

## ELECTRIC VEHICLE MARKET IN THE NATIONAL ECONOMY (ON THE MATERIALS OF PRESRELIZES)

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**Abstract:** The relevance of the study of the electric car market is due to the high dynamics of the development of supply and demand of electric vehicles in national and international economies. The article aims to study the peculiarities of development and state regulation of the electric car market in Ukraine in foreign experience and generalization of recommendations for optimizing the functioning of such a market in the national economy. A systematic approach was applied, which allowed analyzing the structure of demand and supply of electric vehicles, the nature of competition, and the dynamics of changes in the number of such vehicles in recent years. Comparative analysis was used to compare the level of electric vehicle markets and their institutional support in Ukraine and abroad. The theoretical bases of electric car market research are revealed, particularly the properties of the electric car as an economic good, the main elements of the electric car market. The advantages and disadvantages of electric cars compared to traditional cars are clarified. The factors influencing the development of the electric car market in the global and national economies are systematized. The main tendencies of growth of the world market of electric cars and features of formation of the national market of such vehicles are analyzed. The foreign experience of state regulation of the electric car market and the main ways of development in Ukraine in modern conditions are revealed.

**Keywords:** Electric car market, Greening of production, Press release, State regulation of the electric car market, Subjectivity.

### 1 Introduction

The electric car is a private economic good, characterized by divisibility and competitiveness. Their advantages compared to traditional fuel cars include environmental friendliness, energy efficiency, no noise pollution; the disadvantages are the low power reserve, the need to dispose of batteries, and so on. Factors that have a positive impact on the development of the electric car market in the global and national economies greening of production, increasing the level of motorization of the population, reducing prices for lithium-ion batteries. The hindering factors are lower oil prices, higher electricity prices, lack of proper infrastructure, etc. In recent years, the global market for electric vehicles has grown rapidly: demand has increased significantly, as well as supply of electric vehicles; there has been a diversification of goods, there are different price segments in the market of electric vehicles [1, 2, 10, 13].

The first electric cars appeared in Ukraine a little later than in other countries in Europe and Asia. Common trends for the Ukrainian and world markets of electric vehicles are the growth of demand, the expansion of competition between sellers of such vehicles. A feature of the national market of electric cars is a significant share of used cars. The main tool of state regulation of such a market in Ukraine is the abolition of VAT and excise duty on imports of electric vehicles, but this range of tools needs to be expanded. In Ukraine, only the import of electric cars is stimulated, so this approach must be radically changed by stimulating the production of electric cars and their parts in the national economy.

At the present stage of social development, Ukraine and the world suffer from excessive pollution of the atmosphere with harmful emissions, a significant proportion of which are the exhaust gases of transport. Scientists and international organizations consider the spread of electric transport to be an effective solution to this problem. At the same time, the Ministry of Infrastructure of Ukraine announced that it plans to provide 75% of transportation by electric transport by 2030. Given that every twentieth citizen of Ukraine is ready to replace own traditional car with electric, we can say about the prospects of electric vehicles in the national economy. In addition, the transition to electric cars reduces the country's demand for fuel

and oil, which will increase funding for infrastructure development and reduce energy dependence. This explains the relevance of this study.

### 2 Materials and Methods

The information base of the work consists of press releases, statistical materials of the State Statistics Service of Ukraine, the International Energy Agency, the Ministry of Infrastructure of Ukraine, the Ministry of Economic Development, Trade and Agriculture of Ukraine, the World Bank, the World Economic Forum, McKinsey and Deloitte. The study used a causal approach to reveal the causal links between the development of the electric vehicle market in the world and the national economy; a systematic approach that allowed analyzing the structure of demand, supply of electric vehicles, the nature of competition and the dynamics of changes in the number of such vehicles in recent years, comparative analysis was applied to compare the level of markets for electric vehicles and their institutional support in Ukraine and abroad.

### 3 Results

An electric car is an economic good that satisfies the needs of economic individuals in the transport mobility of the population, transportation of goods, towing trailers and vehicles, performing various types of work and services. With the formation of the market for such vehicles, electric cars have become an important commodity that has the properties of a private good: divisibility and competitiveness. According to the criteria for classifying economic benefits, electric cars can be classified as tangible, personal (in most cases) and long-term benefits. Electric car as a type of passenger vehicle provides high mobility of economic agents, work efficiency, determines the modern way of life of society. It can be a consumer good, a means of production, and its level of distribution is an indicator of social welfare of both the individual economic individual and society as a whole.

Electric cars have a number of advantages over traditional cars that use gasoline. Such advantages include the following: 1) it is an environmentally friendly mode of transport (no emissions of gases and other emissions into the atmosphere); 2) simplicity of design; 3) ease of management and cheap operation; 4) energy efficiency (efficiency of the fuel engine is 16%, while the efficiency of the electric motor is almost 85%); 5) no noise pollution; 6) the possibility of charging both at the gas station and from the household mains. At the same time, some disadvantages of electric cars should be mentioned: 1) the charging time is longer than during refueling; 2) low power reserve in the case of long-distance travel and at low air temperatures; 3) the need to dispose of batteries which contain toxic metals (e.g., lead, lithium, mercury, zinc, etc.) that adversely affect living organisms, polluting water and air, and so on.

Electric cars are a diversified product. There is a wide range of electric cars with different parameters: speed, engine power, power reserve and price. There are also hybrids electric cars, which are driven by an electric motor, but can consume both fuel and electricity. The advantage of such a car over gasoline is reducing fuel consumption and emissions.

The electric car belongs to the durable goods, the demand and supply of which are determined by two groups of factors subjective and objective. Objective factors include household income, inflation, exchange rates, interest rates on loans and deposits, prices for related products, technology development, and so on. Objective factors are most often used when forecasting trends in consumer markets.

One of the important factors that determine the demand for electric cars is the income of the population. According to Eurostat, the average salary in the EU is 5,231 euros or 147,000

hryvnias [6], but these figures vary from country to country. While as of February 2021 in Ukraine the average salary was UAH 13,122 [21], which generally does not increase the demand for electric cars. On the other hand, the national economy is characterized by a relatively high level of shadow economy [15], which does not allow assessing the real economic opportunities of the population to buy electric cars and cars in general.

In Europe, the highest level of automobilization is observed in Luxembourg – 678 cars per 1000 inhabitants, the lowest – in Romania (197 cars per 1000 inhabitants). The average value of the level of automobilization in the European Union is 457 cars/1000 citizens [6, 7]. The level of automobilization in Ukraine is 2.9 times lower than the European average; in comparison with the highest in Europe – 4.3 times; for the lowest in Europe – 1.2 times. In the national economy, the main competitor to electric cars are used gasoline cars.

No less important factor influencing the demand for electric cars is the price of complementary goods and substitute goods. Substitute goods include fuel cars, so the price of oil, which is the raw material for fuel, is important. Gasoline analogues of electric cars are 15-35% cheaper, but according to a study by Ukravtoprom, this difference in price will pay off for the consumer for 2-3.5 years of operation of the electric car [25]. The price of car fuel depends entirely on the price of oil imported by the country. At the moment, the prices for oil of reference brands are rapidly declining: the price of Brent has already reached 62 US dollars per barrel. The reason for this was the third wave of the pandemic in Europe, which led to a reduction in production and reduced demand for oil [17]. One of the factors stimulating the demand for electric vehicles is the reduction of prices for lithium-ion batteries. Thus, during 2010-2019, their price decreased by 87%, which led to a partial decrease in the cost of electric cars.

Complementary goods for electric cars are the price of electricity and maintenance. The electricity tariff for the population in Ukraine is one of the lowest among European countries.

One of the important factors in the development of the electric car market is the quality of roads and the development of transport infrastructure. In 2020, according to the sub-index “road quality” of the Global Competitiveness Index, Ukraine significantly improved its position in the ranking (by 20 points), but at the same time ranked 126th. According to the sub-indices “transport”, Ukraine rose by 12, by “access to the market and infrastructure” – in 10 positions, taking 73 and 77 places, respectively. Thus, the leaders in the quality of roads are the United Arab Emirates, Singapore, Switzerland [23].

An important component of transport electrification is the development of charging station infrastructure. As mentioned above, one of the disadvantages of electric cars is that refueling one electric car takes 0.5-10 hours, while refueling a car on fuel no more than 2 minutes. Because of this, a significant number of charging stations are required for the successful development of electric cars. Large manufacturers have already begun to invest in creating their own charging station systems. Ukravtoprom experts believe that for the most comfortable use of an electric car, the number of charging stations should be at least 5 for every 10-15 km [25]. In 2020, the number of charging stations for electric vehicles in Ukraine increased by 57% compared to the previous year and today it has 8529 units [23]. The world also shows a positive trend in the development of electric charging stations.

One of the factors that enhances the competitiveness of electric cars is environmental constraints. As of the beginning of 2021, the level of carbon dioxide emissions in the EU countries should not exceed 95 g/km. The tightening of environmental restrictions in 2020 has already led to a reduction in annual CO<sub>2</sub> emissions by 10% compared to 2019. Thus, in France, annual emissions from transport have decreased by almost 20 million tons of CO<sub>2</sub>. Such environmental restrictions have a positive effect on the electric car market, displacing gasoline cars [8, 12].

Subjective factors in the development of the electric car market include consumer perceptions of the current situation, expectations of future changes, consumer sentiment index, willingness to take out a loan, and so on. The population's propensity for new products is also an important factor influencing the demand for electric cars. Today, automakers offer consumers more than 500 models of electric cars, but a certain proportion of the population still does not perceive electric cars as a global perspective.

The development of the electric car market began more than a century ago in Europe. Subsequently, they became widespread in the United States and Japan. Currently, the world market is segmented by various criteria, in particular, type of vehicle, region, etc. The rise in the development of electric cars began in 2010. The introduction of electric cars in some regional markets was quite rapid, although a third of world sales of electric cars in 2015 were carried out mainly in 14 cities. As of the end of 2016, already in Norway, electric cars accounted for 29% of the market for all vehicles, which was the highest figure in Europe. The Netherlands also showed quite high rates of electric car use 6.4%, while in Sweden it was 3.4% [3]. Later, China became the leader in the number of electric cars. Currently, the number of electric cars in China is at least 40% of “green” cars in the market. This is due to the fact that in 2014, all buyers of electric cars in China were exempt from VAT [5, 7].

In 2019, sales of passenger cars decreased. At the same time, sales of electric cars decreased in the two largest markets – China and the United States. The negative trends in the electric car market were due to the weakening of state support for the purchase and sale of such vehicles. For example, China has almost halved subsidies for the purchase of electric cars as part of a policy of direct incentives introduced in 2016. The US Federal Tax Credit Program for key automakers such as General Motors and Tesla has also ended. In the second half of 2019, such measures contributed to a significant decline in demand for electric cars in China and a drop in supply of electric vehicles in the United States (10% per year). But even with stagnation in the two largest markets, sales of electric vehicles in other countries grew. For example, in Europe, the growth rate of cars sold was 44%, which may be due to the introduction of the International Standard for Pollutants for Traditional, Hybrid Cars, and Electric Vehicles.

In 2019, Europe provided 60 billion euros in investment for the production of electric vehicles and batteries, which is 19 times more than in 2018 [8]. In total, according to Global EV Outlook 2020, sales of electric cars in 2019 reached 2.1 million worldwide, exceeding 2018 [9]. During 2011-2019, 7,896,000 electric vehicles were sold, and more have been sold in the last two years than in the previous seven. In 2020, under the influence of the spread of COVID-19, world sales of electric cars decreased. In January-February 2020, the demand for them in Europe increased, while in February 2020 in China it decreased by 80% [8]. The COVID-19 pandemic has affected global electric car markets, albeit to a lesser extent than the overall passenger car market. This is due to government support in China and Europe. Both markets have national and local subsidy schemes. China recently extended its subsidy policy until 2022.

Consumer expectations for further improvements in technology and new models have played an important role in the electric vehicle market. Automakers have announced the differentiation of electric car models, many of which were introduced in 2020 and will be introduced in 2021. Over the next five years, automakers have announced plans to release another 200 new electric car models, many of which are in the popular segment of the sports car market. [14].

#### 4 Discussion

The growth of investment in electric vehicles is considered the main driver for the market. Companies such as Daimler AG, Ford Motor Company and Renault Group are investing heavily in their electric vehicle production plan. Daimler AG announced an investment of \$20.0 billion in the purchase of battery cells for

electric vehicles. The company plans to electrify its Mercedes Benz portfolio by 2022. Similarly, Ford Motor Company has announced plans to invest \$11 billion in the production of 40 electric vehicles by 2022 [5, 18]. Thus, the market is expected to grow.

Currently, the largest manufacturers of electric cars are Tesla, BYD, BMW, Nissan. The most common models of electric cars in the world are Nissan Leaf, Tesla model 3, model X, Volkswagen e-Up. Their cost ranges from \$25,000 to \$95,000. There are now a number of premium electric cars, the demand for which is relatively stable due to the Veblen effect. In particular, these are models Tesla Roadster, NIO EP9, Lotus Evija. In addition, many electric cars appear not only in the segment of passenger transport, but also in the segment of commercial transport. States are actively investing in and distributing electric public transport. For example, the Estonian government has completely replaced all special services cars with electric cars. Therefore, it can be argued that commercial electric transport is also actively promoted in many regions of the world. Morgan Stanley predicts that the electric car industry will show an average growth of 20% per year until 2040. The best evidence of the industry development and increasing demand for electric cars is that the largest market participants BMW, Ferrari, Mercedes, Audi, Porsche have already reported about the gradual transition to electrical technology.

At the same time, the lack of proper infrastructure will somewhat hinder the growth of the electric car market. Variations in loading load and lack of standardization are the main disadvantages of the market. Different countries have their own standards, such as CCS (Europe, USA and Korea), CHAdeMO (Japan) and GB/T (China). Some manufacturers, such as Tesla, focus on overcoming this obstacle by having their own charging network [8]. Thus, market participants plan to overcome these challenges and expand their business.

The first electric cars appeared in Ukraine in 2012. As of the beginning of 2015, about 150 electric cars have already been registered. Namely in this year, the so-called boom in the electric car market of Ukraine started. Despite the economic downturn, the population actively bought electric cars due to the exemption of the purchase from the tax on the import of electric cars. This has allowed Ukraine to become one of the fastest growing markets for electric vehicles in the world. From January to August 2015 alone, 231 electric vehicles were registered in Ukraine [16]. In 2016, there was an acceleration of the pace of registration of such cars and the development of relevant infrastructure. So, for this year, their number has made about 3,150 units. The ratio of buying new and used cars was 49% to 51%. The most popular electric car was the Nissan Leaf. The year of 2016 can be called the official beginning of the era of "green" cars in Ukraine. At the same time, since 2016, the relevant infrastructure has developed significantly. During 2016, the number of charging stations increased from 153 to 577 units. Until this year, there was no high-speed charging station in Ukraine, and in a year there were already 44. Due to the rapid development of infrastructure, the demand for electric cars has increased significantly.

The first electric cars registered in 2012 had an average age of 6 months, and the vast majority of them were new cars of 2011. In the next four years, the average age of imported electric cars ranged from 1.7 to 2.6 years in 2016. This indicates that the share of imports of electric vehicles that were already in use has increased significantly. In 2017, the share of used electric cars increased to 76%. In fact, out of every 100 electric cars purchased in Ukraine, only 23 were new, and their average age in 2017 increased to 3.5 years. However, during press releases, leading European automakers, namely, BMW, Renault, and Hyundai are interested in the official sale of new electric vehicles in Ukraine [20]. In 2017, sales of electric vehicles more than doubled. In 2017, Ukrainians bought 2,697 electric cars. The number of electric cars has increased due to the fact that Ukrainian dealers have started to buy mostly used cars at American auctions. The most popular "green" car was the

Nissan Leaf. Also in the top, there were BMW i3 and Tesla model S. Infrastructure development did not stop, but the pace of change has partially decreased.

In 2018, a bill on the abolition of VAT and excise duty on imports of electric vehicles was adopted. About 5,350 electric cars were sold this year, which is almost twice as many as in 2017. The share of used cars has hardly changed and amounted to 83.5%. In 2019, sales of electric vehicles increased by one and a half times. The number of electric cars sold reached more than 7,500. Of these, 550 cars are commercial vehicles, the rest are passenger cars. The share of used cars was 92% [19]. The most popular "green" cars in Ukraine were Nissan Leaf, Tesla model S and a new model from Volkswagen e-golf.

According to the criterion of territorial distribution of electric cars in Ukraine, the largest concentration of electric cars was found in Kyiv, Odesa, Kharkiv regions. Dnipropetrovsk and Lviv oblasts are also among the five leaders. The smallest number of electric cars and hybrids was recorded in Luhansk region.

A significant obstacle to the development of the electric car market in the national economy is the lack of official supply in Ukraine. Only from June 2020, one can officially buy a BMW i3, Renault Zoe, Jaguar I-Pace, Nissan Leaf and Hyundai Ioniq and place an order with Tesla through their website.

The number of charging stations is also insufficient. Most power plants in Ukraine (over 90%) are slow and it takes 3-4 hours to charge a car. In addition, power plants are distributed mainly in large cities, which makes the use of electric cars inconvenient in other cities and regions. There are also difficulties in connecting to electricity in Ukraine. In 2019, Elon Musk undertook to build Tesla charging stations in Ukraine. Although only 3 of them were built, namely then Ukraine got on the world map of electric cars.

Climate change is an important factor in the development of electric vehicles. The Paris Agreement, which entered into force in November 2016, brings together a large number of countries in search of reducing greenhouse gas emissions and limiting global warming. The agreement requires all parties to declare "nationally determined contributions" that embody each country's efforts to reduce national emissions and adapt to the effects of climate change. Electric cars have the potential to help countries achieve the Sustainable Development Goals. Electric motors are more efficient than internal combustion engines, and this, along with the shift to a low-carbon power generation mix, is how electric cars can help reduce carbon emissions. The IEA estimates that electric vehicles should account for 35% of new car sales by 2035 to limit climate change to less than 2%.

The European Union has approved several important environmental policy instruments affecting the electric vehicle market. These include fuel economy standards for cars and trucks and the Clean Vehicles Directive, which provides for public procurement of electric buses. The Energy Performance of Buildings Directive sets minimum requirements for charging infrastructure in new and refurbished buildings. Incentives that support the introduction of electric vehicles and chargers are common in many European countries [11].

In China, the policy to stimulate the development of the electric car market includes limiting investment in new plants for the production of traditional cars and increasing fuel savings for cars by 2025. The Chinese government uses a number of non-monetary incentives to develop the electric car market: NEV license plate, exemption from certain traffic restrictions and allocating a special parking space, etc.

Japan's automotive strategy aims to reduce greenhouse gas emissions from vehicles by 2050. Car fuel standards have also been revised.

Canada supports zero-emission vehicles. It has announced ambitious plans to provide 30% of zero-emission (ZEV) vehicles in its fleet by 2030 and 100% by 2040 [5].

In South Korea, the main instruments of state regulation of the development of the electric car market are public procurement, subsidies, reduction of taxes on the purchase of such vehicles, reduction of tolls and parking fees.

However, many countries have legal barriers to the distribution of electric vehicles, including laws that restrict or regulate the installation of charging stations.

Environmental parameters are becoming an increasingly important component of the positioning of a country on the world stage, in assessing the competitiveness of regions, cities and enterprises. Today, this is a pronounced global trend, as evidenced by the number of international and national environmental ratings in recent years. The use of quantitative indicators and indices to assess the effectiveness of environmental policy and sustainable development will continue to grow rapidly, including in connection with the implementation of the 2030 Agenda for Sustainable Development and the Paris Agreement of 2015.

In 2020, Denmark was recognized as the leader in terms of environmental efficiency. The top ten leaders also included Luxembourg, Switzerland, and Germany. Ukraine took 60th place in the ranking and found itself between Venezuela and Uruguay. At the same time, under the terms of the Kyoto Protocol, Ukraine has committed itself to reducing greenhouse gas emissions. Despite the fact that emissions of pollutants in 2010-2015 decreased in the country by 32.3%, and carbon dioxide – by 18.2%, the level of air pollution remains high. A total of 4.52 million tons of pollutant emissions were registered in Ukraine, including more than a third – 36.8%, or 1.66 million tons from road transport [22], so stimulating the electric car market in Ukraine is a matter of time.

As of today, for the expansion of the use of electric vehicles in Ukraine, there is an exemption from VAT and excise duty on imports of electric vehicles until 2022; parking fines are introduced for parking on the places intended for EVs (the law came into force on January 1, 2020). In addition, the Verkhovna Rada of Ukraine adopted the Law of Ukraine No. 10405, which entered into force on January 1, 2020 and provides for new road signs “for electric vehicles”, “exclusively for electric vehicles”, “places for charging electric vehicles”, which should appear throughout Ukraine, etc.

Despite a number of positive changes, there are obstacles. According to Ukrainian legislation, the placement of electric chargers is possible only on roads of state importance, which in Ukraine constitute 46.6 thousand km [23], and the requirements for the number of gas stations on local roads, which are 117 thousand kilometers, are not defined. This limits the ability to travel on this type of transport in the country. The norm is defined for electric charging in parking lots: the number of parking spaces equipped with chargers must be at least 5% of the total number of parking spaces. There are also problems with obtaining technical conditions for connection. It is now known that the Ministry of Infrastructure has initiated and joined the amendments to the state building codes for the placement of gas stations on the roads.

At the same time, the Federation of Employers of the Automotive Industry emphasizes that Ukraine has the opportunity to become a production low-cost for global automakers, but this requires appropriate changes in legislation. There are all the prerequisites for this – a favorable location and logistics, skilled labor (cheaper than in Europe). But this “window of opportunity” is closing quickly, and having only basic benefits is not enough. Conditions that would attract the attention of global automakers to locate their production in Ukraine are not yet available. These conditions should be at least not worse than the ones which the neighboring countries offer the investor to load not only the existing production capacity in

Ukraine of 400 thousand cars per year, but also the production of urban electric transport, moreover, to attract global automakers to localize new industrial capacities for the production of modern electric vehicles in Ukraine.

The Ministry of Infrastructure points out that Ukraine can start mass production of electric cars. For example, the State Space Agency, the Pivdenmash plant and the South Korean company Caris signed a memorandum on the production of 5,000 electric buses by 2023, as well as the placement of 7.8 thousand charging stations. This is not only the localization of electric bus production in Ukraine, but also the exchange of technologies.

## 5 Conclusion

In recent years, the global market for electric vehicles has grown rapidly: demand has increased significantly, as well as supply of electric vehicles; there has been a diversification of goods, there are different price segments in the market of electric vehicles. Currently, the largest manufacturers of electric cars are Tesla, BYD, BMW, Nissan. The most common models of electric cars in the world are Nissan Leaf, Tesla model 3, model X, Volkswagen e-Up. There are now a number of premium electric cars, the demand for which is relatively stable due to the Veblen effect. In addition, many electric cars are not only in the segment of cars but also in commercial vehicles sector. The first electric cars appeared in Ukraine a little later than in other countries in Europe and Asia. Common trends for the Ukrainian and world markets of electric vehicles are the growth of demand, the expansion of competition between sellers of such vehicles. As well as abroad, the most popular models are Nissan Leaf, BMW i3, Tesla Model S. A feature of the Ukrainian market is the growing demand for used cars. In order to implement international agreements, which Ukraine has joined in the framework of greening the economy, and to stimulate the purchase and production of electric cars, it is necessary to enable the following: 1) develop programs to improve energy efficiency, decarbonization and implementation of environmental protection policy; 2) to intensify work on the “Electric strategy of Ukraine's global transition to electric cars”; 3) to extend the law on exemption from VAT on imports of electric vehicles into Ukraine; 4) provide subsidies for the purchase of new electric cars; 5) create conditions for the distribution of electric vehicles in Ukraine and the development of appropriate infrastructure; 6) to create conditions comfortable not only for consumers, but also for manufacturers (to stimulate own production of cars and details); 7) to introduce an emission control system following the example of European countries.

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**Primary Paper Section: A**

**Secondary Paper Section: AH**