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Article

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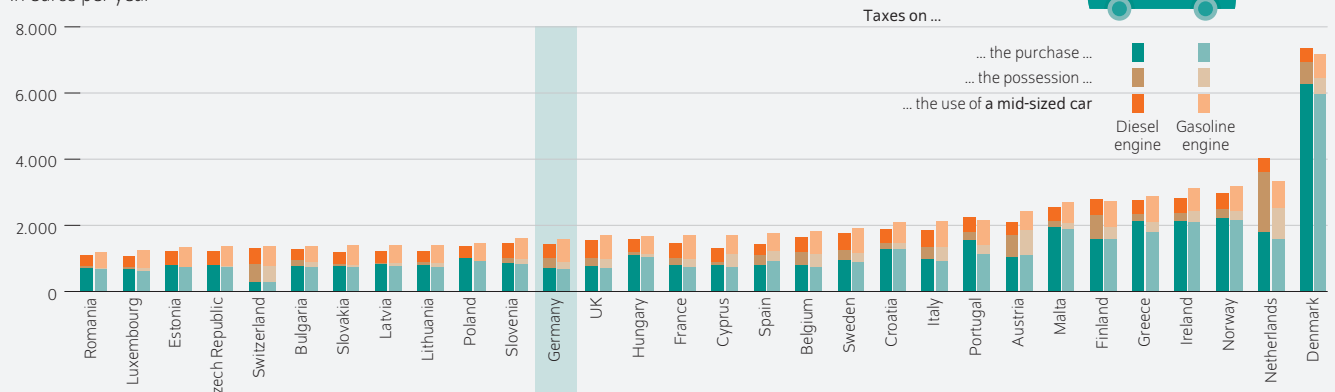
Diesel fuel and passenger cars receive preferential tax treatment in Europe; reform of taxation needed in Germany

By Uwe Kunert

- Systematic comparison of passenger car taxation on acquisition, registration, ownership, and fuel consumption in 30 European countries shows significant differences
- In most countries, fixed charges are higher than use-related levies and diesel cars are taxed less than gasoline-powered cars
- Germany ranks low in terms of the overall tax burden, in part because the energy tax has not been raised since 2003
- The German system in need of reform: tax revenue is stagnating although the number of cars is rising; few incentives for environmentally friendlier cars
- Different assessment bases for the motor vehicle tax and a higher energy tax rate, especially for diesel fuel, are advisable

Germany is in the lower third in terms of overall passenger car taxes in Europe

Taxes on automobiles in European countries
In euros per year¹



Sources: ACEA; ADAC; GDV; European Commission; authors' own calculations. ¹ Assuming mileage of 15,000 kilometers per year, fuel consumption of 4.1 liter per 100 kilometer (diesel) and 5.3 liter per 100 kilometer (gasoline); that the car that the car was purchased new and is in possession of its first owner; the amounts were annualized. © DIW Berlin 2018

FROM THE AUTHOR

"At least in terms of taxes, owning and using a car in Germany is significantly less expensive than in most neighboring countries. Yet the various taxes are neither generating enough revenue for the state nor creating strong enough incentives for using less polluting technology. The tax system is in urgent need of reform."

— Uwe Kunert, survey author —

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Diesel fuel and passenger cars receive preferential tax treatment in Europe; reform of taxation needed in Germany

By Uwe Kunert

Duties and taxes on cars are an important source of revenue for European governments and the tax systems are also designed with the goal of achieving environmental policy objectives. A systematic and quantitative comparison of passenger car taxation in 30 European countries shows significant differences among them. However, in almost every country, the use of vehicles with diesel engines is taxed less than that of cars with gasoline engines, and the share of fixed charges (on acquisition, registration, and ownership) is higher than the share of use-related levies. Germany has shifted its position with regard to both types of tax and now ranks low in terms of the overall tax burden. However, the German motor vehicle tax is neither fiscally profitable nor does it have the desired effect. Energy tax rates have remained the same since 2003 and its real value has declined by a fifth in real terms. With this in mind, both types of taxes are in need of reform and increasing the diesel tax should be a priority.

Around 260 million vehicles are currently driving on Europe's streets with 15 million new registrations every year.¹ The air quality in many European cities remains insufficient, in particular as a result of increased vehicle traffic.² The use of diesel vehicles is increasing and contributing significantly to air pollution with substances such as nitrogen oxide and particulate matter. As a result of imminent or ongoing EU infringement proceedings for exceeding annual limit values for air pollutants in many cities, various measures are being discussed throughout Germany and Europe in response.³ Such measures include restructuring the tax system, which should create incentives that will reduce the market opportunities of high-polluting motor vehicles. With the tax system, purchase decisions and thus the supply on the downstream markets for used vehicles with more than 40 million transactions annually will be strongly influenced.

At the same time, taxes on cars are an important source of revenue in Europe. Depending on the country, duties can yield up to five percent of GDP through registration and periodic ownership fees, the energy tax, and value-added tax.⁴ The energy and vehicle taxes account for the largest share of environmental taxes; in Germany, the share generated by road traffic accounts for 70 to 80 percent of environmental tax revenue.⁵ The fiscal significance of these taxes in many countries makes it necessary to ensure these revenue sources remain available.

Taking the above into consideration, this report systematically compares the tax burdens on gasoline-powered and diesel-powered passenger cars in 30 European countries,

¹ Federal Ministry of Transport, Building, and Urban Development, *Verkehr in Zahlen 2017/2018* (2017) (in German; available online, accessed July 2, 2018; this applies to all other online sources in this report unless stated otherwise).

² European Environment Agency, *Air quality in Europe – 2017 report* (Copenhagen: 2017) (available online).

³ European Union, *Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe*, Official Journal of the European Union (2008) (available online).

⁴ Cf. OECD, *Revenue Statistics 1965-2016* (Paris: OECD Publishing, 2017) (available online).

⁵ OECD, *Taxation, Innovation and the Environment* (Paris: 2010) (available online); Destatis, *Umweltnutzung und Wirtschaft – Tabellen zu den Umweltökonomischen Gesamtrechnungen* (2017) (in German).

including all tax components, in order to show the diversity and range of the tax structures (Box). This comparison shows that reforms are needed in Germany.

Diverse tax assessment and levels in Europe

Taxes on acquisition, registration, ownership, and use of personal passenger cars differ from country to country in terms of their characteristics and components (Table 1). The seven types of taxes are subject to different tax scales (rates and progression of the assessment basis) which use very different tax assessment bases. For two example medium-sized vehicles, one with a gasoline engine and one with a diesel engine, an annual mileage of 15,000 kilometers results in different taxes for both on acquisition and registration, possession, and use (Figure 1).

Annual taxes range between 1,200 euros (Romania) and over 7,000 euros (Denmark) in the first four years for a passenger car with a gasoline engine. The annualized registration tax plays a prominent role in the countries with higher taxes: in Ireland and Norway, these taxes account for half of all vehicle-related taxes, and in Denmark, almost 70 percent. The registration tax has the greatest variation in tax components between the countries.

The annual motor vehicle tax also varies greatly for owners of private vehicles: in six countries it is not levied at all, while in the others amounts of up to 800 euros must be paid. Insurance tax can reach over 200 euros per year with a liability premium of 100 percent and at national tax rates.

In 22 countries, the energy tax is higher than the registration or the annual motor vehicle taxes for the mileage assumed here and the example vehicle's specific fuel consumption. The taxes range from 300 euros (Romania, Bulgaria) to over 600 (the Netherlands) in total. At over 500 euros, Germany is in the upper third of the countries. Value-added tax on fuel is a further tax component: in two-thirds of the countries analyzed, it is higher than the motor vehicle tax.

In terms of total taxes, two-thirds of the countries have sums in a narrow range between 1,200 and 2,000 euros. For countries with higher taxes, the registration tax determines their final ranking.

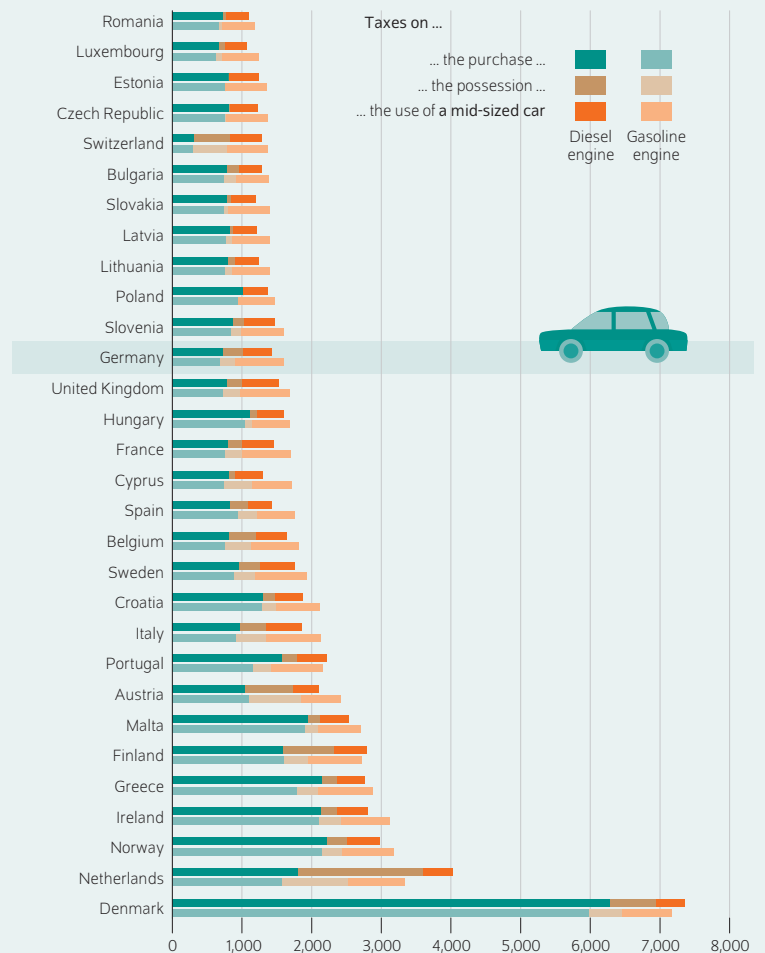
Countries are ranked similarly in the case of a comparable diesel car.⁶ In around ten countries, the (annualized) registration and motor vehicle taxes for a diesel vehicle are higher than those for a gasoline vehicle. In some countries, the tax advantage in fixed costs enjoyed by those purchasing cars with a gasoline engine reaches several hundred euros per year.⁷

⁶ These comparisons are limited by the fact that even in otherwise identical cars, gasoline and diesel counterparts always significantly differ technically. Moreover, it must be noted that in some countries, the taxes are not actually determined by the engine type but rather by differences in engine capacity or performance via registration and motor vehicle taxes.

⁷ With greater cylinder capacity and comparable diesel engine performance.

Figure 1

Taxes on automobiles in European countries In euros per year¹



¹ Assuming mileage of 15,000 kilometers per year, fuel consumption of 4.1 liters per 100 kilometers (diesel) and 5.3 liters per 100 kilometers (gasoline); that the car was purchased new and is in possession of its first owner; the amounts were annualized.

Note: Data from 2017. See Box for explanations.

Sources: ACEA; ADAC; GDV; European Commission; authors' own calculations.

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In most European countries, car owners pay between 1,200 and 2,000 euros a year in taxes for their vehicle.

Box

Duties and taxes on passenger cars in Europe

Duties and taxes on passenger cars were analyzed for the 28 member states of the EU as well as Switzerland and Norway. In Europe, there are countries where the duties and taxes are:

- non-recurring and related to the purchase and registration of automobiles (value-added tax, registration tax, registration fees),
- periodic and related to owning or maintaining a car (motor vehicle tax, insurance tax), or
- usage dependent (energy tax, value-added tax).¹

Table 1 provides an overview of how the various taxes on the purchase, ownership, and use of passenger cars are combined in the 30 countries observed. As different taxes and rates apply in many countries for different user groups, regulations for privately purchased new passenger cars were selected.

In all countries, value-added tax must be paid when a private person purchases and registers a new passenger car. In 23 countries, car owners pay moderate fees and in 19 countries, a registration tax.

Over ten different assessment bases are used in numerous combinations for the various registration taxes.² Purchase price, CO₂ emissions, fuel consumption, and cylinder capacity are the factors most frequently relevant. Of the 19 countries which levy a registration tax, 16 of them take environmental aspects into consideration in the assessment bases.

In nine countries, the registration tax is an ad valorem tax and levied on either the net or gross price. A car's technical features also influence the level of the tax in almost all of the countries observed, and the amount of CO₂ emissions are a factor in eight. In ten countries, this tax is structured as a quantity tax, one directly related to technical characteristics; in seven countries, this includes CO₂ emissions. In extreme cases, the registration tax for a mid-size vehicle annualized is around 5,000 euros.³

Owners of registered passenger cars must pay periodic taxes in most European countries.⁴ The motor vehicle tax on passenger cars is always a quantity tax and levied in 25 countries using eight different bases of assessment in various combinations. The drive type and cylinder capacity are often used as assessment bases, whereby gasoline and diesel engines can be taxed differently. Fuel consumption and CO₂ emissions are also now used as bases of assessment in 13 countries. The weight of the automobile is

also a factor, but its engine power or age are rarely considered. A mid-size vehicle has annual motor vehicle taxes of up to and over 1,500 euros. In ten countries, cars with low levels of air pollutant emissions are rewarded when paying the registration or motor vehicle tax.

In addition, taxes are payable on liability insurance in 24 of the countries surveyed. Tax rates range up to over 40 percent of premiums and in some countries, are even supplemented by para-fiscal charges. Privately owned cars are free from periodic fees in three countries only.

State taxes directly connected to use include the energy tax, other taxes on petroleum, and value-added tax (Figure 2).⁵ In the countries surveyed, the tax rate on premium gasoline is currently between 0.36 and 0.77 euros per liter and 0.33 to 0.69 euros for diesel fuel. In addition to the energy tax, the value-added tax is levied on the product price including the tax at rates, ranging from eight percent in Switzerland to 27 percent in Hungary. At the current prices for unleaded premium gasoline, the taxes account for a total of 50 to over 70 percent of the overall price. For diesel fuel, the share of total taxes is 45 to 65 percent.

The average annual tax on new, privately owned vehicles incurred by the first owner during the holding period is determined using various factors.⁶ It is assumed that the vehicle will remain in the possession of the first owner for four years. The non-recurring taxes on the purchase and registration of the vehicle are allocated pro rata to the first four years in accordance with the average loss in the vehicle's value.⁷ For the calculations, files were created containing all information on each occurrence of a tax burden on motor vehicles. In this database, the vehicle characteristics are linked to the relevant assessment bases. Based on this information, fixed and variable cost items are determined in a model calculation. The calculations for this report are based on a mid-size car with an annual mileage of 15,000 kilometers.

¹ This does not include avoidable use-related charges (tolls, parking fees).

² In four countries, vehicles' technical characteristics (engine rating) are used as a modified basis of assessment for the registration or motor vehicle tax.

³ This corresponds to a one-off tax payment of more than 30,000 euros at registration.

⁴ For example, one of the numerous detailed regulations is that only cars with CO₂ emissions of more than 190 grams per kilometer are subject to a (low) annual tax in France. Private car owners are not taxed in the Czech Republic and Slovakia.

⁵ Other taxes include the CO₂ taxes levied in some countries in addition to the energy tax.

⁶ Temporary tax exemptions are not taken into account here.

⁷ If a registration or transfer tax is also levied for changes in ownership, the full tax will be credited to the initial owner. Recurring registration or registration fees will be attributed to the first owner. Vehicle data, detailed information, and assumptions are required to calculate a car's tax burden. Necessary information includes the car's technical details and average fuel consumption, the amount of the insurance premium, the loss in value over four years after the initial registration, fuel prices, annual mileage, etc.

PASSENGER CAR TAXATION IN EUROPE

Table 1

Taxes and fees on purchase, registration, possession, and use of passengers cars across Europe (2017)

As of 2017

	Registration codes	Value-added tax, in percent	Registration tax (RT), CO ₂ -tax (T-CO ₂)	Registration fee	Car tax (C) CO ₂ tax (C-CO ₂)	Insurance tax, in percent	Fees and levies on the insurance premium, in percent or in euros	Fuel tax
Austria	A	20	T-CO ₂	✓	C	11	0,62 – 0,75 euro/kW	✓
Belgium	B	21	T-CO ₂	✓	C	9,25	17.85 percent	✓
Bulgaria	BG	20	–	✓	C	2	–	✓
Croatia	HRV	25	T-CO ₂	–	C	15	4 percent	✓
Cyprus	CY	19	T-CO ₂	✓	C-CO ₂	5	2 euros	✓
Czech Republic	CZ	21	–	✓	–	–	3 percent	✓
Denmark	DK	25	T-CO ₂	✓	C-CO ₂	42,9	–	✓
Estonia	EST	20	–	✓	–	–	–	✓
Finland	FIN	24	T-CO ₂	–	C-CO ₂	24	–	✓
France	F	20	T-CO ₂	✓	C-CO ₂	33	2 percent	✓
Germany	D	19	–	✓	C-CO ₂	19	–	✓
Greece	GR	24	T-CO ₂	–	C-CO ₂	15	6 percent	✓
Hungary	H	27	RT	–	C	30	1 percent	✓
Ireland	IRL	23	T-CO ₂	–	C-CO ₂	5	1 euro	✓
Italy	I	22	RT	✓	C	12,5	12.91 percent	✓
Latvia	LV	21	–	✓	C	–	–	✓
Lithuania	LT	21	–	✓	–	–	–	✓
Luxembourg	L	17	–	✓	C-CO ₂	4	–	✓
Malta	M	18	T-CO ₂	–	C-CO ₂	11	–	✓
Netherlands	NL	21	T-CO ₂	✓	C-CO ₂	21	–	✓
Norway	N	25	T-CO ₂	✓	C	–	–	✓
Poland	PL	23	RT	✓	–	(1 euro)	–	✓
Portugal	P	23	T-CO ₂	✓	C-CO ₂	9	5.45 percent + 0.75 euros	✓
Romania	RO	19	–	✓	C	5	–	✓
Slovakia	SK	20	RT	✓	–	–	8 percent	✓
Slovenia	SLO	22	T-CO ₂	–	C	8.5	–	✓
Spain	E	21	T-CO ₂	✓	C	6	1.65 percent	✓
Sweden	S	25	–	✓	C-CO ₂	32	–	✓
Switzerland	CH	8	–	✓	C	5	–	✓
United Kingdom	GB	20	–	✓	C-CO ₂	10	–	✓

Sources: ACEA; ADAC; GDV; European Commission; authors' own calculations.

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In contrast, the average burden due to energy tax and value-added tax on fuel purchases is always lower for cars with diesel engines than for gasoline-powered cars because of the lower energy tax and level of fuel consumption. In the calculation, the energy tax on a gasoline-powered car is about twice as high as on a diesel-powered car in a third of the countries.

Ultimately, the sample calculation shows that in 26 countries out of 30, vehicles with a diesel engine have a lighter tax burden than those with a gasoline engine. The advantages range from ten to 20 percent of the total taxes. Only in four countries is the total tax burden on cars with diesel engines higher than for gasoline-powered cars. In every country, fixed charges (registration and motor vehicle taxes) for a diesel-powered car comprise a higher share (between 70 and 90 percent) of all charges than they do for cars with gasoline engines.⁸

Energy tax rates in Europe favor diesel fuel

The final price for fuel varies considerably across Europe, almost exclusively due to taxation. In all countries, the energy tax⁹ is initially added to the product price and the value-added tax is due on the sum. With rates ranging from eight to 27 percent, the value-added tax shows a greater variation country to country than the energy tax.

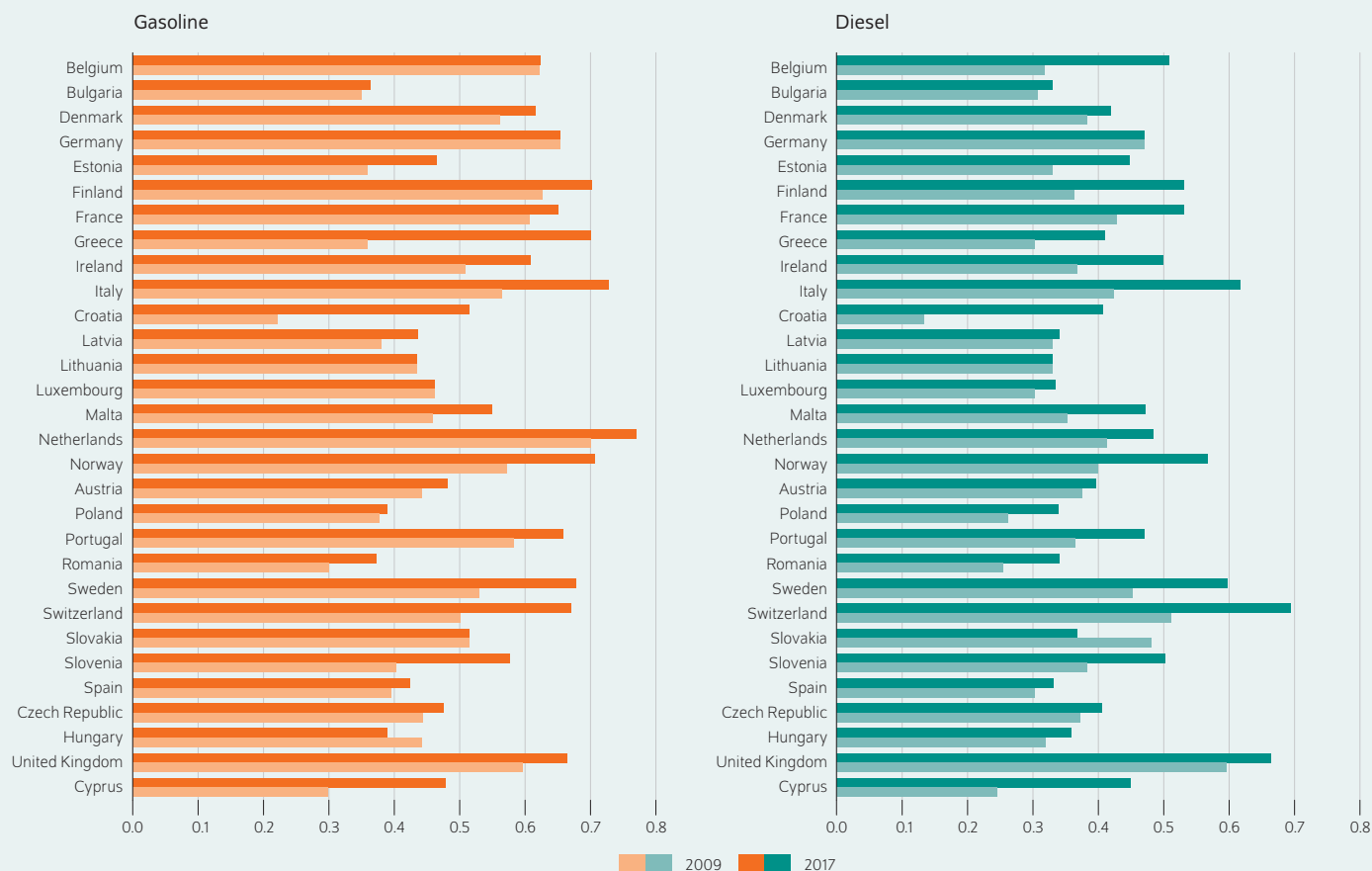
The energy tax rates on gasoline ranged from 0.36 to 0.77 euros per liter in 2017. Due to the importance of the transport industry, all European countries except Switzerland and the United Kingdom tax diesel fuel at a lower rate than gasoline. In many countries, the resulting tax savings are counteracted by a comparatively higher motor vehicle tax. Diesel is taxed

⁸ For details regarding the assessment basis, tax differential, and stability of the rankings across different vehicle classes and levels of use, see Dominika Kalinowska, Kerim Keser, and Uwe Kunert, "CO₂ Based Taxation on Cars is Rising in Europe," *Weekly Report*, no. 23 (2009) (available online).

⁹ Specific tax whose rate is an amount per unit of the assessment basis (volume). In this report, energy tax rates also include carbon/CO₂ taxes levied in six countries.

Figure 2

Fuel tax¹ for gasoline and diesel fuel in European countries In euros per liter



¹ Including carbon tax or CO₂ tax in some countries.

Sources: European Commission; authors' own calculations.

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The Netherlands taxes gasoline the most, Bulgaria the least.

between 0.33 and 0.69 euros per liter (Figure 2).¹⁰ With tax rates of 0.655 euros for gasoline and 0.47 euros for diesel, Germany ranks tenth and 14th respectively.

Since 2009, 24 countries have increased the energy tax rate on gasoline and 26 have raised the energy tax rate on diesel (Figure 2). In recent years, increases in tax rates have been higher for diesel fuel than for gasoline. The value-added tax increased in 14 countries during this period.

In many European countries, the tax savings have contributed to a significant increase in the share of diesel-powered vehicles in passenger cars used for private and commercial

purposes (Figure 3). In some countries, diesel passenger cars accounted for more than 70 percent of new registrations. Influenced by the current debate on air quality and the reduction of tax savings on fuels, this trend has abated in almost all countries: in 2011 and 2012 in the EU-15, 55 percent of new registrations were diesel-powered; in 2017, the share had dropped to 44 percent.¹¹ In Germany, the percentage of diesel cars fell from a high point of 48 percent (2012 to 2015) to 39 percent in 2017.¹²

¹⁰ According to the EU's Energy Taxation Directive, the minimum tax rates for gasoline and diesel are 359 and 330 euros per 1,000 liters, respectively, cf. European Union, Council Directive 2003/96/EC of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity, Official Journal of the European Union (2003) (available online).

¹¹ European Automobile Manufacturer's Association (ACEA), *Consolidated registrations by country* (2018) (available online).

¹² Kraftfahrt-Bundesamt, "Fahrzeugzulassungen im Dezember 2017 – Jahresbilanz," press release no. 1/2018, January 4, 2018 (in German; available online).

Taxation in Germany is in need of reform

Germany, with its relatively low motor vehicle tax and lack of a registration tax, is at the bottom of the list of Western European countries in terms of taxes levied on the purchase and ownership of cars. Only Luxembourg, Switzerland, and seven countries which joined the EU in 2004 levy lower fixed charges. A few Eastern European countries have significantly higher taxes in some cases.

In ten—without exception Western European—countries, fuel consumption is subject to higher taxes than in Germany. In terms of the overall tax burden, Germany ranks low: in the sample calculation carried out here, eleven countries have lower taxes and 18 countries have higher taxes, some of them considerably so.

If the total duties are weighted with purchasing power parities, Germany and two other countries, Luxembourg and Switzerland, are at the end of the burden scale.

New basis of assessment for motor vehicle tax preferable

Since the motor vehicle tax was reformed in 2009, taxes on new cars use both cylinder capacity and CO₂ emissions as bases of assessment. The two components are taxed on a linear scale.¹³ Under the new tax scheme, cars with higher cylinder capacity or fuel consumption are taxed higher than under the previous scheme.

However, this erodes the basis for revenue collected from the motor vehicle tax: the average fuel consumption¹⁴ and cylinder capacity of newly registered cars are decreasing (Figures 4 and 5). There is currently no reliable data available on real fuel consumption or actual CO₂ emissions, but the average fuel consumption trend of passenger cars, as determined from test results, is much weaker (Figure 6). This erosion was offset by the tax scale until 2014, when the threshold of CO₂ taxation fell to 95 grams per kilometer in two steps.

The revenue from the motor vehicle tax currently amounts to almost nine billion euros (including commercial vehicles and trailers), with passenger cars accounting for around seven billion euros (Table 2).¹⁵ This revenue has been stagnating

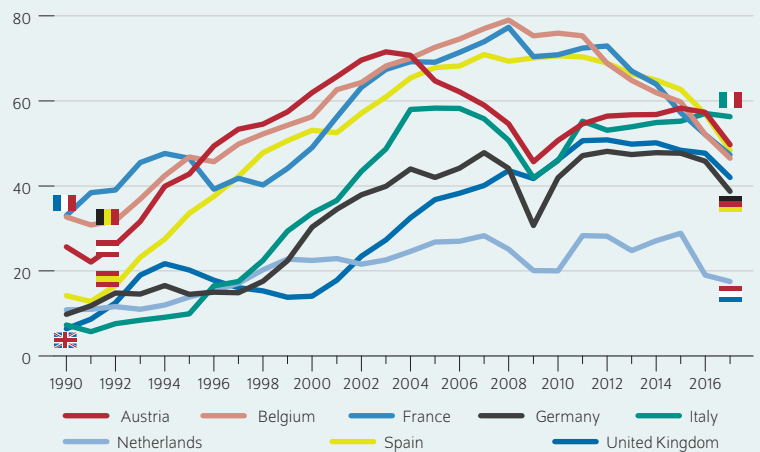
¹³ Cylinder capacity is taxed per 100 cubic centimeters or part thereof at a rate of two euros for spark-ignition and 9.50 euros for auto-ignition engines. The purpose of the higher base rate for diesel engines is to compensate for the lower energy tax on diesel fuel. See the Act on Motorized Vehicles Tax (*Kraftfahrzeugsteuergesetz*) as amended on September 26, 2002 (Federal Law Gazette I, pg. 1491) (in German).

¹⁴ During the type approval process, motor vehicles must comply with the emission thresholds specified by EU directives which have been gradually reduced in accordance with technically viable standards. Limits have been set on the permitted quantities of carbon monoxide, hydrocarbons, nitrogen oxides, and particles (measured in grams per kilometer). CO₂ emissions are determined in a driving cycle completed on the roller dynamometer under (manipulable) laboratory conditions as part of the type approval process. Cf. European Union, *Commission Directive 2003/76/EC* as well as European Union, *Regulation (EC) No 715/2007 of the European Parliament and of the Council of 20 June 2007 on type approval of motor vehicles with respect to emissions from light passenger and commercial vehicles (Euro 5 and Euro 6) and on access to vehicle repair and maintenance information*, Official Journal of the European Union (available online).

¹⁵ Only the total cash revenue of the motor vehicle tax is published, cf. Destatis, *Finanzen und Steuern*, Fachserie 14, Reihe 4 (2018) (in German; available online).

Figure 3

Share of diesel cars in new car registrations in selected European countries 1990 to 2017, in percent



Source: ACEA

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There is a clear trend towards diesel vehicles.

for several years now even though the number of passenger cars is increasing significantly (by over five million cars or 13 percent since 2008). Accordingly, the average tax amount per passenger car from the motor vehicle tax fell to around 100 euros per gasoline vehicle and to less than 300 euros per diesel vehicle currently.

The tax does not have the intended (lowering) effect on CO₂ emissions or fuel consumption.¹⁶ Moreover, the consumption values used as bases of assessment (Figure 5) are unrealistically low; multiple sources report emissions of over 30 percent higher in real-world operation.¹⁷ Considerable tax revenues are lost as a result.¹⁸ In addition, many car buyers base their purchasing decisions on the car label, which shows fuel economy and CO₂ emissions. However, customers receive insufficient information for calculating future operation expenses when purchasing a car. In its current form, this assessment basis is not effective, especially as the EU scheme to reduce CO₂ emissions from passenger cars provides incentives for manufacturers to expand their range of lower-emission vehicles.¹⁹

¹⁶ Cf. Kalinowska et al., "CO₂-Besteuerung von Pkws," 446ff; European Environment Agency, *Appropriate taxes and incentives do affect purchases of new cars*, Briefing 02/2018 (available online).

¹⁷ Cf. The International Council on Clean Transportation (icct), *From laboratory to road international: A comparison of official and real-world fuel consumption and CO₂ values for passenger cars in Europe, the United States, China, and Japan*. White Paper (available online).

¹⁸ For 2016 only, the tax shortfall for Germany was estimated to be around 1.2 billion euros, cf. Green Budget Europe and Forum Ökologisch Sozial Marktwirtschaft, "Loss of revenues in passenger car taxation due to incorrect CO₂ values in 11 EU states," report on behalf of the Greens/EFA in the European Parliament (2018) (available online).

¹⁹ Based on Regulation (EC) No 443/2009, the emission standards for new passenger cars are currently being further developed and linked to a test procedure (World Harmonized Light Vehicles Test Procedure, WLTP) that provides values for CO₂ emissions and fuel consumption that better match real driving conditions.

Table 2

Stock, mileage, and tax revenue of passenger cars in Germany

	Passenger car stock¹			Mileage			Fuel tax revenue (passenger cars only)²			Fuel tax per car²			Additional information: Revenue of motor vehicle tax for all cars, in million euros
	Total	Gasoline	Diesel	Total	Gasoline	Diesel	Total	Gasoline	Diesel	Total	Gasoline	Diesel	
	in 1,000			in billion vehicle-kilometers			in million euros			in euros			
2000	43,759	37,402	6,357	559.5	442.9	116.6	22,727	19,665	3,062	519	526	482	7,015
2001	44,368	37,393	6,975	575.5	438.9	136.6	24,257	20,505	3,752	547	548	538	8,376
2002	44,637	37,029	7,608	583.6	431.2	152.3	25,652	21,191	4,460	575	572	586	7,592
2003	44,996	36,702	8,294	577.8	418.3	159.5	26,303	21,355	4,949	585	582	597	7,336
2004	45,328	36,256	9,072	590.4	412.8	177.6	26,403	20,900	5,503	582	576	607	7,739
2005	46,009	35,918	10,091	578.2	391.4	186.7	25,366	19,647	5,719	551	547	567	8,673
2006	46,414	35,594	10,820	583.9	378.7	205.2	25,028	18,823	6,205	539	529	574	8,937
2007	40,951	30,905	10,046	587.5	370.7	216.8	24,560	18,053	6,507	600	584	648	8,898
2008	40,929	30,639	10,290	584.6	368.0	216.6	23,936	17,460	6,476	585	570	629	8,842
2009	41,268	30,450	10,818	583.6	357.4	226.2	23,836	17,127	6,709	578	562	620	8,201
2010	41,755	30,488	11,267	587.1	349.4	237.7	23,732	16,674	7,058	568	547	626	8,488
2011	42,343	30,452	11,891	595.9	349.3	246.6	23,961	16,663	7,298	566	547	614	8,422
2012	42,785	30,206	12,579	596.2	336.5	259.7	23,569	15,810	7,758	551	523	617	8,443
2013	43,171	29,956	13,215	601.1	329.9	271.1	23,783	15,506	8,276	551	518	626	8,490
2014	43,699	29,838	13,861	613.3	329.6	283.7	24,150	15,491	8,659	553	519	625	8,501
2015	44,357	29,825	14,532	622.3	328.0	294.3	24,202	15,222	8,980	546	510	618	8,805
2016	45,068	29,979	15,089	636.9	330.2	306.7	24,551	15,201	9,350	545	507	620	8,952

1 Until 2006: stock as of July 1; from 2007 onwards: end-of-year figure, excluding idle cars.

2 Based on domestic sales.

Sources: Federal Motor Transport Authority (Kraftfahrt-Bundesamt); authors' own calculations.

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The car's weight or engine power could be considered as the basis for calculating the motor vehicle tax as an alternative to cylinder capacity: both values are objectively measurable; in contrast to the cylinder capacity, both values tend to increase (Figure 4) and thus ensure the efficiency of the tax; both values are related to environmental effects; and a car's weight also has considerable effects on road safety.²⁰

Increase energy tax rates

The comparably low tax burden in Germany is also largely due to the unchanged energy tax rate.²¹ The energy tax (known as the petroleum tax until 2005) has remained unchanged since 2003 at 0.655 euros per liter of gasoline and 0.47 euros per liter of diesel. Due to the consistent energy tax rate and development of fuel prices, the share of energy tax in the price of fuel has been ten percentage points lower than in the 1990s for ten years. The value of the energy tax rate on fuel has fallen by about a fifth since 2003 in real terms (Figure 7).

In this period, the nominal revenue from the energy tax on passenger car fuel consumption was decreasing due to lower overall consumption and the increasing share of diesel cars,

which use fuel that is taxed less. Revenue from this tax has fallen from over 26 billion euros in 2003 to 24.5 billion euros recently, a decrease of 25 percent in real terms. During this period, the mileage and thus the use of the infrastructure caused by passenger cars increased by ten percent (Table 2).

Over the past 15 years, the unchanged tax rates on fuels (decreasing in real terms) and increasing fuel efficiency have led to a trend towards lower usage costs following the oil price peaks. As a result, user costs for drivers have developed more favorably in the longer term than those for users of public transport.²² Together these factors result in an increase in traffic demand.²³

End diesel favoritism

The tax savings associated with diesel fuel have contributed to the fact that diesel engines are becoming more popular in Germany and Europe. The energy tax implicitly taxes CO₂ emissions from diesel fuel in Germany by about a third less compared to gasoline.²⁴ There are—at least in the private sector—no good reasons for such preferential treatment,

²⁰ Cf. for example Reza Tolouei and Helena Titheridge, "Vehicle mass as a determinant of fuel consumption and secondary safety performance," *Transportation Research D* 14 (2009): 385-399; Shanjun Li, "Traffic Safety and Vehicle Choice: Quantifying the Effects of the 'Arms Race' on American Roads," *Journal of Applied Economics* 27 (2012): 34-62; Gesamtverband der Deutschen Versicherungswirtschaft, *Sport Utility Vehicles im Unfallgeschehen*, (Berlin: 2012) (in German).

²¹ Cf. Kalinowska et al., "CO₂-Besteuerung von Pkws."

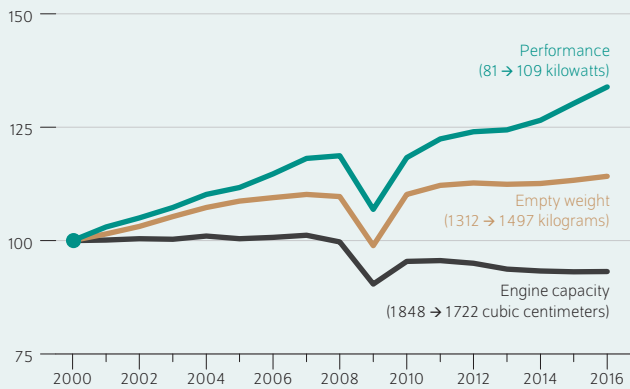
²² Cf. Uwe Kunert and Sabine Radke, "Personenverkehr in Deutschland—Mobil bei hohen Kosten," *DIW Wochenbericht*, no. 24; Destatis, *Preise*, Fachserie 17, Reihe 7, S. 32 ff.

²³ Manuel Frondel and Colin Vance, "Drivers' response to fuel taxes and efficiency standards: evidence from Germany," *Transportation* 45, no. 3 (2018): 989-1001.

²⁴ The CO₂ emissions per liter are 13 percent higher with diesel than gasoline. With the current energy tax rates in Germany, the burden for gasoline is about 281 euros per ton of CO₂, while diesel fuel is 178 euros per ton of CO₂.

Figure 4

Average performance, empty weight, and engine capacity of newly registered cars in Germany Index 2000 = 100



Sources: Federal Motor Transport Authority (Kraftfahrt-Bundesamt); authors' own calculations.

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The introduction of green incentives in 2009 has only interrupted the trend towards heavier and more performant passenger cars.

especially as diesel has clear disadvantages in terms of pollutant emissions (particulate matter and nitrogen oxide) according to EU regulations²⁵ and measurement results in real operation.²⁶ Both the false incentives resulting from this tax differential and the harmful effects on air quality were foreseeable for many years.²⁷

Gasoline and diesel will remain the most important sources of energy in road transport for a long time to come.²⁸ The tax rates on both should therefore be harmonized. Special regulations are possible for commercial diesel²⁹ and Germany should support the increase of EU minimum tax rates in accordance with the Energy Taxation Directive in order to keep the tax differences with other EU countries, especially neighboring ones, low. Harmonizing tax rates would be in line with the Commission's intention in 2011—ultimately in vain—to amend the Energy Taxation Directive, which sought

²⁵ According to the Euro emission standards for passenger cars (vehicle class M1), the thresholds for hydrocarbons and nitrogen oxides are higher for diesel engines than for gasoline engines, and the permissible emissions of carbon monoxide are lower. Cf. European Union, *Commission Regulation (EC) No 692/2008 of 18 July 2008 implementing and amending Regulation (EC) No 715/2007 of the European Parliament and of the Council on type-approval of motor vehicles with respect to emissions from light passenger and commercial vehicles (Euro 5 and Euro 6) and on access to vehicle repair and maintenance information*, Official Journal of the European Union (2008) (available online).

²⁶ Cf. for example Susan C. Anenberg et al., "Impact and mitigation of excess diesel-related NOx emissions in 11 major vehicle markets," *Nature* 545 (2017): 467-471.

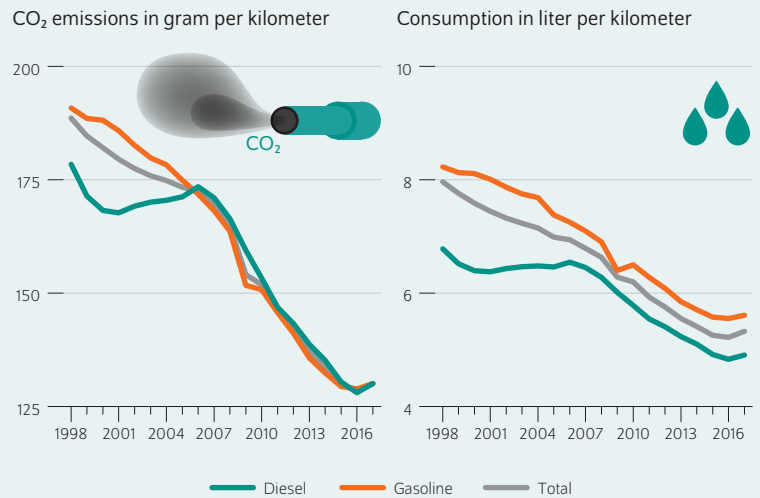
²⁷ Cf. Hartmut Kuhfeld and Uwe Kunert, "Reform der Pkw-Besteuerung überfällig: die Initiative der EU-Kommission zeit den richtigen Weg," *DIW Wochenbericht*, no. 49 (2005): 756f (in German; available online).

²⁸ Hella Engerer and Uwe Kunert, "Gasoline and Diesel Will Continue to Dominate in the Future of Road Transport," *DIW Economic Bulletin* no. 36 (2015): 469-477 (available online).

²⁹ According to Article 7 of the Energy Taxation Directive, member states may differentiate between commercial and non-commercial use of gas oil, cf. European Union, *Council Directive 2003/96/EC of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity*, Official Journal of the European Union (2003) (available online).

Figure 5

CO₂ emissions and fuel consumption of newly registered passenger cars in Germany



1 Standard consumption according to the New European Driving Cycle.

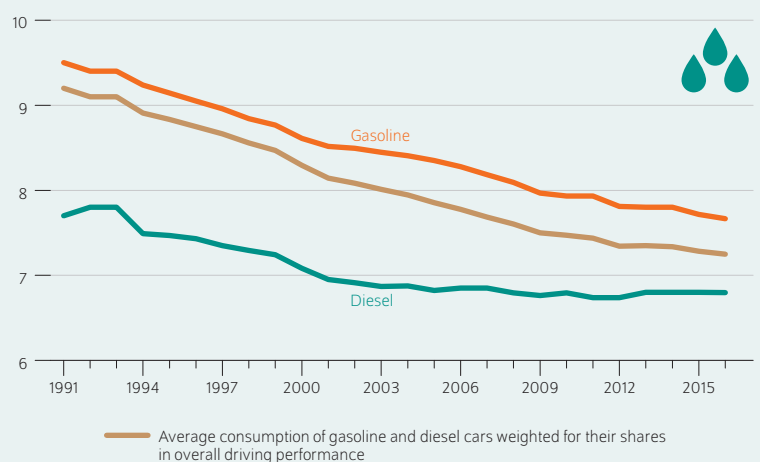
Sources: Federal Motor Transport Authority (Kraftfahrt-Bundesamt); authors' own calculations.

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According to official data, CO₂ emissions and fuel consumption have both declined substantially in the past 20 years.

Figure 6

Average fuel consumption¹ of passenger cars in Germany Liters per 100 kilometers



1 Performance-weighted consumption of all vehicles.

Sources: Authors' own calculations.

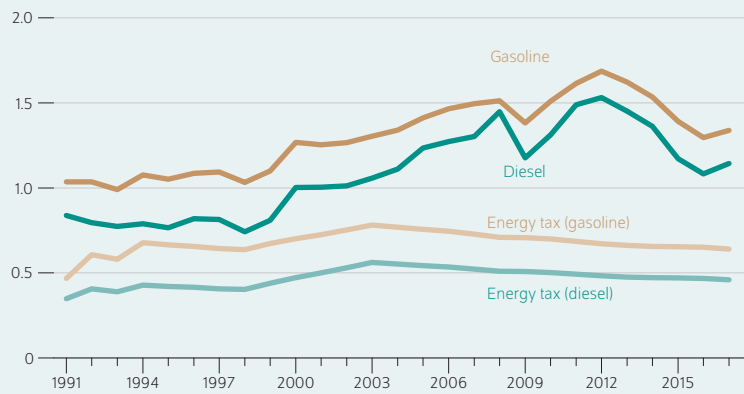
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The average fuel consumption of gasoline cars has dropped more than that of diesel cars.

Figure 7

Real fuel prices and fuel tax in Germany (price base = 2015)

Yearly average prices including taxes and fees, in euros per liter



Sources: Aral; Federal Statistical Office (Statistisches Bundesamt); authors' own calculations.

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The tax rates on fuel have declined by 20 percent since 2003 in real terms.

to reduce implicit tax subsidies and gradually introduce new minimum tax rates for fuels by 2018.³⁰

Even only harmonizing the diesel tax rate and current gasoline tax rate would bring in additional tax revenue of around nine billion euros.³¹ In return, other taxes unrelated to resource consumption could be reduced.³²

³⁰ A key element of the proposal was the taxation of energy sources based on their CO₂ emissions and energy content, cf. European Commission, *Proposal for a Council Directive amending Directive 2003/96/EC restructuring the Community framework for the taxation of energy products and electricity* (2011) (available online). After unsuccessful negotiations in the Council, the Commission withdrew their proposal in 2015.

³¹ Energy and value-added taxes statistically calculated without possible reimbursements for commercial users of diesel fuel and without possible adjustment of motor vehicle tax payments.

³² Cf. Viktor Steiner and Johanna Cludius, "Ökosteuer hat zu geringerer Umweltbelastung des Verkehrs beigetragen," *DIW Wochenbericht*, no. 13/14 (2010) (in German; available online); Stefan Bach, "Zehn Jahre ökologische Steuerreform: Finanzpolitisch erfolgreich, klimapolitisch halbherzig," *DIW Wochenbericht*, no. 14 (2009) (in German; available online).

Conclusion: modernize automobile taxation and focus on future challenges

The design of passenger car tax systems varies greatly from country to country in Europe. However, a systematic comparison reveals certain similarities: in most countries, fixed charges (on acquisition, registration, and ownership) are higher than the use-related charges which depend on fuel consumption. Additionally, diesel technology receives preferential tax treatment in many countries, which has helped diesel engines reach considerable market shares on the European market.

Germany is in the lower third in terms of overall passenger car taxes in Europe. Its tax system has neither the intended steering effect, as the incentives to buy fuel-efficient and low-emission vehicles are minimal, nor brings in enough revenue for the state. Three different reform approaches could remedy this situation: a different basis of assessment for the motor vehicle tax; raising the energy tax, which has not changed since 2003; and harmonizing the taxes on diesel and gasoline engines. In light of the growing public discussion about the environmental and health damage caused by diesel, it no longer seems appropriate to favor this technology.

An initially moderate increase in the energy tax on diesel fuel is easy to implement administratively and would signal changes in the cost structure of automobile drive systems to market participants. This could be followed by planned and foreseeable increases in tax rates which have been shown to have a positive effect on innovation, fuel-efficient vehicle choice, and driving behavior.³³

If reforming the motor vehicle tax and increasing the energy tax raises the tax level for traditional drive systems, the market opportunities for alternative vehicle concepts will improve. This supports the objective of reducing the extensive dependence on petroleum for mobility. Higher fuel prices also contribute to this, as they bring about innovations and structural adjustments.³⁴

³³ OECD, *Taxation, Innovation and the Environment*, 78ff. For consumer reactions to changes in the tax system, see Nicholas Rivers and Brandon Schaufele, "Gasoline price and new vehicle fuel efficiency: Evidence from Canada," *Energy Economics* (68) (2010): 454–465; Laura Grigolon, Mathias Reynaert, and Frank Verboven, "Consumer valuation of fuel costs and tax policy: Evidence from the European car market," *American Economic Journal: Economic Policy* (forthcoming).

³⁴ OECD, *Taxation, Innovation and the Environment*, 175ff.

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