Taxing Energy Use 2015
OECD and Selected Partner Economies

Taxing energy use in the 41 countries

This chapter discusses the reasons for energy taxation, patterns of energy use and pricing policies in the 41 countries included in the report. It outlines the methodology used to develop graphical profiles of energy use and taxation in each country and to conduct the cross-country analysis. It then presents the results of the cross-country analysis, considering general trends in energy use, the taxation of energy used in different sectors (transport, heating and process use and electricity generation), economy-wide tax rates on energy, and the links between taxes, GDP and energy use per capita. The final part of the section draws conclusions on the impact of current energy pricing and tax measures.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West bank under the terms of international law.

1. Introduction

This report analyses and describes the level and the structure of taxes on energy use in 41 countries: the 34 OECD countries and seven selected partner economies; Argentina, Brazil, the People's Republic of China (hereafter "China"), India, Indonesia, the Russian Federation (hereafter "Russia"), and South Africa.

To set the stage for the in-depth analysis in subsequent chapters, this introductory chapter begins by describing the motivation of the work undertaken, in Section 1.1. Section 1.2 briefly discusses why energy use is taxed in practice and explains in some more detail the case for using taxes as environmental policy instruments. Section 1.3 provides a quick overview of patterns of energy use in the 41 countries covered, which together account for 80% of world energy use. It illustrates that the selected partner economies represent a major and quickly growing share of global energy use. Section 1.4 discusses relations between energy taxes and prices, in order to provide insight into the weight taxes on the consumption of energy – which are the focus of the report – have in the formation of the price of energy.

The other sections of Part I are as follows. Section 2 provides a detailed discussion of the way the graphical profiles of the taxation of energy use in Part II of this report (for the selected partner economies), and in Part II of *Taxing Energy Use – A Graphical Analysis* [for OECD countries, (OECD, 2013b)], are structured. The section also explains the underlying methodology and data sources. Section 3 contains an in-depth discussion of the results from a systematic cross-country analysis, examining the tax base and the tax rates across all 41 countries, on an economy-wide basis, and by sector, user type and fuel.

1.1. Motivation

Energy use is crucial for the patterns of production and consumption that characterise modern economies. Ensuring sufficient and secure energy supply and avoiding excessive energy use and limiting negative side effects on health, the environment and the climate is a critical socio-economic process, in which markets and policies are closely intertwined. Price signals are a key feature of this process. Prices influence the amount and type of energy that different users will demand, and they affect how much producers are willing to supply, now and – via investments in capacity – in the future. Prices therefore also affect the health, environmental and climate impacts of energy use. Taxes on the consumption of energy are one tool that governments can use to influence prices, but they are not the only tool: governments can intervene more directly in markets to set or regulate prices using a variety of mechanisms.

Taxes on energy use generate government revenue, a fact well recognised by governments and with considerable impact on the current landscape of energy taxes in many countries. Expenditure on energy use can form a substantial share of total household expenditures, and governments often intervene to contain spending on energy in order to limit inequality or reduce poverty. Energy costs also represent a large share of total costs for some types of firms, and this can inspire public policy choices to limit energy costs in order to support firms' international competitiveness. Taxes are also environmental policy instruments. Since taxes affect the prices of energy products, they can help to steer users' choices on what and how much energy to use. As argued in the next section, taxes on the consumption of energy are among the most cost-effective policy instruments to integrate consideration of the health, environmental and climate costs of energy use into the decision-making of households and firms.

For all these reasons, understanding the structure and level of energy taxes is indispensable for informed policy discussion about energy use. Such policy discussions are a key part of debates on how policy can best support "green growth" as well as contributing to wider policies including industrial, employment, social welfare and health policies.

Taxing Energy Use – A Graphical Analysis was published by the OECD in 2013, with the aim of providing a systematic yet straightforward description of taxes on energy use in OECD countries. The current report describes the structure and the level of taxes on energy use in Argentina, Brazil, China, India, Indonesia, Russia and South Africa. These selected partner economies of the OECD account for 36% of global energy use in 2009, and this share is set to grow quickly along with the weight of these countries in the world economy. Adding the selected partner economies to the set of countries analysed in the 2013 publication results in coverage of 41 countries and just over 80% of world energy use, and 84% of carbon emissions from energy use, in 2009. The present report adopts the same methodological approach as *Taxing Energy Use – A Graphical Analysis* (OECD, 2013b) in that it combines detailed data on energy use (the tax base) with newly-collected information on taxes on energy use, including reported tax expenditures, to produce graphical profiles of the taxation of energy use. The methodology underlying the analysis, and the emphasis in the discussion of the results, are adapted to some specific characteristics of the taxation of energy use found more strongly in the seven countries on which this report focusses than in the OECD countries covered in the 2013 publication. For each of the selected partner economies, graphical profiles of energy use and taxation are constructed that serve three broad goals:

- to understand the composition of energy use and the associated carbon dioxide emissions (CO_2) in each country;
- to illustrate the structure of energy taxation in each country, including:
  - the coverage of the various tax bases related to energy consumption;
  - the effective tax rates in energy and carbon terms that apply to different fuels, uses of fuel, and fuel users;
  - the various tax expenditures that are provided; and
- to help to establish a foundation for analysis of appropriate tax settings on energy.

1.2. Why countries tax, or subsidise, energy use

Together, *Taxing Energy Use – A Graphical Analysis* (OECD, 2013b) and the present report cover 41 countries. All these countries impose broad-based consumption taxes, in the form of VAT or retail sales taxes. A small number of goods and services are frequently subject to specific taxes or subsidies, and the various types of energy are prime examples. Specific taxes on energy are often levied as excise taxes (the focus of this publication) or through differentiation of VAT rates (see Section 1.4). Whereas excise duties increase the price of energy, differential VAT treatment most often means a VAT rate lower than the standard rate and therefore a relatively lower price of energy.

Governments also intervene in other ways, for example through price regulation, to alter energy prices. Price regulation can help to avoid abuse of market power (by aligning prices with short run or long run marginal costs, or average costs), but it can also be used to keep prices below costs (see Section 1.4 for an overview of such mechanisms in the selected partner economies).

There are several reasons why governments intervene to tax or subsidise energy use specifically:

- Taxes can be used to integrate the environmental, health and climate costs of pollution in energy prices, so that energy users will take these costs into account when deciding how much and what energy to use ("internalising external costs"). Tradable permit systems can produce similar results. Box 1 develops the argumentation in some detail.
- Putting specific taxes on energy products often increases the price relative to other goods. This is economically efficient in as far as the demand for energy is relatively inelastic, i.e. demand does not fall strongly when prices increase. The advantage is that market outcomes are not strongly distorted by the tax, so that revenue is raised at a relatively low economic cost. A less elastic tax base is appealing from a revenue-raising point of view but not so much from an environmental point of view, as taxes will reduce pollution less where demand is less elastic. This trade off needs to be considered with the relative weight of revenue-raising and environmental protection objectives in mind.
- In some countries, some types of energy use are subject to a specific tax or charge of which the revenues are hypothecated for particular types of spending. Motor fuel tax revenues, for example, are sometimes reserved for spending in the transport sector. The tax then is akin to a user charge, even if it does not always reflect marginal costs. Where these taxes apply directly to the use of a unit of energy, they are included in our analysis, as their impact is to increase relative prices of energy products, regardless of their stated intent.
- Governments may choose to introduce preferential tax treatment for some types of energy use or for some types of users. They can go further and provide net subsidies for energy use. Such measures are often motivated by distributional or poverty concerns where household use is concerned, and on competitiveness grounds for commercial energy use. Containing inflation is another potential motivation for controlling energy prices, as is stimulating economic development.

In practice, government policies on energy taxation, subsidisation and pricing will be affected by all of the factors mentioned, with the weight of the different factors changing over time and dependent on local constraints and priorities. Economic analysis tends to emphasise the advantages of specific energy taxes as instruments for environmental policy and to some extent as revenue raising instruments (see Box 1). Economic analysis tends to be critical of hypothecation because of risks of misallocating public funds. It also tends to be critical of tax or subsidy policies that keep energy prices for households low, suggesting that distributional goals are better achieved through other means. Competitiveness concerns matter for public policy, but evidence suggests that energy price increases have only limited impacts on firm competitiveness even in energy-intensive sectors (see for example Arlinghaus, 2015).

Box 1. **Why taxes are among the best environmental policy instruments**

Taxes often are levied to raise government revenue, and where this is their principal objective, behavioural responses by taxpayers are usually undesirable. In other cases, including environmental taxation, changing behaviour (to reduce pollution) can be a policy objective, along with revenue raising. Environmentally related taxes are not levied for environmental reasons alone, but – as is explained below – taxes are effective instruments for pursuing environmental objectives.

The environmental, health and climate impacts (in short, pollution) of energy use are not directly borne by producers and consumers, so these costs are not taken into account in decisions based on market prices: these costs are external to the market. The result is that unregulated market outcomes lead to too much pollution, and public policy is needed to improve upon the market outcome by reducing pollution. Governments can intervene with various policy instruments, including taxes, cap-and-trade systems (tradable permits), emission standards, direct technology requirements and restricting the level of pollution-generating activity.

Taxes or auctioned tradable permits tend to outperform other environmental policy instruments in terms of cost-effectiveness. This is because putting a price on pollution provides polluters with incentives to find the cheapest ways of reducing their tax bill. They can reduce the level of the pollution-generating activity or invest in less pollution-intensive ways of carrying out the activity. Alternative instruments, for example energy efficiency standards, imply more prescriptive policy decisions on how to reduce pollution, and given asymmetrical information and heterogeneity among economic agents, the proposed solutions risk not being cost-effective. The economic agents carrying out the pollution-generating activity are better informed than the government about how they can cut pollution, so they are better placed to choose the cheapest option under a regulation-based intervention. Since economic agents differ, the best options can differ as well. For example, some households would be better off by responding to a higher fuel tax by investing in more fuel efficient cars, whereas others would primarily respond by driving less. A fuel economy standard, however, would force the second household to (also) invest in fuel economy, even though this would not be their preferred response. Furthermore, once polluters comply with an energy efficiency standard or a cap on emissions, they do not have an incentive to further reduce pollution, whereas with a tax they have an ongoing incentive to reduce pollution.

Market-based instruments have strong appeal on theoretical grounds and there is evidence that they often work better in practice than other policy instruments (see e.g. OECD, 2013c). Nevertheless, direct regulation, for example with efficiency or emission standards, can be useful in particular circumstances, either in combination with market-based instruments or instead of them. One complication with the use of taxes is that it may be difficult to tax pollution directly and that taxes have to be levied on activities or types of consumption that are more or less strongly related to pollution. When the correlation is weak, taxes become less effective and the relative appeal of direct regulation rises. Fuel taxes, for example, can very accurately reflect the carbon content of fuels and therefore the marginal contribution of fuel use to climate costs, but they correlate less directly with emissions of local pollutants and still less with the ultimate pollution costs resulting from such emissions. Emission standards for local pollutants can usefully complement fuel taxes, but the case for fuel economy standards is weaker. Furthermore, designing effective emission standards is not easy, with e.g. the risk that emission profiles differ substantially between test- and real-world conditions. Using standards to cut pollution is more likely to work well in the early stages of abatement, when pollution is high and cheap technological approaches to reduce it are available. Market-based approaches become more attractive when abatement costs rise and across-the-board measures should make way for more decentralised abatement choices.

Firms often have market power, and this allows them to raise prices above marginal production costs. Producers in the energy sector, where technology often requires large scale operations and where barriers to entry are relatively high, are prone to displaying market power. When market prices exceed marginal production costs, it would seem that the price already covers part or all of the external costs of pollution.

Box 1. **Why taxes are among the best environmental policy instruments** *(cont.)*

The tax needed to internalise the costs of pollution would then be smaller than in a perfectly competitive market. This conclusion, however, is not straightforward. Market power is pervasive throughout the economy, and except in cases where it is particularly strong, prices including mark-ups may not be very far from prices that are as efficient as practically possible. Perfect competition, which would lead to prices equal to marginal costs, is a limiting case that can be approximated but rarely attained in practice. Furthermore, mark-ups can also help pay for fixed costs, and if they do so in ways that are less distortive than alternative ways of funding fixed costs, then mark-ups are efficient in a second-best sense. If market prices are as efficient as possible, then seeking to set taxes or permit prices equal to marginal external costs remains a sensible principle.

In cases where market power is strong, public policy is needed to limit abuse of market power. This can take the form of competition or anti-trust policies and in some sectors (e.g. electricity, utilities) more active regulatory policies or public provision can be justified. In each case, welfare-oriented policy will seek to set prices that align broadly with marginal costs with possibly mark-ups to cover fixed costs and retain investment incentives. As long as such policies are in place and are effective, environmental taxes should still be roughly equal to marginal damage and they should be levied on top of producer prices. Curbing pollution with instruments that generate government revenue (e.g. taxes and auctioned tradable permits) is often preferable to doing so with instruments that do not (e.g. grandfathered tradable permits) or that cost public money (e.g. subsidies for pollution abatement), even if all approaches would yield the same environmental outcome. The reason is that taxes and auctioned permits provide government revenue that can be redirected to more socially or economically advantageous uses, e.g. reducing more distortive taxes, increased expenditure in priority areas, or debt reduction.

Aligning taxes on energy use with its marginal external costs requires estimates of these marginal costs for different forms of energy under different use scenarios. Producing reliable estimates is difficult and costly, and with few exceptions, no "off-the-shelf" information is available for particular situations. A distinction can be made between bottom-up and top-down estimates. Bottom-up estimates model the processes and activities that generate the external cost and combine them with estimates of the economic cost of the impacts. This method provides reliable insight into the strong dependence of some marginal external costs on the time when and place where the externality-generating activity takes place. Air pollution costs, for example, do not only depend on tailpipe or smokestack emissions but also on how these emissions interact with ambient concentrations of other substances, on weather and geographical characteristics, and on how many people are exposed to the resulting level and nature of air pollution. Bottom-up estimates, however, are costly to produce and are not systematically available (see Ricardo-AEA, 2014, for a recent application to the transport sector in Europe).

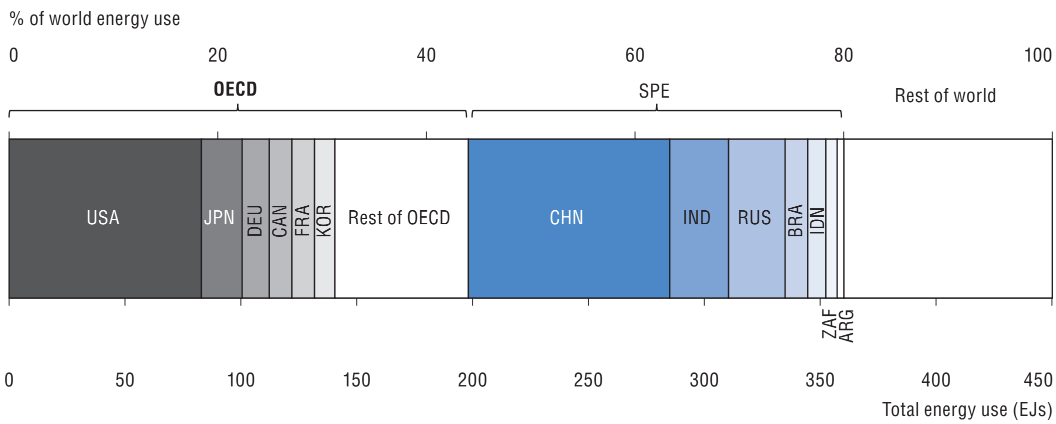
The difficulty and cost of producing bottom-up estimates of marginal external costs explains why attempts are made to combine bottom-up evidence with indicators of local circumstances to produce top-down estimates of marginal external costs (see e.g. Parry et al., 2014). These estimates may not necessarily be sufficiently precise or may be too aggregated to provide guidance on how large environmental taxes really ought to be, but they do show what directions of environmental tax reform are desirable and in that sense provide very useful context for the interpretation of the evidence on current tax profiles gathered in this publication.

1.3. Patterns of energy use, cross-sectional and time trends, and country heterogeneity

The seven selected partner economies represent a large and growing share of global energy use and carbon emissions, as shown in Figure 1. In 2009, the year for which energy use is taken for this publication, they accounted for 36% of world energy use. The OECD countries' share in world energy use was 44.1%. This means that the database underlying

Taxing Energy Use – A Graphical Analysis (OECD, 2013b) and the present publication now covers (just over) 80% of global energy use. The seven selected partner economies include large economies and significant energy consumers. China was the world's largest energy user in 2009, followed closely by the USA. In third and fourth place are two more selected partner economies, India and Russia. The amount of energy used in India and Russia was similar in 2009, at about 30% of the level of energy use in China and the USA. To give further orders of magnitude, Brazil consumed about as much energy as France, and Indonesia consumed slightly less. South Africa is comparable to Italy in the amount of energy used in 2009, and Argentina to Poland or the Netherlands.

Figure 1. **Composition of world energy use**



Source: OECD calculations, based on IEA (2014), *IEA World Energy Statistics and Balances* (database), http://dx.doi.org/10.1787/data-00513-en. 2009 information is shown for compatibility with the graphical profiles in Part II of the report.

StatLink http://dx.doi.org/10.1787/888933205545

The shares of energy consumption illustrate the relevance of including the selected partner economies in *Taxing Energy Use*. Furthermore, and as is well known, the weight of the selected partner economies in the world economy is rising and will continue to rise over the coming decades. OECD long-term baseline projections (Johansson et al., 2013) suggest that China's share in global economic output (in purchasing power parity terms) will rise to around 28% in 2030 and 29% in 2050, from 19% in 2013. India's share will rise from 7% in 2013 to 11% in 2030 and 16% in 2050. On the basis of current membership, the OECD's share in global economic output is expected to decline from 62% in 2013 to 49% in 2030 and 43% in 2050. As will be seen, energy use has been strongly dependent on per capita GDP in the past, and if this trend continues, then the share of the selected partner economies in global energy use is set to rise strongly. Part of the increase in energy use is related to transport. The share of transport energy use in total energy use is currently relatively low in the selected partner economies, and it is likely to rise quickly.

The remainder of this section considers the characteristics and the evolution over time of energy use and carbon emissions in Argentina, Brazil, China, India, Indonesia, Russia and South Africa. To provide context, the evolution over time is briefly compared to cross-sectional trends[1] observed in the set of 41 countries formed by the OECD countries and the selected partner economies, and to time trends in four "reference" countries (Netherlands, Spain, United Kingdom and United States, which differ markedly between them in their energy-carbon emission structure[2] but all have very high per capita income). The time series starts in 1990 and ends in 2010, 2011 or 2012, depending on latest available information for the variable considered. The cross-section is for the year 2009. The following stylised facts emerge:

- Rising per capita GDP is associated with higher energy use, expressed in GJ per capita, in the selected partner economies and on average in the cross-section. The association is stronger in the cross-section than in the time series, perhaps because some very high income economies are also very energy-intensive. The association is not positive on average for the four reference countries, as two of them combine GDP growth per capita with declining energy use per capita and the other two display limited or zero growth in energy use while GDP per capita rises. This is suggestive of a transition to less energy-based growth models in economies where per capita income is high.
- Rising per capita GDP is negatively correlated with the energy intensity of GDP (GJ/GDP). This holds in the cross-section and in the time pattern for the selected partner economies (except Brazil) and the four high income economies. Hence, whereas energy use per capita tends to rise as incomes rise (except possibly at very high incomes), the energy intensity of GDP tends to decline.
- Rising per capita GDP correlates positively with CO_2 emissions per capita, except in South Africa, Russia, and the four reference economies where emissions are mostly flat or decline while per capita income increases, over the period considered. The positive correlation in most selected partner economies is the consequence of rising energy use per capita and mostly time-invariant carbon-intensities of energy use.

The stylised facts provide insight into broad trends, but they hide considerable heterogeneity among countries, heterogeneity which is not due to differences in income levels or other indicators of economic development. Chapter 3 analyses patterns of energy use and taxation, and explores their connections with economic characteristics. Some observations include:

- Among the selected partner economies, India and Indonesia have the lowest per capita incomes, and China stands out by its particularly fast income growth, by which it is rapidly moving from the lowest to the median income levels in the selected partner economies.
- Among the selected partner economies, Russia's per capita energy use is particularly high. It is, however, lower than per capita energy use in the USA and comparable to the level of the Netherlands. South Africa's energy use per capita is high too among selected partner economies but it is not very different from the level in Spain or, in recent years, the United Kingdom. Income differences alone clearly do not explain all these differences. Per capita energy use is low in India and Indonesia, even after controlling for low incomes there. Energy use per capita in China starts to grow more quickly as of 2002, around the same time when per capita income growth accelerates.
- As indicated, the energy intensity of GDP (GJ/GDP) declines in all countries except Brazil, from 1990 to 2012. However, it declines from lower levels in the four reference economies, and the rate at which it declines appears not to differ strongly between the reference countries and the selected partner economies (with the exception of China, where the decline is particularly fast, and Brazil, where there is no decline).

1.4. *Taxes and prices of energy use*

This report analyses taxes on energy use in 41 countries: the seven selected partner economies is described in this report and the 34 OECD countries described in *Taxing Energy Use – A Graphical Analysis* (2013b). As discussed in Box 1, taxes on pollutants are highly effective policy instruments. Taxes on energy use can approximate taxes on pollutants more or less directly (e.g. more directly for carbon, less directly for local pollutants), and are among the preferred instruments to include external environmental costs in prices where that is desirable. Among many factors, the prices of energy use depend on other public measures, including regulation, other tax policies and carbon trading mechanisms. This section provides an overview of how taxes, tax expenditures, and other policies shape energy prices. The goal is not to be comprehensive but to place taxes into the broader picture of energy pricing policies.

Section 1.4.1 summarises the main results of this report concerning energy taxation. Section 1.4.2 discusses some of the main policy measures affecting the producer prices of energy products (before consumption taxes) identified in the selected partner economies, providing the broader policy context for taxes on energy. Section 1.4.3 considers to what extent value-added tax (VAT) systems lead to changes in the relative prices of energy products compared to other consumption items through differentiated VAT rates in many of the 41 countries considered in this report. Whether or not energy taxes are set with environmental objectives in mind, the discussion provides useful insight into how pricing policies as a whole may or may not help to align prices with marginal costs, including environmental costs. Section 1.4.4 briefly discusses the current use of carbon trading mechanisms.

1.4.1. *Taxes on and tax expenditures for energy use*

Energy taxes increase the absolute and relative prices of energy products. They therefore impact energy use patterns, economic outcomes and the environment, and as argued above, specific taxes on energy can be very effective at integrating the environmental costs of energy use into usage decisions.

This analysis considers, on a systematic basis, taxes on the full spectrum of energy use in the 41 countries considered. The taxes covered in the detailed analysis are those levied on a physical measure of energy product consumed. They can be levied in a monetary amount per unit of fuel (per-unit taxes) or as a percentage of the sales price (*ad valorem* taxes). This report converts these tax rates into effective tax rates for each fuel based on, alternately, the energy and carbon content of each fuel. Taxes applying to a very broad range of goods (such as value added and retail sales taxes) are not included in the detailed analysis as they do not change relative prices. However, sometimes energy products are subject to a concessionary rate of VAT, which does affect relative prices. Section 1.4.2 provides insight into the extent of such VAT rate differentiation.

As explained in detail in Chapter 3 of Part I of this report, the pattern and level of taxes on energy use across the 41 countries vary considerably, both across countries and within individual countries for different uses and sources of energy. The way taxes affect the prices of energy use differs, and price signals are strongly heterogeneous across fuels and types of fuel use.

At the economy-wide level, there are large differences in the overall level of taxation across the 41 countries considered, both in energy and in CO_2 terms. The highest overall tax rates tend to be seen in countries which are members of the European Union, whose energy tax policy is significantly shaped by the 2003 EU Energy Tax Directive. Though far from being a homogenous group, the selected partner economies discussed in this report are among the jurisdictions with comparatively low average effective tax rates on energy use on an economy-wide basis, relative to the full group of 41 countries.

The economy-wide effective tax rates mask the diversity of tax rates on different fuels and users of fuels within individual countries and across the 41 countries as a whole. Transport energy is taxed more highly than heating and process energy and energy used for electricity generation. In addition, energy from oil products is taxed more heavily than energy from other sources. Several countries tax coal at very low rates, or do not tax coal at all. With the exception of Brazil, road transport is taxed at higher rates than other uses of energy. Of road use energy, diesel is taxed at lower rates in energy terms than gasoline in 39 of the countries considered, including in all selected partner economies except Brazil.

Regardless of the basis on which governments tax energy products, in practice they have often introduced exclusions or preferences to address potentially adverse impacts (real or perceived) of higher energy prices on particular groups of consumers or producers. It is increasingly recognised, however, that such preferences change relative prices in the economy in ways that have negative environmental impacts, lead to a loss of tax revenue, and create hurdles for increased use of alternative energy sources. Such tax expenditures are included in the analysis in as far as they are reported by the country concerned. Embedding the information on reported tax expenditures in the analysis of the taxation of energy use produces information complementary to the OECD's *Inventory of Estimated Budgetary Support and Tax Expenditures for Fossil Fuels* (OECD, 2015a, forthcoming), which focuses on the value of tax expenditures.

The need to phase out inefficient fossil fuel subsidies was recognised in the OECD's Declaration on Green Growth (OECD, 2009), which 42 countries have signed, and by the G20 leaders (G20, 2009). The OECDs *Inventory of Estimated Budgetary Support and Tax Expenditures for Fossil Fuels* shows that a significant amount of support in the countries analysed is provided through tax expenditures, including reductions in or exemptions from energy taxes.

A full assessment of tax expenditures requires broader consideration of the tax system of which they are a part. This report illustrates the value of the relief given under reported tax expenditures relating to taxes on energy consumption. In addition, it shows the broader context of these measures by showing the actual rate of tax as a result of the tax expenditure, the "normal" level of tax that would otherwise apply (the benchmark rate), and the rates of tax that apply to other products. This evidence-base allows cross-country comparison of effective tax rates and shows how taxes align with principles of environmental taxation. The report finds that there is considerable scope for better use of energy taxes to attain more environmentally-aware decisions on energy use.

1.4.2. Main energy policies affecting producer prices of energy in the selected partner economies

Governments can intervene in energy markets in a variety of ways with more or less direct effects on the producer prices of energy use, i.e. the prices before VAT and excise taxes. At one extreme, they can decide on prices in an *ad hoc* manner not guided by a transparent rule or process. At the other extreme, they can monitor and publish prices, indirectly affecting prices through better transparency and stronger competition. Between those extremes are different types of price regulation, price freezes, price bands and price ceilings, smoothing mechanisms, etc. Taxation or subsidisation at the production stage and the tax treatment of international trade also potentially affects domestic prices, as do quantity restrictions on international trade.

If there are strong differences among countries in the extent to which energy prices are dependent on non-tax policy instruments, and to the extent that these non-tax instruments do not aim to align prices with production costs, then direct comparisons of taxes to assess country differences in environmental and revenue characteristics of energy pricing policies can be misleading. A country where producer prices are in line with production costs and which does not levy taxes on energy use may send better price signals from an environmental point of view than a different country which does levy taxes on energy use but adds them to producer prices that are well below marginal production costs. Direct comparisons of tax profiles are useful as long as the impact of other energy pricing policies on price levels is not too strongly different.

It is beyond the scope of this report to provide a full and detailed description of all relevant measures, or to classify measures by their likely price impacts. Instead, Table 1 lists non-tax measures that affect end-user prices in the seven selected partner economies as identified in the country analyses undertaken for this report, by type of energy (coal, oil and oil products, natural gas and electricity). To provide the context in which these pricing policies apply, the country chapters refer briefly to the structure of the particular market for each broad fuel category. Inclusion of a measure in Table 1 is done on the basis of impacts on prices before VAT and end-user taxes, with no assessment of where the final incidence of the measure lies, or how broad the coverage of the measure is. As can be seen, a variety of pricing policies are being applied, most so in the sector of oil and refined petroleum products. The majority of measures listed in the table keep prices below market prices or production costs, through regulation, price freezes and direct price controls, perhaps reflecting an overall economic, social and political context that is conducive to maintaining prices below market levels even if awareness of drawbacks of such policies, and policy action to undo them, is growing.

1.4.3. Differential VAT rates on energy products in the OECD and in selected partner economies

Like the policies discussed in the previous section and the excise taxes discussed in detail in other parts of this report, value-added taxes (VAT) affect end-user prices of energy products in many jurisdictions, at least for those users that cannot claim back the input credits. As VAT applies to a very broad range – and ideally the broadest possible range – of goods and services in an economy, the tax is not specific to energy products and the relative price level of energy products and other goods and services is unchanged as long as the same VAT rate applies. However, if VAT rates are differentiated in a way that strongly affects the relative price of energy products, then VAT is *de facto* specific to such products and it should be considered when describing effective energy tax rates. Although not shown in the graphical profiles due to the difficulty of assessing and comparing the impact of differential VAT rates on energy products, particularly when differential rates also apply to other goods and services, this section investigates to what extent VAT rates for energy products differ from standard VAT rates. As in the previous section, the objective is to sketch to what extent VAT may interact with the objective of excise taxes, which is more precisely directed towards altering relative prices.

Table 1. **Main energy policies affecting producer prices of energy**

	Coal	Oil and oil products	Natural gas	Electricity	
				Generation	Electricity output
ARG	–	Dominant position of state-owned company in exploration and production (34% of the market) and refining (54%).	Dominant position of state-owned company in exploration and production (30% of the market), regional monopolies for transport and distribution.	Diversified market.	Private monopoly on transmission, regional monopolies on distribution.
		Direct price control at below market rates – *ad hoc* pricing for biodiesel, differentiated prices by company size. Retail price reductions in Jan. 2012, 2011 and Aug. 2010.	**Regulated prices at below-market rates – price freeze** since 2008, **differentiated** by consumer category and region.		**Regulated prices, differentiated** by user category and consumption except for some large users.
		Price freeze for LPG sold in bottles or cylinders in low-income areas.			**Earmarked fund** subsidises electricity tariffs.
		Price monitoring through publishing diesel and gasoline prices on government website.			Electricity bill reduction for savings.
		Export taxes for crude oil, biodiesel (both based on the difference between a national reference price and the international price) and natural gas (100%).			
BRA	–	Dominant position of state-owned company in exploration and production (91%), refining (98%), distribution (40%), service stations (20%).	Dominant position of state-owned company in exploration, production, transmission (90%), distribution (70%) and imports (100%).	Dominant position of state-owned company (40%).	Publicly managed grid, distribution and retail mostly private.
		Direct price control through ownership, price freeze since 2006 (adjusted in 2012 and 2013), subsidy borne by supplier without reimbursement.	**Price regulation at above-market rates:** domestically produced natural gas is priced 1/3 higher than imports.	**Subsidised production inputs** for gas-fired power plants.	**Regulated prices** for non-industrial users.
		Extraction taxes and other taxes apply based on sales revenue of oil and gas extraction.	**Price regulation** at state level for downstream natural gas.	**Earmarked funds** subsidise off-grid diesel-, and coal-fired plants.	**Earmarked fund** subsidises tariffs for low-income users.
		Import tax: specific import tax is charged in addition to excise taxes. Special import tariff (14%) for biodiesel, programme provides imports tax exemptions for oil and oil products.			
CHN	Primarily state-owned, relatively fragmented.	Dominated by state-owned companies in exploration and production, refining and distribution.	Dominated by state-owned companies in exploration and production, refining and distribution.	Dominated by state-owned companies.	Transmission and distribution managed by two state-owned companies.
	Price differentiation by user category and region at subnational level (coal prices can also differ between provinces because of a lack of transport infrastructure).	**Regulated prices – price ceilings** for gasoline, diesel fuel at wholesale and retail level and ethanol, possibility to introduce price ceiling for residential use of LPG at local level.	**Regulated prices at below-market rates** along the entire value chain **– price discrimination and cross-subsidisation** by consumer category and region.	**Regulated prices – *ad hoc* pricing** of coal inputs for power generation.	**Direct price control – *ad hoc* pricing, differentiated** for households.
		Price smoothing for gasoline and diesel according to a basket of crude every 10 work days, additional adjustments if international oil price exceeds certain levels, no regulation for crude oil.	**Price smoothing:** a pilot scheme bases gas-city prices on a weighted average of LPG and fuel oil prices in the Shanghai market with a discount, in 29 provinces.	**Subsidised production inputs** for Chongqing electricity producers.	Gradual elimination of preferential tariffs for large users, surcharges for heavy users.
		***Ad valorem* extraction tax** for oil, targeted reductions for some techniques and regions.	**Extraction tax,** targeted reductions for some techniques and regions.		
		Export quotas on oil products, temporary **export ban** on diesel in 2011.			

Table 1. **Main energy policies affecting producer prices of energy** *(cont.)*

	Coal	Oil and oil products	Natural gas	Electricity	
				Generation	Electricity output
IDN	Production in private hands, relatively concentrated.	State-owned company controls 17% of production and operates nearly all refinery capacity, imports and supply.	State-owned company controls 13% of production and operates nearly all refinery capacity, imports and supply.	Dominated by state-owned company (85%).	Effective monopoly of state-owned company over distribution and retail.
	Regulated prices at below-market rates – *ad hoc* pricing.	**Direct price control at below market rates – *ad hoc* pricing** for crude oil, low grade diesel and gasoline, LPG and kerosene, cost borne by supplier with reimbursement, subsidised sales rationed using quota system. Multiple price increases in 2014 to reduce subsidies.	**Regulated prices at below-market rates – *ad hoc* pricing.**	**Subsidised production inputs** for coal fired-power plants.	**Regulated prices at below cost, uniform** for all consumers, cost borne by supplier with reimbursement.
	Domestic sales mandate: 1/5 of production.	**Domestic sales mandate** for oil. Subsidies are phased out for kerosene, LPG subsidy introduced for households and small businesses. Subsidies for biofuels.	**Domestic sales mandate.**		
IND	Dominated by state-owned companies across the entire value chain, deregulated in 2014.	Dominated by state-owned companies, particularly in refining and distribution.	Dominated by state-owned companies, particularly in refining and distribution.	Diversified.	State-owned company operates about 90% of the grid and transmits 50% of electricity.
	Direct price control through ownership.	**Direct price control at below-market rates – *ad hoc* pricing:** Kerosene and LPG price fix; **price differentiation**: Industrial kerosene is priced more than triple the household price.	**Regulated prices, differentiated** for 1) state run companies; 2) joint venture fields and LNG imports; 3) LNG; 4) power and fertilizer producers; and 5) Northeast India.		**Regulated prices** on state level, some **differentiated** by user category depending on states.
	Subsidised sales are allocated between users.	**Price monitoring** and indirect price fix through publishing diesel and gasoline prices on government website. Downstream oil companies compensated for under-recoveries related to transport of kerosene and LPG to remote areas, diesel, kerosene and LPG sales. Subsidised sales of kerosene and LPG rationed through public distribution system.			
RUS	Private and relatively fragmented.	Dominated by state-owned company in production and refining (40%), distribution (100%) and retail.	Dominated by state-owned company along the entire value chain.	State-owned companies control more than 60%.	Transmission under state control.
		Direct price control – *ad hoc* pricing: decrease gasoline prices in 2011 and provide diesel price discounts to farmers.	**Regulated prices at below-market rates** at wholesale and retail level for non-industrial consumers, **differentiated** by user category.		**Regulated prices, differentiated** by user category, region and technology.
		Regulated prices at below-market rates – price freeze for gasoline between Dec. 2011 and May 2012, temporary rationing of gasoline purchases in April 2011.	**Extraction tax with exemptions and reductions** for selected fields.		
		Extraction tax on crude oil, **exemptions and reductions** for selected fields.	**Export restriction:** export monopoly, monopoly lifted for LNG.		
		Export Tax on crude oil, gasoline, diesel and fuel oil, **exemptions and reductions** for selected fields.	**Export tax with exemptions and reductions** for selected fields.		

Table 1. **Main energy policies affecting producer prices of energy** *(cont.)*

	Coal	Oil and oil products	Natural gas	Electricity	
				Generation	Electricity output
ZAF	Privately owned. Prices set under long-term contracts between mining companies and major consumers (particularly Eskom); average price of coal is below current market prices.	Dominant position of state-owned company in production, other parts of the value chain are more diversified. **Price ceiling** for LPG and kerosene. **Price smoothing:** basic price for gasoline, kerosene and diesel set each month, difference to market price (+/-) covered by fund.	**Regulated prices at below-market rates – price ceiling** for piped based on weighted fossil fuel basket.	Dominant position of state-owned company.	**Regulated prices, differentiated** by consumer category and region. Free basic electricity policy.

Glossary of terms used in Table 1	
Direct price control	
Ownership	Direct ownership of companies at various levels along the supply chain, increases influence on pricing policy.
Ad hoc	Prices are adjusted at irregular intervals without a prescribed formula.
Price regulation or support	
Below-market	Regulating prices at below-market rates decreases user prices.
Above-market	Regulating prices at above-market rates ensures a certain profit margin for producers.
Uniform	Charge same price for all consumers.
Differentiated	Differentiated retail prices by user category or region (includes cross-subsidies).
Cash transfers, vouchers, earmarked funds	Decrease prices paid by all (uniform) or selected (differentiated) users.
Price freeze	Fix prices at the level of a certain date, sometimes for an unknown time period.
Price band	Regulated maximum and minimum prices, cannot be exceeded or undercut.
Price ceiling	Regulated maximum price, cannot be exceeded.
Price smoothing	Prices change according to a formula based on selected variables, sometimes automatic.
Price monitoring	Monitor prices, often via regularly publishing prices on government websites.
Subsidised production inputs	Conceptually similar to beneficial treatment under an extraction tax, subsidised production inputs decrease production costs.
Extraction tax	Levying tax on resource extraction increases the cost of this activity for producers. Beneficial treatment can be provided through tax exemptions or reductions.
Import tax	Levying tax on imports increases the price of imports relative to domestically produced goods.
Domestic sales mandate	Obliges companies to sell a proportion of their production in the domestic market, possibly at below-market prices.
Subsidised imports	Subsidising imports decreases their price on the domestic market.
Export tax and export restrictions	Creates a wedge between world and domestic prices, discouraging exports and decreasing domestic prices. Beneficial treatment can be provided for selected producers or fields through exemptions and reductions.

Table 2 lists the standard VAT rates in 40 of the 41 countries analysed[3] and the differential rates that apply to energy products in these countries.[4] Standard VAT rates differ substantially among these countries, ranging from 8% in Japan and Switzerland to 27% in Hungary. Out of the 40 countries considered, 21 are members of the European Union (EU), which requires member countries to apply a minimum standard VAT rate of 15%, while allowing one or two reduced rates of not less than 5% to apply to specified goods and services.[5] A number of derogations are in place that allow certain member states to continue charging differential VAT rates in addition to EU policy.

Table 2. Differential VAT rates on energy products in selected partner economies and OECD countries, 2014

	Standard VAT rate (%)	Differential VAT rate for energy (%)	Energy product subject to differentiated rate
Australia	10	–	
Austria	20%, specific regional rate: 19%	10	Firewood
Argentina	21	27	Natural gas Electricity (except public lighting)
		10.5	LPG Butane Propane
Belgium	21	12	Coal and solid fuel obtained from coal Lignite and agglomerated lignite Uncharred petroleum coke used as fuel
		6	Electricity (residential) Firewood
Brazil	1. VAT ("Imposto sobre Productos Industrializados", IPI) on industrial products: 5-300%	1. Exempts energy products	
	2. State sales tax (ICMS): 17-19%	2. Natural gas: 12%, Electricity: 25%	Electricity Natural gas
Canada	5% standard rate, specific regional rates: 13%, 14%, 15%.	–	Many provinces have sales tax reductions for energy products.
Chile	19	–	–
China	17	13	Natural gas LPG Biogas (res.) Coal, coal gas (res) Charcoal (res)
		4	Electricity by qualified hydro-electric generators
Czech Republic	21	15	Heating Firewood
Denmark	25	–	
Estonia	20	–	
Finland	24	–	
France	20	5.5	Natural gas Electricity District heating
		10	Firewood
Germany	19	7	Firewood
Greece	23	13	Natural gas Electricity District heating Firewood
Hungary	27	5	District heating
Iceland	25.5	–	Electricity and fuel oil used for the heating of houses and swimming pools
Israel	18	–	
Ireland	23	13.5	Energy for heating and light Natural gas Electricity Firewood Heating oil
India	Subnational sales taxes or VAT at 5-33%	4	Coal Crude oil Aviation fuel LPG for domestic use

Table 2. **Differential VAT rates on energy products in selected partner economies and OECD countries, 2014** *(cont.)*

	Standard VAT rate (%)	Differential VAT rate for energy (%)	Energy product subject to differentiated rate
Indonesia	10, government can vary the rate from 5 to 15%	Exempt	Electricity (res. < 6 600 Watt) LPG (3 kg cylinders) Crude oil, natural gas (unprocessed), coal (unprocessed)
Italy	22	10	Combustible gas for cooking Natural gas Electricity Firewood
Japan	8% (since April 2014)	–	
Korea	10	–	0% supply of mineral oil used for certain purposes in agriculture
Luxembourg	15	12	Solid mineral fuels Wood for fuel use (not for heating) Heat and air conditioning
		6	Natural gas Electricity Firewood LPG
Mexico	16	–	
Netherlands	21	–	
New Zealand	15	–	
Norway	25	–	Electric power and energy supplied by alternative sources in the counties of Finnmark, Troms and Nordland
Poland	23	8	Firewood
Portugal	23	13	Diesel (agriculture)
Russia	18	–	
Slovak Republic	20	–	
Slovenia	22	–	
South Africa	14	0 (zero rated)	Gasoline Diesel Kerosene
Spain	21	–	
Sweden	25	–	Aircraft fuel (kerosene)
Switzerland	8	–	
Turkey	18	–	
United Kingdom	20	5	Fuel and power for domestic and charity use

1. The *Imposto sobre Productos Industrializados* is a mix of a VAT and an excise tax levied on local and intrastate sales transactions of manufactured goods, at rates depending on their classification in the Harmonized Commodity Description and Coding System (HS) by the WCO. Subsequent manufacturers can take credit against IPI liability equal to the IPI paid by its suppliers.

Source: OECD, based on KPMG – VAT essentials (several dates) (selected partner economies); OECD (2014a) (OECD countries), Argentine Ministry of Finance (2013) (Argentina).

Twenty-one countries do not apply a differential VAT rate to energy products. Among the nineteen countries that do, with two exceptions, the rates are concessionary. Argentina levies VAT at a rate higher than the standard rate on some energy products, while Brazil's state sales tax levies a higher rate on electricity.[6] In the seventeen countries which have reduced or zero rates on energy products, the reduced rates are either set at approximately half the standard VAT rate or are substantially reduced to rates between 4% and 7%. Reduced or zero VAT rates are most frequently applied to electricity (13 countries), firewood (10), natural gas (9), LPG (4), district heating (4), heating oils (3), coal (3) and kerosene or aviation fuel (3), crude oil (3) diesel (2) and gasoline (1). Differential rates may apply only to specific users, e.g. all or some households, or small businesses.

One possible reason for reduced rates is policymakers' concern that low-income households spend a relatively larger share of their income on energy.[7] For example, countries with lower rates on residential heating fuels may place a relatively high weight on the ability of lower income households to afford heating fuels. To the extent this is true – and an analysis for 21 OECD countries shows it is less true for lifetime income as approximated by expenditures than for a snapshot of income at one point in time (OECD, 2014c) – it is not clear that VAT is the best instrument to address equity considerations, particularly in countries with broad, well-developed income taxation and social security systems, which may allow better targeting of support than the VAT system.

Among the countries considered, only Indonesia exempts residential electricity (and small LPG cylinders) from VAT. Unlike reduced or zero rates, which allow businesses to reclaim VAT paid on inputs, exemptions break the staged VAT payment system and introduce a cascading effect, as the non-deductible tax on inputs is embedded in the subsequent selling price and is not recoverable by taxpayers further down the supply chain. South Africa is the only country among those considered which has zero-rated some oil products (gasoline, diesel and kerosene).

Reducing VAT rates selectively for energy products counteracts the intention to increase the relative end-user prices of energy (for environmental or for revenue raising reasons). The effect of differential VAT rates on energy on the relative prices of energy is particularly pronounced when the differential rates apply only to energy products or to only a few additional products. By contrast, if the overall VAT system is characterised by strong differentiation of rates for broad sets of consumption items, then the impact of VAT differentiation on the relative prices of energy products is less easily established, but it will be weaker in general. OECD (2014a) provides details of differential VAT rates across all products. There is no apparent general pattern that countries with differentiated rates for energy products also allow differentiated rates for other goods. The degree of relative price differentiation for energy products through differentiated VAT rates is country-specific.

1.4.4. Carbon trading mechanisms

Like taxes, carbon emission trading schemes are a market-based measure that can be used to price carbon. Instead of taxing carbon emissions, governments can introduce an emission trading scheme by capping emissions and introducing tradable emission permits. Tradable carbon emission permits are similar to taxes in that they confront carbon emitters with a cost per unit of carbon emitted, equal to the price of a permit, and in that they allow the same flexibility in responses to reduce emissions. If the permits are auctioned instead of grandfathered or otherwise distributed at no cost, then public revenue is generated and the similarity between trading mechanisms and taxes is stronger. Trading schemes differ from taxes in that the price of tradable permits fluctuates with economic conditions (while the level of emissions does not change as long as the cap is not changed), whereas with taxes the cost of emitting a unit of carbon will not change with economic conditions (but the level of emissions will). However, accompanying measures can limit the range of price fluctuations under a trading scheme, in which case the difference between auctioned tradable permits and taxes becomes still smaller. Ultimately, the difference between the two approaches can become a matter of practical detail, and both approaches can efficiently price carbon.

The World Bank (2014a) estimates that currently about 12% of global greenhouse gas emissions are subject to an explicit carbon price through various mechanisms in around 40 countries and 20 subnational jurisdictions. In 2014, ETS covered more than 7% of global emissions. The 41 countries considered in this report have implemented a range of subnational, national and regional emission trading schemes (ETS), with others scheduled or planned for implementation. As observed in this short overview,[8] the design features of these schemes differ widely.

The EU ETS, operational since 2005, is the largest and longest-operating carbon emissions trading system. While historically most permits were grandfathered to emitters, the third trading phase will feature an increased proportion of auctioned permits. Prices continue to be relatively low, due to considerably slower economic activity after 2007 and also to interactions with other carbon abatement policies in EU member countries. Since the repeal of the Australian carbon pricing scheme in mid-2014, three national ETS exist in the countries considered. In New Zealand, trading started in 2008 (though emissions are uncapped). Switzerland introduced mandatory trading for energy-intensive firms in 2013, and a Korean ETS commenced in January 2015. This scheme started out with free allocation of emissions permits and auctioning will be slowly phased in starting in 2018. A national ETS is due to be introduced in China within the next few years, tentatively scheduled for 2016.

Several subnational emission trading schemes exist. The Californian cap-and-trade system started with voluntary participation in 2012 and obligatory compliance from 2013. The Californian system covers emissions from transport, agriculture, and households in addition to emissions from the industrial sector and power generation. Since January 2014, it has been linked to the ETS in Québec and there are efforts to to align emissions reduction policies, including carbon pricing, among several North American states in the context of the Pacific Coast Action Plan on Climate and Energy.

China has also introduced pilot ETS programs in seven cities and regions. The total emissions allocations of these pilot programs make China the second largest carbon market in the world after the EU ETS in terms of carbon emissions covered. While most pilot schemes use historical emissions or emissions intensity as a base for the free allocation of allowances, Guangdong is the first pilot scheme to have used auctioning as an allocation mechanism. This pilot scheme is also the largest among China's schemes and has the highest allowance prices (Munnings et al., 2014). The design of a national ETS in China, scheduled to be introduced between 2016 and 2020, will be based on the lessons learnt from the pilot schemes.

Other regional or partial trading schemes exist in Japan and in Brazil. In Japan, the Tokyo, Saitama and Kyoto trading schemes cover 8% of Japan's emissions, but only the first two mandate participation. While progress on the development of a national ETS in Brazil has stalled, emission trading has started among 22 companies, all members of the Businesses for Climate Platform.

2. Structure of the graphical profiles, methodology and data sources

The graphical profiles ("profiles") for each of the seven selected partner economies included in this report show the composition of energy use in each country covered and the effective rate of tax on various types of energy use. Both energy use and tax rates are shown, alternately, in terms of energy content and carbon content. The profiles also depict reported tax expenditures, showing both the actual tax rate and the benchmark rate against which the value of the preference is calculated.

This section provides an overview of the methodology, assumptions, and data sources underlying the profiles. Further details on these can be found in Annex A, or, where specific to a particular country, in the relevant country chapter.

2.1. Tax base – energy use

The horizontal axis of each graphical profile shows all final use of energy by businesses and individuals, including the net energy used in energy transmission and in the transformation of energy from one form to another (e.g., crude oil to gasoline, coal to electricity). Energy use has been grouped into three broad categories: transport, heating and process use, and electricity. These three categories have been further disaggregated for each country, generally reflecting the particular tax base of that country. The subcategories therefore differ between countries depending on the nature of the fuel, its user, or its use.

All forms of energy are converted into common units of energy (GigaJoules – GJ) and carbon emissions (tonnes of CO_2), using standard conversion factors. In the first graphical profile for each country, fuel quantities are expressed in terms of energy value (in GigaJoules). In the second graphical profile, the quantities of the various energy sources are expressed in terms of the carbon emissions associated with their use (in tonnes of CO_2).[9] The re-expression of tax bases in terms of carbon content permits a focus on the structure of taxation with respect to one purpose for which fuel can be taxed – to reflect the social cost of carbon emissions.

Electricity is different from most of the other energy types shown in that it is a secondary energy product which must be generated by use of some primary energy (e.g., coal, natural gas, nuclear power, and hydro). The electricity category of the graphical profiles therefore show the energy content or carbon emissions of the underlying primary fuels used to generate the electricity domestically rather than of the electricity itself.

Data on energy use is taken from the *Extended World Energy Balances* (IEA, 2011).

2.2. Tax rates and tax expenditures

On the vertical axis, the graphical profiles show the tax rates and related tax expenditures that apply to energy use as at 1 April 2012 (except for Australia and Brazil, which are shown as at 1 July 2012, and South Africa, which is as at 4 April 2012). The taxes covered are those levied on a physical measure of energy product consumed, whether quoted in a monetary amount per unit of fuel (per-unit taxes), or as a percentage of the sales price (*ad valorem* taxes). In contrast to the 2013 report *Taxing Energy Use – A Graphical Analysis* (OECD, 2013b), *ad valorem* taxes (i.e. not including VAT) and related tax expenditures, set by reference to the value of products are included in the graphical profiles in this report. This is because in several of the selected partner economies, non-VAT taxes on energy products levied as a percentage of the sales price are more commonly used (for example, in Argentina, India and Indonesia). Where taxes on energy are quoted as a percentage of the sales price, price information was 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.

Taxes that apply to a very broad range of goods (such as value added and retail sales taxes) are not included in the graphical profiles on the basis that since they apply equally to a wide range of goods, they do not change relative prices. However, where an energy product is subject, for example, to a concessionary rate of VAT, the concession would affect relative prices. In order to gauge to what extent VAT rate differentiation takes place, VAT and concessionary VAT rates on energy products are discussed in Section 1.4.2. Also excluded are taxes that that may be related to energy use but that are not imposed directly on the energy product (such as vehicle taxes, road user charges or billing charges and taxes on emissions such as NO_x and SO_x) and those which do not have a fixed relationship to fuel volume.

Taxing Energy Use – A Graphical Analysis (OECD, 2013b), as well as this report, consider the impact of energy taxes on the user price of energy from a common base of zero. When taxes are added to producer prices of energy which align broadly with production costs, the end user price aligns with social costs if the tax approximates external costs. However, some of the countries analysed in both this report and in *Taxing Energy Use – A Graphical Analysis* (OECD, 2013b) apply price support measures that keep producer prices below production costs. Countries can also apply production taxes, royalties and other levies on the extraction or harnessing of energy resources, or levy export taxes, all of which may affect producer prices.

Non-tax pricing policies are not shown in the graphical profiles since it was not possible to obtain detailed information on relevant prices for all products and users, as well as on those prices which would apply in the absence of these policies. Furthermore, production and export taxes are usually not directly imposed on the end-users of energy products, and the rate to which they are passed through can vary largely.

Tax rates on the use of energy are re-calculated as effective tax rates per GigaJoule of energy (in the first graphical profile for each country) and per tonne of CO_2 emissions (in the second graphical profile). Tax rates are shown in local currency on the left-hand axis of the graphical profile, and in Euros on the right-hand axis (converted by reference to the average market exchange rates over the 12 months ending August 2012). The tax rate applying to each fuel is shown on the graph as a shaded bar across the portion of energy use or carbon emissions (the tax base) to which the particular rate applies. The shaded rectangle beneath this bar is an approximation of the revenue raised by the tax – the rate multiplied by the base.

Taxes levied on electricity consumption have been shown as effective taxes on the fuels used to generate the electricity. In cases where a common nominal tax rate is applied to all electricity consumption, the effective tax rate on each underlying energy source (e.g., coal, natural gas, hydro) used to generate the electricity is shown. In cases where different rates of nominal electricity tax apply to consumption in different sectors (e.g., residential, commercial, industrial), for each sector, the effective tax rate shown is that of the "average" basket of fuels used to generate electricity in the country. Notably, when there is a general tax on electricity consumption that applies regardless of the generation source, and if carbon energy is a small proportion of the generation mix, the effective tax rate on carbon thus calculated will be high. A tax on electricity consumption that does not distinguish between electricity from carbon sources and electricity from non-carbon sources does not send an effective price signal about the use of carbon.

The graphical profiles also show tax rebates, credits and other tax expenditures that are reported by the country concerned. In the graphical profiles, the area of the light grey shaded rectangles is an estimation of the amount of the tax expenditure. In addition, however, the top of this rectangle is the benchmark or "normal" level of tax from which the measure is a departure while the bottom of the rectangle is the net level of tax that applies as a result of the concession. In the case of tax expenditures from *ad valorem* taxes, the top and bottom of the rectangle show the *ad valorem* benchmark tax treatment and the net level of *ad valorem* tax treatment of the energy product, respectively, converted into a per-unit tax rate.

In this respect, the graphical profiles are a complement to analysis that focuses on the value of tax expenditures, such as the OECD's *Inventory of Estimated Budgetary Support and Tax Expenditures for Fossil Fuels* (OECD, 2013a, 2015, forthcoming). By showing tax expenditures in context, the graphical profiles can facilitate discussion about appropriate tax benchmarks for different fuels, uses and users.

Given the economy-wide scale of the profiles, they do not show certain small details of tax bases, rates and preferences. Where multiple energy taxes or tax components apply to the same base, they have been aggregated. Where important, energy taxes at the sub-national level are indicated for an illustrative group of states or provinces.

Some countries price carbon emissions for some sectors through emission permit trading. The graphical profiles note the interaction of tax systems with emission trading systems (ETS) where applicable, but does not include the price provided by these schemes in the effective tax rates shown. For example, the graphical profiles of countries participating in the European ETS shown in *Taxing Energy Use – A Graphical Analysis* (2013b), distinguish subcategories of energy use which are entirely or partially covered by the ETS. Of the selected partner economies, China has implemented emissions trading on a subnational basis. A description of the seven pilot schemes can be found in the country chapter on China in Part II of this report. However, the trading systems are not shown in the graphical profiles for China as they were not in operation at the time to which these profiles apply.

The underlying data shown in the graphical profiles in this publication, as well as those presented in the previous publication of *Taxing Energy Use* (OECD, 2013b) is used to compile a comparable database of effective tax rates on energy, and energy use for all countries. This database is highly disaggregated by fuel and user and is used to calculate average effective tax rates across a wide range of fuels and users, weighted by the amount of energy subject to each rate. It therefore provides a systematic and comparable basis of analysis across the group of 41 countries. In order to provide some insight into the variety of policy measures that affect producer prices of energy, a summary of pricing measures applied in the selected partner economies is presented alongside their graphical profiles and the main policies affecting producer prices were discussed in Section 1.4.

Information on taxes has been taken from country-specific sources, from the OECD/EEA database on instruments used for environmental policy (OECD, 2014b), from Kojima (2013), and in some cases from country analysis briefs by the Energy Information

Administration (EIA, several years). Tax expenditure information is primarily from OECD (2013a). For Argentina, tax expenditures were retrieved from the Argentinean Ministry of Finance's report on tax expenditures (Argentina Ministry of Finance, 2012).

Further information on the methodology applied in this report can be found in Annex A.

3. Energy use and taxation: Results from the analysis

The graphical profiles presented in the second part of this report provide a number of insights into the taxation of energy use in Argentina, Brazil, China, India, Indonesia, Russia and South Africa. This section uses the data presented in the seven graphical profiles for these countries, together with the information presented in the graphical profiles for OECD countries in *Taxing Energy Use – A Graphical Analysis* (OECD, 2013b) to analyse energy use and taxation patterns across all 41 countries. Together, these countries account for just over 80% of the world's energy use and for 84% of the world's carbon emissions from energy use.

This section considers energy use patterns in each country before examining energy use and taxation in each of the three broad categories of energy use shown in the graphical profiles in more detail: transport, heating and process use and electricity. Finally, the section discusses the economy-wide levels of energy taxation in each country and puts the effective tax rates on energy use into a broader framework, considering energy use and emissions per capita and per unit of GDP, drawing on the context provided in Section 1.3.

The graphical profiles demonstrate that the energy landscape across these 41 countries is quite diverse both in use and in tax patterns. The uses and sources of energy are vastly different between countries. Likewise, countries tax energy in many ways, with variations in tax bases, tax levels, rebates and reported tax expenditures. The patterns and levels of energy taxation vary considerably both across countries and within individual countries for different uses and sources of energy. Countries therefore differ strongly in how taxes affect the prices of energy use, sending very different price signals in respect of different fuels and fuel uses.

3.1. General trends in energy taxation across countries

3.1.1. Uses and sources of energy

Across the 41 countries considered, patterns of energy use vary significantly, both in terms of the sources and uses of energy. Data on energy use and tax rates in these countries is taken from the detailed graphical profiles of energy use and taxation in the selected partner economies shown in this report and in the OECD countries shown in OECD (2013b).

The graphical profiles show energy use divided into three broad categories: transport energy, energy used for heating and process purposes and energy used in electricity generation. The proportion of energy used in each of these categories varies considerably between countries. When considered as a share of carbon emissions from energy use, the relative contribution of each of these three categories will also be dependent on the respective carbon intensity of the fuels used in each category. For example, in countries that rely more strongly on renewable sources of electricity generation, the share of electricity generation energy in total carbon emissions, all else being equal, will be smaller than its respective share in total energy use. Differences in the fuel mix of each country mean that for some countries the proportions of each category differ considerably in terms of energy use as compared to carbon emissions from energy use.

Figure 2 shows the proportion of energy use (left panel) and CO_2 emissions (right panel) in each of the three main categories for each of the 41 countries considered. Of the three categories of energy use, the proportion of transport to total energy use and to emissions from energy use ranges from 6% of total energy use in Iceland (but 43% of carbon emissions from energy, due to the high volume of renewables used in electricity generation), to 65% of energy use (67% of carbon emissions from energy) in Luxembourg. However, both of these countries can be seen as outliers. Luxembourg has a very high level of transport energy both relative to other energy use and relative to other countries' shares of energy use (for example, Slovenia, the second highest, uses only 33% of its energy for transport purposes, even though it also attracts fuel tourism

Figure 2. **Composition of energy use and of CO_2 emissions by use**

Note: Composition of energy use (left panel) and of CO_2 emissions (right panel) by use.

Source: OECD calculations based on energy use data for 2009 from IEA (2014), *IEA World Energy Statistics and Balances* (database), Doi: http://dx.doi.org/10.1787/data-00513-en.

StatLink http://dx.doi.org/10.1787/888933205556

due to comparatively lower transport rates), due to the high volume of motor fuel sales to non-residents. Iceland's small share of transport energy is due to the extremely high amount of energy used in electricity generation (71%), which is well above the share of electricity generation energy in total energy in other countries.

Excluding these outliers, China and India have the lowest transport shares among the 41 countries considered, at 8% of total energy use each (6% of carbon emissions from energy) and South Africa and Russia also have comparatively low shares of transport energy relative to other countries, at 13% and 14% respectively (10% and 14% of carbon emissions from energy). The unweighted country average share of transport energy to total energy is 22% and the average level of carbon emissions from transport energy is 25% of total energy emissions, across all 41 countries considered. With the exception of Brazil (28% of energy and carbon emissions from energy), the selected partner economies all have comparatively low shares of energy use in transport, although in China, Indonesia and India the share of transport energy to total energy use has grown rapidly since 1990 (IEA, 2011).

The share of energy used in the heating and process category ranges from 20% of energy use (14% of CO_2 emissions) in Israel to 56% in Indonesia (37% of CO_2 emissions) and all but eight countries use between 35% and 50% of energy for heating and process purposes. Heating and process use accounts for 41% of total energy use on an unweighted country average and for 48% of total carbon emissions from energy. The selected partner economies typically use larger than average shares of energy use for heating and process purposes, equating to over 50% of total energy use in all selected partner economies except South Africa (44%).

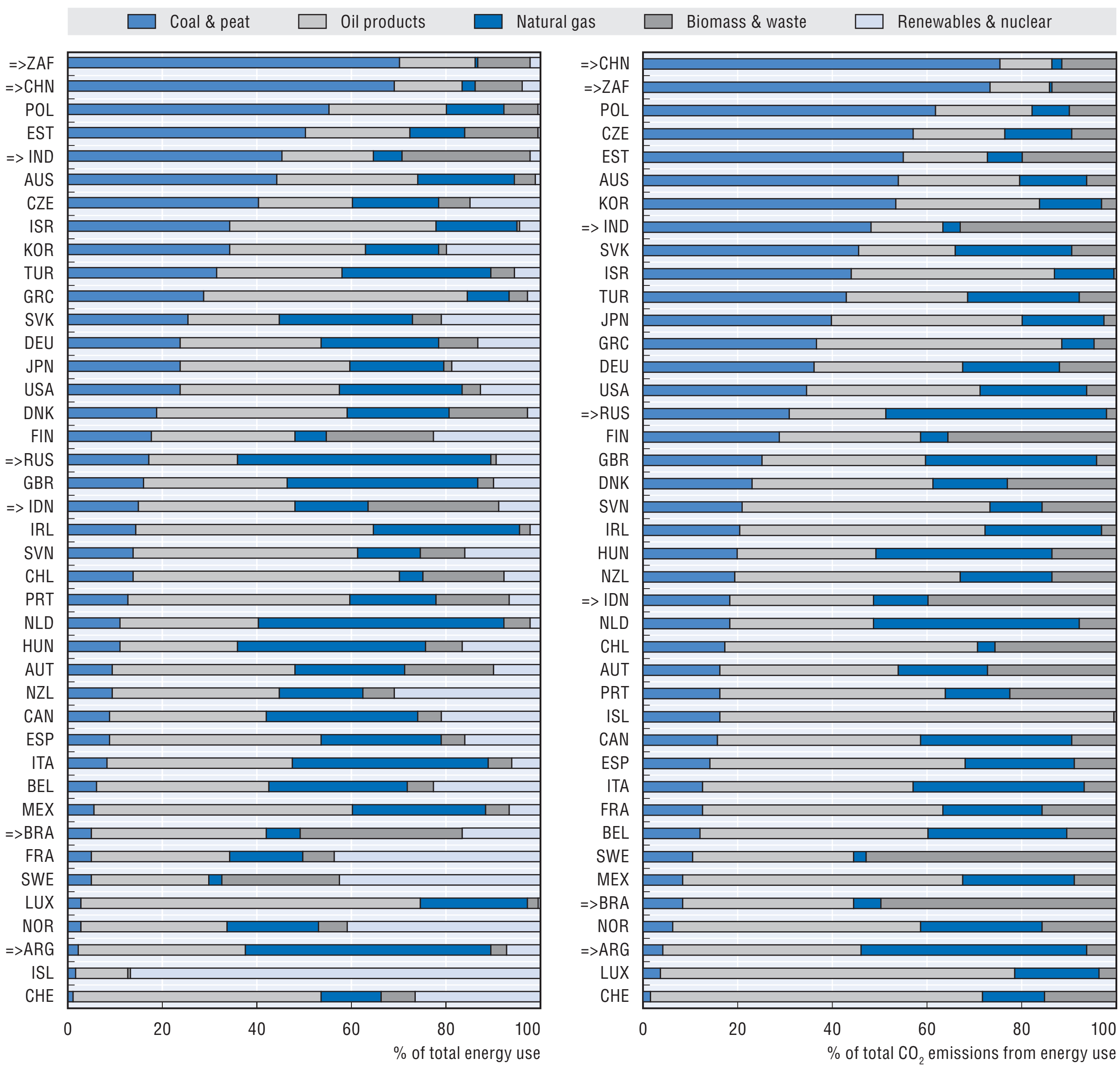
The proportion of energy used in electricity generation ranges from 20% of total energy in Austria to 53% in Korea, with a simple unweighted country average of 37%, again excluding Iceland and Luxembourg. Within the selected partner economies, the share of energy use in electricity generation is lower, varying from 22% in Brazil to 43% in South Africa. However, when considered in carbon terms, the picture is significantly different due to the high diversity in energy sources for electricity generation in different countries. Excluding outliers, Switzerland has the lowest share of carbon emissions from energy used in electricity generation (4%); while Israel has the highest at 58%. Countries that use significant shares of renewable or nuclear electricity generation have low proportions of carbon emissions from energy use in electricity generation, notably Brazil, France, Norway and Switzerland.

The sources of energy also vary substantially across countries. Figure 3 disaggregates energy use (left panel) and CO_2 emissions from energy use (right panel) into five major fuel groups: coal and peat, oil products, natural gas, biomass and waste and renewables and nuclear.

Considering the whole range of energy used in each economy, oil products are the primary source of energy, accounting for 34% of energy use and 39% of carbon emissions from energy use (unweighted country averages). However, the proportions in individual countries range from 11% in Iceland to 72% in Luxembourg, again reflecting the unusual characteristics of energy use in these countries. Even excluding these outliers, there is still a considerable range, from 14% in China and 16% in South Africa to 57% in Chile. Oil products are the largest source of energy in 21 countries. The share of coal in the economy-wide energy mix also varies considerably between countries, accounting for 1%

of all energy in Switzerland to 70% in South Africa. Coal is the dominant source of energy in 9 countries: Australia, China, Estonia (oil shale), India, Israel, Korea, Poland, Turkey and South Africa. On an unweighted country basis, natural gas accounts on average for 21% of energy, although the range between countries is more limited than that of coal or oil. Only Argentina, the Netherlands and Russia derive more than 50% of total energy from natural gas and it is also the dominant fuel (although with a share of less than 50%) in Italy, Hungary, the Slovak Republic and the United Kingdom. For four countries, renewables or nuclear energy is the largest single source of energy (France, Iceland, Norway and Sweden).

Figure 3. **Composition of energy use and of CO_2 emissions by fuel**



Note: Composition of energy use (left panel) and of CO_2 emissions (right panel) by fuel.

Source: OECD calculations based on energy use data for 2009 from IEA (2014), *IEA World Energy Statistics and Balances* (database), Doi: http://dx.doi.org/10.1787/data-00513-en.

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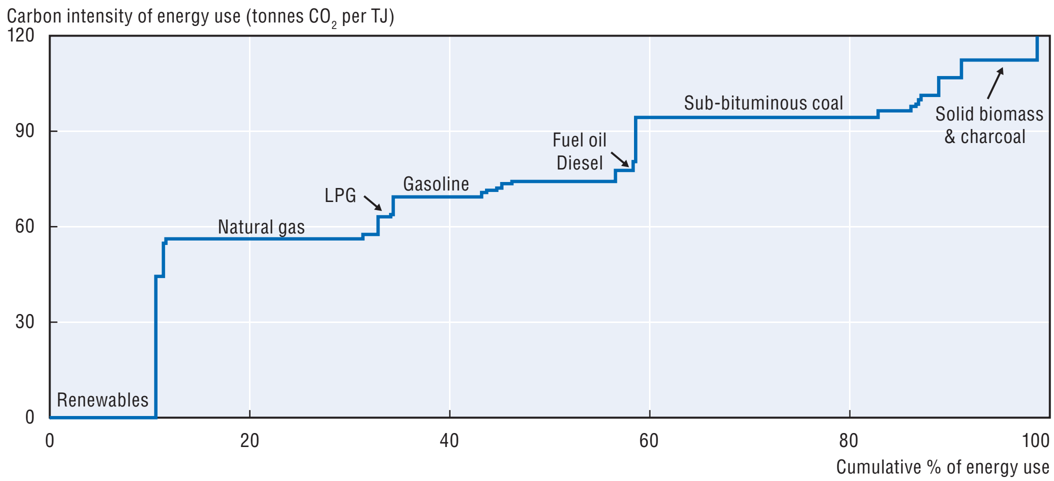
Figure 4 shows the amount of energy use and the carbon intensity of fuel use across all 41 countries. The horizontal axis shows the cumulative proportion of energy use from each fuel, ranked from those with the lowest carbon intensity to the highest. The vertical axis shows the amount of CO_2 emitted when a TJ of each fuel is consumed.

Figure 4. **Carbon intensity and amount of energy use by different fuels across all 41 countries**



Source: OECD calculations based on energy use data for 2009 from IEA (2014), *IEA World Energy Statistics and Balances* (database), Doi: http://dx.doi.org/10.1787/data-00513-en. Conversion factors for different fuels may vary slightly between countries.

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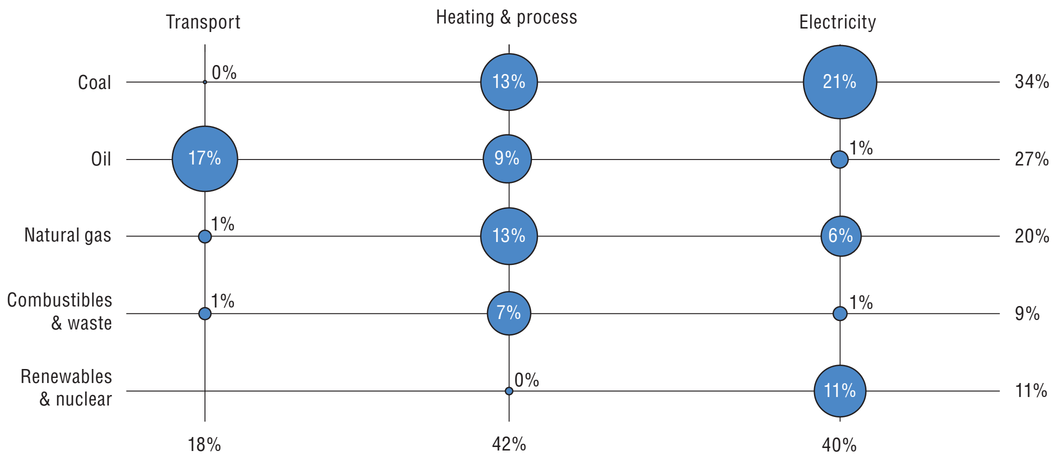
Renewable sources of energy (other than biofuels) and nuclear account for 11% of all energy use across the 41 countries considered and have no carbon emissions per unit of energy use. Natural gas, which represents 20% of total energy use by these countries, has around 56 tonnes of CO_2 per TJ. Oil products range from 63-75 tonnes of CO_2 per TJ, with the most commonly used oil products, gasoline (9% of all energy use) and diesel (10%), ranging from 69 to 74 tonnes of CO_2 per TJ. The most heavily-used coal products have a carbon intensity which ranges from 80 to100 tonnes of CO_2 per TJ and the most commonly used form of coal, sub-bituminous coal, has a carbon intensity of 96.1 tonnes of CO_2 per TJ. Although not commonly used, certain coal gases have higher carbon intensities, of up to 260 tonnes of CO_2 per TJ. Solid biomass and charcoal (7% of energy use, with the vast majority being derived from biomass), has a carbon intensity of around 110 tonnes of CO_2 per TJ. Other than solid biomass and charcoal, combustibles and waste energy products are not clearly identifiable on Figure 4, due to their small amounts of use, and have widely varying carbon intensities per unit of energy.

However, within each of the different categories of energy use lie vastly different fuel mixes. The amount of energy use from different sources by different users is summarised for all countries, on a weighted average basis, in Figure 5. When all energy use in the 41 countries is considered as a whole, transport energy is dominated by oil products (94% of all transport energy in the 41 countries considered), particularly by gasoline and diesel; consequently, transport uses the greatest share of oil products (63% of all oil products), relative to the other use categories. For heating and process energy, the fuel mix is more diverse, with coal and natural gas each accounting for 31% of heating and process energy and oil products (21%) and combustibles and waste (17%) are also significant sources of heating and process energy across the 41 countries considered. In the electricity category, coal is the primary source of energy used to generate electricity (53% of all energy used to generate electricity across all 41 countries considered), with renewables and nuclear energy accounting for just over 27% of energy used in electricity generation. The electricity category uses the highest proportion of coal (62%) of any use category and also uses almost all renewable and nuclear energy (98%).

Figure 5. **Sources and uses of energy for total energy use across all countries (weighted average basis)**



Source: OECD calculations based on energy use data for 2009 from IEA (2014), *IEA World Energy Statistics and Balances* (database), Doi: http://dx.doi.org/10.1787/data-00513-en. Percentages indicated in circles may not sum to the totals indicated due to rounding.

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Each of the different fuel groups has different characteristics in terms of carbon emissions and local air pollutants associated with a GigaJoule of energy. The carbon intensity of energy use varies with each fuel; while these factors may vary slightly between countries, they are roughly consistent across fuels. Broadly speaking, coal has the highest level of carbon emissions per unit of energy, with different coal products ranging from 80 to 260 tonnes of CO_2 per TJ. Oil products have a slightly lower carbon intensity per unit of energy, ranging from 63-75 tonnes of CO_2 per TJ. Natural gas has a lower carbon intensity, at around 55 tonnes of CO_2 per TJ. The carbon intensity of renewables and waste differs markedly by source: some forms of waste or biomass have carbon intensities in the region of those of coal, whereas others, particularly for gaseous biomass, are lower than those for natural gas. Finally, renewables from many sources, such as hydro, solar, geothermal or wind, as well as nuclear, have no carbon emissions per unit of energy.

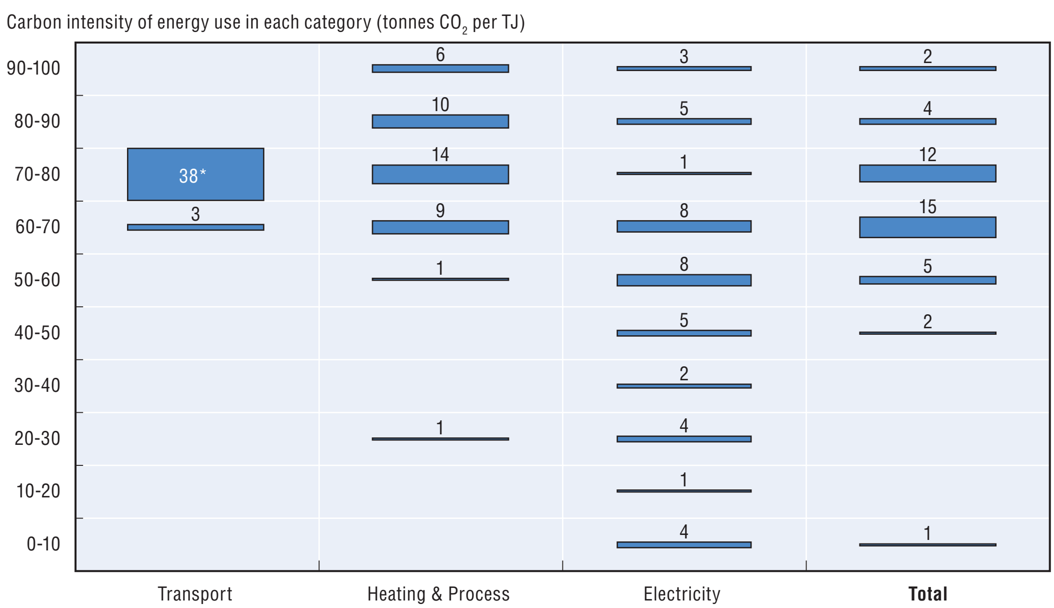
As each of the three categories of energy use have different fuel mixes, their relative carbon intensities, defined as the amount of carbon emitted for each unit of energy consumed in each category, differ. As energy use in transport is dominated by oil products, the carbon intensity of transport energy in most countries is very similar to that of oil products used in this category: 36 countries have a carbon intensity of energy used in transport of between 70 and 73 tonnes of CO_2 per TJ of energy use and the range is only from a minimum carbon intensity of 66 tonnes of CO_2 per TJ in Russia, which uses a comparatively high share of natural gas in transport, to 73.2 tonnes per TJ in Belgium.

Heating and process use energy is more diverse, ranging from coal to natural gas, with varying proportions of each being used in each country. The carbon intensity of heating and process energy in each country is therefore more varied, ranging from 53 tonnes of

CO_2 per TJ in Israel, which uses the highest proportion of renewables in this category, to 100 tonnes of CO_2 per TJ in China, where heating and process energy is primarily derived from coal. The use of coal as a source of heating and process energy, particularly in larger economies, together with the comparatively small share of renewable energy sources in this category, means that the heating and process category has, on average, the highest carbon intensity of energy among the three use categories.

Across the countries considered, the electricity category has the most diverse range of carbon intensities per unit of energy, as the range of fuels to generate electricity on a per-country basis are the most diverse of any category. Several countries, including Australia, China, Estonia (oil shale) and South Africa use high proportions of coal in electricity generation; others, such as Luxembourg and Russia use natural gas as a primary source of electricity generation; and several, use high proportions of renewables (Brazil, Iceland, Norway and Switzerland) or nuclear (France). This results in highly varied carbon intensities of energy for electricity generation for different countries. The distribution of the carbon intensity of energy in each country for each of these categories is shown in Figure 6, where the height of the bars (and the labels) shows the number of countries at the different levels of carbon intensity per unit of energy.

Figure 6. **Distribution of the carbon intensity of energy use in each category by country (number of countries in each range in brackets)**



* In the transport column, at the level indicated as 70-80 tonnes CO_2 per TJ, all of the 38 countries are within a range of 70-73.2 tonnes of CO_2 per TJ.

Source: OECD calculations based on energy use data for 2009 from IEA (2014), *IEA World Energy Statistics and Balances* (database), Doi: http://dx.doi.org/10.1787/data-00513-en.

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3.1.2. Tax rates on energy across the 41 countries

Tables 3 and 4 show the effective tax rates on the average unit of energy (Table 3) and CO_2 emissions from energy (Table 4), disaggregated by major fuel types and fuel use categories. Across the 41 countries considered, the weighted average tax rate on a unit of energy is EUR 1.1 per GJ and EUR 14.8 per tonne of CO_2. However, the weighted average tax rates vary for energy from different fuels and for different users. On average, transport energy is taxed more highly than that derived from other fuels; at EUR 5 per GJ and EUR 70.1 per tonne of CO_2 (weighted averages). Heating and process energy and energy used for electricity generation are taxed at similar rates in both energy and carbon terms (at a weighted average rate of EUR 0.3 per GJ and EUR 3.1 and 3.4 per tonne of CO_2, respectively).

Table 3. **Weighted average effective tax rates on energy by fuel type and use (EUR per GJ)**

		Oil products	Coal and peat	Natural gas	Biofuels and waste	Renewables and nuclear	All fuels
	% of base	27%	34%	20%	9%	11%	100%
Transport use	18	5.20	0.00	0.12	3.74	0.00	4.96
Heating and process use	42	0.82	0.05	0.21	0.00	0.00	0.26
Electricity production	40	0.50	0.13	0.43	0.65	0.38	0.27
Total use	100	3.52	0.10	0.28	0.30	0.38	1.11

Source: OECD calculations for selected partner economies; OECD (2013b), *Taxing Energy Use – A Graphical Analysis*, Doi: *http://dx.doi.org/10.1787/9789264183933-en*, for all other countries. Tax rates are as of 1 April 2012 (except 1 July 2012 for AUS and BRA and 4 April 2012 for ZAF); energy use data is for 2009 from IEA (2014), IEA *World Energy Statistics and Balances* (database), Doi: *http://dx.doi.org/10.1787/data-00513-en*. Figures for CAN, IND and USA include only federal taxes.

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Table 4. **Weighted average effective tax rates on CO_2 from energy use by fuel type and use (EUR per tonne CO_2)**

		Oil products	Coal and peat	Natural gas	Biofuels and waste	All fuels
	% of base	26%	46%	15%	13%	100%
Transport use	17	72.89	0.00	2.13	51.84	70.05
Heating and process use	48	11.60	0.48	3.75	0.01	3.07
Electricity production	35	6.87	2.31	5.85	16.36	3.37
Total use	100	49.32	1.58	4.37	3.61	14.78

Source: OECD calculations for selected partner economies; OECD (2013b), *Taxing Energy Use – A Graphical Analysis*, Doi: *http://dx.doi.org/10.1787/9789264183933-en*, for all other countries. Tax rates are as of 1 April 2012 (except 1 July 2012 for AUS and BRA and 4 April 2012 for ZAF); energy use data is for 2009 from IEA (2014), IEA *World Energy Statistics and Balances* (database), Doi: *http://dx.doi.org/10.1787/data-00513-en*. Figures for CAN, IND and USA include only federal taxes.

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The higher tax rates on transport energy may be explained by the broader range of policy goals that governments address in this category, as well as by the use of transport energy taxes for revenue purposes. Although the contribution of energy to carbon emissions does not vary depending on its use, transport use of fuel is indirectly tied to other externalities, such as local air pollution, congestion, accidents and noise, and taxes on transport energy may be used as an indirect means of internalising these externalities. In addition, a number of countries formally or informally earmark revenue from transport energy taxes to fund infrastructure.

There is also an underlying diversity in how different fuels are taxed. Energy from oil products is taxed more heavily than energy from other sources. While part of this is explained by the higher tax rates applying to transport energy, which is almost exclusively derived from oil products, the same pattern of higher taxation of oil products holds within each of the other categories, with the exception of biofuels and waste used for electricity generation. Natural gas, biofuels and waste are taxed at lower rates, at EUR 0.3 per GJ and EUR 4.4 and 3.6 per tonne of CO_2. Energy from coal is taxed at the lowest rates in both energy and carbon terms, at EUR 0.1 per GJ and EUR 1.5 per tonne of CO_2. On average, coal used in the heating and process category is taxed at the lowest rates of all fuel and use combinations – at less than EUR 0.0004 per GJ and EUR 0.5 per tonne of CO_2 – while coal used in electricity generation is taxed at a slightly higher rate. The amount of coal used in transport, while taxed at very low rates, is negligible.

Some of these patterns are also observed in the selected partner economies. Transport energy is taxed more heavily than other forms of energy in all selected partner economies except Brazil, where between the suspension of the CIDE tax in June 2012 and its re-instatement in February 2015, transport fuels were *de facto* untaxed. Similarly, oil products, particularly those used in transport, are taxed at higher rates in all countries (except Brazil). Natural gas and coal are taxed at lower rates and are more frequently untaxed. Full results for these countries are set out in Annex B. Full results for OECD countries can be found in Annex B of OECD (2013b).

Figure 7 presents a graphical profile of average effective tax rates and energy use across the main fuel categories for total energy use across the 41 countries considered. Figure 8 shows the same information in terms of the carbon emissions from energy use in these countries. These figures show the higher tax rates applied to fuels in the transport category, particularly oil products, which account for almost all energy use and carbon emissions from this category. The average effective tax rates applied in the heating and process use and electricity categories are considerably lower, and there is variation within these categories for different fuels. In both the heating and process category and the electricity category, coal is taxed at lower rates than other fossil fuel sources of energy, with oil products facing the highest rate. The lower tax rate on coal is particularly pronounced in the graphical profile shown in carbon terms, due to the higher carbon intensity of coal. From an environmental perspective, the lower tax rates on coal do not reflect the social costs associated with its use. It has a greater carbon content, per unit of energy, and is also associated with higher levels of air pollutants (particularly sulphur dioxides and particulate matter, as well as smaller contributions from nitrogen oxides), although the level of air pollutants emitted per unit of energy varies with the location and height of emissions, as well as any control technologies used. However, in many countries the mortality and health costs associated with air pollution are significantly higher per TeraJoule of coal than per TeraJoule of natural gas, gasoline or diesel (Parry, 2014).

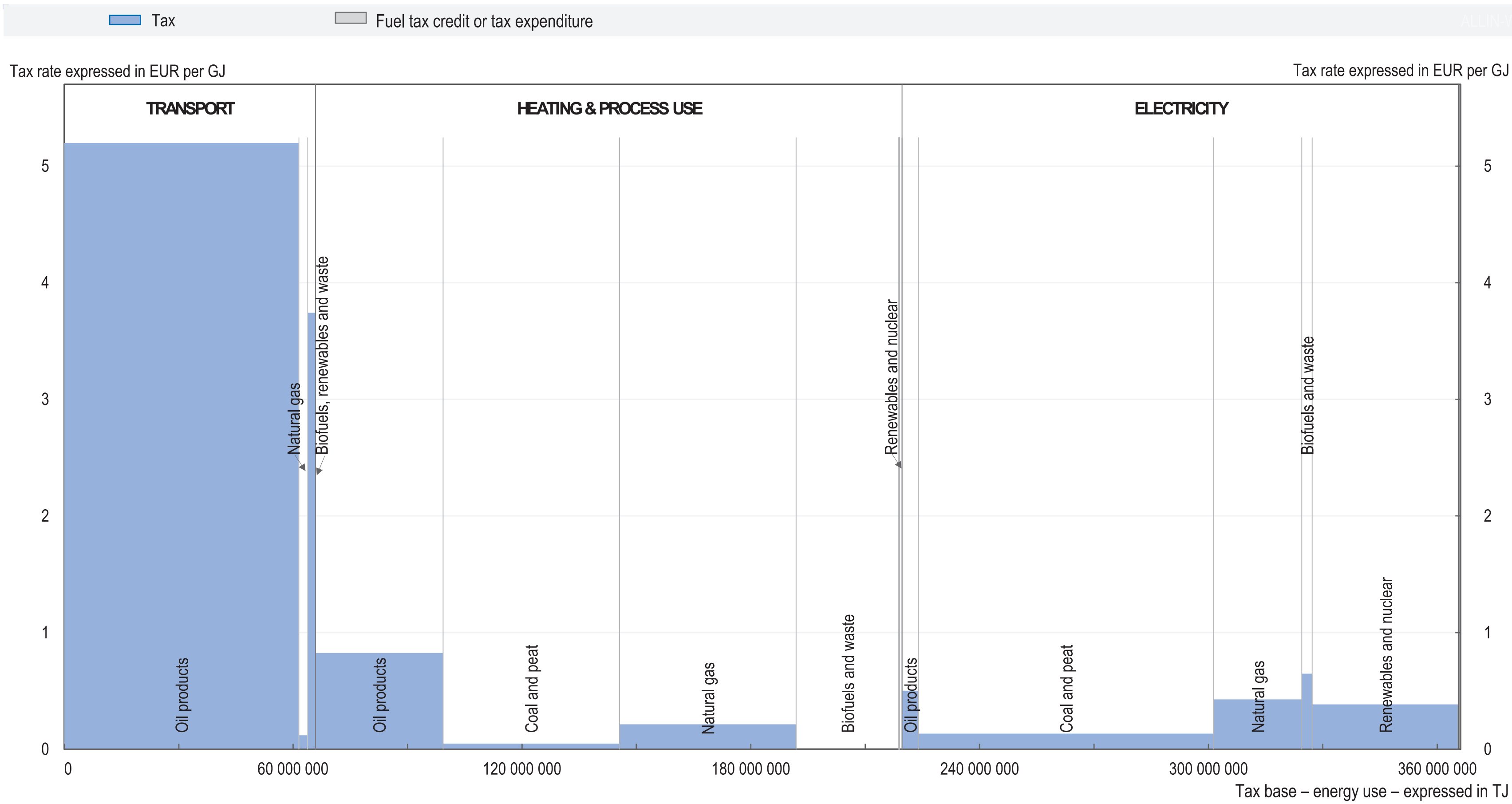
The contrast between the relatively high taxation in the transport category and the relatively low taxation in the heating and process and electricity categories is very evident from both graphical profiles. Equally evident in the graphical profiles is the variation in tax rates on different fuels within each of the three use categories. Sections 3.2 to 3.4 of this chapter examine these differences in treatment within each of the three broad use categories: transport, heating and process use and electricity generation.

3.2. Taxation of energy used in transport

3.2.1. Users and sources of transport energy

The transport category includes road transport and rail, marine and domestic air transport. Across the 41 countries considered, transport accounts for around one-fifth to one-quarter of energy use and a slightly higher proportion of carbon emissions from energy use, although in several countries, transport energy accounts for a lower proportion of both energy use and emissions. Road transport is the primary user of energy in this category in all countries, accounting for 87% of total energy use. However, as a result of the substantial tax rates highlighted above, it generates the vast majority of revenue from energy taxes in almost all countries.

Figure 7. **Graphical profile of energy use and taxation across all energy use in the 41 countries (weighted average basis)**



Source: OECD calculations for selected partner economies; OECD (2013b), *Taxing Energy Use – A Graphical Analysis*, Doi: http://dx.doi.org/10.1787/9789264183933-en, for all other countries. Tax rates are as of 1 April 2012 (except 1 July 2012 for AUS and BRA and 4 April 2012 for ZAF); energy use data is for 2009 from IEA (2014), *IEA World Energy Statistics and Balances* (database), Doi: http://dx.doi.org/10.1787/data-00513-en. Figures for CAN, IND and USA include only federal taxes.

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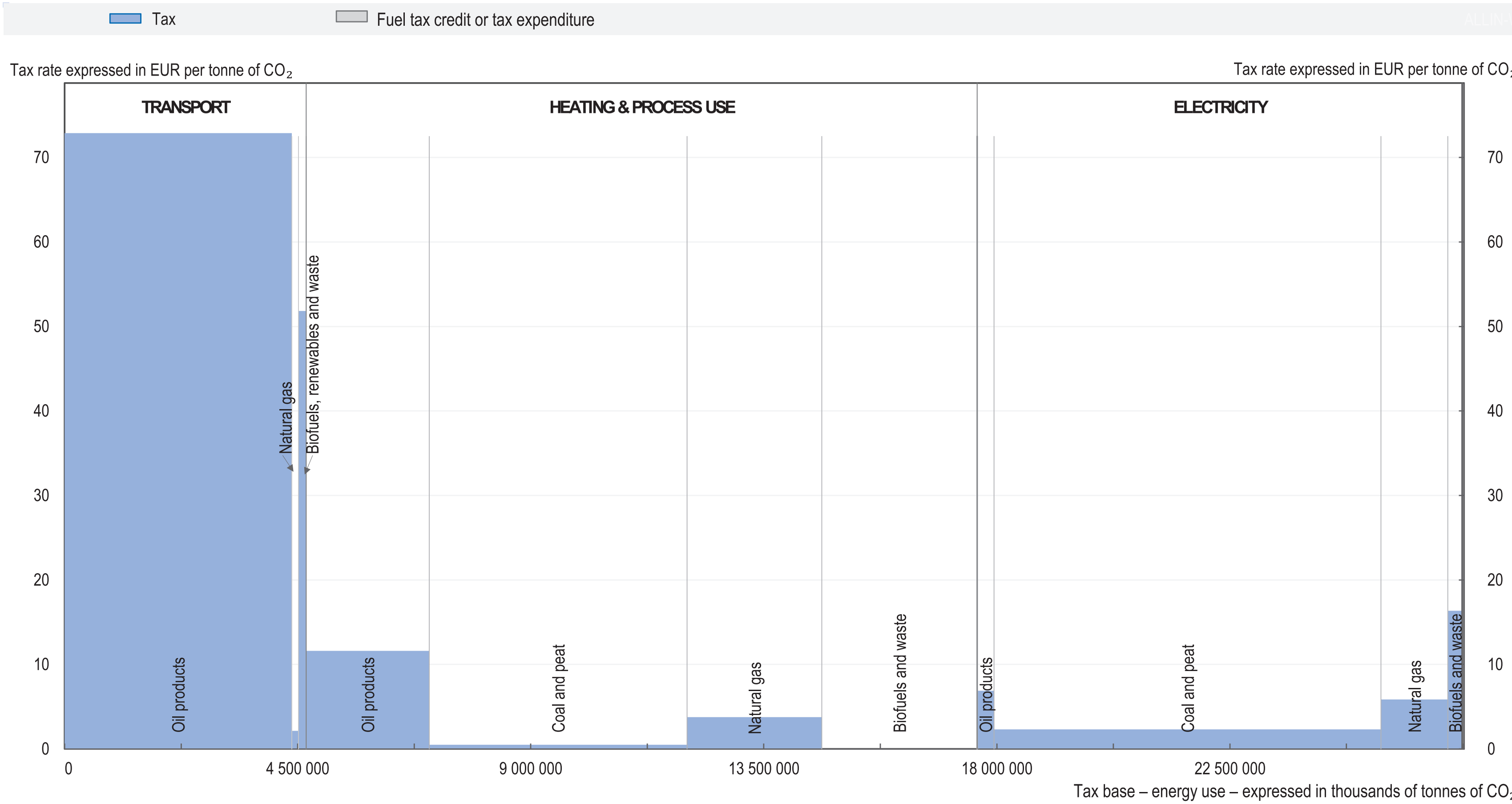
Figure 8. **Graphical profile of energy use and taxation across all carbon emissions from energy use in the 41 countries considered (weighted average basis)**



Source: OECD calculations for selected partner economies; OECD (2013b), *Taxing Energy Use – A Graphical Analysis*, Doi: http://dx.doi.org/10.1787/9789264183933-en, for all other countries. Tax rates are as of 1 April 2012 (except 1 July 2012 for AUS and BRA and 4 April 2012 for ZAF); energy use data is for 2009 from IEA (2014), *IEA World Energy Statistics and Balances* (database), Doi: http://dx.doi.org/10.1787/data-00513-en. Figures for CAN, IND and USA include only federal taxes.

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As seen in Figure 5, energy used in transport is dominated by oil products, which account for 94% of all energy used in transport across the 41 countries. Oil represents between 67% of all transport energy in Russia, which uses a high proportion of natural gas in transport, and 100% in Estonia, Israel, Japan, Mexico and South Africa. Diesel and gasoline are the two most commonly used fuels in the transport category, accounting together for 86% of all transport energy and of CO_2 emissions from transport energy. They are also the most dominant fuels in transport in every country considered – and more than 80% of transport energy in 35 countries – although the respective shares of diesel and gasoline used vary between countries.

Outside oil products, natural gas forms a significant proportion of transport energy in several countries, with the highest shares being seen in Russia (33%), Argentina (20%) and the Slovak Republic (18%). Brazil and the Slovak Republic also use a small proportion of biofuels in transport (8% and 7%, respectively). Only Argentina, Brazil, Korea, Russia, the Slovak Republic and Turkey derive more than 20% of their transport energy from non-oil sources.

Figure 9 summarises the composition of transport energy and emissions from transport energy, ordered from those countries with the highest share of diesel and gasoline to total transport energy, to those countries with the least.

3.2.2. Effective tax rates on transport energy and carbon emissions from energy use in transport

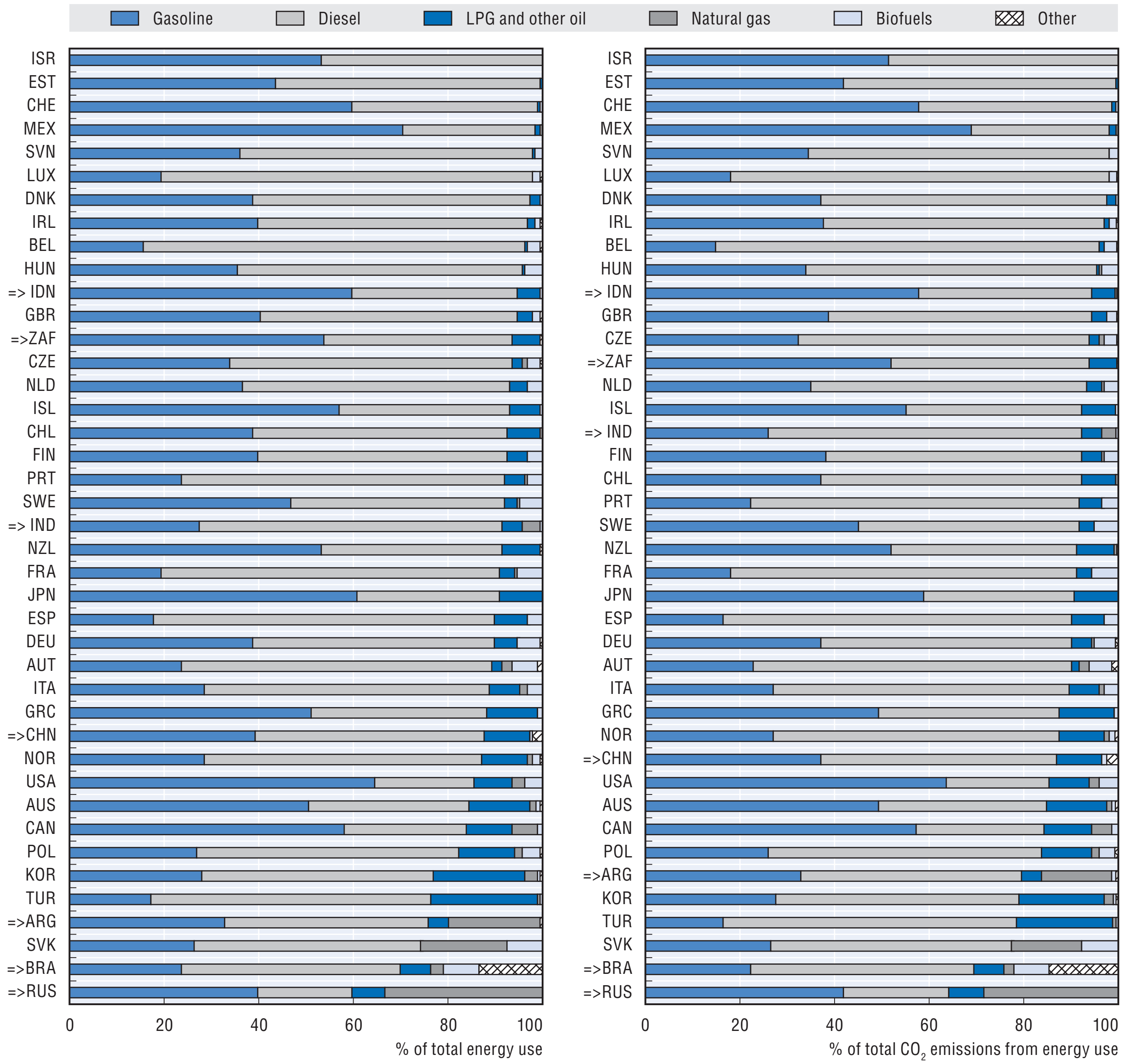
As seen above, the transport category is taxed more heavily than other categories. This is true both across all countries and within all countries (except for Brazil, where transport energy is untaxed), as seen in the graphical profiles in Part II of this report and in Part II of OECD (2013b).

Although effective tax rates on energy use and carbon emissions from transport energy are higher than on other uses of energy, there is still a wide degree of variation between countries, from zero taxation in Brazil (during the temporary suspension of the CIDE between June 2012 and February 2015) and low effective tax rates in Indonesia and Russia (less than EUR 0.01 per GJ and less than EUR 0.1 per tonne of carbon emissions from energy) to EUR 18.9 per GJ and EUR 263 per tonne of CO_2 in the United Kingdom. Among the other selected partner economies, Argentina and South Africa tax transport energy at rates similar to Poland and Spain and at higher rates than the Americas and Australasia.

As effective tax rates on transport energy are typically higher for oil products than on other fuels, countries with higher shares of non-oil energy in transport have comparatively lower cross-category rates, all else being equal. This is the case, for example, in Turkey, which has the highest observed tax rate on gasoline used for transport purposes, but has a comparatively high share of LPG in transport.

Effective tax rates on transport fuels also vary considerably within countries, both by fuel use and by fuel type. Tables 5 and 6 present average rates on transport energy and on carbon emissions from transport energy, respectively. Information on the contribution of different fuels to the total size of the respective tax bases is also provided. Some fuels used in small amounts are not presented, although they are included in the calculation of the overall rate for transport fuels. Individual country results are set out in Annex B.

Figure 9. **Composition of transport energy and of CO_2 emissions by fuel**



Note: Composition of transport energy (left panel) and of CO_2 emissions (right panel) by fuel.

Source: OECD calculations based on energy use data for 2009 from IEA (2014), *IEA World Energy Statistics and Balances* (database), Doi: http://dx.doi.org/10.1787/data-00513-en.

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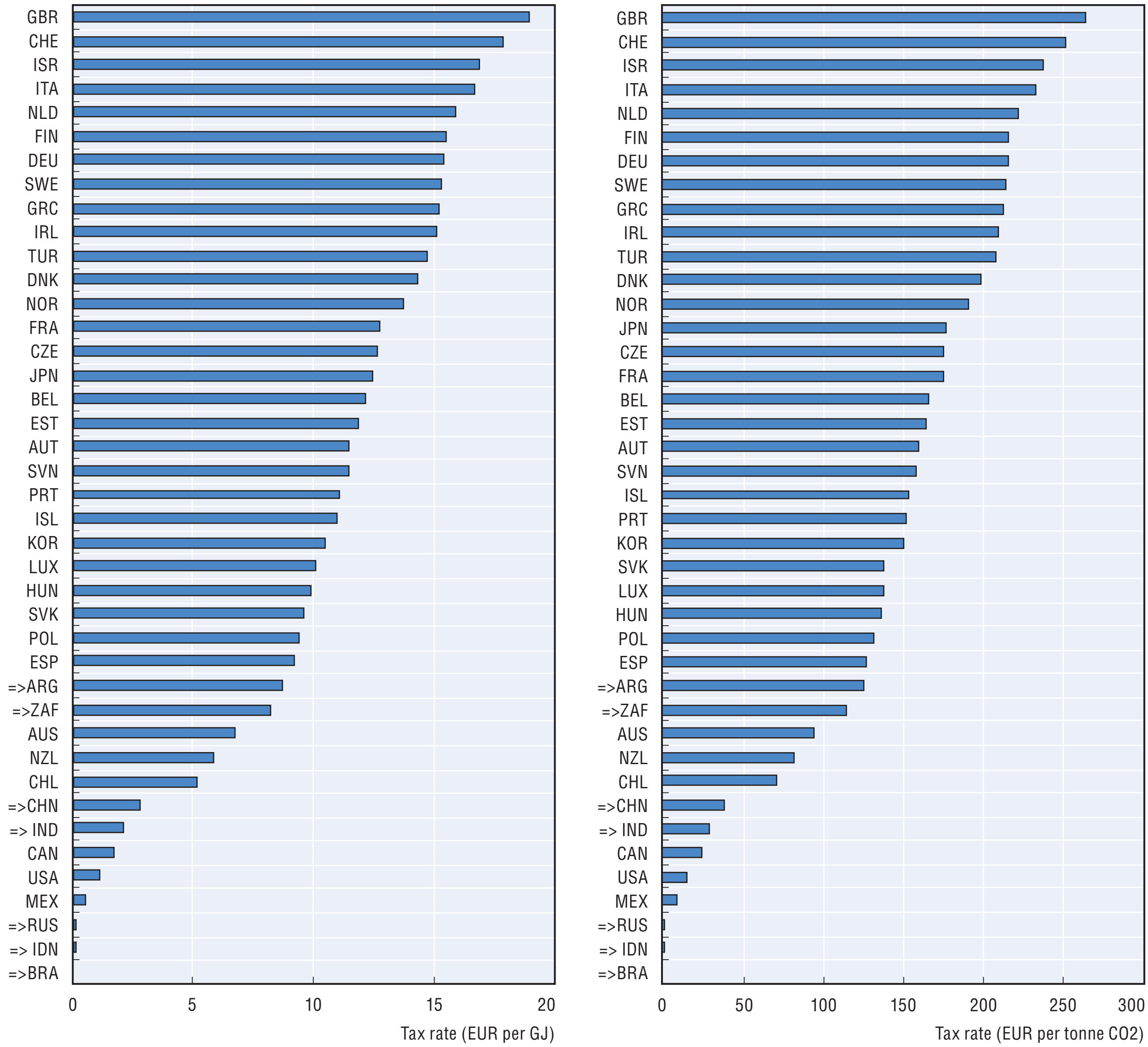
Across and within all 41 countries considered, except Brazil, road transport is taxed at higher rates than non-road transport, whether considered in terms of energy content or in carbon emissions from transport energy use. Across all 41 countries considered, road energy is taxed on average at EUR 5.6 per GJ (78.8 per tonne of CO_2) as opposed to EUR 0.8 per GJ for non-road fuels (10.8 per GJ). This may be for several reasons. Firstly, oil products are taxed at higher rates – and other sources of energy are more commonly used in non-road transport. However, a more likely reason is that governments deliberately choose to apply higher taxes to road fuels, either for revenue purposes or to address other externalities associated with their use.

Figure 10. **Average effective tax rates on transport energy and on CO_2**



Note: Average effective tax rates on transport energy (left panel) and on CO_2 (right panel).

Source: OECD calculations for selected partner economies; OECD (2013b), *Taxing Energy Use – A Graphical Analysis*, Doi: http://dx.doi.org/10.1787/9789264183933-en, for all other countries. Tax rates are as of 1 April 2012 (except 1 July 2012 for AUS and BRA and 4 April 2012 for ZAF); energy use data is for 2009 from IEA (2014), *IEA World Energy Statistics and Balances* (database), Doi: http://dx.doi.org/10.1787/data-00513-en. Figures for CAN, IND and USA include only federal taxes.

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Table 5. **Weighted average effective tax rates on transport energy by fuel type and use (EUR per GJ)**

		Gasoline	Diesel	LPG	Aviation fuels	Biofuels	Natural gas	All fuels
	% of base	49%	37%	1%	6%	3%	3%	100%
Road use	87	5.18	6.47	5.86	0.00	4.47	0.54	5.60
Non road use	13	1.20	1.81	2.93	0.40	0.00	0.04	0.75
Total transport use	100	5.16	6.06	5.84	0.40	4.46	0.12	4.96

Source: OECD calculations for selected partner economies; OECD (2013b), *Taxing Energy Use – A Graphical Analysis*, Doi: http://dx.doi.org/10.1787/9789264183933-en, for all other countries. Tax rates are as of 1 April 2012 (except 1 July 2012 for AUS and BRA and 4 April 2012 for ZAF); energy use data is for 2009 from IEA (2014), *IEA World Energy Statistics and Balances* (database), Doi: http://dx.doi.org/10.1787/data-00513-en. Figures for CAN, IND and USA include only federal taxes.

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Table 6. **Weighted average effective tax rates on CO_2 from transport energy by fuel type and use (EUR per tonne CO_2)**

		Gasoline	Diesel	LPG	Aviation fuels	Biofuels	Natural gas	All fuels
	% of base	48%	38%	1%	6%	3%	3%	100%
Road use	87	74.69	87.33	92.81	0.00	63.08	9.69	78.76
Non road use	13	17.34	24.48	46.51	5.64	0.00	0.67	10.83
Total transport use	100	74.41	81.84	92.57	5.64	63.07	2.13	70.05

Source: OECD calculations for selected partner economies; OECD (2013b), *Taxing Energy Use – A Graphical Analysis*, Doi: http://dx.doi.org/10.1787/9789264183933-en, for all other countries. Tax rates are as of 1 April 2012 (except 1 July 2012 for AUS and BRA and 4 April 2012 for ZAF); energy use data is for 2009 from IEA (2014), *IEA World Energy Statistics and Balances* (database), Doi: http://dx.doi.org/10.1787/data-00513-en. Figures for CAN, IND and USA include only federal taxes.

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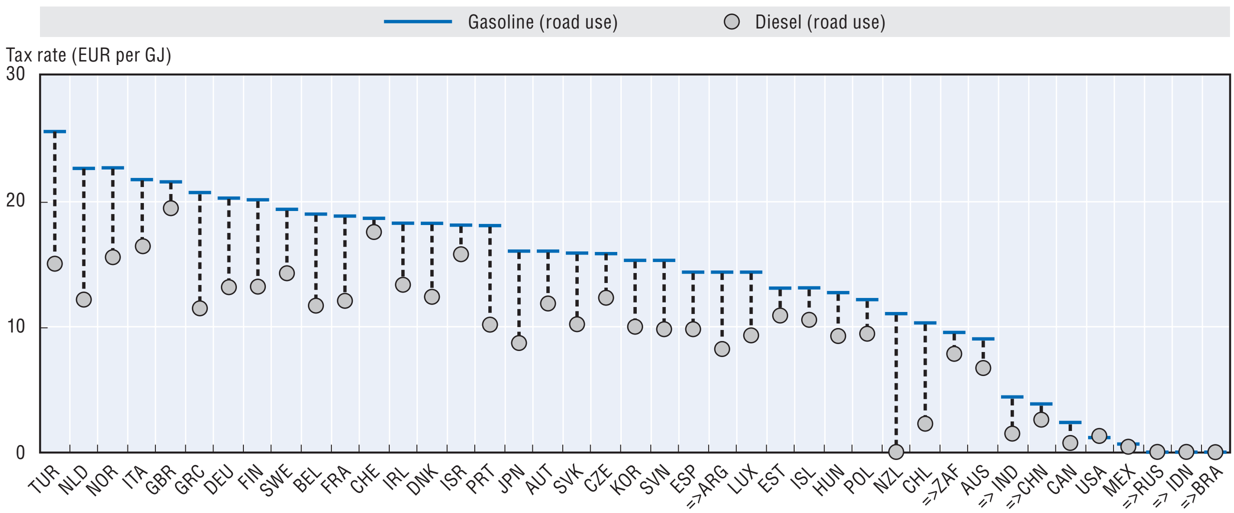
Among the fuels used in the transport category, gasoline and diesel are the highest taxed in energy terms, both across and within all countries (excluding Brazil). The lower relative carbon content of LPG means that in carbon terms, the LPG used for transport faces the highest tax rate. LPG accounts for only 1% of all energy used in transport, however. By contrast, other transport fuels are taxed at much lower rates (for example, natural gas, which is taxed at EUR 0.1 per GJ and EUR 2.1 per tonne of CO_2) and in many countries are not taxed. With the exception of Argentina, the selected partner economies do not tax either natural gas for transport use or energy used in domestic aviation. On average, biofuels (mostly ethanol and biodiesel) are taxed at around two-thirds of the rates applying to oil products. The underlying treatment is quite diverse, likely reflecting differing views as to the net carbon impact of biofuels and the role of non-tax policies like blending requirements as well as other policy objectives including industry support or energy supply concerns. The result is that a few countries tax biofuels at rates equivalent to the energy product they replace, some exempt them from taxation entirely, and many tax them at concessionary rates.

While a unit of gasoline is taxed at a lower rate than a unit of diesel (EUR 5.2 per GJ against EUR 6.5 per GJ, or EUR 74.7 per tonne of CO_2 against EUR 87.3 per tonne of CO_2), the opposite is the case when countries are considered individually, where diesel is taxed at a lower rate than gasoline in both energy and carbon terms in all countries except Brazil (where transport fuels were *de facto* untaxed due to the temporary suspension of the CIDE tax between June 2012 and February 2015) and the United States, where diesel is taxed at slightly higher rates. In most countries, the lower effective tax rates on diesel in energy and carbon terms are due to tax rates per litre for both fuels which are lower for diesel. The different characteristics of both fuels – diesel fuel has roughly 10% more energy and 18% more carbon emissions per litre than gasoline – mean that these differences are greater when effective tax rates are measured in energy terms and greater still if measured in carbon terms.

Between countries, the simple average difference between tax rates on gasoline and diesel is 32% in energy terms and 37% in carbon terms. Among selected partner economies, the difference is greatest in India, where diesel is taxed at an effective tax rate that is 66% lower than gasoline in energy terms and 68% lower in carbon terms, and smallest in Indonesia, where diesel is taxed at an effective tax rate that is 4% lower in energy terms and 10% lower in carbon terms, although effective tax rates on both fuels in Indonesia are very low. Among the selected partner economies, Argentina is the only country to report a tax expenditure in respect of the lower tax rate on diesel. Figure 11 shows the tax rates on gasoline and diesel in all countries on an energy basis.

Figure 11. **Effective tax rates on gasoline and diesel for road use**



Source: OECD calculations for selected partner economies; OECD (2013b), *Taxing Energy Use – A Graphical Analysis*, Doi: http://dx.doi.org/10.1787/9789264183933-en, for all other countries. Tax rates are as of 1 April 2012 (except 1 July 2012 for AUS and BRA and 4 April 2012 for ZAF); energy use data is for 2009 from IEA (2014), *IEA World Energy Statistics and Balances* (database), Doi: http://dx.doi.org/10.1787/data-00513-en. Figures for CAN, IND and USA include only federal taxes. NZL applies a road-user charge to diesel vehicles on a per-kilometre basis which is not included in the figure.

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From an environmental perspective, the lower tax rates for diesel relative to gasoline are not warranted, even where diesel vehicles are more fuel efficient than their gasoline counterparts, due to the higher levels of air pollutants, CO_2 and other social costs (e.g. accidents, congestion and noise) associated with a litre of diesel (Harding, 2014).

The lower effective tax rates on diesel in 39 countries are considered alongside the respective use of diesel and gasoline in each country. Figure 12 shows on the horizontal axis the size of the road diesel tax base in each country in terms of energy, relative to that of gasoline. A number greater than 100% indicates that a country uses more diesel than gasoline. Similarly, on the vertical axis, the graph shows the effective tax rate on diesel in energy terms as a percentage of the effective tax rate on gasoline, with a number above 100% representing a higher tax rate on diesel than gasoline. With the exception of the United States (in the upper left hand corner) and Brazil (at 0 on the horizontal axis), as noted above, all countries apply a higher effective tax rate to diesel than gasoline for road use. Twenty-eight countries are shown in the lower right-hand quadrant, where there is both a lower effective tax rate on diesel and a higher share of carbon emissions from diesel than gasoline, with the difference being the most marked in Belgium, France, Luxembourg and Spain. Among the selected partner economies, Argentina, Brazil and India have higher levels of carbon emissions from diesel than from gasoline; while the differential in diesel taxation relative to gasoline taxation is highest among selected partner economies in Argentina, India and Russia.

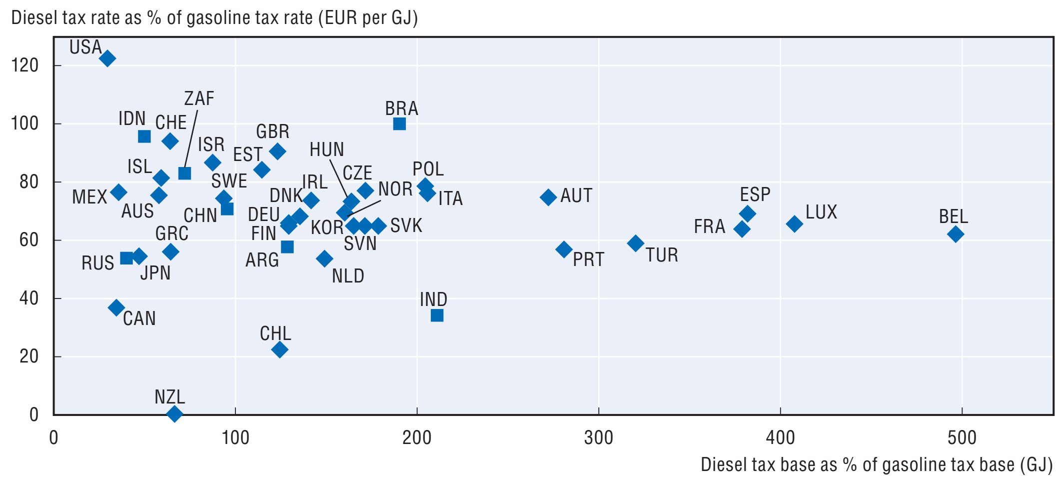
3.3. Taxation of heating and process use of energy

3.3.1. Users and sources of heating and process energy

The heating and process category includes energy used for industrial production and energy transformation as well as energy used for commercial and residential heating. Across all 41 countries considered, heating and process energy accounts for around 40%

of energy use and around 50% of carbon emissions from energy use; ranging from 20% of energy use (and 14% of emissions from energy use) in Israel to 56% of energy use in Indonesia and 71% of carbon emissions from energy use in the Slovak Republic. Across all energy considered, 64% of heating and process energy and emissions are accounted for by industrial production or energy transformation, with the remainder being accounted for by the residential and commercial sectors.

Figure 12. **Use and taxation of diesel for road use relative to gasoline (GJ)**



Source: OECD calculations for selected partner economies; OECD (2013b), *Taxing Energy Use – A Graphical Analysis*, Doi: http://dx.doi.org/10.1787/9789264183933-en, for all other countries. Tax rates are as of 1 April 2012 (except 1 July 2012 for AUS and BRA and 4 April 2012 for ZAF); energy use data is for 2009 from IEA (2014), *IEA World Energy Statistics and Balances* (database), Doi: http://dx.doi.org/10.1787/data-00513-en. Figures for CAN, IND and USA include only federal taxes. NZL applies a road-user charge to diesel vehicles on a per-kilometre basis which is not included in the figure. BRA is shown at 100% as taxes on both gasoline and diesel were suspended between June 2012 and February 2015.

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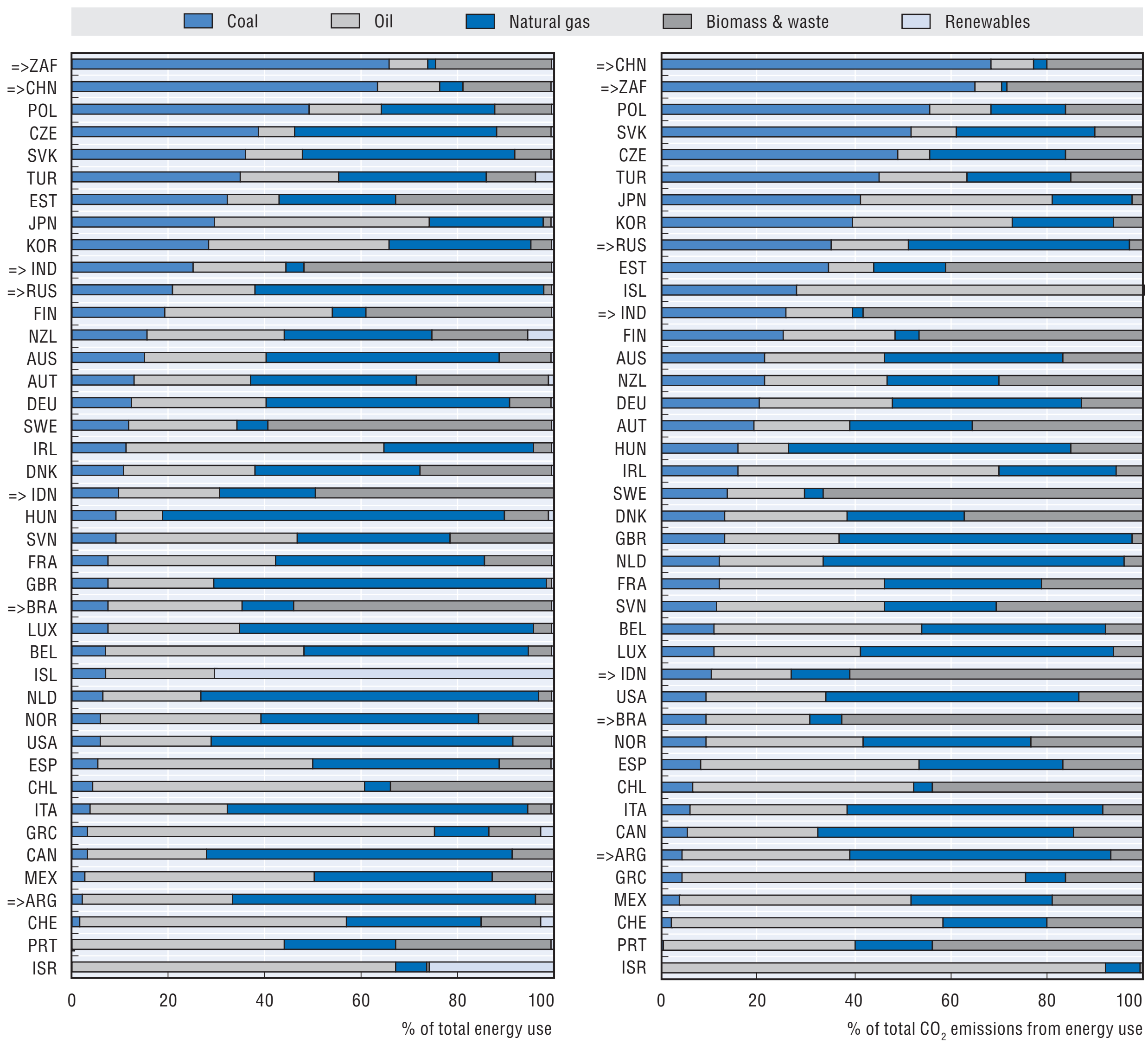
As shown in Figure 5, heating and process energy is derived from a more diverse range of fuels than transport energy. The most common forms of heating and process energy are coal and natural gas, at 30% of all heating and process energy each, although the higher carbon content of coal means that coal is responsible for 38% of carbon emissions from heating and process fuel use compared to 20% from natural gas. Coal is intensively used by South Africa, China and Poland, where it accounts for 50% or more of heating and process fuel, with a lesser share in the other countries considered. Twenty-two of the forty-one countries source less than 10% of their heating and process energy from coal, including Argentina, Brazil and Indonesia.

Other fuels used in the generation of heating and process energy include oil products (22% of all heating and process energy and 18% of emissions, of which the largest share is from diesel, at 8% of heating and process energy and 7% of emissions), although the share of oil products varies considerably between countries from 8% in the Czech Republic and South Africa to 67% in Israel. The remainder of heating and process energy is derived from biomass – most significantly in Brazil, India, Indonesia and Sweden – and renewables, although these account for only a very small share of heating and process energy in total, at 0.5% of all energy use. Higher shares are seen in Iceland (70%) and Israel (26%); in no other country does the proportion of renewable energy to total heating and process energy exceed 5%.

Fossil fuels therefore account for 82% of all energy use in the heating and process category across the 41 countries considered. They are the source of more than 75% of energy use in this category in all countries except Austria, Brazil, Denmark, Estonia, Finland, Iceland, Indonesia, Israel, Portugal, New Zealand, Sweden and Switzerland.

Figure 13 summarises the composition of energy for heating and process use and emissions from energy for heating and process use, ordered from those countries with the highest share of coal to total heating and process energy, to those countries with the least.

Figure 13. **Composition of heating and process energy and of CO_2 emissions from heating and process energy**



Note: Composition of heating and process energy (left panel) and of CO_2 emissions from heating and process energy (right panel).

Source: OECD calculations based on energy use data for 2009 from IEA (2014), *IEA World Energy Statistics and Balances* (database), Doi: http://dx.doi.org/10.1787/data-00513-en.

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3.3.2. Effective tax rates on heating and process energy and carbon emissions from energy for heating and process use

Drawing on the graphical profiles for the 41 countries (presented in Part II of this report and in Part II of OECD, 2013b), heating and process energy is shown to be taxed at lower rates, and less consistently, than energy used in transport. There is wide variation between countries in their approach to the taxation of energy in this category, both in terms of the rates applied and in the sources and uses of energy which are taxed. As a result, effective tax rates in this category also vary widely, from being slightly negative (effectively a subsidy of EUR 0.01 per GJ and EUR 0.10 per tonne CO_2) in Chile, as a result of a petroleum price stabilisation scheme, to EUR 2.61 per GJ in Ireland and EUR 42.25 per tonne of CO_2 in Israel. Among the selected partner economies, rates range from EUR 0 per GJ and tonne of CO_2 in Brazil and Indonesia (and less than EUR 0.001 per GJ and EUR 0.01 per tonne of CO_2 in Russia), who together with the United States do not tax energy used in heating and process use, to EUR 0.2 per GJ and EUR 3 per GJ in Argentina. EU member countries, which are subject to the EU's Energy Tax Directive, apply nineteen of the twenty highest tax rates in this category, even before the price signal provided by the EU ETS (which has not been incorporated into these effective tax rates, as described in Section 2) is taken into account.

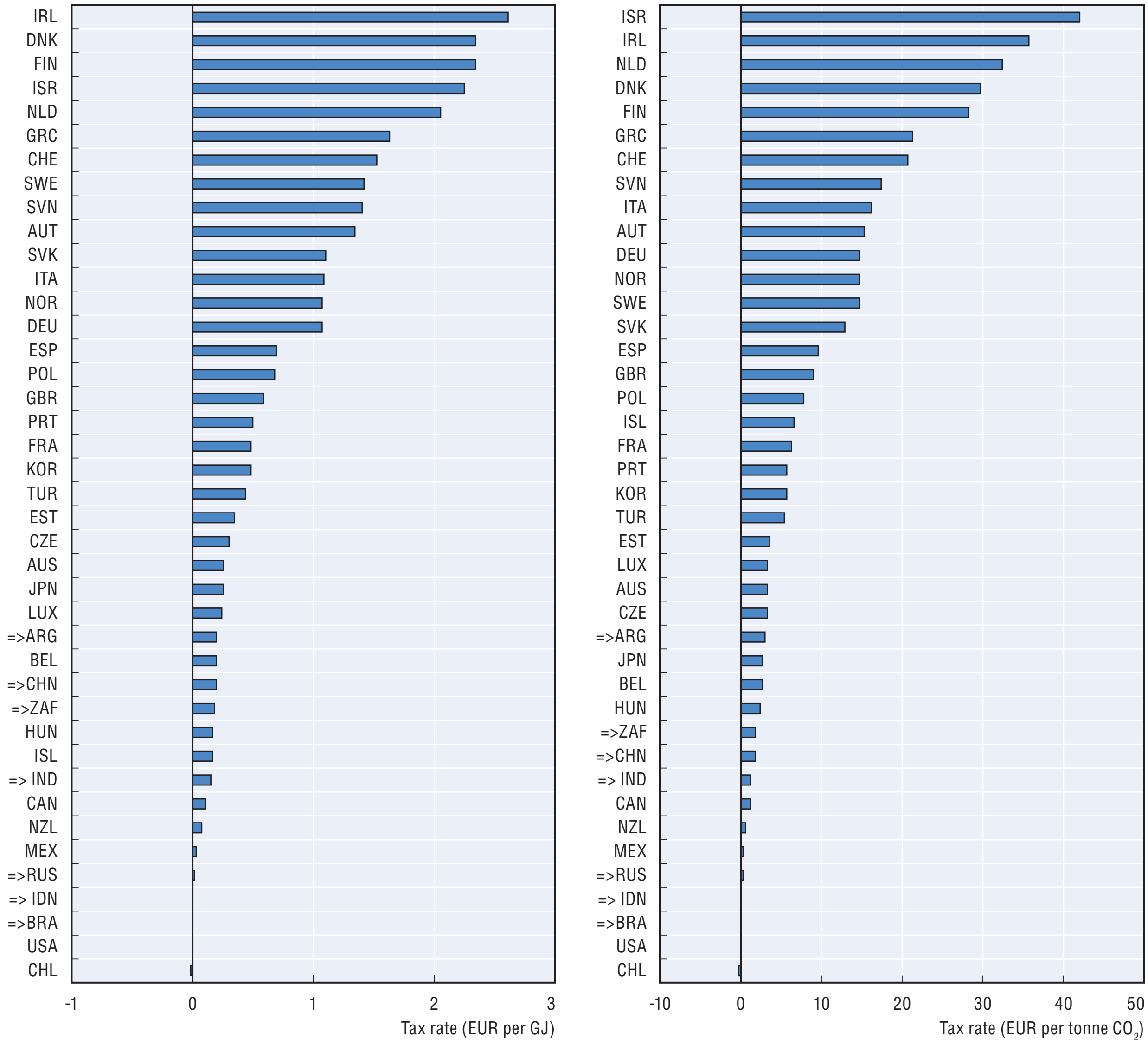
Most of the American and Asian countries tax heating and process fuel more lightly (Argentina, Australia, China, India, Japan, Mexico and New Zealand) or do not tax heating and process energy (Brazil, Indonesia and the United States).

Within the selected partner economies there is a wide variation in the tax rates applied to fuels and in the fuels that are taxed. Argentina, India, China and South Africa tax some oil products for heating and process use, at rates ranging from around EUR 1.45 per GJ in India to EUR 72.28 per GJ in South Africa. Argentina also taxes natural gas for heating and process purposes, while India taxes coal used in this category at a low rate. Tables 7 and 8 summarise, on an energy and carbon basis respectively, the effective tax rates on all energy used in this category, broken down by broad categories of fuel use and fuel type. Fuel use is divided into residential and commercial use on the one hand and industrial and energy transformation use (e.g. oil refineries) on the other. Information on the shares of different fuels in the respective tax bases is also provided. Some fuels used in small amounts are not presented in a separate column though they are included in the overall rate for all fuels. Individual country results are again provided in Annex B.

Across all energy use considered, diesel has the highest tax rate in energy and carbon terms, being taxed, on average, at EUR 1.6 per GJ and EUR 22.2 per tonne of CO_2. Other oil products are also taxed at higher rates. Natural gas is taxed at much lower rates, on average, at EUR 0.2 per GJ and EUR 3.8 per tonne of CO_2. The lowest tax rate on heating and process energy is seen for coal, at EUR 0.04 per GJ and EUR 0.5 per tonne of carbon emissions from energy.

The average unit of energy for industrial and energy transformation purposes is taxed lower than for residential and commercial use, particularly in carbon terms, which may result from the different profile of fuels used in each category; with lower taxed fuels, particularly coal, being more common in industrial and energy transformation use. The distinction between tax rates on industrial and energy transformation use of fuels and fuels used for commercial and residential heating varies by country. This pattern holds for the different fuels shown in Tables 7 and 8, with the exception of coal and fuel oil for residential use, which are taxed at lower rates than the same fuel for industrial and energy transformation purposes.

Figure 14. **Average effective tax rates on heating and process energy and on CO_2**



Note: Average effective tax rates on heating and process energy (left panel) and on CO_2 (right panel).

Source: OECD calculations for selected partner economies; OECD (2013b), *Taxing Energy Use – A Graphical Analysis*, Doi: http://dx.doi.org/10.1787/9789264183933-en, for all other countries. Tax rates are as of 1 April 2012 (except 1 July 2012 for AUS and BRA and 4 April 2012 for ZAF); energy use data is for 2009 from IEA (2014), *IEA World Energy Statistics and Balances* (database), Doi: http://dx.doi.org/10.1787/data-00513-en. Figures for CAN, IND and USA include only federal taxes. The price signals sent by the EU ETS (EU member countries, Iceland and Norway) to some forms of energy use in this category are not included in the figures, but were relatively modest over the time period considered (on average EUR 13 per tonne of CO_2 in 2010-11).

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However, on a country by country basis, the pattern is more varied. Residential and commercial use of fuels is taxed at higher rates in energy terms than industrial fuels in 21 countries (22 in carbon terms); with industrial use being taxed more highly in 17 countries in energy terms (16 in carbon terms). The difference is most pronounced in Israel, Denmark and the Netherlands, where residential rates are higher than industrial rates and in Sweden and Ireland, where industrial rates are higher than residential rates. In several other countries the difference is very small (Chile, Estonia, Greece, Mexico, Russia, the Slovak Republic and Spain). Figures 15 and 16 show effective tax rates on energy for both uses, in energy and carbon terms respectively.

Table 7. **Weighted average effective tax rates on heating and process energy by fuel type and use (EUR per GJ)**

		Coal	Natural gas	Diesel	Fuel oil	Other oil products	All fuels
	% of base	30%	30%	8%	2%	11%	100%
Residential and commercial use	36	0.04	0.30	1.79	0.67	0.42	0.33
Industrial and energy transformation use	64	0.05	0.14	1.54	0.97	0.12	0.22
Total heating and process use	100	0.05	0.21	1.64	0.95	0.21	0.26

Source: OECD calculations for selected partner economies; OECD (2013b), *Taxing Energy Use – A Graphical Analysis*, Doi: http://dx.doi.org/10.1787/9789264183933-en, for all other countries. Tax rates are as of 1 April 2012 (except 1 July 2012 for AUS and BRA and 4 April 2012 for ZAF); energy use data is for 2009 from IEA (2014), *IEA World Energy Statistics and Balances* (database), Doi: http://dx.doi.org/10.1787/data-00513-en. Figures for CAN, IND and USA include only federal taxes. The price signals sent by the EU ETS (EU member countries, Iceland and Norway) to some forms of energy use in this category are not included in the figures, but were relatively modest over the time period considered (on average EUR 13 per tonne of CO_2 in 2010-11).

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Table 8. **Weighted average effective tax rates on CO_2 from heating and process energy by fuel type and use (EUR per tonne CO_2)**

		Coal	Natural gas	Diesel	Fuel oil	Other oil products	All fuels
	% of base	38%	20%	7%	2%	9%	100%
Residential and commercial use	34	0.42	5.27	24.21	8.70	6.38	4.01
Industrial and energy transformation use	66	0.48	2.54	20.78	12.58	1.70	2.58
Total heating and process use	100	0.47	3.75	22.19	12.22	3.08	3.07

Source: OECD calculations for selected partner economies; OECD (2013b), *Taxing Energy Use – A Graphical Analysis*, Doi: http://dx.doi.org/10.1787/9789264183933-en, for all other countries. Tax rates are as of 1 April 2012 (except 1 July 2012 for AUS and BRA and 4 April 2012 for ZAF); energy use data is for 2009 from IEA (2014), *IEA World Energy Statistics and Balances* (database), Doi: http://dx.doi.org/10.1787/data-00513-en. Figures for CAN, IND and USA include only federal taxes. The price signals sent by the EU ETS (EU member countries, Iceland and Norway) to some forms of energy use in this category are not included in the figures, but were relatively modest over the time period considered (on average EUR 13 per tonne of CO_2 in 2010-11).

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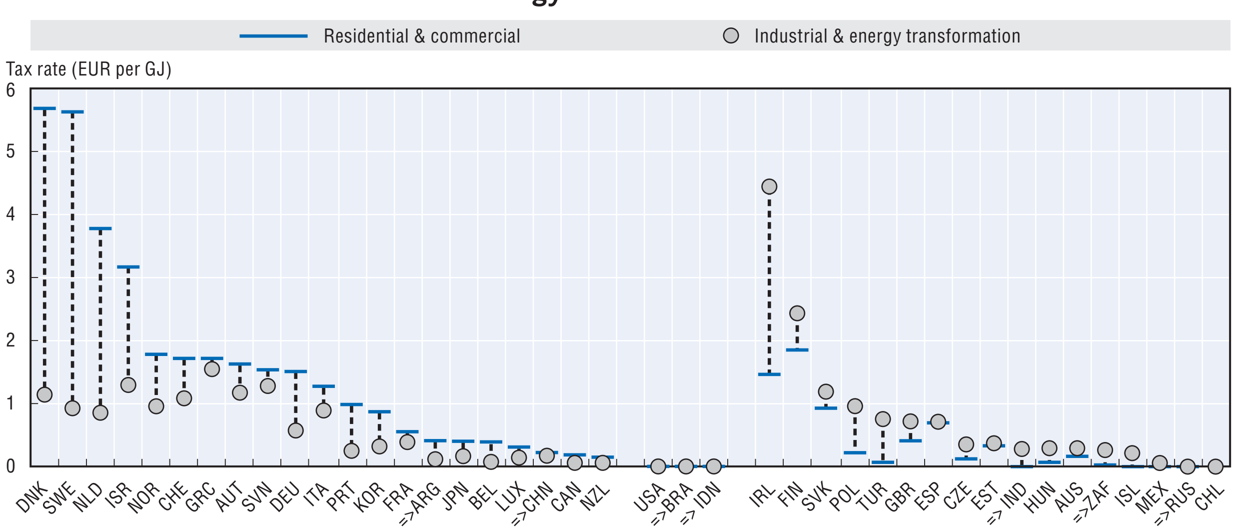
Figure 15. **Effective tax rates on energy: Residential and commercial vs. industrial and energy transformation use**



Source: OECD calculations for selected partner economies; OECD (2013b), *Taxing Energy Use – A Graphical Analysis*, Doi: http://dx.doi.org/10.1787/9789264183933-en, for all other countries. Tax rates are as of 1 April 2012 (except 1 July 2012 for AUS and BRA and 4 April 2012 for ZAF); energy use data is for 2009 from IEA (2014), *IEA World Energy Statistics and Balances* (database), Doi: http://dx.doi.org/10.1787/data-00513-en. Figures for CAN, IND and USA include only federal taxes. The price signals sent by the EU ETS (EU member countries, Iceland and Norway) to some forms of energy use in this category are not included in the figures, but were relatively modest over the time period considered (on average EUR 13 per tonne of CO_2 in 2010-11).

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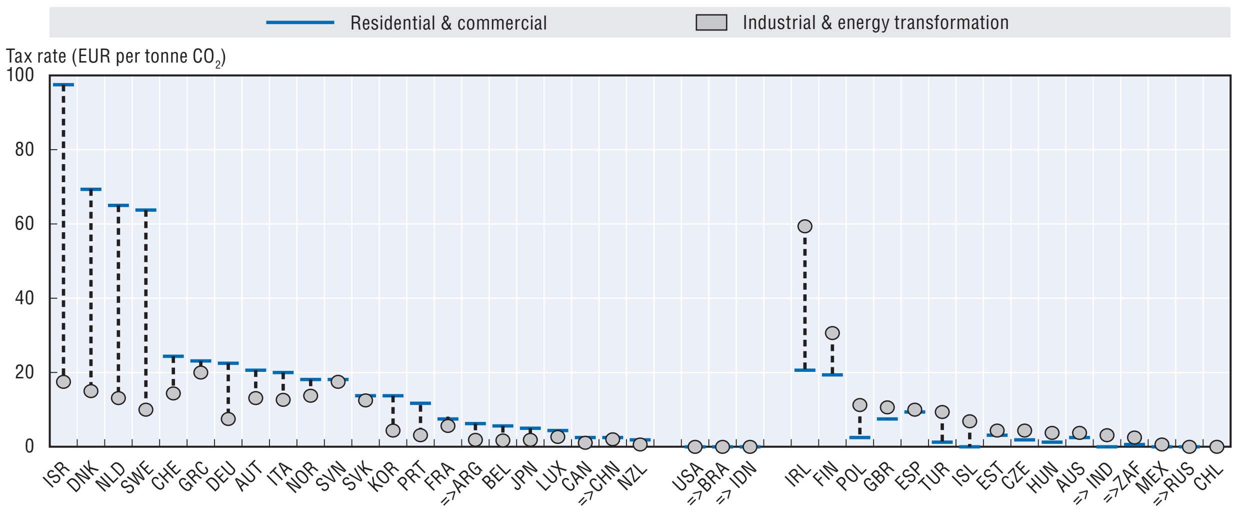
Figure 16. **Effective tax rates on CO_2: Residential and commercial vs. industrial and energy transformation use**



Source: OECD calculations for selected partner economies; OECD (2013b), *Taxing Energy Use – A Graphical Analysis*, Doi: http://dx.doi.org/10.1787/9789264183933-en, for all other countries. Tax rates are as of 1 April 2012 (except 1 July 2012 for AUS and BRA and 4 April 2012 for ZAF); energy use data is for 2009 from IEA (2014), *IEA World Energy Statistics and Balances* (database), Doi: http://dx.doi.org/10.1787/data-00513-en. Figures for CAN, IND and USA include only federal taxes. The price signals sent by the EU ETS (EU member countries, Iceland and Norway) to some forms of energy use in this category are not included in the figures, but were relatively modest over the time period considered (on average EUR 13 per tonne of CO_2 in 2010-11).

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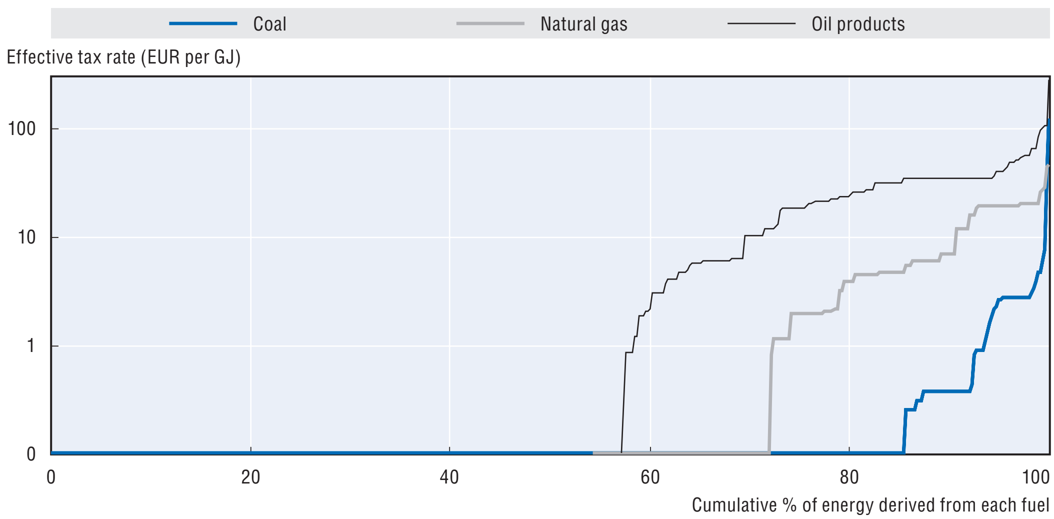
The typically lower tax rates in the heating and process category together with the large variation in rates between different users may be the result of deliberate policy choices to lower rates for that particular sector, perhaps prompted by competitiveness or distributional concerns. Another possible explanation for the different rates applied to different users of heating and process energy, which is particularly likely when the difference in the rates of both groups is small, is that the different fuels used by each group could result in this difference. Among the countries considered, coal and oil products are used more heavily in industrial processes than in domestic or commercial use. Conversely, natural gas is the most common residential and commercial heating fuel, together with biomass. The different tax rates that apply to different fuels may therefore result in different effective tax rates for different users of these fuels.

The heating and process category contains the most diverse use of fossil fuels of all three use categories. Given the different ways and frequencies with which the different fuels are taxed in this category, it is interesting to compare the taxation of the three main sources of fossil fuels (oil, coal and natural gas) within this category.

Figure 17 sets out along the horizontal axis the cumulative percentage of energy across all 41 countries considered derived from each of the three sources of fossil fuels, ranked from the lowest to the highest taxed. The vertical axis shows the tax rates in EUR per GJ that applies to each of the three fuels at each percentage of use. The vertical axis is shown in logarithmic terms in order to better display the detail of the figure. This figure shows that coal is the least taxed of all fossil fuel sources of energy in this category, with over 85% untaxed. Reflecting the presence of large coal users among those countries which apply lower or zero tax rates on coal, less than 0.5% of coal is taxed at a rate higher than EUR 10 per GJ, despite the high environmental and other social costs associated with coal. Natural gas is more frequently taxed and typically taxed at higher rates: 72% of energy derived from natural gas is untaxed and 10% is taxed at a rate higher than EUR 10 per GJ. Oil products are taxed at the highest rates and most frequently, with 54% of energy derived from oil products subject to energy taxes and 30% taxed at a rate higher than EUR 10 per GJ.

Figure 17. **Tax rates on fossil fuels used in heating and process use, by cumulative energy use from each fuel**



Source: OECD calculations for selected partner economies; OECD (2013b), *Taxing Energy Use – A Graphical Analysis*, Doi: http://dx.doi.org/10.1787/9789264183933-en, for all other countries. Tax rates are as of 1 April 2012 (except 1 July 2012 for AUS and BRA and 4 April 2012 for ZAF); energy use data is for 2009 from IEA (2014), *IEA World Energy Statistics and Balances* (database), Doi: http://dx.doi.org/10.1787/data-00513-en. Figures for CAN, IND and USA include only federal taxes. The price signals sent by the EU ETS (EU member countries, Iceland and Norway) to some forms of energy use in this category are not included in the figures, but were relatively modest over the time period considered (on average EUR 13 per tonne of CO_2 in 2010-11). Tax rates are shown on a logarithmic scale on the vertical axis.

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This figure does not include, however, the coverage of emission trading schemes, such as the EU and NZ ETS, or regional level ETS schemes such as those that apply in China. Emissions trading schemes are more likely to cover coal and natural gas use than oil products, which would change the picture shown in this graph. However, recent prices under ETS schemes have been comparatively low, relative to energy taxes (World Bank, 2014a).

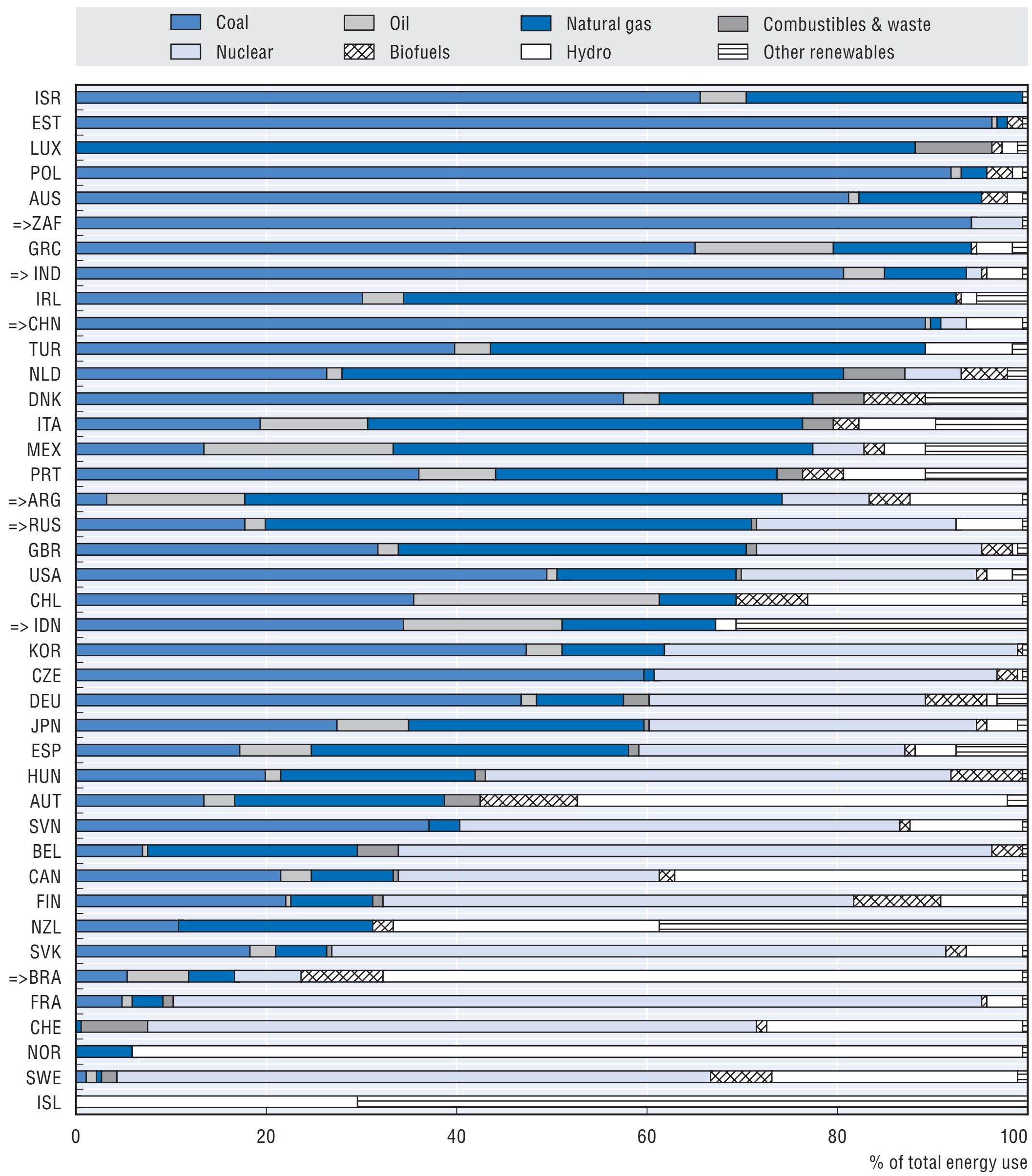
3.4. *Taxation of energy used to generate electricity*

3.4.1. *Users and sources of energy used to generate electricity*

Energy used to generate electricity is the most diverse in terms of the fuel-mix used across countries. Coal, oil, natural gas, combustibles and renewables are all used in significant proportions in many countries. The most common source of energy used in electricity generation across the countries considered is coal, followed by renewables. The electricity category is the only category of energy use where renewables form a significant part of the energy mix.

Figure 18 shows the sources of energy used to generate electricity in each country, in energy terms. This graph shows the proportion of each energy source used to generate energy (the input energy), rather than the resulting electricity (the output energy) derived from each source. Differences in the efficiency of generation from different fuel sources will mean that fuels which are comparatively more efficient (often renewable forms of electricity generation) will represent a smaller share of the input energy than of the output energy. The converse is true for fuels which are less efficient. The graph is ordered by those countries with the highest share of fossil fuels in electricity generation to those with the lowest share. This ranges from Israel, where 100% of energy used to generate electricity is derived from fossil fuel sources, to Iceland, where over 99% of energy used to generate electricity is from renewable sources.

Figure 18. **Composition of energy used to generate electricity, by input fuel**[1]



This graph shows the proportion of fuels used as inputs to electricity generation in each country. Electricity is a secondary energy product which is derived from these primary sources. Different fuels and electricity plants have differing ratios of generation efficiency, which means the proportions of electricity derived from each fuel will differ from that fuel's proportion of the input energy.

Source: OECD calculations based on energy use data for 2009 from IEA (2014), *IEA World Energy Statistics and Balances* (database), Doi: http://dx.doi.org/10.1787/data-00513-en.

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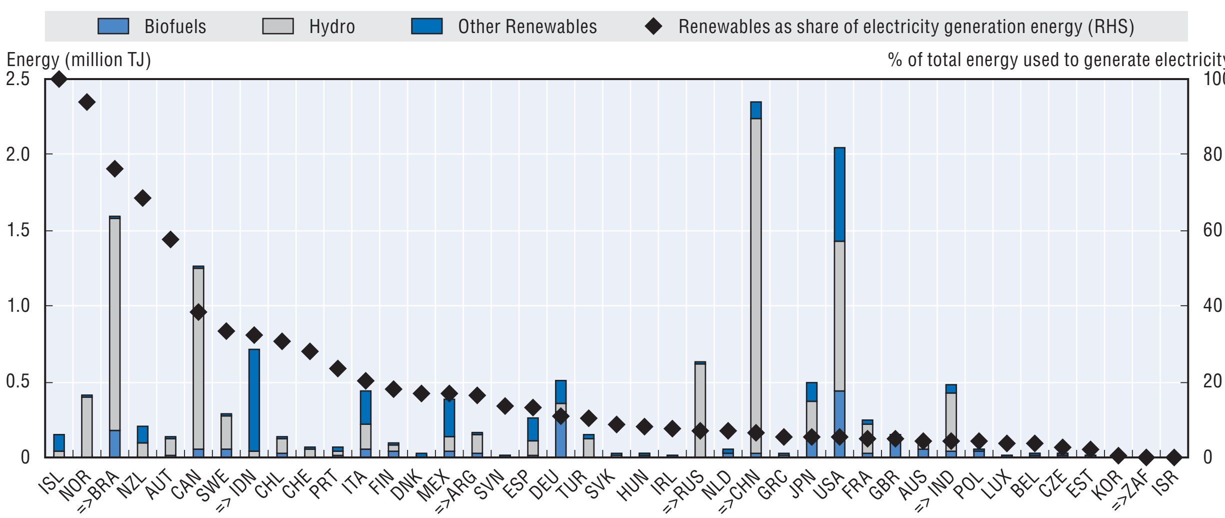
Coal forms a large proportion of energy used to generate electricity in several countries. It represents more than 50% (and in several cases, more than 80%) of energy used to generate electricity in Australia, China, Denmark, Estonia (oil shale), Greece, India, Israel, Poland and South Africa. Natural gas is the source of over 50% of energy used in electricity generation in Argentina, Ireland, Luxembourg and Russia. Relative to both the transport and heating and process categories, oil accounts for only a small proportion of most countries' energy use in electricity generation. Energy from non-carbon sources, including renewable and nuclear sources forms the majority of energy used in electricity generation in 14 countries (Austria, Belgium, Brazil, Canada, Finland, France, Hungary, Iceland, New Zealand, Norway, the Slovak Republic, Slovenia, Sweden and Switzerland).

The size and share of renewables as inputs to electricity generation differs between countries. Figure 19 shows the total amount of renewable energy used to generate electricity in each country (measured in TJs, on the left-hand axis) against the proportion of renewable energy to total energy used to generate electricity (measured as a % of all energy used to generate electricity), on the right-hand axis.

Figure 19. **Amount and proportion of renewables (excluding nuclear) in electricity generation**



Source: OECD calculations based on energy use data for 2009 from IEA (2014), *IEA World Energy Statistics and Balances* (database), Doi: http://dx.doi.org/10.1787/data-00513-en.

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China uses the highest amount of renewables in electricity generation, at 2.5 million TJs (just under 7% of energy used in electricity generation), with the majority of this coming from hydro generation. Significant levels of energy from renewable sources are also found, in decreasing order, in the United States, Brazil, Canada, Indonesia, Russia, India and Germany. When considered as a proportion of energy used to generate electricity, the percentage of renewable energy sources is highest in Iceland, Norway and Brazil (again in decreasing order). The selected partner economies account for 43% of the total amount of renewables used in electricity generation across all 41 countries considered.

In addition, 24 countries generate electricity from nuclear sources. In 2009, the largest user of nuclear energy for electricity generation in absolute terms was the United States (26% of electricity generation fuels). Around half as much nuclear energy is used to generate electricity in France and in Japan. In percentage terms, France uses the highest amount of nuclear energy as a share of all input energy for electricity generation, at 85%. Other countries that use nuclear energy for more than 50% of their input energy for electricity generation, in decreasing order, are the Slovak Republic, Switzerland, Belgium, Sweden and Finland. Among the selected partner economies, India, China, South Africa, Brazil and Argentina use a small proportion of nuclear energy as an input to electricity generation (less than 10%) and Russia uses nuclear energy for around 20% of its inputs to electricity generation.

3.4.2. Effective tax rates on energy used to generate electricity

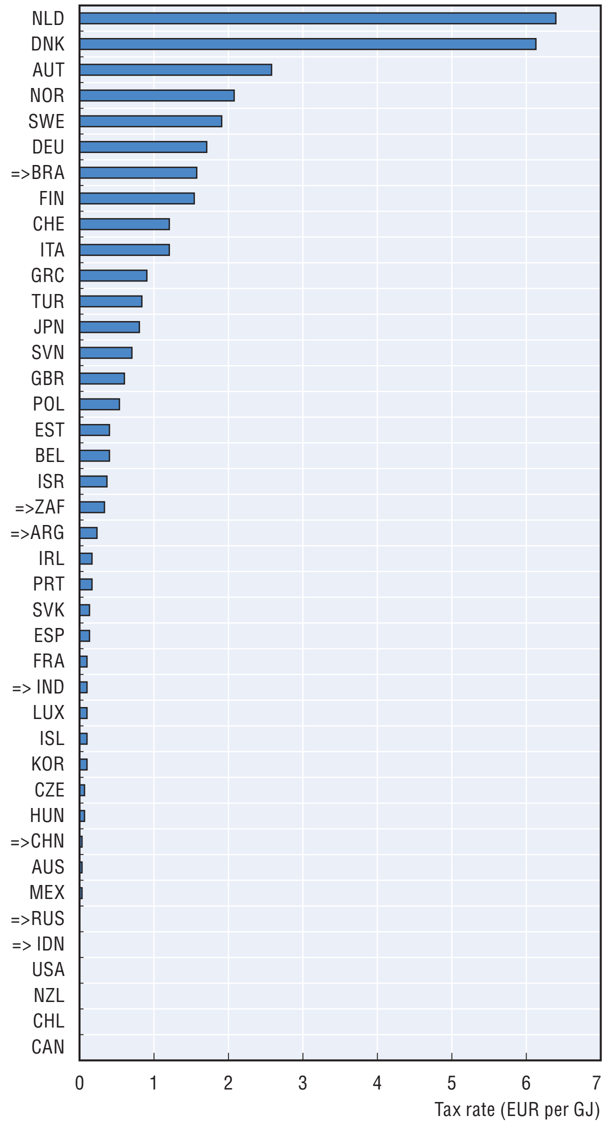
Taxes on electricity may be levied either directly on the fuels used to generate electricity or on the consumption of the resulting electricity. The approach to the taxation of electricity across the 41 countries is mixed, although the taxation of electricity on a consumption basis is more common. This is also true for the selected partner economies, where Argentina, Brazil and India tax electricity consumption. India and South Africa also directly tax coal and some other input fuels used to generate electricity.

As discussed in Section 2.2, the methodology used in this report "looks through" taxes on electricity consumption to estimate the implicit tax rates on the primary energy source used to generate electricity. This approach means that comparatively efficient and low-carbon fuels will have a lower implicit tax rate in energy and carbon terms than those that are less efficient or more carbon-intensive. Where countries tax the primary energy used to generate electricity directly, the tax rate for each energy source is calculated. Where a country taxes both the fuels used to generate electricity and electricity consumption, both levels of taxation are taken into account in calculating the effective tax rate on each primary energy source. In the EU countries, as well as Iceland and Norway, the EU ETS will provide an additional price on carbon emissions from electricity generation from some sources. As described in Section 2, the price signals provided by the EU ETS have not been included in the analysis.

Although taxing electricity consumption is viewed for the purposes of this report as an indirect tax on the fuels used to generate electricity, an electricity tax that does not distinguish between sources of electricity generation does not send any price signal with regard to the fuels used to generate electricity or with regard to the efficiency of generation.

As seen in the other categories, effective tax rates on the different fuels used to generate electricity differ significantly between countries in energy terms. Tax rates are highest in two EU member countries, Denmark and the Netherlands, at more than EUR 6 per GJ of energy used in electricity generation. Several countries (Canada, Chile, Indonesia, New Zealand, Russia and the United States) do not tax either electricity or the fuels used to generate it, and several others (Australia, China and Mexico) have an effective tax rate on energy used to generate electricity that is less than EUR 0.1 per GJ. Of the selected partner economies, Brazil taxes energy used in electricity generation at the highest rates, at EUR 1.56 per GJ. This is the 7th highest rate across all 41 countries considered. Argentina and South Africa tax energy used in electricity generation at EUR 0.33 and EUR 0.24 per GJ, respectively, around the average country rate for the group of countries considered.

Figure 20. **Average effective tax rates on energy used in electricity generation**



Source: OECD calculations for selected partner economies; OECD (2013b), *Taxing Energy Use – A Graphical Analysis*, Doi: http://dx.doi.org/10.1787/9789264183933-en, for all other countries. Tax rates are as of 1 April 2012 (except 1 July 2012 for AUS and BRA and 4 April 2012 for ZAF); energy use data is for 2009 from IEA (2014), *IEA World Energy Statistics and Balances* (database), Doi: http://dx.doi.org/10.1787/data-00513-en. Figures for CAN, IND and USA include only federal taxes. The price signals sent by the EU ETS (EU member countries, Iceland and Norway) to some forms of energy use in this category are not included in the figures, but were relatively modest over the time period considered (on average EUR 13 per tonne of CO_2 in 2010-11).

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As in the other categories of energy use shown in the graphical profiles, different fuels used in electricity generation are taxed at different rates. Tables 9 and 10 show the rates applying to different forms of energy products used to generate electricity, in energy and carbon terms respectively. These take into account both direct taxes on the fuels used to generate electricity and taxes on the consumption of electricity. Due to the more complicated construction of the effective tax rates in this category, they should be interpreted carefully. These rates demonstrate the implicit effective tax rate on the energy (or alternately, carbon content) in electricity if the electricity tax were assumed to be a tax on the input fuels. Consequently, if carbon-intensive fuels form a small proportion of the generation mix, the effective tax rate on carbon thus calculated will be very high. A tax on electricity consumption that does not distinguish between electricity from carbon sources and electricity from non-carbon sources cannot send an effective price signal about the use of carbon-intensive generation sources. Nonetheless, in this report, in order to maintain the same tax coverage for energy and carbon statistics, undifferentiated taxes on electricity consumption are included in the computation of effective tax rates on carbon emissions.

Table 9. **Weighted average effective tax rates on energy used in electricity generation by fuel type (EUR per GJ)**

	Coal	Biofuels	Waste	Natural gas	Oil	Renewables	Hydro	Nuclear	All fuels
% of base	53	1	1	16	3	2	6	18	100
Electricity	0.13	0.64	0.66	0.43	0.50	0.58	0.65	0.27	0.27

Source: OECD calculations for selected partner economies; OECD (2013b), *Taxing Energy Use – A Graphical Analysis*, Doi: http://dx.doi.org/10.1787/9789264183933-en, for all other countries. Tax rates are as of 1 April 2012 (except 1 July 2012 for AUS and BRA and 4 April 2012 for ZAF); energy use data is for 2009 from IEA (2014), *IEA World Energy Statistics and Balances* (database), Doi: http://dx.doi.org/10.1787/data-00513-en. Figures for CAN, IND and USA include only federal taxes. The price signals sent by the EU ETS (EU member countries, Iceland and Norway) to some forms of energy use in this category are not included in the figures, but were relatively modest over the time period considered (on average EUR 13 per tonne of CO_2 in 2010-11).

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Table 10. **Weighted average effective tax rates on CO_2 from energy used in electricity generation by fuel type (EUR per tonne CO_2)**

	Coal	Biofuels	Waste	Natural gas	Oil	All fuels
% of base (excl. ISL, NOR, SWE)	80	2	1	14	3	100
Electricity (excl. ISL, NOR, SWE)	2.22	10.77	14.11	5.37	6.67	3.10

Source: OECD calculations for selected partner economies; OECD (2013b), *Taxing Energy Use – A Graphical Analysis*, Doi: http://dx.doi.org/10.1787/9789264183933-en, for all other countries. Tax rates are as of 1 April 2012 (except 1 July 2012 for AUS and BRA and 4 April 2012 for ZAF); energy use data is for 2009 from IEA (2014), *IEA World Energy Statistics and Balances* (database), Doi: http://dx.doi.org/10.1787/data-00513-en. Figures for CAN, IND and USA include only federal taxes. Tax rates and energy use in electricity generation are not included for Iceland, Norway and Sweden. The price signals sent by the EU ETS (EU member countries, Iceland and Norway) to some forms of energy use in this category are not included in the figures, but were relatively modest over the time period considered (on average EUR 13 per tonne of CO_2 in 2010-11).

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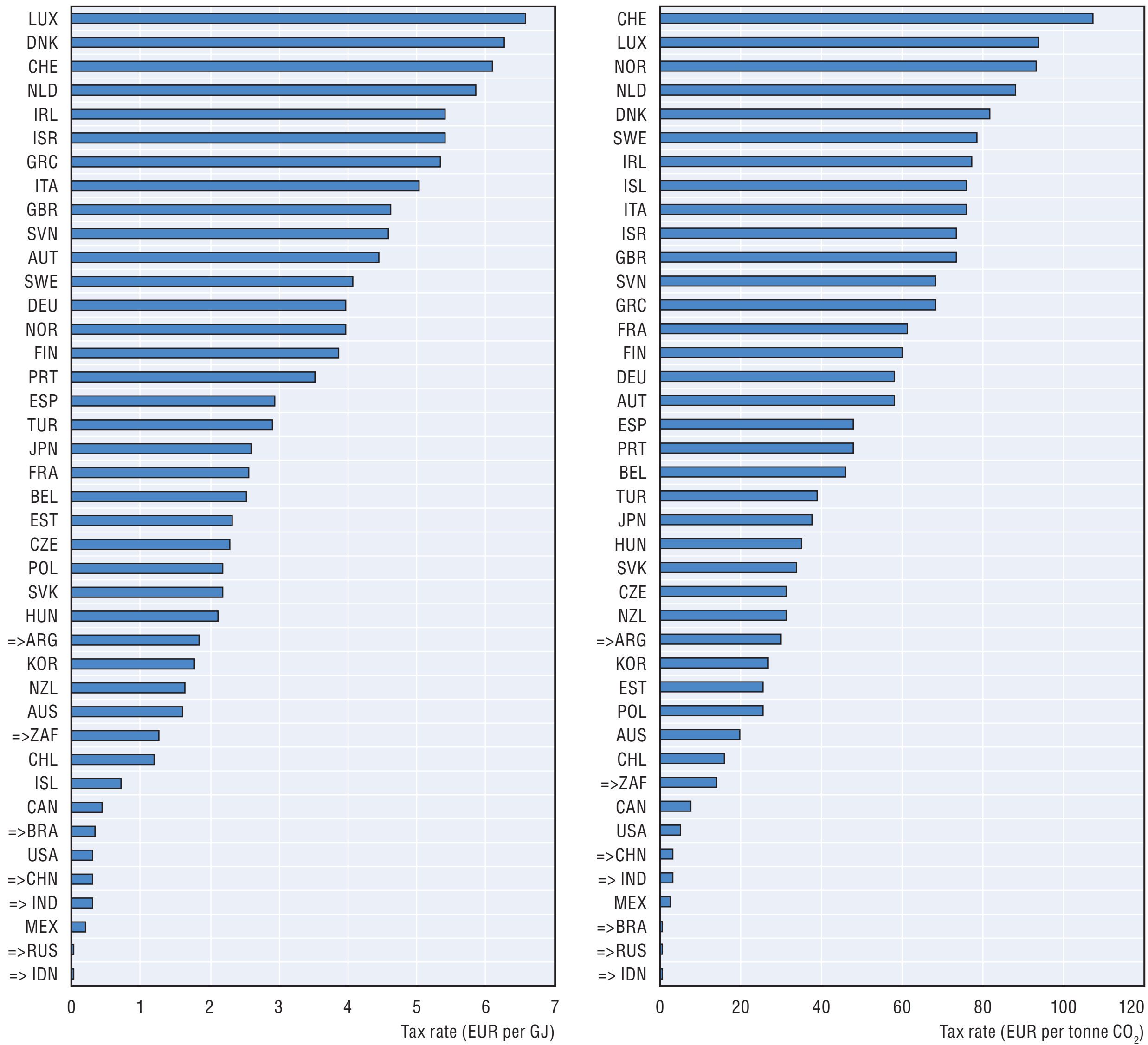
3.5. Economy-wide effective tax rates

3.5.1. Overview of economy-wide effective tax rates

The heterogeneous patterns of energy use and taxation in each of these categories across the 41 countries considered result in significant differences in the overall level of energy taxation across the 41 countries considered. Figure 21 sets out for each country the overall effective tax rate, on a weighted basis, on energy use (left panel) and on CO_2 emissions from energy use (right panel). Please note that for countries that impose energy taxes at both the federal and provincial level (notably Canada, India and the United States), these figures only account for taxes imposed at the federal level. This is the case for all the results presented in this part of the report.

Figure 21. **Economy-wide average effective tax rates on energy and on CO_2 from energy**



Note: Economy-wide average effective tax rates on energy (left panel) and on CO_2 from energy (right panel).

Source: OECD calculations for selected partner economies; OECD (2013b), *Taxing Energy Use – A Graphical Analysis*, Doi: http://dx.doi.org/10.1787/9789264183933-en, for all other countries. Tax rates are as of 1 April 2012 (except 1 July 2012 for AUS and BRA and 4 April 2012 for ZAF); energy use data is for 2009 from IEA (2014), *IEA World Energy Statistics and Balances* (database), Doi: http://dx.doi.org/10.1787/data-00513-en. Figures for CAN, IND and USA include only federal taxes.

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In energy terms, the variation in country averages is very wide, from effective tax rates of less than EUR 0.001 per GJ in Indonesia and Russia, to EUR 6.58 per GJ in Luxembourg. Luxembourg has the highest rate even though its tax rates on most fuel products are not among the highest. Although transport tax rates in Luxembourg are low compared to transport tax rates in neighbouring jurisdictions, the resulting high proportion of transport to total energy generates a high overall tax rate. This is because transport tax rates in Luxembourg are higher than the rates applied to heating and process and electricity in other jurisdictions. The variation in rates among the selected partner economies is narrower: in addition to Indonesia and Russia, economy-wide tax rates on energy in Brazil, China and India range from EUR 0.28 and EUR 0.35 per GJ and in South Africa and Argentina are EUR 1.25 and EUR 1.84 per GJ, respectively.

Similarly, there is a wide range of effective tax rates on CO_2, when measured on an economy-wide basis, as set out in the right panel of Figure 21. Consistent with the approach of this report these figures take into account all specific taxes on energy whether or not they are explicitly intended to tax carbon emissions. The lowest economy-wide effective tax rates on CO_2 are found in Indonesia and Russia (EUR 0.002 and EUR 0.006 respectively). China and India have an average effective tax rate on carbon emissions from energy of EUR 3.4 and 3.12 per tonne CO_2, respectively, while South Africa has an effective tax rate of EUR 13.86 per tonne CO_2.

In addition to the underlying tax rates, the size of the different use categories in each country, and particularly the share of transport in total energy use, influences the economy-wide tax rates. Since the transport category is taxed at higher rates in every country except Brazil, the share of transport energy in total energy will influence the economy-wide effective tax rates, as seen for Luxembourg. Conversely, countries with a comparatively small share of transport energy, notably China, Iceland, India, Russia and South Africa, will tend to have slightly lower rates than they would if the shares of transport energy were standardised between countries.

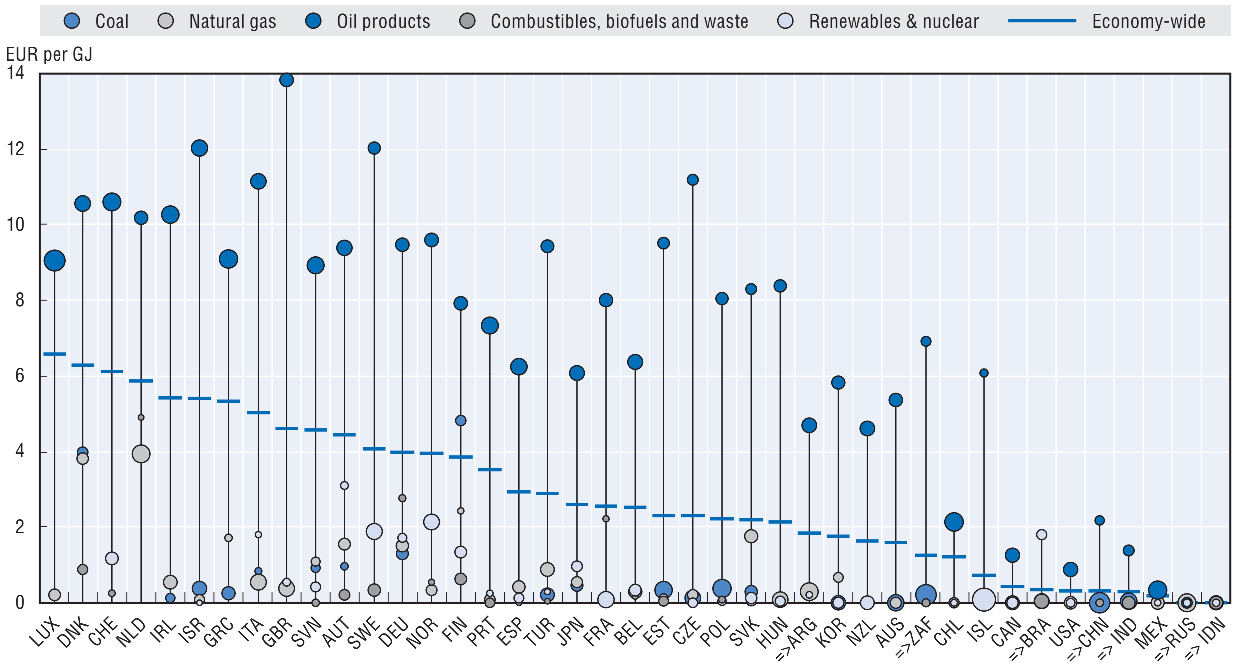
The highest overall tax rates on CO_2 tend to be seen in countries which are members of the European Union. In these countries, energy tax policy is significantly shaped by the 2003 EU Energy Taxation Directive, which sets minimum tax rates for a wide range of energy commodities. Many countries with the highest effective tax rates on CO_2 in Figure 21 are countries with explicit carbon taxes (e.g. Denmark, Iceland, Ireland, Norway, Sweden and Switzerland). Eastern European countries tend to have lower effective tax rates on CO_2 and Australasia, the Americas, and Asian economies have the lowest tax rate and typically tax only a small share of total energy use.

3.5.2. Economy-wide effective tax rates on fuels

The economy-wide effective tax rates shown for each country in Section 3.5.1 are the result of the differing tax rates applied to different fuels and users of fuel within each country. As shown above, tax rates on oil products are typically higher than those applied to other energy products. This is particularly the case in transport energy, where oil, being the dominant fuel for road use, is taxed at comparatively high rates relative to other fuels and users. Coal and natural gas, which are primarily used for heating and process and electricity generation energy rather than in transport, are taxed at much lower rates for all uses, and coal in particular is often untaxed. Renewables are almost exclusively used in electricity generation and are subject only to the implicit taxes from consumption taxes on energy.

These patterns can be seen in Figures 22 and 23, which set out the effective tax rate for each major fuel group in each country, together with the economy-wide effective tax rates set out in Figure 21. The size of the circle for each fuel represents the share of that fuel in total energy use (Figure 22) and total carbon emissions (Figure 23). Fuels representing less than 5% of total energy use in that country were excluded for clarity. These graphs illustrate the patterns described above. In all countries except Brazil, oil is taxed at the highest effective rate, and is typically the only tax rate above the economy-wide effective tax rate, demonstrating the role of transport in determining economy-wide averages. Conversely, most other fuels are taxed at comparatively low rates, or at zero.

Figure 22. **Summary of energy use and effective tax rates on energy for each fuel and on an economy-wide basis**



Source: OECD calculations for selected partner economies; OECD (2013b), *Taxing Energy Use – A Graphical Analysis*, Doi: http://dx.doi.org/10.1787/9789264183933-en, for all other countries. Tax rates are as of 1 April 2012 (except 1 July 2012 for AUS and BRA and 4 April 2012 for ZAF); energy use data is for 2009 from IEA (2014), *IEA World Energy Statistics and Balances* (database), Doi: http://dx.doi.org/10.1787/data-00513-en. Figures for CAN, IND and USA include only federal taxes.

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3.5.3. Tax rates on energy and CO_2 – Summary squares profiles

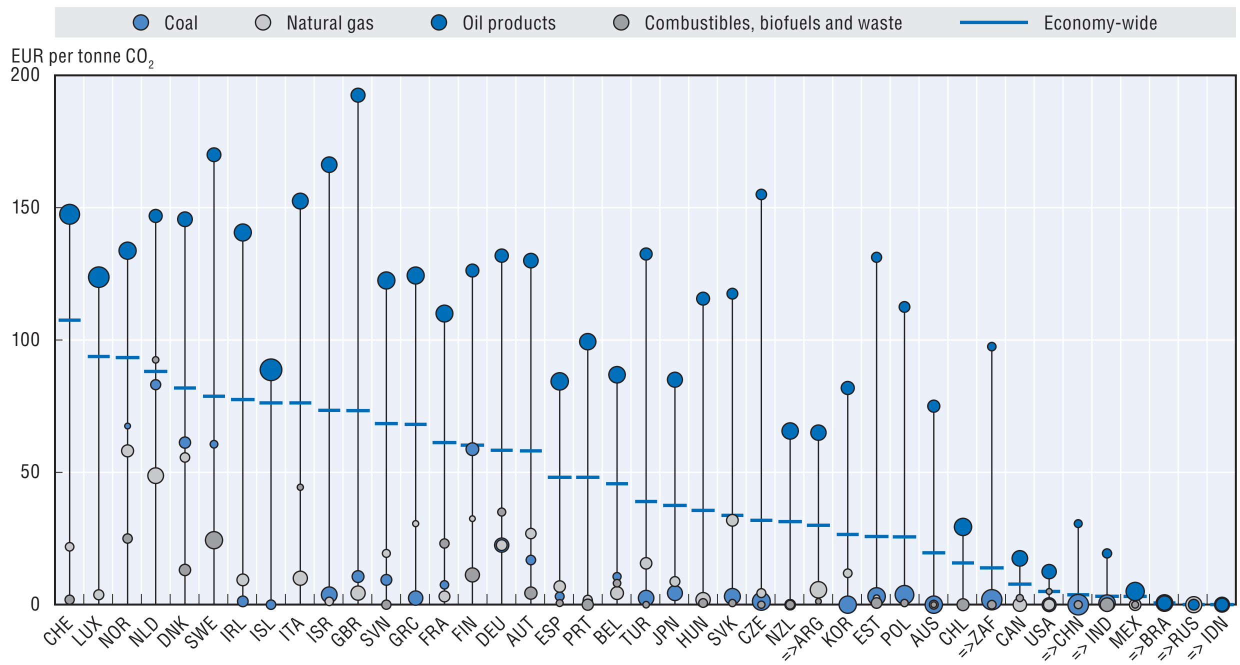
The full detail of the energy tax picture in each country is set out in the detailed graphical profiles of energy use and taxation shown in Part II of this report, and in *Taxing Energy Use – A Graphical Analysis* (OECD, 2013b). This information can however be condensed into a summary square of energy use and taxation in each country. Figure 24 shows these summary squares of the effective tax rates in terms of energy and carbon content in each of the 41 countries considered. Each of the squares represents the total amount of energy use in each country. The shading shows the proportion of energy subject to each tax rate, from EUR 0 per GJ (white) to over EUR 25 per GJ (black). The dot in each box shows the economy-wide average effective tax rate in that country. Its placement indicates where the mean sits in the percentile distribution of effective tax rates.

As for the summary statistics above, these summary squares highlight the wide variation in effective tax rates on carbon both within and across country economies. Typically, the highest tax rates in each country, the darkest shaded area, are the tax rates on oil products in transport.

3.6. Energy, GDP and population

To better understand the different patterns of energy use and taxation observed across the 41 countries considered, these patterns are put into the broader context provided by other economic and demographic indicators, particularly GDP (adjusted for purchasing power parity, PPP) and population.

Figure 23. **Summary of carbon emissions from energy use and effective tax rates on carbon from energy use for each fuel and on an economy-wide basis**



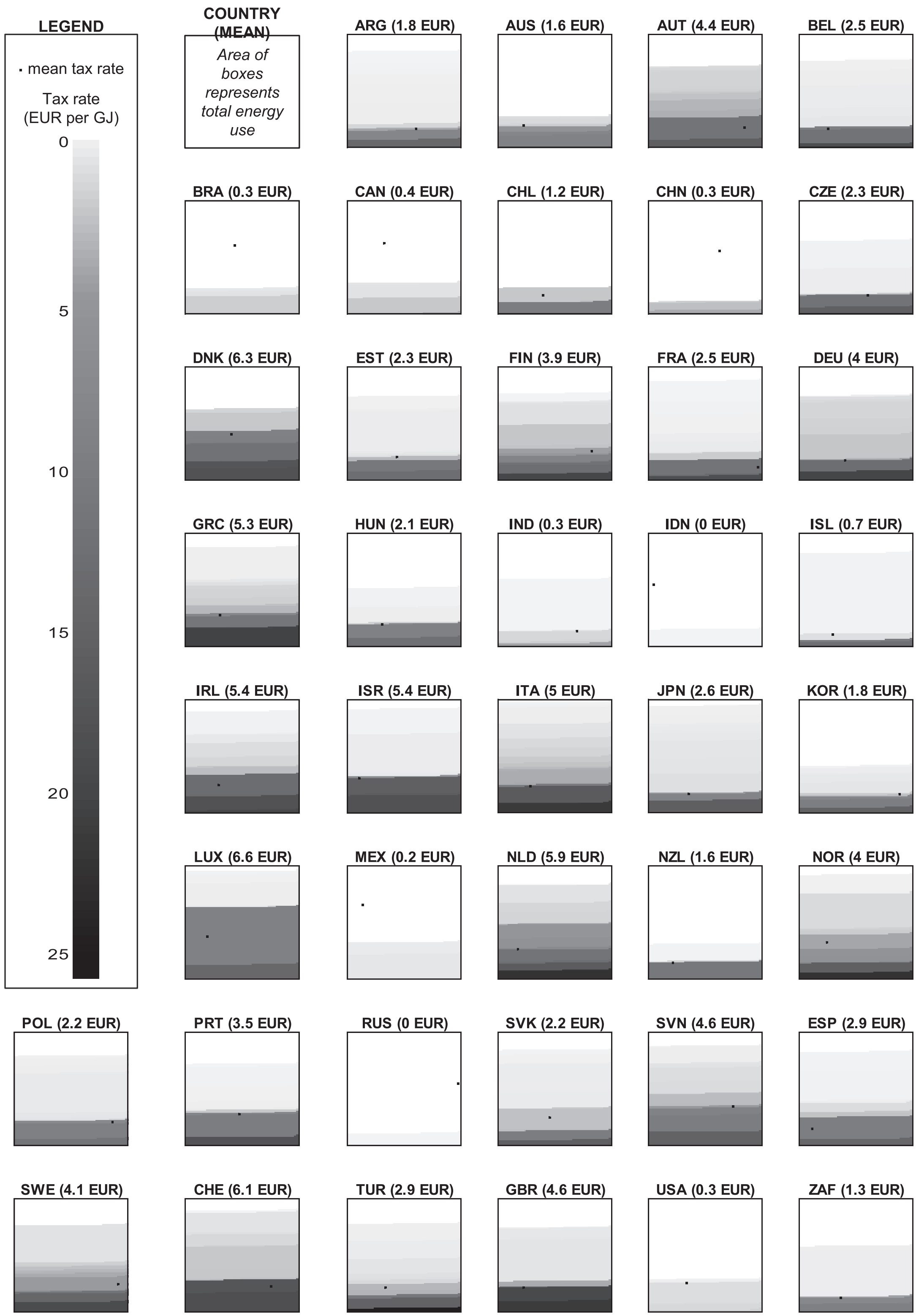
Source: OECD calculations for selected partner economies; OECD (2013b), *Taxing Energy Use – A Graphical Analysis*, Doi: http://dx.doi.org/10.1787/9789264183933-en, for all other countries. Tax rates are as of 1 April 2012 (except 1 July 2012 for AUS and BRA and 4 April 2012 for ZAF); energy use data is for 2009 from IEA (2014), *IEA World Energy Statistics and Balances* (database), Doi: http://dx.doi.org/10.1787/data-00513-en. Figures for CAN, IND and USA include only federal taxes.

StatLink http://dx.doi.org/10.1787/888933205768

The countries considered in this report have vastly different levels of energy use, population and GDP. Comparing the total level of these variables between countries is therefore not helpful in understanding broader patterns of energy use in these countries. However, the relationships between these variables can be compared across countries: energy use or carbon emissions per capita or the energy or carbon efficiency of GDP allow a common basis of consideration across countries. The relationship between these variables differs over time, as described in Section 1.3. The relationships between energy use, carbon emissions from energy use, population and GDP are summarised in Figure 25.

Figure 26 shows, for each of the 41 countries considered, the amount of energy used per capita (on the horizontal axis) against the carbon efficiency of energy use in that country (on the vertical axis). The area under and to the left of each country's position is therefore the level of carbon emissions per capita in each country. A country with a low level of energy use per capita may, for example, have the same level of emissions per capita as a country with higher energy use per capita but a less carbon intensive energy mix: compare for example Denmark and Sweden, which both have around 10 tonnes of carbon emission per person but have very different characteristics of carbon intensity and energy use per capita.

Figure 24. **Summary squares of energy taxation in each country**



Source: OECD calculations for selected partner economies; OECD (2013b), adapted from *Taxing Energy Use – A Graphical Analysis*, Doi/ http://dx.doi.org/10.1787/9789264183933-en, for all other countries. Tax rates are as of 1 April 2012 (except 1 July 2012 for AUS and BRA and 4 April 2012 for ZAF); energy use data is for 2009 from IEA (2014), *IEA World Energy Statistics and Balances* (database), Doi: http://dx.doi.org/10.1787/data-00513-en. Figures for CAN, IND and USA include only federal taxes.

StatLink http://dx.doi.org/10.1787/888933205775

Figure 25. **Relationships between energy use, carbon emissions from energy use, population and GDP**

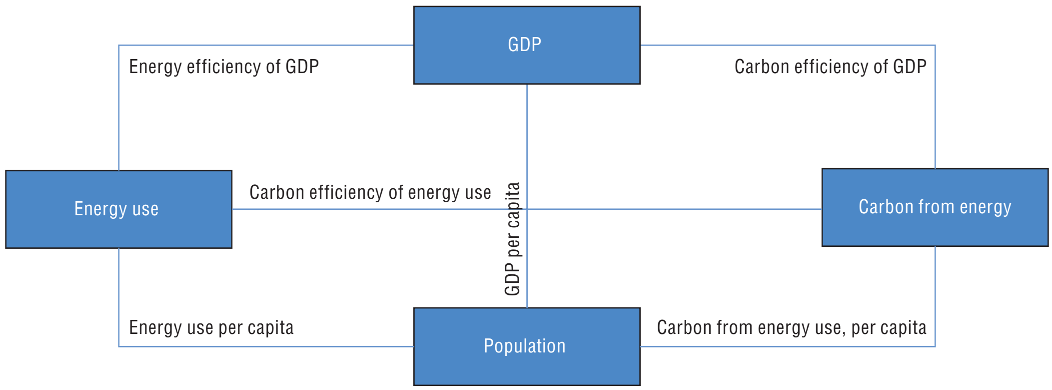
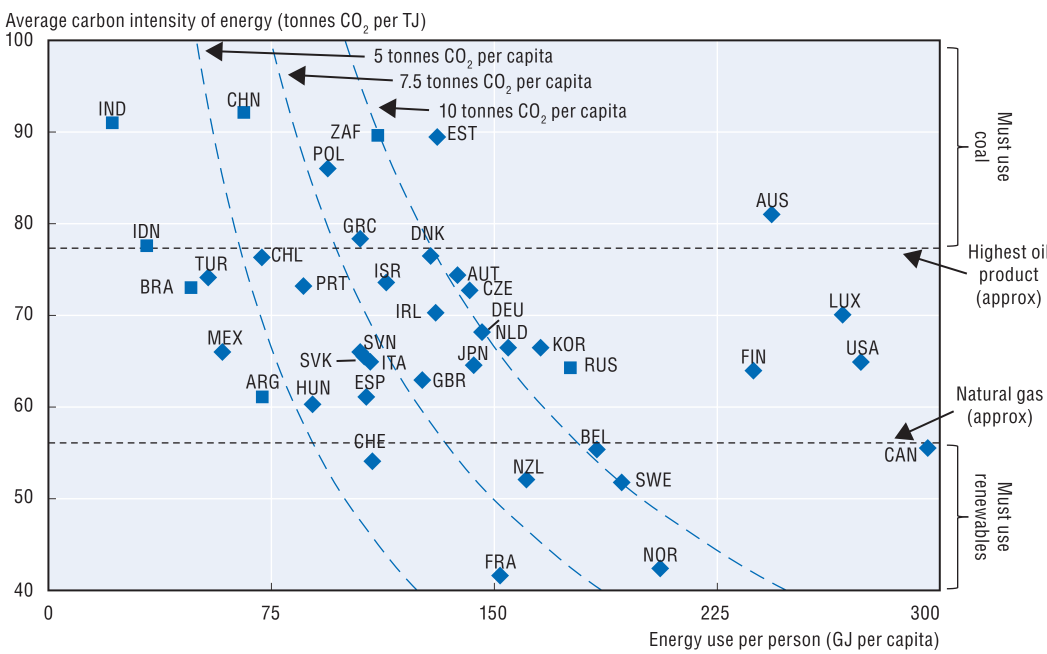


Figure 26. **Energy use per capita and carbon intensity of energy use**



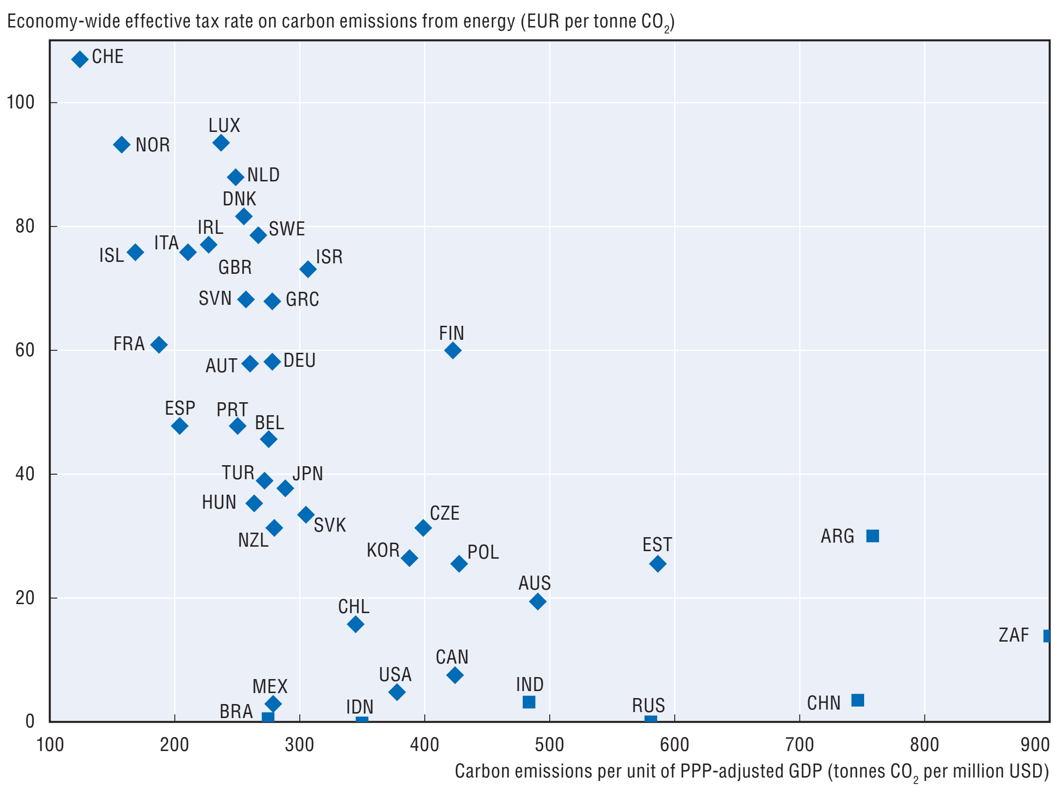
Source: OECD calculations for selected partner economies; OECD (2013b), *Taxing Energy Use – A Graphical Analysis*, Doi: http://dx.doi.org/10.1787/9789264183933-en, and the *World Development Indicators* (World Bank, 2014b).

StatLink http://dx.doi.org/10.1787/888933205784

On the figure, the curved dotted lines show the position on the graph of 5, 7.5 and 10 tonnes of CO_2 per person, respectively, for different levels of carbon intensity and energy use per capita. The horizontal dotted lines show the approximate carbon intensities of natural gas and the most carbon intensive oil product. Natural gas has one of the lowest carbon intensities of any energy source, other than nuclear and renewable energy sources. Therefore, any country which is positioned below this line must have a significant share of renewables or nuclear as part of their energy mix. Similarly, the upper horizontal line denotes the carbon intensity of fuel oil, the highest most-commonly used oil product. Countries above this line therefore must have a significant proportion of coal in their energy mix. A position between these two lines is less clear-cut; countries in this area may have a mix of any energy source, including coal or renewables, but their overall carbon intensity is not dominated by either renewables or coal.

Effective tax rates can also be considered against these broader economic characteristics. Figure 27 shows a simple scatterplot of the effective tax rates on CO_2 emissions from energy use in the 41 countries against their respective carbon intensities of GDP (measured in tonnes of carbon per USD million, adjusted for purchasing power parity). Carbon intensity in relation to GDP is determined by both the relative energy efficiency of GDP and the carbon intensity of the energy mix in each country. Countries with a relatively high carbon intensity of GDP are shown towards the right-hand side, while countries with a relatively low carbon intensity of GDP are located towards the left-hand side of the figure. High carbon intensity of GDP is usually due to relatively low energy-efficiency or due to a relatively carbon-intensive fuel mix (for example, countries that use a high proportion of coal are shown toward the right of the figure), while countries at the left-hand side of the figure are either more energy efficient or have a relatively low-carbon fuel mix (for example, due to a high share of renewable or nuclear energy).

Figure 27. **Average effective tax rates on CO_2 from energy and carbon intensity of GDP (PPP-adjusted)**



Source: OECD calculations for selected partner economies; adapted from OECD (2013b), *Taxing Energy Use – A Graphical Analysis*, Doi: http://dx.doi.org/10.1787/9789264183933-en, for all other countries. Tax rates are as of 1 April 2012 (except 1 July 2012 for AUS and BRA and 4 April 2012 for ZAF); energy use data is for 2009 from IEA (2014), *IEA World Energy Statistics and Balances* (database), Doi: http://dx.doi.org/10.1787/data-00513-en. Figures for CAN, IND and USA include only federal taxes.

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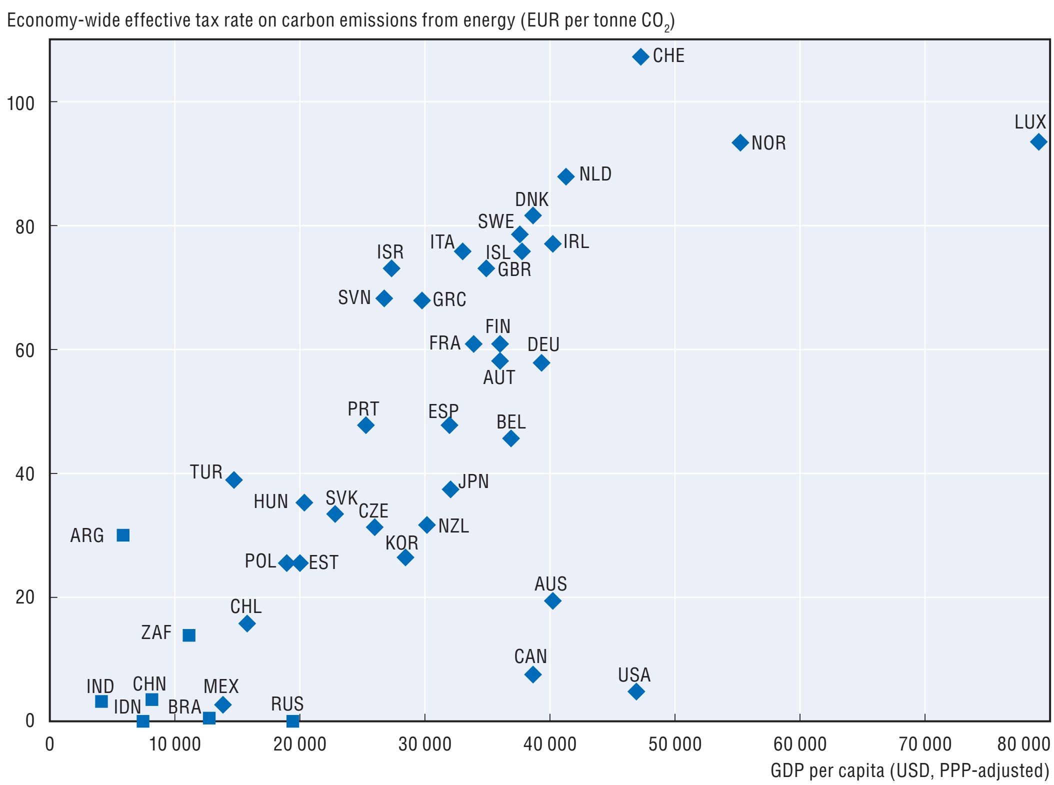
Figure 27 indicates that countries with higher average effective tax rates on CO_2 tend to have less carbon-intensive economies (measured as lower carbon emissions per unit of GDP). While this correlation does not imply causation, it suggests that there is a linkage. It also does not indicate the direction of any causation that may exist. A low carbon intensity may be the result of increased efficiency or different fuel mixes used, partially as a result of higher taxes on carbon. Conversely, a country which has a carbon-intensive GDP may find it more feasible to have a higher tax rate on carbon.

Countries with lower tax rates on carbon less clearly fit the pattern observed among other countries. This may be for two reasons. Firstly, in many of these countries, particularly in the selected partner economies, government intervention in energy markets through non-tax pricing measures means that the energy taxes shown on the right-hand axis of Figure 27 are a less complete indication of the government's energy policy settings than in the other countries. A further possible explanation is that many countries with low tax rates on carbon emissions from energy use have lower per capita incomes, which appear to be positively correlated with energy tax rates, as shown in Figure 28.

Figure 28. **Average effective tax rates on CO_2 from energy and GDP (PPP-adjusted) per capita**



Source: OECD calculations for selected partner economies; OECD (2013b), *Taxing Energy Use – A Graphical Analysis*, Doi: http://dx.doi.org/10.1787/9789264183933-en, for all other countries. Tax rates are as of 1 April 2012 (except 1 July 2012 for AUS and BRA and 4 April 2012 for ZAF); energy use data is for 2009 from IEA (2014), *IEA World Energy Statistics and Balances* (database), Doi: http://dx.doi.org/10.1787/data-00513-en. Figures for CAN, IND and USA include only federal taxes.

3.7. Conclusions

Energy taxes have an important impact on energy use patterns, economic outcomes and the environment through their impact on the overall and relative prices of energy products. The cross-country analysis presented in this report has highlighted the wide diversity of tax rates that apply both across and within the 41 countries for which graphical profiles have been presented in either this report or in *Taxing Energy Use – A Graphical Analysis* (OECD, 2013b). As well as taxes on energy use, many non-tax policies, together with differential rates of value-added taxes, also impact the prices of energy products for different fuels and fuel users. Considering taxes against this broader backdrop is important in understanding the broader policy signals provided in respect of energy use.

The 41 countries analysed in this chapter represent just over 80% of global energy use, and 84% of carbon emissions from energy use, in 2009. The seven selected partner economies that are the focus of this report account for around 36% of energy use in 2009, a share that has grown quickly and is expected to rise rapidly in the coming decades – along with these countries' weight in the world economy.

The selected partner economies discussed in this report are not a homogenous group in terms of their energy use or taxation patterns and should not be construed as such. Nonetheless, certain common themes emerge across several of these countries. On an economy-wide basis, the selected partner economies are among the jurisdictions which have comparatively low average effective taxes on energy use, relative to the full group of 41 countries discussed in this chapter. Underpinning this economy-wide picture, some commonalities emerge in the treatment of different fuels or fuel users. Several of the selected partner economies tax coal at very low rates, or do not tax coal at all, despite its comparatively high environmental and other social costs. Across all 41 countries considered, with the sole exception of Brazil, road transport is taxed at higher rates than other uses of energy in the same jurisdiction, although road transport rates also vary considerably between countries. Diesel for road use is taxed at lower rates in energy terms than gasoline for the same purpose in 39 of the countries considered, including in all selected partner economies except Brazil.

Taxes are one means by which governments can influence the prices of energy products. In addition, as discussed in the introductory chapter, the impact of differential VAT rates and of the main non-tax energy policies influencing producer prices is also important in understanding the broader price signals provided in respect of energy use. Many countries, including some selected partner economies, allow lower VAT rates on some types of energy. The use of non-tax pricing instruments is more common in some of the selected partner economies than it is on average. These policies often, but not always, result in relatively low end-user prices for energy. Considering both the effective tax rates on energy and the non-tax pricing measures, the emerging picture for several of these countries is one of moderate to low end-user prices for energy.

In practice, energy taxation and pricing policies pursue several – and often competing – purposes. Taxes on energy products may be set primarily to raise revenue, but they can also be used to integrate the costs of environmental and health damage into prices, so that energy users take these costs into account in their production and consumption decisions. Taxes and pricing policies may also be designed to keep energy prices low for reasons of equity to contain inflation or to stimulate economic growth. The weight given to these and possibly other motives in decisions related to energy taxes and pricing policy differs between countries due to their economic, social, and energy resource characteristics, and evolves over time.

Ideally, energy tax and pricing policies should aim to align end-user energy prices of energy with marginal production and social costs, as this helps the economy make the most productive use of resources while ensuring the well-being of the population and the environment in the most cost-efficient manner. Other policy objectives, including equity and economic development, are of course of strong importance in this discussion. However, economic analysis would suggest that where more targeted policy instruments exist for pursuing these objectives, these instruments should be used in preference to those that blunt or reduce the price signals provided in respect of energy products.

The role of price signals for energy use should also be considered in a dynamic sense, in terms of the signals they provide to long-term decisions that will influence future energy use patterns. There are advantages to bringing end-user energy prices more in line with production and environmental costs earlier rather than later. The reason is that decisions with difficult-to-reverse impacts (e.g. in relation to land use) or with long term impacts (e.g. investments in electricity generating plants or in transport infrastructure) are influenced by expectations of future energy prices, which in turn are affected by current prices and policies. Hence, if current prices accurately reflect production and societal costs, long-term decisions will support future energy use patterns with lower social costs, by encouraging more efficient or less-polluting energy use. Tax instruments therefore provide price signals that can help to modify the energy mix towards less harmful fuels, improve energy efficiency, or reduce demand for energy, both on a static and dynamic basis.

The uneven price signals with respect to different energy products, and the low tax rates that apply to many of them, suggest that with few exceptions the 41 countries considered do not harness the full power of taxes on energy use for environmental purposes. However, there is evidence that countries are progressing in this direction due to rising awareness of the negative side-effects of some sources of energy use and of the urgency of environmental problems related to some types of energy use. Among the selected partner economies, for example, China has introduced cap-and-trade systems that cover the second-largest amount of CO_2 emissions and is undertaking numerous measures to combat air pollution. Similarly, India is in the process of deregulating oil product prices, and has introduced a Clean Energy Cess on coal use, recently doubling the rate. In many selected partner economies, efforts are underway to stimulate the use of renewables in electricity generation, and across the 41 countries considered many are pursuing the G20 objective of phasing out inefficient support measures for fossil fuels. Such policies are indispensable to the promotion of sustainable development, which will require accommodating strong growth of energy use while containing the negative side effects. Taxes on energy are therefore an important part of the policy mix that can help to ensure that countries pursue their economic, social, and environmental objectives as effectively as possible.

Notes

1. Over the period considered, annual GDP has grown on average in all countries considered, so that considering changes over time approximates changes by GDP.
2. The USA is one of several countries with high per capita energy use and carbon emissions. Spain is a country of moderate energy intensity and carbon intensity of energy. In terms of energy use, like Spain, the Netherlands are a modal country but compared to Spain (and similar countries) it uses more energy per capita and energy is more carbon-intensive. The United Kingdom takes an intermediate position between Spain and the Netherlands.
3. The United States does not have a nationwide VAT. State-wide sales taxes are collected in 45 states, while 38 states collect local sales taxes. The five states with the highest average combined rates are Tennessee (9.45%), Louisiana (8.89%), Washington (8.88%) and Oklahoma (8.72%), while the five

states with the lowest average combined rates are Alaska (1.69%), Hawaii (4.35%), Wisconsin (5.43%), Wyoming (5.49%) and Maine (5.5 %).

4. The table excludes VAT concessions which may be related to energy use, but that are not directly related to fuels, such as VAT concessions for passenger transport or agriculture.
5. The EU VAT Directive requires a standard rate of at least 15% and reduced rates of at least 5%. The latter can only be applied to the set of goods and services listed in Annex III of the Directive. For more detail, see: *http://ec.europa.eu/taxation_customs/taxation/vat/how_vat_works/index_en.htm#vat_overview*.
6. Brazil also levies a higher rate of social security contributions on the sales revenue of energy products, translating into a higher specific taxation of energy products.
7. A detailed analysis of the distributional effects of consumption taxes can be found in OECD (2014).
8. Information on ETS is primarily taken from World Bank (2014).
9. The CO_2 emission figures have been derived from fuel use volumes using standard physical conversion factors from the sources set out in Annex A (see p. 212-13). This is possible since CO_2 emissions are generally fixed for given quantities of particular fuel types (subject to variations in fuel quality) regardless of the particular combustion technology used.

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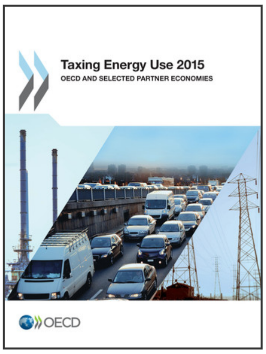

Taxing Energy Use 2015

OECD and Selected Partner Economies

Please cite this chapter as:

OECD (2015), “Taxing energy use in the 41 countries”, in *Taxing Energy Use 2015: OECD and Selected Partner Economies*, OECD Publishing, Paris.

DOI: https://doi.org/10.1787/9789264232334-3-en