The Russian electric car market: prospects, factors hindering industry development, specifics of component production

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Abstract. The article examines the general course of federal policy in the Russian Federation with regard to the development of the car market in the electric vehicle segment. Government policy should aim to reduce the percentage of vehicles with internal combustion engines (ICE). As of early 2022, projects for the production of electric cars and electric motors are being developed in the Russian Federation and are in the implementation stage. The raw material base in the Russian Federation makes it possible to produce electric vehicles and their components without exporting raw materials. The increase in mineral production is necessary to boost the rate of production of high-tech and innovative products for various industry segments. Trends in the global energy transition are reflected not only in the dynamics of the oil and gas market but also in the development of related industries. They influence the demand for different types of metals and minerals. It is well known that clean technologies require much more metals than their fossil fuel based counterparts. Rare earth metals have now become an integral part of green technology as they are widely used in wind turbine generators, engines for electric vehicles.

1 Introduction

The global electric car market has shown 5 percent growth on the back of an overall 18 percent drop in car sales at the start of the 2020 pandemic caused by the COVID-19 virus. The shift away from internal combustion engines is a growing trend among all existing car companies, regularly announcing the latest electric vehicle models. In their paper Frits Møller Andersen, Henrik Klinge Jacobsen, Philipp A. Gunkel write "electrification of the transport sector is a central element in many countries" [1].

Big European, Asian and North American corporations have announced that in the space of 10-15 years they will give up the use of combustion engines both in passenger cars and trucks. Marianna Rottoli, Alois Dirnaichner, Robert Pietzcker, Felix Schreyer, Gunnar Luderer write in their research paper "There is a wide consensus that a fundamental technology shift within the light duty vehicles" [2]. Thus, foreign authors point out changes

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in the transport industry under the influence of the fight for ecology, use of renewable resources, refusal from petrol and diesel internal combustion engines.

In Russia, the development of the electric vehicle market is becoming noticeable: the number of electric vehicles being purchased is increasing annually. According to the innovative development scenario in the Transport Strategy of the Russian Federation, the share of hybrid and all-electric vehicles could reach 30% by 2030. The development of a government policy line for the development of the electric vehicle market should take into account global trends towards prohibitive measures to reduce the percentage of internal combustion engine vehicles to electric vehicles. In the Russian Federation, a focus on the full production and recycling cycle of electric vehicles in the country is needed.

1.1 Relevance

The relevance of the research is determined by the urgent need to find ways to develop the sphere of electric vehicles in the Russian market. At the moment, the Russian market is significantly lagging behind the leading countries in electric vehicle sales, and the electric vehicle service sector does not allow for an active increase in the number of such vehicles on our country's roads, which makes the topic particularly attractive to study.

Russian companies have the potential to lose the segment of innovative developments in electric vehicles by waiting for the market to develop through imported products and production technologies.

The electric car market at the beginning of 2022 is not adequately saturated with demand, while new offers are coming in in increasing waves. By stimulating state corporations and private business through government support programmes, it is possible to ensure that the country becomes one of the leaders in the electric vehicle market, which is emerging under the influence of global trends towards green transport.

It should be emphasised that the smallest plan for shaping the market for electric vehicles in Russia has been formed and spelled out in the Strategy for the Development of the Automotive Industry of the Russian Federation up to 2025. According to this legal act, the percentage of electric cars should increase to 5% by 2025, which is 129 thousand units in numerical terms, taking into account the support of the project by the state authorities and the budget of the Russian Federation. Scenarios for the development of the market for cars with electric motors are presented in Figure 1.

![Fig. 1. Scenarios for the development of the electric vehicle market in the Russian Federation.](image-url)
The described scenarios are feasible if car companies in the Russian Federation work on a full-cycle development and production programme for electric vehicles and their components.

Marketing research by the SPbPU STI Centre, which is cited in the 2021 expert analytical report Prospects for the Development of Electric Vehicle and Charging Infrastructure in Russia, reflects the existence of potential demand in the Russian electric vehicle segment, which may well become a crucial step in achieving the goals outlined in the said strategy. A prerequisite for demand to be realised is the cost ratio of electric vehicles to internal combustion engine vehicles, as well as an equal or higher level of technical characteristics and a set of consumer properties.

To summarise, we emphasise that an electric car is capable of entering the Russian market as a full-fledged competitor to cars with internal combustion engines (in terms of price segment, technical characteristics and satisfaction of the buyer's comfort needs). The effectiveness of measures to promote sales and consumption of products with electric motors will be proven if a competitive in-demand product is created. The domestic and foreign electric vehicle market is capable of achieving a growth rate of 5% to 18%, which in quantitative terms amounts to an increase from 129,000 to 360,000 units.

1.2 Literature review

This paper considers the works of foreign authors investigating the issue of converting public electric transport to electric motors in order to preserve the environment by reducing emissions.

Research in the field of reduction of negative impact on the environment includes works of groups of researchers all over the world [1-12]. Their works reflect the issues of the CO2 emission, greenhouse effect and other problems and solutions for the development of the electric motor vehicle. Daniel Arturo Maciel Fuentes, Eduardo Gutiérrez González mention, perhaps, the main idea, which is reflected in all the works used: "Air pollution originates mainly from anthropogenic activities, resulting in changes to natural resources such as water, air, and soil" [3].

The majority of the works describe the damage to the environment, but only two works mention the reduction of the load on it by using the mechanism of import substitution. A variant way of producing lithium-ion batteries is possible through the development of lithium production on the territory of the Russian Federation, as written by Melentiev G. B., Yurgenson G. A., Delitzyn L. M. "Variants of the reconstruction of lithium production facilities in Russia from domestic raw materials are evaluated in order to solve the problem of import substitution. [13]. Alkhasov A.B. "The integrated exploration of high-temperature brines of the ECAB using idle wells at worked-out gas-oil deposits can solve the problems of electric power supply of the region and the problems of import substitution and fulfill the needs of Russia in food and technical salt, lithium carbonate, and salts of other rare elements" [14].

In general, the mechanism of production of components for electric vehicles is described very poorly.

In our opinion, the issue of import substitution, as well as imports of raw materials for the production of components for internal combustion engines is not sufficiently reflected in the literature. Groups of Russian researchers practically do not consider this issue in their works, while foreign authors are not interested in the production of minerals in the aspect of import substitution. Also, the lack of the described experience in the extraction of minerals for domestic production hinders the development of this area in the Russian Federation.
1.3 Problem statement

Problems in the development of the electric vehicle market in the Russian Federation include the following:

1. Lack of a well-developed system for the production of electric components. Companies are forced to resort to importing components to produce both individual parts for electric cars and imported raw materials. Lack of interconnected work of the existing federal programs, which could form a new industry of research and development and promotion to consumption.

2. Insufficiently developed mining of minerals necessary for the production of lithium-ion batteries. There is no mining for lithium production in the Russian Federation. Although the North Caucasus region is rich in minerals and fossils, as pointed out by Alkhasov A. B. "Brines of this layer are the industrial hydromineral raw material with high lithium, rubidium, cesium, strontium, iodine, bromine, boron, potassium, and magnesium contents. The potential geothermal water and brine resources of the lower layer are 2.6 mln m3/day". [14]. The lack of mining enterprises of their own in this mineral group makes it necessary to import the material from China.

3. Lack of policy coordination at the governmental level for the development of electric vehicles and the subsequent production of electric vehicles in the Russian Federation. Development projects in the electric vehicle industry should accumulate scientific and technological know-how and the technological and organisational capacity of production facilities in order to ensure victory in the technological race of car companies.

4. Irreparable damage to the environment, reduction of the general immunity of the population. The environmental situation in major Russian cities is getting worse every year. The increase in the number of private cars, as well as public transport powered by gasoline and diesel fuel, is causing irreparable damage to public health. The Americans Audrey Ku, Daniel M. Kammen, Sergio Castellanos "...These emissions have shown direct links to chronic respiratory and cardiovascular diseases which disproportionately affect vulnerable segments of the population such as children, the elderly, and those with long hours of outdoor life" [4]. The problem has also been noted by Turkish researchers Shihomi Ara Aksoy, Anna Kıziltan, Mustafa Kıziltan, Merih Aydınalp Koksal, Fatma Oztürk, Elçin Tekeli, Yeşer Aslanoğlu, Ulas Im, Nihvan Düran, Alper Ünal, Metin Baykara, Nazan Ozyürek, Perin Dogan, Agaça Gül Yılmaz, Canan Eskin Koksal, İrde Çetintürk Gürtpe, Ahmet Buğra Yereli, Mehmet Emin Birpinar, Gülen Güllü wrote "Government policies on renewing vehicle fleet by introducing newer, cleaner vehicles and removing old, polluting vehicles have significant impacts on air pollution. [5].

1.4 Aim, objectives and hypothesis

The presented study aims to find current problems hindering the development of electric transport in the Russian Federation and the ways to address them.

The objectives of the study are:
- to consider scenarios for the development of the electric transport market in the Russian Federation;
- to examine existing marketing research on the feasibility of switching from internal combustion engines to electric motors;
- to consider the stage of implementation of projects for the transition from internal combustion engines to electric motors in the Russian Federation;
- to formulate the problems of industry development and propose solutions.
The research hypothesis is that Russia has the necessary production capacity to implement an import substitution policy, to produce components independently and the entire chain of electric vehicle production.

2 Methods

The method of ascent from the abstract to the concrete was used as the main method of research. On the basis of empirical-theoretical research methods, let us examine the state of the electric vehicle market in Russia, focusing on the problem of production of components for electric vehicles.

3 Results and discussion

By the end of the first quarter of 2022, several large companies are conducting R&D in the electric vehicle industry in the Russian Federation. The projects are at various stages of development and are aimed at the market in several segments.

Emilia M. Szumska says in a research paper: "Growing environmental concern prompts vehicle users to search for cleaner and ecological transport modes. Many consumers and organisations have decided to replace conventional diesel or gasoline powered vehicles with alternative drive or alternative-powered vehicles". [6].

The market segment of electric buses in the Russian Federation is represented by three companies - KAMAZ, GAZ and Volgabus. These industrial giants have established mass production of electric buses, which are successfully operated in major Russian cities. More than 300 Russian-made electric buses are produced each year. One of the green transport projects is the organisation of an installation platform for electric motor buses at the Mosgortrans branch of GUP Mosgortrans (the project is based at Sokolnichesky Car Repair and Construction Plant). A positive aspect of the implementation of the project to produce more than 500 vehicles at the Mosgortrans branch is the reduction of the environmental load (greenhouse gas emissions). In the study of Md Mamunur Rahman, Yuan Zhou, Jamie Rogers, Victoria Chen, Melanie Sattler, Kate Hyun it is reflected that "Electrification of passenger vehicles could be an effective strategy to curb GHG emissions" [7]. The issue of GHG emission is also raised by Óscar García-Afonso, Itziar Santana-Méndez, Agustín M. Delgado-Torres, Benjamin González-Díaz, saying, "Passenger cars and light commercial vehicles accounts for approximately 15% of the total CO2 emissions in the European Union (European Environment Agency, 2020) [8]. Polish authors noted the effectiveness of electric transport against the background of the COVID-19 pandemic wave. Stanislaw Iwan, Mariusz Nürnberg, Mariusz Jedlinski, Kinga Kijewska write: "City users gladly apply comfortable and time-saving e-commerce solutions as an alternative to traditional shopping. The present pandemic crisis made this issue even more important" [9].

Anders Fjendbo Jensen, Mikkel Thorhauge, Stefan Eriksen Mabit, Jeppe Rich write about the need to increase the electric fleet in the following words "The electrification of transport systems requires a change in the composition of the vehicle fleet towards higher shares of electric vehicles" [10]. From which it can be concluded that the problem is common across the globe.

On December 17, 2019, the machine-building holding Sinara - Transport Machines and Škoda Transportation signed an agreement to establish a joint venture in St. Petersburg to produce urban electric transport. The estimated cost of the new vehicle model ranges between 20 and 40 million roubles depending on its specifications. The joint work of the holding and the concern involves creation of a fleet of electric buses, trolleybuses, trams and metro cars. Green electric transport is also reflected abroad, in particular, the Chinese
research team Liu Kaia, Gao Honga, Liang Zheb, Zhao Mengc, Li Chen writes "As a public transport mode that relies on a green energy source, electric buses play a positive role in energy conservation, emissions reduction and the improvement of urban power utilization" [11].

Electric cars, and specifically the segment of their production, present a slightly different picture - the models are at varying levels of readiness. A striking representative of the project for the end of 2021 is KAMA-1, executed by Peter the Great St. Petersburg Polytechnic University. The investment project is implemented as part of the Federal Target Programme "Research and Development in Priority Areas of Development of the Scientific and Technological Complex of Russia in 2014-2020". The industrial partner of the project is PJSC KAMAZ.

A small-size city electric vehicle was designed in 2 years, which is essentially the shortest timeframe for the automotive industry. "KAMA-1 is a unique product in the segment of industrial high-tech developments created on the basis of interaction between SPbPU and KAMAZ which emphasizes efficiency of development and investments into the programmes of the Ministry of Education and Science of the Russian Federation aimed at creating a competitive branch of applied research of scientific nature in the Russian segment of development of a priority area of the engineering industry. The electric car has a cruising range of up to 250 km, a maximum speed of 150 km/h, and a fast EPC charge time of 20 minutes.

As M.A. Hannan, Ali Q. Al-Shetwi, R.A. Begum, Pin Jern Ker, S.A. Rahman, M. Mansor, M. S. Mia, K.M. Muttaqi, Z.Y. Dong, "Battery energy storage system (BESS) has many purposes especially in terms of power and transport sectors (renewable energy and electric vehicles)" [12].

The Russian Federation has sufficient competence and production capacity to create traction batteries for electric transport, but at the same time there is no production of lithium-ion battery cells with the required specific energy and in a satisfactory quantitative indicator. The priority of state support should be focused on the scientific, technical and production development of this segment, since the battery system accounts for up to 50% of the cost of an electric vehicle. The battery is a critical component of a green car. Electrically-powered vehicles can only be produced safely and reliably if they have their own technology base, the production chain - from the production of minerals (raw materials) to the final product (electric vehicle).

The Russian Federation has 25% of the world's rare earth metals on its territory. The raw material base required for the production of high-tech innovative products is represented by a full range of minerals. The main omission in this case is the absence of a production chain for deep processing of mined minerals. Accordingly, the demand for the necessary raw materials and components is met by imports. More than 1/3 of strategic minerals are imported to Russia. Import becomes a forced measure due to the low quality of mined raw materials, lack of well-developed technological scheme of extraction of minerals, remoteness of extraction facilities from production (consumers).

In view of the above, we note the need to form and implement a comprehensive programme for the production of batteries in Russia as an integral part of the strategy for the development of electric transport.

4 Conclusions

The outcome of this article is the identified problems hindering the development of the electric transport sector, namely the production of batteries driving electric vehicles.
The primary objective in the development of the industry is to create a high-tech modern concern for the production of electric vehicles that are competitive in the market, possibly through the development of raw material bases within the country, relying on platforms for the development of own energy system developments (these include batteries with subsequent assembly of fuel cells). The increasing demand for electric vehicles is allowing the market for electric motors to grow and expand, which is leading to a need for more production of the main component, the battery. Typically, batteries are created by combining metals from the heavy, medium and light groups, namely lithium, nickel, manganese, cobalt, copper, aluminium, etc.

The main problem fronts are:
1. Russia imports lithium from abroad, namely from China. This is due to a lack of quarries with this metal deposit.
2. Current state of production and market makes it necessary to import 2/3 of lithium-ion batteries from China.
3. Stalling of the transition to green transport is also having a negative effect on the environment. The lack of a transition to green and healthy transport threatens the health of the nation.

The following suggestions can be considered as solutions to the identified problems:
1. Experts estimate Russia's lithium reserves at 1-1.5 million tonnes, which puts the country in 10th place in the ranking of mineral reserves. The resource is found in 16 deposits, one of the largest in the world. Hence, it is proposed to develop quarries in the deposits of the said metal.
2. In Russia there are significant reserves of raw materials for the production of not only lithium-ion batteries, but also other energy storage batteries. In the Russian market there is a need to increase the rate of stimulation of domestic markets for metals and other imported raw materials in order to create a full cycle for the processing of minerals. One of the priority areas for state support and promotion should be integrated "pull-out" projects, capable of concentrating scientific, technological, production, organizational resources and providing a breakthrough in key areas of the market.
3. The state policy in the electric transport industry should be coordinated: from assembly to production of electric vehicles in the Russian market.
4. The solution can be formulated as: speeding up the transition to green transport based not only on government policy, but also on public education on the environmental friendliness of the vehicles in use.

References