ANASTASIA PETROVA

# WHAT IS THE BEST ROAD TAX MODEL TO REDUCE CO2 EMISSIONS IN THE EU?

The Hague University of Applied Science
Faculty Management & Organisation
European Studies

13019643
Supervisor P.Pijlman

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## 1. Abstract

The main purpose of this dissertation is to establish which road (ownership or circulation) car tax model is best to reduce CO2 emissions in the European Union. In Europe, climate change and reduction of greenhouse gasses is a concern among the population, as it is seen by the growing Eco activism as well as general public awareness. In 2011 the European Commission presented a vision on the future of the EU transport developments. This program is essential for Europe to reach its resource-efficiency goals and reducing emissions. One of the main points is that the car taxation system must be reassessed in order to link taxation to environmental performance of a vehicle, or "polluter-pays". However, there are challenges to EU's ambitious goals. One of them is the inconsistency of real world and test values of CO2 emissions. By reviewing existing literature it was possible to establish a theoretical framework, as well as understand various scholarly opinions on the issue of CO2 based taxation and passenger cars in Europe. A closer comparison of ownership tax costs between four selected European countries (the Netherlands, Germany, Poland, the United Kingdom) serves as a demonstration of inconsistency between road tax models, as well as between the environmental attitudes in general. The key findings of this work answer the main research question and sub questions: which road tax model is the best for reducing CO2 emissions in the EU, how it is calculated in different countries, what are the stakeholders involved, what are the problems caused by the differences in road tax, what are best and worst practices. In short, there should be significant tax incentives upon purchase, such as exemption of electric vehicles from acquisition tax, which will influence consumers to purchase an electric vehicle. There also should be ensured tax benefits for continuation of the car usage, such as exemption of electric vehicles from ownership (circulation/road) tax. As of now, the best road tax model among the analyzed countries is the Netherlands, and Poland is the worst. However, there is room for improvement in the area of CO2 based taxation, for example feebates or pay-per-kilometer tax. This research is significant because in the times of immediate action to help against climate change, such instruments such as fiscal policy can be an effective tool to help reduce emissions in Europe.

Keywords: *road tax, car ownership tax, European Union, CO2 emissions, fiscal policy, environment, electric vehicles*

## 2. Table of Contents

## List of abbreviations

EU – European Union

CO2 – carbon dioxide

EV – electric vehicle

VAT – value added tax

GDP – gross domestic product

ICCT – International Council on Clean Transportation

GHG – greenhouse gasses

NEDC – New European Driving Cycle

WLTP – Worldwide harmonized Light vehicles Test Procedure

EEA – European Environment Agency

OECD - Organization for Economic Co-operation and Development

PLN – Polish zloty

IEA – International Energy Agency

MRB – Motorrijtuigenbelasting (car tax) (Dutch)

LPG – liquified petroleum gas

## 3. Introduction

One of the most relevant and often discussed topic in politics nowadays is climate change and reduction of CO2 emissions and other greenhouse gasses. Among others, the main contributor to climate change is the transport sector. Since 2014 greenhouse gas emissions from the European Union member states' transport sector have been increasing. In 2016, emissions had increased by almost 3%, mainly on account of higher emissions from road transport; including aviation and shipping, transport sector contributed 27% of total greenhouse gas emissions in the EU-28. European Environment Agency estimates show that "emissions from transport (including aviation) further increased by 1.5 % in 2017. In 2016, road transport was responsible for almost 72 % of total greenhouse gas emissions from transport. Of these emissions, 44 % were contributed by passenger cars, while 19% came from heavy-duty vehicles" (European Environment Agency, 2018). In 2016 cars were responsible for 60.7% of all transport emissions in the EU. (European Environment Agency, 2018).

Over the years, many EU-countries implemented greener car taxes though either a revision of purchase taxes, company car taxes or annual road taxes. Academic studies show that fiscal policy can influence sustainable development and reduce CO2 emissions from cars (Gerlagh, 2015). The European Commission already expressed intention to create a homogeneous system of taxes, which could deal with the challenge of rising CO2 emissions from transportation.

The European Parliament states that it is impossible to create a single European market for road transport without harmonising the relevant legal provisions in force in the Member States, since the road taxes are in the competences of national governments. At present there is little EU legislation, or harmonisation of national fiscal provisions, applied by the Member States in the area of passenger car taxation. Therefore, it is for each Member State to lay down national provisions for the taxation of these cars. For now.

As many experts agree, different taxation levels influence consumer's purchase decision. Appropriately designed taxes can significantly contribute to a fleet turnover towards low emissions vehicles, thus committing to the emissions reduction levels on European scale. As the main question suggests, various road taxation models from European countries will be analysed and the best policy will be determined. To answer the main question, first general information about road taxation in the EU and the different factors at play will be researched. Different topical areas are explored: overall environment policy situation in Europe, the case studies on how car taxes work in selected European countries, the stakeholder analysis of different parties at play regarding the car tax issue, as well as the differences and ways to solve the car tax issue and lower the CO2 emissions from cars in Europe.

## 4. Methodology

This section provides the reader with overview of methods used during this research. In order to answer the main question a combination of qualitative and quantitate research is used. First, to familiarize with the issue at hand and build a solid theoretical framework, desk research is a necessity: reading and analyzing secondary data, already existing academic articles and academic reports on taxation policy in EU, which road tax models exist, who are the stakeholders, to establish a good fact-based foundation for further research and comparison. Moreover, documents such as communications, directives and regulations are available to anyone on websites of the European institutions.

Using raw data from statistical, scientific and governmental reports it is possible to calculate and establish the framework on how car taxation works in selected European countries. For this research first a foundation is built on literature review and further re-analysis of case studies within the wider context. Case studies are fundamental for this research to narrow down the focus of this thesis. Case studies are used here to compare best and worst practices of road tax policy using desk research data and statistics. Comparing case studies will be the key to answer the main research question and determine the best road tax model, by the means of finding correlations and differences between selected countries.

It is essential to mention the research limitations. First, it was not possible to organize interviews with experts from public and private sectors due to time constraints. None of the interview requests were answered, which deemed this research to be heavily reliant on secondary data. Thus the risks of these methods are that this research lacks primary insights from representatives of the industry, and not to mention secondary data is an interpretation of another author. Therefore, using sufficient primary data and extensive secondary data it is most feasible to arrange a comprehensive and detailed exploration of the issue at hand.

# 5. Literature Review

In order to answer the questions outlined above, it is time to select the relevant literature that will give a solid foundation for this research and establish a theoretical framework. This section provides the reader with essential theory behind the issue of car taxation in Europe and the main problem at hand. First of all, it is no secret that the demand for mobility is growing. There are on average 602 vehicles per 1000 inhabitants in the European Union (ACEA European Automobile Manufacturers' Association, 2019). In contrast, in 1999 the European average of car ownership was 422 cars per 1000 inhabitants. Personal mileage is estimated to rise by 23% by 2030 to 5.88 trillion kilometers in Europe (Felix Kuhnert, 2018). In the European Commission's White Paper 2011 says that since the first big oil crisis in the 70s the transport system has not fundamentally changed, despite technical progress, potential for cost-effective energy efficiency improvements and policy efforts. Transport has become more energy efficient, but EU transport still depends on oil and oil products for 96% of its energy needs. Transport has become cleaner, but increased volumes mean it remains a major source environmental pollution (European Commission, 2011). Electric cars seem like the ideal solution, but it is demonstrated to be difficult to make the transition from combustion engine cars and convince more people to purchase an electric vehicle and ensure a steady car fleet turnover.

The idea behind electric mobility is not new. The world has already seen a short rise and decline of electric vehicles in early 20$^{th}$ century. The fall was due to lack of infrastructure, long recharging time, low range and speed, which therefore limited electric mobility only to urban areas. The rapid development of combustion engine cars, as well as the discovery of petroleum eventually led to affordable fuel and therefore the combustion engine cars were cheaper to operate and had a longer range. The revival of the electric car started by the end of 20$^{th}$ century, and was steadily growing, however not without minor inconveniences. (Encyclopaedia Brittanica, 2019). The rise of businesses such as Tesla in the latest decade, and general awareness on the issue of electric mobility caused a popularity boost. To demonstrate this fact, in the Netherlands the all-electric Tesla Model 3 is the most selling car as of October 2019 (Behrmann, 2019). In Norway 45% of all cars sold in the first half of 2019 in Norway were electric (Sleire, 2019).

## 5.1 Types of car taxes in Europe

For the sake of clarity, it is a must to define the different types of taxes imposed on cars in Europe. It is worth noting that different types of taxes are used differently by individual Member States. Research by *Philip Klein "European Car Taxes and the CO2 Intensity of New Cars"* at Erasmus University Rotterdam gives an overview of taxes imposed on cars in Europe (Klein, 2014). Klein describes three types of taxes:

- Acquisition tax: a non-recurring charge, to be paid when a new vehicle is purchased and registered. It is also known as registration tax, registration fee, turnover tax or vehicle sales tax
- Ownership tax: charged periodically, also known as annual circulation tax, vehicle tax or road tax
- Fuel tax: a usage-based tax, different in each Member State and depends on policy (Klein, 2014, pp. 5-6)

Additionally, Klein writes that acquisition tax is probably the most effective tool to influence consumer behavior since it is considered immediately when the decision is made. Acquisition tax by definition is usually a large sum that one must pay upon purchase, which offsets the desire to buy a new car. "The average renewal time of the car fleet will rise and lead to inefficient technology and lowered amount of car sales. In contrast, the total costs of ownership taxes accumulate over a car's lifetime. Thus, a near-sided buyer might not take into account the full price at the time of purchase and make an buying decision that costs him more money and potentially produces more emissions over the active life-span" (Klein, 2014, p. 5). Whereas the fuel tax is paid on actual usage whenever the consumer is paying for fuel, it is relative and even though essential to reduction of CO2 emissions, is not a primary focus of this research.

*European Commission's Guide "Transport taxes and charges in Europe"* from March 2019 sets the premise for the main research question: "the internalization of external (and infrastructure) costs is one of the leading principles in EUs transport policy. The 2011 White Paper on Transport argues that transport charges and taxes must be restructured in the direction of wider application of the 'polluter-pays' and 'user-pays' principles. Recently, the European Parliament has called for renewed efforts in internalization and also the Commission Communication of 2016 on 'A European Strategy for Low-Emission Mobility' emphasized the need for making steps forward in applying the 'polluter-pays' and 'user-pays' principles" (European Commission, 2019, p. 14). Since the report is focusing on *all* transport taxes in Europe, for this research only passenger car related taxes will be picked out. The report states that CO2 emissions is the most important parameter to which the acquisition tax of passenger cars is differentiated: about 55% of the acquisition tax in the EU28 are based on the CO2 emissions of the car. Moreover, acquisition taxes for passenger cars are often differentiated to fuel type, price and engine size. For electric passenger cars, in most European countries no acquisition tax is levied. Poland is the only European country where the purchase tax for an EV (electric vehicle) is higher than for the combustion engine car. However, tax level in Poland is one of the lowest in Europe. As for ownership tax (road tax), engine size and CO2 emissions are the most common parameters to which the tax of passenger cars is most often differentiated: a half of European countries use tax schemes based on these parameters. In addition, some ownership tax schemes for passenger cars are also differentiated to fuel type. Emission class, vehicle weight and engine power are also relevant parameters, as they

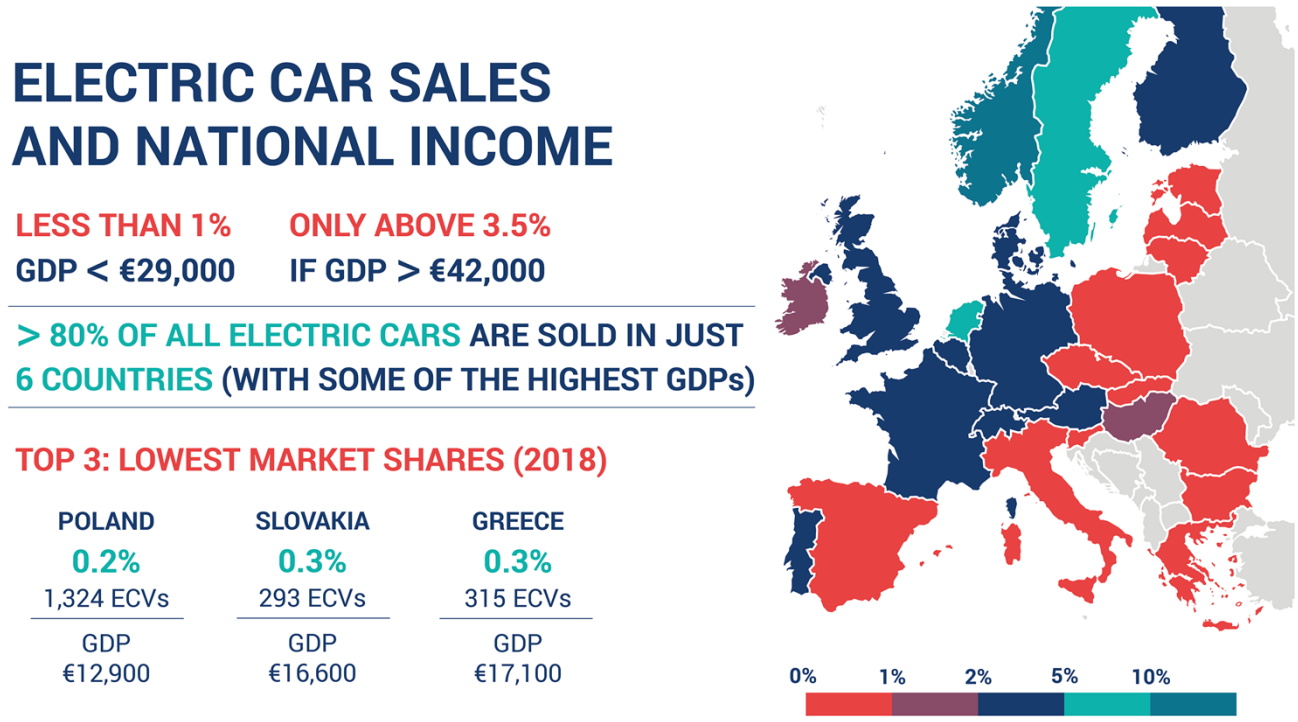
are used in ownership tax schemes in other European countries (European Commission, 2019, pp. 38-39). Even though most European countries base their road tax on car characteristics, CO2 based tax has been introduced recently: within the last two decades, and therefore this topic is relatively new.

It is crucial to include the *White Paper on transport 2011* by European Commission as it defines the overall development strategy. White Paper on transport 2011 is a roadmap to a single European transport area, which aims to move towards a competitive and resource-efficient transport system throughout European Union. The paper mentions fundamental points relevant to this research. First of all, when talking about a vision for a competitive and sustainable transport system, in chapter 2.1 "Growing transport and supporting mobility while reaching the 60% emission reduction target" it is said that "the EU and government need to provide clarity on the future policy frameworks <…> for manufacturers and industry so that they are able to plan investments. Coherence at EU level is vital – a situation where one Member State opted exclusively for electric cars and another only for biofuels would destroy the concept of free travel across Europe" (European Commission, 2011). In chapter 2.5 "Ten goals for a competitive and resource-efficient transport system: benchmarks for achieving the target" there is a suggestion to increase the efficiency of transport and of infrastructure use with information and market-based incentives. "By 2020, establish the framework for a European multimodal transport information, management and payment system. <…> Move towards full application of 'user pays' and 'polluter pays' principles and private sector engagement to eliminate distortions, including harmful subsidies <…> and ensure financing for future transport investments" (European Commission, 2011, pp. 9-10). The "polluter pays" principles are also mentioned later in chapter 3.3 "modern infrastructure, smart pricing and funding": "Transport charges and taxes must be restructured in the direction of wider application of 'polluter pays' and 'user pays' principles" (European Commission, 2011, p. 27). In the same chapter, it says that "the elimination of tax distortions and unjustified subsidies and free and undistorted competition are therefore part of the effort to align market choices with sustainability needs and to reflect the economic costs of 'non-sustainability" (European Commission, 2011, p. 16).

The most up-to-date information available on all EU transport taxes is the 2019 edition of the *annual Tax Guide published by the European Automobile Manufacturers' Association (ACEA)* and it presents a comprehensive overview of specific taxes that are imposed on motor vehicles in Europe. It contains all the latest information about taxes on vehicle acquisition (VAT, sales tax, registration tax), ownership (annual circulation tax, road tax) and motoring (fuel) tax. It is clear that this report will be referenced throughout this research (ACEA European Automobile Manufacturers' Association, 2019). For the purpose of this research, the first most important information is the overview of taxes for passenger cars in Europe. Table 1 and 2 can be found in Appendices A and B. Further the report goes into detail of each country. However, in order to save

time this research will focus on several countries of which the taxation models will be compared. In Table 1 it is shown that some countries impose no road tax on passenger cars, for example Poland and Slovenia. It is obvious that the tax systems differ drastically. However, just 12 EU member states offer bonus payments or premiums to buyers. Most countries only grant tax reductions or exemptions for electric cars (ACEA European Automobile Manufacturers' Association, 2019).

For the purpose of this report, four countries were chosen: the Netherlands, Germany, Poland and the United Kingdom. These countries are in top ten most populated countries in the European Union. Secondly, there is a premise for comparison. For example, as mentioned above Tesla Model 3 became the most sold car this year in the Netherlands, while Poland has the lowest market share of electric vehicles. Recent research by European Automobile Manufacturers' Association also shows the correlation between the uptake of electric cars and GDP in the European Union. As it is demonstrated on ACEA's infographic below, the chosen countries and the divide between them.




Source: (European Automobile Manufacturers' Association ACEA, 2019)

### 5.2 CO2 based car taxation in Europe

As previously mentioned, the 2019 report by *Sandra Wappelhorst, Peter Mock and Zifei Yang "Using Vehicle Taxation Policy to Lower Transport Emissions" for International Council on Clean Transportation* suggests that it is indeed possible that taxation policies can provide

significant consumer incentives to encourage the purchase of a zero- or low-emissions car. The report indicates that most European countries adopted the taxation systems that already influence citizens to buy electric or hybrid vehicles while sanctioning the use of petrol vehicles. To demonstrate, the authors compare five countries: the Netherlands, the UK, Norway, France and Germany. The methodology of ICCT's report is most relevant to this research. Most European countries impose different forms of emission-based registration or ownership tax on passenger cars, and the emission-based taxation varies widely regarding elements such as CO2 emissions, NOx emissions, Euro Emission Limits, and fuel consumption. Moreover, the taxation is also different in terms of timing (for example acquisition or during ownership). To analyse the differences in the five countries' tax liabilities for car ownership, purchase and consumption a car model was chosen. The authors picked four different Volkswagen Golf models, varying in engine power, CO2 emissions based on the NEDC, and engine size. In 2018 VW Golf was the most selling car in Europe. Among the four cars picked conventional gasoline and diesel models ownership costs are compared with those for electrically-driven counterparts. The authors take many different factors into account such as VAT, one-time subsidies for low-emission vehicles, initial one-time registration tax, road tax (or *periodic motor vehicle tax*), taxes and prices on fuel and electricity, and, where applicable, highway tolls. The authors also note private use of a company car, in case of which the relevant cost value is defined as the taxable benefit in kind an employee must pay as a part of income tax. However, the actual amount
payable depends on the employee's income tax rate, which usually varies according to salary. Company cars account for nearly half of all car sales in the EU. Thus, by analysing five countries' tax liabilities for four different car models the recommendation for national governments is as follows:

- "Create significant tax advantages for low-emission vehicles at the point of purchase,
- Ensure continued tax benefits for low-emission vehicles during their use,
- Account for the emissions of a vehicle as part of the company-car tax system,
- Balance and regularly re-adjust the tax system to be self-sustaining.

In combination with adequate charging infrastructure fed with renewable energy and consumer information campaigns to raise awareness, the penetration of low-emission vehicles will then help to leverage efforts to reduce vehicle emissions at the European and national levels" (Sandra Wappelhorst, 2018, p. 39).

Another report that provides information relevant to this research is on Fair & Low Carbon Vehicle Taxation in Europe, *"A comparison of CO2-based car taxation in EU-28, Norway and Switzerland" by Matthias Runkel and Alexander Mahler* for Forum Ökologisch-Soziale Marktwirtschaft e.V. (Matthias Runkel, 2018). As it shows above, in European countries many cases of well-designed and effective vehicle taxation are available. In FÖS' report the authors

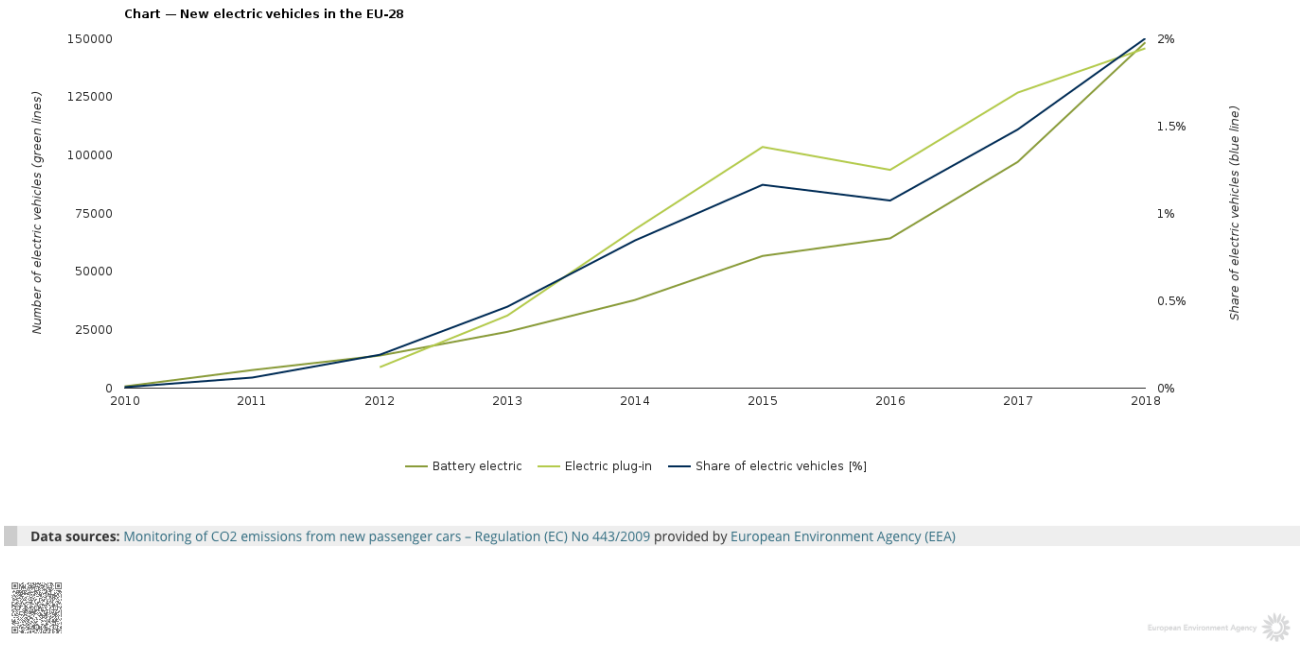
compare the different tax systems and derive several policy recommendations. Similar to ICCT report, this comparison is among eight countries in Europe and four sample vehicles. However, the main difference is that FÖS report is more climate-focused, which will be relevant for this research. The main idea behind the FÖS report is to propose a policy recommendation 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. "Vehicle taxation is a key determinant of progress made and the current level of emission values" (Matthias Runkel, 2018, p. 4). As well as ICCT's report, the authors of this report also compare taxes on acquisition, road tax (periodical taxes on ownership or circulation taxes), taxation of company cars and fuel taxes. In countries with well-designed CO2-based taxes, especially registration tax, tend to perform better in terms of CO2 emission reduction. However, the authors mention that all the progress of reduction of CO2 emissions is more solid on paper and the reality is different. The gap between real and on-paper values widened from 14% in 2006 to 42% in 2016. "This implies that the reduction of CO2 emission values has had a much weaker impact in terms of actual CO2 emissions from the road sector. It is also undermining the policy efforts of CO2-based taxation" (Matthias Runkel, 2018, p. 4). This huge gap is a problem for several reasons. "First, the EU's emissions reduction targets are diluted, if the reductions on the test stand have only limited impact on real-world emissions. Secondly, CO2-based vehicle taxation is losing its effectiveness and efficiency, because the tax base is extremely distorted" (Matthias Runkel, 2018, p. 5). Even though most European countries have implemented CO2-based car taxation elements over the last two decades, those climate policy efforts require reliable emission values safeguarded by a rigorous regulatory framework and realistic test procedures. This, in turn brings to light other problems such as consumers who base their purchase decision off unreliable fuel consumption values and thus bear unexpected financial obligations; the market becomes distorted and manufacturers focus on test results rather than real world. Moreover, this is hurting manufacturers with more realistic values who suffer a disadvantage, as their cars appear more climate-damaging on paper and they are taxed at higher rates, if taxation is based on CO2. Even though most European countries base their road tax on car characteristics, CO2 based tax has been introduced recently: within the last two decades. However, "only few countries have introduced CO2-related elements in the taxation of company cars. The private use is usually taxed as income, based on a percentage of vehicle price" (Matthias Runkel, 2018, p. 5). Further, the authors' analysis indicates that taxes on acquisition (or registration tax) are a very effective instrument regarding the reduction of CO2 emissions. "The additional upfront costs are a clear price signal and fiscal incentive to the buyer" (Matthias Runkel, 2018, p. 8). Therefore, it is clear that countries with CO2-based taxes have lower CO2 emission values.

However, it is absolutely essential to understand that the CO2 measurements are taken during tests are not accurate in real world. Amela Ajanovic writes in her article in *Energy*

*Efficiency "Reducing CO2 emissions of cars in the EU: analysing the underlying mechanisms of standards, registration taxes and fuel taxes"* that to make measurements comparable between manufacturers, "the specific CO2 emissions of a vehicle version are determined using a type approval test cycle, the New European Driving Cycle or NEDC, in laboratory conditions. The problem is that NEDC cycles represent an artificial driving speed pattern with low accelerations, constant speed cruises and many idling events. As a result, the measured emission levels can be different from those in real-world conditions" (Amela Ajanovic, 2016, p. 930). One of the conclusions of the report is that CO2 emission standards currently in place in the EU will not lead to the possible energy savings and CO2 reductions. The main reason behind this is that the "rebound effect" because more kilometres driven results in less savings (Amela Ajanovic, 2016, p. 932).

In the report by *European Federation for Transport and Environment* the author also mentions how the tests divert from real world CO2 values. "New car CO2 regulations have delivered only about a 10% reduction in on-road emissions in the 20 years since the first Voluntary Agreement was established in 1998" (Grelier, 2018). However, it is important to note that in the last years there was little to no improvement, and the gap between the test and real world values has increased from 9% to 42%, "equivalent to 31gCO2/km of fake savings" (Grelier, 2018). The car manufacturer industry has been increasingly cheating the tests so expertly that the gap between official fuel economy tests and real-world driving has become very wide.

Moreover, this research requires back up from scientific data that is openly available from European Environment Agency. It is evident that electric vehicles are getting more popular in Europe, as it is demonstrated on this chart below (European Environment Agency, 2019).



On the EEA report published on 12th April 2018 the main findings were:

- "In 2016 most EU member states employed incentives or taxes based on emissions to steer purchasing decisions on cars.
- The number of countries offering incentives for electric vehicles increased considerably between 2010 and 2016.
- Where appropriate incentives were in place, people bought vehicles with lower CO2 emissions. However, other factors such as availability of new technologies and economic conditions were also important.
- Policies must be carefully designed to avoid rebound effects and unintended adverse impacts such as increased emissions of other pollutants" (European Environment Agency, 2018).

In the report from September 2019 "Fiscal instruments favoring electric over conventional cars are greener" however it states that even though it is evident that proper fiscal policy promotes the uptake cars with lower carbon dioxide emissions, the main problem is that current tax incentives are "based on type-approval emissions tested in the laboratory, which are lower than the real-world emissions on the road. As the gap between type-approval CO2 emissions and real-world emissions has increased, the real-world emissions of new cars have decreased significantly less than expected" (European Environment Agency, 2019). This report, as mentioned above as well pinpoints one of the main issues is the gap between the CO2 emissions tests. "Since 2017, the new Worldwide Harmonized Light Vehicle Test Procedure (WLTP) has been put in place, with the objective to gradually replace the outdated New European Driving Cycle (NEDC). The WLTP allows to obtain more realistic information on vehicle emissions in the type approval tests. In 2018, Member States reported both NEDC and WLTP emission factors for around 4.4 million cars (around 30 % of new registrations). For those vehicles, the WLTP emission factor was on average 20 % higher than the NEDC emission factor" (European Environment Agency, 2019). This report also proves that countries that promote greener vehicles through tax incentives have significantly reduced their CO2 emissions., as well as other pollutants such as NOx and PM (European Environment Agency, 2019).

### 5.3 Ownership or circulation (road) taxes

Thus, for this research it is established that taxation policy influences the decision or indecision of the consumer to purchase an electric vehicle. However, there is no long-term risk with acquisition tax – tax incentives for electric vehicles already influence one's decision to purchase an eco-friendly car. Regarding ownership tax, it is obvious that just owning a car and

actually using a car are different actions. Strictly speaking, ownership of a car does not produce CO2 emissions if the car is parked at a garage all the time. This car would harm the environment less than a car that drives large distances every day. Imagine a situation such as this: person A owns a sports car with a big engine – definitely not a fuel-efficient vehicle, but person A only drives this car once a month, for example on a racetrack. Person B owns a more fuel-efficient car, like a diesel or a hybrid, but has a long commute every day. Which person is more of a polluter? Which person pays more taxes? Person A would pay more while driving less, while person B pays less for driving more. Would it make sense to pay the ownership tax based on actual usage, and not "ownership"? Some experts support this idea (Parry, 2011) (European Environment Agency, 2018) (De Mobiliteitsalliantie, 2019) (German, 2010).

For example, already in 2009, the Dutch government already passed a bill that allowed motorists to pay tax per kilometre driven. This was done to reduce CO2 emissions and reduce fatalities in road accidents (Deutsch Welle, 2009). Now the Dutch Mobility Alliance, which is a partnership of 25 parties such as ANWB, NS, HTM, resealed a framework called "Deltaplan 2030" to ensure that the freedom of movement of the Netherlands is retained in the future. One of the key points in the mobility vision "Deltaplan 2030" is to reform the car ownership tax system, namely to transition from fixed taxes to a variable system with a flat kilometre price on the road and present innovative rush-hour solutions to achieve a better spread of the mobility. The new system would replace the current motor vehicle tax (MRB), including surcharges and the BPM. Differentiation also takes place on the basis of environmental characteristics because this tax model directly serves the planet's interest (De Mobiliteitsalliantie, 2019).

Ian W.H. Parry writes in his study titles "Reforming the Tax System to Promote Environmental Objectives: An Application to Mauritius" for 2011 International Monetary Fund that "recommend converting the road tax into a tax on annual kilometres driven to initiate a progressive transition to a GPS-based pricing system where tolls vary across region and time of day according to congestion severity. Although focused on Mauritius, the discussion potentially serves as a template for other countries" (Parry, 2011, p. 5). Fiscal instruments are powerful tools to exploit a behaviour response: for example "a carbon tax is passed forward into the price of fossil fuels, it will reduce $CO_2$ emissions by encouraging a shift away from carbon-intensive fuels in power generation" (Parry, 2011, p. 6). Parry also argues that the European Union's Emissions Trading Scheme, a cap-and-trade system, which is a market-based alternative to green taxes is less effective. First, the cap-and-trade systems do not raise revenues if the allowances are given away for free and not auctioned. This does not provide beneficial gains in economic efficiency. Moreover, the fluctuation of year-to-year price volatility may also "deter investments in clean technologies with high up-front costs and long run payoffs. Green taxes,

in contrast, can create a more stable environment for investments in clean technology, as firms and households know future emissions prices (assuming the policy is credible and sustained)" (Parry, 2011, p. 7). It is also important to note that the price volatility can be addressed through provisions such as allowing firms to bank or borrow allowances over time, however the provisions just make the cap-and-trade systems more complicated and less efficient. Parry also provides a counter-argument for green taxes. A common criticism is that they can harm industry competitiveness and the poor by raising the price of fuels, electricity, etc. It is easy to address with, for example, tax relief for low-income workers and vulnerable firms. "In short, fiscal instruments have a potentially critical role to play in ameliorating the major environmental and other externalities and providing signals for the development of low-carbon and other technologies that will ultimately be needed to achieve environmental sustainability" (Parry, 2011, p. 9). Back to the vehicle ownership tax however. Parry uses Mauritius as a case study, but as it is the case with several European countries, in Mauritius the annual vehicle ownership tax is based on engine capacity. Parry concludes that there are several problems with Mauritius vehicle ownership tax system. First, there are no incentives to reduce the distance driven. Second, there are no incentives for better fuel economy. "One reason is that it does not reward a switch towards more fuel-efficient vehicles within an engine size category defined by a given tax rate. Another is that smaller engine size by itself does not always imply greater fuel economy" (Parry, 2011, p. 21). Third, as is the case with European countries, people pay most tax upon registration and/or purchase, and that makes people hold on to their old vehicles longer, hence slow fleet turnover.

Parry offers this outline for pay-per-kilometer car tax. An alternative method could be a proportional tax on CO2 emissions in line with kilometers driven. This policy promotes cost-effectiveness by presenting the identical reward for the final ton of CO2 reduced. Moreover, the tax offers ongoing incentives to always keep lowering CO2 emissions per kilometer, even in fuel-efficient vehicles. Parry further explains that none of the tax systems currently in place actually reduce the distance driven in a vehicle. In order to control traffic congestion and reduce the CO2 emissions a transition is needed from the current tax system to nationwide, GPS-based tolling system. A good starting point is to turn the road tax into a variable charge. The periodic road tax payment would be the product of a congestion charge per kilometer and total kilometers driven by the motorist in the previous year. That would encourage people to drive less in the following year to reduce the costs. As to the means of implementation, Parry offers an odometer solution. "Annual kilometer driven can be recorded by yearly odometer readings—for example, when cars are brought in for safety inspections (readings would also be taken when used vehicles are sold). At the same time, a progressive transition to GPS-based charging

system could be encouraged through offering lower toll rates to drivers who can demonstrate (by installing GPS) that their driving is predominantly rural or off-peak. As more drivers opt for GPS, the congestion toll for drivers on the odometer system could rise, encouraging further switching to GPS. Again, the tax rate could easily be chosen to maintain approximate revenue from the road tax (by setting the per kilometer charge equal to total road tax revenue last year divided by projected total car mileage under the new scheme)" (Parry, 2011, p. 25).

Another option for reform is feebates. Parry defines feebates as "a proportional fee on CO2 per kilometer over and above some threshold or —pivot point level for relatively fuel-inefficient vehicles and a proportional rebate or subsidy on the difference between CO2 per kilometer and the pivot point level for relatively fuel efficient vehicles" (Parry, 2011, p. 23). The rate can be calculated using the following formula:

$$t \cdot (CO_2/km - \overline{CO_2/km})$$

In this formula, the *t* is the tax rate per gram of CO2 per kilometer, and the bar denotes the pivot point. Parry says that feebates can help with reduction of emissions and providing incentives for people to shift away from large to small vehicles. "Potential revenue losses from the feebate component are avoided, because the pivot point declines over time as the average CO2 per kilometer of the new vehicle fleet falls" (Parry, 2011, p. 23). Feebates are another fiscal policy solution, that would encourage fuel economy and maintain excise tax revenues.

Thus, having established the theoretical background of the issue, in this research the selected countries' taxation systems for road (ownership) tax will be compared, best and worst practises highlighted, and a better policy recommendation proposed.

# 6. Results

This section provides the reader with a look into how the road tax is calculated in selected EU countries in order to fully understand what a citizen pays in ownership tax in chosen countries. As mentioned above, the following countries were chosen for analysis: the Netherlands, Germany, Poland and the United Kingdom. To start and properly analyse how much one will pay for ownership (road or circulation) tax in a country sample vehicle will be chosen. The vehicles chosen to represent a best-selling car in Europe in its respective class. Information in the table below is based on car manufacturers' specifications in the Netherlands. The values may differ by country. Further for more context it is also fair to include the general attitudes toward eco-friendlier and sustainable future in terms of environment policy in each country.

| Car Model | Engine | Power (kW) | CO2 Emissions (g/km) | Weight |
|---|---|---|---|---|
| VW Golf 1.5 TSI | Petrol | 110kW | 118 g/km | 1500 kg |
| VW Golf 2.0 TDI | Diesel | 110kW | 118 g/km | 1600 kg |
| Toyota Prius | 1.8 Hybrid | 90kW | 75 g/km | 1790kg |
| Tesla Model 3 | Electric | 72kW | 0 | 1611kg |

Table 3. Sample Vehicles

## 6.1 Case study: The Netherlands.

The Netherlands has one of the highest GDP in Europe at 44,600 Euros per capita (2018) (European Automobile Manufacturers' Association ACEA, 2019). The Netherlands is also known in Europe to be a leader in terms of promotion of sustainability and green policies. The Netherlands is party to many international climate agreements, including the United Nations convention on climate change and the Kyoto Protocol. The Dutch climate policy is based on those agreements, as well as focused around reducing greenhouse gas emissions. It appears that the Dutch government, along with the "Dutch Climate Coalition", nearly 50 representatives of the private sector (such as Phillips, DSM and FrieslandCampina), all agree that the scientific data presented by the Intergovernmental Panel on Climate Change and other experts requires rapid action. Moreover, local governments are set to become self-supporting with their energy use (Government.nl, 2019). "The government actively supports EU efforts in the development and advancement of global environmental regimes. Domestically, climate adaptation has taken priority over structural reforms" (Sustainable Governance Indicators, 2019). It is fair to conclude that the Netherlands is progressive in terms of climate policy.

The Dutch tax authority Belastingdienst declares that when one registers a motor vehicle (passenger car, delivery van, truck, bus or motorcycle), one must immediately declare the Motorrijtuigenbelasting (MRB) or road tax. Belastingdienst also states that it does not matter

whether one is using the vehicle on the road, or if the vehicle is stationary on private property. The factors which determine the amount to be levied are weight, fuel, how environmentally harmful the motor vehicle is, and in which province the owner is registered. The tax is paid every 3 months, but one can also authorise a monthly payment. Electric vehicles and cars with hydrogen combustion engines are exempt from paying the MRB. (Belastingdienst, n.d.). It is also worth noting that there most likely will be a new diesel surcharge and a new "fine dust" surcharge of the motor vehicle tax from 1 January 2020 for diesel vehicles. However, the new rates will not be considered for this research since this new regulation has not been passed by the Dutch Senate yet (Belastingdienst, n.d.).

Based on the calculation available at the tax authority website, the tax amount to be paid in the Netherlands as an owner of the sample vehicle is the following:

| Car Model | Ownership tax **per year** |
|---|---|
| VW Golf 1.5 TSI | € 904 |
| VW Golf 2.0 TDI | € 1844 |
| Toyota Prius | € 1192 |
| Tesla Model 3 | € 0 |

Table 4. Ownership taxes for sample vehicles in the Netherlands

### 6.2 Case study: Germany

Germany's GDP is at 41,000 Euros per capita. Moreover, in Germany 67,658 electrically charged vehicles, or 2.0% of the 3.4 million cars were sold in 2018 (European Automobile Manufacturers' Association ACEA, 2019). The official data website by German Ministry of Foreign Affairs states that "*Energiewende*, known as the energy transition, Germany is leaving the fossil-nuclear energy era behind and is on the way to a sustainable energy future. This includes the gradual phase-out of nuclear power by 2022. By 2030, Germany also wants to reduce its greenhouse gas emissions by 55 percent compared to 1990, by 2040 the target is at least 70 percent, and by 2050 80 to 95 percent are to be achieved. In November 2016, Germany was one of the first countries worldwide to set appropriate climate policy principles and goals in the "Climate Protection Plan 2050". A reduction of 28 percent had been achieved by 2017" (Ministry of Foreign Affairs, 2019). Moreover, the German government also states commitment to various international climate agreements and environmental protection, energy cooperation and climate-friendly development. However, SGI states that "despite a strong push into renewable energy production and energy-efficient infrastructure, Germany will fail to meet its 2020 greenhouse-gas emissions-reduction goals. Part of the issue is the continued reliance on coal as the country seeks to phase out nuclear power by 2022" (Sustainable Governance Indicators, 2019).

A car owner in Germany pays the ownership tax annually. The tax is called the "Kraftfahrzeugsteuer" (or Kfz-Steuer), which must be paid at the local tax office (or Finanzamt). The amount levied is calculated based on CO2 emissions and cylinder capacity characteristics of a passenger car. According to ACEA Tax Guide 2019, "in 2009, the German government changed the annual circulation tax for new passenger cars registered as of 1 July 2009. It now consists of a tax base and a CO2 base, whereby the CO2 tax is linear. The tax base amounts to €2 per 100cm3 (petrol cars) or €9.50 per 100cm3 (diesel cars). As of 1 January 2014, every gram above the minimum level of 95g/km is taxed at €2 and this applies to both diesel and petrol cars. Previously, the minimum level was 120g/km (2009) and 110g/km (2012). The method used to measure the relevant pollutants and CO2-data has changed for all passenger cars registered from September 2018. The NEDC Procedure has been replaced with the WLTP procedure. In the case of passenger cars registered before 1 July 2009, the annual circulation tax will continue to be based on emission classes and on cylinder capacity. A planned integration of these vehicles into the new system has not been implemented" (ACEA European Automobile Manufacturers' Association, 2019). However, it is also worth noting that since the main goal is to cut carbon dioxide emissions in half by 2030, the German government now offers subsidies of up to €4,000 to offset the cost of a new electric vehicle. For electric vehicles, initial registrations from 1 January 2016 until 31 December 2020, there is a tax exemption of *10 years* (purely electric or fuel-cell vehicles, not hybrids). After the exemption, the car tax will amount to 50% of €11.25 (up to 2,000kg), €12.02 (up to 3,000kg) or €12.78 (up to 3,500kg) for each 100cc or part thereof.

For the purpose of this research, all the sample vehicle tax calculations assume that the initial car registration is after 2014.

| Car Model | Ownership tax **per year** |
|---|---|
| VW Golf 1.5 TSI | € 76 |
| VW Golf 2.0 TDI | € 236 |
| Toyota Prius | € 36 |
| Tesla Model 3 | € 0 (for 10 years) |

Table 5. Ownership taxes for sample vehicles in Germany

### 6.3 Case study: Poland

In 2018 in Poland the market share of electric (or hybrid) vehicles was 0.2% with 1,324 units sold, while the country's GDP of €12,900. Poland is one of the biggest GHG emitters in Europe and is highly reliant on the coal production for its energy consumption. Combined with less progressive climate policies, as well as slowing down common action on European level, Poland is yet to show commitment to European environment goals. As per Organization for Economic Co-operation and Development," Poland has not yet adopted a coherent national climate protection policy, despite some steps to integrate climate protection concerns into energy policy. Such a policy would facilitate identification of the climate protection measures that would most cost-effectively reduce emissions of other air pollutants as well as GHGs, thus contributing to more efficient use of limited pollution control resources. Poland's emissions of acidifying pollutants per unit of GDP remain among the highest in the OECD" (Organization for Economic Co-operation and Development, n.d.).The recent developments are not optimistic either. First, according to Sustainable Government Indicators, Poland has been "one of the primary critics of the EU's climate policy and emissions-trading system. It has faced increasing pressure to meet climate-protection goals and has agreed to dialogue seeking compromises for countries with a high dependence on coal. The EU has sued the country for beginning shale-gas drilling without an impact assessment" (Sustainable Governance Indicators, 2019). Second, Poland is a country heavily reliant on coal, is opposed to the new European Green Deal presented recently by the new EU Commissioner von der Leyen, and therefore Poland has been exempted from the deal for now. "Polish Prime Minister Mateusz Morawiecki said it had been a "difficult negotiation" but welcomed his country's exemption. He said: "this rule that must also be included in the legislative process, the rule that Poland would be reaching climate neutrality at its own pace" (BBC, 2019). It appears that even with the emergence of more climate awareness, Poland's general attitudes toward environmental policy are not as progressive as in wealthier European countries.

It is worth mentioning that Poland has a Green Investment plan in place which consists of programs or projects connected with protection of the environment, in particular with reducing or avoiding national greenhouse gas emissions, absorption or sequestration of carbon dioxide, mostly focused around the energy sector.

It is important to note that out of all EU Member States, only 6 countries that do not apply CO2-based taxation. These countries are Bulgaria, Estonia, Hungary, Lithuania, Poland and Slovakia.

In Poland there are no typical ownership taxes. Newly registered vehicles are subject to an excise tax up 18.6%, which is to be paid on top if the tax base by the buyer. Since this tax is levied upon registration, it does not count as a periodic ownership tax.

There is only a local tax for owners of commercial vehicles with weight over 3.5t. The amount of tax paid depends on weight and number of axles. The lowest tax is PLN 24.89 and the highest is

PLN 3,181. However, since March 2009 there exist excise taxes on various products, including but not limited to, used cars.

For new and second-hand vehicles, the rate of excise tax depends on the engine capacity (ACEA European Automobile Manufacturers' Association, 2019). The tax due is calculated using this calculation method:

Tax rate x Vehicle value

| | |
|---|---|
| Electric vehicles | 0% |
| Plug-in hybrid electric vehicles | 0% |
| < 2,000cc (engine capacity) | 3.1% |
| > 2,000cc | 18.6% |

Table 6. Excise tax on passenger cars in Poland

Therefore, it can be concluded that for our sample vehicles the cost of ownership tax per year equals 0 euros, since Polish excise tax is paid upon purchase.

| Car Model | Ownership tax **per year** |
|---|---|
| VW Golf 1.5 TSI | € 0 |
| VW Golf 2.0 TDI | € 0 |
| Toyota Prius | € 0 |
| Tesla Model 3 | € 0 |

Table 7. Ownership tax for sample vehicles in Poland

### 6.4 Case study: The United Kingdom

In the United Kingdom in 2018 there are 59,947 electrically charged vehicles, or 2.5% of the 2.4 million cars sold in 2018, while the country's GDP is at €37,600 per capita. According to Sustainable Governance Indicators, "despite strong environmental rhetoric, subsidies for green energy have been cut in recent years, and the UK government has intensified support for fracking and nuclear power. Market-based mechanisms continue to inform environmental policy, paired with planning systems such the effort to protect green belts around urban areas. Some ecological programs have fallen victim to spending cuts" (Sustainbale Governance Indicators, 2019). It is understandable that the United Kingdom has more burning issues to deal with, however there is no way to ignore climate change. SGI also writes that "the UK government ratified the Paris climate-change accord in late 2016. It has also announced plans to relax regulations for on-shore wind farms and natural-gas fracking. Following a public consultation, it has developed plans to reduce plastics use, including a new plastics tax" (Sustainbale Governance Indicators, 2019). It is fair to say in the case with the United Kingdom that its commitment to international climate agreements shows overall strong environmental discourse.

In the UK buyers can get a discount on the price of brand-new low emission vehicles through a grant the government gives to vehicle dealerships and manufacturers. Grants range from £3,500 for qualifying vehicles (BEVs), up to £8,000 for LCVs (GOV.UK, 2019).

Here below is the basis of taxation on ownership.

| | | |
|---|---|---|
| Private cars | Up to 1999 | Flat Rate |
| | Up to March 2001 | Graduated system (all cars based on engine size) |
| | From March 2001 | Existing cars based on engine size and new cars based on CO2 emission ratings |

Table 8. Basis of taxation on ownership in the UK

For the purpose of this research coaches, buses and lorries are excluded. The rates for private cars and vans of dead weight less than 3,500kg are based on CO2 emissions ratings and fuel type (petrol/diesel). However, these rates apply only to "cars that have been type approved within category M1 of Annex II to Council Directive 70/156/EEC and which have been registered on the basis of a type-approval certificate that shows the CO2 emissions level in terms of grams per kilometre driven. Cars without a CO2 value or registered before March 2001 have a rate determined by engine size, over or under 1,549cc. Cars registered before 1 January 1974 are exempt from the tax" (ACEA European Automobile Manufacturers' Association, 2019). Since 1st April 2019, new rates of vehicle tax were released. They are as follows:

**First licence rates for cars registered on or after 01/04/19 based on $CO_2$ emissions and fuel type**

| $CO_2$ | Petrol car/diesel car* (tax class 48 and 49) 12 months | Diesel car** (tax class 49) 12 months | Alternative fuel car (tax class 59) 12 months |
|---|---|---|---|
| 0 | £0 | £0 | £0 |
| 1-50 | £10 | £25 | £0 |
| 51-75 | £25 | £110 | £15 |
| 76-90 | £110 | £130 | £100 |
| 91-100 | £130 | £150 | £120 |
| 101-110 | £150 | £170 | £140 |
| 111-130 | £170 | £210 | £160 |
| 131-150 | £210 | £530 | £200 |
| 151-170 | £530 | £855 | £520 |
| 171-190 | £855 | £1,280 | £845 |
| 191-225 | £1,280 | £1,815 | £1,270 |
| 226-255 | £1,815 | £2,135 | £1,805 |
| Over 255 | £2,135 | £2,135 | £2,125 |

* Diesel cars tested to RDE2 standards.
** Diesel cars tested to RDE standards.

Table 9. (Driver and Vehicle Licensing Agency , 2019)

Assuming all our sample vehicles are new, the ownership tax per year is calculated by their CO2 output below. Currency exchange rate is 1 British Pound = 1.20 Euro as of 14 December 2019.

| Car Model | Ownership tax **per year** |
|---|---|
| VW Golf 1.5 TSI | € 203,84 |
| VW Golf 2.0 TDI | € 251,80 |
| Toyota Prius | € 29,98 |
| Tesla Model 3 | € 0 |

Table 10. Ownership tax ownership tax in the UK

To conclude this section, a more comprehensive table to demonstrate the ownership tax burden in each country for owners is provided below.

| Car Model | The Netherlands | Germany | Poland | The UK |
|---|---|---|---|---|
| VW Golf 1.5 TSI | € 904 | € 76 | € 0 | € 203,84 |
| VW Golf 2.0 TDI | € 1844 | € 236 | € 0 | € 251,80 |
| Toyota Prius | € 1192 | € 36 | € 0 | € 29,98 |
| Tesla Model 3 | € 0 | € 0 (for 10 years) | € 0 | € 0 |

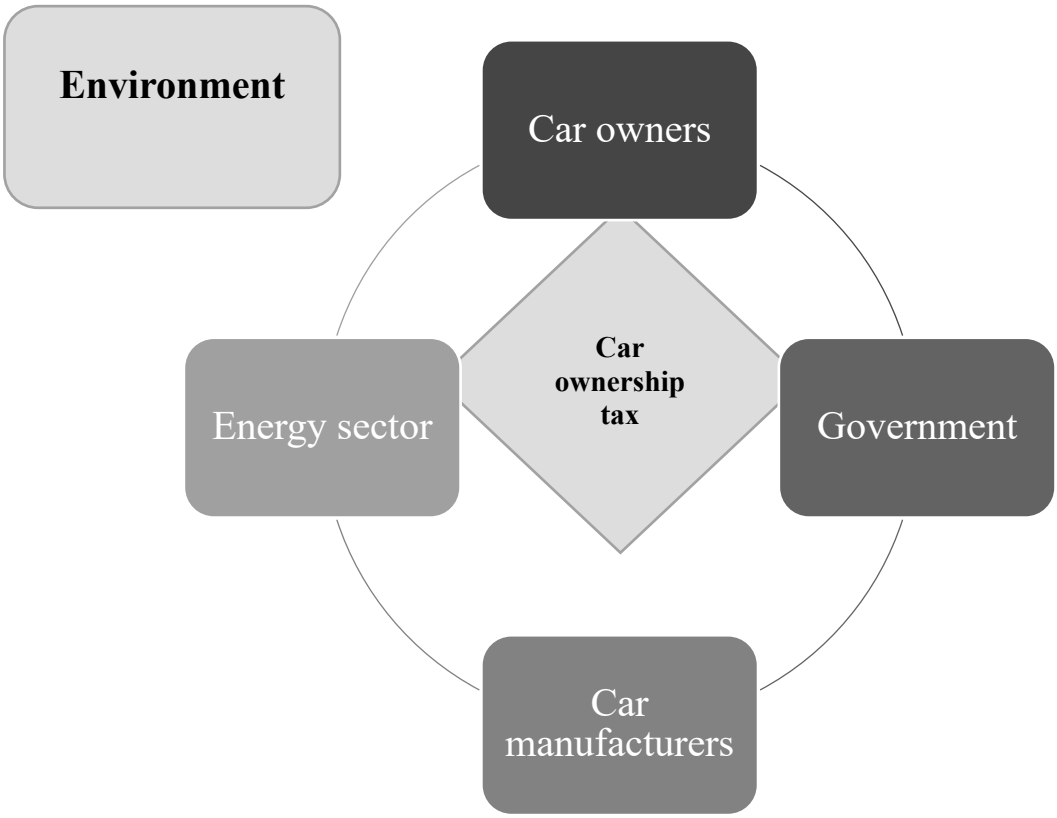
Table 11. Summary of ownership taxes for sample vehicles in selected countries.

It is clear to see that Tesla and other electric vehicle owners are not burdened by the ownership taxes such as diesel car owners. The ownership tax is one of main incentive instruments and as it is demonstrated in the Netherlands, where Tesla model 3 is the most sold car of 2019, the incentive is working on the de-carbonisation of the fleet of vehicles. It is also demonstrated that diesel car owners are burdened with ownership tax the most – it is evident that there is no incentive for consumers to purchase a diesel car. However, the share of diesel cars on the road is still large: for example, in Germany they account for 31,6% as of November 2019 (Kraftfahrt Bundesamt, 2019). Another conclusion can be drawn: it is most expensive to own a combustion engine car in the Netherlands. The ownership car tax on its own it already is a huge incentive to *not* buy a car in the Netherlands. In the UK the problem is that old cars (registered before 2001) are taxed based on their engine capacity and not CO2 emissions.

To properly determine the best tax model for reducing the CO2 emissions and provide the best possible recommendation, stakeholders and other factors involved in car taxation shall be established.

## 7. What are stakeholders involved in car ownership tax?

In the previous chapter the ownership tax is selected European countries was discussed, and now this section deals with the stakeholders involved in the issue of ownership car tax. It is evident that there are 5 primary actors involved in car ownership tax. National governments set the taxation policy, which tax authority enforces. People buy cars from manufacturers and fuel them up, which involves the consumers, the car industry and the energy sector. Last but not least, the environment is essential to consider due to ecological impacts of passenger cars.




Graph 1. Stakeholders

Hereafter each stakeholder will be discussed separately. As seen on the graph above, the three stakeholders with highest interest are car owners, government and energy sector. However, car manufacturers play a great role as well as the environment, and ideally the responsibility to make a sustainable choice as a consumer.

### 7.1 Environment

It is essential to include the environment as a separate stakeholder, since climate change is a great challenge that is shaping our future as we approach a new decade. Climate change has been a big debate in the past few years, even though the concern is not a new idea. It is obvious, as mentioned before, that transport sector must adapt to climate change and European Union's

environmental goals. Furthermore, climate change is a growing concern of a large part of European population, as it was demonstrated at the latest 2019 European Parliament elections. The Group of the Greens/European Free Alliance gained 22 seats compared to the last EP election. Renew Europe group (formerly known as Alliance of Liberals and Democrats for Europe) gained 39 seats. A huge victory for Volt – a new progressive Pan-European party that was formed only two years ago – first elections and one seat (European Parliament, 2019). Europeans noticeably care about climate change and it reflects on the latest vote, even if it's mostly in the west (Oroschakoff, 2019). It is obvious that the damage that the transport sector does to the environment in term of CO2 emissions is a serious concern at this point in time. Ideally, in case with car taxation, the damage done to the environment must be considered throughout the European continent. Now it is not the case.

### 7.2 Government

As mentioned in the Environment section, climate change is a growing concern among European population. Therefore, today politicians must comply with the environmental goals and adapt greener policies. National governments have the most power in case with car taxation, since it is the national government sets the fiscal policy. However, in the Treaty on the Functioning of the EU Title I Article 4 paragraph 2 on Areas of shared competence it is stated that:

> *"2. Shared competence between the Union and the Member States applies in the following principal areas <...>:*
>
> *c. economic, social, territorial cohesion*
>
> *e. environment*
>
> *g. transport"* (Kluwer, 2013)

As by definition, shared competence means both the EU and the Member States may adopt legally binding acts in those areas. This means that both politicians in the EU institutions and politicians in national governments are responsible for forming a proper and sustainable fiscal policy. However, since European law is superior to the national laws of Member States and always takes precedence, it is only fair to commit to the 2011 White Paper on Transport outline: "polluter pays", cohesion on EU level, the elimination of tax distortions for sustainable economy. Better regulation in the area of fiscal policy in transport sector is a commitment to the sustainability goals of the 2011 White Paper on transport. In December 2019, at COP25 a European Green Deal has been presented by the new Commission. Among other points, it includes such objectives as one million recharging points refuelling stations for low emissions and electric vehicles by 2025 for estimated 13 million vehicles on European roads (European Commission, 2019). Motor vehicles account for €428 billion in tax contributions in 15 European countries alone.

### 7.3 Car owners

It is obvious that car owners are essentially the tax payers, and therefore have a high interest in the issue with car taxation. Transport sector is fundamental to European economy and society. The demand for mobility is high and with freedom of movement mobility is more popular than ever. ACEA states that as of 2017 the European Union counts 602 motor vehicles per 1,000 inhabitants. 30 new cars were registered per 1,000 inhabitants in the European Union in 2018. Out of the total, alternatively-powered passenger cars make up only 3.4% of the total EU car fleet. It is obvious that when thinking of purchasing a car, consumers take into account how much they will be burdened with tax. First thought that comes to mind is the registration tax. In countries such as the Netherlands no registration tax is levied for electric vehicles, therefore providing incentive to purchase a clean vehicle. In many, but not all, European Countries registration tax is calculated based, among other characteristics, on CO2 emissions. As mentioned previously, registration tax is proved to be motivating a consumer towards an eco-friendlier vehicle choice. However, there is no long-term risk with registration tax. Regarding ownership tax, it is obvious that just owning a car and actually using a car are different actions. For a car owner, it is only fair and just that ownership tax is paid by the distance driven (or as many pollutants emitted), and not just for "owning" a vehicle. This would benefit people who drive less while still own a heavy or powerful car and put most tax burden on people who drive consistently the most.

For now, however, even with incentives and government subsidies the main concern is that electric vehicles are expensive and there is a lack of cheap second-hand options for a low-income buyer. As Nik Martin from DW writes in his 2019 article, "lower-income groups, who can pick up a traditional used car for just a few hundred euros, risk being left out of the electromobility era altogether" (Martin, 2019). The analysis showed that low-income drivers living in rural areas felt somewhat detached from the new electric mobility era as they assume, they cannot to afford an electrical vehicle, or face a shortage of charging stations if they can and be dependent on poor public transportation. Martin concludes that "a solution could come from the advance of autonomous vehicles, which are currently being tested in Germany and several US cities". As well as car sharing platform, autonomous taxis can be beneficial for those who cannot afford an own electric vehicle (Martin, 2019).

### 7.4 Energy sector

Obviously, energy sector is an essential part of transportation in general, and car taxation as well. First of all, it is mentioned in the 2011 White paper on Transport that Europe should address the oil dependence question. "The less successful the world is in decarbonising, the greater will be the oil price increase" (European Commission, 2011). As it is pointed out by the European Environment Agency "Our quality of life depends, among other things, on a reliable supply of energy at an affordable price. But energy production and use place significant pressures on the

environment, as we chiefly rely on fossil fuels and waste a substantial part of this energy before and during use. Energy activities give rise to greenhouse gas and air pollutant emissions, land use, waste generation and oil spills, contributing to climate change, damage of natural ecosystems and of the built environment, and adverse effects on human health. We therefore need to consume less energy and step up the clean energy transition that is already unfolding across Europe" (European Environment Agency, 2019).

International Energy Agency states in their 2019 report on fuel economy in major car markets that between 2005 and 2017 average fuel economy in light duty vehicles improved, but there is a wide difference between trends and levels in various regions. One of the key drivers behind this is the overall decline of diesel sales in several major car markets, such as Europe. Hereafter the IEA also states that "a growing amount of evidence highlights the importance of policies to improve average fuel consumption" (International Energy Agency, 2019). A separate section of the report is dedicated to fiscal policy. "Taxing at the point of vehicle purchase and/or circulation can also affect transport decisions. Differentiated taxation schemes, also known as 'feebates', can incentivise vehicle makers to provide more efficient technologies and consumers to purchase cleaner, more fuel-efficient cars. Ideally, taxation schemes should directly target performance outcomes, including CO2 or local pollutant emissions reductions" (International Energy Agency, 2019).

In the World Energy Outlook 2019 the IEA reports that the global oil demand rose in 2018. However, the results show that the leader in oil demand is the United States, and not China or India, as one might expect. Moreover, even though the sales of electric vehicles are setting records, they still do not visibly decrease the oil demand levels. The main increases in oil demand levels are from gasoline and diesel but there had been also significant contributions from ethane, liquefied petroleum gas (LPG) and naphtha as using oil as feedstock (International Energy Agency, 2019).

Apart from this, as previously described in the case studies, there is agreement in parliaments across the selected countries that seem to recognize the need for renewable and sustainable energy measures. In Germany, the government is embracing the Energiewende strategy – a shift from traditional energy sources, as well as away from nuclear energy, and focusing only on renewable sources such as wind, hydroelectric and solar. The switch to renewable energy sources is fundamental to reduce GHG emissions in Europe, however, there are opinions that advice not to count off nuclear energy if the European population is to consume as much energy as we do now. For example, Holger Rogner includes reduction in harmful emissions, enhancement of energy security and manageable waste among the advantages of nuclear energy. "When judging nuclear power on its green growth merits, one should be aware that there is no technology without risks and interaction with the environment. Fossil fuel chains cause tens of thousands of deaths every year and contribute to climate change. While wind, solar and nuclear energy have quasi no

interaction with the environment at the point of electricity generation, there are emissions and wastes associated with material extraction, manufacturing and construction and, in the case of nuclear, with the front and back-end of the fuel cycle. It is therefore imperative to compare all options on a level playing field. Some societies may well view the risks as excessive and shy away from nuclear energy. Other societies will continue to adopt or expand its use as an integral part of their national green growth strategies" (Rogner, 2012). Richard Rhodes is also among the supporters of nuclear energy. He writes that "nuclear power is not the only answer to the world-scale threat of global warming. <…> so, at least for leveling the flow of electricity when renewables vary, does natural gas. <…> Nuclear is a valuable, even an irreplaceable, part of the solution to the greatest energy threat in the history of humankind" (Rhodes, 2018). Inclusion of nuclear energy in the energy transition is almost essential to meet current consumption needs, especially considering the de-carbonization of cars and the rise of electric mobility.

Furthermore, it is worth mentioning that Europe is on track for European-based electric battery production. This will prove to be fundamental in further decarbonisation of European fleet of cars. As per this May 2019 DW reportage, for now the battery cells are mostly manufacture in Asia, the main producers being companies such as Panasonic, Envision and LG Chem. In order to European battery production France and Germany are planning to subsidize the industry with an amount of 1.7 billion Euros. However, critics say that subsidies may do little, since European batteries would be less competitive due to high cost of electricity. Another critique is that battery production is highly automated and would lower job creation. (Jelinnek, 2019)

### 7.5 Car manufacturers

As data by ACEA shows, 13.3 million people out of the EU employed population – work directly and indirectly in the automotive sector. The 3.4 million jobs in automotive manufacturing represent over 11% of total EU manufacturing employment. The sector is also a key driver of knowledge and innovation, representing Europe's largest private contributor to R&D, with €54 billion invested annually. The automotive sector is the EU's number one investor in R&D, responsible for 28% of total spending. The automobile industry generates a trade surplus of €90.3 billion for the EU. No doubt that automotive sector is a shining jewel among European industries. European cars are well known all around the world, may it be a powerful German sedan, a French conventional hatchback, or a fast and sleek Italian sportscar. However, after the "Dieselgate" scandal it is again most important to keep in mind that the car manufacturer industry has been increasingly cheating the tests so expertly that the gap between official fuel economy tests and real-world driving has become very wide and therefore CO2 emissions test results are not reliable.

ACEA Secretary General says that "People throughout the EU should be able to consider purchasing an electric vehicle – no matter which country they live in – north or south, east or west. The affordability of the latest low- and zero-emission technologies needs to be addressed by

governments as a matter of priority<…> Besides investing in charging infrastructure, governments across the EU need to put in place meaningful and sustainable incentives in order to encourage more consumers to make the switch to electric" (European Automobile Manufacturers' Association ACEA, 2019).

With proper investment management and allocation, as well as rapid development of infrastructure, it is possible to lower CO2 emissions in Europe without "killing" the automotive sector. Bernhard Mattes, president of German Association of Automotive Industry says that "The EU has set very ambitious CO2 fleet limits for manufacturers to achieve by 2030<…> it will require high consumer acceptance and optimal framework conditions. German manufacturers and suppliers are making enormous advances to this end, investing €40 billion ($44.5 billion) over the next three years. Every third patent in the field of electromobility and hybrid drive worldwide comes from Germany" (Martin, 2019). Automotive analyst Matthias Schmidt states that the sweet spot for electric cars will come post-2030s, "when the EU enforces a 37.5% cut in CO2 emissions from carmakers' fleets. Electric vehicles will be an absolute necessity to reach this target. If electric cars aren't profitable by then, there is little hope for car manufacturers going forward" (Martin, 2019).

As the stakeholder analysis suggests, there are many different factors at play and each stakeholder impacts another. All stakeholders considered, the problems arising as a result of different taxation are discussed in the next chapter.

## 8. What are the problems caused by the differences in road tax?

After the stakeholders were established in the previous chapter, in this section the results from case studies are looked at within the extra context. As demonstrated above, the most expensive country to own a combustion engine vehicle is the Netherlands, which is also explained by its high GDP. Of course, a wealthier country prioritizes environment more than a country with a low GDP. It is shows on the example with Poland – even as one of fastest developing economies in Europe, its environmental policy leaves much to be desired. Among the four selected countries, Poland is the only one with the lack of CO2 based car ownership tax. As it was noted earlier, only 6 countries in the European Union that do not apply CO2-based taxation. These countries are Bulgaria, Estonia, Hungary, Lithuania, Poland and Slovakia. The most obvious deduction from this fact is that in a post-socialist bloc countries environment and climate change is not a top priority. Because of this, and since Europe aims to be cohesive in CO2 emission reduction, it is important that all Member States are on board with more environment friendly policies.

There are several issues that arise due to incoherence in road tax models. During this research several problems have been identified directly related to the proper functioning of the European Single Market:

- Cross-border constrains
- Currency exchange rate
- Stakeholder behaviour

To elaborate further, cross-border constrains, for example double taxation when moving from one country to another or importing a car, are primary a problem for consumers, as the process becomes complicated and eventually prevents a person from buying a car in another country, and European Commission proposed a directive in 2005 to address this problem, but the proposal failed (European Commission, 2012). Self-evidently, as not all European Union Member States are members of the Eurozone, such as Poland for example, a country that is using złoty (PLN); as the currency rate fluctuates, it has some degree of impact to the price levels. Here below is the elaboration of stakeholder behaviour differences per stakeholder.

a. Car manufacturing industry

   Different taxation systems, and therefore price levels cause the car manufacturing industry build different specifications to same model of a car, just to adjust to a different market.

b. Car owners

   Apart from cultural and socio-economic differences between countries, the differences in tax systems causes the lack of system transparency. For example, it makes sense that one pays taxes on a vehicle to a country where the vehicle is used and not where it is purchased. Thus “people in some smaller countries of high taxation can seize the

geographic factor to develop active tax avoidance" (European Commission - DG Taxation and Customs Union, 2002).

Even though the European Union law has tax cooperation to some degree, circulation taxes are under the national governments' competences as of now. In the European Commission communication COM2012 756 to the European parliament the Commission outlines the guidelines that Member States are advised to follow. Currently, there is no harmonisation at EU level of car registration and circulation taxes (European Commission, 2012). This means that the evolution of vehicle taxation is within dependency of the Court of Justice of the European Union. As per this communication, regarding circulation tax, the problems of double taxation in case of a cross-border use of passenger cars are limited" (European Commission, 2012). According to the Commission, different taxation level is a result of Member States using different thresholds while applying same environmental elements in their taxation policy.

Thus, having identifies the main problems at hand, it is important to determine solutions and recommendations available nowadays.

## 9. Discussion

This section provides the reader with conclusions of the sub questions and case studies, as well as possible solutions explored. As discussed above, Ian Parry writes that "economically efficient tax reforms could be straightforward to implement, such as incorporating carbon content into the taxation of fossil fuels. For other problems, such as vehicle fuel economy, tax design is more complicated if governments care about revenue as well as environmental objectives" (Parry, 2011). European Environment Agency states that "Where there were appropriate levels of taxes and incentives in place, consumer adoption of lower CO2 emitting vehicles followed". Moreover, reducing GHG emissions is a key priority to the EU (European Environment Agency, 2018).

As described, car taxation is a complex issue in Europe. This research shows that among four countries the best practise of car ownership tax in terms of reduction of CO2 emissions is the Netherlands. It is evident that we also have to keep in mind that the Netherlands has exceptions for electric vehicles for registration tax as well. People pay more the dirtier their vehicle is. The Netherlands is a bright example of how tax incentives encourage a car fleet turnover toward electric and low emission vehicles.

The worst practice among the chosen countries is Poland. Weak excise tax on cars with medium to high engine capacity combined with no tax incentive to purchase electric or low emissions vehicle. People also hold on to their old vehicles longer, which causes slow fleet turnover. As per Eurostat, Poland has the largest share of old (20 and more years) cars in the EU, which is at 35.2 % (Eurostat, 2019).

In Germany and the United Kingdom there are comparatively minor tax benefits for owners of electric or low emissions vehicles. "The tax payment curve is relatively balanced in these two markets, with negligible cost increases for a car emitting more than 50 g CO2/ km in the United Kingdom and 95 g CO2/km in Germany" (Sandra Wappelhorst, 2018). Subsidies help to significantly reduce the tax burned, however to reach most recent CO2 reduction goals more adjustment is needed.

It is obvious that there is always room for improvement. There are several possible adjustments that can be made to the tax systems in selected countries and in the European Union to commit to environmental goals of the upcoming decade.

As mentioned in the beginning, one of the solutions can be a proportional tax on CO2 emissions in line with kilometers driven, which promotes cost-effectiveness
by presenting the identical reward for the final ton of CO2 reduced. This is a fairer tax where the main tax burden is on people who drive the most, which also allows for better fuel economy and overall greener consumer decision making. Another option is feebates. As previously defined, the feebate system would avoid potential revenue losses, because the pivot point declines over time as the average CO2 per kilometer of the new vehicle fleet falls (Parry, 2011).

However, for the reforms to be economically efficient, they must be straightforward. For example, a simple implementation of a carbon tax, or a more up-to-date and relevant CO2 emissions element. As sources above prove, for a faster charge to electric and low emissions vehicles, it is evident that significant tax incentives cause an uptake in electric car sales.

Matthias Runkel suggests that ideally, taxation should be harmonized as widely as possible. This would help avoid adverse tax competition and fuel tourism on the continent. In the UK for example are diesel and gasoline being taxed at the same rate (Matthias Runkel, 2018, p. 18).

A whole other issue is company car privileges. “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 <…> emissions should be accounted for as part of the company-car tax system” (Matthias Runkel, 2018, p. 18). For example, in Germany, for company car users the percentage tax base is the same for all vehicle types, and as a result the tax advantages for users with low emissions vehicles are very minor. On the other hand, employees in the Netherlands systems ensures significant tax advantages for users of a low-emission company car. There is a similar situation in the UK. It is important to include company car taxation to motivate employees choose a low-CO2 company car (Sandra Wappelhorst, 2018, pp. 39-40).

## 10. Conclusion

It is established that around half of all transport emissions in the European Union are caused by passenger cars. While the concern about the environment and awareness of sustainable consumer choice among the young European population is rising, as well as the need for mobility across the continent, European leaders are at the start of de-carbonization. Yet politicians are not to be alone. Car manufacturing industry as well as the energy sector, should work together to achieve CO2 emissions reduction, as per environmental goals stated by European Commission. Several challenges remain on the path to turnover of the European car fleet toward zero emissions vehicles. Lack of infrastructure for electric vehicles and plug-in hybrids in many European Member States is discouraging for consumers while considering a purchase of an electric vehicle. Moreover, appropriately designed and significant tax incentives do affect reductions in average CO2 emissions from passenger cars in Europe.

So, what is the best road tax model as of now? At present among the analyzed countries the tax system of the Netherlands is the most effective in reducing CO2 emissions. The Netherlands ownership tax model ensures tax benefits upon registration, as electric vehicles are exempt from registration and ownership taxes, thus providing incentives for people to consider and purchase of an electric vehicle, as it also shows progress in demand for electric cars. Among the analyzed countries the worst system as of now is in Poland. There are no tax incentives for people to switch to an electric or a low emissions vehicle, but also the excise tax on cars in Poland only promotes a purchase of a small capacity engine car. It also makes people hold onto their old cars longer, thus slowing down the car fleet turnover. In Germany and the United Kingdom overall the tax incentives for electric cars are comparatively weak. However, in terms of overall attitude toward environmental policies both of these countries are making progress with CO2 based taxation of company cars, and electric cars subsidies. It is also worth noting that in Germany, the NEDC tests were replaced in favor of the more reliable WEDC tests, which is a good sign. As Runkel wrote, it is essential that the CO2 values are reflective of real world values. “Taxation based on CO2 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. One of the most rigorous registration taxes can be found in the Netherlands. The tax amount is quickly increasing with every gCO2/km and already starts at low levels (80 g/km)” (Matthias Runkel, 2018, p. 18). Hence once more proving that as of present, the best road tax system is in the Netherlands, although there is always room for improvement.

To conclude, below several recommendations are provided.

## 11. Recommendation

In this short recommendation the reader is provided with a summary of best possible solutions to the problem of CO2 based car taxation in Europe. First of all, it is important that there are significant tax incentives upon purchase, such as exemption of electric vehicles from acquisition tax or exemption from VAT, which provides substantial influence on consumer behavior. It is also vital to ensure the tax benefits for continuation of the car usage, such as exemption of electric vehicles from ownership (circulation/road) tax. Moreover, the lower cost of ownership tax, as well as electricity cost versus the cost of fuel and diesel can significantly influence the decision of a consumer. It also must be said that company car systems should account for CO2 emissions and provide incentives for electric or low-emissions vehicle, which will persuade the employee choose a more eco-friendly car. Besides, it is important to periodically readjust the tax systems in order for them to be sustainable. The countries have to make sure that tax revenue is generated by highly polluting vehicles, to allow for lower taxes for electric vehicles, and therefore faster car fleet turnover. Which, in turn will lower CO2 and other GHG emissions in Europe.

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# Appendix A

*Table 1. Taxes on Ownership* (ACEA European Automobile Manufacturers' Association, 2019, p. 7)

| **Country** | **Passenger cars** |
|---|---|
| Austria | Engine power (kW) |
| Belgium | Cylinder capacity, CO2 emissions, fuel type and emission standards |
| Bulgaria | Engine power (kW), year of production and emission standards |
| Croatia | Engine power (kW) and age |
| Cyprus | CO2 emissions |
| Czechia | Engine size |
| Denmark | Fuel consumption and weight |
| Estonia | None |
| Finland | CO2 emissions, weight and fuel type |
| France | Fiscal power (hp) and CO2 emissions |
| Germany | CO2 emissions and cylinder capacity |
| Greece | Engine capacity or CO2 emissions |
| Hungary | Engine power and year of production |
| Ireland | Cylinder capacity or CO2 emissions |
| Italy | kW, emission standards and fuel type |
| Latvia | GVW, engine capacity (cc), power (kW) |
| Lithuania | None |
| Luxembourg | CO2 emissions or cylinder capacity |
| Malta | CO2 emissions and age |
| Netherlands | GVW, province, fuel, CO2 emissions |
| Poland | None |
| Portugal | Cylinder capacity and CO2 emissions |
| Romania | Cylinder capacity (cc) |
| Slovakia | Cylinder capacity and age |
| Slovenia | None |
| Spain | Engine rating (hp) |
| Sweden | Weight, fuel type and CO2 emissions |
| United Kingdom | Engine size or CO2 emission |

## Appendix B

*Table 2. Taxes on Acquisition* (ACEA European Automobile Manufacturers' Association, 2019, p. 6)

| **Country** | **VAT** | **Registration tax** |
|---|---|---|
| Austria | 20% | Based on CO2 emissions (max 32% + bonus/malus) |
| Belgium | 21% | Based on cylinder capacity and age (Brussels-Capital)<br>Fuel, age, emission standards and CO2 (Flanders)<br>Cylinder capacity, age and CO2-based bonus/malus scheme (Wallonia) |
| Bulgaria | 20% | Plate costs (BGN 25) + eco tax (BGN 160) |
| Croatia | 25% | Based on purchase price, CO2 emissions and fuel type |
| Cyprus | 19% | Based on CO2 emissions and cylinder capacity |
| Czechia | 21% | Registration tax (max CZK 800) + eco tax based on emission standards |
| Denmark | 25% | 85% of vehicle's value up to DKK 193,400 + 150% of the rest. Reductions<br>based on safety equipment and fuel consumption |
| Estonia | 20% | Registration label (€62) + registration card (€130) |
| Finland | 24% | Based on retail value and CO2 emissions (min 2.7%, max 50%) |
| France | 20% | Registration tax (varies by region) + CO2-based bonus/malus scheme |
| Germany | 19% | Registration fees (€26.3) |
| Greece | 24% | Based on net retail price, emissions technology and CO2 |
| Hungary | 27% | Based on cylinder capacity and emission standards |
| Ireland | 23% | Based basic price and CO2 emissions |
| Italy | 22% | Based on vehicle type and horsepower + registration fees (+ €145.00) +<br>CO2-based bonus/malus scheme |
| Latvia | 21% | Registration costs (€43.93) + national resources tax (€55) |
| Lithuania | 21% | Based on vehicle type |
| Luxembourg | 17% | Registration stamp (€50) + supplement (€24 or €50) |
| Malta | 18% | Based on vehicle's value, CO2 emissions and length |
| Netherlands | 21% | Based on CO2 emissions and fuel efficiency |
| Poland | 23% | Based on cylinder capacity (up to 18.6% of vehicle's value) |
| Portugal | 23% | Based on cylinder capacity and CO2 emissions |

| | | |
|---|---|---|
| Romania | 19% | Registration fees (€8.6) |
| Slovakia | 20% | Registration fees (min €33 based on vehicle's value, engine power and age) + plate costs (€16.5) |
| Slovenia | 22% | Based on selling price, CO2 emissions and fuel type |
| Spain | 21% | Based on CO2 emissions (max 14.75% for 200g/km or more) |
| Sweden | 25% | None |
| United Kingdom | 20% | First registration fee (£55) |

## Appendix C

Student Ethics Form on separate page

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## European Studies Student Ethics Form

**Your name:**

**Supervisor:**

**Instructions:**
Before completing this form you should read the APA Ethics Code (http://www.apa.org/ethics/code/index.aspx). If you are planning research with human subjects, you should also look at the sample consent form available in the Final Project and Dissertation Guide.

a. Read section 2 that your supervisor will have to sign. Make sure that you cover all these issues in section 1.
b. Complete section 1 and, if you are using human subjects, section 2, of this form, and sign it.
c. Ask your project supervisor to read these sections (and the draft consent form if you have one) and ask him/her to sign the form.
d. Always append this signed form as an appendix to your dissertation. This is a knock-out criterium; if not included the Final Project/Dissertation is awarded an NVD.

***Section 1. Project Outline (to be completed by student)***

**(i) Title of Project:**

**(ii) Aims of project:**

**(iii) Will you involve other people in your project – e.g. via formal or informal interviews, group discussions, questionnaires, internet surveys etc. (Note: if you are using data that has already been collected by another researcher – e.g. recordings or transcripts of conversations given to you by your supervisor, you should answer 'NO' to this question.)**

**If yes: you should complete the section 2 of this form.**

**If no: you should now sign the statement below and return the form to your supervisor. You have completed this form.**

This project is not designed to include research with human subjects . I understand that I do not have ethical clearance to interview people (formally or informally) about the topic of my research, to carry out internet research (e.g. on chat rooms or discussion boards) or in any other way to use people as subjects in my research.

Student's signature _____ Date _____