Report for Transport & Environment

Fair & Low Carbon Vehicle Taxation in Europe

A comparison of CO_2-based car taxation in EU-28, Norway and Switzerland

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Content

Abstract

In order to be able to achieve the European Union's emission reduction targets for new passenger cars and to make real progress regarding the actual emissions of the road transport sector, European countries have to improve and sharpen their policy instruments at hand. There is plenty of room to align the fiscal incentive scheme with climate and environmental policy goals by using the available vehicle and related taxes much more efficiently.

Looking at the 28 European member countries plus Norway and Switzerland, many cases of well-designed and effective vehicle taxation are available. This paper compares the different tax systems and derives several policy recommendations. For eight countries (Belgium, France, Germany, Italy, Netherlands, Portugal, Spain, and United Kingdom), a more detailed comparison along four example vehicles was conducted and a ranking was compiled.

The first chapter takes a look at the progress made so far. Some countries have reduced average emission values substantially, but the growing gap between these type-approval and real-world values is alarming and has some serious implications for climate policy, CO_2-based vehicle taxation and tax revenues, consumers and manufacturers. The second chapter gives a broad overview over vehicle taxation in all countries under consideration, focusing on their CO_2-based components, and looks at each tax in more depth in the subsections. Chapter 3 gives a systematic comparison of the different tax systems by calculating and comparing actual tax amounts for a selection of eight countries. Some noteworthy examples of good and bad practice are highlighted in chapter 4. The last chapter derives several policy recommendations regarding the use and design of vehicle taxes.

1 Introduction

The European Union has set mandatory emission reduction targets for new vehicles in order to improve fuel economy and reduce the total CO_2 emissions of the road transport sector in Europe. By 2021, the EU-wide fleet value for passenger cars has to be reduced to 95 grams of CO_2 per kilometre (gCO_2/km). For the years until 2030, the European Commission propose that average CO_2 emissions will have to be 37.5% lower compared to 2021. The intermediate target is to reduce emissions by 15% until 2025. The 95g target thus applies until and including 2024.

Some progress has been made since regulation 443/2009 of the European Parliament setting emission performance standards for new passenger cars was adopted in 2009. Figure 1 shows that all 28 EU member countries plus Norway and Switzerland have been moving towards the target.

The largest change (-65.5 g/km) can be seen in Sweden. The country started from the last place though, and it is still far behind countries like Norway or the Netherlands. A very high share of battery electric and plug-in hybrid vehicles (29% of passenger car registrations in 2016) is one reason for Norway's very low average CO_2 emissions. The Netherlands achieved their progress with fewer electric vehicles (6%). Denmark and Portugal, too, have very low emission values despite a very low electric share (<1%). The countries with the lowest reductions between 2006 and 2016 are Slovakia, Hungary and Poland. The unweighted average for all countries fell from 163.8 g/km in 2006 to 118.8 g/km in 2016 – minus 45 g/km in 10 years.

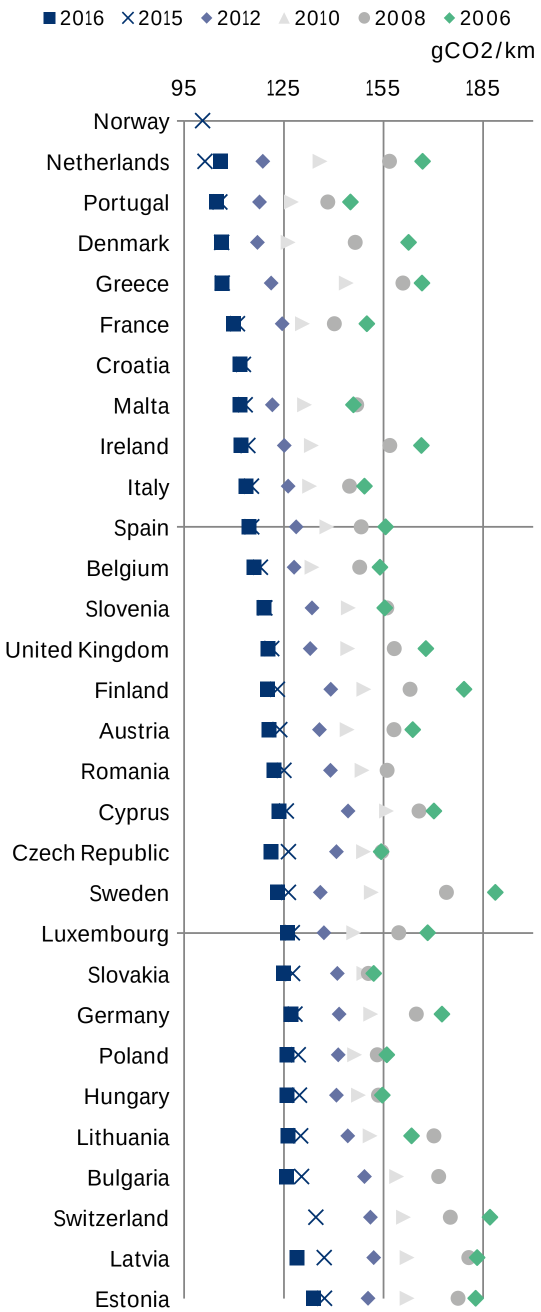
Vehicle taxation is a key determinant of progress made and the current level of emission values. All countries under consideration have different tax systems. They levy various vehicle-related taxes with different tax bases, rates, etc. This paper compares passenger car taxation among these countries and identifies some key features of fair, low carbon taxation. Specifically, this paper looks at:

- taxes upon registration,
- taxes on acquisition,
- periodical taxes on ownership,
- taxation of company cars
- and fuel taxes.

Countries with well-designed, CO_2-based taxes, most importantly registration taxes, appear to perform way better in terms of reducing average CO_2 emission values.

Nevertheless, there is plenty of room for improvements in all countries, and further improvements are absolutely essential. It is far from certain whether the target of 95 gCO_2/km (EU average) will be reached. Also, most of the progress made so far only exists on paper. The CO_2 emission values, which are measured on the test stand have been diverging from real-world values. The gap between both values widened quickly from 14% in 2006 to 42% in 2016 (ICCT/TNO 2017). This implies that the reduction of CO_2 emission values has had a much weaker impact in terms of actual CO_2 emissions from the road sector. It is also undermining the policy efforts of CO_2-based taxation.

Figure 1: Average CO_2 emissions from new passenger cars by year of registration (2006-2016)



Source: based on Eurostat (2017); FleetNews (2016); Statista (2017)

The CO_2 Emissions Gap

As mentioned before, the gap between type-approval and real-world CO_2 emission values for passenger cars has widened to around 42% in 2016 (ICCT/TNO 2017). The enormous gap is a serious problem for many reasons. Firstly, the EU's emission reduction targets are diluted, if the reductions on the test stand have only limited impact on real-world emissions.

Secondly, CO_2-based vehicle taxation is losing its effectiveness and efficiency, because the tax base is extremely distorted. The emissions gap is impairing the instruments' steering effect and governments' revenues (FÖS 2018). The following chapters show that most European countries have implemented CO_2-based car taxation elements over the last two decades. Such climate policy efforts require reliable emission values safeguarded by a rigorous regulatory framework and realistic test procedures.

Beyond the political dimension, unreliable CO_2 emission values are also detrimental to consumers and car manufacturers (ICCT 2016). Consumers base their buying decisions on unreliable fuel consumption values, which are equivalent to CO_2 values and bear unexpected running costs in the future. At the same time, manufacturers are competing on a heavily distorted market, focusing on the test stand rather than the real world. Manufacturers with more realistic values suffer a disadvantage on many dimensions. Their cars appear more climate-damaging on paper and they are taxed at higher rates, if taxation is based on CO_2.

The introduction of the Worldwide harmonized Light vehicles Test Procedure (WLTP) in 2017 will reduce the emissions gap to some extent. But it will not close it entirely. Stewart et al. (2015) estimate for the United Kingdom that the WLTP will reduce the gap to the still very large number of 23% in 2020, and they expect it to rise again in the following years.

2 Vehicle Taxation in Europe

The most relevant taxes for buyers, owners or users of passenger cars are value added taxes (VAT), additional sales or registrations taxes, periodical taxes on ownership like annual vehicle taxes, fuel taxes as well as income tax on the use of company cars. They have a significant impact on the total costs of ownership and thus determine, depending on their design, consumer choices.

Table 1 on page 6 gives an overview of passenger car taxation in the EU28, Norway and Switzerland. In recent years, many countries have adopted taxes or tax components based on CO_2 emissions or, equivalently, fuel consumption (bold and highlighted in grey).

All countries under consideration have value added taxes, which apply to a vehicle's price. However, there are exemptions or special regulations in some states, especially for electric vehicles. For example, electric vehicles are required to pay neither VAT nor registration tax in Norway (Norwegian Customs 2018), which is a huge financial advantage. Applicable VAT rates vary widely between countries. For EU member states, the legal minimum VAT rate is 15%.

Most European countries impose one-off taxes on the acquisition of cars (e.g. registration tax, sales tax; see chapter 2.1) and periodical taxes on ownership (e.g. road tax, motor vehicle tax; see chapter 2.2). These taxes are usually based on car characteristics like weight, cylinder capacity, fuel consumption or CO_2 emissions. In most cases CO_2-based tax components have been introduced within the last two decades. Taxes that are (partly) based on CO_2 are highlighted in Table 1.

Only few countries have introduced CO_2-related elements in the taxation of company cars. The private use is usually taxed as income, based on a percentage of the vehicle's price. The taxation of company cars is described in more detail in chapter 2.3.

Like VAT, fuel taxes are one of the most common taxes across countries. Taxes on gasoline, diesel etc. are imposed in all thirty countries under consideration. For EU member states, minimum rates are applicable, but the taxed rates above the minimum vary widely. The taxation of fuels, especially alternative fuels like electricity, is neither coherent between nor within most countries. This creates incoherent price structures, which often benefits diesel. The taxation of fuels is looked at in chapter 2.4.

Table 1: Passenger car taxation in EU28 + NO, CH (CO_2- and fuel consumption related taxes highlighted)

Country	VAT	Registration/Purchase	Ownership	Use of company car (taxable benefit)
Austria	20%	Price, CO_2 emissions, fuel type, CO_2-based malus	Engine power	18% (per year) of cost price (24% for cars above CO_2 threshold); maximum rates apply
Belgium	21%	CO_2 emissions, Cylinder capacity, age, regions	CO_2 emissions, cylinder capacity	4-18% (per year) of list price depending on CO_2 and fuel type times 6/7 and age-based correction; CO_2-based "solidarity contribution"
Bulgaria	20%	-	Engine power	Taxed as a benefit or companies pay 10% of related costs
Croatia	25%	CO_2 emissions, fuel type	Engine power, age	No information
Cyprus	19%	CO_2 emissions, cylinder capacity	CO_2 emissions	No information
Czech Republic	21%	-	Engine size	12% (per year) of the actual purchase price
Denmark	25%	Fuel consumption, safety equipment	Fuel consumption, weight	25% (per year) of the value of the car price up to DKK 300,000; 20% of the rest; environmental fee equivalent to the car's green owner's tax based on fuel consumption
Estonia	20%	-	-	From 2018, benefit based on vehicle capacity and age (regular rate 1.96€/kW, 1.47€/kW for vehicles older than 5 years)
Finland	24%	CO_2 emissions, price	CO_2 emissions, weight x days	10.8-16.8% (per year) of cost price or 17-19 cent/km depending on year of first registration
France	20%	CO_2 based Bonus-Malus system	CO_2 emissions	9% (per year) of cost price; 12% if employer pays fuel; the rate is reduced by 3% points if the car is older than 5y
Germany	19%	-	CO_2 emissions and cylinder capacity	12% (per year) of list price plus factor based on commuting distance
Greece	24%	CO_2 emissions, price	CO_2 emissions or cylinder capacity	4%-22% (per year) of net retail price (rate increases with price)
Hungary	27%	Age, cylinder capacity	Age	Taxable benefit based on engine power (in kW); motor vehicle tax is deductible
Ireland	23%	CO_2 emissions, price	CO_2 emissions	6-40% (per year) of original market value depending on CO_2 thresholds and business mileage (not yet operational)
Italy	22%	Kilowatt, weight, seats	Engine power	30% of 15,000km per year are assumed to be for personal use and taxed at a rate per kilometer determined by the Italian Automobile Club (ACI)
Latvia	21%	Weight, fuel type	Weight, cylinder cap., engine power	€348-€744 (per year) depending on cylinder capacity
Lithuania	21%	-	-	No information
Luxembourg	17%	-	CO_2 emissions or cylinder capacity	6-21.6% (per year) depending on fuel type and CO_2 emissions
Malta	18%	CO_2 emissions, price, vehicle length	CO_2 emissions, vehicle age	22% (per year) of list price (if private use >500km/year), 4% for zero emission cars
Netherlands	21%	CO_2 emissions, fuel efficiency	CO_2 emissions, weight, province, fuel	Taxable benefits (per year): 0-35% (per year) of list price depending on CO_2 emissions, fuel type and age
Poland	23%	Cylinder capacity	-	3,000-4,800 PLN (per year) depending on cylinder capacity
Portugal	23%	CO_2 emissions, cylinder capacity	CO_2 emissions and cylinder capacity	0-20% (per year) depending on purchase price and fuel type
Romania	19%	CO_2 emissions, cylinder capacity, exhaust emissions	Cylinder capacity	No information
Slovakia	20%	Engine power, age	Cylinder capacity	12% (per year) of cost price
Slovenia	22%	CO_2 emissions, price	Cylinder capacity	18% (per year) of cost price
Spain	21%	CO_2 emissions, price	Engine rating	20% (per year) of cost price; reduction if low private use; since 2016, reduction for alternative vehicles (incl. Euro 6)
Sweden	25%	-	CO_2 emissions, weight	9% (per year) of list price + additional components based i.a. on interest rate; reductions for "green cars" apply

Country	VAT	Registration/Purchase	Ownership	Use of company car (taxable benefit)
United Kingdom	20%	- (CO_2-based 'first year rate' of ownership tax)	By fuel since 2018; CO_2 emissions, cylinder capacity until 2017	37% (per year) of list price if income is >£8,500 per annum; discounts based on CO_2 emissions and fuel type
Norway	25%	CO_2 emissions, weight, exhaust emissions, fuel type	Motor vehicle tax replaced by "Traffic insurance tax" in 2018	30% (per year) of list price; reductions for electric cars
Switzerland	7,7% +4%[1]	-	Engine power, cylinder capacity, weight, fuel	9.6% (per year) of cost price excl. VAT

Source: based on ACEA (2016), ACEA (2017a), complementary information from 1Office (2017), Corporate Vehicle Observatory (2016), Deloitte (2016), Harding (2014), Kuljus (2017), Trafikkforsikringsforeningen (2017)

[1] The Swiss car tax amounts to 4% of the imported car value (ACEA 2017a). It is a tax on the acquisition of a car, but is more similar to VAT than other registration/purchase taxes in all other countries.

2.1 Registration/purchase taxes

Taxes on the registration or acquisition of vehicles are often found to be a very effective instrument in terms of CO_2 reductions (see e.g. Adamou et al. (2014), Brand et al. (2013), D'Haultfœuille et al. (2014), Gerlagh et al. (2016), Kok (2015)). The additional upfront costs are a clear price signal and fiscal incentive to the buyer.

The effectiveness, of course, depends on the tax design, most importantly the tax amount. In contrast to annual vehicle or fuel taxes, which incur over an indefinite time horizon and are likely to change, one-off taxes upon registration are much easier to take into consideration when buying a car.

It is therefore not surprising that countries with CO_2-based taxes on registration or purchase tend to have lower average CO_2 emission values. Figure 2 shows all thirty countries ranked by their average CO_2 value for new passenger car registrations in 2015. There is a clear distinction between countries with CO_2-related taxation (green) and countries with no (grey) or different tax systems (blue) – with the exception of Italy. Other tax bases like engine power or weight correlate only roughly with CO_2 and are thus less accurate.

Of course, Figure 2 does not imply causality, but it supports the scientific findings that well-designed taxes upon acquisition can be an important climate policy instrument.

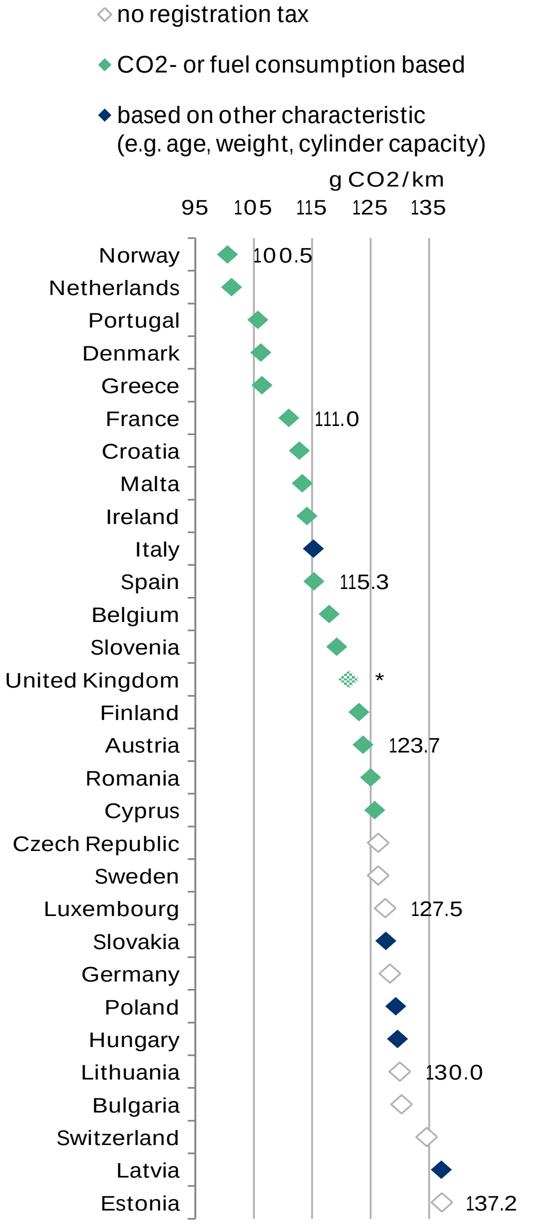
It is worth mentioning that there are important differences within the group of countries with CO_2-related taxation. The Netherlands, Denmark and France, for instance, have very high fiscal incentives. The bonus-malus system in France not only punishes the purchase of high-emission vehicles, but also grants premiums for low-emission vehicles. The state-induced cost incentives between low- and high-emission vehicles can easily amount to several thousand euros, which is usually a relevant fraction of the vehicles' price.

The effectiveness of a tax clearly depends on its design. A CO_2-related but weak tax may not have any significant impact at all. Several important design elements to consider are described in the case studies in chapter 4.

Despite their effectiveness, several countries, including Sweden, Germany, Luxembourg and Switzerland, do not impose any registration tax at all. This may partly explain their rather high CO_2 values.

Almost all European countries subsidize the purchase of electric vehicles (see e.g. European Environment Agency 2016). These subsidies are often, but not always, implemented as an exemption from registration taxes.

Figure 2: Registration taxes and average CO_2 emissions in 2015



* The vehicle excise duty (VED) in the United Kingdom is a periodical tax levied on car ownership. Its first year rates, however, are different from the standard rates; they have the effect of an implicit registration tax.

Source: based on ACEA (2017a), Eurostat (2017), FleetNews (2016), Statista (2017)

2.2 Taxes on ownership

Vehicle ownership (including leased cars) is usually taxed on a periodical, often annual basis. The most common tax bases are engine power, engine size or cylinder capacity (e.g. in horse power or cc) and CO_2 emissions. In Germany, for example, the annual motor vehicle tax is based on cylinder capacity, differentiated by diesel and gasoline, and type-approval CO_2 emissions. Every additional gram of CO_2 above 95 is taxed at two euros.

Taxes on ownership are less effective than registration taxes regarding the reduction of CO_2 emission values (see e.g. Alberini/Bareit (2017), Gerlagh et al. (2016), Malina (2016)). The financial implications of the recurring tax are harder to evaluate in advance, among other things, because the holding period is uncertain and tax laws may change. In many cases, CO_2 is only one of several tax components. The financial advantage of buying a low-emission vehicle is less clear. Consumers are thus less sensitive to ownership taxes than to one-off registration taxes with a clear price signal. The impact on the buying decision is hence rather low.

Ownership taxes, like registration taxes, also do not affect usage. The tax is independent of actual kilometres driven or litres of fuel consumed, so there is no impact on actual emissions of CO_2. The instrument is not suited to address neither average CO_2 emission values nor actual CO_2 emissions.

Despite the lower environmental effectivity, many countries have adopted CO_2-based ownership taxes (see Table 1). The periodical taxes generate a constant stream of revenues, because a country's fleet does not change quickly. The predictability is of course a great advantage for governments' budgets.

Most European countries subsidize the ownership of electric vehicles (see e.g. European Environment Agency 2016). These subsidies are often implemented as an exemption from motor vehicle taxes. This is the case for example in Germany. The CO_2- and cc-based annual tax does not apply to electric vehicles. Instead, EVs, which are usually heavier than comparable conventional cars without battery, are taxed based on their total permitted weight, like trucks. There is however a temporary tax exemption for the first five years after registration.

The case of Germany illustrates that many vehicle taxes in Europe are not yet aligned with recent technological developments. Often, there is no logic in the taxation of alternative technologies.

Table 2 shows three variations of a 2017 VW Golf VII (diesel, electric and gasoline), the main vehicle attributes and the corresponding tax amounts. The three examples demonstrate the incoherencies in German motor vehicle taxation.

The CO_2-based tax component (€2 for every gram above 95 g/km) creates a clear incentive for conventional cars, but cannot be applied to electric vehicles. The tax rate for cylinder capacity differs for gasoline and diesel (€2 and €9.50 for every 100 cc, respectively). Since Germany does not have a target to reduce cc, this distinction is not purposeful and distorts competition. Cylinder capacity is not a good indicator for engine performance, which could be a more suitable tax base. It also cannot be applied to electric vehicles. These are instead taxed based on their total permitted weight.

The German motor vehicle tax is not technology-neutral and creates contradicting tax incentives. The cc and weight components do not follow a clear political goal and are not applied consistently. The CO_2 component has a political goal, but cannot be applied uniformly across all vehicle types. A more coherent, goal-oriented and accurate taxation of conventional and alternative vehicles is desirable.

Table 2: Motor vehicle tax examples for Germany

Attributes	VW Golf VII (2017) 1.0 TSI BMT	e-Golf	GTD
Fuel type	Gasoline	Electric	Diesel
cubic capacity (cc)	999	-	1,968
gCO_2/km	109	0[1]	116
kilowatt	81	100	135
horsepower, PS	85	136	184
Perm. weight, kg	1,720	2,020	1,890
list price, €	22,875	35,900	32,425
Motor vehicle tax, annual tax amount	**€48**	**€62** [2]	**€232**
By tax component			
CO_2	€28	-	€42
cc	€20	-	€190
weight	-	€62	-

Sources: ADAC Autodatenbank for attributes. Own calculations

[1]Electric cars have zero CO_2 emission in use, but the generation of electricity may be accompanied by high emissions depending on the energy source.

[2]Electric vehicles are exempted from the motor vehicle tax for the first five years after registration.

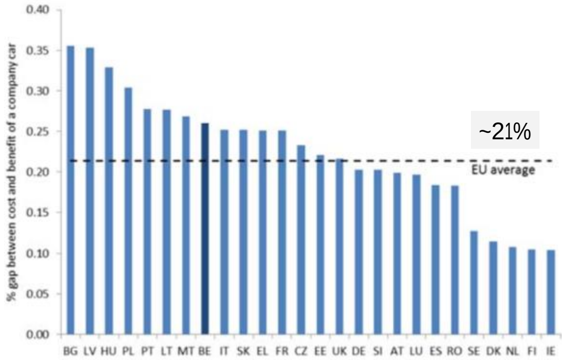
Other countries, of course, face the same problem. In many cases, battery electric vehicles (BEV) are simply exempted from taxation. Under CO_2-based taxation the tax amount often just turns out to be zero. In Spain, annual ownership taxes are based on a calculated engine rating, which leads to unfavourable tax rates for electric vehicles. In most regions, tax rates for BEV are therefore reduced by 75%. In the case of a Renault Zoe, the annual tax amounts to €3 (see Annex A). Tax rates are however generally very low, so that the Spanish tax on car ownership is unlikely to have any incentivizing effect.

2.3 Company car taxation

The use of a company car for private purposes without reimbursement is defined as a benefit in kind (BIK) that has to be added to the taxable income of the beneficent. In most European countries, the BIK is calculated as a percentage of the car's list or cost price (see also Table 1). But the real financial benefit of privately using a company car often exceeds the BIK by far, which constitutes a subsidy to the employee (as well as the use of a car instead of other modes of transportation). The subsidy disproportionally benefits people with higher incomes and encourages the purchase and use of larger, more expensive cars (Damert/Rudolph 2018; Jacob et al. 2016). Studies in different countries show that the undertaxation of company cars also causes employees to make use of it more excessively (Harding 2014). The privilege promotes car usage, aggravating air pollution and CO_2 emissions and should be considered an environmentally harmful subsidy (Princen (2017), UBA (2014)).

Figure 3 (Princen 2017) compares the level of subsidization among European countries. It shows the percentage gap between the company cost of providing a car and the taxable benefit of using a car. This indicator shows that company cars appear to be undertaxed in all countries. The size of the gap is however very different. The gap amounts to around 35% in Bulgaria, because, among other things, the flat rate for calculating the BIK is only 10% (see Table 1). On the other end of the spectrum, the rate in Ireland ranges from 5-30% depending on business/private mileages. In the future, the system will also take into account CO_2 emissions and the rate will range from 6-40% (ACEA 2017a).

Figure 3: Subsidy for private use of company cars



The subsidy is calculated as the percentage gap between the company cost of providing a car and the taxable benefit of using a car.

Source: Princen (2017)

In Belgium, the applicable rate is determined by a formula that is linearly increasing with CO_2. The resulting rates, which are applied to the list price and an age correction factor, are rather low. The tax incentive is thus weak despite its dynamic tax design. According to own calculations, the rate is approximately 5% at 90 gCO2/km and 14.4% at 199 g.

One result of the high subsidization is the high and rising share of commercially registered passenger cars. In Germany, for example, 65% of all new passenger cars in 2016 were registered by companies. Not all of them are also used privately though (e.g. rental cars or cars registered by dealers). The share for top-end vehicles, which are often heavier and less fuel efficient, is even higher: 88% according to UBA (2014). Company cars thus shape a country's composition of new cars significantly. Via the second-hand market they also have a substantial long-lasting effect on the overall fleet (Jacob et al. 2016).

Taxation based on environmental aspects, e.g. fuel efficiency, emissions or distance travelled for private purposes, would incentivize smaller, less environmentally harmful cars and less car use. It could have long lasting positive effects, as observed in the UK when the company car tax bill was reformed. Taxation is now based on a car's CO_2 emission value, and company car drivers have been choosing cars with lower values since the reform (Her Majesty's Revenue and Customs (HMRC) 2006). The number of registered company cars also declined: by 250,000 between 2001 and 2003 (ibid.). The reform was a main reason for employers and employees to give up their company cars (ibid.). Additionally, a change in the taxation of free fuel for private use made it less attractive to grant this incentive, resulting in a reduction of private mileage driven in company cars (ibid.).

Similar effects were observed in the Netherlands, where a tax reform towards a CO_2-based system, including company car taxation, resulted in a decrease of 11% average CO_2 emissions (13 g/km) and a higher share of electric vehicles (Kok 2015). The subsidization of company cars is also among the lowest in EU countries (see Figure 3).

2.4 Fuel taxes

While registration taxes, ownership taxes, etc. address efficiency of the vehicle itself, fuel taxes address the demand for fuel directly – and thus actual CO_2 emissions. Every litre of fossil fuel contains a certain amount of carbon dioxide and a tax puts a price on every gram emitted. Fuel taxes are hence most suitable to internalize climate costs.

Fuel taxes are imposed in all countries under consideration, and the EU Energy Tax Directive provides minimum rates for member countries. Tax rates vary considerably between countries and fuels though. In particular, diesel is taxed at a lower rate than gasoline in most countries (see Figure 4), although it has a considerably higher energy and carbon content. It has to be taken into account though that the different VAT rates across countries multiply the effect on final fuel prices at the gas station.

Well-designed energy taxation should be based on the principle of equivalence, i.e. fuels should be taxed according to their energy and/or carbon content (see e.g. FÖS/IKEM 2016, Transport & Environment 2017). This implies that diesel should be taxed at a higher rate than gasoline. The current system thus, grants diesel an unjustified cost advantage, which in turn increases demand for and production of diesel cars.

A removal of the tax gap has been called for by many actors (e.g. European Commission 2011, OECD 2012) and several European countries have started reducing the gap (see e.g. Damert/Rudolph 2018) or announced to so, like Belgium and France.

Additionally, tax rates should be harmonized in order to restrict tax competition between countries and avoid a race to the bottom. Lower rates in centrally located countries like Luxembourg attract additional revenues from fuel tourism and they are a challenge to neighbouring countries that want to implement more progressive fuel taxation.

This chapter only looks at diesel and petrol, because they are still the most common types of fuel for passenger cars. The taxation of electricity is not yet adapted to the electrification of transport and a consistent comparison between countries is difficult. Tax rates vary even more widely and are often depending on the charging location or the consumer. In most countries, electricity is taxed at much lower rates than conventional fuels, because, among other things, they are not intended to contribute to road financing. In the long term, the electrisation of transport necessitates new road financing models like intelligent road pricing.

Figure 4: Diesel and petrol tax rates, in Euro/1000 liter; diesel share in new car registrations in 2016

Source: graph based on ACEA (2017a), Federal Customs Administration (2017), The Norwegian Tax Administration (2016); diesel share calculated using EEA (2017) data

[1] Includes a tax on CO_2

3 Country Ranking

Chapter 3 looks at a selection of eight countries and gives a systematic comparison of the different tax systems by calculating and comparing actual tax amounts. The ranking is based on the total of the four individual tax rankings. For each tax, countries were ranked according to the differential between the highest and the lowest tax amounts payable (or taxable benefit-in-kind for company cars) for the four vehicles under consideration. The ranking thus takes into account the level of taxation (as an indicator of effectiveness) and the degree of differentiation (as an indicator of efficiency).

The sum of all rankings is not weighted, although it is obvious that some taxes are more important than others. In particular, registration taxes and company car taxation appear to have a much higher impact on buying behaviour than taxation of car ownership. It is however difficult to justify specific weights that could be applied.

The individual rankings are shown and explained in chapter 3.2.

Table 3: Country ranking of passenger car taxation in eight countries

Country	Ø gCO_2/km new registrations 2016	Ranking of tax system					
		Registrations	Ownership	Company Cars	Fuel	Total	Rank
Netherlands	105.9	1	1	2	8	12	**1**
Portugal	104.7	2	3	3	5	13	**2**
United Kingdom	120.1	6	5	1	1	13	**2**
Belgium	115.9	4	2	5	4	15	**4**
Italy	113.5	7	4	7	2	20	**5**
France	109.8	3	7	8	3	21	**6**
Spain	114.4	5	8	4	7	24	**7**
Germany	127.0	8	6	6	6	26	**8**

Sources: ACEA (2017a, 2017b, 2018), Eurostat (Passenger cars by age [road_eqs_carage])

The Netherlands are in the first place because of their high and differentiated vehicle taxes. Registration as well as ownership taxes are high and (partly) based on CO_2 emission values. Computation of the benefit-in-kind is also high and CO_2-based. The tax system seems to have a positive effect on average CO_2 emission values, which are among the lowest in the EU28. On the downside, the Netherlands have the largest gap in fuel taxation.

Germany can be found at the bottom of the ranking. In terms of taxation, buying, owning and fuelling a car (preferably a big diesel company car) is comparatively cheap. The absence of any registration tax is a wasted opportunity to incentivise a reduction in average CO_2 emission values, which are among the highest in the EU28. Ownership taxes are CO_2-based, but tax rates are too low to be effective.

Portugal and the United Kingdom share the second rank. The UK appears to score on the wrong taxes though. Registration taxes in particular seem to be too low to be effective and the average emission value (120.1 gCO_2/km) is rather high.

3.1 Country and vehicle selection

Tax amounts payable are calculated for eight countries (Belgium, France, Germany, Italy, Netherlands, Portugal, Spain, and United Kingdom) and four cars (see Table 4).

The countries chosen represent the seven largest EU car markets (in terms of fleet size in 2016, excluding Poland). The Netherlands are of particular interest, because all taxes under consideration are directly or implicitly linked to CO_2. Belgium is of particular interest because of its company car market and the CO_2-based taxation of company cars.

The cars were selected in order to cover a wide range of tax-relevant vehicle characteristics with representative models from various segments. The most relevant characteristic for this report is the CO_2 emission value (or equivalently fuel consumption). Therefore, the Renault Zoe was chosen as the best-selling zero-emission vehicle (B-segment small cars). The VW Golf was chosen as the best-selling car in Europe (C-segment medium cars). The Audi A4 was chosen as a representative company car (diesel, D-segment large cars). The Mercedes-Benz GLE350d was chosen as a high-emission SUV (J-segment sport utility cars).

The vehicle characteristics and assumptions presented in Table 4 were used for the calculations of tax amounts payable. OEMs offer slightly different vehicles in different countries. Characteristics were tried to match the car specifics as close as possible.

Table 4: Vehicle characteristics and assumptions

	Renault Zoe (R90)	VW Golf VII 1.0 TSI	Audi A4 2.0 TDI	Mercedes-Benz GLE350d
Euro market segment	B – small	C – medium	D – large	J - SUV
Fuel type	Electric	Gasoline	Diesel	Diesel
Euro norm	-	Euro 6b	Euro 6b	Euro 6c
CO_2 emissions (g/km)	0	109	109	199
List price incl. VAT (Euro)[a]	23,818	21,333	38,078	66,899
List price excl. VAT (Euro)[a]	19,771	17,709	31,609	55,543
Purchase price (assumption 10% off)	21,437	19,199	34,271	60,209
cc	-	999	1,968	2,987
Empty weight (kg)	1,502	1,237	1,615	2,175
kW	68	81	110	190
kWh battery capacity	22	.	.	.
Assumed vehicle age	2.4 [c]	9.9 [b]		
Assumed annual mileage (private use)	12305 km [d]			
Average fuel/energy consumption per 100km	13,3kWh	4.8l	4.2l	7.5l
Annual fuel/energy consumption	1,729kWh	624l	546l	975l

Sources and explanations: [a] entry prices for basic models (i.e. without options) from national OEM websites weighted by fleet size in 2016 of eight countries under consideration (Eurostat; road_eqs_carage); [b] average age of passenger cars in 2016 (ACEA 2018) weighted by fleet size); [c] sales-weighted average age (2012-2017, worldwide); [d] mileage by country (data from T&E's EUTRM model) weighted by fleet size.

3.2 Tax calculations

The tax amounts payable for each car in each country were calculated using information from the ACEA Tax Guide 2017 (ACEA 2017a). In some cases information was taken from additional sources. If available, official tax calculators were used to confirm the calculations.

Registration taxes

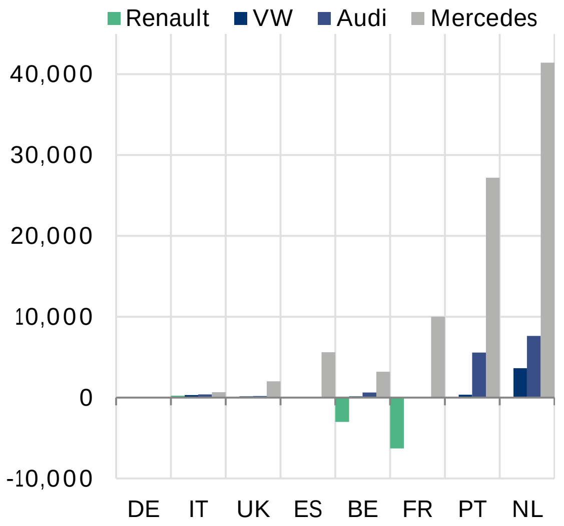
As mentioned in chapter 2.1, registration taxes are often found to be the most effective incentive in terms of reduce the average CO_2/km emission of car fleets.Figure 5 shows the tax amount payable for the four cars in all eight countries. The amounts differ significantly between countries.

Taxation is very high in the Netherlands and Portugal, especially for high-emission vehicles. Tax rates are high and highly differentiated (by CO_2). Germany does not levy any registration tax. In Italy, tax rates are very low with little differentiation. Also, the tax is not based on CO_2 but kilowatts. In the UK, tax rates are highly differentiated but comparatively low.

The tax system in Spain appears ineffective. Due to the very rough differentiation, only the Mercedes-Benz falls into the taxable region, which only starts at 120 gCO_2/km.

Belgium and France have built their subsidisation of BEV into their tax systems. Registration taxes are negative for such cars (Bonus-Malus-Schemes).

Figure 5: Registration tax payable (Euro)



Source: own calculations

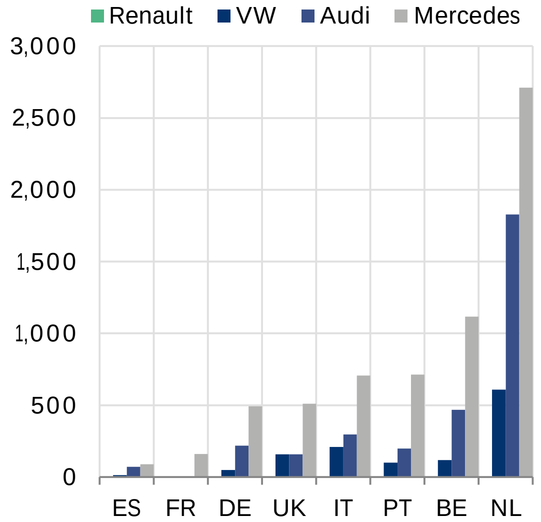
In Annex A (Table 7 on page 24) tax curves can be found for six countries. The curves show how the CO_2-based tax component changes with every g/km. The curves visualise the incentive structure of the tax system with respect to CO_2 emission values. To understand a tax incentive structure it is illuminating to look e.g. at the curve's steepness, minimum and maximum and its effective range. In the case of France, for instance, the tax curve is very steep, but only between 127 and 191 g/km. Below and above these thresholds there is no additional incentive to reduce emissions (except for additional bonuses for low emission vehicles).

Periodical ownership taxes

Ownership taxes are levied in all eight countries under consideration. They are generally much lower than registration taxes (mind the different scale on the y-axis in Figure 6).

Again, we see high and differentiated rates in the Netherlands. In France, there is a flat tax of €160 for passenger cars with more than 190 g/km. This only affects the Mercedes-Benz here. It is unlikely that such a tax has any effect on CO_2 emission values. The threshold at 190 g/km is way above the average of 109.8 g/km for new passenger cars in France in 2016.

Figure 6: Ownership taxes payable (Euro)



Source: own calculations

Fuel taxes

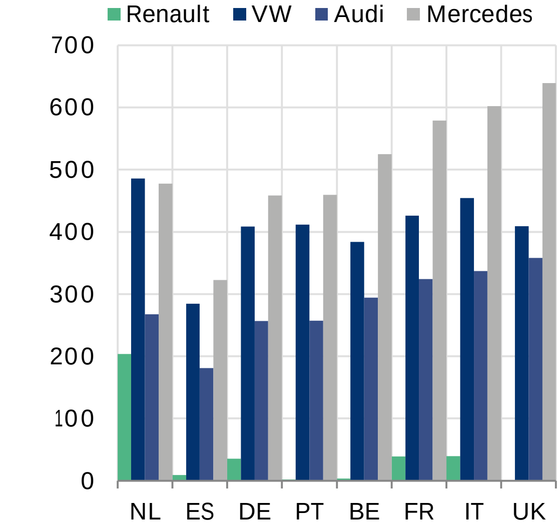
The UK is the only country under consideration without a tax gap between diesel and gasoline. Also, its diesel tax rate is highest in this group of countries and even within the EU28.

In all other seven countries, road fuel taxes favour diesel. This can be seen most clearly when comparing the VW Golf VII (gasoline) to the Audi A4 (diesel). Although both models emit 109 gCO_2/km, fuel taxes are significantly lower for the diesel car.

The tax gap in the Netherlands is so large that annual fuel taxes are higher for the VW Golf than the Mercedes-Benz GLE350d (199 gCO_2/km). The share of diesel cars is nevertheless very low. The Dutch registration tax puts a hefty surcharge on diesel (€87.38 per gram of CO_2 above 63 g/km in 2018), which amounts to almost €12,000 in the case of the Mercedes.

Electricity tax rates vary from zero (UK) to €117.8 per MWh (NL). The annual tax thus amounts to zero to €204 under the assumptions mentioned, adding to the operating cost advantage of electric vehicles.

Figure 7: Fuel taxes payable



Source: own calculations assuming an annual mileage of 12,305km and using the cars' fuel consumption values from Table 4.

Table 5 shows the total of registration, ownership and fuel taxes in the first year of registration. Countries are sorted by the amount payable for the Mercedes-Benz GLE 350d.

As mentioned before, Germany's level of taxation is very low even for luxurious high-emission vehicles. In all other seven countries, the tax systems put a significantly higher burden on such cars, discouraging the acquisition of expensive, high-emission vehicles. The differences in taxation between the C-segment VW Golf VII and the D-segment Audi A4 are however much less pronounced in most countries. Portugal and the Netherlands are notable exceptions.

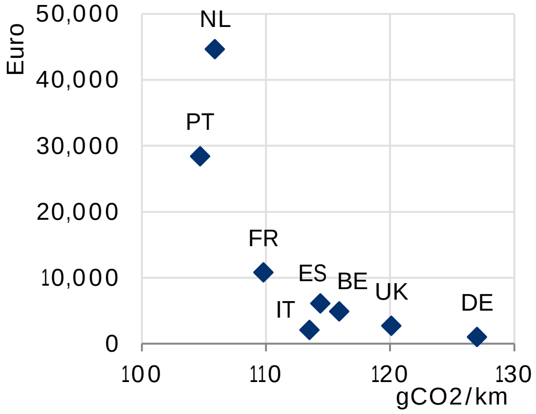
Table 5: Taxes in the first year of registration

	Total tax amount payable in first year (registration, ownership and fuel taxes)			
	Renault	VW	Audi	Mercedes
DE	35	456	475	952
IT	278	948	1,020	1,976
UK	0	165	187	1,998
BE	-2,997	652	1,364	4,819
ES	12	297	253	6,019
FR	-6,261	426	324	10,739
PT	2	847	6,038	28,356
NL	204	4,700	9,721	44,612

Source: own calculations based on ACEA (2017a), PwC (2016), Agenzia delle Entrate (2016), Government Digital Services (n.d.), HMRC (2018), Indicator (2017), Belastingdienst (2018), Grant Thornton (2018); see Annex A, Table 6Table 5 for more details.

The level of taxation seems to have a real impact. A higher first-year tax level for the high-emission vehicle is associated with a lower average CO_2 emission value. Figure 8 compares the tax amount payable in the first year of registration for the Mercedes-Benz GLE 350d (as an example for a high-emission vehicle) with the average CO_2 emission value of new registrations in 2016. This very simple correlation, of course, does not imply causation, but it is line with the findings of many studies on the effectiveness of such tax instruments.

Figure 8: Total first year taxes (Mercedes-Benz) and average CO_2 emission values



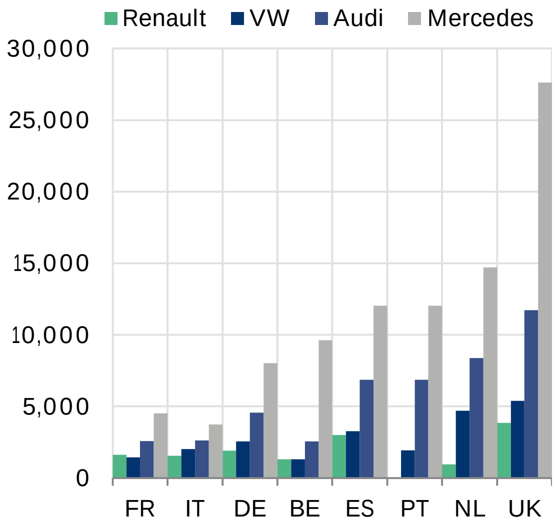
Source: own graph based on Table 3 and Table 5

Taxable benefit in kind

The taxable benefit in kind (BIK) of each car is highest in the UK. The applicable rates for the calculation of the BIK are differentiated by CO_2 bands and vary from 13% to 37%. In the Netherlands, the rate is 4% for zero emissions vehicles and 22% for all others, also resulting in high and differentiated BIK. Portugal is the only country with a 0% rate for purely electric cars.

France is on the last rank, because the total BIK and its differentiation are comparatively low. It is also the only country where the Renault Zoe has a higher BIK than the VW Golf. It has to be taken into account though that France has an additional ownership tax for company cars, which is highly differentiated by CO_2.

Figure 9: Taxable benefit in kind (Euro)



Source: own calculations

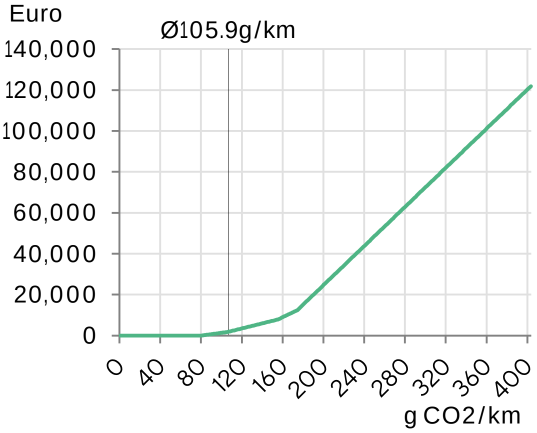
4 Case Studies

4.1 Best practice examples

The most striking feature of countries with very low average CO_2 emission values is a graduated and high taxation upon registration or acquisition. In Norway (Ø 100.5 gCO_2/km in 2015), every gram of CO_2 per kilometre can add between €100 and €370 to the registration tax bill.

In the Netherlands (Ø 105.9 gCO_2/km in 2016), the registration tax is also quickly increasing with every gram of CO_2. As shown in Figure 10, the CO_2-based component of the tax is flat up to and including 80 g/km, but rises quickly thereafter. The tax curve is very steep after 175 g/km and every additional gram costs €478 (an additional surcharge of €86.43 per gram above 67 g/km applies to diesel cars). This makes high-emission cars substantially more expensive.

Figure 10: **Dutch registration tax ("BPM"),** CO_2-related tax amount payable

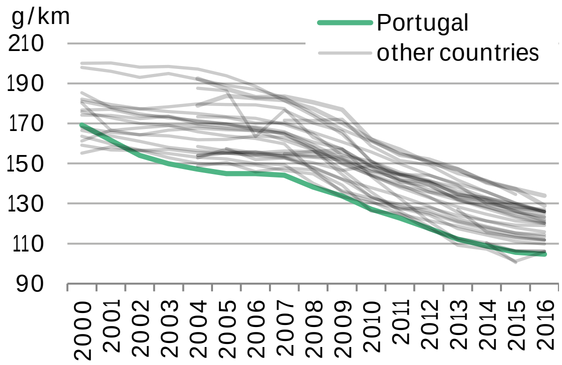


Source: graph and calculation based on ACEA (2017a), Belastingdienst (2017), FÖS (2018)

In Portugal (Ø 104.7 gCO_2/km in 2016), the registration tax (Imposto Sobre Veículos) is also highly graduated according to CO_2, but not as heavily as in the case of Norway or the Netherlands. The maximum rate is €183.34 for every gram above 195 g/km.

The tax was introduced in 1998, but has been changed frequently. Until 2006, the tax had been based on cylinder capacity (in cubic centimetres) only. The CO_2 component was added in 2006 and the according rates were increased steadily over the following years. The continuous development of the instrument might be one reason why Portugal has been among the top countries (in terms of average CO_2 emissions) for many years, as shown in Figure 11. The introduction of the CO_2 component also seems to have had a visible effect on new car registrations.

Figure 11: Ø gCO_2/km for new passenger cars (Portugal)



Source: graph based on Eurostat (2017); FleetNews (2016); Statista (2017)

Taxes on the registration or acquisition of vehicles are so effective, because they are a clear price signal and fiscal incentive to consumers. The relevant tax rates in Norway, the Netherlands and Portugal are so high that fuel-efficient, low-emission vehicles have a significant price advantage already upon acquisition. The recurring savings at the filling station are more difficult to evaluate upfront.

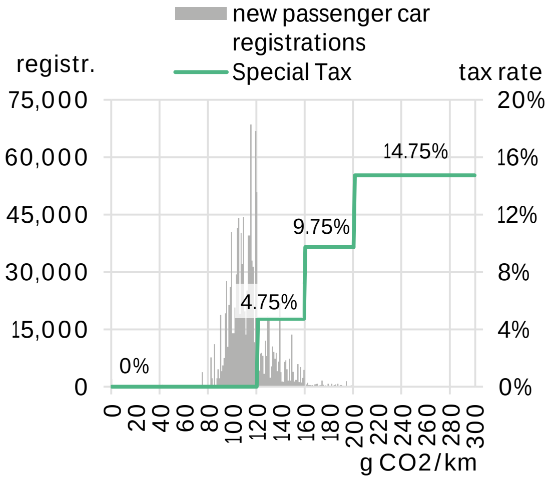
Registration taxes, of course, need to be well-designed. Visualizing the tax curves (see Figure 10 and Figure 12) is a useful way to understand its incentive structure. Some design characteristics are more effective and others may lead to unintended consequences (see next chapter). Decisions about these characteristics have to be made consciously.

4.2 Examples of bad practice

The registration tax in Spain is actually not a bad practice example, but it is a good case to illustrate how an inadequate tax design can create a weak incentive structure with unintended consequences. The tax rate (applied to the car price) is 0%, 4.75%, 9.75% or 14.75% depending on the CO_2 emission value (see Figure 12). The tax amount payable hence increases significantly at certain thresholds.

The sudden tax increase at 121 g/km has a visible effect. The number of new passenger car registrations drops markedly from 120 to 121 g/km, which is also apparent in Figure 12 (grey bars). The same holds for the next two thresholds. There are some indications that manufacturers optimize a car's last digit for CO_2 emissions in order to benefit from such incentive points in taxation schemes (Mock 2015).

Figure 12: Spanish registration tax rates and number of new registrations



Source: graph and calculation based on ACEA (2017a), EEA (2017), FÖS (2018)

The tax effectively incentivizes people to stay just below these emission thresholds, but there is no dynamic incentive to reduce emissions any further. Additionally, the limits are somewhat random, and the abrupt but steep hikes in taxation do not seem fair or logical. A more continuous tax curve (see e.g. Figure 10 for the Netherlands) has many advantages over stepwise design chosen in Spain.

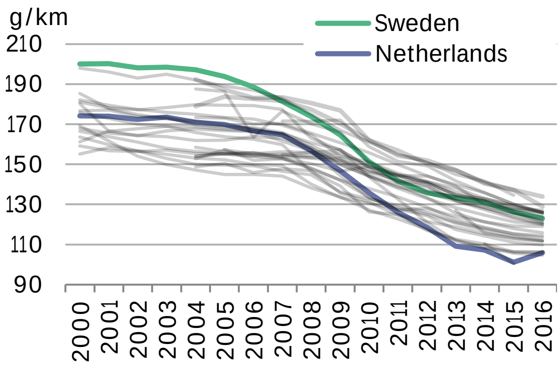
The suboptimal tax in Spain is, of course, better than having no or no CO_2-related registration tax at all.

Figure 2 indicates the importance of such taxes as a likely determining factor of CO_2 emission values of new cars. Czech Republic, Sweden, Luxembourg, Slovakia, Germany, Poland, Lithuania, Bulgaria, Switzerland, Latvia and Estonia do not levy any registration tax, and they all have comparably high average CO_2 values. This indication is supported by the literature (see e.g. Adamou et al. 2014, Brand et al. 2013, D'Haultfœuille et al. 2014, Gerlagh et al. 2016, Kok 2015). Tax competition between neighbouring countries may impair the effectiveness, if registration abroad is easy.

4.3 Policy impacts

Historically, Sweden had been among the worst performing countries under consideration for many years (see Figure 13). Its average CO_2 emission value for new passenger cars (123.1 g/km in 2016) is still way above the unweighted average of all countries (118.8 g/km). But Sweden made significant progress in the years following the introduction of a CO_2 component in its annual vehicle tax in 2005 (see e.g. Transport & Environment 2013). Between 2005 and 2016, the average CO_2 emission value fell from 193.8 g/km to 123.1 g/km (-71 g/km) – the highest absolute reduction in any country.

Figure 13: Ø gCO_2/km for new passenger cars (Sweden and Netherlands)



Source: graph based on Eurostat (2017), FleetNews (2016), Statista (2017)

The highest relative reduction for the same period of time can be found in the Netherlands (-38%). An interesting anomaly is the trend reversal in 2016 though, which is most probably due to the expiration of a tax incentive for company car drivers in 2015. The tax break was worth several thousand euros per year and its expiration supposedly led to increased sales of plug-in hybrid vehicles (Automotive News Europe 2015).

Similar incentives for electric and/or plug-in hybrid vehicles have helped to bring down emission values over the last years. An overview of purchase and tax incentives for EU countries is frequently prepared e.g. by the European Automobile Manufacturers Association (ACEA 2017b).

Such incentives can be effective in general – as long as they are in place. However, they are costly to the tax payer and often socially unjust, because a privileged group of people benefits at the expense of the society. Rather than subsidizing road transport, which has negative environmental effects beyond CO_2, well-designed vehicle taxation is usually more efficient, technologically neutral and in line with the user pays principle and fair taxation.

5 Policy Recommendations

The previous chapters reveal ample room for better taxation of passenger cars in European countries. The different taxes create price incentives that need to be well-designed and thought out in order to create a coherent system.

1. First of all, it is of high importance to close the emissions gap between type-approval and real word emission values by sharpening the regulatory framework. Taxation based on CO_2 emission values can only be effective if these values are reliable and realistic. The huge gap has been impairing taxation in many European countries on a massive scale (see FÖS 2018). Some progress is to be expected with the introduction of WLTP and RDE, but further improvements will be needed (see e.g. Stewart et al. 2015).
2. Another key recommendation is to implement or reform registration taxes, as they appear to be the main instrument regarding the reduction of average CO_2 emission values. But their effectiveness depends on a clever tax design, which includes, among other things, conscious decisions about the tax base, tax rates, tax calculations and continuous adjustments to keep up with technological advances. This is of course true for all policy instruments.
   One of the most rigorous registration taxes can be found in the Netherlands (see chapter 4.1). The tax amount is quickly increasing with every gCO_2/km and already starts at low levels (80 g/km). The country also raises CO_2-based ownership and company car taxes and has the highest score in our ranking of car taxation in chapter 3.
   Other countries also have CO_2-based registration taxes, but they are often less effective because of their less rigorous tax thresholds. In the case of Spain, steep tax thresholds have unintended consequences, because buyers and manufacturers appear to be optimizing the tax burden (see 4.2).
3. Closing the diesel tax gap is a time-critical and opportune measure. The issue has been getting a lot of attention during the diesel scandal. The scandal has created much momentum and changed the public perception. Fuels should be taxed according to their energy and carbon content to create a fair and technologically neutral playing field. Preferably, taxation should be harmonized as widely as possibly to avoid adverse tax competition and fuel tourism within the EU and beyond its external borders.
   Only in the UK are diesel and gasoline being taxed at the same rate. Countries like Belgium and France have high diesel shares (as a percentage of new registration), but they have begun closing the gap. The largest gap can be found in the Netherlands, but the diesel share is rather low (19%) due to a hefty diesel surcharge in the registration tax.
   In most European countries, the gap is so large that owning and using a diesel car is still beneficial from a tax perspective (see also Kunert 2018).
4. The taxation of vehicles needs to be prepared for the electrification of transport and the use of alternative fuels and technologies. Many questions e.g. regarding the taxation of electricity as an alternative fuel remain unanswered. So far there seem to be many temporary solutions in place that will have to be adjusted eventually. Intelligent road pricing schemes are an obvious choice, because they can address vehicle attributes and actual vehicle use as well as congestion, air pollution and other externalities from road transport. Technological advances have made it easier to set up such systems. They can also be limited to certain areas, e.g. cities or city centres, is the case in London and Stockholm. Fuel taxes, in contrast, put a price signal on every litre of fuel (and hence CO_2 emitted), but their impact on buying decisions seems to be limited. Other local instruments include environmental zones or improved parking management and pricing, which proved to be effective for example in San Francisco.
5. The taxation of company cars is in need for reform, too. The benefit of driving a company car for private purposes is not adequately covered by taxation. The current undertaxation in virtually all countries constitutes an environmentally harmful and socially unfair subsidy. Ireland has one of the most elaborate systems in the EU. The benefit in kind is calculated as 6-40% per year of original market value, depending on CO_2 thresholds and business mileage.

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Annex A – Tax Amounts

Table 6: Tax amounts payable in the first year **of registration (€)**

	Renault Zoe	VW Golf	Audi A4	Mercedes GLE
one-time registration tax (€)				
DE	0	0	0	0
IT	239	284	386	667
FR	-6,300	0	0	10,000
UK[1]	0	165	187	1,998
ES	0	0	0	5,606
NL	0	3,606	7,625	41,423
BE[2]	-3,000	150	601	3,178
PT	0	335	5,582	27,184
annual ownership tax (€)				
DE	0	48	218	493
IT	0	209	297	706
FR	0	0	0	160
UK	0	159	159	511
ES	3	13	72	90
NL	0	608	1,828	2,712
BE[2]	0	118	468	1,116
PT	0	100	199	713
fuel taxes (€)[3]				
DE	35	408	257	459
IT	39	455	337	602
FR	39	426	324	579
UK	0	409	358	639
ES	9	284	181	323
NL	204	486	267	478
BE	3	384	294	525
PT	2	411	257	459
total first year (registration, ownership and fuel taxes)				
DE	35	456	475	952
IT	278	948	1,020	1,976
FR	-6,261	426	324	10,739
UK	0	165	187	1,998
ES	12	297	253	6,019
NL	204	4,700	9,721	44,612
BE	-2,997	652	1,364	4,819
PT	2	847	6,038	28,356
taxable benefit-in-kind (€)				
DE	1,898	2,560	4,569	8,028
IT	0	2,014	2,625	3,734
FR[4]	1,608	1,440	2,570	4,516
UK	3,842	5,388	11,714	27,624
ES	3,001	3,264	6,854	12,042
NL	953	4,693	8,377	14,718
BE	1,310	1,310	2,546	9,633
PT	0	1,920	6,854	12,042

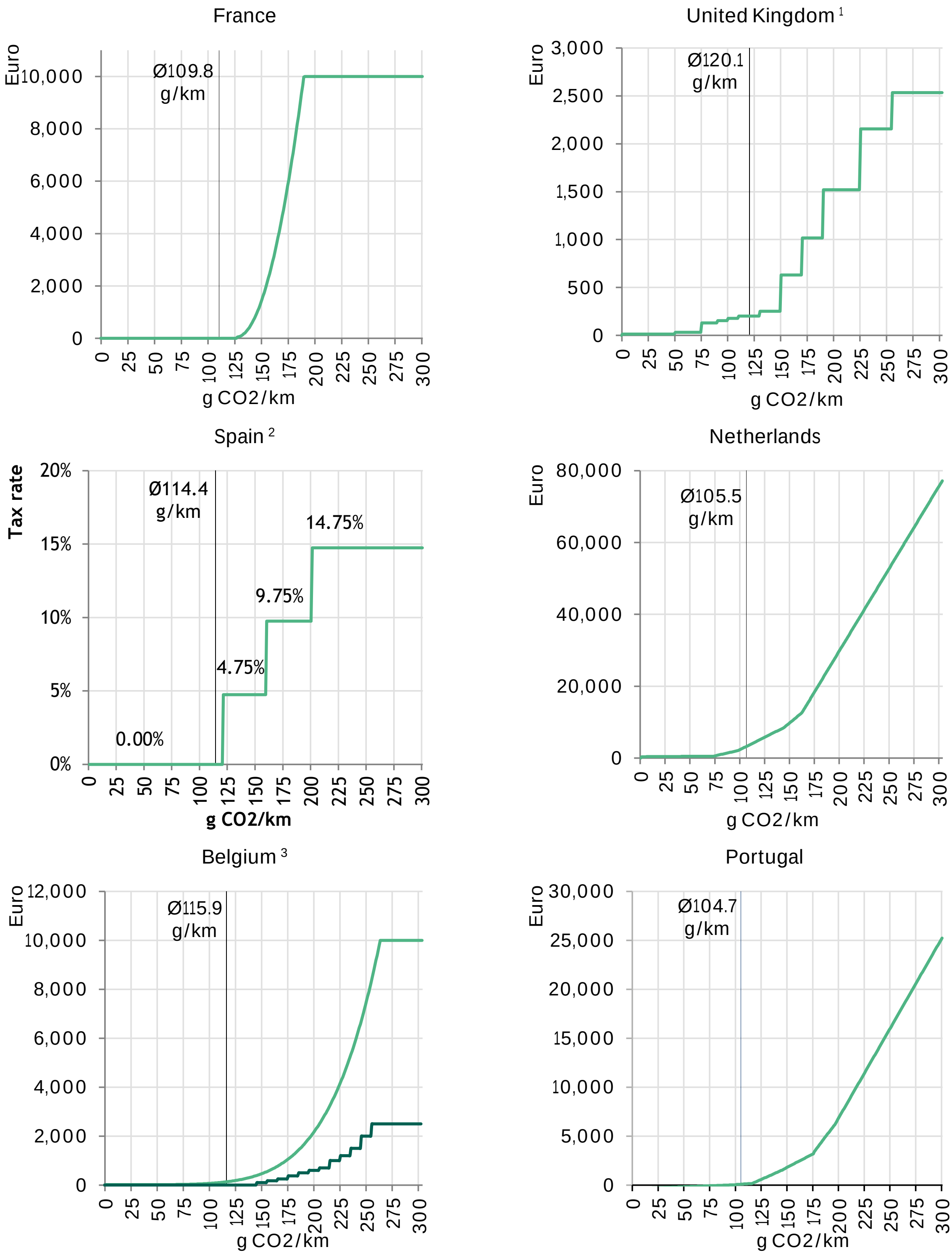
Source: own calculations based on ACEA (2017a), PwC (2016), Agenzia delle Entrate (2016), Government Digital Services (n.d.), HMRC (2018), Indicator (2017), Belastingdienst (2018), Grant Thornton (2018)

[1] The vehicle excise duty (VED) in the United Kingdom is a periodical tax levied on car ownership. Its first year rates are different from the standard rates and are treated as an implicit registration tax here. [2] Different tax schemes apply in the three Belgium regions: Flanders, Wallonia and the Brussels-Capital Region. The values shown here are based on the Flemish "Green TES" (registration tax); calculations of the annual circulation tax (ACT) include the Flemish ACT correction. [3] Based on assumed annual private mileage (12,305 km) and vehicle fuel/energy consumption. [4] Rates for BIK vary depending on car age (older or younger 5 years) and whether employer or employee pays fuel. The values shown here are simple averages of the four possible scenarios.

Annex B – Tax Curves

Table 7 shows tax curves for registration taxes in six countries with respect to CO_2 emission values, i.e. the curves show the component of the tax that is based on CO_2. The average emission values of new passenger car registrations in 2016 are indicated as a point of reference for each country individually.

Table 7: Tax curves for CO_2-based components of registration taxes



[1] The first year rates of the vehicle excise duty (VED) in the UK are treated as an implicit registration tax here. [2] The tax curve for Spain shows the CO_2-based tax rate that is applicable to the acquisition price of the car, rather than the actual amount payable. [3] Different tax schemes apply in Belgium. The values shown here are based on the Flemish "Green TES" (registration tax).

Sources: own graphs based on ACEA (2017a) as well as PwC (2016), Agenzia delle Entrate (2016), Government Digital Services (n.d.), HMRC (2018), Indicator (2017), Belastingdienst (2018), Grant Thornton (2018)