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# STRATEGIC TRANSPORT MOBILITY OF MODERN RUSSIA

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**Abstract.** Recent geopolitical disagreements have caused tectonic changes in economic, technological and scientific ties between the North-South countries. Russia, as a country with the largest territory and substantial natural resources, found itself at the epicenter of these changes. Numerous sanctions adopted by the collective West after February 2022 created a new geopolitical reality, when Russia can rely only on its own intellectual and technological resources. In such external conditions, Russia will most likely be guided only by its national interests, with the climate agenda playing a secondary role. This research examines a conceptual model of transport mobility, when not the climate agenda, but technological development becomes the main dominant of development. The basis of such transport mobility is the existence of critical technologies and new economic mechanisms for their implementation. In this paper the possible implementation of such a new model is presented, in particular, on the basis of national-scale projects to create a country's own technological base in the field of electric vehicle (EV) manufacturing, hydrogen fuel cell locomotives, and modern shipbuilding.

**Keywords:** transport mobility, critical technologies, economic tools, national projects, global economic trends

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# СТРАТЕГИЧЕСКАЯ ТРАНСПОРТНАЯ МОБИЛЬНОСТЬ СОВРЕМЕННОЙ РОССИИ

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**Аннотация.** Геополитические разногласия последнего времени стали причиной тектонических изменений в экономических, технологических и научных связях стран Севера и Юга. Россия, как страна с крупнейшей территорией и значительными природными ресурсами, оказалась в эпицентре этих изменений. Многочисленные санкции, принятые коллективным Западом после февраля 2022 года, создали новую геополитическую реальность, когда Россия может рассчитывать только на собственные интеллектуальные и технологические ресурсы. В таких внешних условиях Россия, скорее всего, будет руководствоваться только своими национальными интересами, а климатическая повестка будет играть второстепенную роль. В статье рассматривается концептуальная модель транспортной мобильности, когда не климатическая повестка, а технологическое развитие становится главной доминантой развития. Основой такой транспортной мобильности является наличие критических технологий и новых экономических механизмов их реализации. В статье рассматривается возможная реализация новой модели, в частности, на основе проектов национального масштаба по созданию собственной технологической базы в области производства электромобилей (ЭМ), локомотивов на водородных топливных элементах и современного судостроения.

**Ключевые слова:** транспортная мобильность, критические технологии, экономические инструменты, национальные проекты, глобальные экономические тренды

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## Introduction

A key feature of global economic trends over the past five decades has been the exponential growth in energy consumption. Between 1973 and 2022, energy use around the world doubled from 6,210.8 million tons of oil equivalent (Mtoe) to 14,591.1 Mtoe (IEA, 2023). This growth in energy use has been driven not only by the development of industries but also by an expanding range of goods and services, as well as the emergence of new sectors that rely on high-tech applications. As further increases in energy consumption are expected to lead to climate change, experts have called for a reassessment of current energy practices. The transition to a new energy paradigm is underway, driven by the widespread adoption of digital technologies kicking off at the turn of the 21st century. The first trend relates to the development of critical technologies that are shaping the formation of new product markets, which is driven by the increasing significance of these technologies in determining the future of industries and economies. The second trend is centered around the intensification of the climate change agenda, resulting in the creation of new segments in the energy sector. This includes the development of renewable energy sources and energy-efficient technologies for transportation, energy distribution, and energy use. A third trend involves a shift in the nature of labour, with an increase in online employment opportunities, emergence of digital platforms, and a substantial rise in the share of services. This trend has led to changes not only in the lifestyles of employees but also in the functioning of social and industrial infrastructures. The fourth trend has demographic implications and is directly linked to the rapid growth in the number of large cities, particularly on the Asian continent where the phenomenon significantly exacerbates challenges related to transport mobility and environmental conditions in these urban areas.

The total global carbon dioxide (CO2) emissions in 2022 amounted to 36.8 billion metric tons (IEA, 2023), with approximately 15% (about 5.5 billion metric tons) emitted from global road transport (Ritchie, 2020). In the Russian Federation, the Transport Strategy for the Russian Federation 2030, with a forecast up to 2035, serves as the primary document for long-term planning and development of the transportation industry and sets objectives for reducing greenhouse gas (GHG) emissions from all modes of transportation (Transport Strategy of the Russian Federation, 2021). An ambitious target for reducing GHG emissions through 2035 was set: a 30%-70% reduction in the "carbon footprint" of public transportation in large and major urban areas compared to 2019. Moreover, the results of the joint research "Scientifically Based Forecast of Adaptation of the Road Transport Sector to the Likely Consequences of Climate Change and Possible Scenarios of Its Decarbonization in the Russian Federation" summarizing international and domestic experience and assessing the prospects for the decarbonization of the Russian road transport sector and its adaptation to climate change, were also published in 2022 (Skolkovo – MADI, 2022). However, it must be noted that these significant documents were published prior to the events of February 2022. A sharp change in the geopolitical situation has made it almost impossible and unfeasible to implement the significant number of measures outlined in the aforementioned documents.

After February 2022, Western economic sanctions have taken on a more complex nature and are now aimed at undermining the economic foundation of Russia. A significant number of Western companies have withdrawn from the Russian market, leading to a near-complete halt in economic and technological cooperation. Currently, the number of sanctions imposed on Russia has exceeded 12 000, encompassing a wide range of economic measures. These include 14 packages of sanctions from the European Union, over 3 600 restrictive measures from the United States, as well as additional measures from Britain, Canada, and Japan.

In the financial sector, these sanctions include a prohibition of direct or indirect trading in investment services related to securities and financial instruments, measures preventing the Central Bank of Russia from utilizing its international reserves, restrictions on debt and equity transactions, and the exclusion of major Russian banks from the SWIFT international payments system.

In addition to the financial sector, strict sanctions are also aimed at the operations of the energy companies, which are crucial for the Russian economy. The industry has imposed a ban on the export of high-tech and crucial technical equipment and components for sectors such as electronics, telecommunications, and aerospace, as well as aircraft, spare parts, and equipment. This includes a ban on insurance, reinsurance, and maintenance services. Drastic restrictions have also been imposed on the import of computer chips to Russia. Particularly noteworthy are the negative effects of these economic sanctions on the oil and gas production sectors, as well as on energy production. These sectors accounted for approximately 2/3 of the country's foreign exchange earnings. The country now faces the challenge of reorienting significant commodity flows geographically and towards East (in 2021, Russia accounted for 8.4% of global oil exports and 6.2% of gas exports).

The above-mentioned circumstances have served as a basis for the elaboration of new strategies in the development of transportation mobility in modern Russia. It is primarily related to an increased understanding of the importance of critical technologies in the formation of new market niches for products on a global scale.

**Materials and Methods**

This research implements the methods of collection and information synthesis, comparison, and description. The authors largely rely on the UN resolutions and other legal documents that focus on the matter of tranport mobility.

The main concepts of transport mobility system stem from the need to (a) achieve the goals of sustainable development, and (b) prevent further warming of the Earth's climate through reduction of CO2 emissions.

It is largely due to the adoption of directives set in two important documents in 2015 based on a broad international consensus: the UN General Assembly resolution "Transforming Our World: The 2030 Agenda for Sustainable Development" and the Paris Climate Agreement. With the practical implementation of various transport mobility models, the focus has begun to shift towards the problem of large cities, given the following objective prerequisites:

1. The mobility of many urban residents currently relies heavily on cars and other motorized vehicles, meaning that the number of worldwide vehicles amounts to approximately 1.44 billion, many of which operate within or near urban areas.

2. The share of the global urban population has increased from approximately 30% in 1950 to 55% in 2015 and is expected to reach 68% by 2050 (UN, 2019). This trend is observed against a backdrop of significant regional disparities.

To support the prerequisites, the proportion of urban residents in East Asia more than tripled over the past 65 years, rising from approximately 18% in 1950 to over 60% by 2015. In contrast, a similar shift required 80 years in more developed regions between 1875 and 1955 (UN, 2018). At the time, ground passenger transportation emissions in 2015 accounted for nearly 50% of all global CO2 emissions from transportation, primarily due to an increase in private vehicle ownership, particularly in urban areas (OECD, 2019). Cars, having become a symbol of industrialized society and providing greater personal mobility, have literally "tied" people as the most common mode of transportation. For example, in the United Kingdom, 87% of personal journeys in rural areas are undertaken by car or minibus, while in urban areas this figure is 78%. (Taylor et al., 2019)

Therefore, it is not surprising that reducing reliance on cars has emerged as one of the primary objectives in the development of transportation mobility models, initially in major cities and, subsequently, in rural areas of many developed European nations. Further significant principles of transportation mobility systems have included accessibility and an optimal price-to-quality ratio. Design and planning of transportation systems have become critical components of these models. Making significant infrastructure decisions for long-term use has been recognized as an essential element of balancing local interests with financial, operational, and strategic objectives. The integration of passenger and freight transportation, as a means to reduce future uncertainties in the use of urban spaces for housing, has become a central component of a comprehensive policy for the development of urban infrastructure. The widespread adoption of digital technology has demonstrated that its use can contribute to the overall sustainability of urban transportation systems by optimizing freight transportation and implementing new logistics strategies (Taylor et al., 2019). Additionally, adjustments to institutional arrangements, budgeting processes, data collection, and management, as well as improvements in institutional coordination mechanisms, have emerged as essential components of these models (GEF-STAP, 2010).

**Results and Discussion**

*"Mobility as a Service"*

Although the principles and approaches discussed above have shaped the basis for modern models of urban transport, new ideas and methods are continuously emerging with the aim of further improvment. One of the concepts is similar to terms used in computer science – "Mobility as a Service" (MaaS), which aims to integrate complex transport systems and address the challenges of urban mobility. The approach has been proposed as an alternative to traditional planning and provision methods (Brown et al., 2022). The development of electric vehicle (EV) technologies has provided a significant impetus for the growth of carbon-neutral public transportation. The concept of green transport, for example, – a low-emission mode of transportation that aims to reduce greenhouse gas emissions, pollution, noise, and land use – has gained attention as a means to promote economic growth and reduce poverty (Larina et al., 2021). It is to be noted that transport mobility models are also being developed in relation to the specific economic development of individual countries, such as India and Turkey, as well as the territories of specific communities, such as universities (Downes et.al., 2022; Cevheribucak, 2021; Aniegbunem, Kraj; 2023). New technological solutions, including unmanned vehicles, are also influencing transport mobility scenarios and models, particularly in the context of investment strategies and "smart" cities (Richter et.al., 2022).

*Indirect policy measures*

Indirect policy measures aimed at reducing emissions, in the form of managerial, regulatory, and economic solutions tailored to the specific circumstances of large cities and urban areas, have become an integral part of many transport mobility models. As demonstrated by the accumulated experience of numerous countries, such policy interventions include:

– Low-emission zones, in which vehicle entry is restricted based on the level of environmental standards;

– Restrictions on car use, prohibiting residents from using personal vehicles during peak hours on certain days;

– Limits on the importation of second-hand vehicles, such as banning the import of vehicles older than a specified year or imposing higher import duties;

– Regulation of the parking system, including the establishment of low-emission areas and restrictions on access to city centers;

– Modernization of urban spaces. Encouraging the use of non-motorized modes of transportation such as hiking and cycling, as well as public transportation, is essential. Additionally, the use of alternative fuels such as gas, hydrogen, and biofuels in place of diesel fuel, and the introduction of electric vehicles with zero emissions, are all important steps towards a more sustainable future (Shergold, Bartle; 2016).

*"Europe on the Move" – AI supported transportation models*

New developments in information and communication technology (ICT), particularly in mobile and big data applications, have enabled us to address practical challenges in creating a more integrated and efficient transport system in Europe, while erasing traditional boundaries between public and private modes of transportation. This principle of integrated transport and mobility strategies brought to life the new "Europe on the Move" package in 2017, adopted by the European Commission (Tsakalidis et.al., 2020).

The significant breakthroughs in artificial intelligence (AI), cloud services, and fifth-generation (5G) technologies have created conditions for automakers to utilize these new technologies to develop modular integration systems that enable independent, highly efficient, and multi-modal connections between vehicles, drivers, and passengers. For the Chinese market, for instance, such developments are spearheaded by Mercedes-Benz and Alibaba (Ng, Gao; 2020).

Thus, modern models of transportation mobility primarily focus on addressing environmental and transportation challenges in urban areas through the development of a cost-effective infrastructure that ensures safe and reliable transportation services for both individuals and goods, while minimizing negative environmental impacts. These transportation mobility models do not directly aim to develop new technologies themselves, they rather draw upon existing technologies that are the product of the scientific and commercial efforts of various economic actors, often not directly connected to transportation systems or efforts to reduce emissions.

*Russia's transportation system status*

To some extent, Russian concepts of transportation mobility have undergone a similar evolutionary process to those in the West. If we look at the Transport Strategy of the Russian Federation until 2035, we can see that the goals, objectives, and means for achieving transportation mobility are similar in formulation (Transport Strategy of the Russian Federation, 2021). The analysis presented above has shown that most research on transportation mobility issues, with some exceptions, focuses on large urban areas, which is explained by the fact that urbanization and motorization processes in Russia, like in the rest of the world, occur in parallel.

According to the NAPI marketing agency, there were 50.6 million registered passenger cars in Russia by the end of 2022, out of which half (50.9%) were older than 10 years, one-fifth (21.6%) were between 5 and 10 years old, and 27.5% were under 5 years old. At the same time, 96.6% of all cars in the fleet could only use gasoline and diesel fuel (NAPI, 2023). The growth of motorization in cities is facilitated by continued urban planning practices, where large-scale construction occurs without sufficient consideration for social and transportation infrastructure. It is no coincidence that, since the end of the Soviet era 30 years ago, the average daily car mileage in Russia has increased by 37%.

*"Green and Healthy Streets" — Moscow initiative*

Transport mobility problems are most pronounced in the Moscow metropolitan area. In response, the Moscow government launched a program in 2010 to improve the efficiency of its transport system. This has led to a 62% increase in passenger traffic on public transportation over the past 10 years (Kargin, Putilov, Khametova; 2020). Additionally, as part of its "Green and Healthy Streets" initiative, Moscow has announced its intention to fully replace its bus fleet with electric buses by 2032. The challenges and ways of developing transport mobility systems within the Moscow agglomeration have been detailed for example in the studies by Kargin et al. (Kargin, 2020) and by Zavyalov (2023). The social functions of transportation mobility and its impact on the quality of life for citizens are discussed in the study by Berezhnova and Grishine (2019) as well as by Tinkov (2023). The development of new forms of mobility in the urban environment based on the use of small transport (bicycles, scooters, segways and other self-balancing electric transport devices, including even such futurological means as an individual social transport system) is analyzed by Kogan (2016). The appeal to the concept of utilizing small-scale transportation is not unfounded. In fact, the underlying issue that characterizes most Russian cities lies in the implementation of a vehicle—centric development model, where their planning is unable to adapt to mass motorization (Komarov, Akimova, 2021), which results in the fact that, in Russia, a car requires an area four times greater than the average living space per person (22—23 square meters), and each additional vehicle is equivalent to the construction of a single-story private home in the city (Komarov, Akimova, 2021, p. 96).

Models of transport mobility in a narrow sense, as shown above, are mainly related to transport problems of large agglomerations. The approach we propose is based on the need to create strategic transport mobility, which primarily involves spatial development based on new transport systems. The latter can be implemented using critical technologies.

*Critical technologies and their status in Russia*

The diverse range of industrial technologies available today can be categorized into two groups based on their prevalence and strategic significance. The first category comprises general-purpose technologies, while the second category includes breakthrough or critical technologies. Both categories are essential for the successful implementation of economic activities.

The second category of technologies comprises a subset of advanced technologies which have the potential to be significant for national security. These are typically technologies associated with promising areas of scientific research, development in the most technologically significant sectors of the economy, and require investment of highly skilled labor. In Russia, critical technologies, as defined in the Concept of Technological Development of the Russian Federation until 2030, are understood to be "industrial technologies that are essential for the production of significant types of high-technology products and the provision of high–quality services that are systemically important for economic functioning, addressing socio–economic challenges, and ensuring national defense and state security".

One of the major challenges for modern Russia is the advancement and development of crucial technologies, particularly given the prominent position that Russia currently holds in global technology rankings (Zavarukhin et al., 2023). A most recent study by the Institute for the Development of Science at the Russian Academy of Sciences analyzed the main indicators that characterize the state of the scientific potential and the indicators that reflect the effectiveness of scientific activity in 43 countries, including Russia and China. The analysis revealed that Russia currently has a scientific potential that is closest to that of countries such as Australia, Canada, Czech Republic, Estonia, Greece, Hungary, Italy, Latvia, Lithuania, Malaysia, New Zealand, Poland, Portugal, Slovakia, Slovenia, and Spain (Zavarukhin et al., 2023).

Over the past 15 years, more than 10 government–level regulatory documents have been adopted in Russia in order to ensure a new quality of scientific and technological development of the country. But as practice has shown, the adoption of the regulations and provisions defined in these documents did not solve the issue of ensuring the competitiveness of the Russian industry and saturating the consumer market with high-quality domestic products. The problem of chronic lagging behind the West in the development of high technologies is due to a number of various reasons, including the following (Lenchuk, 2022):

a) There have been serious miscalculations in the scientific and technological policies and reforms in the field of science.

b) There has been a decline in the scientific and technological potential.

c) Applied sciences have been almost completely eliminated.

d) Science has become separated from the real sector of the economy.

An additional systemic factor was the "gap" between the levels of the country's scientific and technological system, which resulted in the formation of "four different branches" of science, loosely related to each other. These include fundamental "academic" science; "applied" science and technology within state scientific institutions and corporations; a majority of medium-sized companies; and cutting-edge technology companies (Belousov and Frolov, 2022).

Among other factors contributing to the technological lag, researchers have identified the following problematic issues (Mazilov and Davydova, 2020):

1. A reduction in the cost of internal research and development (R&D), which has decreased

from 2% to 1% of GDP over the past 30 years.

2. A threefold reduction in the number of personnel involved in R&D.

The current higher education system, which focuses primarily on training specialists in accordance with the technologies of the third industrial revolution (1950–2010), has not been effective in reducing the gap in technological development despite the fact that rapidly evolving technologies of the fourth industrial revolution are constantly shifting the demand for workers towards highly qualified professionals, particularly specialists and researchers in STEM fields (Akaev et al., 2020).

*Development of critical technologies in Russia – the "Catch-up development"*

One possible scenario for Russia's technological development could be based on the trajectories of "catch-up development", which is a historical practice seen in countries that have achieved significant success in technology, such as 19th-century England and the United States, and 20th-century Japan, South Korea, and Taiwan (Chang, 2002). It should be noted that, in relation to Russian practice, the conceptual provisions of such a scenario are set out in the works by Polterovich (2007; 2016).

The main points of their provisions are:

– establishment of catch-up development institutions to ensure economic growth under conditions of cultural, institutional, and technological constraints that are typical of developing countries;

– creation of corporatism, a system of political and economic decision-making that is based on the interaction between the government and organizations representing interest groups, primarily employees and employers;

– establishment of a national planning system, including indicative and programmatic approaches, and the creation of a federal development agency to prevent market failures and the unpredictability of government and partner behavior when considering large projects that are not managed as a single planning unit;

– development of a modern scientific sector and enhancement of human capital;

– combination of public-private partnerships and project funding;

– implementation of a policy to reduce economic inequality. The development of a national innovation system is seen as a tool to effectively adopt technologies and innovations from abroad.

The aforementioned provisions of the "catch-up development" scenario are largely reflected in the Concept for Technological Development of the Russian Federation until 2030 (The Concept, 2024), according to which, the main mechanism for achieving technological development is through the implementation of major projects (megaprojects) for the production of new complex machinery, mobile equipment, and pharmaceutical products in various industries such as aerospace, shipbuilding, electronics, radioelectronics, engine manufacturing, railway engineering, transportation engineering, machine tools, heavy machinery, and pharmaceuticals. These megaprojects will be executed through the establishment of associations that include educational, research, development, and production components, involving technological startups.

The Concept identifies four groups of measures:

1. formation of government orders for research and development in all forms (excluding basic research), based on cross-cutting technological priorities;

2. change in general approaches to development of incentive mechanisms;

3. creation of new markets for promotion of fundamentally new high-tech products based on end-to-end technologies and development of business models through a number of pilot projects;

4. overcoming technological barriers hindering the development of new markets based on

end–to–end technologies through the launch and development of an open technology competition system, including within the National Technology Initiative framework.

In accordance with the Concept, the main functions of the state in ensuring technological development are: (a) strategic planning and goal setting, (b) management of lists of critical and end-to-end technologies; (c) financial support for private innovative projects, including development institutions and state corporations and companies with state participation; (d) state order for fundamental and applied research and development, priority technological solutions; (e) taking risks and part of the costs in the implementation of certain long-term non-repayable innovative projects; and (f) support for the development of small technology companies. It should be particularly noted here that in order to ensure a new quality of technological development, the state is ready to take on the risks and part of the costs of certain non-funded innovative projects.

There are certain hopes that the institutional and organizational mechanisms outlined in the Concept will give a new impetus to Russia's technological development, especially given that the "Strategy for Scientific and Technological Development of the Russian Federation" approved in February 2024 aims to "increase total expenditures on research and development to at least 2% of GDP, including proportional growth of private investments, the level of which should not be lower than the state by 2035 (The Concept, 2024).

The concept of technological advancement is based on the establishment of domestic manufacturing facilities for the production of new sophisticated equipment and mobile devices, particularly in industries such as aviation, shipbuilding, railways, and transportation engineering.

It is evident that the necessity for implementing such projects, particularly in the fields of energy and transport engineering, is driven by a number of factors specific to Russia. Firstly, the geographical factor, namely the existence of a vast territory necessitates the establishment of a transportation mobility system as a crucial element of the nation's economic stability. Secondly, there is a need to support modes of transportation that have not been previously developed by Russian businesses, but which are essential for establishing new export routes, particularly for hydrocarbons. Thirdly, the technological aspect, which relates to the requirement for concurrent development of novel technologies as critical components of transportation mobility models. Due to the fact that the future technological development of Russia will occur without the transfer of Western technology, it becomes an important task to develop models of transport that are simultaneously aimed at developing critical technologies. A fourth consideration relates to the need for a balance between energy development and the transition to renewable energy sources. Significant progress has been made in the production of electric vehicles and the development of charging infrastructure. The creation of fuel cells that use hydrogen as a fuel has allowed for the development of the world's first 100% hydrogen train routes.

Taking into account the new institutional and organizational mechanisms laid down in the Concept of Technological Development of the Russian Federation, the production of electric vehicles, railway locomotives on hydrogen fuel cells and large-capacity vessels for LNG transportation must be considered as national-level projects aimed at creating a system of strategic transport mobility.

*Three national-level projects in Russia*

*1. EV production*

By the end of 2022, there were 50.6 million registered passenger cars in Russia, out of which, cars older than 10 years made up 50.9% of the total, cars between 5 and 10 years old accounted for 21.6%, and cars up to 5 years old made up 27.5%. At the same time, 96.6% of the entire car fleet could use only gasoline or diesel fuel. This is understandable, considering that the total number of EVs in Russia totalled 23 000 units and the number of hybrids equalled 138,500 units. In August 2021, the Government of the Russian Federation approved the "Concept for the Development of Production and Use of Electric Motor Transport in the Russian Federation until 2030", the provisions of which will be implemented in two phases, the first being from 2021 to 2024, and the second one from 2025 to 2030. By the end of the initial phase, it is projected that at least 25 000 EVs will be manufactured and 9 400 charging stations will be deployed across the country. By the year 2030, one in every ten cars produced will be electric, with an annual output of 220 000 units, and the number of electric fueling stations will increase to 72 000. In Russia, plans call for the launch of battery cell production by 2030 and the establishment of 1 000 hydrogen fueling stations for hydrogen fuel—driven vehicles by the same date. The departure of Western automakers from the Russian market has not led to a revision of these plans, but the disruption that occurred in the Russian market in 2022 has, to some extent, stimulated the development of EV manufacturing, which developments are still preliminary and uncertain though.

According to the review of the information available on the TAdviser business portal, approximately 10 companies and research institutes have currently announced their plans for the design and production of EVs in Russia. One initiative out of the 10 projects announced, has a high probability of being successfully implemented. A new series of atom electric cars is expected to be launched in the year 2025, featuring domestic high-tech software developed in Russia. These vehicles will be powered by lithium-ion batteries manufactured by Rosatom's subsidiary, Renera. Approximately 75 000 units of these electric vehicles are planned to be produced annually in various configurations. This project represents the first attempt by a Russian company to establish a production line for EVs. The current annual production of EVs of approximately 75 000 units It seems to fall far short of what would be required to significantly influence technological trends in the industry's development. Based on China's experiences, such trends may be considered to have occurred when EV sales approach one-quarter of the total market volume. Considering the Russian market as of 2021, with approximately 1.7 million vehicles sold, this number would equate to approximately 450 000 — 500 000 electric vehicles per year. Furthermore, it is essential to take into account the significant factor that EVs comprise approximately 15 000 components, which is half the number of components found in vehicles with internal combustion engines.

Considering the above, it is impossible to create a new competitive industry for the production of EVs that takes into account the requirements of a low-carbon economy without state participation. This is due to the specific historical, economic, and technological conditions in modern Russia. State involvement is necessary in the form of investment support to acquire the entire chain of technological equipment in three key areas:

1. Production of traction batteries for EVs;
2. Production of electric motors;
3. Production of assembly lines for electric vehicles.

A prerequisite for the implementation of the project is the presence of a foreign partner and the localization of all components and parts for 100% within five years. An essential component of the project will be the creation of a Russian ecosystem that supports the project, based on a network of local manufacturers with the ability not only to replicate and create new industries, but also with scientific and technical capabilities to address important issues such as lithium-ion battery disposal and the development of a comprehensive charging station infrastructure. As demonstrated by global experience, state involvement through economic incentives and support for R&D, production, and consumer demand can provide greater market stability and consumer demand formation.

*2. Production of large-capacity vessels for LNG transportation*

The second, strategically important element of the country's modern transport mobility system should be the production of large-capacity vessels for LNG (Liquefied Natural Gas) transportation in order to develop new export routes.

As one of the world's largest producers of natural gas, Russia has focused on exports through trunk pipelines. In the new geopolitical realities, Russia is forced to significantly transform export energy flows from the West to the East and South, where Russian oil and gas can be supplied mainly only by sea.

The creation of its own gas carrier fleet of 100-120 vessels is becoming a strategically important task aimed at increasing exports and ensuring high transport mobility in the cargo transportation segment. The special importance of this task is also associated with the unique logistical opportunities that the Northern Sea Route opens up as a new transport route. The solution to this problem will require not only the mobilization of the intellectual potential of domestic shipbuilding, expansion of production capacities, but also maximum use of the scientific and technical potential of the state corporation Rosatom. The main components of such a development model should be: (a) design and production of large-tonnage vessels at domestic shipyards, and (b) creation of technologies and organization of production of large-capacity cryogenic devices. The state should also provide for the creation of a system of economic incentives and measures to support R&D and production.

*3. Hydrogen Fuel Cell Locomotives*

Today, global hydrogen production is about 85 million tons, of which 48% is produced from gas, 30% from oil, 18% from coal and 4% from water electrolysis (IOGP, 2018).

In August 2022, the French company Alstom made an official announcement about the creation of the world's first hydrogen-powered train Coradia ILint. The first 14 trains are used on the world's only 100% hydrogen passenger train route in Bremerwдrd (Germany). American Wabtec, Canadian Pacific and Japanese East Japan Railway are also working on creating a similar train. This means that a new stage in the development of low-carbon transport has begun, already in the railway segment, which would not ensure transport mobility without new technologies for the electrolysis of renewable hydrogen.

Transport mobility in this segment of transportation can be ensured if three tasks are solved in parallel, namely, (a) materials and technologies for the production of industrial electrolyzers and efficient fuel cells are developed, (b) industrial prototypes of new hydrogen-powered locomotives are created, and (c) economic incentives and measures of state support for R&D and production are adopted.

**Conclusion**

In the context of ongoing geopolitical changes, technological development is becoming one of the decisive conditions for maintaining the economic and political sovereignty of states. A new redistribution of global energy markets is becoming a reality, and the technological race for new renewable energy sources has entered an active phase. In this regard, the stability of the Russian economy will be largely predetermined by its competitiveness not only in the segment of traditional, hydrocarbon energy sources, but also by the pace of industrial development of critical technologies. Since Russia has entered the stage of mobilization development of the scientific and technological sphere under the pressure of sanctions, the formation of technological development institutions should proceed in two directions, the maximum possible borrowing of technologies from friendly states, and the formation of leading areas based on domestic fundamental and applied scientific research.

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