

# FINANCIAL INCENTIVES FOR ELECTRIC VEHICLES ADOPTION: EXPERIENCES AND EVIDENCES FROM EUROPEAN COUNTRIES

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**Abstract:** Solving environmental problems caused by road transport, in particular problems of global warming and climate change is one of the biggest challenges today. Given that vehicles are significant sources of CO<sub>2</sub> emissions, many European countries have decided to speed up the transition from fossil fuel-powered vehicles to electric vehicles and thus contribute to the solution of these problems. Their experiences in this field can be very useful for other countries. For this reason, different financial incentives which are applied in European countries, as well as the effects of their implementation and therefore the ability to accelerate adoption of electric and other zero and low emissions vehicles are researched in this paper. Particular attention is given to financial incentives and their role in vehicle electrification policy in Norway, since it is the country with the most experience in this field in Europe as well as the country with large market share of electric vehicles. At the end of the paper, special attention is paid to financial incentives that favor these innovative technological solutions in the Republic of Serbia, as well as to reasons that explain the existing difference in the level of electrification of vehicles in the Republic of Serbia compared to other European countries.

**Keywords:** financial incentives, electric vehicles, CO<sub>2</sub> emissions, vehicle taxes, purchase incentives.

## 1. Introduction

Transport is one of the key drivers of economic and social development. At the same time, transport sector is a large consumer of energy, mostly in the form of fossil fuels. Consequently, this sector is one of the major contributors to CO<sub>2</sub> and other greenhouse gas emissions that are causing global warming and climate change. For this reason, the decarbonisation of transport is one of the priorities today (Ivković *et al.*, 2018; Čokorilo *et al.*, 2019).

A substantial reduction in CO<sub>2</sub> emission levels can be achieved through the application of various policy measures (Kaplanović *et al.*, 2009; Kaplanović, 2013). Recently, special attention has been paid to the electrification of vehicles and strategies for the rapid adoption of these technological solutions. Precisely, increasing the share of more energy-efficient and environmentally friendly vehicles, that is, increasing the share of vehicles that use electricity, either exclusively like battery electric vehicles or in combination with other fuels, as in the case of

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hybrid electric vehicles, is widely considered as an attractive solution for reducing the environmental impact of transport.

Numerous studies and experimental research confirmed that electric vehicles have significant environmental advantages compared to the internal combustion engine vehicles (Hawkins *et al.*, 2012; Haddadian *et al.*, 2015; Onat *et al.*, 2015; Wee *et al.*, 2020). Consequently, the increase in the share of electric vehicles can significantly reduce greenhouse gas emissions in road transport as well as noise and local air pollutions emissions. However, despite large investments in the electric vehicle industry, numerous incentive measures and huge promotion of electro mobility, the major expansion of this market segment has not yet occurred and the share of electric vehicles, in the entire world, is still very small today.

## 2. Motor Vehicles and CO<sub>2</sub> Emissions

Although much cleaner, and in terms of fuel economy much more efficient than ever before, motor vehicles still represent one of the most important sources of emissions of different pollutants which have a very harmful affect on the environment and human health (Bojković *et al.*, 2021). Some of these influences are manifested in the immediate vicinity of the pollution sources, while other consequences can be manifested on regional or global level. It is common knowledge that road transport is one of the biggest sources of greenhouse gas emissions, particularly CO<sub>2</sub>. Passenger cars and light commercial vehicles bear the greatest responsibility for this. In the European union member states, the share of passenger

cars in total emissions of carbon dioxide is around 12%, while light commercial vehicles are responsible for around 2,5% of these emissions (EC, 2022).

Bearing in mind both the shares of certain categories of vehicles in the total fleet of electric vehicles and the structure of newly registered electric vehicles in the world, it is clear that, within this market segment, consumers are most interested in electric passenger cars. Consequently, consumers are offered the largest number of models of electric passenger cars from different manufacturers on the market. In the last few years, it is also noted that in the market of electric vehicles, light commercial vehicles have recorded a growing interest from buyers.

According to data from the European Environmental Agency (EEA), after a three-year slight increase, the average emission of new passenger cars dropped significantly in 2020, recording a level of 107.5 gCO<sub>2</sub>/km (EEA, 2020; 2022a). The previous increase in average emissions was due to an increased share of newly registered cars that use gasoline as a fuel, especially in the segment of sports utility vehicles, while the increase in the share of electric cars influenced the reduction of these emissions in the last observed year. The situation is similar with light commercial vehicles. The multi-year trend of reducing the average CO<sub>2</sub> emissions of these vehicles was broken in the period from 2018 to 2019. This happened due to an increase in their mass, engine capacity and size (EEA, 2020). In 2020, the average emissions of newly registered light commercial vehicles in Europe again fell by 2% (EEA, 2022b).

### 3. Financial Incentives for Electric Vehicles

There is a whole range of financial incentives that can significantly increase the adoption of zero and low-emission vehicles and contribute to the reduction of CO<sub>2</sub> and other greenhouse gases emissions from road transport. In this paper the emphasis is on demand side incentives. They can be related to the purchase of the vehicle, the ownership of the vehicle and its use. Some of them provide an upfront reduction of the vehicle purchase cost, while other are applied after a zero and low-emission vehicle is purchased. In this paper, the few main financial incentives and their effects are analyzed. Those are point of sale grant incentives, vehicle registration tax and circulation tax reduction and exemption. Several other financial incentives, such as value-added tax exemption, company car tax exemption, discounted or free parking, as well as certain financial disincentives are also considered.

In general, electric vehicles are still more expensive than corresponding vehicles with internal combustion engines in the same class. Therefore, it is not surprising that the high purchase price is arguably the most important factors affecting electric vehicles adoption. Also, a lot of evidence suggests that financial incentives which reduce the upfront purchase price of electric vehicles are the most effective type of policy in stimulating their adoption (Gass *et al.*, 2014; Hardman *et al.*, 2017).

According to Hardman *et al.* (2017) purchase incentives can be grouped into four different types: (i) point of sale grant incentives, (ii) value added tax and purchase tax exemptions, (iii) post purchase rebates and

(iv) income tax credits. Bearing in mind the abovementioned, of particular interest are the initiatives applied at the time of purchase of a vehicle. At the same time, they are widely used in European countries. These include point of sale grant incentives, registration vehicle tax and value added tax reduction and exemption, etc. The second large group consists of incentives that are received later i.e. after the purchase.

#### 3.1. Point of Sale Grant Incentives

Point of sale grant incentives are reductions of the purchase price granted by government authorities at various levels. Governments of many European countries provide these incentives in an attempt to accelerate the diffusion of electric vehicles. The United Kingdom government is one of them. In this country, certain types of low-emission vehicles are eligible for a grant from the government (Alali *et al.*, 2022).

France is another country that uses this type of incentives. It practices a system of bonuses that reward buyers of environmentally friendly vehicles. The amount of the bonus varies depending on the vehicle emissions of CO<sub>2</sub>, price of the vehicle, whether the buyers are households or legal persons, as well as depending on whether the subject of purchase is electric passenger cars and light commercial vehicles or electric heavy goods vehicles (ACEA, 2021).

Numerous studies found purchase and other financial incentives to be positively correlated to a country's electric vehicle market share (Sierzchula *et al.*, 2014; Alali *et al.*, 2022). On the basis of responses from experts and stakeholders from five European countries, Santos and Davies (2020) confirmed this, but also found that the

development of charging infrastructure has the greatest impact on the quick penetration of electric vehicles, while purchase subsidies and tax incentives are in second and fourth place, respectively.

### 3.2. Vehicle Registration and Circulation Tax Exemptions

It is noticeable that many European countries have introduced CO<sub>2</sub> based registration and annual circulation taxes on vehicles. In the same time, it is notable that there is a wide range of methodologies used for their calculation. This causes the existence of different tax rates and tax burdens in different countries. Basis for their calculation is not unique. Some countries have taxes totally based on CO<sub>2</sub> emissions, while in others it is only one of the determinants. These types of taxes are related primarily on passenger cars.

In addition to value added tax, many European union member states, as well as European's countries in general, apply some form of taxes which are charged at the time of the first registration. They are known as registration taxes. Periodic taxes that relate to the ownership of the vehicles also exist in many European countries. They are known as annual circulation taxes. Basis for calculating these taxes differ among countries. Beside CO<sub>2</sub> emissions they may include some of the key characteristics of vehicle such as the cubic capacity, engine power, vehicle weight, type of engine, age of vehicles, etc. In many countries, these taxes are differentiated depending on whether it is commercial or passenger motor vehicles, and in some countries depending on whether it is petrol or diesel powered vehicles. Both, above mentioned, types of taxes can significantly affect the reduction of

negative external effects, such as greenhouse gas emissions, especially when they are based totally or even partially on CO<sub>2</sub> emissions. This particularly applies to taxes that are charge when registering a vehicle. They can lead to significant increase in vehicle price, and also to less demand for environmental harmful vehicles such as internal combustion engine vehicles. At the same time, this way of taxation favors environmental friendly vehicles. The principle of taxation is actually very simple: larger polluters have higher tax burdens while zero and low emission vehicles are either subject to lower tax burdens or are completely exempt from taxes. Similar to other point of sales incentives, the advantage of the registration tax is that it forces buyers to respond to the clear tax incentives they receive immediately when making the decision to buy a car. Battery electric vehicles are categorized as zero emission vehicles. As such they are exempted from the vehicle registration tax in Croatia, Hungary, Norway, Netherlands, Spain, and Poland, while, for example, in Denmark zero emission vehicles and low emission vehicles pay 40% and 45 % of registration tax, respectively (ACEA, 2021). Battery electric vehicles are, also, exempted from the vehicle annual circulation tax in Austria, Germany, Portugal and Netherland, while in Ireland there are minimum and reduced rates for battery electric vehicles and plug-in hybrid electric vehicle, respectively (ACEA, 2021). Numerous studies confirm the positive effect of these incentives for the uptake of electric vehicles. For example, Mabit and Fosgerau (2011) concluded that vehicle registration tax benefits in Denmark would boost the market adoption of alternative-fuel vehicles while Gómez Vilchez and Thiel (2019) revealed that the abolition of tax benefits resulted in significant decrease of electric car sales in Denmark and Netherlands. On the

other side, Lévy *et al.* (2017) find that the registration and circulation taxes exemption in Norway and the Netherlands favors big electric vehicles.

### 3.3 Other Financial Incentives

In addition to the above, there are many other financial incentives that influence the faster adoption of electric vehicles. Value added tax is a general consumption tax. This tax is levied in all European countries, but only few of them use this instrument to solve environmental problems. It is clear that value added tax exemptions belong to the group of initiatives that apply at the time of purchase. For example, in Austria there is a value added tax deduction and exemption from tax for zero-emission cars, while in Portugal these tax deductions are related to company cars (ACEA, 2021).

Another type of taxes can be used for promotion electro mobility. It is company car tax. Company cars are often used for both business and private purpose. Using company cars for private purposes, employee receives benefit in kind which is taxable. In order to increase the share of clean and energy efficient cars in the segment of company cars, some European countries have introduced an environmental component in the taxation of these benefits.

There are other financial incentives. In the Czech Republic, for example, certain battery electric vehicles and fuel cell electric vehicles are exempt from purchasing a vignette (ACEA, 2021). Also, cities of many countries provide free or discounted parking for electric vehicles as well as for other alternative fuel vehicles in order to encourage more potential buyers to switch from internal

combustion engine vehicle to electric. These benefits can also contribute to faster adoption of electric vehicles. However, the best results would be achieved by applying several incentives at the same time.

### 3.4. Financial Disincentives for Internal Combustion Engine Vehicles

Aside from the fact that taxes related to the vehicles represent an important source of state revenues, this economic instrument can be a very powerful mechanism for reducing CO<sub>2</sub> and other greenhouse gases emissions and solving ecological problems. From an economic point of view, the best solution for internalization of external cost of CO<sub>2</sub> emissions would be achieved by applying tax on vehicle emissions in the amount of marginal external damage caused to society. This way, there would be strong economic incentives to reduce CO<sub>2</sub> and pollutant emission levels through an adequate selection of vehicles and optimization of the driven kilometers (Kaplanović and Mijailović, 2012). Unfortunately, the previous solution is still not applicable in practice. Fuel tax, also, represents a good solution for internalization of external costs of CO<sub>2</sub> emission and implementation of a polluter pays principle, given that the CO<sub>2</sub> emission correlates with the quantity of fuel consumed. Heavier taxation of fossil fuels on the one hand, and relatively lower taxes on electricity on the other, can ensure lower energy costs for driving electric vehicle compared to a vehicle powered by a regular internal combustion engine. This stimulates greater use of the first-mentioned category of vehicle, and thus leads to the decarbonization of road transport. This kind of taxation could be characterized as financial disincentives for internal combustion engine vehicles.

However, the political resistance to higher fuel taxes puts these taxes and initiatives related to them on the back burner. Considering the current events, that resistance is particularly pronounced today. This is one of the main reasons why vehicle acquisition and ownership taxes and related incentives are widely accepted as a good solution to increase the share of zero and low emission vehicles and consequently to reduce CO<sub>2</sub> emissions of national vehicle fleets.

#### **4. Financial Incentives and Vehicle Electrification in the Republic of Serbia**

There are numerous studies investigating previously described financial incentives and the effects of their implementation. Most of them confirm the positive impact of financial incentives on the purchase of battery electric and hybrid electric vehicles in many countries (Sierzchula *et al.*, 2014; Münzel *et al.*, 2019). Many European countries, already, use different financial incentives in order to accelerate electric vehicle market diffusion. Their experiences in this field can be very useful for other countries and their governments, as well as for the government of the Republic of Serbia. However, it is of particular importance to know the vehicle electrification policy in Norway, since it is the country with the most experience in this field in Europe as well as the country with a large market share of electric vehicles. This came in response to numerous and strong financial incentives aimed at accelerating the technological transition from vehicles using internal combustion engines to electric ones. Moreover, financial incentives are the most generous in Norway. Also, it is important to emphasize that these incentives were implemented very early. Namely, in Norway, since 1990, electric vehicles have

been exempt from taxes that are paid when registering the vehicle and since 2001 from value added tax (Figenbaum, 2017). In addition, significantly higher parking fees, ferry prices and tolls are associated with internal combustion engine vehicles compared to electric (Figenbaum, 2017). However, there are numerous studies and evidence that even the best tax policy cannot ensure the development of the electric vehicle market if the necessary infrastructure is not developed at the same time. This is the main reason why this country constantly increases the number of charging stations. Also, it is important that there are a greater number of models of electric vehicles. Only then the positive effects of the above-mentioned measures on the penetration of electric vehicles into the market and the increase of their market share can be felt (Figenbaum *et al.*, 2015). In addition to all of the above, it should be emphasized that the development of the electric vehicle market is also due to the fact that the tax burden on conventional fuels, such as petrol and diesel is very high in Norway.

According to the Statistical Office data of the Republic of Serbia, road transport plays a main role in passenger and freight transport in the Republic of Serbia. More precisely, road transport, traditionally, has the largest share in total passenger transport performance, expressed in passenger-kilometers (pkm) (SORS, 2019). Also, analyzing the modal split in freight transport it could be noted that the majority of total tonne-kilometres (tkm) in transport of goods is contributed by road and rail transport modes (SORS, 2019). Consequently, road transport is the largest consumer of fuel among the transport sector (SORS, 2018). At the same time, this means that this

transport mode significantly contribute to the overall greenhouse gases and air pollutants emissions in the transport sector as well as in the Republic of Serbia in general. In order to develop an environmentally friendly transport system, a rapid reduction of this transport mode's emissions will be required. Increasing the share of electric vehicles in the vehicle fleet could help achieve that goal. However, currently, only a few incentives for faster adoption of electric and other environmentally friendly vehicles exist in the Republic of Serbia. Precisely, according to the Law on taxes on the use, possession and carrying of goods (Law, 2021) owners of electric and hybrid vehicles do not pay tax on the use of motor vehicles. The expansion of the electric vehicle market has been supported, also, by purchase subsidies. By means of them, the Government of the Republic of Serbia encourages the use of an environmentally friendly mode of transport, that is, use of hybrid and electric vehicles (Decree, 2021). The right to subsidized purchase of vehicles for legal entities, entrepreneurs and individuals is prescribed. The amount of subsidies varies depending on the type of vehicle and the amount of emissions. Of all vehicle types, passenger cars and light trucks receive the largest amount of subsidies. More precisely, the largest amount of state subsidies (5.000€) can be obtained by buyers of pure electric vehicles. Those who are interested in plug-in hybrid electric vehicles as well as extended-range electric vehicles with emissions up to 50 g CO<sub>2</sub>/km, can receive a subsidy from the state in the amount of 3.500€, while those who are interested in hybrid electric vehicles with emissions up to 140 g CO<sub>2</sub>/km, can receive 2.500€. Buyers of mopeds and light tricycles are entitled to a purchase aid worth 250€, while those interested in motorcycles, can receive 500€.

## Conclusion

This research identifies the key financial incentives that encourage consumers to switch away from conventional gasoline and diesel power vehicles to electric vehicles. Precisely, various financial incentives have been used by many European countries to promote electric vehicle and other fuel efficient and zero and low emission vehicles. However, the experience of these countries shows that types of incentives that are applied at the time of purchase have proven to be the most effective in fostering the adoption of electric vehicles. These incentives include: purchase subsidies, as well as incentive in the form of value added tax and registration tax reductions and exemptions. The fact that these incentives are the most effective clearly signals that the high price of electric vehicles is still one of the main reasons for their low share in vehicle fleets.

The role of the other financial incentives in the form of discounted or free parking and annual circulation tax reduction or exemptions is smaller, but it should not be neglected. This especially applies to annual circulation tax benefits. Furthermore, it has been observed that the introduction of the CO<sub>2</sub> emissions as reference values for calculating registration and annual circulation taxes can be very powerful tool for promoting more environmentally friendly and energy efficient vehicles. On the other side discounted or free parking for electric vehicles can be very powerful mechanism for solving ecological problem in the urban area.

It was also concluded that even the best mix of different financial incentive cannot lead to the desired outcomes if other policies measures are not applied simultaneously.

This specially refers to the development of electric vehicle charging infrastructure.

Republic of Serbia lags far behind Norway and many other European countries in terms of the level of vehicle electrification. In addition to general factors, such as high initial purchase price, vehicle range, long charge times, it was observed that insufficient number of charging station as well as a small number of government financial incentives are key barriers for the widespread diffusion of electric vehicles in the Republic Serbia.

The imperative of sustainable development requires increasing efforts to reduce CO<sub>2</sub> and other greenhouse gas emissions. Electric vehicles could significantly contribute to the decarbonisation of transport sector and the economy as whole, but only if renewable sources for electricity production are used.

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