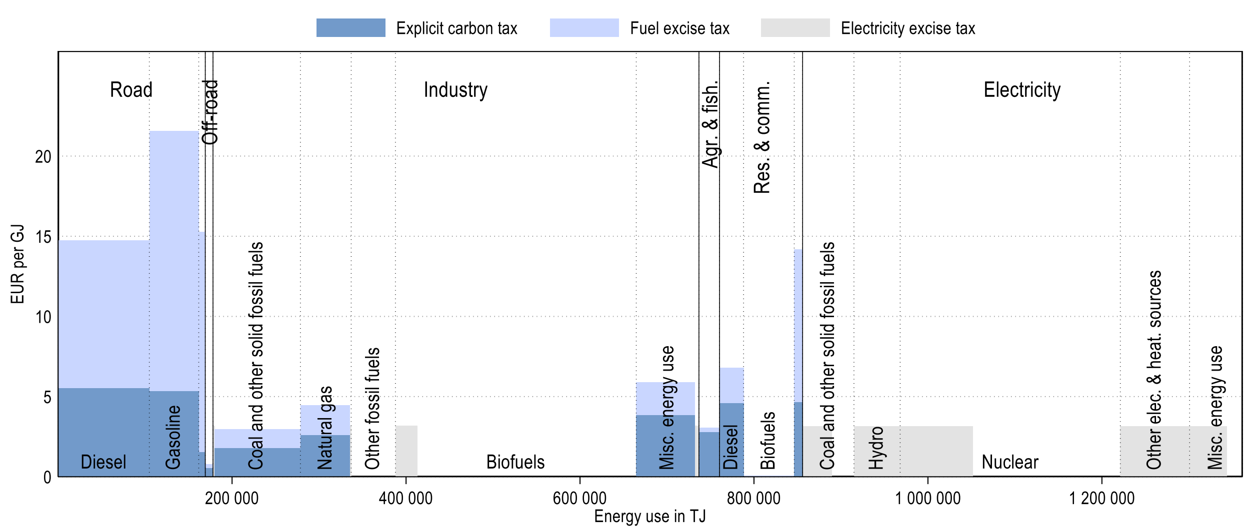


Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled.

StatLink https://doi.org/10.1787/888934008475

Annex Figure 2.A.13. Effective energy tax rates in Finland

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ

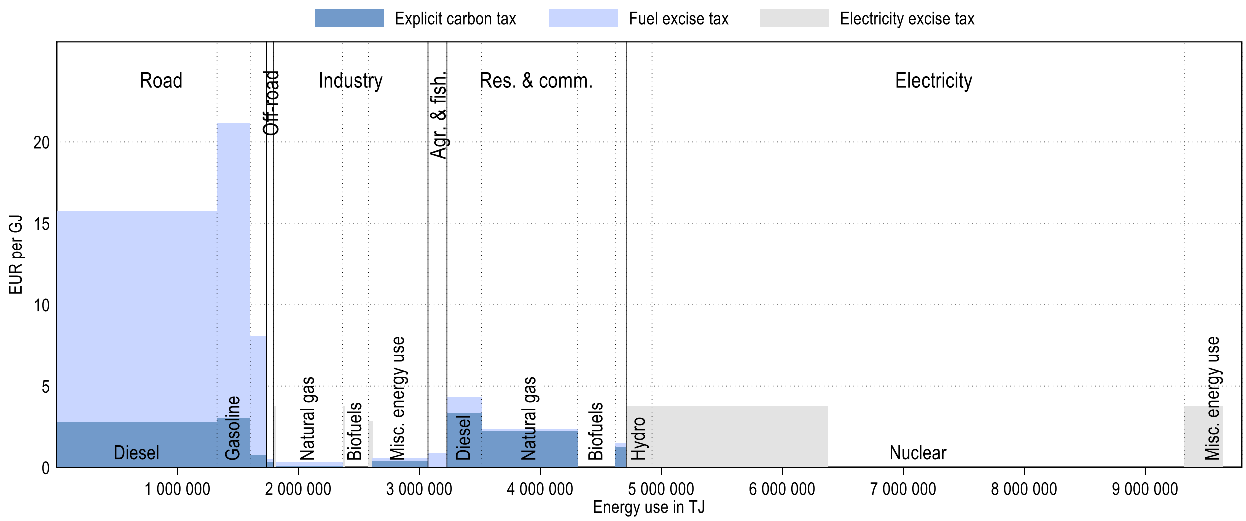


Note: Tax rates applicable on 1 July 2018, assuming use of common diesel (see online country note). Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled.

StatLink https://doi.org/10.1787/888934008494

Annex Figure 2.A.14. Effective energy tax rates in France

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ

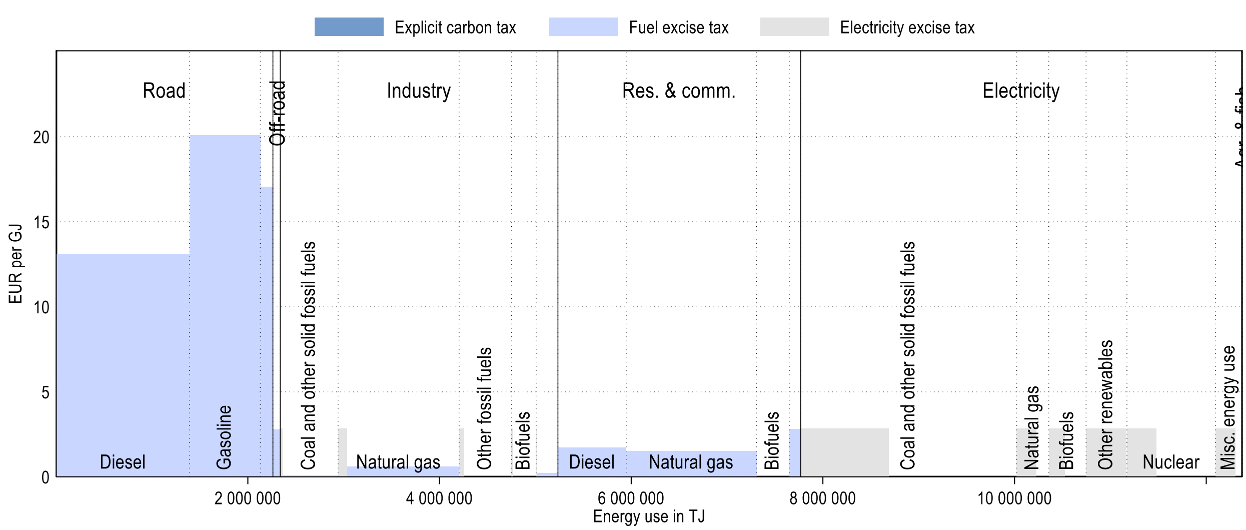


Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into “miscellaneous energy use”, which is not always labelled.

StatLink https://doi.org/10.1787/888934008513

Annex Figure 2.A.15. Effective energy tax rates in Germany

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ

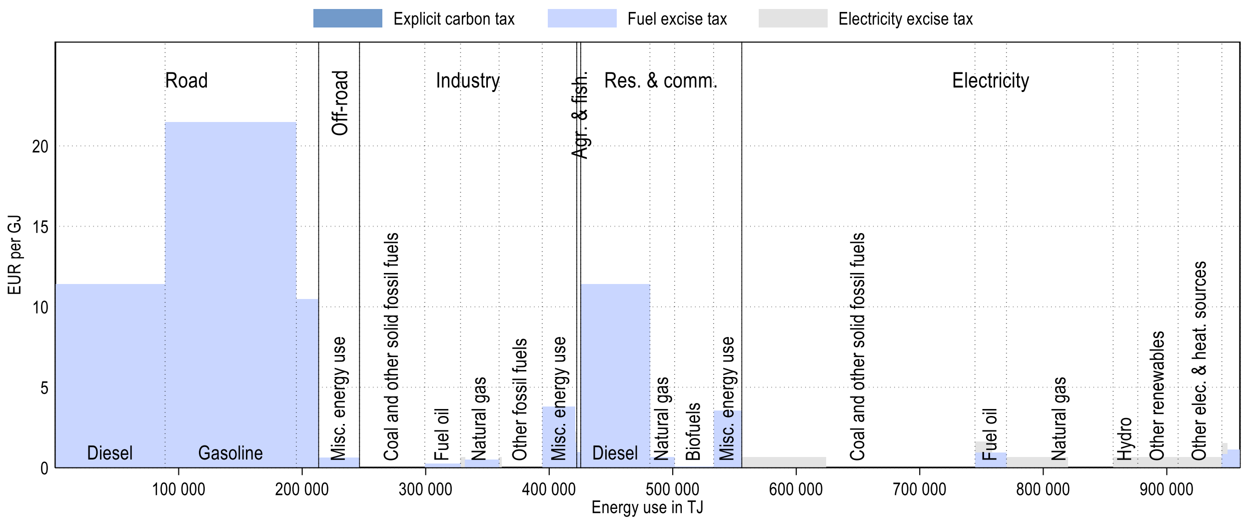


Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into “miscellaneous energy use”, which is not always labelled.

StatLink https://doi.org/10.1787/888934008532

Annex Figure 2.A.16. Effective energy tax rates in Greece

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ

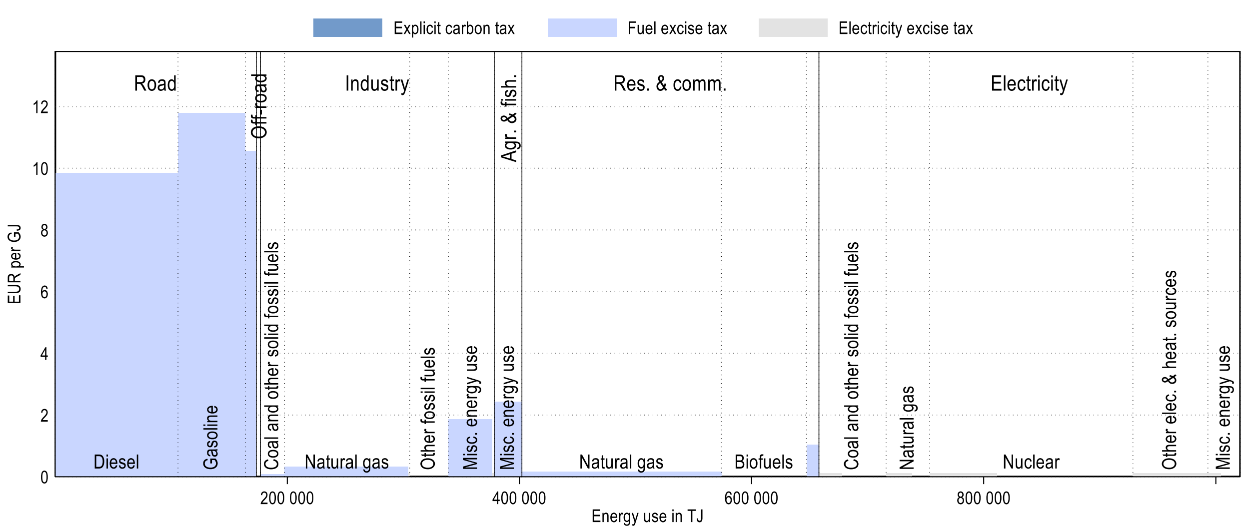


Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled.

StatLink https://doi.org/10.1787/888934008551

Annex Figure 2.A.17. Effective energy tax rates in Hungary

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ

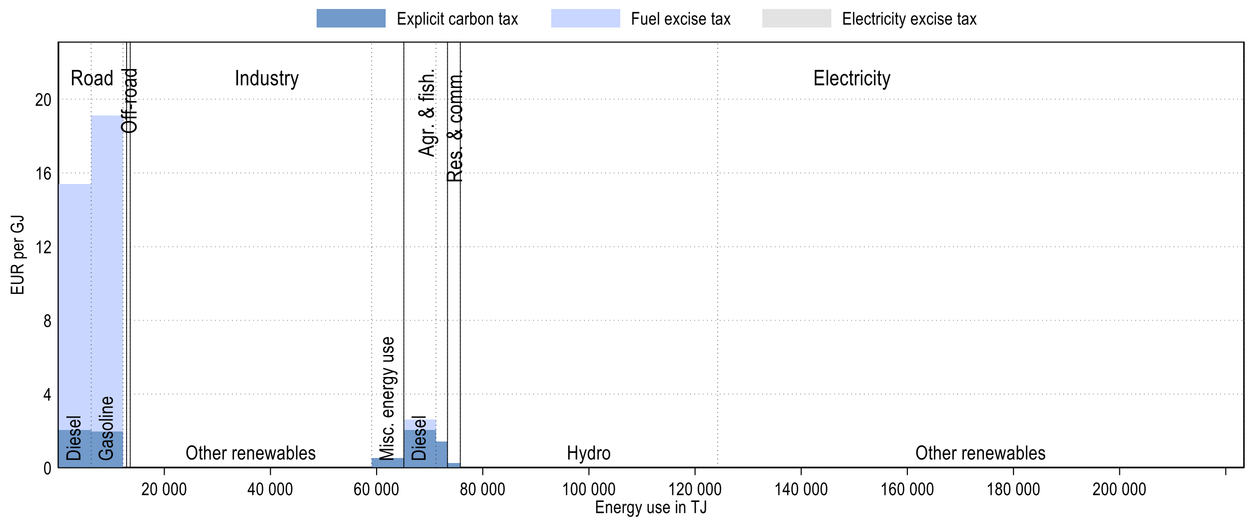


Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled.

StatLink https://doi.org/10.1787/888934008570

Annex Figure 2.A.18. Effective energy tax rates in Iceland

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ

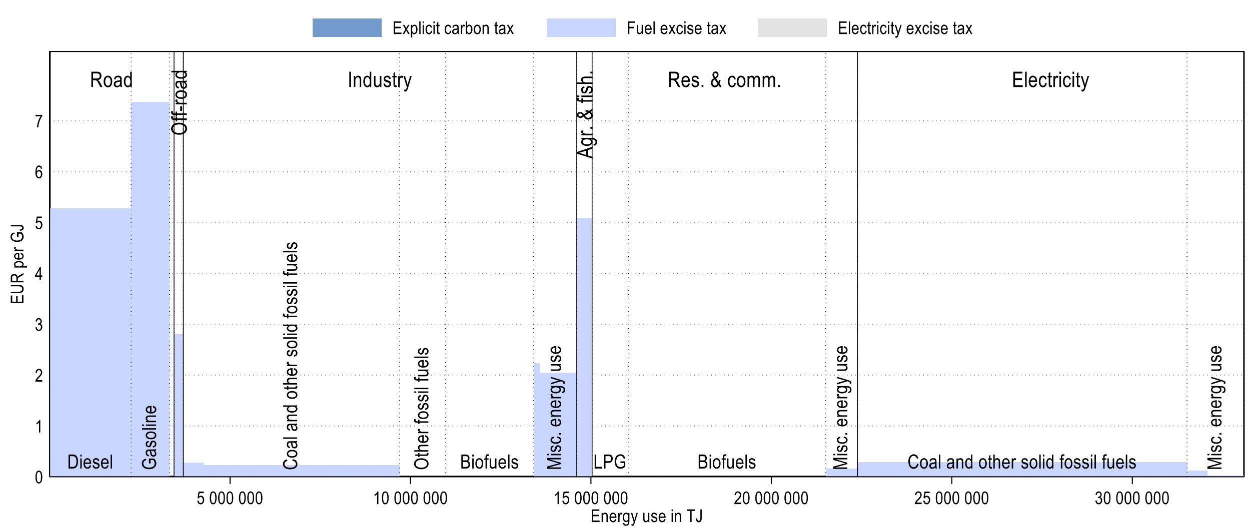


Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled.

StatLink https://doi.org/10.1787/888934008589

Annex Figure 2.A.19. Effective energy tax rates in India

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ

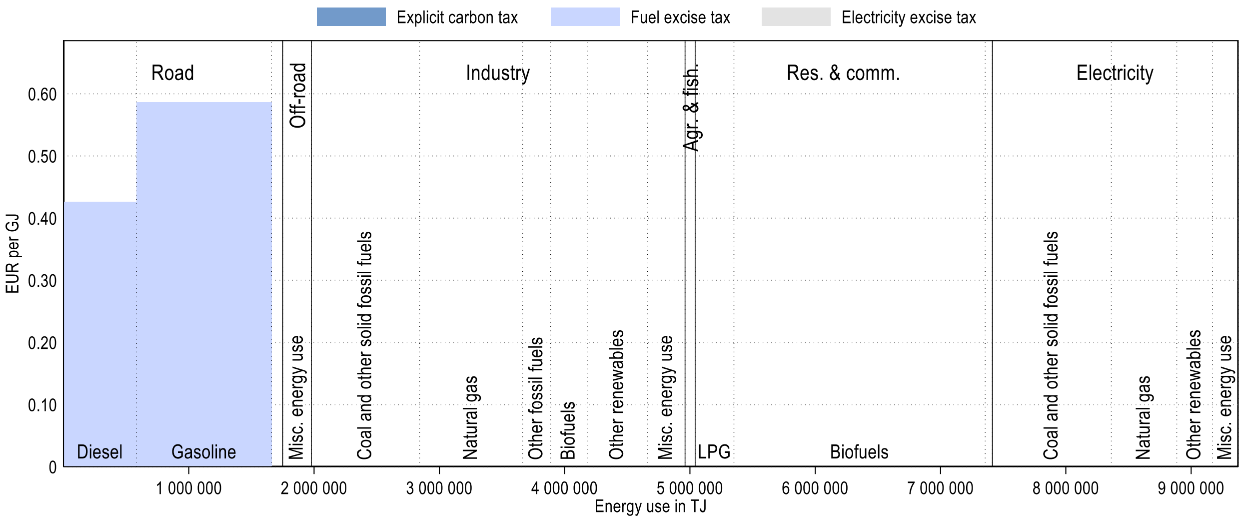


Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled.

StatLink https://doi.org/10.1787/888934008608

Annex Figure 2.A.20. Effective energy tax rates in Indonesia

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ

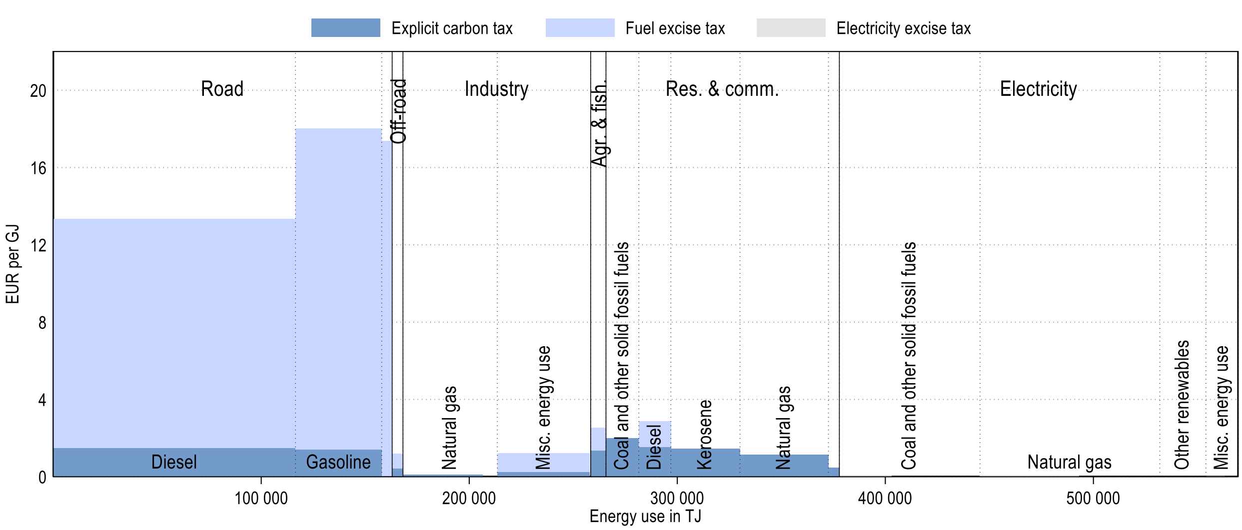


Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled.

StatLink https://doi.org/10.1787/888934008627

Annex Figure 2.A.21. Effective energy tax rates in Ireland

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ

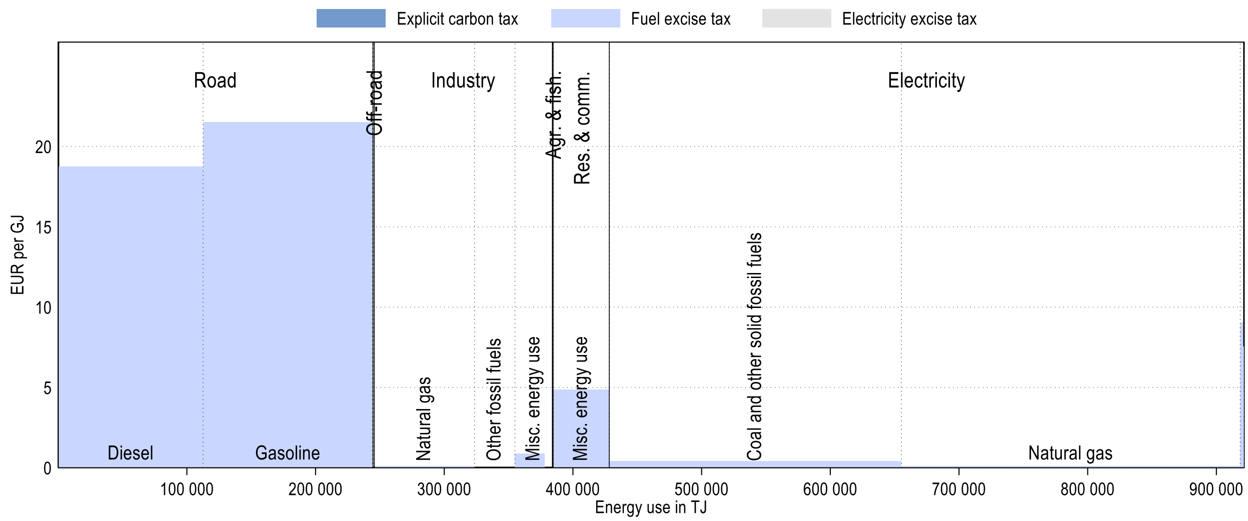


Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled.

StatLink https://doi.org/10.1787/888934008646

Annex Figure 2.A.22. Effective energy tax rates in Israel

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ

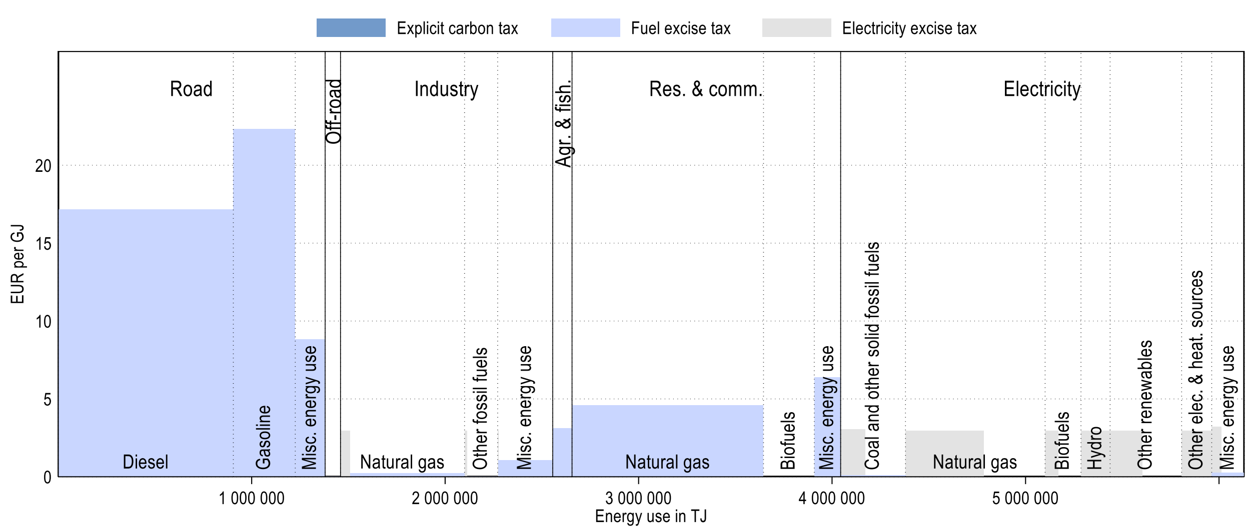


Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled.

StatLink https://doi.org/10.1787/888934008665

Annex Figure 2.A.23. Effective energy tax rates in Italy

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ

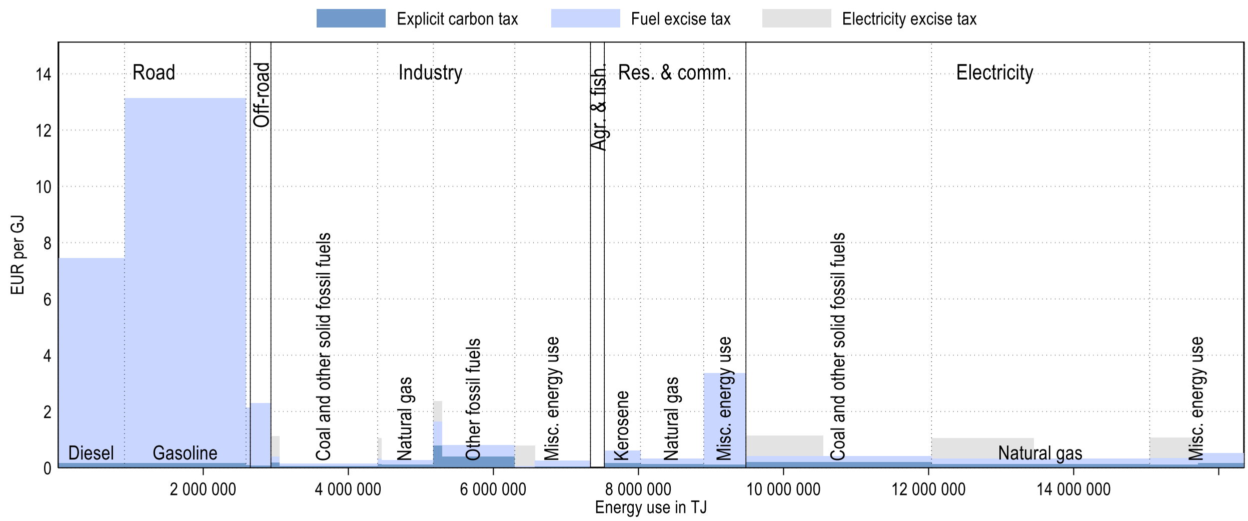


Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled.

StatLink https://doi.org/10.1787/888934008684

Annex Figure 2.A.24. Effective energy tax rates in Japan

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ

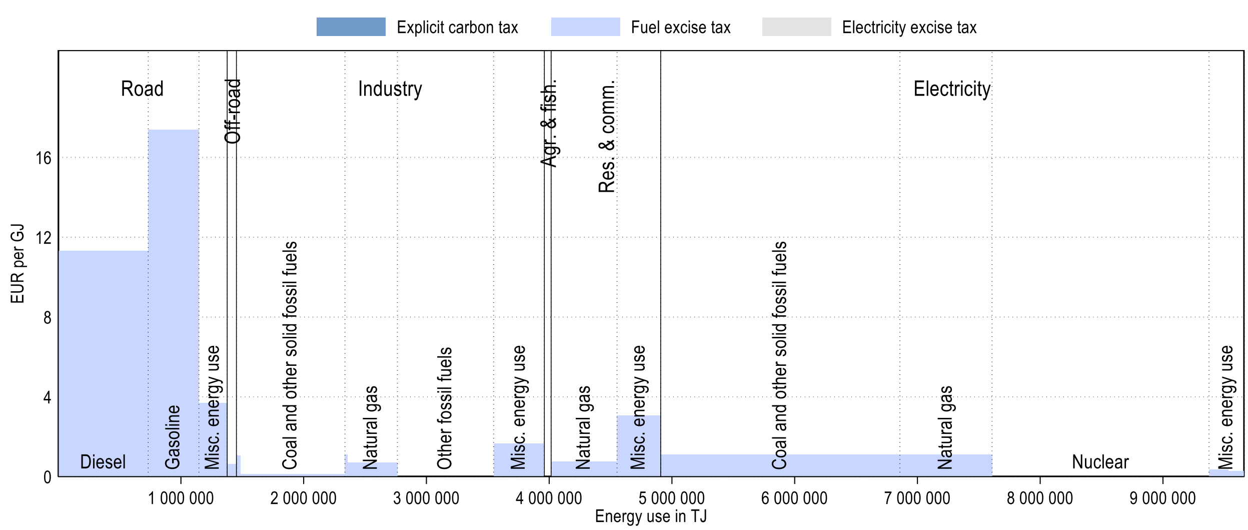


Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled.

StatLink https://doi.org/10.1787/888934008703

Annex Figure 2.A.25. Effective energy tax rates in Korea

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ

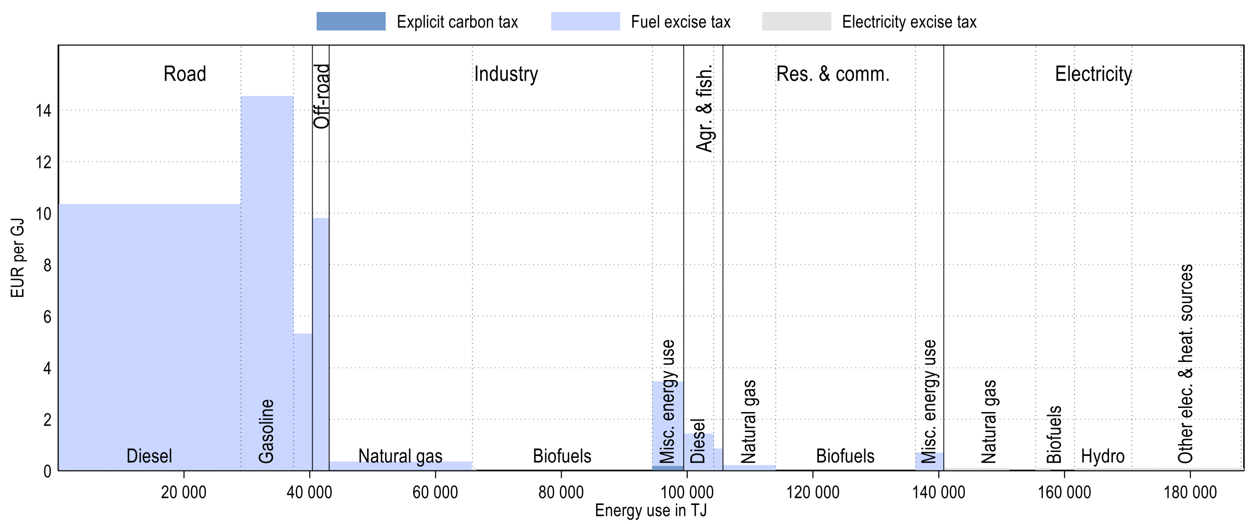


Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled.

StatLink https://doi.org/10.1787/888934008722

Annex Figure 2.A.26. Effective energy tax rates in Latvia

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ

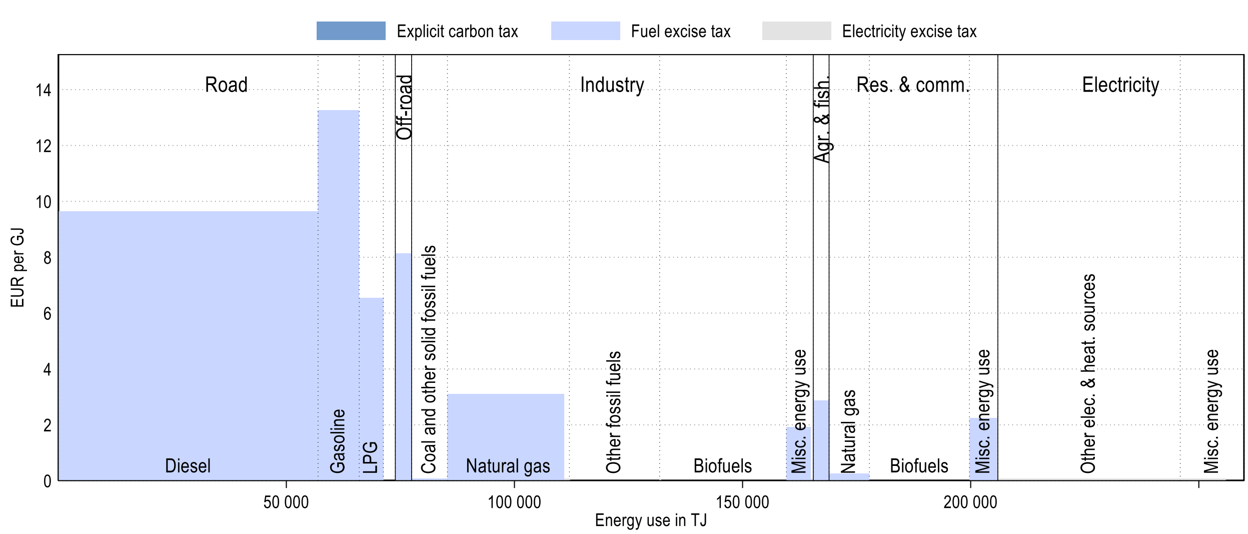


Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled.

StatLink https://doi.org/10.1787/888934008741

Annex Figure 2.A.27. Effective energy tax rates in Lithuania

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ

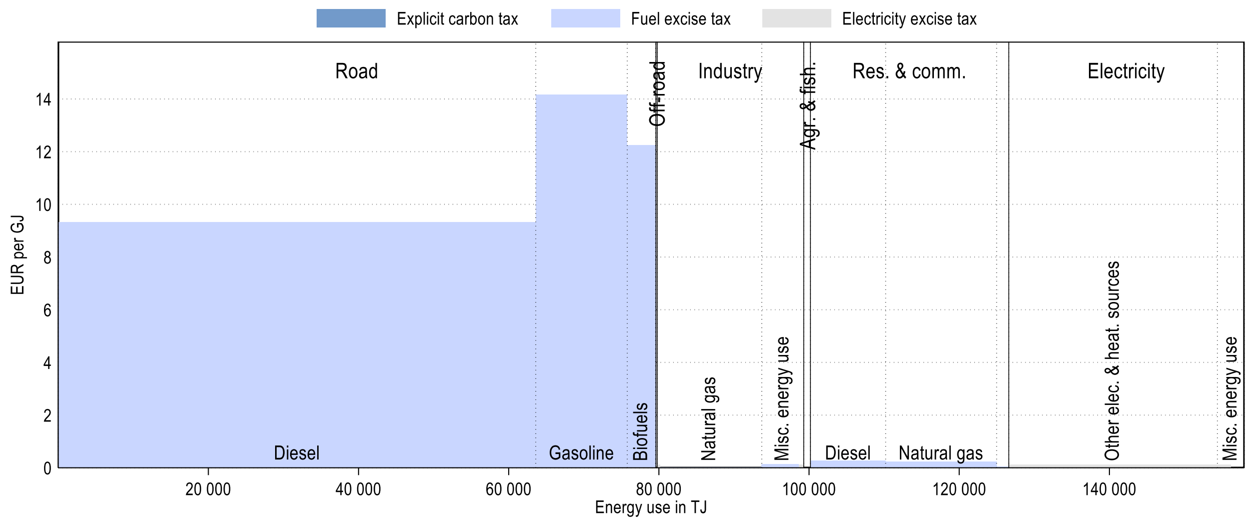


Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled.

StatLink https://doi.org/10.1787/888934008760

Annex Figure 2.A.28. Effective energy tax rates in Luxembourg

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ

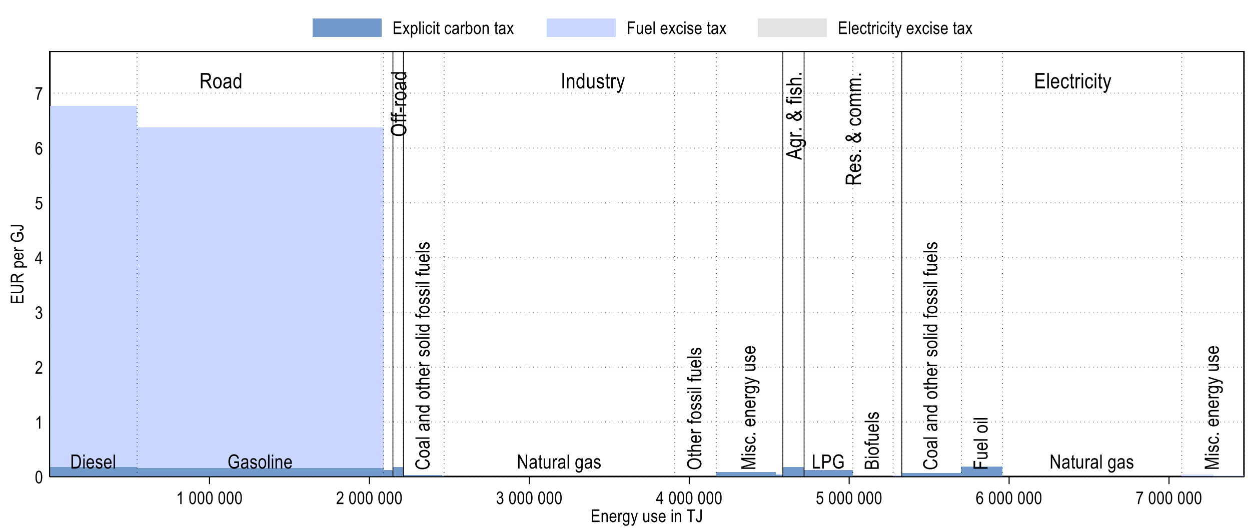


Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled.

StatLink https://doi.org/10.1787/888934008779

Annex Figure 2.A.29. Effective energy tax rates in Mexico

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ

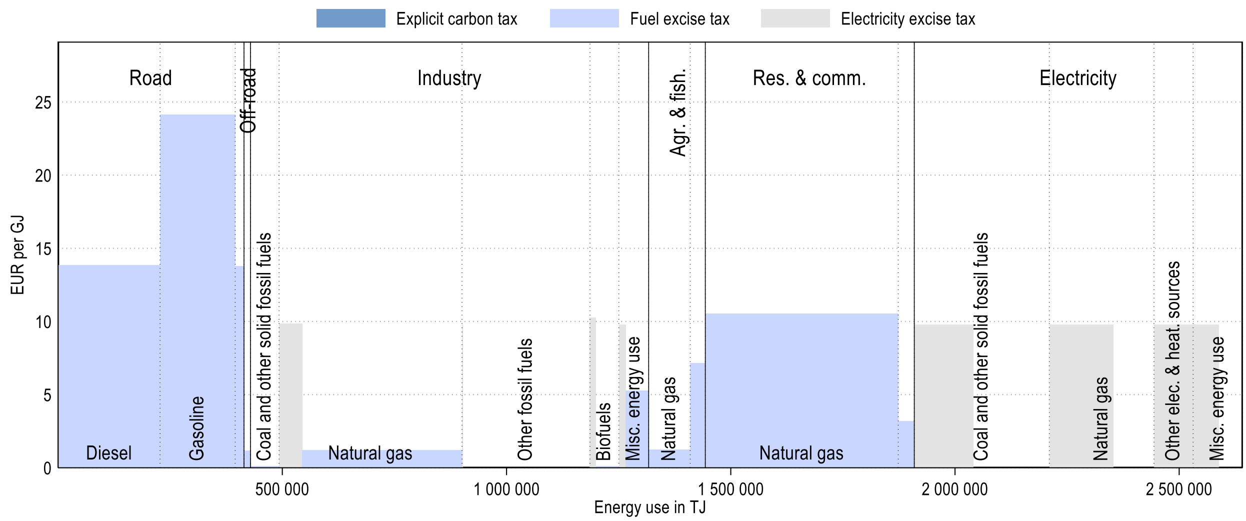


Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled.

StatLink https://doi.org/10.1787/888934008798

Annex Figure 2.A.30. Effective energy tax rates in the Netherlands

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ

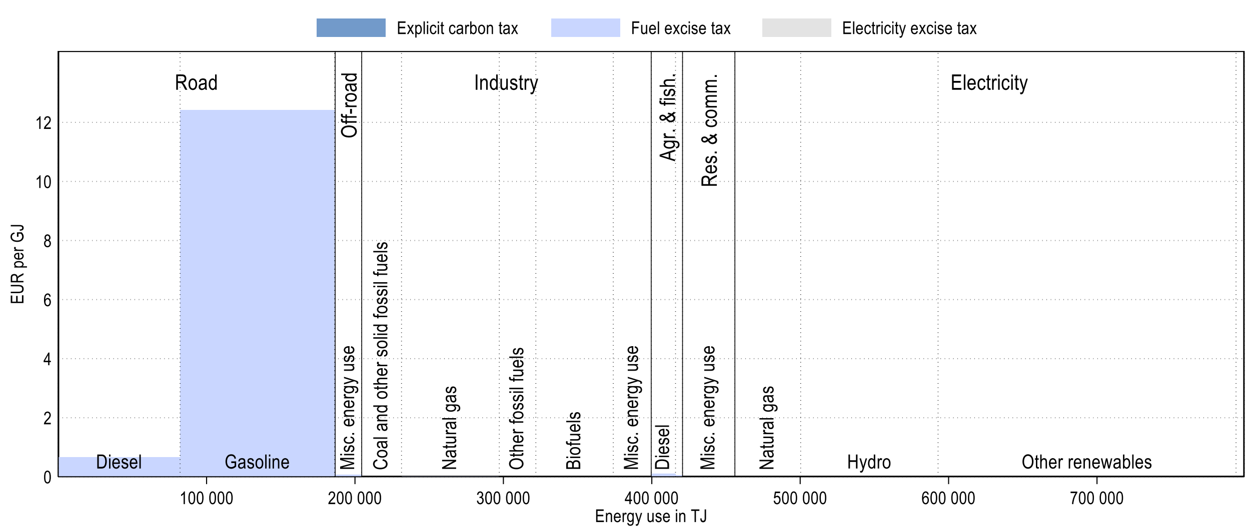


Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled.

StatLink https://doi.org/10.1787/888934008817

Annex Figure 2.A.31. Effective energy tax rates in New Zealand

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ

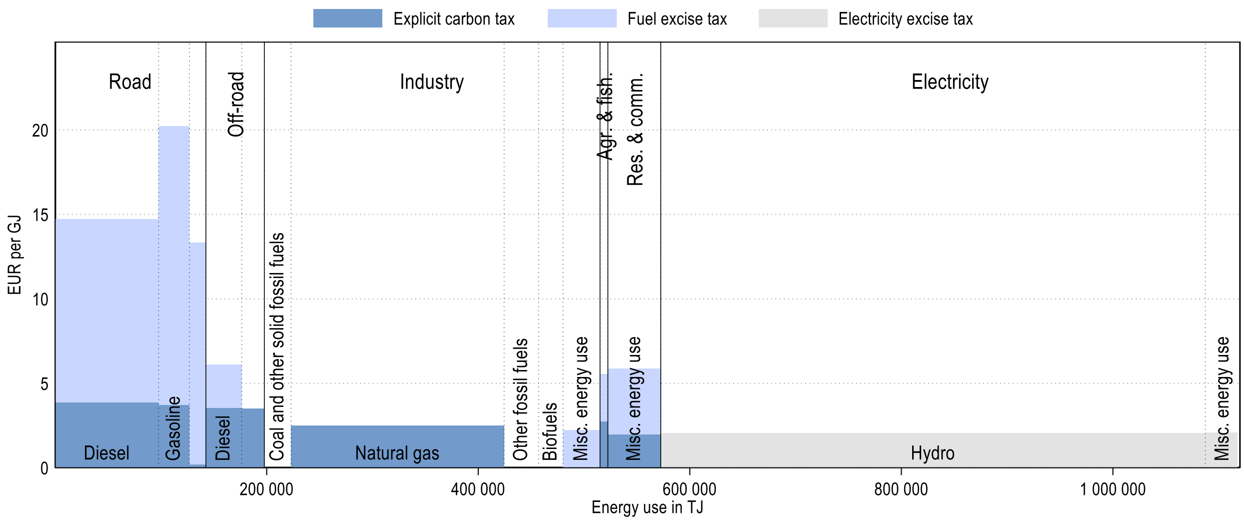


Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled.

StatLink https://doi.org/10.1787/888934008836

Annex Figure 2.A.32. Effective energy tax rates in Norway

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ

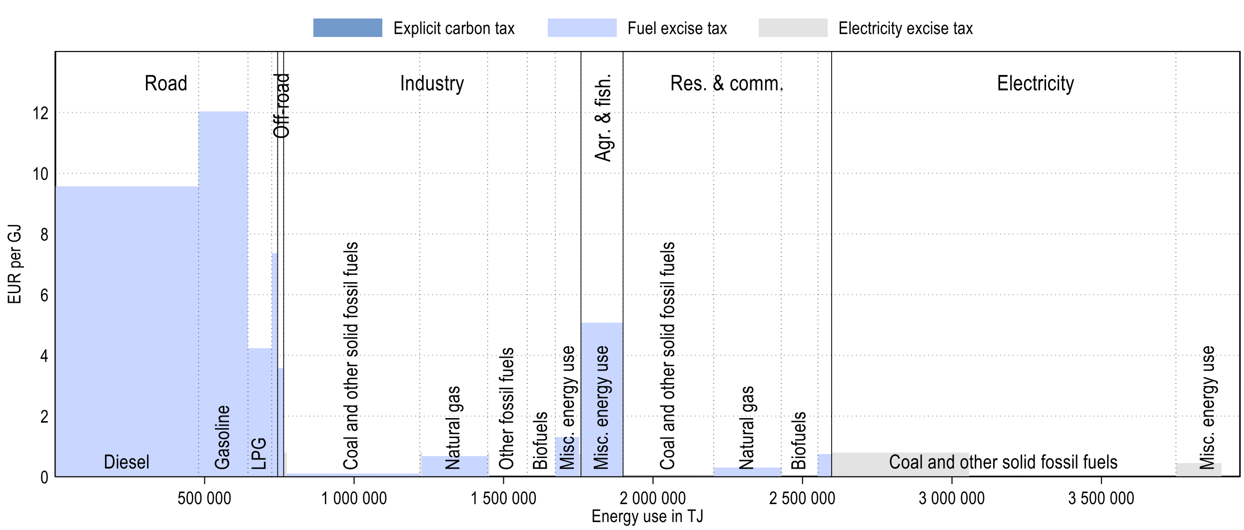


Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled.

StatLink https://doi.org/10.1787/888934008855

Annex Figure 2.A.33. Effective energy tax rates in Poland

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ

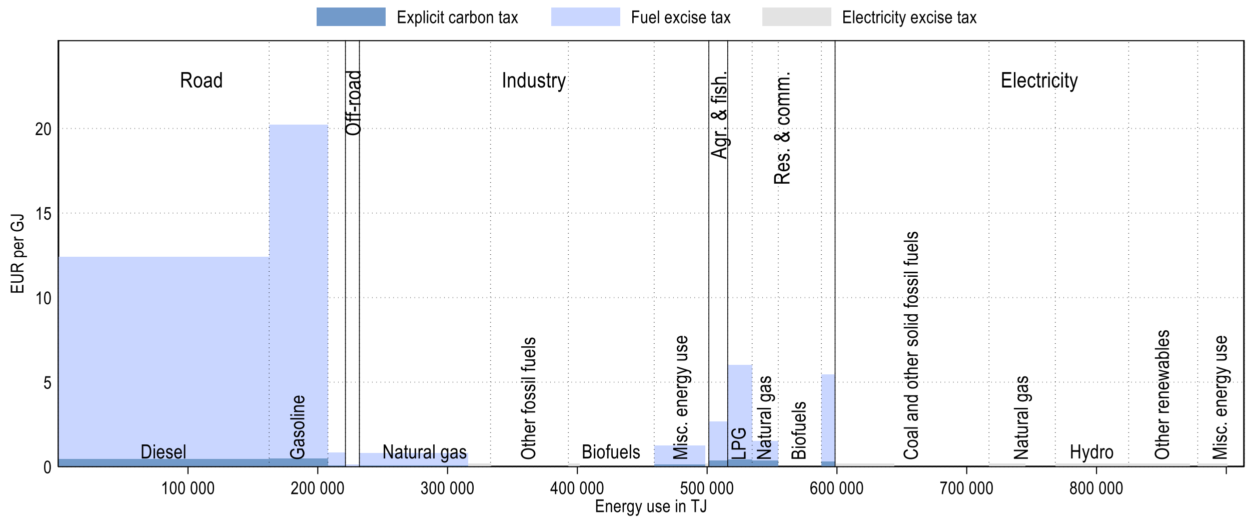


Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled.

StatLink https://doi.org/10.1787/888934008874

Annex Figure 2.A.34. Effective energy tax rates in Portugal

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ

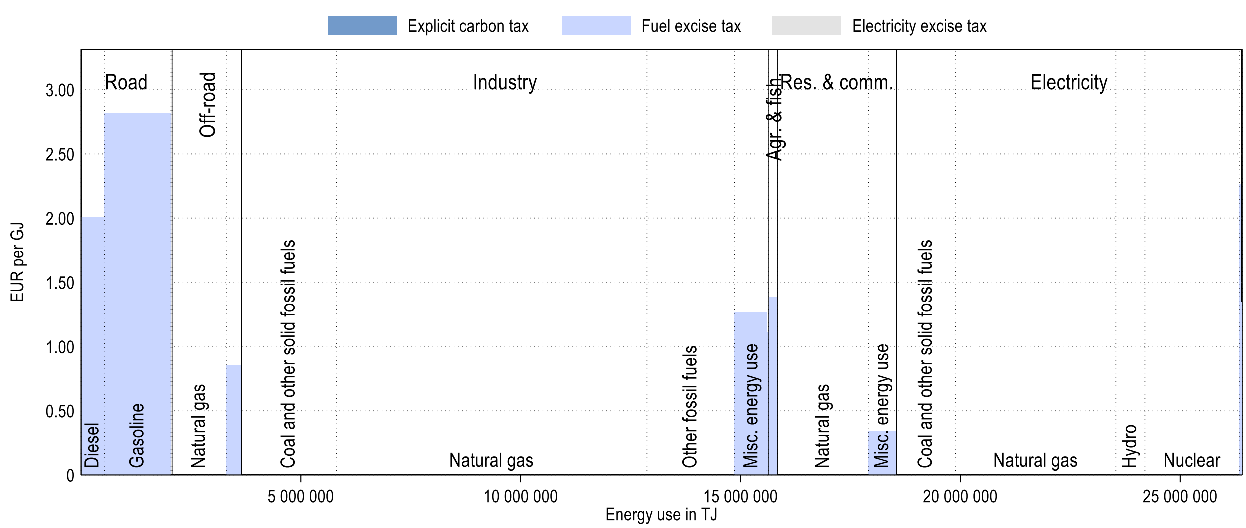


Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled.

StatLink https://doi.org/10.1787/888934008893

Annex Figure 2.A.35. Effective energy tax rates in Russia

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ

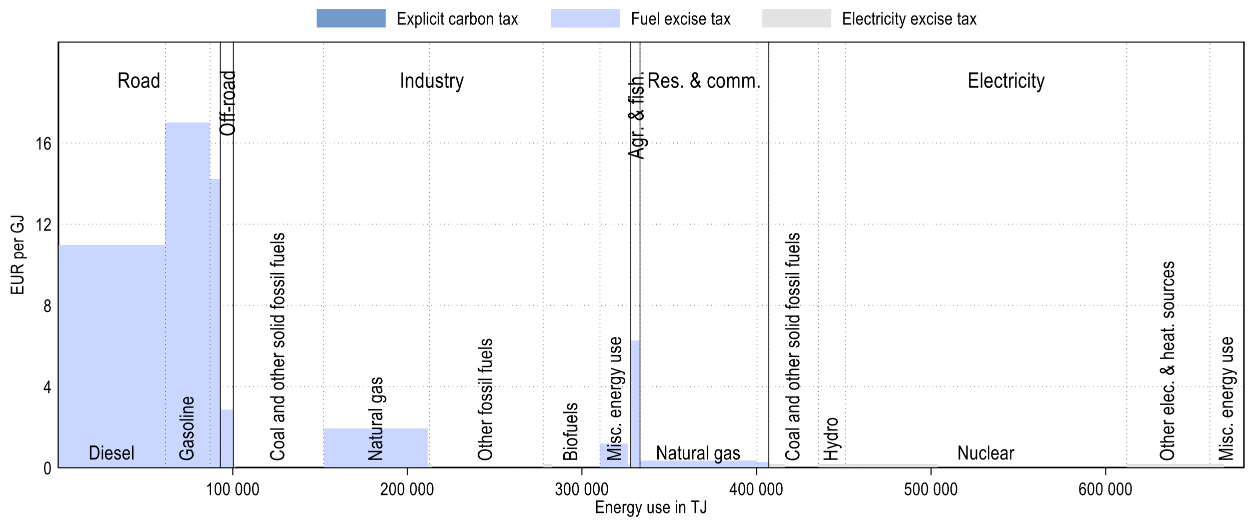


Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled.

StatLink https://doi.org/10.1787/888934008912

Annex Figure 2.A.36. Effective energy tax rates in the Slovak Republic

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ

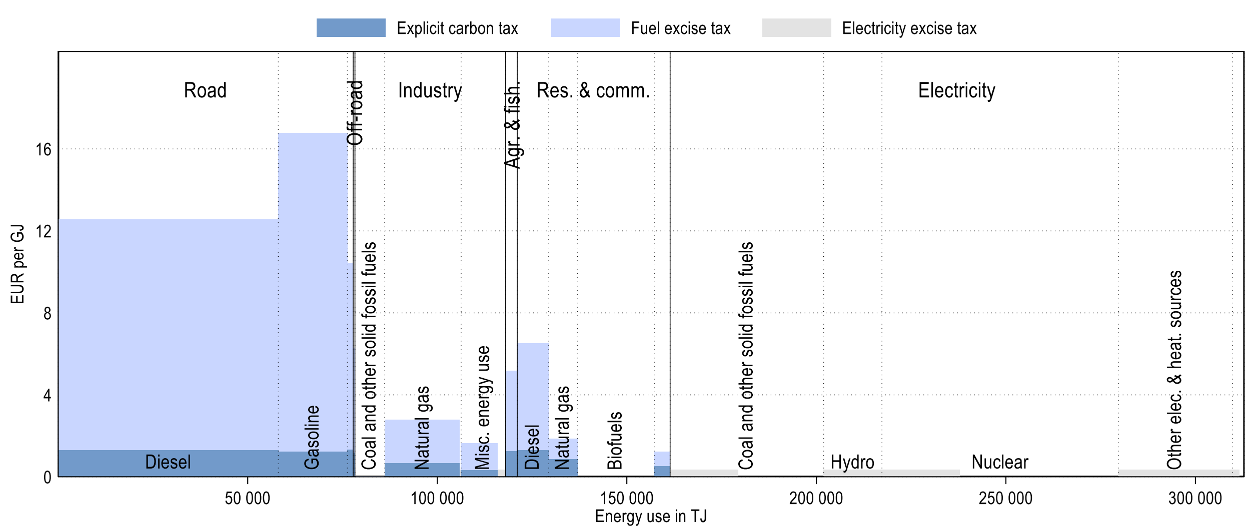


Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled.

StatLink https://doi.org/10.1787/888934008931

Annex Figure 2.A.37. Effective energy tax rates in Slovenia

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ

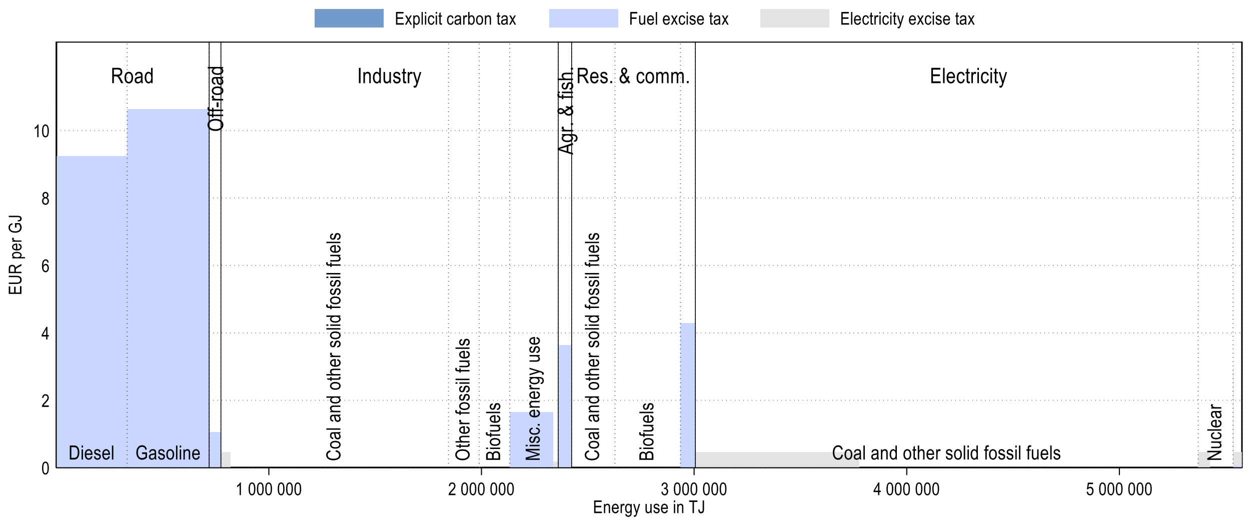


Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled.

StatLink https://doi.org/10.1787/888934008950

Annex Figure 2.A.38. Effective energy tax rates in South Africa

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ

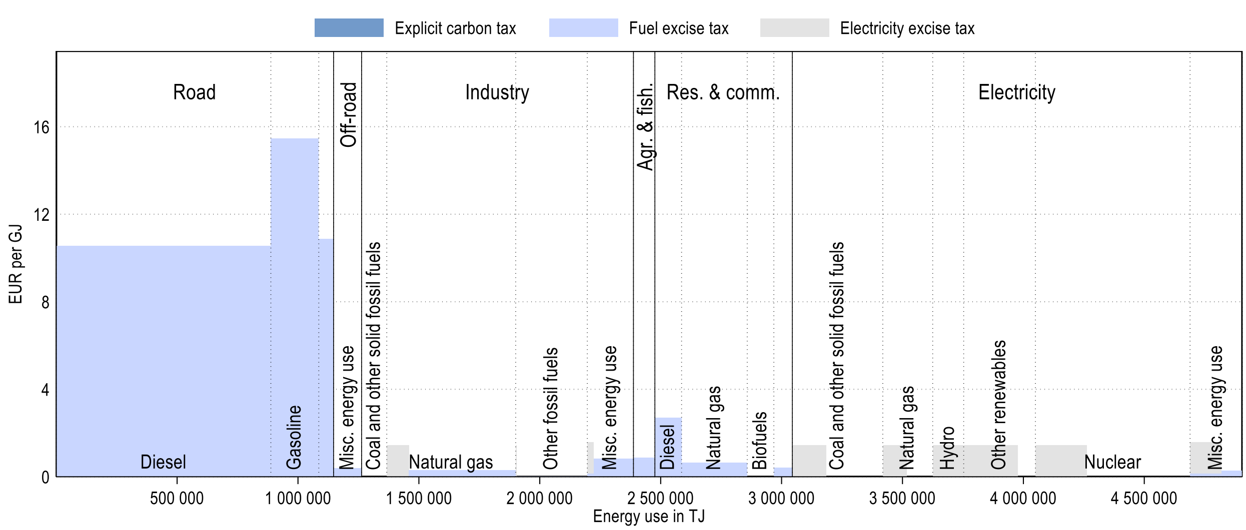


Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into “miscellaneous energy use”, which is not always labelled.

StatLink https://doi.org/10.1787/888934008969

Annex Figure 2.A.39. Effective energy tax rates in Spain

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ

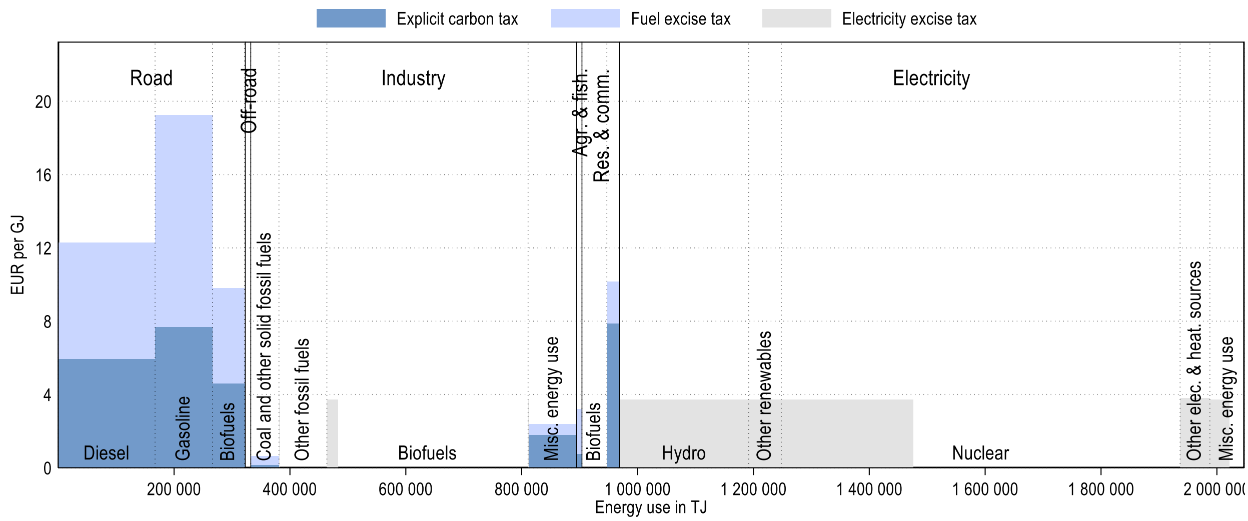


Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into “miscellaneous energy use”, which is not always labelled.

StatLink https://doi.org/10.1787/888934008988

Annex Figure 2.A.40. Effective energy tax rates in Sweden

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ

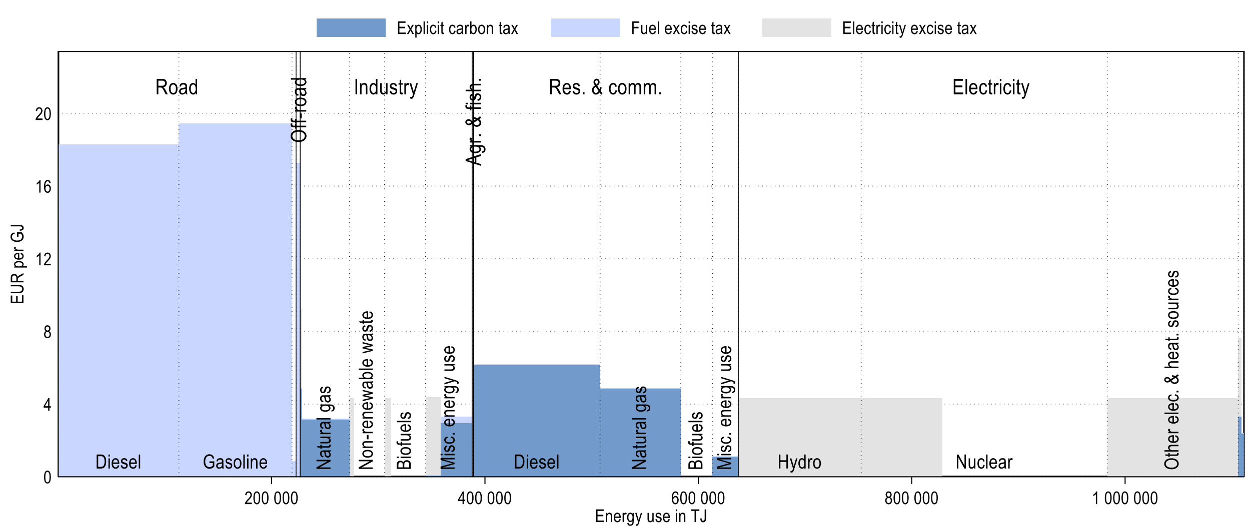


Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into “miscellaneous energy use”, which is not always labelled.

StatLink https://doi.org/10.1787/888934009007

Annex Figure 2.A.41. Effective energy tax rates in Switzerland

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ

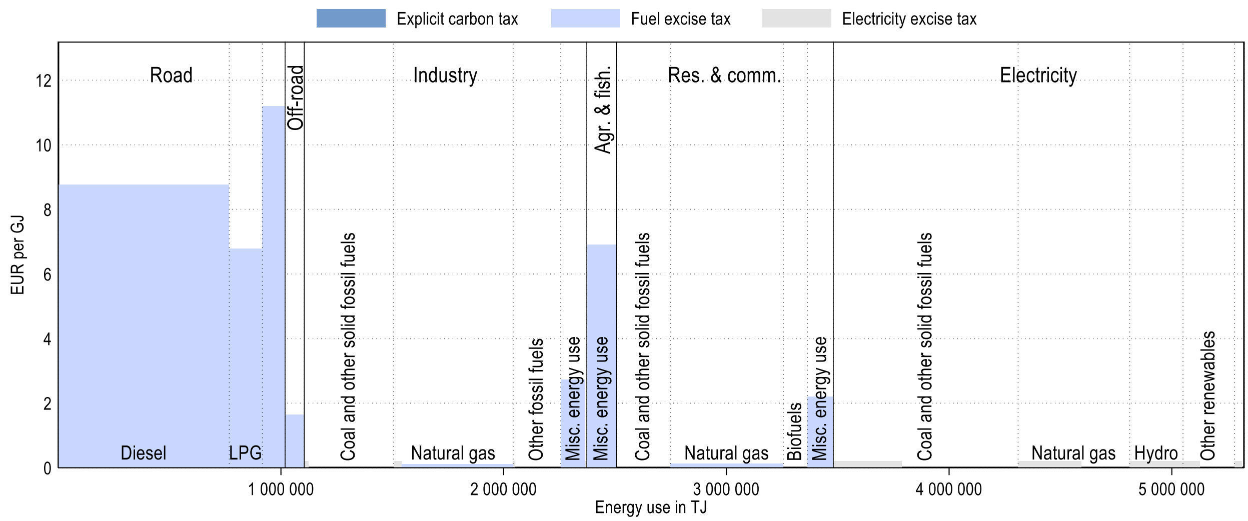


Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into “miscellaneous energy use”, which is not always labelled.

StatLink https://doi.org/10.1787/888934009026

Annex Figure 2.A.42. Effective energy tax rates in Turkey

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ

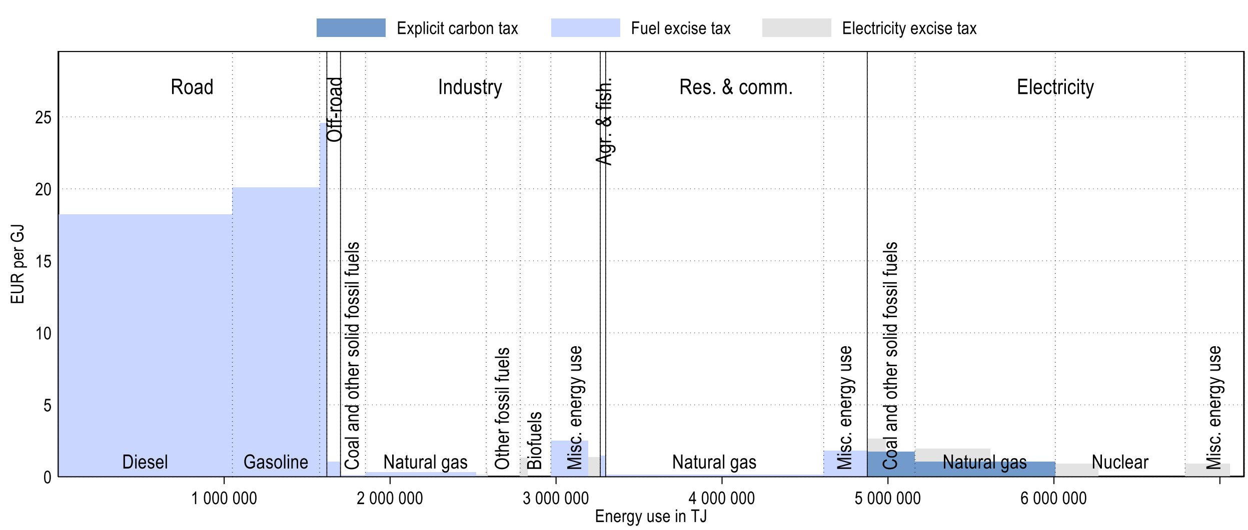


Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled.

StatLink https://doi.org/10.1787/888934009045

Annex Figure 2.A.43. Effective energy tax rates in the United Kingdom

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ

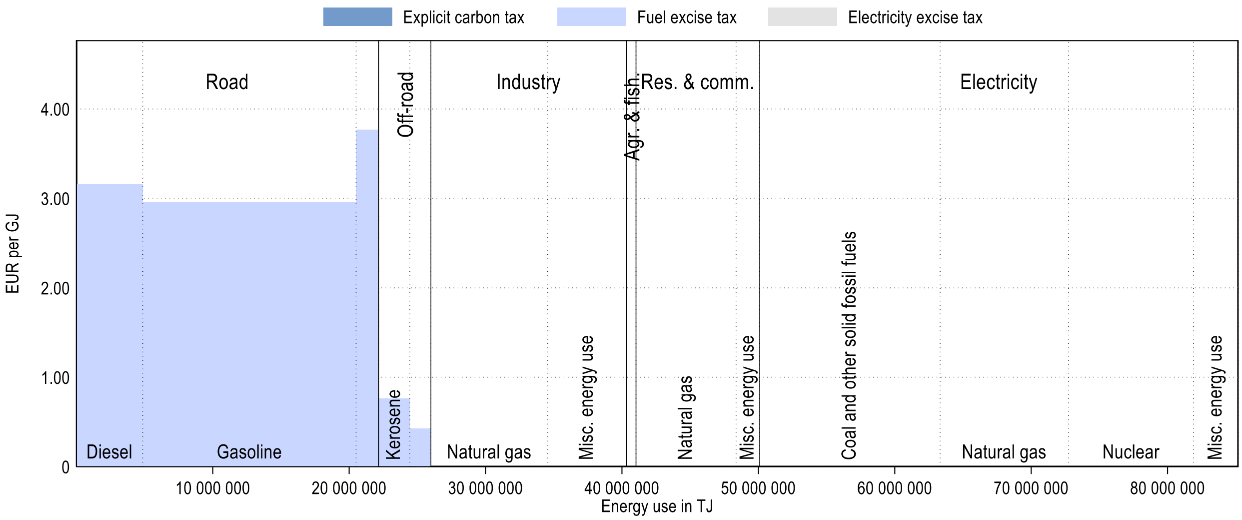


Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled.

StatLink https://doi.org/10.1787/888934009064

Annex Figure 2.A.44. Effective energy tax rates in United States

Average by sector, energy category and end-use energy (electricity or other) - rate in EUR per GJ



Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into “miscellaneous energy use”, which is not always labelled.

StatLink https://doi.org/10.1787/888934009083

Notes

[1] The skewed distribution also implies that average tax rates have to be interpreted with caution, especially at the level of aggregation shown in the figure. The remainder of this report therefore reports average effective tax rates at lower levels of aggregation. The full distribution of unaveraged tax rates are available as online country notes.

[2] This holds even if taxes are only partially passed through to end users, e.g. in settings where energy suppliers enjoy market power (Alm, Sennoga and Skidmore, 2009[22]).

[3] The statement only considers the direct effects of the energy savings on environmental outcomes. There could be environmental damage associated with the production and deployment of more energy-efficient technologies, or the revenue raised by such taxes could be employed for environmentally harmful purposes. Such indirect effects can in principle outweigh the benefits resulting from the energy savings.

[4] For non-climate damage, other factors, such as end-of-pipe technologies, as well as time and place of use are also important in determining the magnitude of the environmental damage.

[5] The figure somewhat overstates the contribution that combustible fuels make to meeting countries' energy needs. The reason is that the figure shows energy use in primary energy equivalents as defined in the IEA World Energy Balances (see also, Chapter 1). This implies that a substantial share of combustible energy use is not available for final consumption as it is thermal waste lost in the conversion process. Notably, when coal is converted to electricity, 62% of the primary energy is lost on average – this "thermal waste" never becomes electricity. Most non-combustible sources, on the other hand, do not cause thermal waste, meaning a large part of the primary energy use shown is available for final consumption by end users. Notable exceptions are nuclear power and geothermal energy, where approximately two thirds of the primary energy use are lost.

[6] Combusting biofuels also releases CO_2 and pollutants into the atmosphere. However, if sustainably sourced, biofuels may be carbon-neutral over their lifecycle because the biofuels feedstocks have previously absorbed a similar amount of CO_2 from the atmosphere.

[7] Notice, however, there may be other environmental damage, for example in relation to nuclear waste, that is not necessarily reflected in market prices – e.g. because of power producers' limited liability, which may warrant corrective taxation (Banerjee and Besley, 1990[19]). Energy savings incentivised by energy and carbon taxes could thus lead to improvements in environmental outcomes, even with respect to non-combustible energy sources. Also note that there are non-environmental reasons for fostering energy efficiency improvements through taxes, e.g. energy security issues for energy-importing countries (Linares and Labandeira, 2010[2]). By contrast, there are better instruments than energy and carbon taxes to deal with the possibility that some energy users undervalue fuel savings (Allcott, Mullainathan and Taubinsky, 2014[17]).

[8] Iceland introduced an electricity tax in 2010, but discontinued it at the end of 2015.

[9] The link is even more indirect with respect to the health and environmental damage caused by the energy combustion, which additionally vary with time, location and population density, among other factors.

[10] Some countries, notably Sweden (Sterner and Turnheim, 2009[18]), directly tax certain air pollutants, but standards are the more commonly used policy instrument to tackle local air pollution.

[11] From a social welfare perspective, it is also important that the carbon benefits of electrification are not outweighed by other environmental costs (Kouloumpis, Stamford and Azapagic, 2015[21]).

[12] Norway is in the process of electrifying all domestic ferries (by 2025) – but electrifying long-distance maritime transport remains a challenge.

[13] EU minimum rates are low, however, relative to fuel tax minima (on an energy content basis). As a result, the existence of electricity taxes in EU countries is not always discernible in the country profiles (Annex 2.A).

[14] Note, however, that in many countries that rely on electricity taxes, the power sector is additionally subject to an emissions trading systems, which may further decrease the effectiveness of electricity taxes at triggering net emission reductions. Also note that electricity taxes also have the advantage that they can be levied on electricity imported from abroad. In countries where geographic conditions and transmission infrastructure permit, countries may be hesitant to introduce or raise fuel excise and carbon taxes on inputs used to generate electricity, for fear of putting domestic producers at a disadvantage to foreign producers. Sufficiently high effective carbon tax floors agreed among interconnected countries could address such competiveness concerns and ensure a level playing-field between domestic and foreign electricity producers. This would decrease the need to rely on electricity taxes as second or third best instruments to achieve emission reductions from trade-exposed power sectors.

[15] Carbon taxes would still be cost-effective, but the emission reduction triggered for a given carbon tax level would be lower.

[16] In addition, pre-tax electricity prices generally do not reflect the marginal private cost of electricity supply. In particular, pre-tax electricity prices rarely reflect the fact that supply costs vary substantially across time. In addition, many fixed costs associated with the provision of electricity, e.g. for network infrastructure, are recuperated at the margin (though network tariffs that are charged on a volumetric basis). Aligning electricity pricing with decarbonisation objectives will therefore require going beyond energy and carbon tax design (Borenstein and Bushnell, 2018[20]).

[17] These could be environmentally related, such as emission standards for PM and NO_x. The recently introduced stricter emission standards regarding NO_x emissions have significantly increased the relative price of diesel vehicles, compared to petrol vehicles – especially for relatively small (cheap) vehicles.

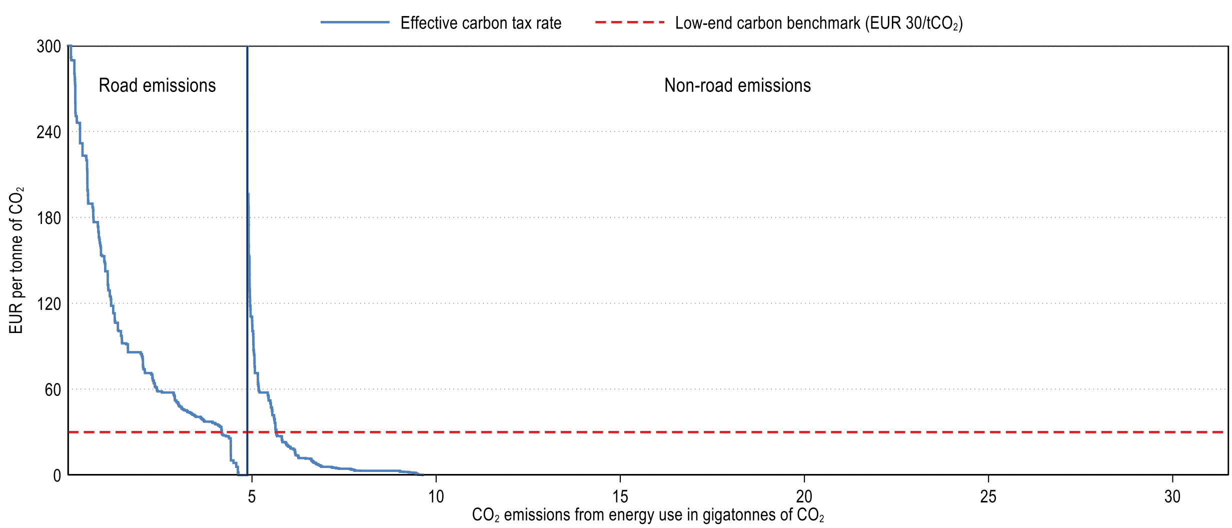
3 Carbon price signals through taxes

This chapter focuses on the taxation of combustible energy sources, and establishes the extent to which tax-based carbon price signals are aligned with a low-end carbon benchmark. The chapter compares tax-based carbon price signals across countries, sectors, and fuels. Special emphasis is placed on the relative taxation of coal and natural gas, as well as on the taxation of aviation and maritime transport. The chapter annex present carbon tax profiles for all 44 OECD and Selected Partner Economies.

The case for broadening carbon price signals

Effective carbon taxes – i.e. the sum of explicit carbon taxes and fuel excise taxes, net of applicable exemptions, rate reductions and refunds – currently fail to provide broad-based carbon price signals. Figure 3.1 shows that most non-road emissions remain entirely untaxed. When non-road emissions are taxed, effective carbon taxes rarely reflect even a low-end estimate of the damage that CO_2 emissions impose on society (EUR 30 per tonne of CO_2). Specifically, 82% of non-road emissions are entirely untaxed, and 97% are taxed at less than EUR 30 per tonne of CO_2. Effective carbon taxes tend to be higher in the road sector, but this is a sector where non-climate externalities are relatively high (see Chapter 2).

Figure 3.1. Distribution of effective carbon tax rates across CO_2 emissions for 44 OECD and Selected Partner Economies and international transport



Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. Emissions from the combustion of biofuels are included (see Chapter 1). The vertical axis is cut off at EUR 300, but the share of emissions priced higher is negligible.

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Effective carbon taxes are not the only price-based climate policy instrument; emissions trading systems (ETS) equally target CO_2 emissions from energy use, and sometimes also include other greenhouse gas emissions and different emission sources. If designed well, emissions trading systems can be similarly effective and cost-effective as carbon taxes. ETS account for approximately 6% of effective carbon rates in OECD and Selected Partner Economies (OECD, 2018[1]).[1] The extent to which countries choose to price carbon emissions through taxes and or ETS varies substantially. The European Union's ETS, for instance, covers most emissions from electricity generation and in industry; allowance were traded at approximately EUR 25 at the time of writing.[2] Carbon price signals are thus somewhat more widespread than what Figure 3.1 suggests. Nevertheless, carbon price signals remain insufficient even when considering emissions trading systems (OECD, 2018[1]).

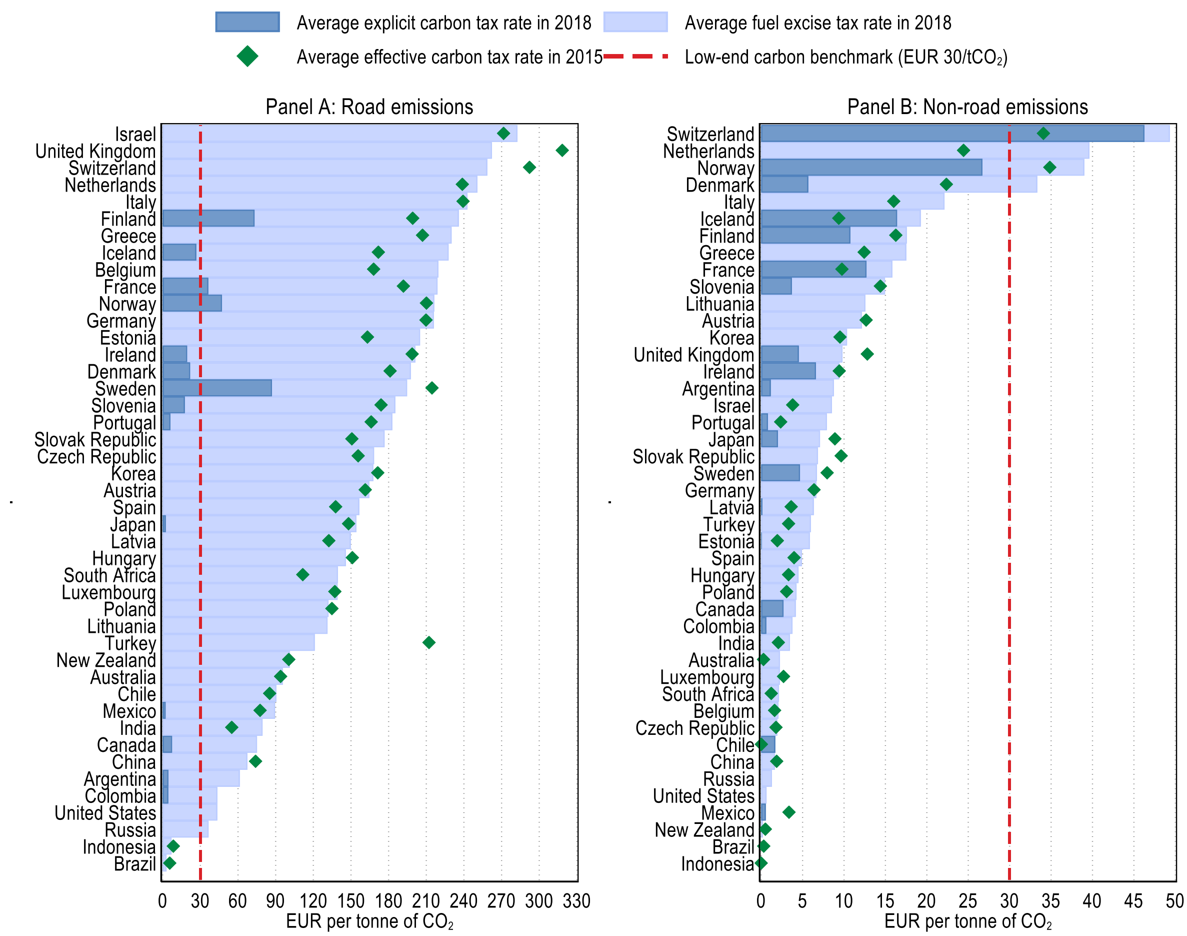
In the absence of carbon price signals, citizens and businesses lack the economic incentives to take the cost to the climate that their actions impose on society into account. As a direct consequence, citizens and businesses consume too many carbon-intensive goods and services, and spend too little on low- or zero carbon activities. In addition, overinvesting in carbon-intensive assets today risks creating high adjustment costs in the future. This carries systemic financial risk as the value of carbon-intensive capital could drop dramatically once countries take the necessary measures to drive deep decarbonisation in line with the goals of the Paris Agreement (OECD, 2018[1]).

The present lack of carbon price signals puts clean technology firms at a competitive disadvantage *vis-à-vis* polluting firms – frequently the incumbents. Businesses thus continue to invest in more carbon-intensive technologies than what would be in the interests of society, as prices fail to reflect the climate cost of products and services. Because of technological advances in clean technologies, many low- or zero carbon technologies, such as wind and solar, are increasingly competitive nonetheless. However, policy can and should do a better job at levelling the playing field, which would also help mobilise private and public finance for the technologies and infrastructure of the future (OECD/The World Bank/UN Environment, 2018[2]).

Extending carbon price signals to all sectors of the economy would help to ensure that abatement decisions are taken where they cost the least. Only those emitters that find it cheaper to cut emissions than pay the tax (or buy a certificate in the case of a trading system) will decide to invest in abatement technologies. In addition, abatement decisions would be taken by those who know the best – the polluters.[3] Carbon price signals would thus take into account the fundamental information asymmetry between governments, companies and citizens. As opposed to one-off measures such as a fuel-economy standard, carbon pricing would provide for a continued incentive to cut emissions. As a result, carbon pricing has a track record of outperforming non-price instruments, such as emission standards, which tend to come with substantially higher cost per tonne of CO_2 avoided (OECD, 2013[3]) and lead to rebound effects (see Chapter 2).

Only a few countries provide substantial tax-based carbon price signals for non-road emissions. Whereas all but three countries tax road emissions at EUR 30 per tonne of CO_2 on average (Figure 3.2, Panel A), only four out of 44 countries do so for non-road emissions. Paradoxically, the four countries are Switzerland, the Netherlands, Denmark, and Norway, which additionally participate in emissions trading systems (OECD, 2018[1]).

Figure 3.2. Average effective carbon tax rates by country



Note: 2018 tax rates as applicable on 1 July 2018. The average effective carbon tax rate in 2015 is the sum of the average explicit carbon tax rate in 2015 and the average fuel excise tax rate in 2015, as reported in OECD (2018[4]), *Taxing Energy Use* 2018, converted in 2018 prices using OECD inflation data. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), *World Energy Statistics and Balances*. Emissions from the combustion of biofuels are included (see Chapter 1). The scale of the horizontal axis differs between Panel A and Panel B. Note that changes in average effective tax rates over time are also affected by inflation, exchange rate fluctuations, and changes in the composition of the energy mix. In Chile, the explicit carbon tax is levied as part of the Green Tax. In Finland, TEU assumes the use of common diesel in the road sector (see online country note). The comparison excludes 2015 rates for the United States and Canada as data on subnational taxes was not available for 2015. 2015 data for Columbia and Lithuania are missing because they were not yet covered in the previous vintage of TEU. Argentina is missing because no inflation data was available.

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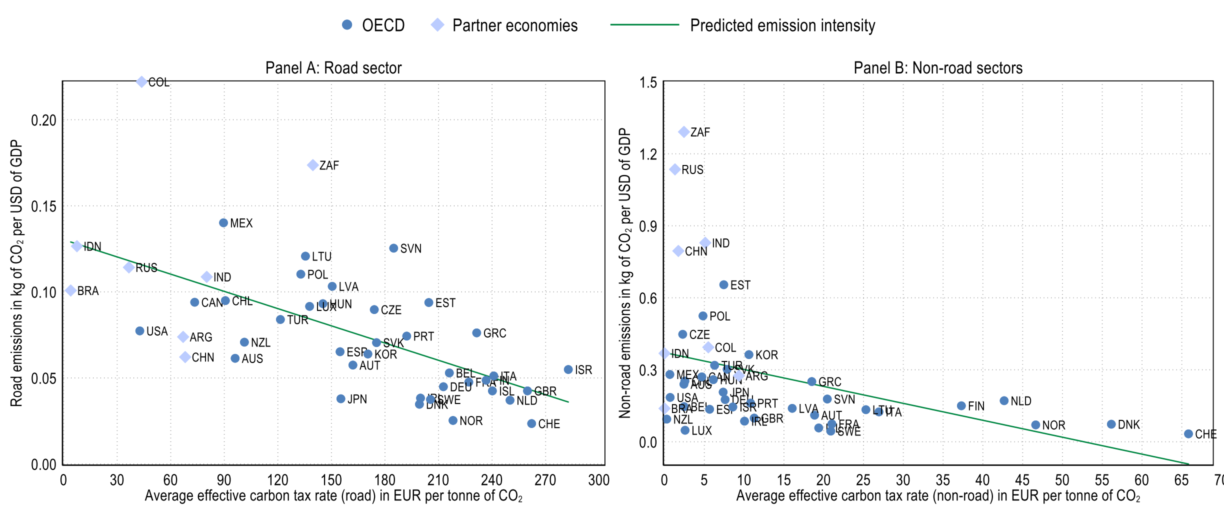
Fuel excise taxes continue to dominate explicit carbon taxes. This holds for all countries in the road sector. In non-road sectors, by contrast, explicit carbon taxes tend to play a relatively more important role. Specifically, in a number of countries – Canada, Chile, Finland, France, Iceland, Ireland, Mexico, Sweden, Switzerland – explicit carbon taxes account for most of the tax-based carbon price signal (Figure 3.2).

Little progress has been made in extending tax-based carbon price signals since 2015 – the year analysed in the last edition of *Taxing Energy Use* (OECD, 2018[4]). Figure 3.2 shows that there was no fundamental shift towards providing greater carbon price signals in either road (Panel A) or non-road sectors (Panel B). Nevertheless, in the road sector, average effective carbon tax rates increased substantially in a number of countries. In particular, Belgium, Estonia, Finland and Iceland saw the greatest increase in real terms – in all of these countries rates increased by more than EUR 30 per tonne of CO_2. In relative terms, increases were largest in Russia, followed by India and Iceland.[4]

Some countries have made progress in extending carbon pricing to non-road emissions. Effective carbon tax rates increased by more than ten euros on average in the Denmark, the Netherlands and Switzerland. In relative terms, increases were largest in Chile, Australia and Portugal, albeit starting from relatively low baseline rates. In Chile, this is due to the entering into force of the Green Tax for fixed emissions sources, which is equivalent to USD 5 per tonne of CO_2. Canada's recent progress as part of the federal carbon pricing backstop initiative is not reflected in the figure, as the backstop entered into force in 2019 only.

Carbon prices are effective – countries that levy higher effective carbon taxes are less carbon-intensive. Figure 3.3 shows that this correlation holds for both road (Panel A) and non-road sectors (Panel B). It is clear that CO_2 emission intensities differ across countries for reasons that are unrelated to carbon tax levels, such as emission standards. Raising effective carbon taxes might also be politically easier in countries that are already less emission intensive (see also, Chapter 2). Nevertheless, the economic evidence is equally clear – carbon taxes are effective at reducing CO_2 emissions – as recently confirmed in a study that estimated the long-run effects of a broad-based carbon tax on carbon emissions from fossil fuel consumption (Sen and Vollebergh, 2018[5]).[5]

Figure 3.3. Countries with higher effective carbon taxes tend to be less emission intensive



Note: 2018 tax rates as applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), *World Energy Statistics and Balances*. Emissions from the combustion of biofuels are included (see Chapter 1). The output-based GDP is for 2016 and from the OECD National Accounts database. The scales of both horizontal and vertical axes differ between Panel A and Panel B.

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Raising carbon price signals for non-road emissions is appealing for governments seeking to cut emissions fast. The reason is that carbon taxes tend to be more effective at reducing emissions outside the road sector, where carbon taxes generally have a relatively larger impact on retail prices. Specifically, increasing carbon prices by EUR 30 per tonne of CO_2 (see Table 3.1) would roughly double coal prices, but it would only increase end prices for gasoline and diesel used as road fuels by approximately five to seven percent (IMF, 2019[6]).[6]

Investing in public transport and other low-carbon infrastructure, such as electric vehicle charging stations, can further increase the effectiveness of carbon taxes in reducing emissions. Research shows, for instance, that consumers' responsiveness to fuel prices tends to be larger if citizens have access to public transport, such as in Denmark (Gillingham and Munk-Nielsen, 2019[7]). This may thus be one of the reasons for which road emissions in Denmark are lower than what the country's average effective carbon tax rate on road emissions alone would predict (Figure 3.3).

Extending tax-based carbon price signals to all emissions would generate substantial revenues. Raising effective carbon taxes to EUR 30 per tonne of CO_2 for all energy-related CO_2 emissions would generate revenues corresponding to approximately 1% of GDP of the 44 countries covered in TEU, and would roughly double current revenues from carbon pricing (Marten and Van Dender (2019[8])).

The revenues from such broad tax-based carbon price signals could not only remain stable, but increase further in the medium term, provided that governments raise rates progressively as the carbon tax base declines gradually. By contrast, in the absence of rate increases, carbon tax revenues will decrease over time as energy-use patterns adjust in response to carbon price signals. Assuming rising rates, carbon tax revenues would eventually decline, but in a matter of decades, not years (Marron, Toder and Austin, 2015[9]).

Raising revenues through carbon taxes creates opportunities for fiscal reform, which can substantially alter the distributional effects of a carbon tax (Goulder et al., 2019[10]).[7] The most socially productive and politically expedient use of these revenues depends on local circumstances. Reform options include modifying the tax mix to foster inclusive growth, e.g. through lowering personal and corporate income taxes; increased investment, e.g. in education, health and infrastructure; and decreasing the level of public debt. Revenues can also fund direct transfers to households.

Using carbon tax revenues for R&D and other climate policy measures is another option, considering that the failure to price in the climate externality is not the only climate-related market failure. Such "fresh spending", e.g. Bowen (2015[11]), could in turn strengthen support for carbon taxes, not only with constituencies that strongly favour climate action, but also with voters that doubt the effectiveness of carbon pricing as a behavioural signal but support climate spending (Klenert et al., 2018[12]).

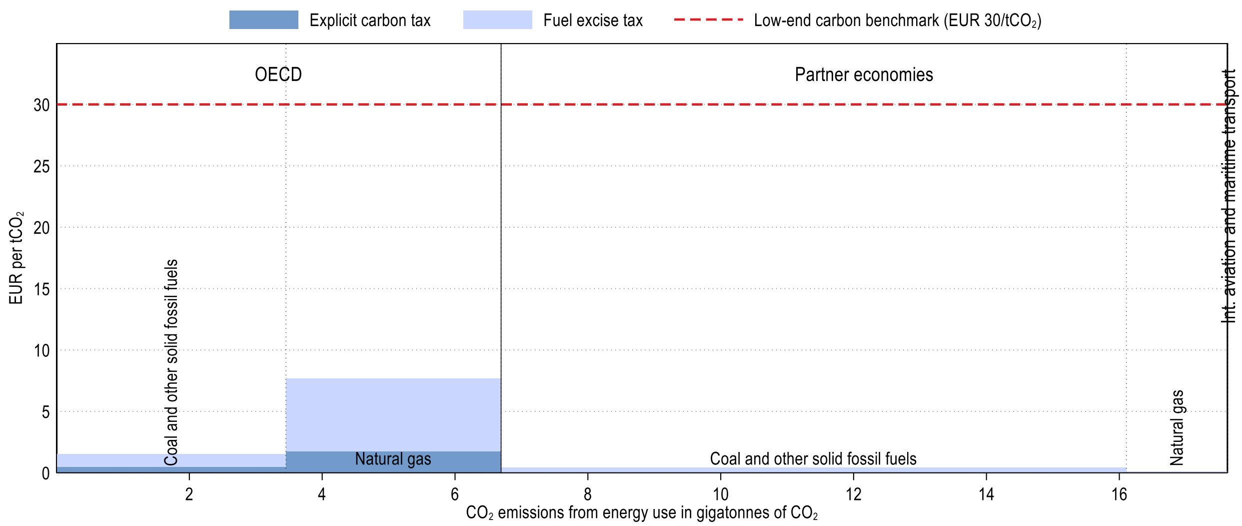
Creating stable, predictable and credible carbon price signals is key to providing citizens and businesses with certainty for their long-term investment decisions. While short-term carbon price signals can sometimes be effective, and for instance lead to the dispatch of cleaner gas-fired power plants as opposed to coal-based generation, most low-carbon technologies, such as wind and solar, are relatively capital intensive (Dressler, Hanappi and van Dender, 2018[13]). Their long-run business case will improve as expectations about future carbon prices increase. Fuel excise and carbon taxes, which have historically remained stable over time (see also, Figure 3.2), are in principle able to provide carbon price predictability. Against this background, agreeing on predictable rate schedules does not only make sense to ensure fiscal sustainability; it also decreases the risk of stranded assets in the future.[8]

The coal discount

Overall, taxes fail to provide meaningful carbon price signals for coal and natural gas, which account for more than half of non-road emissions. Granted, the picture shown in Figure 3.4 would be somewhat less bleak if emissions trading systems had been included in the analysis, as in *Effective Carbon Rates* (OECD, 2018[14]). Coal, in particular, is mainly used for electricity production and in industries, and in countries that operate or participate in emissions trading systems such as the EU ETS, most of these emissions face a carbon price resulting from the ETS.

Figure 3.4. Effective carbon tax rates on coal and natural gas

Weighted average for coal and natural gas by group



Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), *World Energy Statistics and Balances*.

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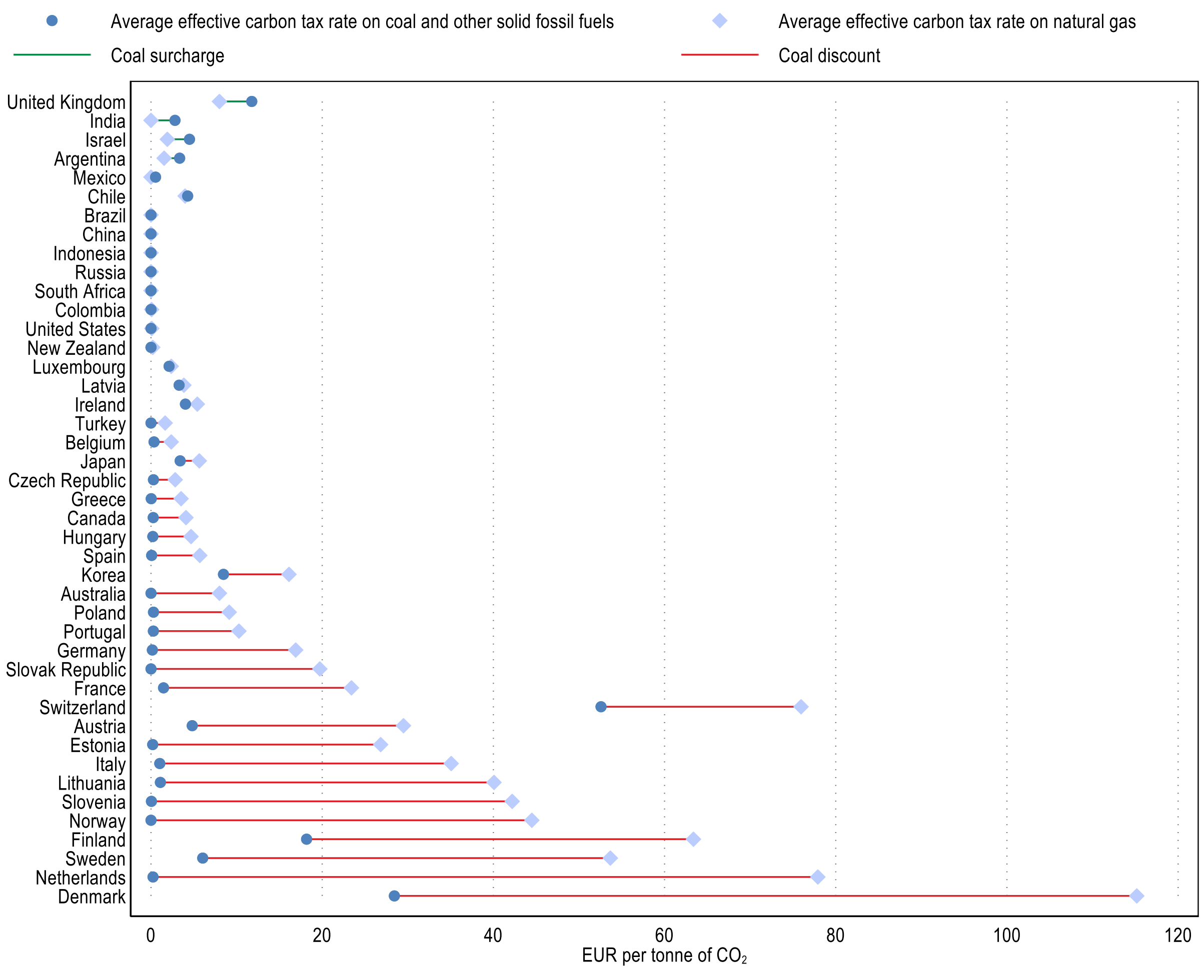
From a climate perspective, the effective carbon rate per tonne of CO_2 should be the same irrespective of the fossil fuel from which the emissions result. Figure 3.4 demonstrates that at least with respect to tax-based carbon price signals, as measured by effective carbon tax rates, this is not the case in OECD countries. In the partner economies, coal is taxed at a higher rate than natural gas on average, but tax rates are far below the low-end carbon benchmark of EUR 30 per tonne of CO_2.

From a broader environmental perspective, coal ought to be taxed at a higher effective carbon rate per tonne of CO_2 than natural gas, as air pollution costs from coal tend to be higher (see also Chapter 2). By contrast, whereas some countries tax coal at a higher rate than natural gas, most countries tax coal at a discount relative to natural gas. In line with what environmental considerations would suggest, the United Kingdom, India, Israel and Mexico effectively levy a surcharge on coal use (per tonne of CO_2). Other countries, on the other hand, either do not tax either of the two, or tax coal less than natural gas.

Figure 3.5. The coal discount

Countries are sorted by coal discount, showing the country with the largest coal discount at the bottom



Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), *World Energy Statistics and Balances*. Iceland is not shown because there is no reported consumption of natural gas.

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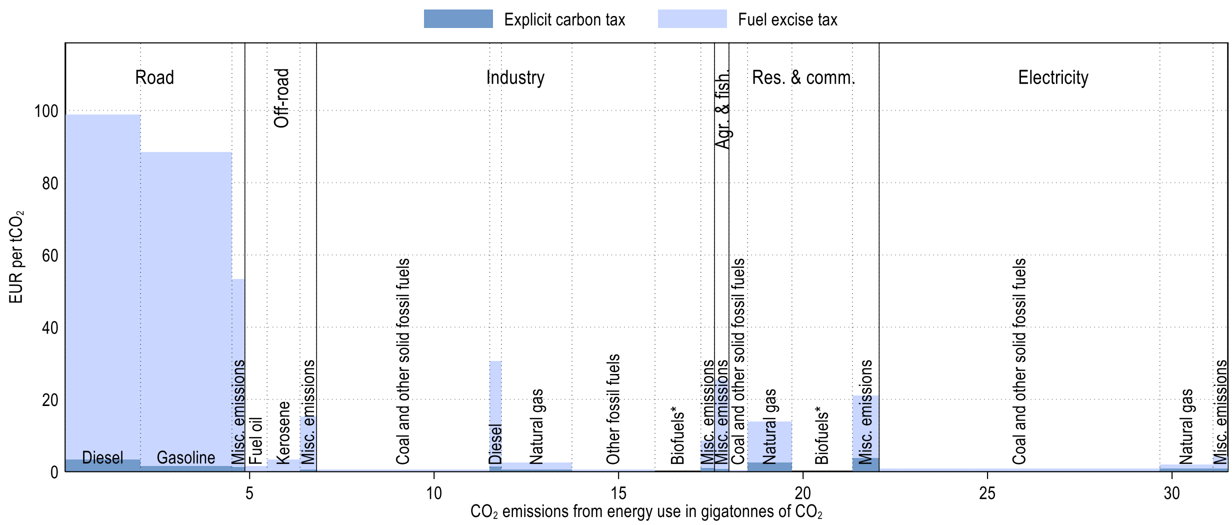
Taxes on coal and natural gas also vary across sectors, and so does their use. Figure 3.6 shows that most coal and natural gas emissions take place in the electricity and industry sectors (where they may be subject to carbon price signals provided by emissions trading systems (OECD, 2018[14])). Natural gas is the main fossil fuel used in the residential and commercial sector, where coal only plays a minor role (and emissions trading systems are less common). Whereas taxes on coal tend to be low across all sectors, natural gas is taxed at relatively higher rates, on average, when it is used in the residential and commercial sector. Annex 3.A reports the profile shown in Figure 3.6 for all countries covered.

Figure 3.6. Effective carbon taxes in OECD and Selected Partner Economies differ substantially across sectors, and so does the composition of CO_2 emissions

Average by sector and energy category – rate in EUR per tonne of CO_2



Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), *World Energy Statistics and Balances*. Off-road includes emissions from international aviation and maritime transport. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1). The figure groups energy categories that represent less than 1% of the horizontal axis into "miscellaneous emissions".

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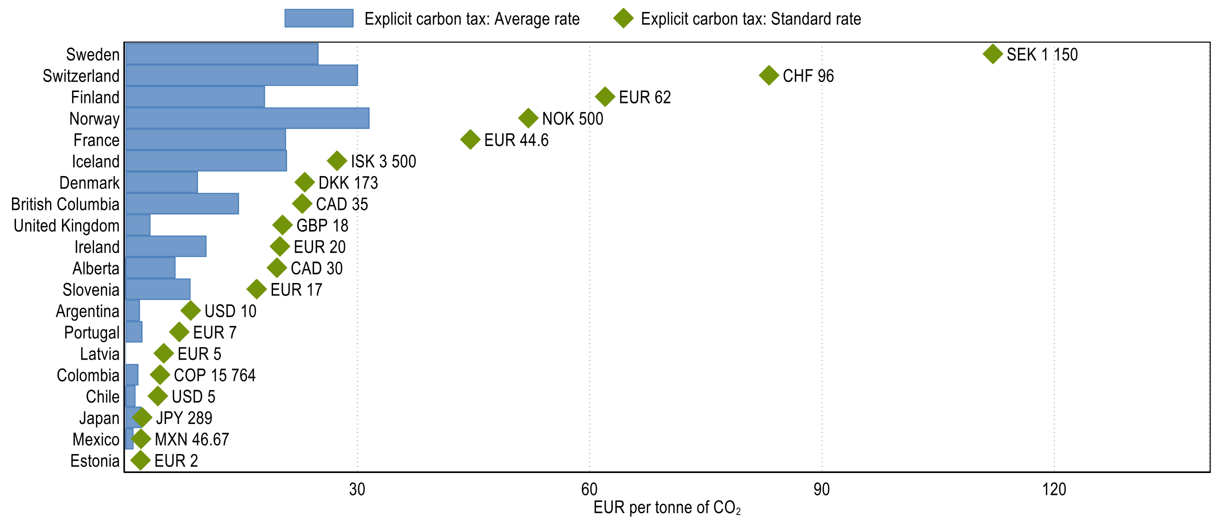
Carbon tax design

An increasing number of jurisdictions levy explicit carbon taxes (Ramstein et al., 2019[15]).[9] Figure 3.7 shows all jurisdictions within the 44 countries covered that had an explicit carbon tax in place as at 1 July 2018. Sweden is the country with the highest standard carbon tax rate, followed by Switzerland, Finland and Norway.

Figure 3.7. Explicit carbon taxes do not cover all energy-related emissions

Jurisdictions are ordered by standard rate, showing the jurisdiction with the highest standard rate at the top



Note: Tax rates as applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), *World Energy Statistics and Balances*. Emissions from the combustion of biofuels are included (see Chapter 1). Carbon tax rates are converted into EUR using official OECD exchange rates.

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For a number of reasons, the coverage of explicit carbon taxes varies substantially across countries. It is worth noting, for instance, that the average explicit carbon tax rate is higher in Switzerland than in Sweden, even though Sweden levies a higher standard rate. If countries applied a uniform carbon tax to all energy-related CO_2 emissions, standard and average rate would be the same. However, this “carbon tax ratio”, i.e. the average rate divided by the standard rate, rarely exceeds 50%, and is typically even lower.

One reason is that many jurisdictions additionally operate emissions trading systems, and often exempt emissions already subject to emissions trading from the carbon tax. Alberta, for instance, operates an output-based trading system for large emitters, mainly from industry and power sectors. Low-carbon tax ratios do not necessarily imply a lack of carbon price signals in general (see OECD (2018[1])), but may reflect that only a share of emissions are subject to *tax-induced* carbon price signals.

In addition, countries generally do not subject CO_2 emissions from biofuels to explicit carbon taxes. This drives down the average explicit carbon tax rate, which is particularly relevant for countries such as Sweden that rely more strongly on biofuels to meet their decarbonisation objectives (see also, Figure 3.9).

Another noteworthy design feature is that countries do not always impose carbon taxes on all fossil fuels. Argentina and Mexico, for instance, exempt natural gas, which is generally considered the cleanest fossil fuel. Iceland, on the other hand, exempts coal, even though it is among the most polluting fossil fuels. Note, however, that Iceland only uses coal in the industry sector (see also, Annex Figure 3.A.18), and generally has a very clean energy mix (see also, Annex 2 A).

Finally, some countries exempt certain energy users from the carbon tax or offer reduced rates or refunds. The carbon tax in the United Kingdom, for instance, only applies to the power sector. Such measures are often justified on competitiveness or affordability grounds. There are, however, in principle better policy instruments available to address competiveness and affordability issues than rate reductions and exemptions. Nevertheless, more targeted compensation instruments, such as lump sum transfers, may be challenging to implement effectively in practice, e.g. due to information and administrative constraints (Sallee, 2019[16]).

The tax base of explicit carbon taxes is rarely carbon content or CO_2 emissions. Instead, most countries administer explicit carbon taxes in the same way as fuel excise taxes. 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. For illustration purposes, Table 3.1 shows how high a carbon tax set to EUR 30 per tonne of CO_2 is when expressed in common commercial units.

Table 3.1. The low-end carbon benchmark in common commercial units

Energy category	Low-end carbon benchmark (EUR 30 per tonne of CO_2)
Coal and other solid fossil fuels	6.24 eurocent per kilogramme
Fuel oil	8.94 eurocent per litre
Diesel	7.99 eurocent per litre
Kerosene	7.58 eurocent per litre
Gasoline	6.86 eurocent per litre
LPG	4.75 eurocent per litre
Natural gas	5.13 eurocent per cubic metre

Note: OECD calculations based on IEA (2018), *World Energy Statistics and Balances*. The benchmarks shown are based on average carbon content of these energy categories across the 44 countries covered. Actual carbon emissions associated with combusting the respective fuel may vary depending on local fuel characteristics. The table excludes carbon benchmarks for other fossil fuels, non-renewable waste, and biofuels, as energy products' carbon content varies widely within these energy categories.

Explicit carbon taxes can be collected from fuel suppliers in the same way as pre-existing fuel excise taxes. As a result, the administrative and compliance costs of such an approach are generally low (Pavel and Vítek, 2012[17])

There are a number of countries that tax CO_2 directly. Countries that pursue such an emissions-based approach include Chile, Estonia and Latvia. Under this approach, carbon taxes tend to resemble emissions trading systems and are only applied to emitters above a certain emissions threshold or to installations that fulfil certain technological criteria. The functional reason for this is that under emissions-based approaches, emissions need to be measured (or calculated), which would be challenging to implement downstream for small emitters.

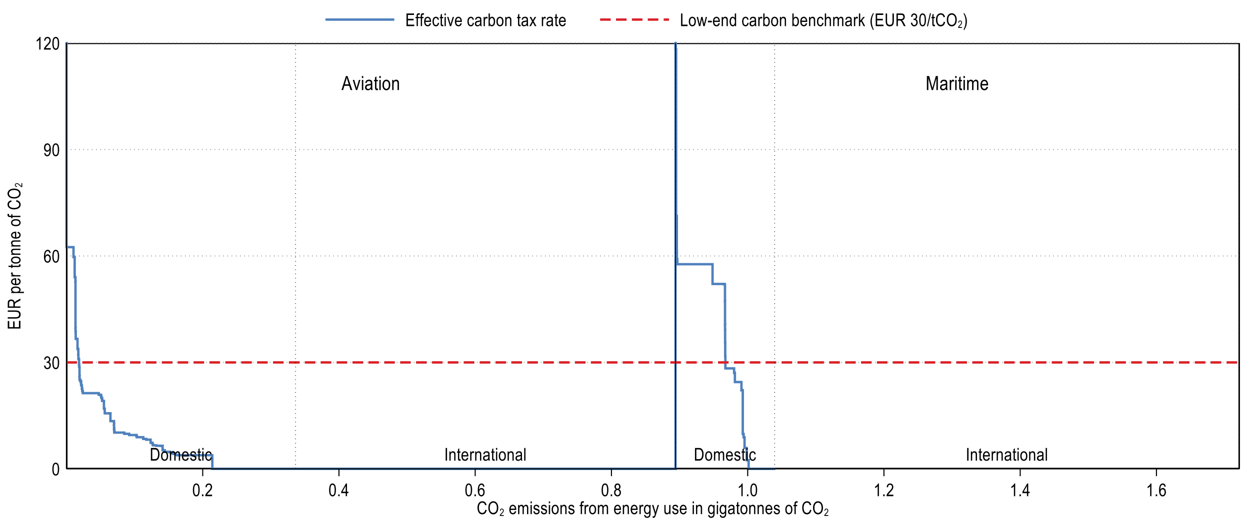
Emissions-based approaches have the advantage that they can readily be extended to non-energy and non-CO_2 emissions, e.g. in agriculture or industry. Administrative and compliance costs tend to be somewhat higher than with fuel-based approaches. Whether such differences in administrative and compliance costs are relevant in practice may depend on pre-existing reporting obligations for other purposes. Specifically, the additional effort of reporting carbon emissions for tax purposes may be negligible for facilities that have reporting obligations for other reasons. More generally, administrative and compliance costs become relatively less important as carbon tax levels increase.

In practice, the choice between a fuel-based and emissions-based carbon taxes will also be influenced by political and legal/ constitutional considerations. In many countries, fuel-based carbon taxes fall under the responsibility of finance ministries, whereas emissions-based carbon taxes (and emissions trading systems) may be under the remit of environment ministries. In addition, legal arguments may favour fuel-based or emissions-based approaches.

Emissions from aviation and maritime transport are rarely taxed

Aviation and maritime transport are major and growing sources of CO_2 and other emissions. At present, aviation causes approximately 2.8% of all emissions covered in TEU, whereas maritime shipping accounts for roughly 2.6% (see Figure 3.1 and Figure 3.8). Aviation activity is expected to grow strongly in the coming decades as passenger kilometres could roughly double by 2030 (ITF, 2019[18]). Seaborne trade is estimated to grow by around 3% annually in the coming years (Balcombe et al., 2019[19]). Decoupling activity growth from emissions will therefore be necessary to limit the contribution of aviation and maritime to climate change.

Figure 3.8. Effective carbon tax rates on carbon emissions from energy use in aviation and maritime



Note: 2018 tax rates as applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), *World Energy Statistics and Balances*.

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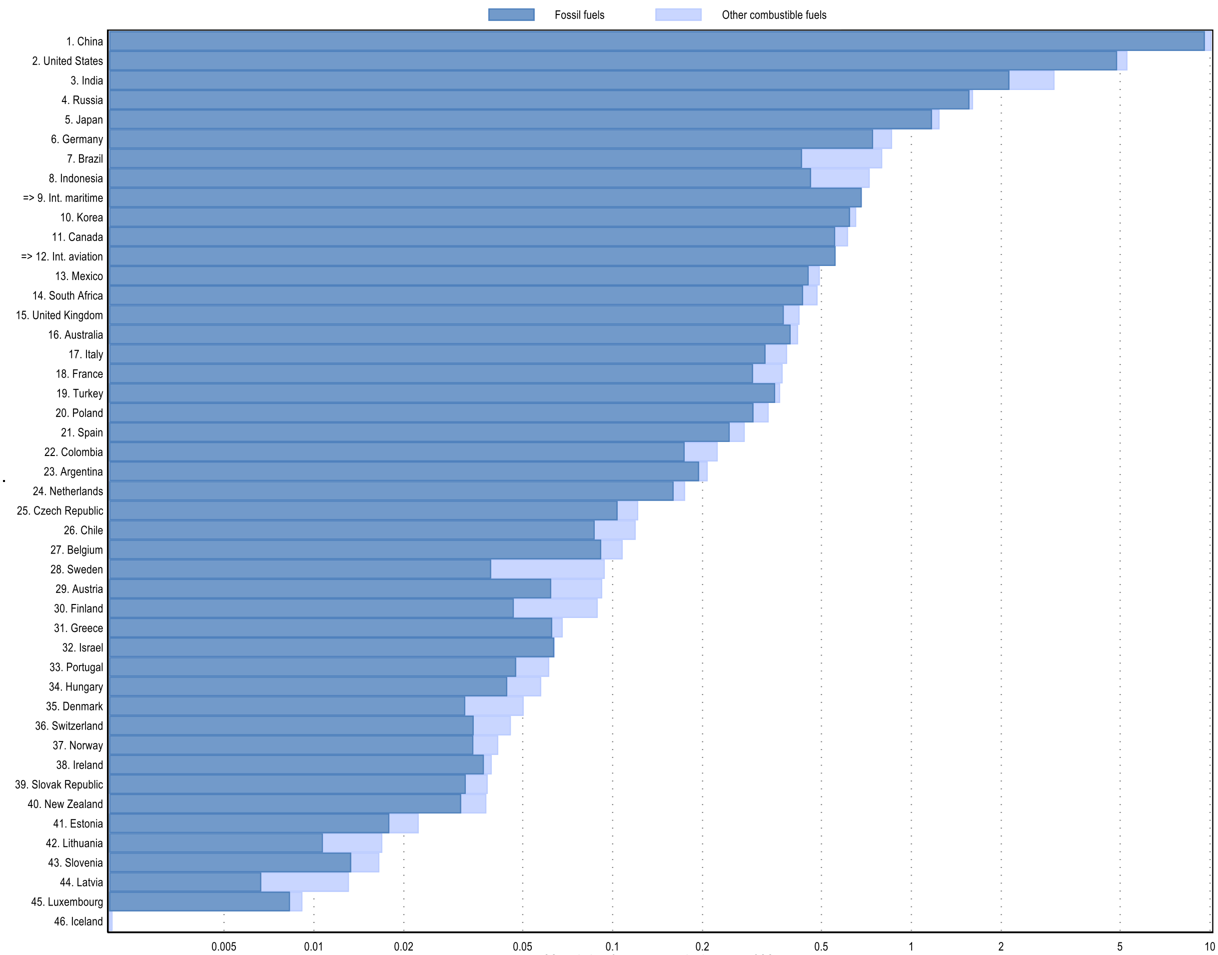
Against this background, it is disconcerting that neither international aviation nor international maritime transport are subject to fuel excise and carbon taxes – effective carbon tax rates are zero everywhere, as shown in Figure 3.8 and Figure 3.9.[10] If international aviation (excluding domestic aviation) and international maritime transport (excluding domestic navigation) were countries, they would be the world's 12th and 9th largest emitters of CO_2, respectively, as shown in Figure 3.9. Also note that aviation and maritime transport exclusively burn fossil fuels; there is no reported use of biofuels, which would decrease the sectors' carbon footprint if sourced sustainably (see Chapter 2).

Figure 3.9. International aviation and maritime transport account for more CO_2 emissions than most countries



Note: CO_2 emission numbers are calculated based on energy use data for 2016 from IEA (2018), *World Energy Statistics and Balances*. Emissions from the combustion of biofuels are included (see Chapter 1). The horizontal axis is log-transformed.

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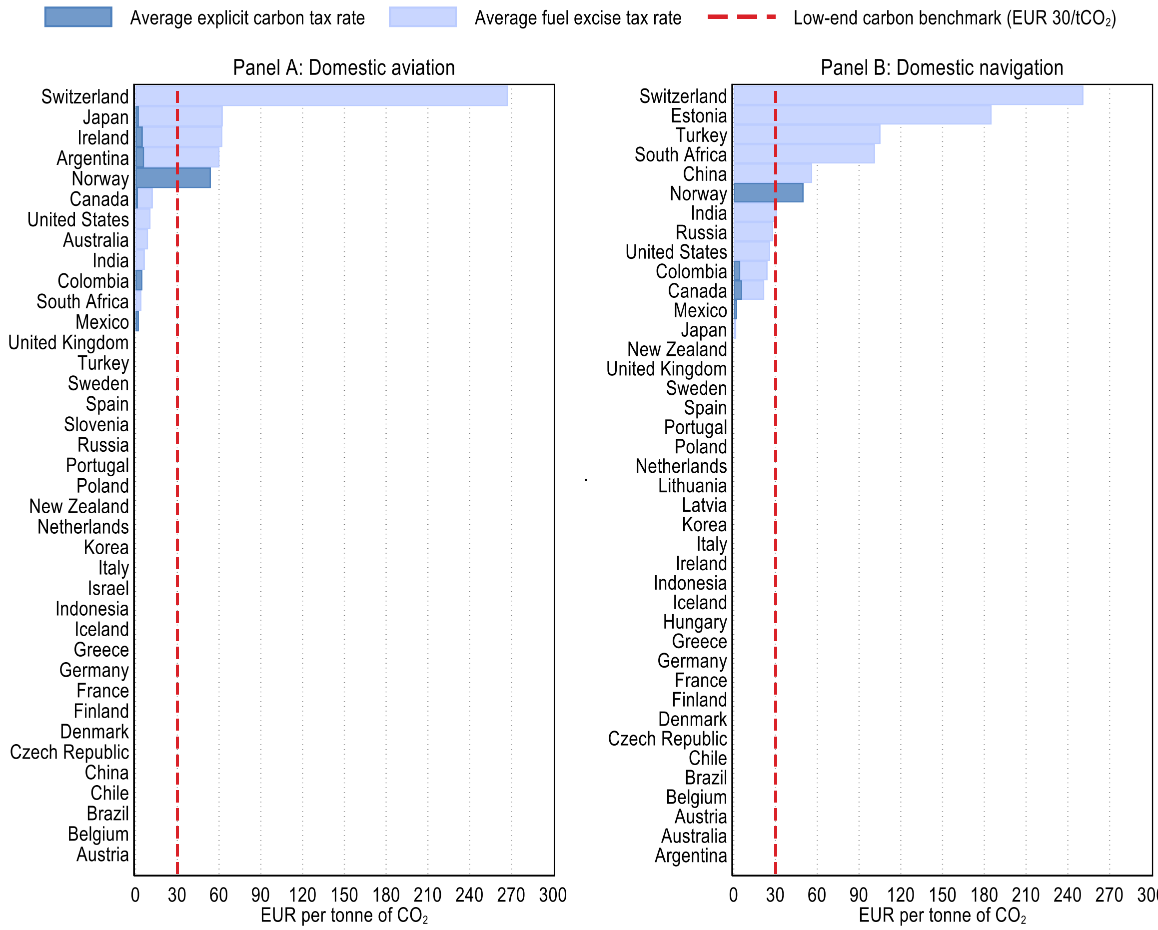
Domestic aviation makes a sizeable contribution to the sector's carbon footprint as well. With 38% of total emissions from aviation (Figure 3.8), domestic aviation (grouped with the individual countries in Figure 3.9) is thus also a major source of CO_2 emissions. Domestic navigation is responsible for 18% of overall emissions from domestic navigation and international maritime transport.

Few countries tax domestic aviation and domestic navigation. Figure 3.10 shows, for instance, Ireland, which taxes aviation gasoline for both private and commercial use, but exempts aviation kerosene for commercial use, is at present the only EU member state that taxes an aviation fuel that is used for commercial purposes. Non-EU countries do better. Japan, in particular, has levied a fuel tax on commercial domestic aviation since 1972, which has reduced CO_2 emissions (González and Hosoda, 2016[20]). Argentina, Norway, and Switzerland also tax domestic aviation at rates that exceed the low-end carbon benchmark of EUR 30 per tonne of CO_2. Taxes on domestic navigation are similarly rare as taxes on domestic aviation.

Figure 3.10. Few countries tax emissions from domestic aviation and domestic navigation



Note: 2018 tax rates as applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), *World Energy Statistics and Balances*. Even countries that are shown with an effective tax rate of zero typically tax fuel used for private pleasure-flying and private pleasure craft. Ireland taxes aviation gasoline, but exempts aviation kerosene that is used for commercial purposes; the table shows the weighted average rate. Indonesia levies VAT on aviation fuels, but VAT are not covered in TEU. Luxembourg and Slovakia are missing from both panels because there is no reported fuel consumption for either domestic aviation or domestic navigation. Estonia, Hungary, Latvia and Lithuania are missing from Panel A because no fuel consumption is reported for domestic aviation. Israel and Slovenia are missing from Panel B as no fuel consumption is reported for domestic navigation.

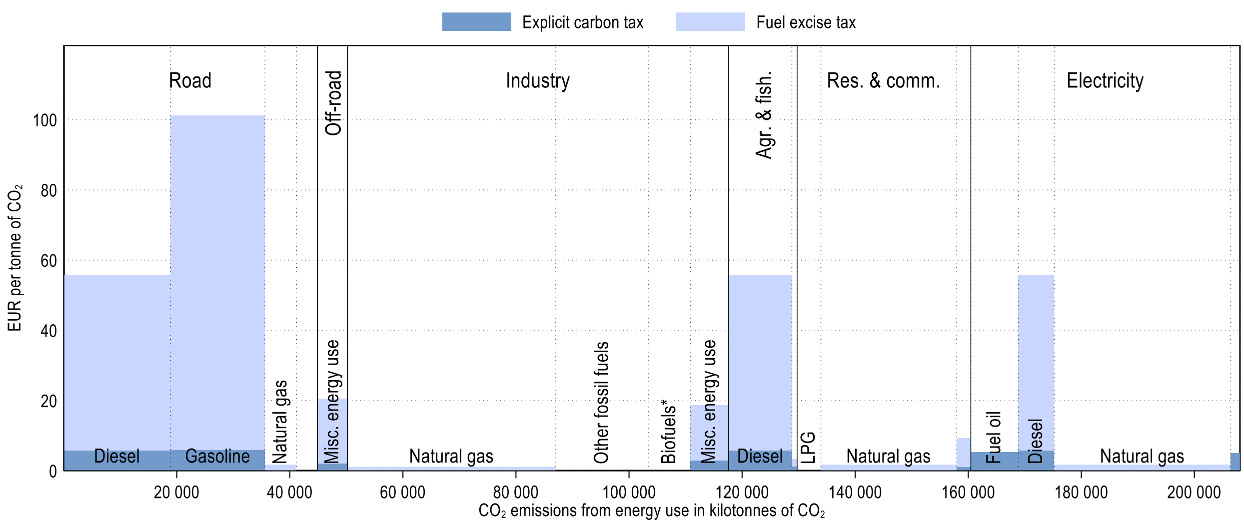
StatLink https://doi.org/10.1787/888934009273

Annex 3.A. Carbon tax profiles

This annex provides carbon tax profiles for all 44 countries covered in TEU 2019. General assumptions are explained in Chapter 1. For country-specific assumptions and more fine-grained data, please consult the online country notes. Notice that vertical axes vary widely across countries, depending on how high tax rates are.

Annex Figure 3.A.1. Effective carbon tax rates in Argentina

Average by sector and energy category – rate in EUR per tonne of CO_2

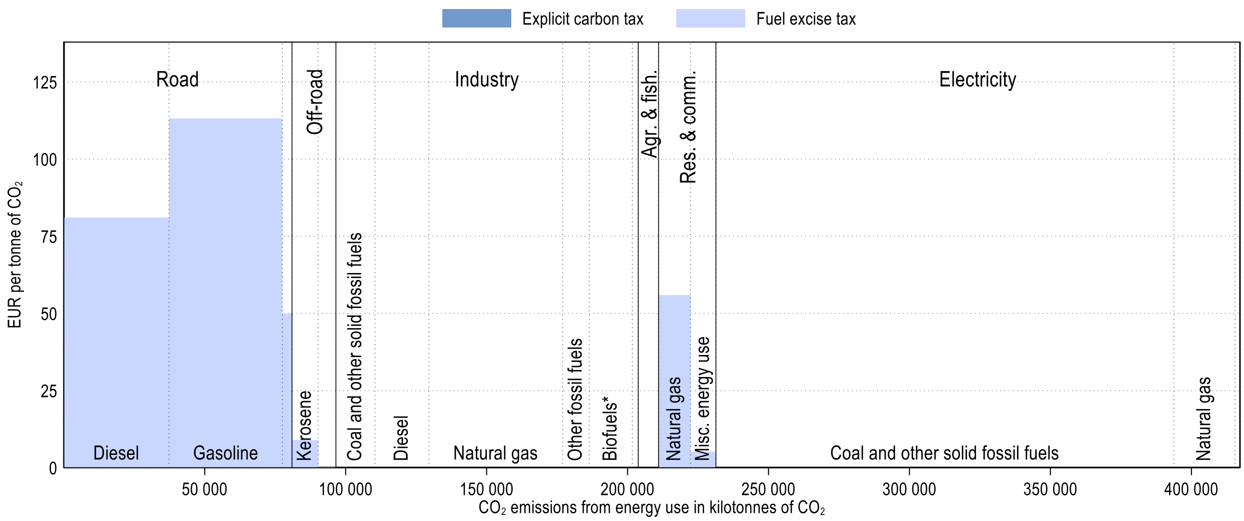


Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934009292

Annex Figure 3.A.2. Effective carbon tax rates in Australia

Average by sector and energy category – rate in EUR per tonne of CO_2

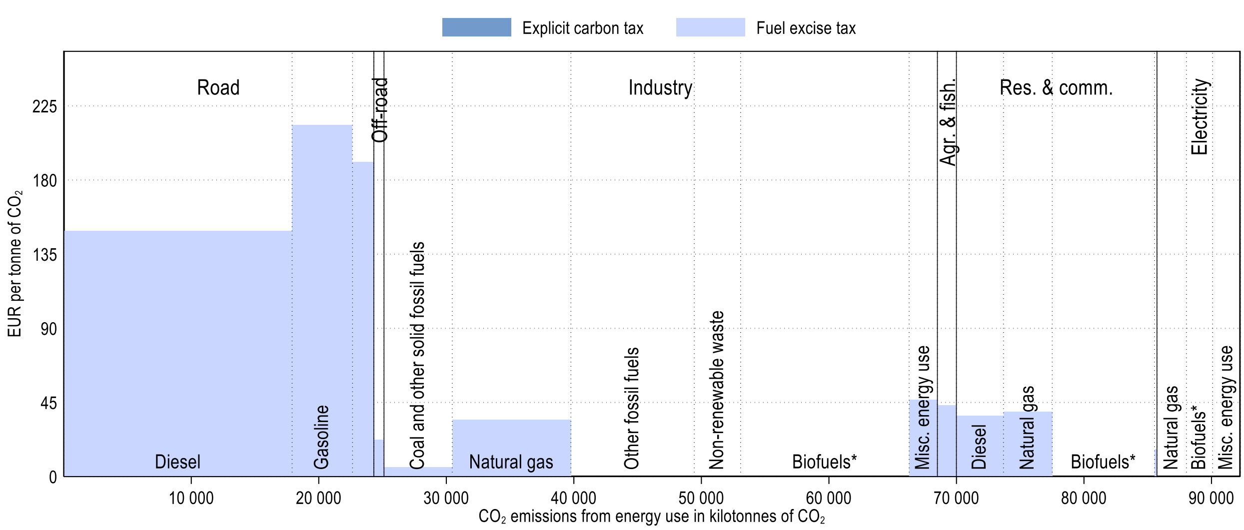


Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934009311

Annex Figure 3.A.3. Effective carbon tax rates in Austria

Average by sector and energy category – rate in EUR per tonne of CO_2

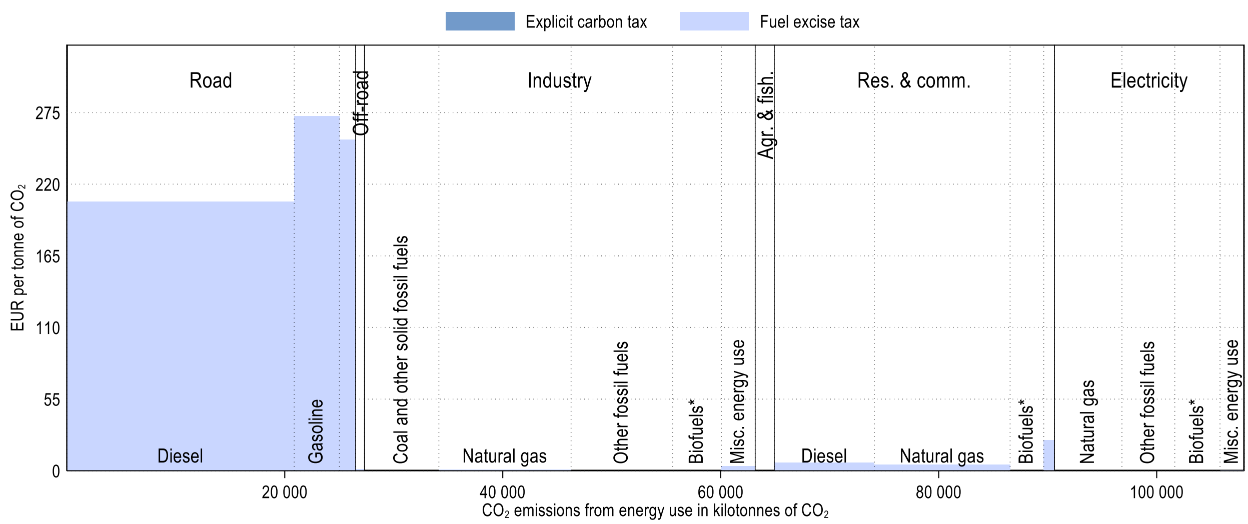


Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934009330

Annex Figure 3.A.4. Effective carbon tax rates in Belgium

Average by sector and energy category – rate in EUR per tonne of CO_2

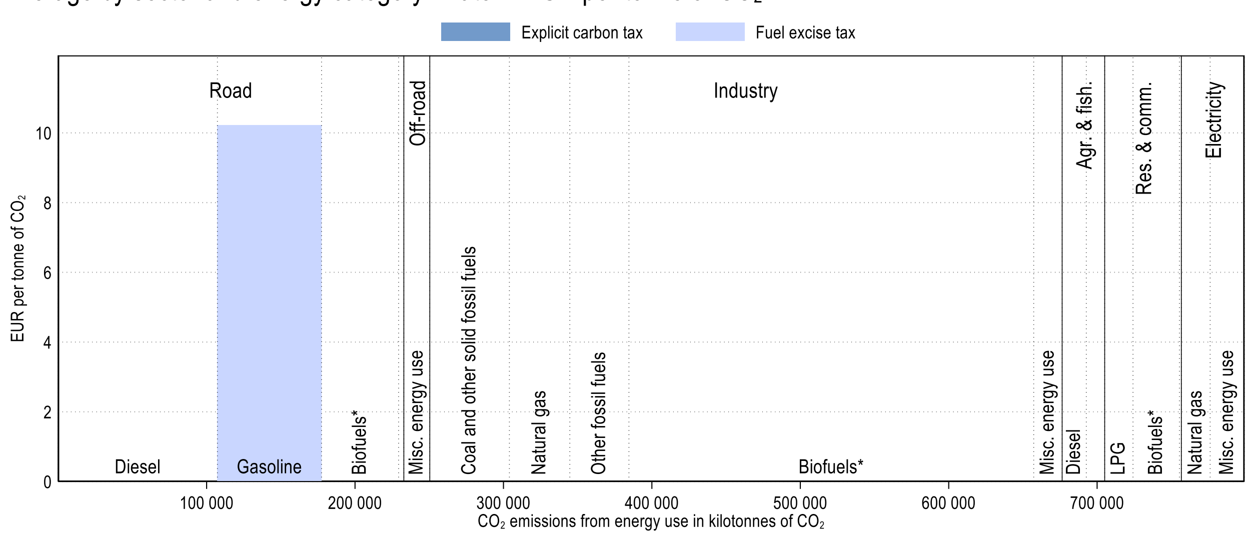


Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934009349

Annex Figure 3.A.5. Effective carbon tax rates in Brazil

Average by sector and energy category – rate in EUR per tonne of CO_2

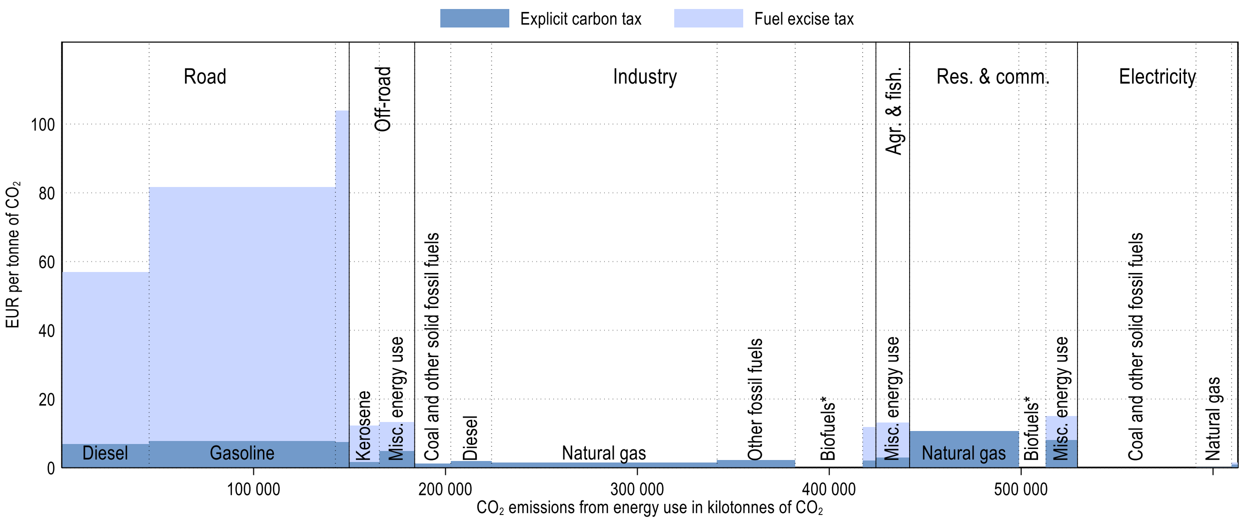


Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934009368

Annex Figure 3.A.6. Effective carbon tax rates in Canada

Average by sector and energy category – rate in EUR per tonne of CO_2

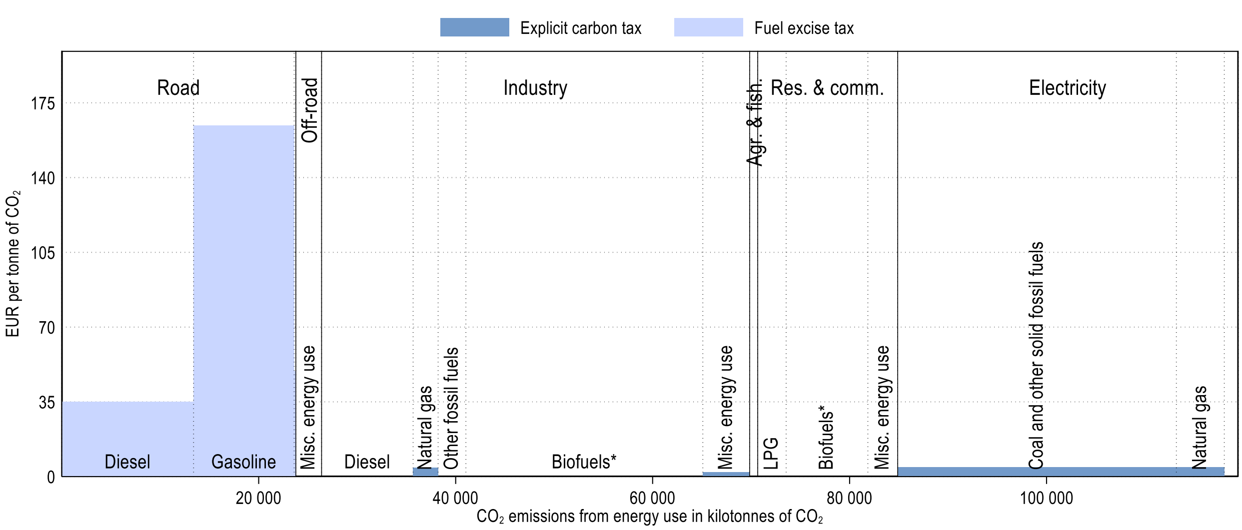


Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934009387

Annex Figure 3.A.7. Effective carbon tax rates in Chile

Average by sector and energy category – rate in EUR per tonne of CO_2

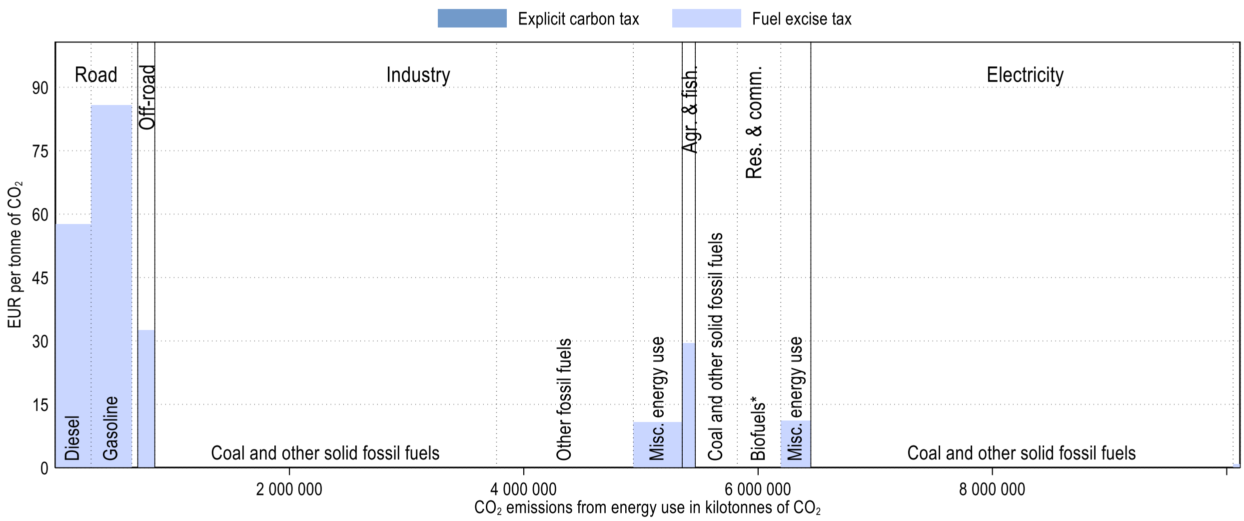


Note: Tax rates applicable on 1 July 2018. The explicit carbon tax shown in dark blue refers to the Green Tax (see online country note for modelling assumptions). CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934009406

Annex Figure 3.A.8. Effective carbon tax rates in China

Average by sector and energy category – rate in EUR per tonne of CO_2

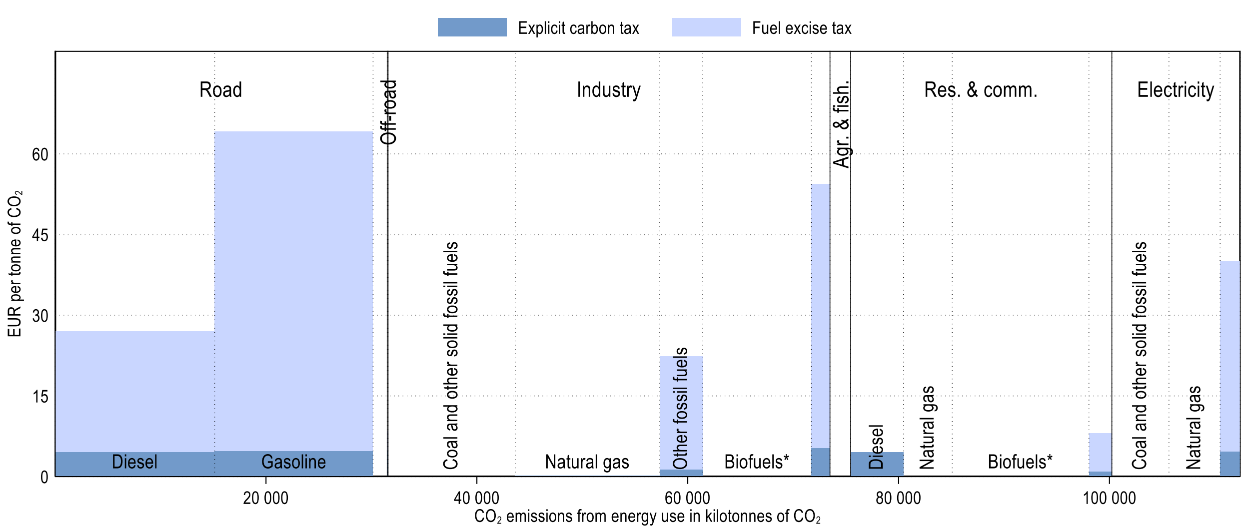


Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934009425

Annex Figure 3.A.9. Effective carbon tax rates in Colombia

Average by sector and energy category – rate in EUR per tonne of CO_2

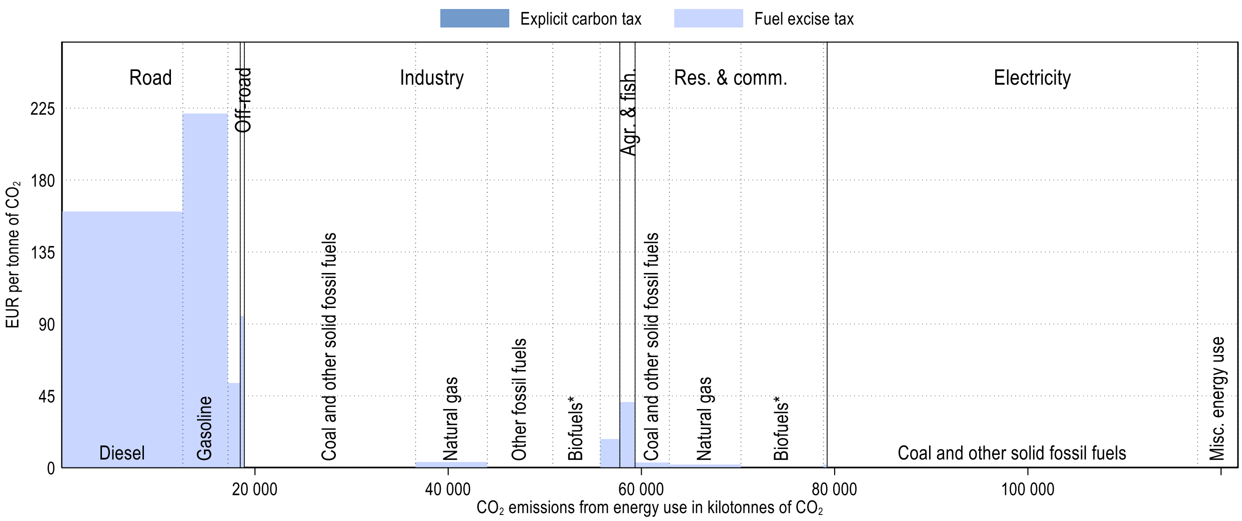


Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934009444

Annex Figure 3.A.10. Effective carbon tax rates in the Czech Republic

Average by sector and energy category – rate in EUR per tonne of CO_2

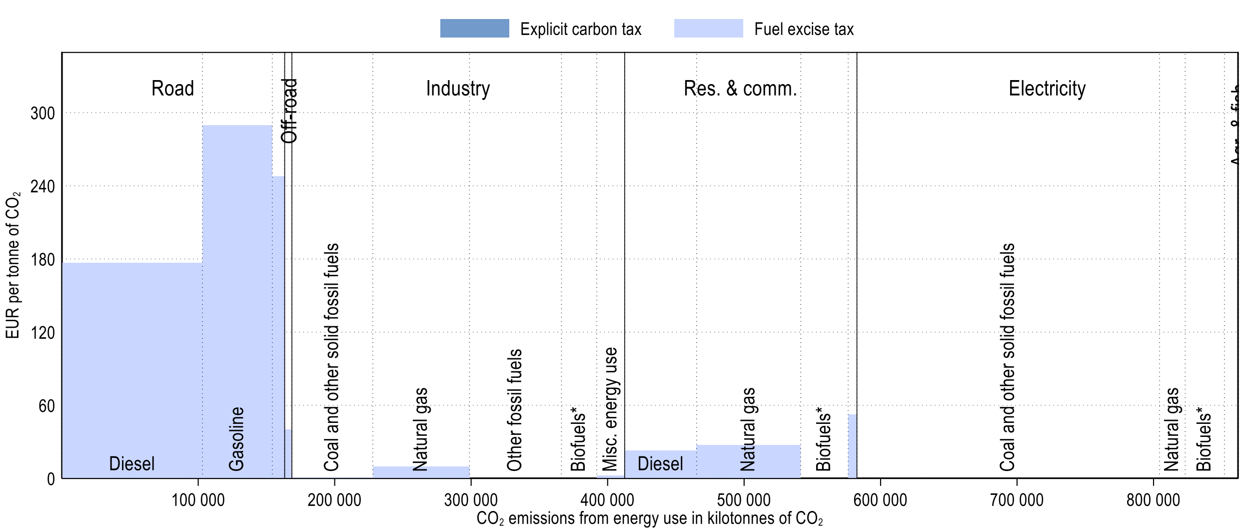


Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into “miscellaneous energy use”, which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934009463

Annex Figure 3.A.11. Effective carbon tax rates in Germany

Average by sector and energy category – rate in EUR per tonne of CO_2

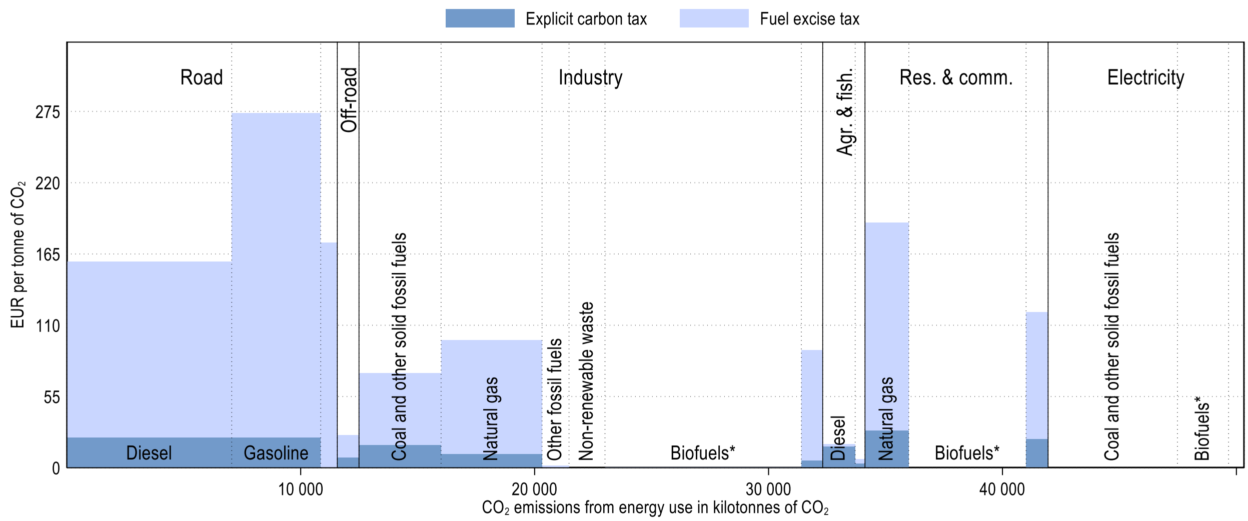


Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into “miscellaneous energy use”, which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934009482

Annex Figure 3.A.12. Effective carbon tax rates in Denmark

Average by sector and energy category – rate in EUR per tonne of CO_2

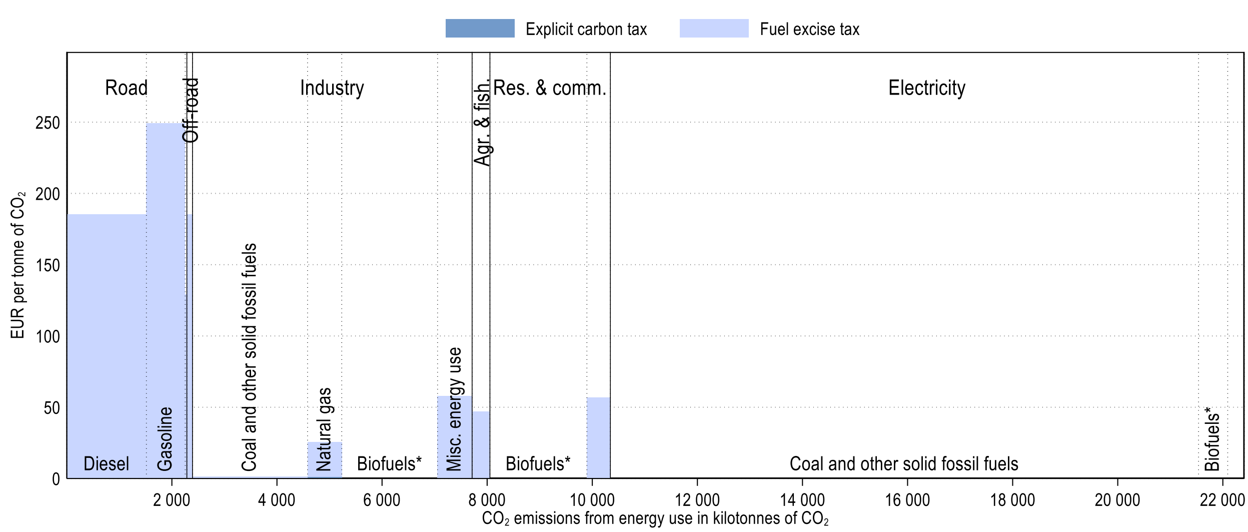


Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934009501

Annex Figure 3.A.13. Effective carbon tax rates in Estonia

Average by sector and energy category – rate in EUR per tonne of CO_2

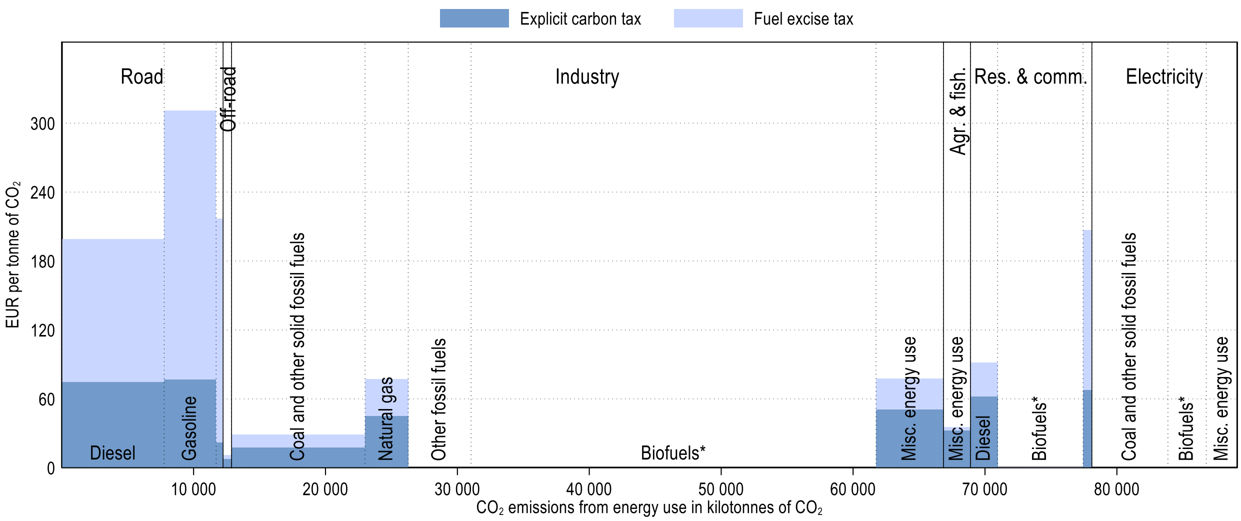


Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934009520

Annex Figure 3.A.14. Effective carbon tax rates in Finland

Average by sector and energy category – rate in EUR per tonne of CO_2

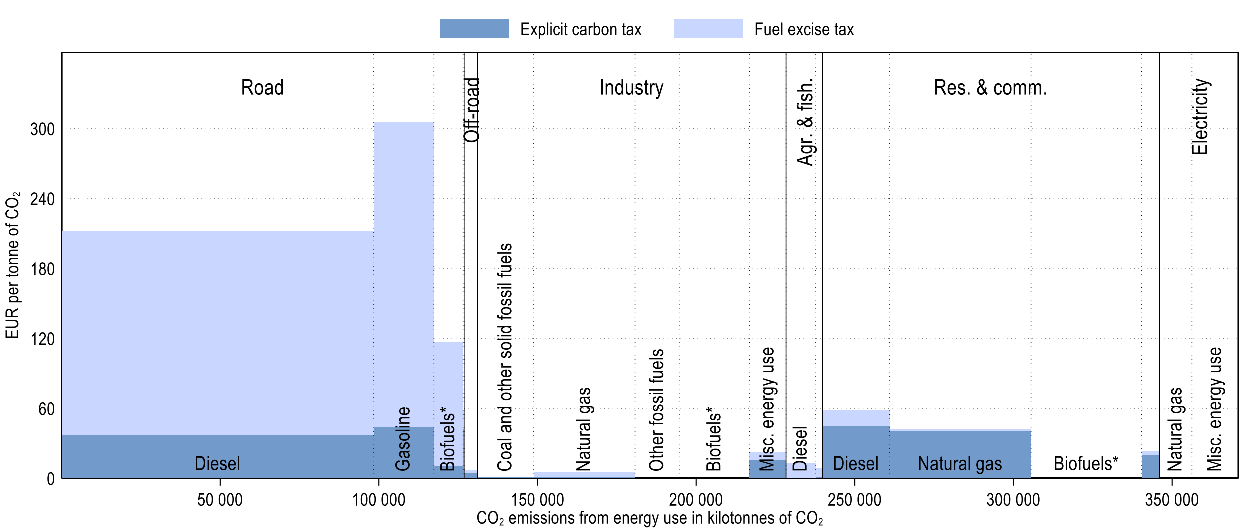


Note: Tax rates applicable on 1 July 2018, assuming use of common diesel (see online country note). CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into “miscellaneous energy use”, which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934009539

Annex Figure 3.A.15. Effective carbon tax rates in France

Average by sector and energy category – rate in EUR per tonne of CO_2

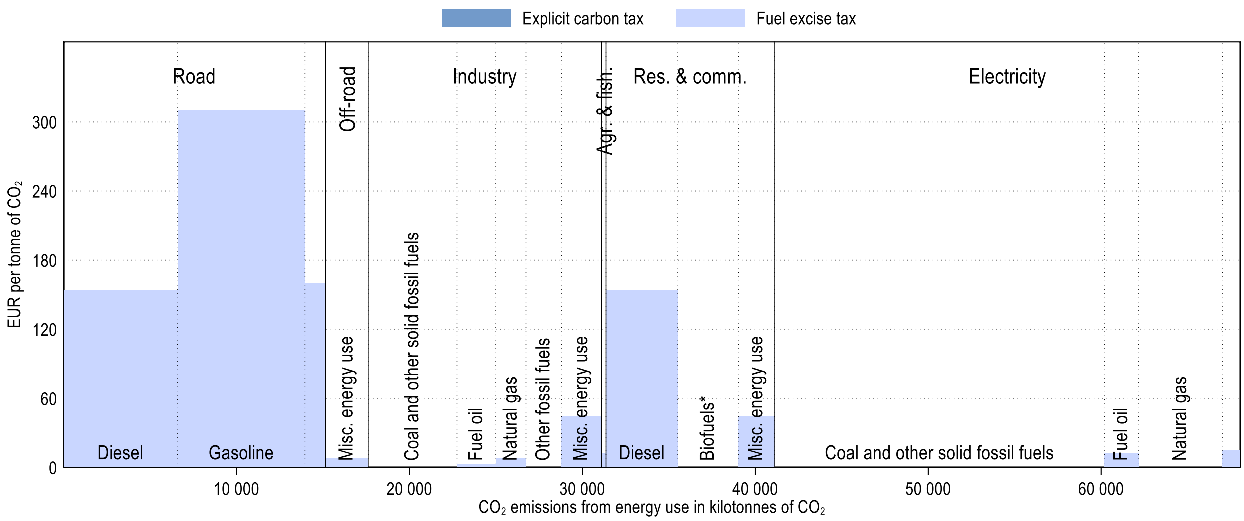


Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into “miscellaneous energy use”, which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934009558

Annex Figure 3.A.16. Effective carbon tax rates in Greece

Average by sector and energy category – rate in EUR per tonne of CO_2

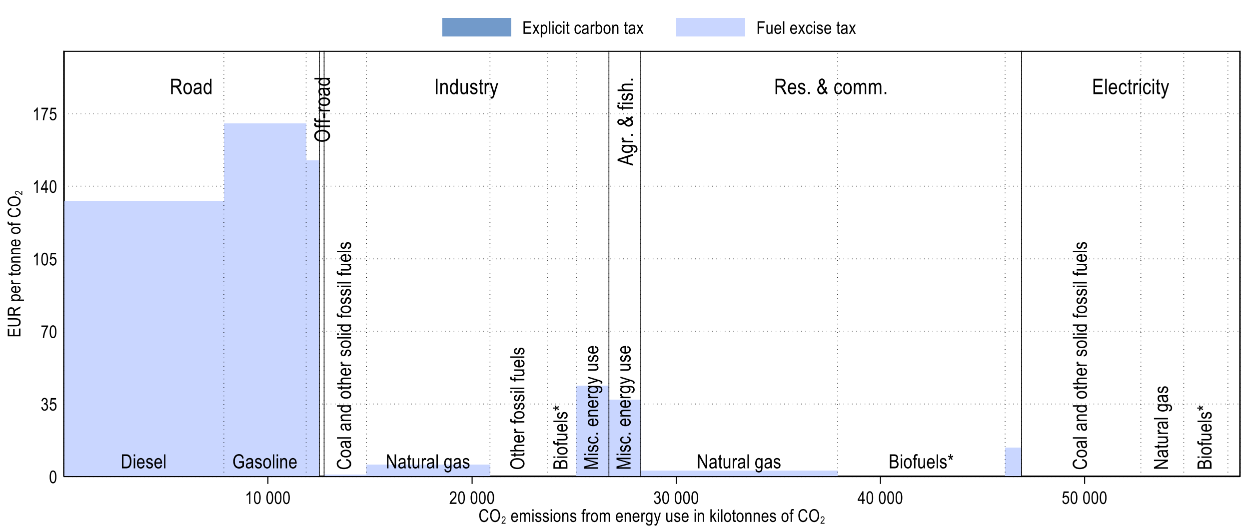


Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934009577

Annex Figure 3.A.17. Effective carbon tax rates in Hungary

Average by sector and energy category – rate in EUR per tonne of CO_2

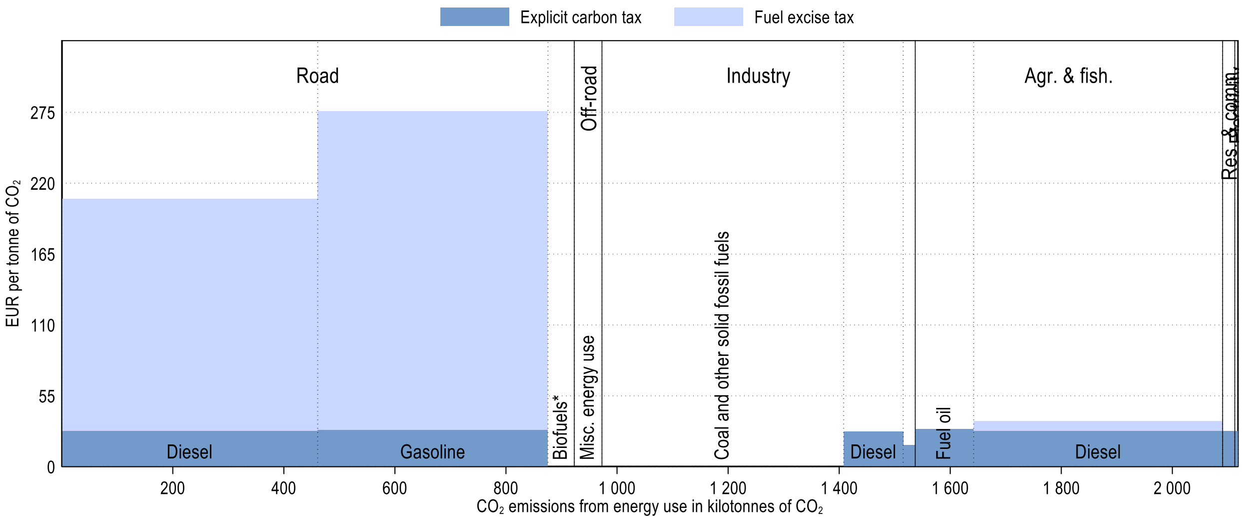


Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934009596

Annex Figure 3.A.18. Effective carbon tax rates in Iceland

Average by sector and energy category – rate in EUR per tonne of CO_2

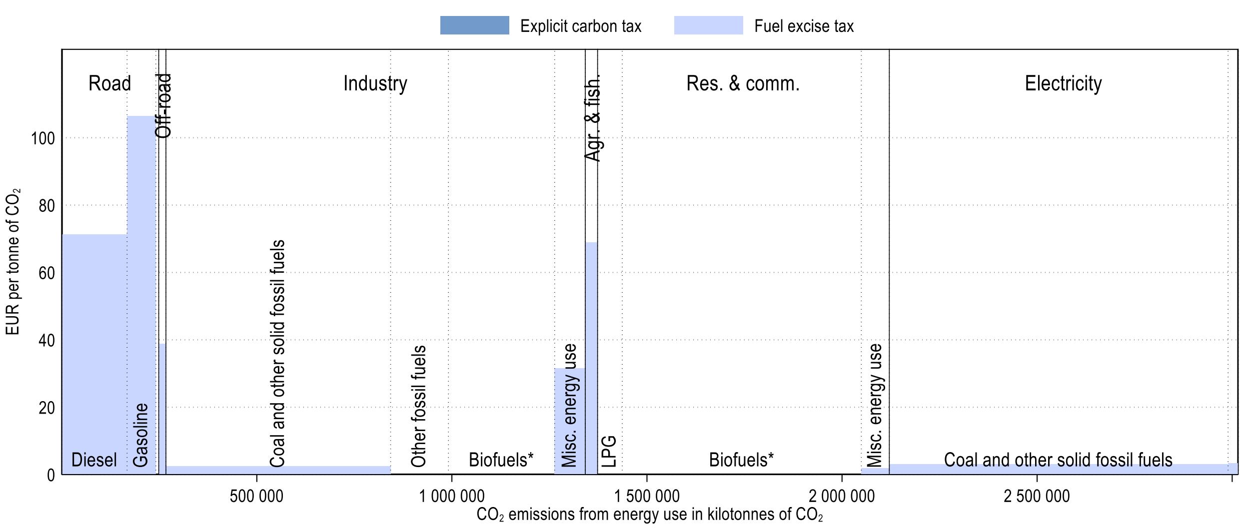


Note: Tax rates applicable on 1 July 2018. CO2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934009615

Annex Figure 3.A.19. Effective carbon tax rates in India

Average by sector and energy category – rate in EUR per tonne of CO_2

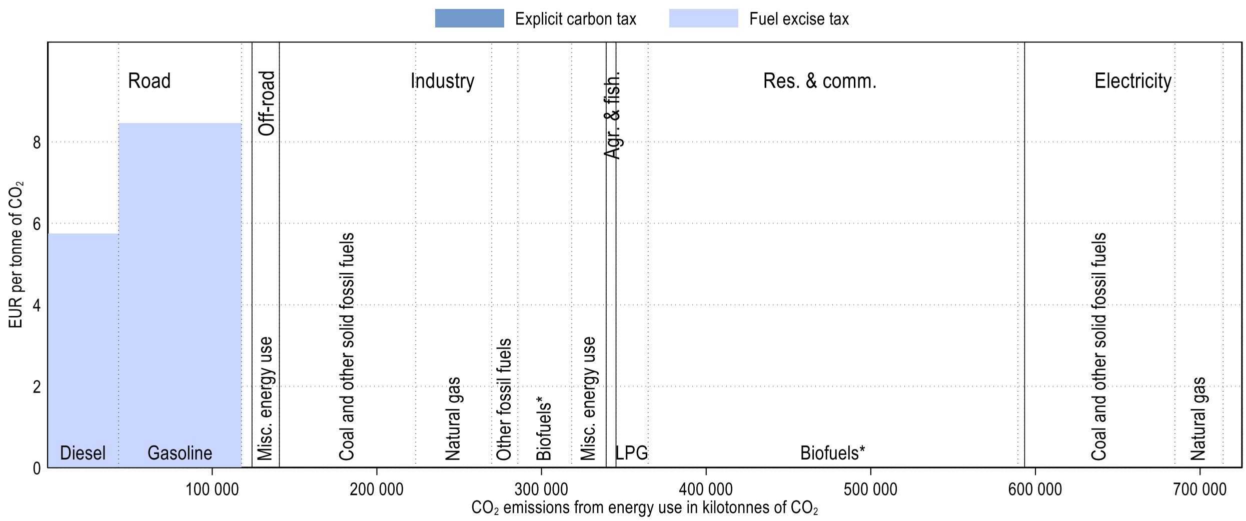


Note: Tax rates applicable on 1 July 2018. CO2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934009634

Annex Figure 3.A.20. Effective carbon tax rates in Indonesia

Average by sector and energy category – rate in EUR per tonne of CO_2

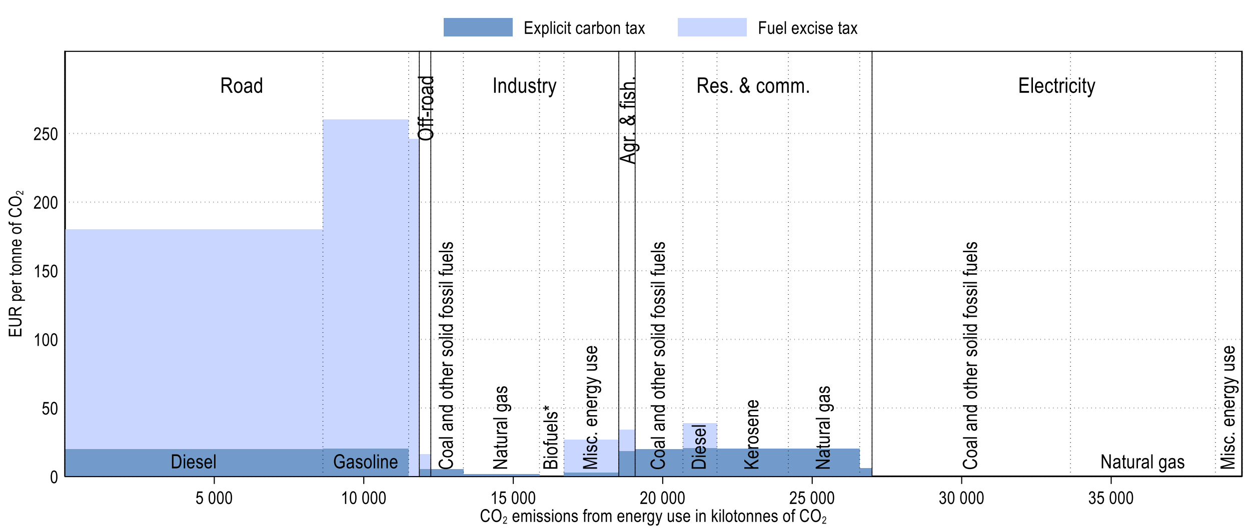


Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934009653

Annex Figure 3.A.21. Effective carbon tax rates in Ireland

Average by sector and energy category – rate in EUR per tonne of CO_2

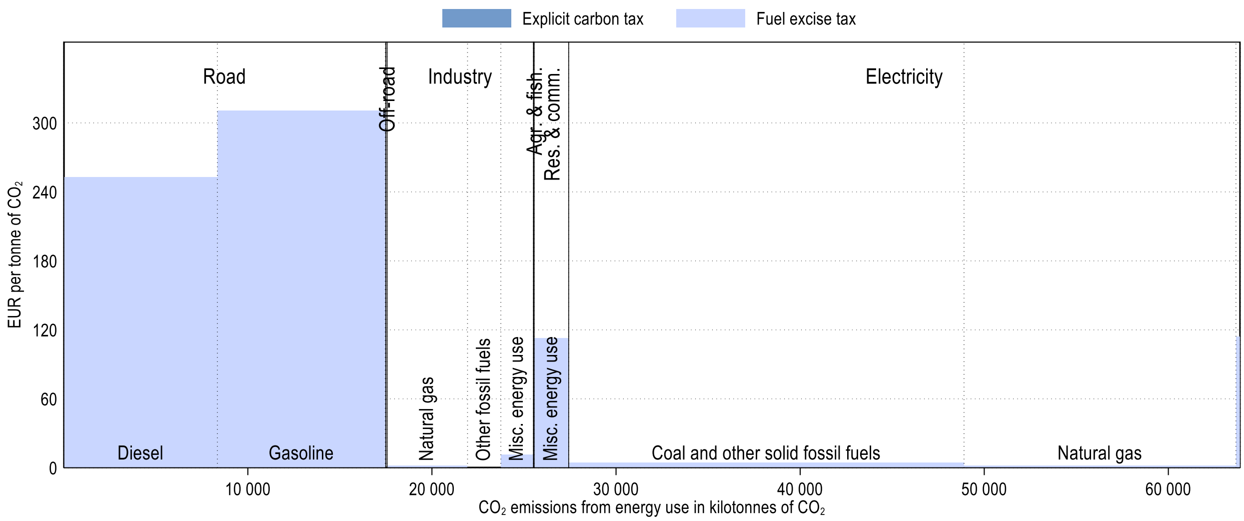


Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934009672

Annex Figure 3.A.22. Effective carbon tax rates in Israel

Average by sector and energy category – rate in EUR per tonne of CO_2

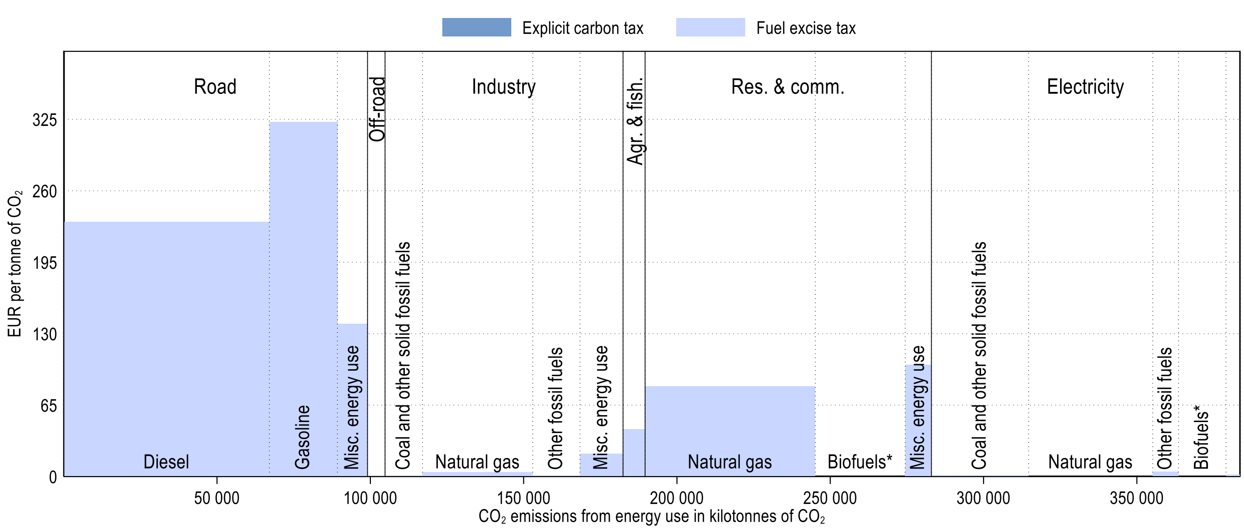


Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934009691

Annex Figure 3.A.23. Effective carbon tax rates in Italy

Average by sector and energy category – rate in EUR per tonne of CO_2

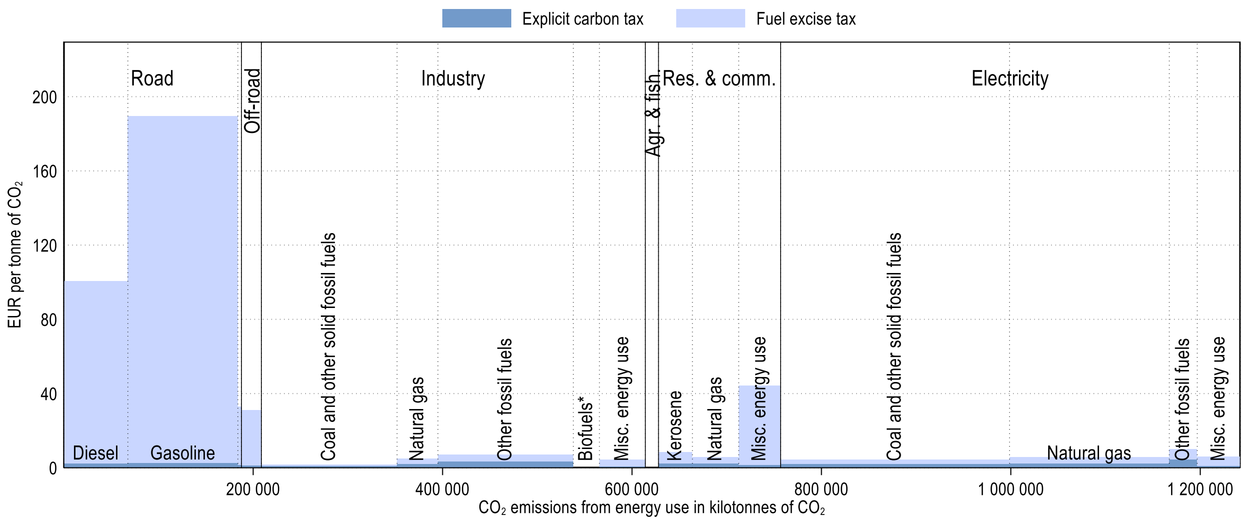


Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934009710

Annex Figure 3.A.24. Effective carbon tax rates in Japan

Average by sector and energy category – rate in EUR per tonne of CO_2

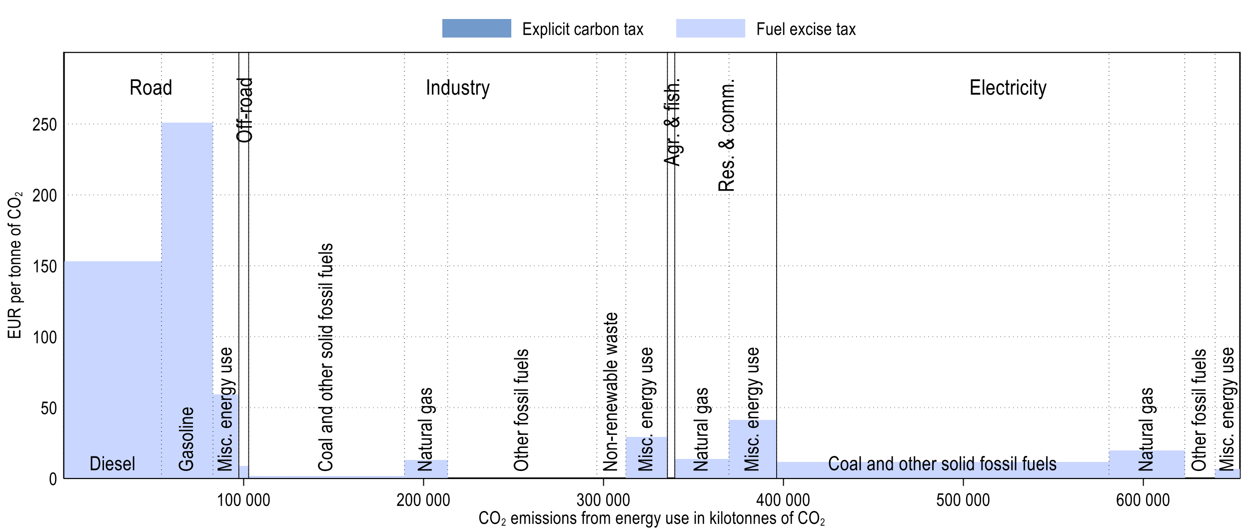


Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934009729

Annex Figure 3.A.25. Effective carbon tax rates in Korea

Average by sector and energy category – rate in EUR per tonne of CO_2

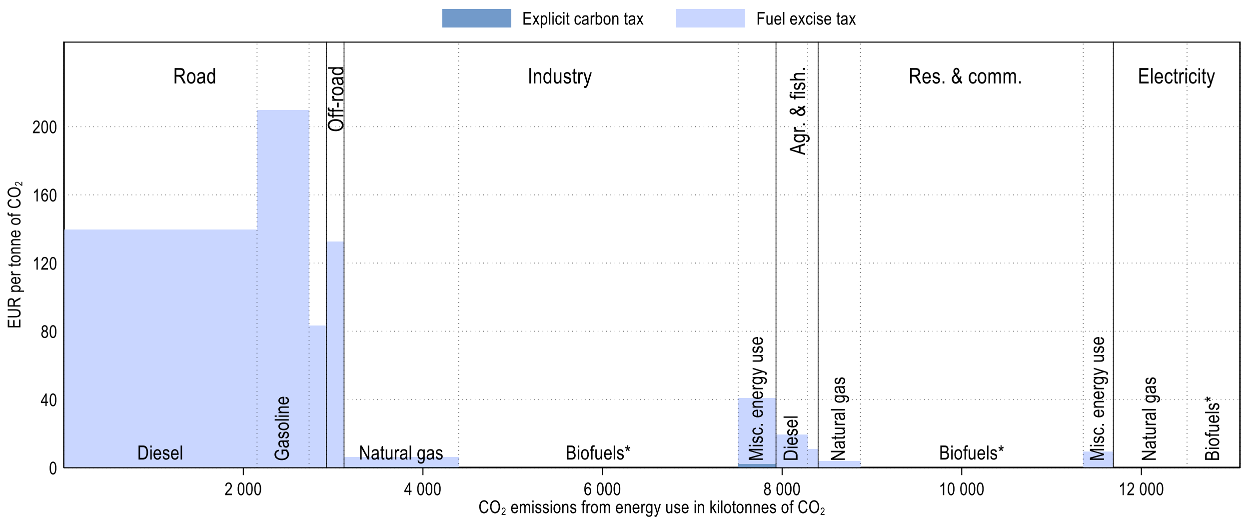


Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934009748

Annex Figure 3.A.26. Effective carbon tax rates in Latvia

Average by sector and energy category – rate in EUR per tonne of CO_2

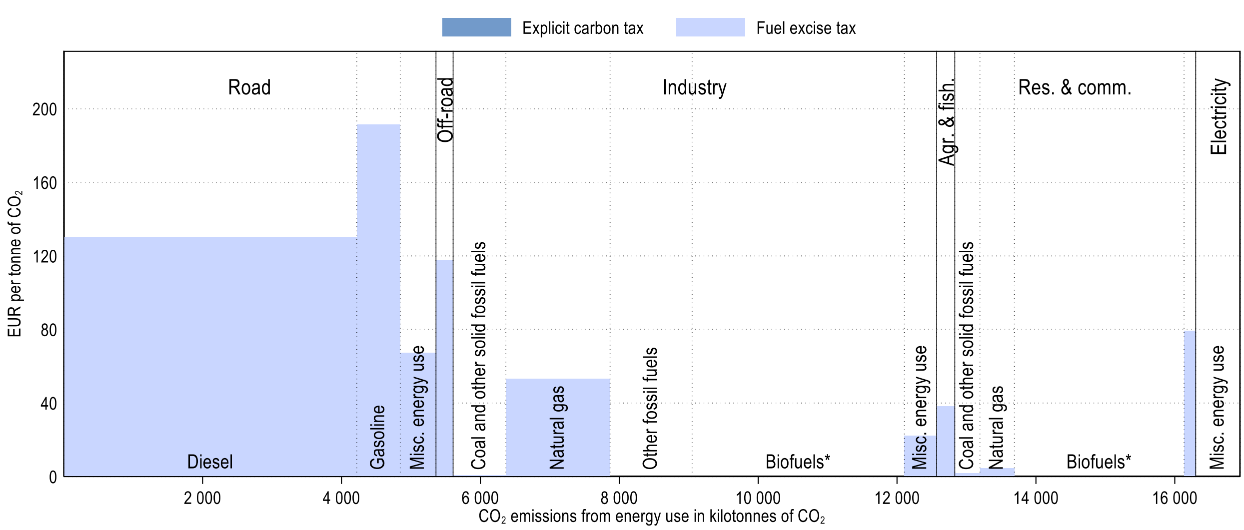


Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934009767

Annex Figure 3.A.27. Effective carbon tax rates in Lithuania

Average by sector and energy category – rate in EUR per tonne of CO_2

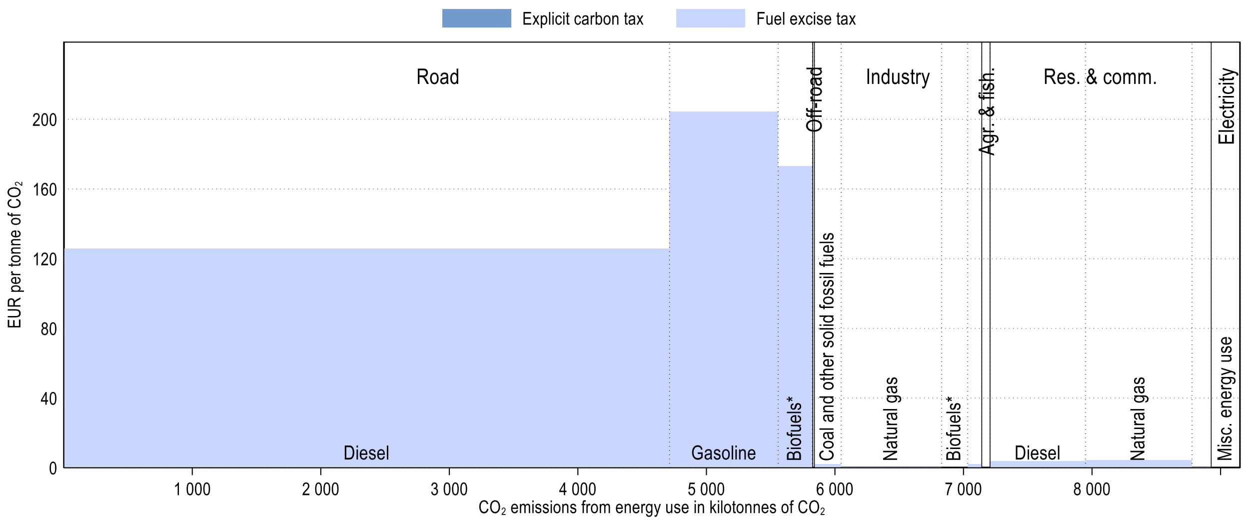


Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934009786

Annex Figure 3.A.28. Effective carbon tax rates in Luxembourg

Average by sector and energy category – rate in EUR per tonne of CO_2

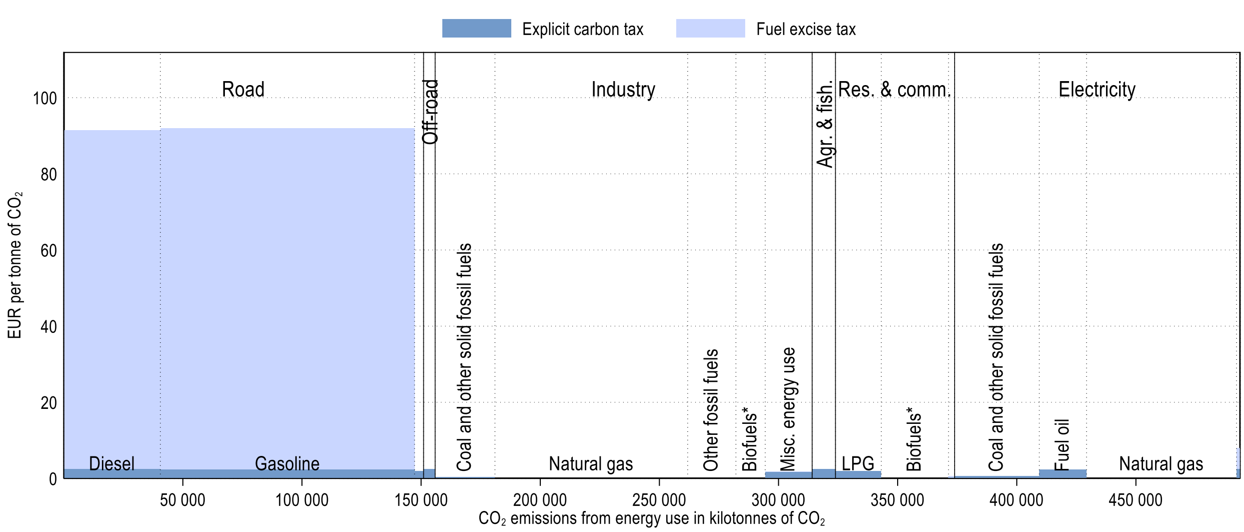


Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934009805

Annex Figure 3.A.29. Effective carbon tax rates in Mexico

Average by sector and energy category – rate in EUR per tonne of CO_2

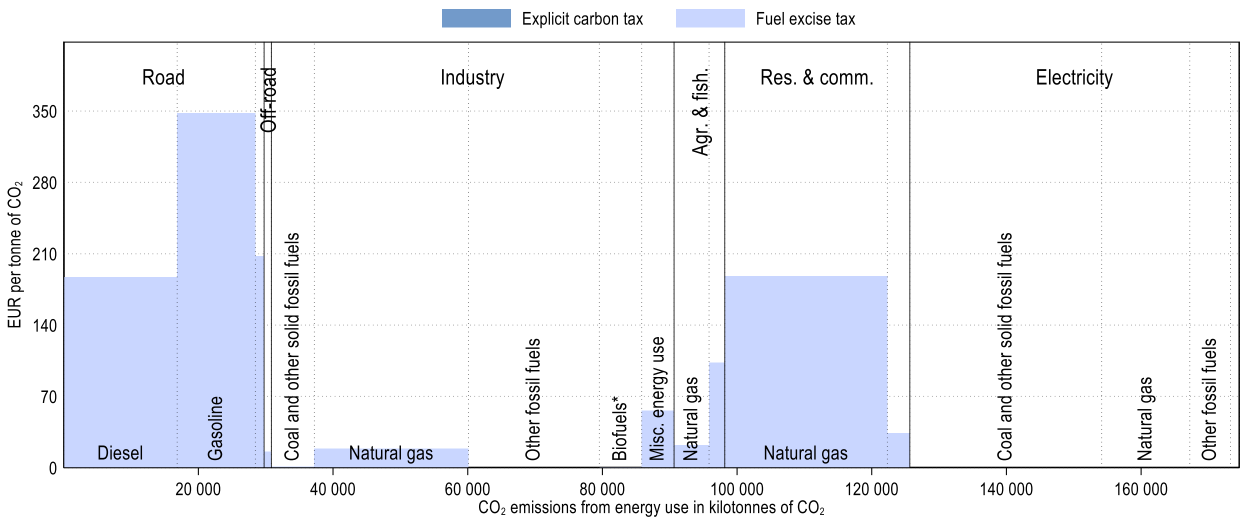


Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934009824

Annex Figure 3.A.30. Effective carbon tax rates in the Netherlands

Average by sector and energy category – rate in EUR per tonne of CO_2

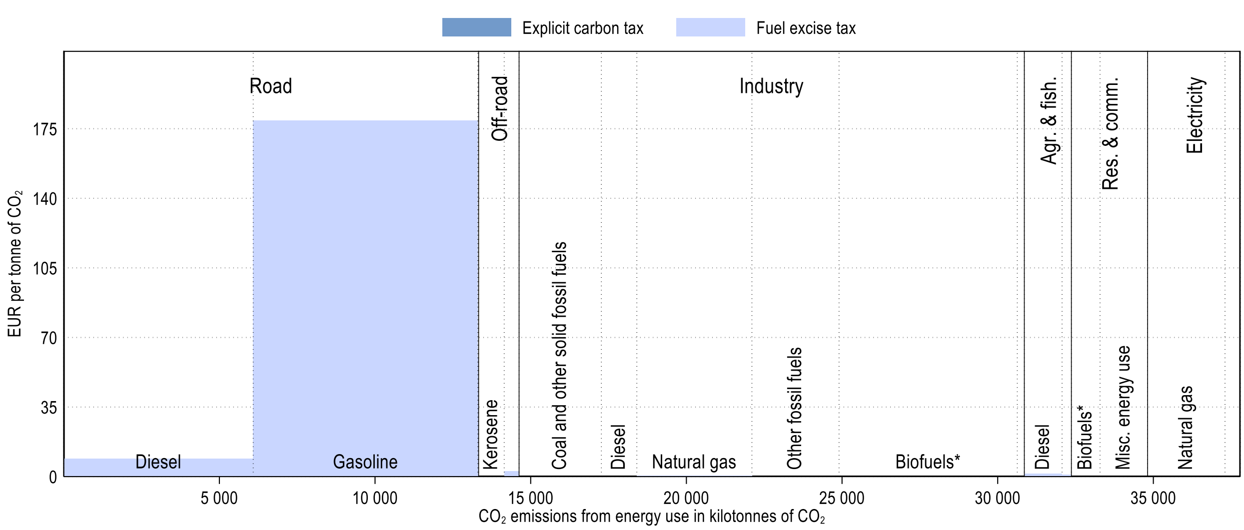


Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934009843

Annex Figure 3.A.31. Effective carbon tax rates in New Zealand

Average by sector and energy category – rate in EUR per tonne of CO_2

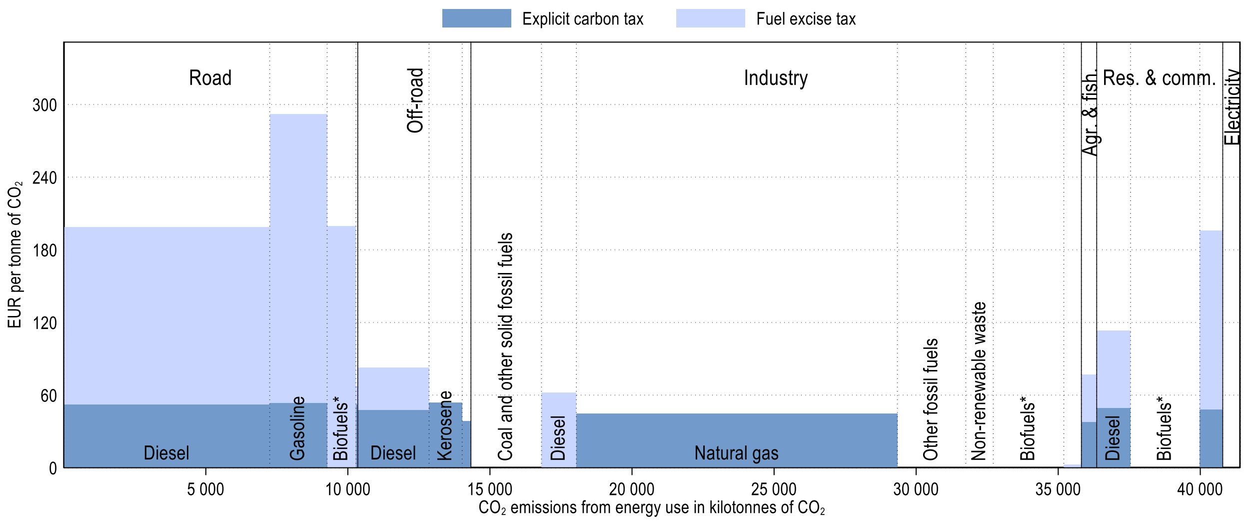


Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934009862

Annex Figure 3.A.32. Effective carbon tax rates in Norway

Average by sector and energy category – rate in EUR per tonne of CO_2

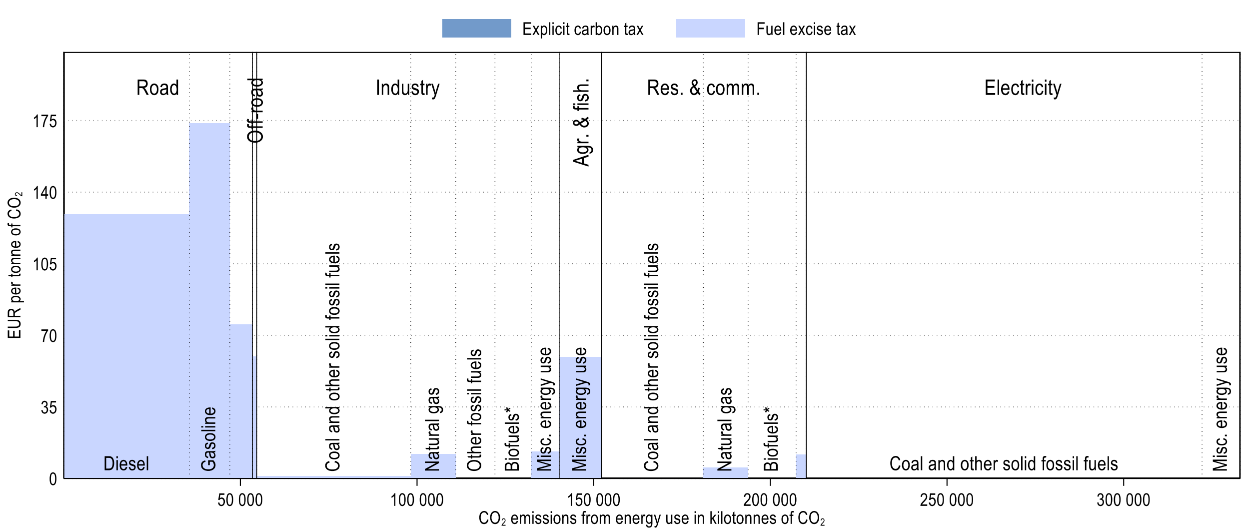


Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934009881

Annex Figure 3.A.33. Effective carbon tax rates in Poland

Average by sector and energy category – rate in EUR per tonne of CO_2

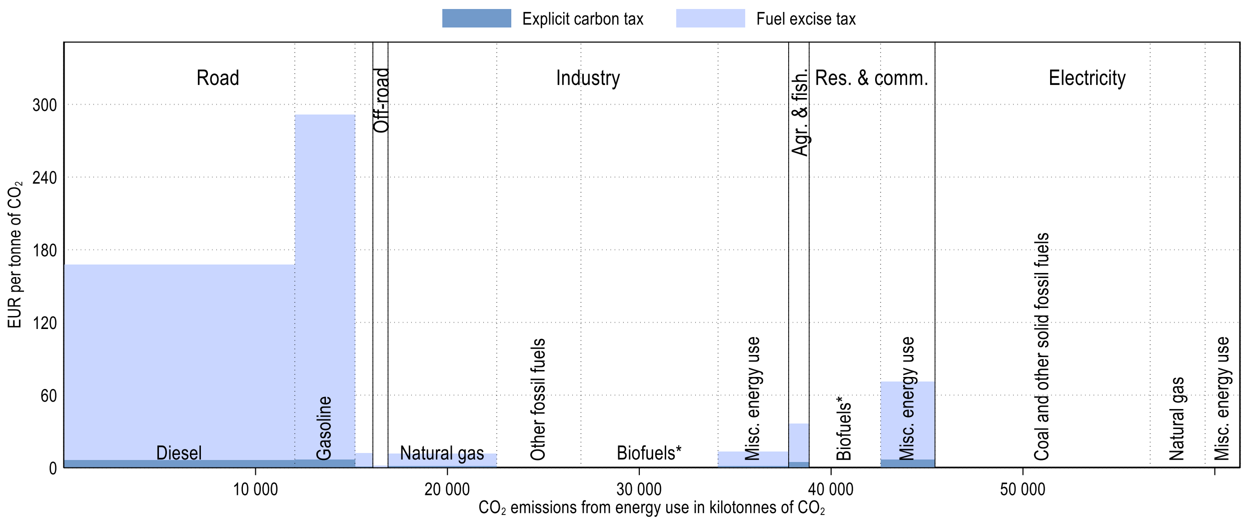


Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934009900

Annex Figure 3.A.34. Effective carbon tax rates in Portugal

Average by sector and energy category – rate in EUR per tonne of CO_2

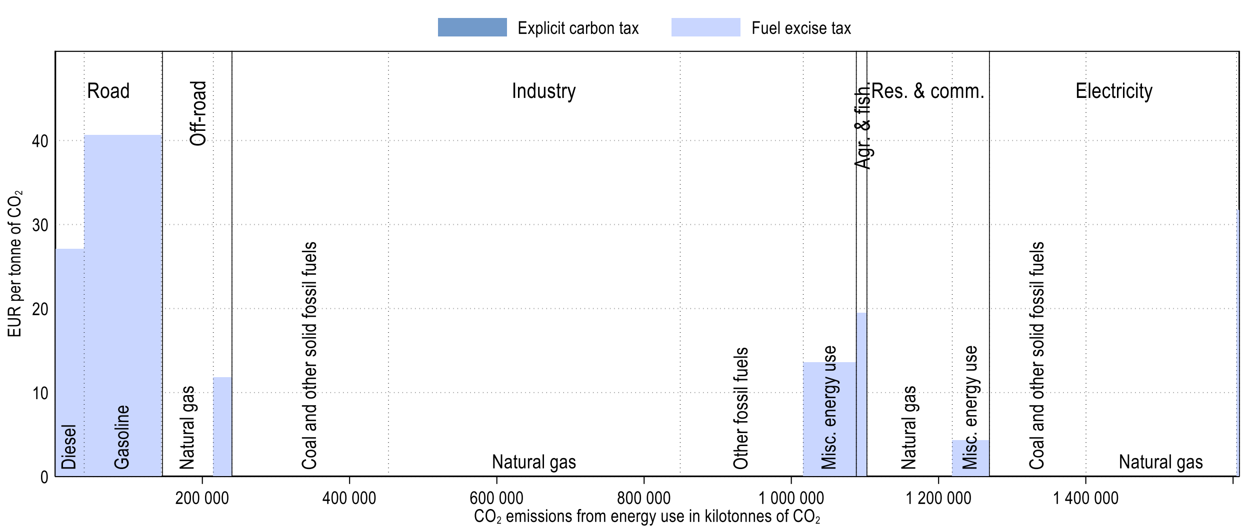


Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934009919

Annex Figure 3.A.35. Effective carbon tax rates in Russia

Average by sector and energy category – rate in EUR per tonne of CO_2

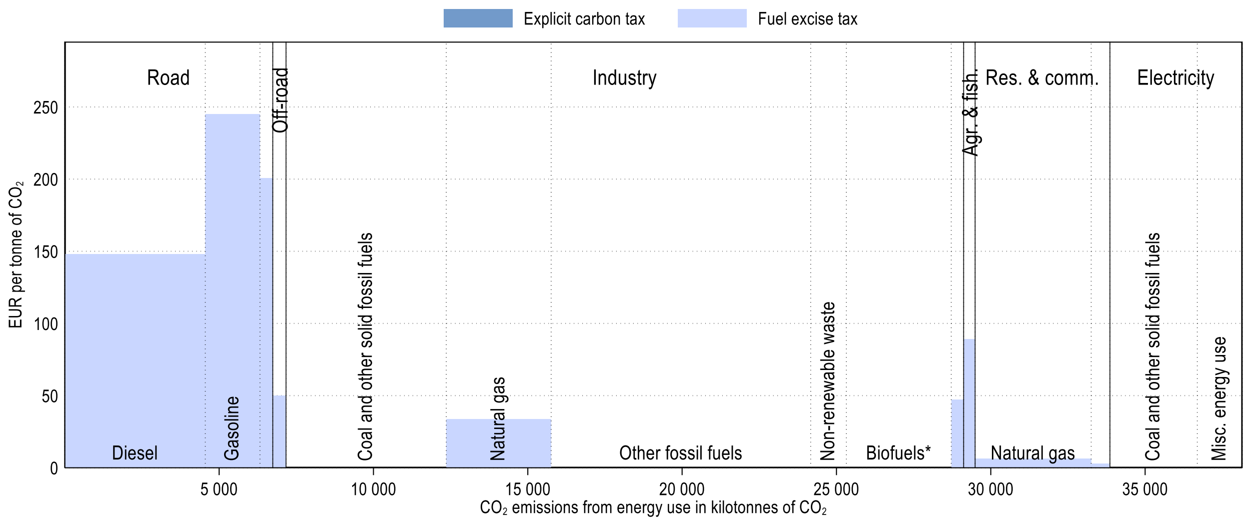


Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934009938

Annex Figure 3.A.36. Effective carbon tax rates in the Slovak Republic

Average by sector and energy category – rate in EUR per tonne of CO_2

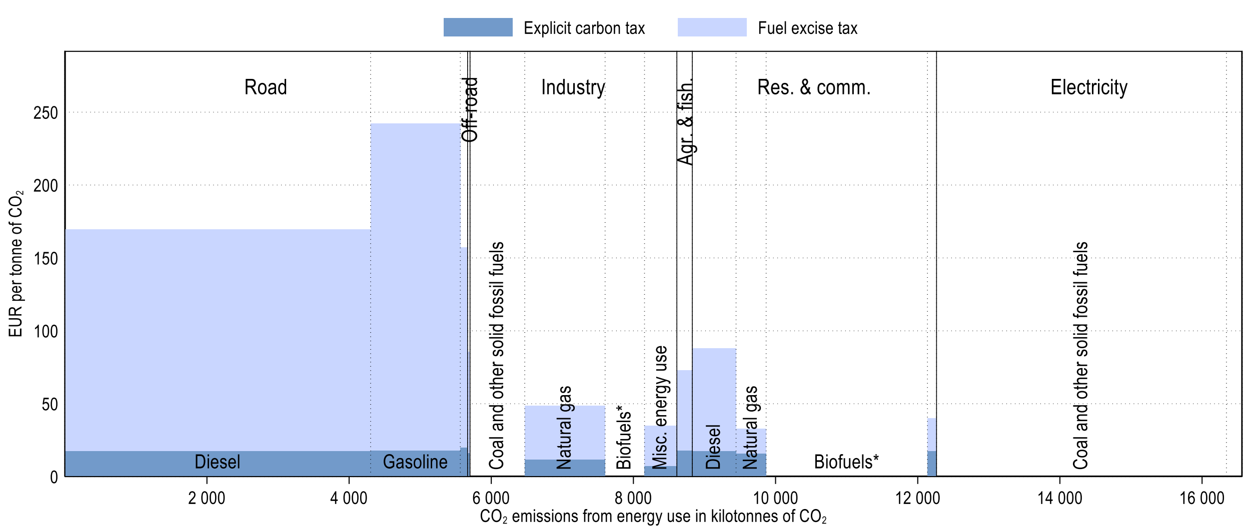


Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934009957

Annex Figure 3.A.37. Effective carbon tax rates in Slovenia

Average by sector and energy category – rate in EUR per tonne of CO_2

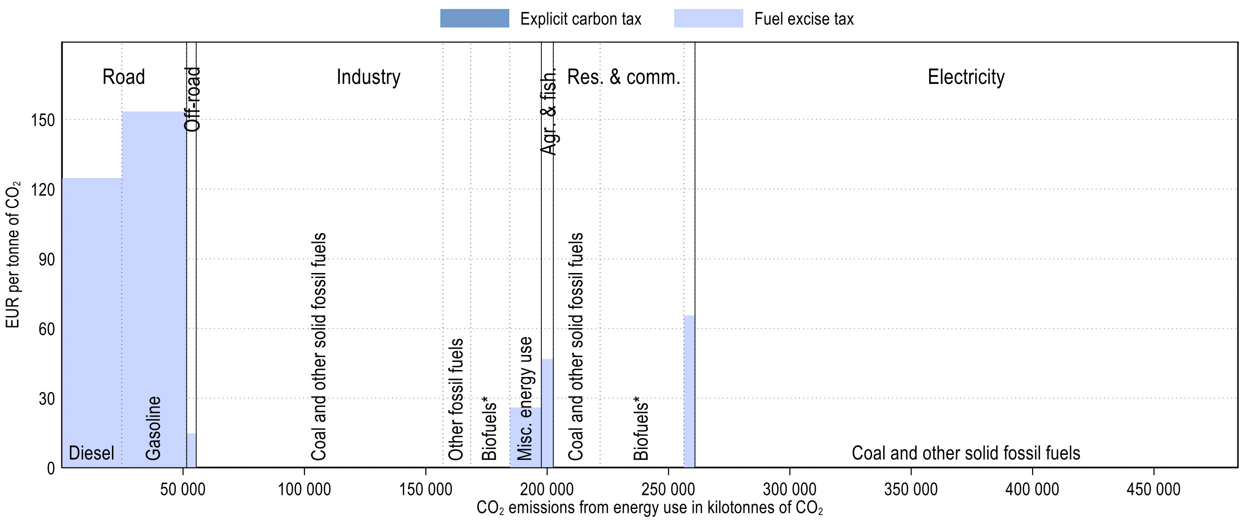


Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934009976

Annex Figure 3.A.38. Effective carbon tax rates in South Africa

Average by sector and energy category – rate in EUR per tonne of CO_2

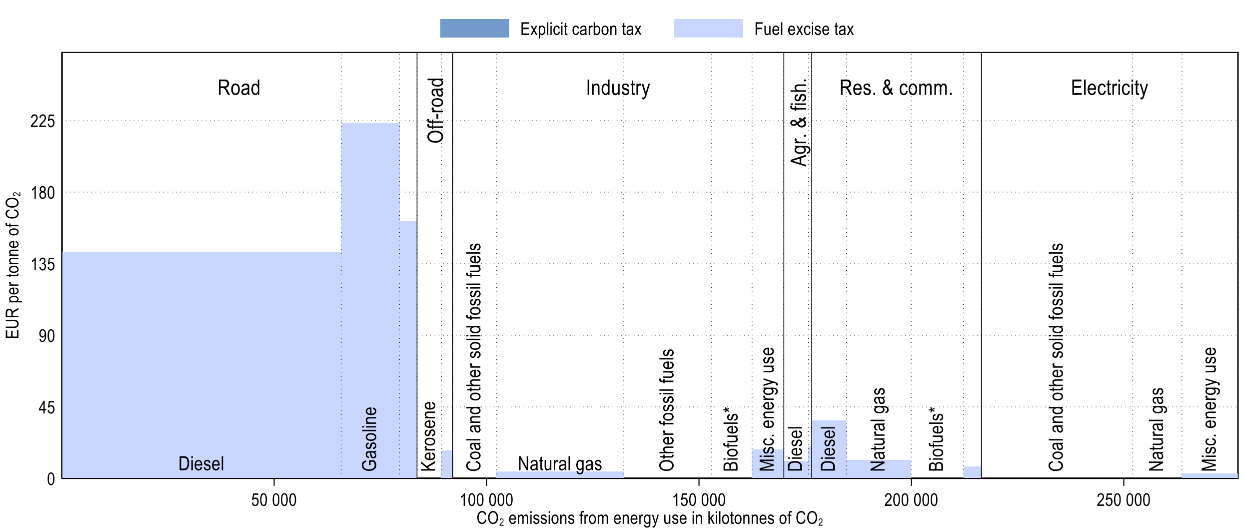


Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934009995

Annex Figure 3.A.39. Effective carbon tax rates in Spain

Average by sector and energy category – rate in EUR per tonne of CO_2

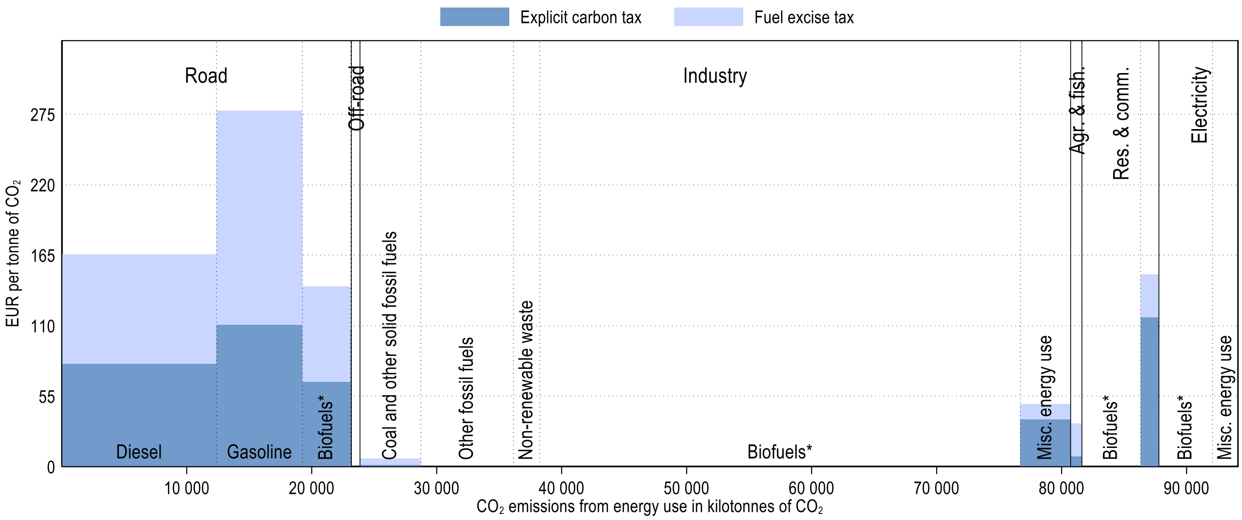


Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934010014

Annex Figure 3.A.40. Effective carbon tax rates in Sweden

Average by sector and energy category – rate in EUR per tonne of CO_2

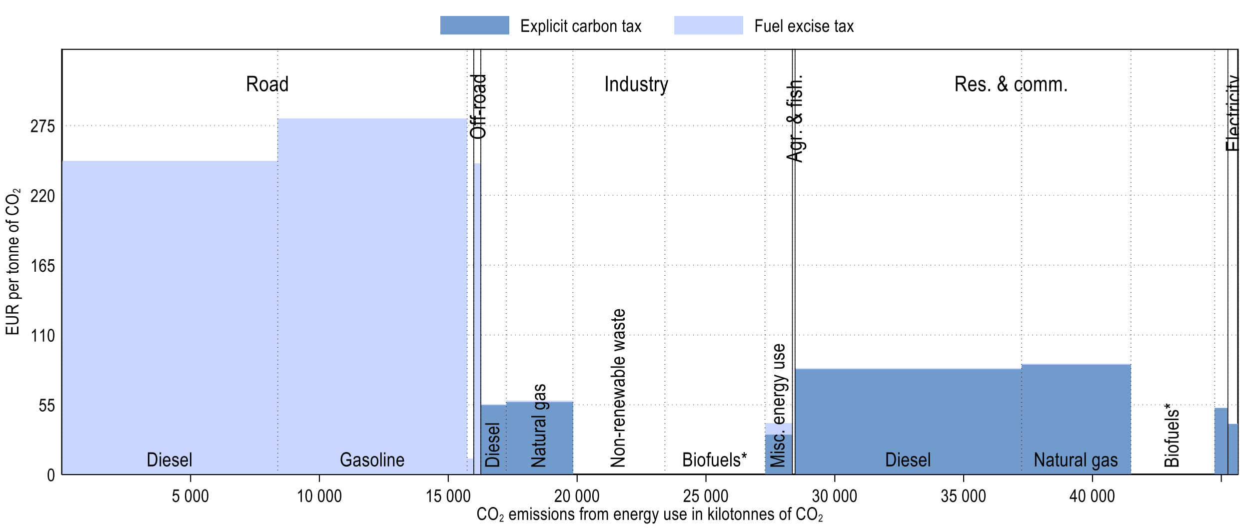


Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into “miscellaneous energy use”, which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934010033

Annex Figure 3.A.41. Effective carbon tax rates in Switzerland

Average by sector and energy category – rate in EUR per tonne of CO_2

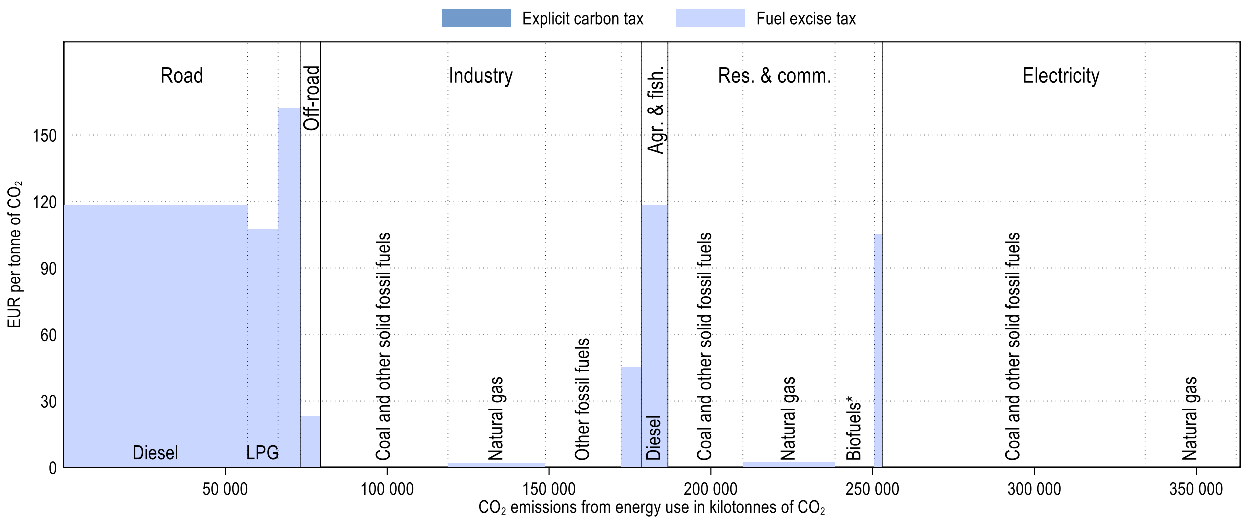


Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into “miscellaneous energy use”, which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934010052

Annex Figure 3.A.42. Effective carbon tax rates in Turkey

Average by sector and energy category – rate in EUR per tonne of CO_2

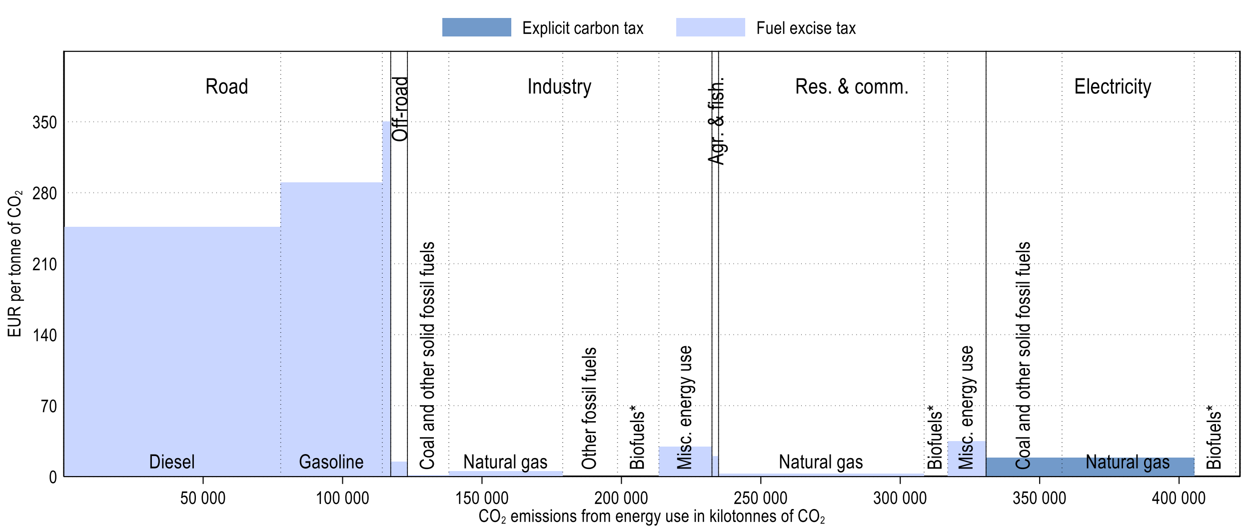


Note: Tax rates applicable on 1 July 2018. CO2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934010071

Annex Figure 3.A.43. Effective carbon tax rates in the United Kingdom

Average by sector and energy category – rate in EUR per tonne of CO_2

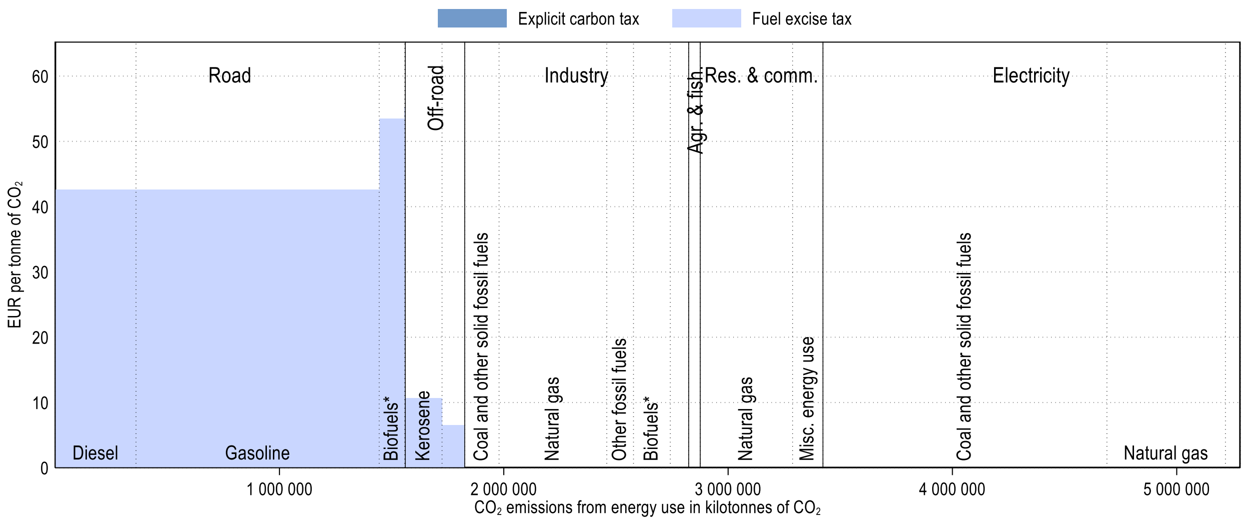


Note: Tax rates applicable on 1 July 2018. CO2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934010090

Annex Figure 3.A.44. Effective carbon tax rates in the United States

Average by sector and energy category – rate in EUR per tonne of CO_2



Note: Tax rates applicable on 1 July 2018. CO_2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances. The figure groups energy categories that represent less than 2% of the horizontal axis into "miscellaneous energy use", which is not always labelled. Biofuels are marked with an asterisk as under the IPCC Guidelines for emissions from energy use, emissions from the combustion of biofuels are not included in the national total (see Chapter 1).

StatLink https://doi.org/10.1787/888934010109

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Notes

[1] Specifically, approximately 12% of energy-related emissions were covered by emissions trading systems. For 8% of emissions, the ETS was the only price-based policy instrument that applies.

[2] In addition to European Union member countries, Iceland, Lichtenstein and Norway also participate in the EU ETS.

[3] Polluters are, for instance, better informed than policy makers on whether to close down coal plants or invest in CCS technologies. Banning coal shuts down the second abatement option.

[4] The large decrease in average effective carbon taxes in Turkey and the United Kingdom is largely due to the fact that these countries' currencies depreciated relative to the euro. Tax policy changes that have occurred between 2015 and 2018 are, for instance, described in OECD's Tax Policy Reforms publication series (OECD, 2016[25]) (OECD, 2017[24]) (OECD, 2018[14]).

[5] Their estimation results that are based on an instrumental variables identification strategy, applied to TEU data, suggest that a ten euro increase in effective carbon taxes reduces CO_2 emissions by 7% in the long run.

[6] The IMF calculations are based on a carbon tax benchmark of USD 35.

[7] The following two paragraphs are based on Marten and Van Dender (forthcoming).

[8] There may be constitutional constraints for such rate schedules. In Norway, for instance, the Constitution does not allow tax rates to be fixed several years in advance; they have to be adopted separately each year by the Parliament.

[9] The focus is on jurisdictions and not countries because in cases where standard carbon tax rates differ across subnational jurisdictions, it would be unclear as to which rate should be considered as the standard rate.

[10] Trading systems could also price emissions from international transport, and that they do so to some extent as flights within the European Economic Area are covered by the EU ETS, but these emissions represent a small share of global emissions from international transport (Larsson et al., 2019[23])

Taxing Energy Use 2019

USING TAXES FOR CLIMATE ACTION

Well-designed systems of energy taxation encourage citizens and investors to favour clean over polluting energy sources. In particular, fuel excise and carbon taxes are simple and cost-effective tools to curb dangerous climate change. Energy and carbon taxes also contribute to limiting health damage from local pollution. Taxing Energy Use (TEU) 2019 presents a snapshot of where countries stand in deploying energy and carbon taxes, tracks progress made, and makes actionable recommendations on how governments could do better. The report contains new and original data on energy and carbon taxes in OECD and G20 countries, and in international aviation and maritime transport.

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