RETRACTED

Development of the electric vehicle market in Russia and China

Natalia Gorodnova[1*]

[1]Ural Federal University, 19, Mira st., 620002, Yekaterinburg, Russia

Abstract. The scientific problem of the energy transition and building a "green" economy remains one of the most pressing both abroad and in Russia. The main directions are the development of environmentally friendly production, achieving carbon neutrality, developing the car market using new energy sources, etc. In this regard, the object of this paper is to conduct a more in-depth study and analysis of the regulation of electric vehicles sales globally, in China and Russia. This article presents a proactive transportation strategy and forecast that prioritizes the expansion of the electric vehicle segment and the technologies used in production in Russia and China. The legal and economic basis for regulating the use of electric vehicles is characterized, and a comparative characterization of production and development of the transport market is made. As the main recommendation, the need to improve Russian transportation legislation with further changes and adjustments to the regulatory framework can be outlined. It seems appropriate to develop a number of additional incentive measures for both manufacturers of electric vehicles and their consumers, providing the emerging market with the necessary service and electric charging infrastructure, which confirms the proposed research hypothesis. The results of the work may be useful to experts and specialists in the field of green energy and transport, government authorities, as well as researchers studying scientific problems of developing environmentally friendly and intelligent electric vehicles.

1 Introduction

Russia's transportation system and electric vehicle market are developing at an accelerated pace every year. The Russian Transport Strategy adopted in 2021 forecasts the growth dynamics of electric vehicles in the world as a whole. Taking into account the pace of automobile fleet renewal, by 2035, the expected share of electric vehicles globally will amount to: 20 % - for passenger cars; 15 % - for light trucks; 25 % - for buses; 5 % - for heavy-duty trucks (Transport Strategy of the Russian Federation to 2030 with a forecast to 2035. URL: https://rosavtodor.gov.ru/docs/transportnaya-strategiya-rf-na-period-do-2030-goda-s-prognozom-na-period-do-2035-goda (30/4/2024)).

In order to increase the number of electric vehicles in Russia, the number of charging stations is expected to increase. That said, the main obstacle to the development of new

* Corresponding author: n.v.gorodnova@urfu.ru

© The Authors, published by EDP Sciences. This is an open access article distributed under the terms of the Creative Commons Attribution License 4.0 (https://creativecommons.org/licenses/by/4.0/).

infrastructure is the high cost of investments in installing charging stations and electricity storage systems. According to the Automotive Industry Development Strategy of the Russian Federation to 2025, monetary and non-monetary incentives for developing the charging infrastructure can be implemented in Russia.

In this regard, greenhouse gas emissions from the transport sector are expected to decrease by 1.2% compared to the total emissions in 2017, in prospect to 2050 - by 4.2% against the 2030 figure, influenced by such fundamentals as the use of new energy-efficient vehicles, widespread introduction of hybrid energy storage systems in transport; electrification and gasification of public transport, encouraging the transition to using models with low CO2 and pollutant emission levels; conversion of motor transport to hybrid, developing the charging infrastructure for electric vehicles (including electric buses) [1-8].

The development of technologies for hybrid cars and electric vehicles is provided for in the Energy Strategy to 2035, as well as in the Concept for the development of production and use of electric road transport in Russia. Due to the development of the Russian legal framework of transition to new "green" technologies, which is one of the priorities of the Russian state, the topic of this study becomes even more relevant.

Topic of the study. The issue of the energy transition and building a "green" economy on a global scale with the achievement of carbon neutrality remains one of the most important both in Western countries and in Russia. This modern problem is recognized by the economic and scientific community as one of the most difficult to solve. The main path of achieving carbon neutrality is the development of an environmentally friendly transport system, as well as the development of the design and use of new energy vehicles (NEVs), which include electric vehicles, hybrid vehicles and hydrogen fuel vehicles.

In this regard, the main scientific problem is to conduct a more in-depth study and comparative analysis of legal and economic regulation of the processes of promoting electric car sales in Russia and China.

The object of this paper is to conduct a comparative analysis of economic and legal aspects of producing and using electric cars in Russia and China.

2 Materials and methods

Expanding the production of electric vehicles is one of the main aspects of building a "green" economy [3]. The need to carry out a comparative analysis of the process of introducing electric vehicles in the Russian Federation and China is explained by the fact that China is one of the global market leaders in the production and sales of electric vehicles [9]. Today Russia is at the initial stage of using new technologies in the automotive sector and introducing electric cars. The PRC is improving not only the production and economic aspects of the use of electric vehicles, but also state regulation of the use of these innovations [2].

An electric vehicle is understood as a passenger vehicle in which an electric motor powered by a battery is used to drive the drive wheels, and there is no internal combustion engine (ICE) at all; the power is supplied from a current source installed on the same vehicle [10-12]. Batteries, fuel cells, supercapacitors (which do not require recharging for a long time), as well as an internal combustion engine (gasoline or diesel) used as a drive for the electric motor (hybrid power system for electric vehicles) can be used as a power source in an electric vehicle. Such electric cars can go at lower speeds using electricity. When it is necessary to use the full power of the vehicle, switching to internal combustion engine is carried out.

The second type of hybrid electric vehicle is the plug-in hybrid. These vehicles are powered by an internal combustion engine, which is supported by a plug-in electric motor.

RETRACTED

When the battery is discharged, the driver can switch to the internal combustion engine. Electric vehicles mainly use a lithium-ion battery, consisting of a series of modules connected in series. The output voltage of this battery is 300 V DC.

The main advantages of owning and using an electric car include:

- low cost of ownership (per 1 km) [9];
- no transport tax [4];
- parking in specially equipped charging terminals;
- the possibility of free passage on toll highways and a specially designated lane for public transport, etc. [5, 6].

The main negative consequences of electric vehicle development include high selling prices, poor infrastructure, lack of chargers, rapid battery discharge due to low temperatures, as well as the risks of environmental pollution when disposing of used lithium-ion batteries [1].

Introducing innovations and information technologies goes along with a high level of capital investment and resource costs [2]. In particular, analysts say that prices for new electric cars reach RUB 6 million and for used electric cars – approximately RUB 3.1-3.2 million.

However, it should be noted that demand for electric cars in Russia is growing dynamically. At the end of June 2023, the number of electric cars registered in Russia exceeded 30,200, having increased by over 23 % since the beginning of the year. According to Avtostat, the top 5 most popular electric car brands in Russia currently include Zeekr and Voyah (China), Evolute (Russia), Volkswagen (Germany), and Tesla (US) (Why electric cars in Russia have a long road ahead of them to reach mass consumers. URL: https://www.rbc.ru/industries/news/6603d99a9a79471b60ddaf58 (28.04.2024)).

Electric vehicles and charging infrastructure are developing within the framework of the "Electric and Hydrogen Car" strategic initiative:

- at the first stage, in 2022, the market was launched, the infrastructure (charging stations) was created, and the regulatory framework was developed; 439 charging stations were built in 12 pilot regions;
- at the second stage, the demand is expected to increase and production capacities are expected to be used;
- at the third stage - localization, in particular, in November-December 2022, the weekly growth in sales of electric vehicles exceeded 180 units.

The key goals of the "Electric and Hydrogen Car" strategic initiative in Russia by 2030 are to achieve a share of at least 10 % of electric cars in total vehicle production; commissioning of over 1,000 hydrogen fueling stations and over 72,000 charging stations for electric cars.

One of the measures of state support for the development of electric transport in Russia and the creation of infrastructure as listed is subsidizing fast charging stations. For this purpose, Methodological recommendations for the implementation of this area have been developed. The recommendations are intended for use in the territories of Russian constituent entities designated as pilot ones for the creation of charging infrastructure for electric vehicles to 2024 (inclusive). When placing "fast" charging stations for electric vehicles on the territory of a constituent entity of Russia, the following must be taken into account:

1) when choosing locations, one should proceed from the minimum number of locations per 1 planned charging infrastructure facility (3-4 locations);

2) when determining the cost and volume of technological connection, the issue should be first studied together with grid operators prior to signing a lease agreement for a land plot for installing the electric charging infrastructure;

RETRACTED

3) on federal highways, “fast” charging stations for electric vehicles are recommended to be placed at intervals of 80 – 120 km.

The state subsidy for installing one electric charging station is approximately RUB 2.7 million, including RUB 1.8 million – the cost of equipment and RUB 900,000 – the cost of connection to the power grid.

Below is the list of measures of state support and development of electric transport in Russia:

• providing a 25 % discount on purchasing a Russian electric car on credit or on lease;

• subsidizing taxi and car sharing companies to reduce costs for users who choose electric vehicles;

• allowing private owners to install slow charging stations in the parking lots of apartment buildings for use at night (during excess energy capacity);

• the possibility of revising the cost of compulsory third-party liability insurance for electric vehicles in taxis and car sharing;

• financing programs to increase demand for electric vehicles.

Despite the active promotion of electric vehicles, sales of electric cars in the Russian Federation are only 1.3 %. The main problem is the waning enthusiasm of the major EV manufacturers. For example, according to Rho Motion, sales growth in 2022 was twice as high as in 2021, at 60 %, which is 31 % higher than in 2022. Active growth in sales of electric vehicles in 2023 was observed in the US and Canada (by 50 %), in Europe (by 27 %), and in China (by 15 %). However, according to BloombergNEF, in 2024, growth in electric vehicle sales could decline by approximately 20 %, and the share of electric vehicles in global new car sales could fall by 14 %, compared to 17 % in 2023.

The main reason for the decline in dynamics is the closure of a number of projects by hi-tech companies and automakers. For example, due to changes in the market situation, Apple closed the project to develop an electric car model, in which it had been investing for the last ten years. Over 2,000 employees were transferred to projects to develop and improve artificial intelligence algorithms.

Aston Martin adjusted the company’s strategy and postponed the debut of the first mass-produced electric vehicle, abandoning the production of electric crossovers and a sedan under the Lagonda sub-brand. The Aston Martin electric car will enter the market no earlier than 2026 - it is expected to be a Grand Tourer with increased ground clearance.

Mercedes-Benz management has revised its strategy for a complete transition to producing electric cars by 2030 and announced the resumption of research in the field of internal combustion engines. This situation in production markets does not mean a complete stop in producing electric vehicles. Hi-tech companies are devising strategies to develop the transport market that take into account priorities at a given time, for example, the introduction of unmanned vehicles, the development and implementation of which in a number of countries is carried out in parallel with programs for introducing electric transport.

In February 2017, the Decree of the Government of the Russian Federation entrenched in the Road Traffic Rules such concepts as “electric vehicle” and “hybrid vehicle” (Decree of the Government of the Russian Federation No. 832 dated July 12, 2017 (as amended on October 6, 2022) “On Amending Resolution of the Council of Ministers - Government of the Russian Federation No. 1090 of October 23, 1993”. URL: https://www.consultant.ru/document/cons_doc_LAW_220068/ (30.04.2024)). In particular, paragraph 1 of the amendments of December 31, 2020, and October 6, 2022, sets forth the following definitions:

“**hybrid vehicle**” is a vehicle that has at least two different energy converters (motors) and two different energy storage systems (on-board) for the purpose of propelling the vehicle;

RETRACTED

"**electric vehicle**" is a vehicle driven solely by an electric motor and charged by an external source of electrical power.

The process of introducing electric vehicles in Russia began in 2017, with active introduction observed in the period 2021-2022. The state provides for the introduction of a number of benefits for owners of electric vehicles. Thus, from March 1, 2023, owners of electric vehicles will not have to pay toll roads. In a number of Russian regions, for example in the city of Moscow, the Moscow Region and St. Petersburg, electric vehicles are not subject to transport tax (this benefit is determined by regional authorities) [4]. From January 1, 2023, the state pays compensation in the amount of 25 % of the cost of an electric car (but not more than RUB 625,000) when purchasing a Russian-made electric car. From January 1, 2022, the zero customs duty that had been in force since 2020 was abolished in Russia and other EAEU countries.

Pursuant to Law of the city of Moscow No. 33 (Law No. 33 dated July 9, 2008 "On Transport Tax". URL: https://www.nalog.gov.ru/rn77/about_fts/docs/4473161/ (01.05.2024)), from January 1, 2020, individuals in whose name vehicles equipped exclusively with electric motors are registered are exempt from paying transport tax on such vehicles. It should be noted that these provisions will cease to be effective from January 1, 2025. According to the regulation in effect until January 1, 2025, if a taxpayer has the right to receive these benefits on several grounds, the benefit may be granted on one ground chosen by a taxpayer.

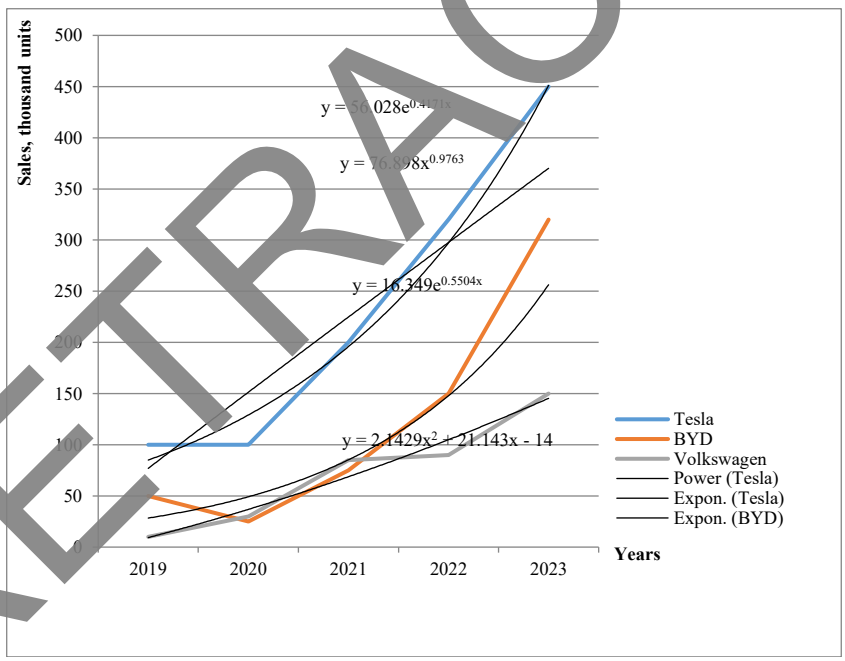

Fig. 1. Dynamics of sales of electric vehicles for the 1st quarter (2019-2023). Source of information: Electric vehicles (global market).

In the future, the Ministry of Economic Development of the Russian Federation recommends maintaining tax benefits for owners of electric vehicles, as well as providing free parking with installed chargers for cars, and creating special "environmentally friendly zones" for the use of electric vehicles. These provisions are recommended for implementation at the regional level.

RETRACTED

Turning to the analysis of China's transportation system, it can be seen that the PRC is a leader in electric vehicles, continuing to improve and produce new smart cars. In Q4 2023, BYD overtook Tesla in electric vehicle sales and took the first place in the world. Based on the results of the entire year, BYD remains in second place (Figure 1).

3 Results and discussion

Interest in electric cars in China is mainly related to the environmental agenda. When producing electric cars in China, the following objective advantages should be highlighted:

1) construction of new automobile plants designed for the production of electric vehicles (in Europe, America and Japan it was necessary to rebuild existing capacities);

2) due to the development of the radio-electronic industry, there was a large-scale development of battery production and the creation of batteries for electric vehicles.

Besides, the development of the Chinese electric vehicle industry has been facilitated by government policies aimed at supporting the production of new energy vehicles (NEVs). This concept includes pure battery-powered electric vehicles, rechargeable hybrids, and hydrogen-powered vehicles.

Figure 2 shows the sales volumes of the best-selling electric cars at the end of 2023. Tesla is in the leading position.

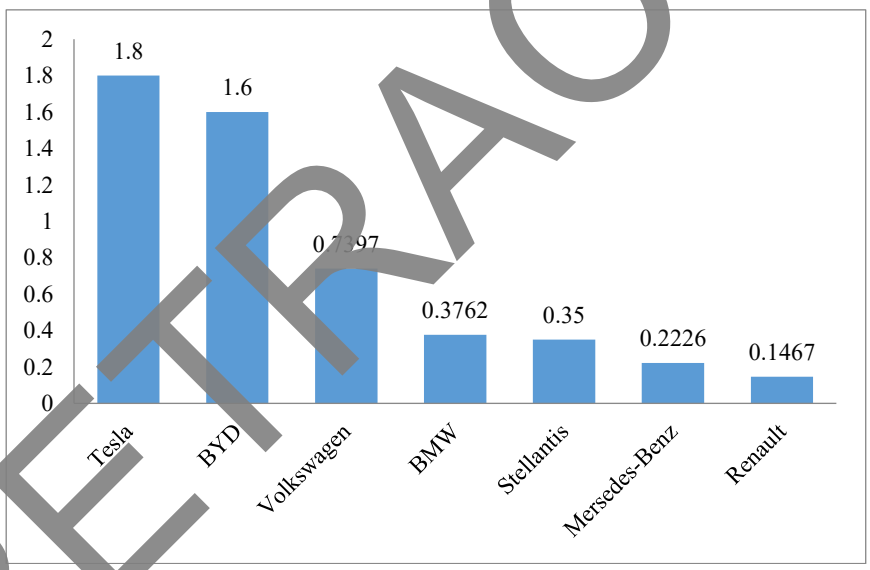

Fig. 2. Electric vehicle sales volumes (2023), million units. Source of information: Electric vehicles (global market).

In 2021, China increased its electric vehicle exports by 260 % year-on-year, totaling over 500,000 units. China became the largest electric vehicle producing country in the world, surpassing the United States and Germany, which were among the top three.

By the end of June 2022, China had installed 3.918 million charging stations, an increase of 101.2 % over the same period in 2021. As of June 2022, the number of public charging stations reached 1.528 million units, including 665,000 DC stations, 863,000 AC stations and 472 integrated DC and AC charging stations. Sales of electric vehicles and plug-in hybrids doubled in 2022.

RETRACTED

In 2022, 5.67 million electric vehicles and plug-in hybrids were sold in China. The rise in demand is due to high oil prices and government subsidies. Over 4 million all-electric vehicles have been sold, which is 5 times more than were sold in the US in 2021 (Electric vehicles. Tadviser. URL: https://www.tadviser.ru/index.php/Статья:Электромобили (30.04.2024)). The growth dynamics of charging station infrastructure is shown in Figure 3.

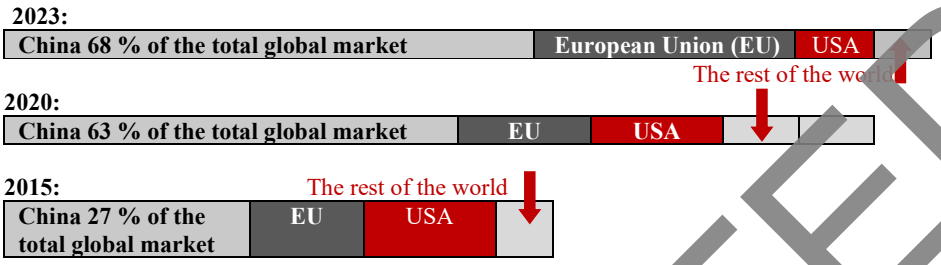

Fig. 3. The share of electric gas stations in China from the total global market [11, 12].

According to BloombergNEF, within 2017-2023, over 18 million electric vehicles were sold in China, which is about 50 % of total sales in the world, and 4 times higher than in the same period in the United States. According to Bloomberg experts, by 2026, the share of new passenger electric vehicles in China will be over 50 %, in the United States - about 25 %.

Due to government subsidies from the Chinese government, sales of electric vehicles and plug-in hybrid electric vehicles (PHEVs) have been steadily increasing. A significant portion of sales of electric vehicles are carried out in large Chinese cities with a population exceeding 5 million people, such as Beijing and Shanghai (Electric cars are more likely to be bought in metropolitan areas, but the future lies with small-town buyers. URL: https://chinaved.com/elektromobili-chashche-pokupayut-v-megapolisah-no-budushchee-za-pokupatelyami-iz-malenkih-gorodov (02.05.2024)). This is due to the possibility of receiving a wider range of different incentives, for example, leasing batteries for electric vehicles or participating in license plate lotteries for conventional cars, which severely limits the number of licensed internal combustion engine cars with a winning rate of less than 1 % (in Beijing - 0. 00039 %), which forces Chinese citizens to abandon cars with internal combustion engines and purchase electric vehicles.

The state strategy of the PRC involves achieving peak CO_2 emissions by 2030, and achieving carbon neutrality by 2060. Since 2009, the government has provided 15 % subsidies and tax exemptions for electric vehicle manufacturers [3]. In particular, the share of electric buses in use by 2025 should increase from 66.2 % to 72 % against the backdrop of a 5 % reduction in carbon dioxide emissions intensity.

In terms of legal regulation of China's electric vehicle market, within the 4-year subsidy program (to 2027), in 2023, over USD 72 billion was allocated for tax incentives for the purchase of electric vehicles. Thus, electric cars purchased between 2024 and 2025 will be exempt from purchase tax of up to 30,000 yuan ($4,170). For electric cars purchased during 2026-2027, the tax exemption will be reduced by 50 % and will be no more than 15,000 yuan. Moreover, the tax exemption applies to fully battery electric cars, plug-in gasoline-electric hybrids, and hydrogen fuel cell cars.

Today, China has laws that set minimum sales limits for electric cars in order to achieve a final transition to “green” cars. In 2025, the share of electric vehicles in the total sales of all automobile companies should be at least 8 %. It should be noted that in mid-May 2024,

RETRACTED

the United States increased the duty on Chinese electric cars by 4 times, this is a 100 % tax on electric cars from China (U.S. strikes new blow to China: tax on Chinese cars quadrupled, on solar panels doubled, on steel and aluminum more than tripled. URL: https://www.ixbt.com/news/2024/05/15/ssha-nanosjat-novyj-udar-po-kitaju-nalog-na-kitajskie-mashiny-podnjali-v-chetyre-raza-na-solnechnye-paneli--vdvoe-na.html (15.05.2024)).

4 Conclusion

The Russian electric vehicle market is forming and developing; therefore, the patterns and main trends of its functioning have not yet emerged, which makes it difficult to predict its development and find ways of effective management. In this regard, a pressing problem for the coming years remains the search for new ways to modernize and adapt electric vehicles to Russian conditions of production and operation. One of the main advantages of using electric vehicles in Russia is their environmental friendliness, which eliminates emissions of harmful substances into the environment [7]. Other advantages are ease of use and maintenance, reliability and a high degree of protection against various breakdowns, reduced costs per kilometer driven, lack of noise during operation, etc. The main disadvantages of using electric cars are high cost, insufficient infrastructure development, lack of chargers outside the car showroom, risks of rapid battery discharge due to difficult climatic conditions in most parts of the country. In addition to difficult accessibility of chargers, long charging times (several hours), etc., remain a disadvantage.

References

1. N. V. Gorodnova, S. A. Sokolov, Economics, Entrepreneurship and Law **13–6**, 1963–1982 (2023) DOI: 10.18334/epp.13.6.117812.
2. A. M. Zbarsky, D. V. Gorbunov, K. A. Ivasheva, Economics, Entrepreneurship and Law **13–7**, 2385–2398 (2023) DOI: 10.18334/epp.13.7.118347.
3. N. G. Kobozeva, Economics, Entrepreneurship and Law **13–12**, 6009–6018 (2023) DOI: 10.18334/epp.13.12.120494.
4. M. Jun, Tax incentives for the production and use of electric cars in China. Diss. candidate of Economic Sciences. Ekaterinburg, 190 (2023)
5. Yu. L. Sagimov, O. V. Pischikova, Economics, Entrepreneurship and Law **14–3**, 827–842 (2024) DOI: 10.18334/epp.14.3.120605.
6. K. A. Ustinova, Creative Economics **14–5**, 709–724 (2020) DOI: 10.18334/ce.14.5.100945.
7. D. P. Khitrich, Energy Policy **1–155**, 22–33 (2021)
8. L. V. Shkurina, E. A. Seslavina, E. N. Evdokimova, Economic Security **3–2**, 145–154 (2020) DOI: 10.18334/ecsec.3.2.110267.
9. R. Backhaus, ATZelectronics Worldwide **1–2**, 34–39 (2023) DOI: 10.1007/s38311-022-1449-8.
10. S. German Galkin, D. Tarnapowicz, M. Staude, et al., IOP Conf. Series: Mat. Science and Eng. **1247–1**, 012043 (2022) DOI: 10.1088/1757-899x/1247/1/012043.
11. H. Hu, Electrotehnica, Electronica, Automatica**70–1**, 13–22 (2022) DOI: 10.46904/eea.22.70.1.1108002.
12. J. Tollefson, Nature **616**, 424 (2023) DOI: 10.1038/d41586-023-01255-y.

RETRACTED