

# Technological sovereignty in the Era of energy transition and implementation of ESG principles in regional industrial agenda

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**Abstract.** The world economy has entered an era of profound transformations associated with the fourth energy transition. The technological development of states should not only ensure technological sovereignty, but also comply with ESG standards. The purpose of article: based on the analysis of foreign and domestic scientific approaches to content of "technological sovereignty", to formulate the author's definition, as well as to identify some concepts of investment industrial policy that meets the principles of ESG. Based on the study of patent activity in Russia, it is concluded that there is a critical "compression" of innovation activity, which, in the conditions of unprecedented sanctions, threatens national sovereignty and actualizes the task of forming a new model of economy. A number of positions are reasoned and proposed, which it is advisable to include in the new Concept of technological development of Russia for the coming years. The concepts of the regional technological agenda aimed at enhancing innovation activity and particularly relevant for traditionally "old-industrial" regions in the context of the transition to a new technological order are identified. It is argued that the technological development of industry should be based on a solid institutional foundation, in which ESG principles should be implemented.

## 1 Introduction

A series of events in the recent years has shown that the world has changed. The beginning of tectonic shifts in the world economy and politics reflect the transition of civilization to a new formation. What are the signs of these changes? What are the signs of these changes? Let's define global trends and "big challenges": Industry 4.0; digitalization; ESG transformation; energy transition; climate agenda [1]. As S.D. Bodrunov notes: "New technological challenges ... make us think about the reindustrialization of Russia on the most advanced technological base" [2]. We are talking about the formation of a deep Concept that reflects national interests. Technological sovereignty should become a priority of state policy. At the beginning of 2023, the Government of the Russian Federation announced a draft The concept of technological development of the Russian Federation until 2030. The concept should outline the goals, objectives, principles, conditions and

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mechanisms for achieving technological sovereignty of the Russian Federation and targets for technological development. The new concept of technological development is being actively discussed by business community and science. Despite growing interest, it is difficult to find an unambiguous and exhaustive definition of the concept of "technological sovereignty" in modern research. Taking into account the above, the task is to comprehend content of category "technological sovereignty", to analyze innovation activity in Russia and, on this basis, to develop separate provisions that could be included in the updated Concept and State industrial policy at federal and regional levels.

## 2 Materials and methods

The study of technological sovereignty is based on theory of technological development, system analysis, theory of spatial economics and historical analysis. Applied general scientific methods (analysis, synthesis, deduction, logical approach, comparative analysis) and special economic methods of analysis (graphical method), as well as methods of qualitative and quantitative information collection. The sources of information in the study were data from reputable foreign research organizations, publications of foreign and domestic experts in the field of theory of technological development. The logic of the research provided for solution of a two-pronged task: firstly, definition of substantive characteristics of technological sovereignty in context of Western and Russian approaches in order to form the author's definition; secondly, analysis of innovation activity in Russia, which will allow to substantiate strategic attitudes and conceptual provisions that can be included in the Concept and regional agenda for achieving technological sovereignty.

At the St. Petersburg Economic Forum in 2022, Russian President Vladimir Putin outlined the key principle of forming a new economic model: "achieving true technological sovereignty, creating an integral system of economic development that does not depend on foreign institutions for critical components" [3]. In the draft Concept of Technological Development for the period up to 2030, technological sovereignty is defined as "presence in a country (under national control) of critical and end-to-end technologies of its own development lines and production conditions based on them, providing a sustainable opportunity for the state and society to achieve their own national development goals and realize national interests. Technological sovereignty is ensured in two main forms: research, development and implementation of critical and end-to-end technologies (according to the established list); production of high-tech products based on these technologies" [4]. The above definition does not reflect full breadth and depth of meanings invested in concept of technological sovereignty, and requires a deeper study.

The first foreign official mention of term "technological sovereignty" dates back to 1967, when the Scientific Council of Canada, within framework of determining the strategy for development of state and maintaining national independence against an international background, proposed the following main components as its content [5]:

- 1) development tool;
- 2) a way to control technologies;
- 3) a means of maintaining national sovereignty.

Then there were rare attempts to adapt this term to the specific requirements of time and place, among which only the following deserve attention [6]:

- 1) the European interpretation of 1983, in which technological sovereignty was considered as "technologies necessary for industrial innovation";

- 2) the American version of the concept, dated 1989, interprets technological sovereignty as "... technologies that are essential for ensuring the long-term national security and economic prosperity of the United States.

At the beginning of the XXI century, countries, institutions and researchers began to become more actively involved in attempts to interpret this complex term, which was due to both development of economy and desire to avoid "technological localization", meaning inability to self-sufficiency, as well as corresponding dependence on other states, primarily China, India, the USA. The following are distinguished as substantive characteristics of technological sovereignty:

- independence, control and autonomy of collective communities in terms of developing technologies that ensure sustainability and competitiveness, but also the security of confidential data [5];

- characterizes level of technology protection in contracts [7];

- defines global economic and geopolitical influence [8];

- provides defense, network security, protection of critical infrastructure [7];

- include critical technologies in areas of vaccine development, 5G technology infrastructure and artificial intelligence [9];

- characterizes « the ability of a state or a federation of states to provide the technologies it deems critical for its welfare, competitiveness, and ability to act, and to be able to develop these or source them from other economic areas without one-sided structural dependency» [9];

- is a condition to sovereignty as a principle of international law and it is a key to other types of sovereignty (economic, agriculture, science, innovation) [10].

This concept varies from political to social, as technologies, including artificial intelligence technologies, affect all actors and spheres of activity [11].

Technological sovereignty, being a complex scientific category, characterizes various aspects and conditions of the state economy. It is not only multinational corporations whose ultimate goal is profit that are chasing technology. States are competing for technological sovereignty to ensure peace and security. In the European Union, technological sovereignty has become central theme of industrial policy in relation to six key enabling technologies (KETs): advanced manufacturing, life-science technologies, micro/nano-electronics and photonics, artificial intelligence, and security and connectivity technologies [12]. The priority of the EU's industrial policy is technological competition with China. The United States of America is also concerned that «China has the capability to directly attempt to alter the rules-based global order in every realm and across multiple regions, as a near-peer competitor that is increasingly pushing to change global norms» [13]. In March 2023, the Chinese authorities announced large-scale measures to develop the field of research and development. In conditions of fierce international competition for breakthrough scientific results, advanced technologies, qualified personnel, the leadership of China considers it critical to expand areas of cooperation, preserve existing advantages and rely on their own strength [14]. The US and China are the largest economic powers and "view the European market as a decisive battleground in the broader struggle to establish their global technological and industrial dominance." [15]. In turn, the India is solving the task of forming a strategy "that will allow it to break out of the technological hegemony of the West and China." [15]. At the same time, it should be noted that there is still no single name for technological sovereignty at the international level, since neither it nor its digital counterpart have been included in the Glossary of terms the Charter of the United Nations [16]. Such isolation predetermined both multiplicity of interpretations and corresponding national disunity of content components.

**Table 1.** Interpretation of the term "technological sovereignty" abroad.

Source	Content components				
	Ability to dispose of critical technologies	The ability to develop or obtain new technologies without unilateral dependence on other states	The impossibility of extracting disproportionate economic benefits from the possession of any exceptional technologies	Technologies related to defense and national	Part of the overall strategy of China's independence, focused on domestic demand, compared with external, focused on foreign markets and external resources
Fraunhofer Institute for System Innovation Research (Europe, Germany) [17]	+	+			
SPMRF Research Foundation (India) [18]			+		
National Institute of Digital Autonomy (USA) [19]				+	
Political Bureau of the Communist Party of China (China) [20]					+

As follows from the table, it is legitimate to distinguish three different approaches to the interpretation of the term "technological sovereignty" in foreign sources:

- 1) political, indicating that it belongs to the original definition of "state sovereignty" - this approach is especially clearly seen in the Chinese version of the interpretation;
- 2) technological – assuming as a priority – the component of technical and technological independence – for example, European and Indian interpretations;
- 3) security – characterizing technological sovereignty as the basis of defense capability (USA).

The positions of Russian researchers can be summarized in the following aspects:

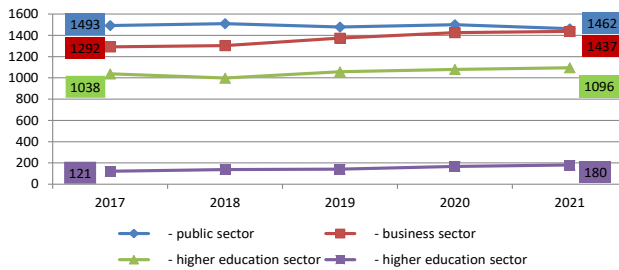
- the current level of scientific and technological development, which forms the prerequisites for the unhindered realization of national technological interests in the conditions of existing and future threats [21];
- personnel, financial, legal, information security of innovative scientific and technical developments to accelerate their effective implementation; availability of specialized programs for the formation of technological sovereignty in all spheres of life, including through end-to-end digitalization [22];
- the most important characteristic and function of the national security system, reflecting the inextricable link with the "functioning of the national security system, in particular the scientific and technological component" [23, 24];
- "satisfaction of present and future needs in maintaining a certain level of technological development mainly at the expense of Russian R&D with mandatory specification of ownership rights to developments" [25].

Most authors view technological sovereignty as a component of national and political sovereignty, which is difficult to disagree with [26-29]. However, it seems to us that the above-mentioned approaches need to be rationally combined, since technological sovereignty is based on and covers both security issues and technical, technological and other independence at the state and international levels. According to the authors, technological sovereignty is a component of state sovereignty that ensures the unhindered implementation of the entire complex of national interests and development goals, provides basic current and future needs for critical and end-to-end technologies, guarantees of

information, energy, transport and other types of security throughout the country on the basis of harmonious interaction of the state, society, science.

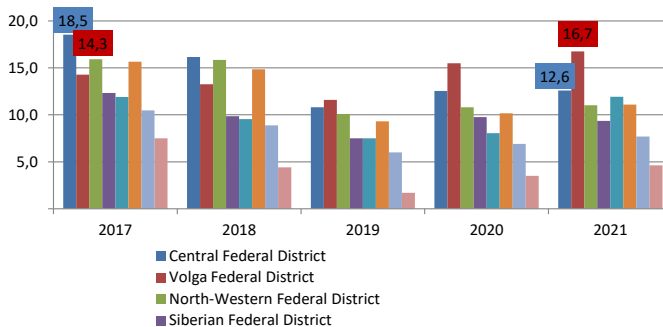
### 3 Results

Since the beginning of market reforms, Russia has been undergoing an aggressive transformation, which has led to the destruction of coordinating and public institutions, increased imbalances of intersectoral ties and "failures" of the market; the formation of insurmountable "innovation gaps" (institutional, sectoral, social, regional, transformational, investment, temporary). In 2023, the country entered conditions of unprecedented geopolitical tension, sanctions, isolation of banking sector, disruption of supply chains for a wide range of technological import positions. The question arises as to how own innovative developments can ensure the competitiveness of the national industry. The analysis of state statistics data for 2017-2021 allows us to draw conclusions about the innovative potential of Russia, including in the context of federal districts.



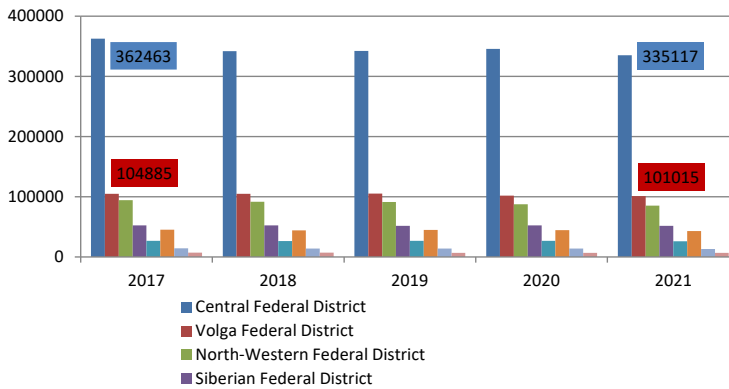
**Fig. 1.** The number of organizations that have carried out R&D by sector of activity (2017-2021).

When analyzing the indicators for 2017-2021 in the Russia, we observe a slight increase or a "compression" in indicators of innovation activity. Over the period from 2017 to 2021, the total number of organizations that carried out research and development (R&D) in Russia increased from 3944 to 4175. The growth was only 5.8%. In the public sector, there was a decrease of 2.08%; growth was provided by the business sector (11.22%), the higher education sector (5.6%) and the non-profit organizations sector (48.8%).



**Fig. 2.** The level of innovation activity of organizations (by federal districts), %.

In most cases, in all federal districts, we observe a decrease in the innovative activity of organizations. The Central Federal District has traditionally been a leader in terms of innovative development. However, the number of organizations engaged in research and development decreased from 18.5% to 12.6%. A noticeable increase in the number of organizations conducting research and development (from 14.3 to 16.7%) was observed only in the Volga Federal District. The number of personnel engaged in research and development decreased in all regions during the analyzed period.



**Fig. 3.** The number of personnel engaged in research, total (people).

The largest number of people employed in research and development in the Central Federal District, which historically occupies a special position in the innovative, scientific and technological development of the state economy. However, comparing the values of the indicators of 2017 and 2021, we see a decrease of more than 7.5%.

In almost all indicators (applications for patents for inventions and utility models were filed, patents for inventions and utility models were issued, coefficients of inventive activity), the "compression" of activity was over 10%. A slight increase in inventive activity in the Siberian and Ural Federal Districts. The results of the analysis demonstrate disproportions and stable negative trends of innovative development.

**Table 2.** Change in patent activity by federal districts (2021 to 2017, %).

Federal districts	Applications for issuance of patents for inventions have been filed	Patents for inventions have been issued	Applications for utility model patents have been filed	Patents for utility models have been issued	Coefficient of inventive activity excluding utility models	Coefficient of inventive activity taking into account utility models
Central FD	75.35	68.93	90.45	82.14	75.17	79.29
Volga FD	93.33	69.57	91.96	83.78	95.87	94.74
North-Western FD	101.11	95.48	75.58	74.63	100.65	90.49
Siberian FD	104.64	69.60	95.67	88.43	119.15	115.33
Southern FD	89.83	61.51	72.13	76.24	89.36	83.57
Ural FD	108.37	77.35	88.64	76.37	108.43	100.71
Far Eastern FD	98.47	71.15	91.86	54.34	80.00	73.53
North Caucasus FD	67.71	63.68	73.33	69.89	66.15	67.09
Average value by federal districts	85.69	71.31	87.28	80.35	89.43	88.40

Source: Compiled according to [30]

The results of the analysis demonstrate disproportions and stable negative trends of innovative development. The reasons for decline in innovation activity are various: high risks of introducing latest technologies into existing business processes; weak development of venture capital investment market; outflow of qualified engineering personnel. The reduction of access to Western high-tech developments is taking place in conditions of increasing "big challenges": increased climate risks, energy transition, ESG transformation, etc. Against background of rapid climate change and energy transition, drastic changes are taking place in production systems and in key markets, reflecting the innovative development of industry in developed countries based on latest technologies and their ability to adapt to global trends.

Important institutions that are directly related to formation of technological sovereignty are national projects, federal and departmental programs. In particular, the project "FastTrack for investments in the regions (support system for medium-sized investment projects)". ESG criteria can be a decisive argument for potential investors when making investment decisions.

**Table 3.** ESG criteria in "Fast Track" for investments in regions.

<b>FastTrac-position</b>	<b>ESG criteria (author's proposals)</b>
Investment declaration of the subject of the Russian Federation	It is advisable to additionally include: <ul style="list-style-type: none"> <li>– a declaration of commitment to ESG principles, support and promotion of "responsible", "green" and "sustainable" investment;</li> <li>– a list of economic entities from the list of "300" of the Ministry of Natural Resources of the Russian Federation, operating on territory of the subject of Federation, which should begin to pursue an ESG transformation policy.</li> </ul>
Investment map of the subjects of the Russian Federation	It should contain information about: polluting enterprises from the list of "300" of the Ministry of Natural Resources of the Russian Federation, which require investments to implement best available technologies; about the problems of ecological and economic security of region and long-term plans to solve these problems through the implementation of investment projects in region.
Set of investment rules	Along with determining the optimal algorithm of investor actions ("client path"), it should contain the requirements of ESG criteria for specific industries and spheres.
Investment Committee of the region. Investment Development Agency of region.	It is advisable: <ul style="list-style-type: none"> <li>– regulatory documents should indicate the mandatory participation of these structures in organizing, ensuring the development and financing of large projects aimed at developing the economies of territories in accordance with ESG criteria, including on the principles of public-private partnership;</li> <li>– members of these structures on a permanent or associate basis should include persons who are able to give a qualified assessment of regional investment projects for their compliance with ESG criteria.</li> </ul>

Source: Compiled according to [31]

## 4 Conclusions

As a result of the theoretical analysis of foreign and domestic scientific approaches to the content of "technological sovereignty", its unambiguous relationship with national sovereignty has been revealed. The new Concept of Russia's technological development should correspond to global attitudes of civilizational development, have a strategic orientation and an organic link with national security. Firstly, technological developments must meet the requirements of energy efficiency and energy conservation. Special attention should be paid to power engineering. Secondly, the directions of scientific and technological progress in Russia should correspond to the Goals of Sustainable Development. To increase investment attractiveness of regions, it is necessary to implement ESG criteria in activities of industrial enterprises and regional institutions. Thirdly, in order

to increase the competitiveness of Russian industry, an influx of engineering personnel is necessary, which implies, first of all, a multiple increase in wages. The authority of national engineering thought should be formed in society, demonstrating contribution of Russian scientists to world science.

The formation of technological sovereignty requires not only scientific research and development and further production of high-tech products based on key enabling technologies. Equally important is the technological support for reducing energy intensity and improving the environmental friendliness and energy efficiency of production systems.

With regard to the regional agenda, there should be recognition of the fact of correction of the previous regional proportions and changes in the specialization of the regions, opening up opportunities for the development of new technological centers of innovative growth.

The conducted research allowed us to draw a number of conclusions.

1. In the face of unprecedented sanctions and the escalation of "big challenges" into "challenges of technological development," the previous strategic guidelines have become seriously outdated.

2. Overcoming the challenges of technological development is a critical condition for ensuring Russia's technological sovereignty.

3. Achieving goal of technological development, along with ensuring technological sovereignty, should be complemented by requirements of improving the energy efficiency of technologies, industries and the entire national economy.

4. For the regions that are the basis of scientific and technological country, it is necessary to determine the "poles of growth", mechanisms and tools that contribute to accelerating the processes of formation of technological sovereignty.

The provisions of study can be included in the Concept of Technological Development of the Russian Federation until 2030.

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