The Energy Aspect of the Transition to Environmentally Safe Vehicles in Russia

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Abstract: The article considers the main energy risks of the transition of the Russian transport sector to an environmentally safe type of motor transport. Numerous studies related to the analysis of the impact of transport on the environment have confirmed that motor transport is the main source of air pollution not only in megapolises, but also in large logistics centers, industrial clusters. To solve the problem of air pollution, the most appropriate way is to replace motor transport with environmentally friendly vehicles, such as electric cars. However, a wild scale replacement of vehicles with an internal combustion engine (ICE) with electric cars in megapolises is real, provided that the necessary infrastructure can be created. At the same time, the policy of replacing traditional cars with ICE raises a question about the increasing requirements for the environmental purity of energy carriers of motor vehicles. The authors present a projection of the number of electric cars, on the basis of which the amount of reduction in carbon dioxide emissions is calculated as well as given a potential estimate of the increase in electricity consumption. As a result of the study the hidden threats and trends in the transition to environmentally friendly vehicles and the assessment of the consequences of the introduction of electric cars in Russia were identified.

1 INTRODUCTION

The environmental situation in the Russian Federation over the past decade indicates that environmental conditions in the territories considered to be the most economically developed remain adverse, and environmental pollution continues to increase. Many cities in the country have high average annual levels of air pollution exceeding sanitary and hygienic standards. The greatest contribution to the negative impact on air quality is made by industry and motor transport.

At the moment, limiting the environmental impact of motor transport is the most significant problem facing the cities (Jovovic, 2016; Mathew, 2018). In solving this problem, the most important thing is not only the elimination of the effects of the impact, but also its prevention or reduction of air pollution by toxic substances emitted by motor transport.

The widespread transition from the use of cars with an internal combustion engine to the use of cars with an electric engine in industrially developed countries is still at an early stage, but the world's largest vehicle manufacturers have already started mass production of electric cars (for example, Nissan Leaf, Opel Ampera, Chevrolet Volt, Mitsubishi iMiEV and others) (Golovanova, 2015).

A number of electric vehicles produced today are hybrid models, since they use either ICE and electric engines at the same time, or ICE in addition to batteries. However, the main long term trend is a complete rejection of the ICE, and the transition to a fully electric car, in which an electric motor is used as an engine, and a battery in one form or another is used as a power source (Danilov, 2019).

According to the annual "Global Automotive Executive Survey", published by KPMG, the growing popularity of electric vehicles demonstrates a significant change in the automotive industry, as well as the increasing role of the state. Thus, about 77% of the surveyed managers agree with the statement that it is the regulatory authorities that will play a key role in choosing the direction of development of the automotive industry. State support is observed in such economically developed

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countries as the USA, France, Germany, Japan, China.

The article analyzes the potential risks associated with the directions of electrification of motor transport, the dynamics of the current development of the electric vehicle market in the world and Russia, and evaluates the prospects until 2035-2040. Statistical data and data of long-term forecasts of energy development published by Russian and international energy organizations (Ministry of Transport of the Russian Federation; Federal State Statistics Service) are used for evaluation purposes.

1.1 Current Status and Projection of the Development of Electric Vehicles in the World and Russia

Today, the world economy demonstrates the trend of development of the transport sector in the direction of production and maintenance of electric vehicles, which in the future may change its whole basis in the energy industry. Therefore, we can expect some additional risks associated with transformation and variability in the ways of development in the national energy sector and the petroleum refining industry.

The global electric vehicle market, even during the 2020 pandemic, showed a 5% increase, considering an 18% drop in vehicle sales (Golovanova, 2015). Three of the ten biggest car manufacturers (by value) produce only electric vehicles. Automakers announce new models of electric cars on a weekly basis and declare the refusal of ICE. The current situation resembles a "wave" that has been gaining strength for more than ten years, and now it is covering the whole world.

More than 20 countries, including European countries, China, India, Japan, South Korea, etc., have already taken measures concerning the production and marketing of electric vehicles (Danilov, 2019) In Norway, only electric cars should be sold from 2025. Other countries plan to completely displace cars with ICE from the market for 2030-2040. Probably, by 2030, the majority of cars imported into Russia will be electric, foreign markets will be closed for Russian cars with ICE, as well as roads outside our country (Golovanova, 2018). The fact of the absence of Russian companies at the stage of formation of the electric vehicle market may be the cause of the loss of this market.

Foreign experience shows that most countries use forms of support, such as the demand of private buyers of commercial organisations for electric cars. In particular, monetary and non-monetary measures to support owners of electric vehicles stand out. Monetary measures include subsidies or tax deductions provided when buying an electric car. Non–monetary ones include the right of way on bus-only lanes, toll roads, quotas, incentive support measures, etc.

According to the IEA projection, the number of electric vehicles will increase by about 50% per year and will reach 30 million units by 2025, and by 2040 it will exceed 150 million units (Fig.1).

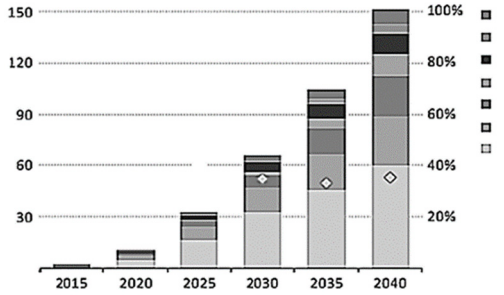

Figure 1: Projection of the growth dynamics of electric vehicles in the world (World Energy Council Regency House. 2011).

In comparison with the leading countries in the application of green technologies in transportation, Russia is still lagging behind. According to the experts (Romanov, 2017), in the Russian realities, the most promising areas of transport development are resources based on natural gas and electricity.

The Russian Federation is currently inferior to the leading countries in the application of green technologies in relation to motor transport. According to many experts, resources based on natural gas and electricity can become promising areas for the development of road transport in Russia.

It is obvious that without the creation of an appropriate infrastructure, it is impossible to develop electric vehicles in Russia, the elements of which are electric charging stations, electric car maintenance and repair services, diagnostic centers (World Energy Council Regency House. 2011). In addition, to stimulate this process, it is necessary to adopt a national program with clear deadlines and targets, taking into account the specifics of the regions.

2 MATERIALS AND METHODS

Transportation is one of the key components of the economy, which also has a significant impact on the development of the oil and gas industry. Thus, more

than 60% of the total demand for petroleum products is formed by the transport sector (Mathew, 2018). Currently, the automotive industry is going through structural changes regarding the introduction of hybrid powerplants and electric vehicles. These changes will lead to a transformation in the consumption of petroleum products in the medium term (World Energy Council Regency House. 2011). Therefore, the issues associated with assessing the prospects for the development of road transport in the regions of Russia from the point of view of the impact of energy risks are becoming increasingly relevant.

In most developed European countries, the desired level of provision of the population with road motor vehicles is 400-600 cars per 1000 people (Golovanova, 2018). In Russia, in almost all regions, the level of motorization is far from this level. On average, there are 301 cars per 1,000 people in Russia (Figure 2).

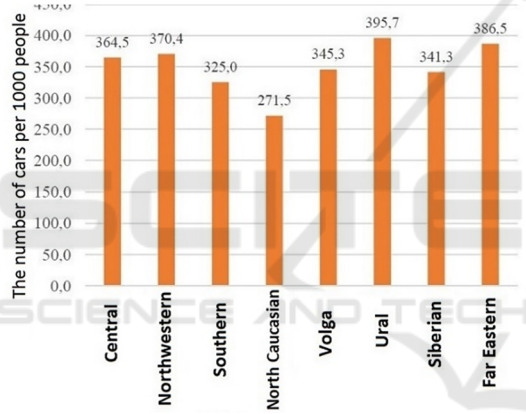

Figure 2: The number of cars per 1000 people in the federal districts of Russia [data from the Federal State Statistics Service].

The authors have made a projection of the number of vehicles per capita until 2035 (Table 1). The fleet of electric cars was calculated considering the availability of cars per 1,000 people and the share of electric cars in the total fleet of vehicles. For electric cars, it was determined using data adopted in the Strategy for the Development of the Automotive Industry of the Russian Federation for the period up to 2025, taking into account the dynamics of their development.

Table 1 shows a projected assessment of the possible consequences of the widespread introduction of electric vehicles in Russia. Projection data on emissions and dynamics of specific fuel (gas and coal) consumption for electricity production were used in calculations of the environmental effect and the volume of possible reduction of greenhouse gas emissions.

Table 1: Assessment of electricity demand and reduction of greenhouse gas emissions during the introduction of electric transport in Russia [data from the Ministry of Transport of the Russian Federation and the Federal State Statistics Service].

Indicator	Indicator by year		
	2025	2030	2035
Projection of electricity consumption, billion kWh	1220	1285	1340
Number of cars per 1000 people	345	396	456
Percentage of electric vehicles, %	5	8	12
The total number of vehicles, million units.	52	60	69
including the fleet of electric vehicles, million units.	2,6	4,8	8,28
Reduction of CO2 emissions, million tons per year	2	13	17
Increase in electricity consumption, TWh	4	27	36

Based on the forecast for the number of electric vehicles (10-13 million units in 2030-2035), it can be expected that the volume of CO2 in the air will decrease by 13-17 million tons per year. At the same time, latent threats associated with additional electricity consumption do not create a problem situation, since the increase in electricity demand will be 27-36 TWh (considering battery charging).

The calculations show that about 2.2 to 2.7% ([increase in electricity consumption / projection of electricity consumption] * 100%) of the total final electricity consumption will be consumed from the Russian energy system in 2030-2035 under the initial scenario of energy supply. According to the authors, such an increase in electricity consumption does not pose a serious issue for the country's electricity industry in the long term.

The ability of the Russian energy system to adapt to the growth of electricity consumption by the automotive sector is another possible risk, considering the degree of differentiation of the regions by the number of vehicles, which in the long term may slow down the growth of the share of electric cars.

However, in accordance with the projection of additional energy consumption (Table.1), as well as under the condition of continuous improvement of energy efficiency of road transport, It can be noted

that in this segment, the country is able to adapt to the transition to electric vehicles over a ten-year period.

That would also facilitate by the transition to more cost-effective alternative energy sources. According to the estimated values (World Energy Council Regency House, 2011; ERI RAS, 2013; Bloomberg, http://www.bloomberg.com), the transition to alternative sources by 2040 will entail a reduction in energy consumption by road transport from 65.9 million toe to 62.3 million toe (Table 2).

Table 2: Projection of energy consumption by motor transport, million toe (World Energy Council Regency House. 2011).

Federal district	2020	2025	2030	2035	2040
Central	16,9	16,7	16,5	16,2	15,9
Northwestern	7,5	7,4	7,3	7,2	7,1
Southern	7,3	7,2	7,1	7,0	6,8
North Caucasian	1,5	1,4	1,4	1,4	1,4
Volga	13,5	13,4	13,2	13,0	12,9
Ural	6,9	6,9	6,8	6,7	6,5
Siberian	9,2	9,2	9,0	8,9	8,8
Far Eastern	3,2	3,1	3,0	2,9	2,8
Russia	***65,9***	***65,2***	***64,3***	***63,4***	***62,3***

The transition to alternative types of energy carriers, mainly electricity, will lead to a decrease in the consumption of hydrocarbons (gasoline and diesel fuel), and consequently to a change in the model of energy supply to the transport sector. Obviously, there will be subsequent changes in such dependent indicators: fuel and electricity prices, capital investments, fuel and electricity consumption, etc.

Strictly speaking, the conversion of vehicles to electricity will cause the modernization of the Russian energy system and it is important that this process takes place due to the growth of the share of clean electricity gained from renewable energy sources, and that is the best scenario.

3 RESULTS

The viability of transition to an environmentally friendly transport can be found from the perspective of assessing the success of the governmental measures to support and develop the industry: stimulating the production and sales of electric vehicles; formation of the domestic market of electric vehicles; stimulating the development of electricity gained from renewable energy sources, subsidizing the modernization of the energy system, etc.

The research considered only one side of the issue related to the assessment of the need for additional energy resources during the transition of vehicles to electricity. As it turned out, the expected increase in the volume of additional demand for electricity does not pose a big threat to the energy system, the load increase will be 27-36 TWh.

The calculations did not take into account the tendency to reduce the consumption of oil and petroleum products used for the production of motor fuel due to an increase in the consumption of natural gas used for electricity generation, therefore, the total amount of carbon dioxide emissions reduction will be even greater as a result.

Another positive result should also be taken into account, due to the fact that the transition from ICE to electric engines reduces the emission of pollutants into the air, preventing damage to the environment and preserving its acceptable quality. A positive impact of the transition to electric vehicles is also the reduction of heat and noise pollution in megapolises, which reaches thresholds in present day processes of urbanization.

4 CONCLUSIONS

It is obvious that in the future, traditional cars powered by ICE will be replaced by cars powered by new alternative fuels and energy. In Russia, the conversion of the car fleet to electric ones will cause an increase in demand for electricity and its decrease in motor fuel, as a consequence. However, the projected estimates show that the rapid development of electric vehicles over the long term and the growth of their share in the total fleet of cars in the country do not pose a serious issue for the electricity generation sector of our country. This will be possible thanks to the effective implementation of green energy carriers for transport, which will change the dynamics of energy prices.

The research demonstrated that in the medium term, hybrid cars will occupy a large part of the electric vehicle market, and plug-in vehicles will remain in the premium segment of the market for a ten-year period and will be present on the urban roadways. However, in the long term, the main efforts of the developers of new technologies will be focused towards electric vehicles due to their environmental and economic benefits.

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REFERENCES

Jovovic, R., Draskovik, M., Delibasik, M. 2016. The concept of sustainable regional development – institutional aspects, policies and prospects. *Journal of International Studies.* 10 (1). pp. 255-266.

Mathew, S., Kara, M., Thompson, M. 2018. Greenhouse gas emission control options: assessing transportation and electricity generation technologies and policies to stabilize climate change. *Journal of International Studies*. 10 (7). pp. 254-285.

Golovanova, L. A., Danilchuk, M. A. 2015. Formation of a strategy of competitive advantages in the transport services market: the theory of the question. *Russian Economic Journal*. 2. pp. 27-35.

Danilov, A. M., Kaminsky, E. F., Khavkin, V. A. 2019. Alternative fuels. Advantages and disadvantages. Implementation problems. *Russian Economic Journal.* XLVII. 6. pp. 4-11.

Golovanova, L. A., Danilchuk, M. A., 2018. Foreign experience of reforming transport infrastructure of the territories. *Bulletin of PNU.* 3. pp. 17-25.

Romanov, O. A., Starikov, E. N. 2017. Implementation of the transport strategy of the Russian Federation for the period up to 2030. *Economy of region.* 5. pp. 322-333.

Global Transport Scenarios 2050. World Energy Council Regency House. 2011. p. 76.

Transport Outlook 2050: Seamless Transport for Greener Growth. 2012. p. 60.

Global and Russian Energy Outlook up to 2040. ERI RAS. 2013. p. 110.

Official website «Bloomberg». http://www.bloomberg.com