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.[1] Together, these countries represent more than 80% of global energy use.

TEU provides information on all specific taxes on energy use.[2] 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").[3] Table 1 provides definitions of these specific taxes

Table 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[1]). Permit prices that result from emissions trading systems are not covered in TEU, but are included in OECD's *Effective Carbon Rates* (2018[2]) 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[3]), *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 2. Electricity taxes are attributed to the share of the associated primary energy use that is transformed into electricity.

Table 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[3]), *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.[4] 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[2]; OECD, 2016[4]) 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 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 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 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[3]), *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] 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.

[2] 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).

[3] 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.

[4] 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[5]).

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[6])

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[7]), 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[8]; OECD, 2015[5]) (OECD, 2018[7]) as well as of *Effective Carbon Rates* (OECD, 2016[4]; OECD, 2018[2]), 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.

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