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Product Niches of the Region's Chemical Complex: Potential, Barriers, and Macroeconomic Effects

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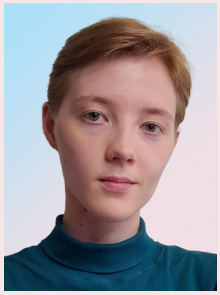

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Abstract. The global economy is undergoing a period of transformation, which is characterized by a deep recession, increased market volatility, instability of the financial system, a slowdown in the formation of new transnational production chains, and a decrease in investment flows. The technological foundation of economic activity is changing, and new sectors are emerging. For the Russian Federation, the harsh sanctions imposed by Western countries after the start of the special military operation in Ukraine are an additional deterrent to development. In conditions of external constraints and uncertainty, the issue of finding ways to develop domestic industry and organize new production facilities, taking into account national priorities, is acute. The latter include the structural transformation of the economy and an increase in its technological efficiency. It is important in this context to study the issue of identifying promising types of economic activity and areas for completing regional value chains in key areas of the national economy, one of which is the chemical industry. The purpose of the study is to identify and scientifically substantiate strategic niches for the development of the chemical complex in the region. Research objectives: to analyze the region's potential for the development of the chemical industry, identify product niches of specialization, identify barriers to their implementation and assess the effects of the development of selected areas. The Vologda Region was chosen as the object of research. The information base of the study consists of data from the Federal State Statistics Service and its territorial division in the Vologda Region, the Federal Agency for Subsoil Use, industry rating agencies, input-output tables of the Vologda Region for 2020, and information on companies' investment plans. An analysis of the potential showed that the Vologda Region has its own resources for the production of forest chemical products, and logistical capabilities allow organizing other chemical production using imported raw materials. However, the production and technological potential of the industry's enterprises is limited by capacity utilization and significant depreciation of fixed assets, and the innovative potential is not sufficiently developed. The strategic priorities of the regional chemical complex have been identified, including the production of fertilizers, composites and new materials. Potential niches of specialization are substantiated, such as the production of polymer-metal composites, polymers for additive technologies, phosphogypsum building materials and forest chemicals. The multiplicative effect of the impact on the gross regional product of the production development of the identified niches is calculated. The technological, economic, industrial and environmental barriers that hinder the implementation of the proposed priority areas are highlighted. The scientific novelty of the study lies in identifying niches of promising specialization for the Vologda Region chemical complex. The results of the study can be used by regional authorities to substantiate strategic directions of economic policy.

Key words: structural transformation, chemical complex, promising specialization, strategic niches, region.

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Introduction

The effects of the transformation of the global economy, the harsh anti-Russian sanctions imposed by Western countries after the start of a special military operation in Ukraine in 2022 were disruption of supply chains, restrictions on exports of goods to traditional markets, the departure of foreign companies, etc. These circumstances required manufacturers to take measures to adapt to the new market realities by transforming production chains, changing the structure of their products, and restructuring trade and logistics relationships. However, the problems outlined above are compounded by the export-oriented economic development model formed in the country, in which low-value-added products predominate (Porfir'ev et al., 2024). As a result, combined with tight monetary policy, which leads to a decrease in investment and business activity, the growth rate of the economy has slowed down.

The current situation is increasingly pressing the issue of finding sources of economic growth, primarily based on the development of industry, the organization of new industries, taking into account the needs of import substitution, the activation of the domestic market and the achievement of technological sovereignty. This is consistent with the strategic plans of the state, one of the key directions of which is the structural transformation of the economy, its transfer to a new technological basis. According to the Plan of Structural Changes in the Russian Economy until 2030[1], national priorities include increasing the level of technological development of the economy and achieving technological independence in key areas, among which the chemical industry occupies a special place, primarily the manufacture of new materials. At the same time, strategic documents set general development vectors, identify economic policy priorities represented by large industries, which actualizes the task of detailing promising economic activities to specific product niches.

It is important to study the issue related to the identification of promising types of economic activity and areas of completion of value chains through the formation of new industries at the regional level. The aim of the study is to identify and scientifically substantiate strategic niches for the development of the chemical complex in the region. As the object of research, we chose the Vologda Region, which has material, technological and financial potential, as well as undisclosed reserves for the modernization of chemical industries. It is important to solve the following tasks as part of the research objective:

– to conduct a comprehensive analysis of the Vologda Region's potential for the development of the chemical industry;

– to identify priority product niches of specialization;

– to identify key barriers to the implementation of the identified niches and assess the expected economic impact of the development of the selected areas.

Theoretical background of the research

In the context of the development of the national and regional economy, the issue of its structural and technological transformation has received wide discourse (Porfir'ev et al., 2024). Through the restructuring of the economy, its long-term growth is achieved, a new spatial structure is formed, and the added value produced increases (Mikheeva, 2024).

One of the key directions of the structural transformation of the economy is the development of value chains. Their contribution to the formation of economic dynamics, the relationship between involvement in the global economy and the development of the national economy is studied (Sayapova, Shirov, 2025). Experts pay special

[1] Plan of structural changes in the Russian economy until 2030 (approved by the minutes of the meeting of the Government of the Russian Federation 41, dated November 27, 2025).

attention to regional chains, their completion, and the possibilities of integrating enterprises into interregional and national chains (Lukin, 2025). In this context, the tools of input–output modeling have found wide application. It allows assessing the consequences of the implementation of structural policy, the dynamics of socio-economic development of the region (Ivanter, 2018), the involvement of the regional economy in the processes of the international division of labor. Researchers are developing statistical and dynamic models (Kurz, Salvadori, 2000), including those involving a block of investments (Sayapova, Shirov, 2019).

Researchers pay special attention to regional cross-industry models based on input–output tables. They are being developed in the USA (Boero et al., 2006), Brazil (Dietzenbacher et al., 2012), China (Jiang, 2011) and other countries. Similar studies are presented in Russia. One of the first models based on the System of National Accounts (SNA) was the Republic of Bashkortostan (Nigmatulin et al., 2006). Other examples are the Republic of Buryatia (Dondokov et al., 2014), the Kaliningrad Region, the Republic of Sakha, etc. A number of input–output tables, not only regional, but national, were proposed by specialists from the Institute of Economics and Industrial Engineering, Siberian Branch of the Russian Academy of Sciences and the Institute of Economic Forecasting of the Russian Academy of Sciences. They include inter-regional optimization, forecasting and analytical model complexes that allow coordinating macroeconomic and sectoral indicators, predicting the state of the economy in the medium and long term, etc. (Suslov, Suspitsyn, 2005; Suvorov, Balashova, 2009).

The use of input-output modeling makes it possible to determine the multiplicative effects of the development of economic sectors and the implementation of investment projects. The most significant are production and investment multipliers. The mechanism of the multiplier effect formation consists in initiating a change in the volume of final output or investment, which leads to an increase in production in related sectors and the economy as a whole, the formation of additional income and its redistribution in final demand. The calculations are based on the input–output tables (Suvorov et al., 2005), followed by the calculation of changes in value added across economic sectors. It is worth noting that the multiplier effect is influenced by transformations in the structure of the economy, which require adjustments to the cost coefficient matrix, as well as the structure of demand (Sayapova, Shirov, 2019).

Research involving input–output is also being conducted for the Vologda Region (Ilyin et al., 2021). The author's team from the Vologda Research Center of the Russian Academy of Sciences concluded that the region is deeply integrated into national and global value chains, but at the same time, the region's position in the Russian supply chains is deteriorating. The distance from the last links of the chain and from the final consumer, associated with an increase in the supply of intermediate goods, is cited as a factor constraining the development of the Vologda Region. The result is a decrease in resource efficiency, a reduction in income generation opportunities and an increase in added value.

Thus, the priority areas for the development of the regional economy should be to increase the degree of processing of domestic and imported resources, eliminate "gaps" and lengthen of value chains. The results will be an increase in the incomes of economic agents, increased domestic consumption, increased demand for innovation, expansion of capacity and qualitative transformation of the engineering, educational, transport and financial services market (Nikitenko, Goosen, 2017; Lukin, 2023). At the same time, it is worth noting that there is a need to localize high-income CSR units in the region (Pilyasov, 2018).

For the transformation of production and distribution chains and, as a result, the implementation of structural changes in the economy, it is necessary to determine the current and future economic specialization of the region (Lukin, 2023). The basic sectors for the formation of promising specialization and modernization of the Vologda Region economy are agro-industrial and timber complexes, metalworking and mechanical engineering, as well as the chemical complex. They have a certain industrial, scientific, technological and innovative reserve for the development of national value chains (Lukin, 2025).

The chemical complex is one of the leading sectors of the heavy industry. It contributes not only to the development of productive forces, but also to strengthening the state's defense capability and ensuring the vital needs of society (Malyshev, Pechenskaya-Polishchuk, 2024). Its distinctive feature is its connection with many industries, since most segments of the national economy are consumers of its products.

The chemical industry is described as a driver of economic growth in the country and the region (Shirokova, 2021), with the potential to become the flagship of the Russian industry (Malsagov, 2022). In particular, the market of mineral fertilizers is considered to be one of the most promising markets in terms of development in the near future (Malyshev, 2024). This is due to the fact that this industry ensures food security not only for the country, but also for the whole world, since Russia is one of the largest suppliers of fertilizers (Bogachev, Dorofeeva, 2022).

The issue of the specifics of the functioning of the chemical complex under the conditions of sanctions has received wide discourse in the scientific community. They led to an increase in prices for the industry's products, especially for ammonia and fertilizers, disruption of logistics supply chains, a decrease in exports and imports, a decrease in the availability of investments, etc. (Ashinova et al., 2022; Smagulova, Fetisova, 2023). Due to the sanctions blocking access to foreign equipment, technologies and components, the problem of import substitution has become more acute for some chemical industries. Researchers note that the development of the chemical complex is hindered by an insufficiently favorable business climate in the industry, lack of transparency in the distribution of government subsidies for production, as well as high bureaucratic barriers when applying for subsidies or grants (Provorova, Zhemerikin, 2020). Scientists at the Oryol State Agrarian University named after N.V. Parakhin emphasize the need to improve the material and technical base and government support measures for the industry, in particular chemical fertilizers, the production of which has been particularly affected by sanctions (Bogachev, Dorofeeva, 2022).

The publications of the Vologda Research Center of RAS examine large chemical industry corporations. Aspects such as the formation of financial results (Malyshev, 2024), production indicators and their analysis (Kopytova, 2017) are being studied. The research block is devoted to assessing the financial interaction of enterprises with the state, their role in generating revenues for the budget system (Malyshev, 2023). The trends of export-import relations (Malyshev, Pechenskaya-Polishchuk, 2024), environmental protection activities of large Russian producers of mineral fertilizers (Malyshev, 2025), and the impact on the development of regional economies (Razgulina, Barabanov, 2014; Razgulina, 2015) are studied.

A number of studies have identified promising specializations in the Vologda Region, including in the chemical complex. For example, the production of basic chemicals is named among such industries (Rumyantsev, 2023). The identification of promising specializations is based on the author's methodology, which is based on an integral score composed of assessments of the following components of

the industry's functioning: its efficiency, market potential, innovation activity and patent security. The export priorities of the Vologda Region are determined based on the calculation of the index of revealed comparative advantages (Balassa, 1965) within the framework of the concept of economic complexity (Hausmann, Klinger, 2006; Hidalgo, et al., 2007). These include nitrogen and complex chemical fertilizers (Cheplinskite, Lukin, 2024). The centers of regional specialization of the Vologda Region have also been identified. They represent potential clusters of sectoral development, the most significant of which for the region is the cluster uniting the metallurgical and chemical industries. In the latter, the main chemical production and the manufacture of rubber and plastic products are identified as promising industries (Danilova et al., 2021).

Thus, the chemical complex is characterized by a number of problems, the solution of which is possible through the search and development of new industries in the region. Different methods are used to identify them, but in the presented works, the proposed industries focus on the main chemical industries, the manufacture of rubber and plastic products, and less often fertilizers. It is necessary to form methodological tools aimed at finding and substantiating narrower niches of specialization.

Materials and methods

This study uses an approach to the selection of specialization niches developed with the participation of the authors (Glazyev et al., 2025). It determines the prospects of a niche based on compliance with a number of selected criteria.

1. Compliance with global macro-trends in the industry: economic, social, and demographic. For example, an increase in the rate of urbanization leads to an increase in the production of packaging materials from polymer products. As a result of the substitution of traditional materials with polymer ones, it becomes necessary to increase the production of the latter.

2. The presence of a fast-growing product market: the growth of a promising niche is assessed through the study of analytical reports from various industry agencies, such as mordorintelligence.com, precedenceresearch.com and others.

3. Compliance with global technological trends. They are met by products that are required to implement global trends, including cross-industry ones (for example, digitalization, robotics, etc.), or are an innovative industry product.

4. Compliance with the strategic plans of the state, determined on the basis of an analysis of the sectoral development strategy and other documents indicating which products and technologies the state plans to develop.

5. The need for import substitution.

6. Availability of the region's raw material base.

7. Availability of existing production facilities, determined based on their search for both large product groups and technologically similar products.

8. Availability of energy resources.

9. Availability of logistical opportunities for the production and sale of finished products.

10. Compliance with the plans of major players in the industry. It is based on an analysis of reports and strategic plans of companies of major players in the industry, primarily PhosAgro enterprises.

11. Availability of technological competence centers. It is conducted through the database of the TC NTI centers, and a university or an enterprise with a similar unit can also act as such a center[2].

12. Availability of training opportunities in the region, based on the assessment of educational programs of higher and secondary educational institutions of the region.

13. Lack of competitive industries in the country. The analysis according to this criterion includes an assessment of the availability of analog production

[2] NTI competence centers. National Technology Initiative Foundation. Available at: https://nti.fund/support/centers/ (accessed: 02.02.2026).

facilities in the country through a search on special sites, for example, "Sdelano u nas" (Products of our own production). Products with pronounced competitive advantages also meet this criterion.

The assessment of the macroeconomic effects of the development of promising niches in the region is based on an approach using the input–output methodology (Miller, Blair, 2009) and the theory of production multipliers (Ksenofontov et al., 2018).

It is necessary to apply an input–output approach based on input–output tables (input–output balances) to quantify these effects. The methodology is based on V.V. Leontiev's static model, which makes it possible to calculate the multipliers of output, gross value added (GVA), investment and employment.

The regionalized symmetrical input–output table of the Vologda Region (the base is 2020) was used for calculations in the context of 35 enlarged industries. The matrix of intermediate consumption, the vectors of gross output and final demand (adjusted for imports and inter-regional trade) were calculated based on the SNA data for the Vologda Region. The shares of value added, taxes, and wages in the output of industries are from the third quadrant of the input–output balance.

The calculation algorithm is as follows.

A matrix of direct cost coefficients is constructed $A = [a_{ij}]$:

$$a_{ij} = Z_{ij} / X_j,$$

where a_{ij} – the coefficient of direct material costs, which shows how much output of industry *i* is needed to produce a unit of gross output of industry *j*;

Z_{ij} – costs of industry *i* products in sector j;

X_j – gross output of the industry *j*.

The total cost matrix (Leontiev matrix) is calculated:

$$B = (E - A)^{-1},$$

where E – the identity matrix.

The element b_{ij} shows how many rubles the output of industry *i* will increase with an increase in the final demand for products of industry *j* by 1 ruble.

3. For Chemical Industry, column *B* of the matrix is used to calculate multipliers:

– the total effect of the release is equal to the sum of the elements of column *j* (chemical production);

– the indirect effect is equal to the full effect minus the direct effect;

– the induced effect is estimated separately through the re-expenditure of income (wages, taxes, profits) using the elasticity coefficients of household consumption and budget expenditures.

Within the framework of this study, a scenario modeling of the production and resource potential of the Vologda Region has been carried out, which is changing as a result of the development of the proposed specialization niches in the chemical complex. The full multiplicative effect of the Vologda Region GRP is considered. Its calculation is performed by multiplying the cost volumes of the chemical complex by production multipliers. The latter are calculated based on data from the regionalized input–output table for the Vologda Region for 2020.

The forecasting of the output of the chemical complex as a whole until 2030 and for the future until 2040 was carried out within the framework of two scenarios: inertial and target. Within the framework of the first, the retrospective trends of 2017–2023 were extrapolated, while the second was based on the target levels of industry output approved in national development plans, taking into account existing restrictions on production capacity.

Within the framework of the inertial scenario, the stagnating dynamics of the region's economy and an increase in the production of low-value-added products are being laid. The growth in the chemical complex is provided by the export

of fertilizers, but the emerging growth rates are insufficient to become a key driver of the economy. The calculations were based on the volume of products shipped at comparable prices in 20203.

The target scenario implies the dynamic development of the economy in the context of an investment breakthrough, where growth rates reach 15–20% per year, the formation of the core of a new technological structure and the achievement of national development goals. The growth rates of production of fertilizers, rubber and plastic products, as well as other chemical products correspond to those laid down in the innovative scenario for the development of the Russian chemical complex (according to the Strategy for the Development of the Chemical and Petrochemical Complex for the period up to 2030).

The model is based on the basic equation of the input–output balance, the equation was used in the modeling:

$$(E - A)^{-1} * Y = X,$$

where E – the identity matrix;

$(E - A)^{-1}$ –matrix of total cost coefficients.

Based on the obtained matrix dependence, it is possible to calculate what the volume of sales of X in all sectors of the economy should be if it is planned to change the end use of Y, i.e. the full costs are calculated.

Based on the data from the table of use of goods and services, the direct cost matrix is calculated. For this purpose, the share of direct costs F_{ij} in the volume of output X_j is determined:

$$a_{ij} = F_{ij} / X_j.$$

Next, the total cost matrix $B = (E - A)^{-1}$ is calculated. The element b_{ij} of the matrix B characterizes the need for the gross output of industry i, which is necessary to obtain a unit of the final product of industry j in the process of material production. The total cost matrix B multiplied by the planned end-use vector Y equals the gross output of all industries X:

$$x_i = f(y_1, y_2, y_3 \ldots, y_n) = \sum_{j=1}^{n} b_{ij} y_j.$$

The execution of this algorithm allows obtaining the vector X (gross output) for each industry. However, to predict the dynamics of end-use items, it will be necessary to calculate the values of the Y vector, which includes components such as household consumption, investment, exports, etc.

To calculate the rate of change of individual elements y_j of the end-use vector Y, the formula is used:

$$y_j = fc_j * w_j^{fc} + ga_j * w_j^{ga} + ge_j * w_j^{ge},$$

where fc_j – dynamics of final consumption;

ga_j – dynamics of gross accumulation;

ge_j – dynamics of net exports;

w_j^{fc}, w_j^{ga}, w_j^{ge} – share of relevant elements in the end-use structure.

This decomposition is applied due to the fact that individual elements of end-use can be predicted more accurately using indirect statistics: for example, changes in population and income levels for end-use, dynamics of investments in fixed assets for gross accumulation, demand for key goods and price changes for net exports (Rumyantsev, Lukin, 2024).

Within the framework of the study, the shares in the end-use structure were averaged based on retrospective dynamics (forecasting structural proportions is considered as the development of the model complex and the research area as a whole), while the dynamics of indicators in the industry context is an exogenous variable of the model and is calculated taking into account retrospect and expert assessments.

[3] A more detailed description of the scenarios is presented in (Glazyev et al., 2025).

The limitation of the study consists in evaluating the multiplicative effects without detailed financial modeling of each niche of specialization, as well as performing calculations based on data for 2020.

The information base of the study included data from industry rating agencies, the Federal State Statistics Service and its territorial division in the Vologda Region, the Federal Agency for Subsoil Use, the input–output tables of the Vologda Region for 2020, as well as information on investment plans of companies and strategic acts of the state.

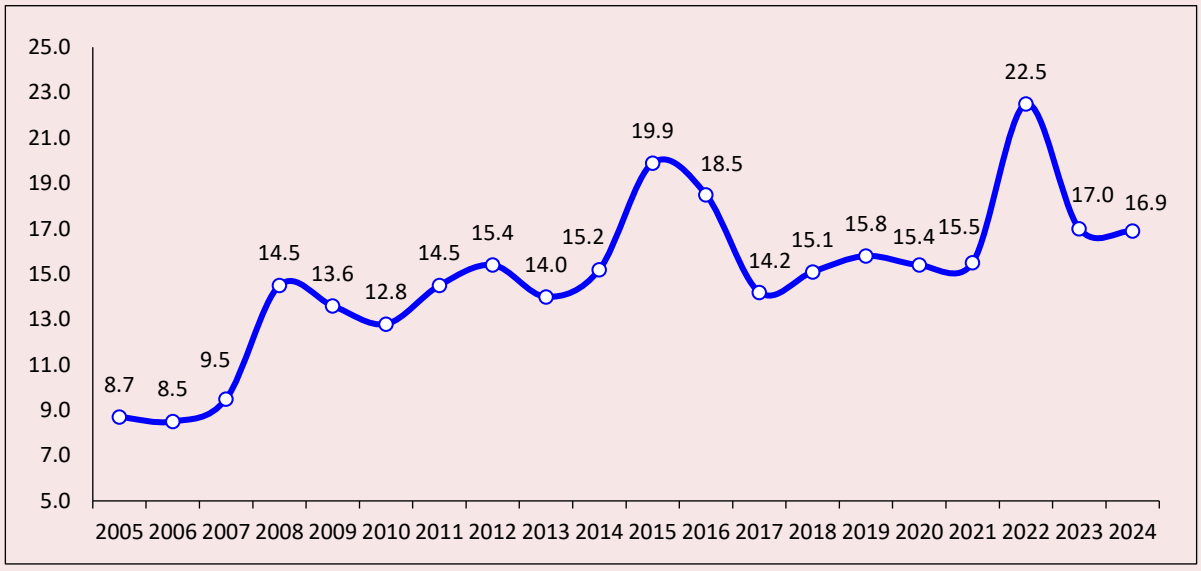
Analysis of the potential for the development of the chemical industry

The chemical industry is the most important branch of the Vologda Region economy. Its share in the total volume of shipped products in the region in 2024 was 16.9%. Compared to 2019, it increased by 1.1 percentage points, and has almost doubled over the past twenty years (*Fig. 1*). The industry's contribution to the region's tax revenues is also very high. Thus, by the end of 2023, the taxes of industry enterprises in the total tax revenues of the region amounted to almost 9%.

The main products of the chemical industry in the region are phosphorus-containing mineral fertilizers produced by PJSC PhosAgro. The raw materials for them are apatite-nepheline ores extracted from the Khibinsky deposit in the Murmansk Region. The mining and processing plant of JSC Apatit produces apatite concentrate, which is then supplied to the Vologda Region4. In other words, the phosphorus-containing raw materials are located outside the region, but the developed infrastructure and logistics links have made it possible to establish a "raw materials – processing" scheme.

The Vologda Region has reserves of minerals such as fluxed limestones, peat, building materials, expanded clay and pottery clays, etc. (*Tab. 1*). Their main consumers are construction and metallurgical

Figure 1. Share of the chemical industry in the total volume of shipped products in the Vologda Region in 2005–2024, % of the total



Source: own compilation based on Rosstat data.

[4] Kirov branch of JSC Apatit. PhosAgro. Available at: https://www.phosagro.ru/about/holding_kirovsk/ (accessed: 04.02.2026).

Table 1. Mineral reserves of the Vologda Region

Group and type of mineral	Units of measurement	Stocks	% of reserves in the federal district	% of reserves in Russia
Solid combustible fuels				
Peat	Thousand tons	3127781	39.7	16.8
Building materials				
Construction sands (man-made)	Thousand m^3	122727	6.6	
Brick and tile raw materials	Thousand m^3	52779	11	0.9
Other minerals				
Mineral paints	Thousand tons	138,7	3.6	0.4
Carbonate rocks for lime firing	Thousand tons	52125	14	1.9
Carbonate rocks for chemical soil reclamation	Thousand m^3	12768	25.7	3.6
Expanded clay materials	Thousand tons	5663	7.5	0.4
Source: data from the Federal Agency for Subsoil Use.				

industries, but a number of resources can also be used in chemical production. For example, by chemical processing of peat, components of the feed mass can be produced for the needs of agriculture.

Oil, associated gas and natural gas are definitely important sources of raw materials for the chemical industry. The Vologda Region does not have its own reserves of these critically important minerals, but a branch of the Yamal – Europe main gas pipeline runs through the region on the Ukhta – Gryazovets – Vyborg section. The design capacity of the gas pipeline is about 55 million m^3 per year[5]. Natural gas can be considered as a raw material for expanding the range of chemical products produced in the region.

The Vologda Region is rich in forest resources, which are widely used primarily in the timber chemical industry. The region has extensive timber reserves, reaching about 1.6 billion m3. This volume can provide raw materials for the industry in the long term, taking into account the renewable nature of this resource. Its other advantage is that its use can contribute to the development of the economy in local territories by creating jobs in the forestry industry and related sectors, bringing additional economic and social benefits to the region.

Thus, chemical production in the Vologda Region is carried out mainly on the basis of imported raw materials, which is facilitated by a well-developed transport network and stable logistics links with other regions. Raw materials for potential small- and low-tonnage chemical projects can be supplied from the European part of Russia via the Transsib and North – South railway transport routes.

The region is also rich in water resources. There is a dense river network, many lakes and a number of reservoirs on its territory. This factor is especially important in the location of water-intensive chemical industries, primarily polymer ones.

The region's energy resources provision is estimated as average. Since the region's energy system is in short supply in terms of electricity and capacity, its production is carried out by its own generating sources of large enterprises. These include, for example, the Nyuksen linear production management of main gas pipelines, branch of Gazprom Transgaz Ukhta LLC, and the Jubilee linear production management of main gas pipelines, branch of Gazprom Transgaz Ukhta LLC.

[5] Gryazovets – Vyborg main gas pipeline. Gazprom Invest. Available at: https://invest.gazprom.ru/about/projects/seg/ (accessed: 04.02.2026).

An analysis of the degree of utilization of the main production facilities suggests that the Vologda Region chemical complex has the potential to accelerate the growth rate of key products. In the production of a number of products, capacity utilization has almost reached 100% (*Tab. 2*). This applies to ammonia, oleum, sulfuric acid and fertilizers. This situation is due to the high demand for these products, primarily on the foreign market. Underutilization of capacities for two types of products, plastics and bricks, ranges from 35 to 43%. The reasons for this are insufficient demand for these products on the domestic market and the disruption of production chains in the Russian economy, which has resulted in manufacturers focusing on exports. Supplies come from low-grade products, while imports are high-value-added end products made from Russian raw materials.

The implementation of the production potential of the region as a whole and the chemical complex in particular, and the increase in economic growth rates depend on the state of production assets. The degree of their wear exceeds 50% for a number of products of the complex, primarily non-metallic mineral products and chemicals (*Tab. 3*). In recent years, there has been a tendency to increase the degree of wear of funds used in the manufacture of chemicals, and to a slight decrease in two other industries. The potential threat of loss of the material and technical base is created by high wear of machinery and equipment, which exceeds the average for all fixed assets. This is due to the high import dependence on investment goods and the sanctions imposed, which limit the ability to purchase new machinery and equipment, along with technologies and components for the production of chemicals (Smagulova, Fetisova, 2023).

At the same time, new production facilities are being gradually introduced. The renewal coefficients exceed the liquidation coefficients (*Tab. 4*), which indicates the gradual replacement of fixed assets with new ones. However, the renewal of funds in the industry of production of other non-metallic mineral products is proceeding at a slow pace, in the production of rubber and plastic products, the value of the indicator for 2024 decreased by almost 20% compared to the previous one. The production facilities being repaired and re-commissioned are characterized by accelerated physical wear and obsolescence.

Table 2. Level of utilization of the average annual production capacity of organizations for production of certain types of products in the Vologda Region in 2019–2024, %

Products	2019	2020	2021	2022	2023	2024
Production of chemicals						
Oleum, sulfuric acid	98.2	94.0	99.4	97.3	99.0	96.2
Ammonia	98.5	99.2	98.9	98.3	97.9	99.5
Phosphorous fertilizers	96.2	93.5	92.4	93.4	98.2	94.0
Plastics in primary forms	56.2	54.1	63.6	58.7	61.3	64.9
Production of other non-metallic mineral products						
Glass bottles	97.6	99.0	92.4	94.6	93.7	97.8
Building brick	56.0	60.0	56.4	66.7	60.8	57.1
Products made of cement, concrete or artificial stone	38.6	41.2	42.3	54.2	35.1	33.5
Source: own compilation based on Vologda Statistical Office data.						

Table 3. Degree of depreciation of fixed assets of the Vologda Region in 2019–2024, % of the total book value

Products	2019	2020	2021	2022	2023	2024
Chemicals and chemical products	40.9	54.2	55.1	55.9	57.6	59.4
Rubber and plastic products	80.1	82.2	71.8	51.5	42.0	41.9
Other non-metallic mineral products	68.0	67.4	60.4	61.2	67.0	65.3
Source: own compilation based on Vologda Statistical Office data.						

Table 4. Renovation of fixed assets in the Vologda Region in 2019–2024, %

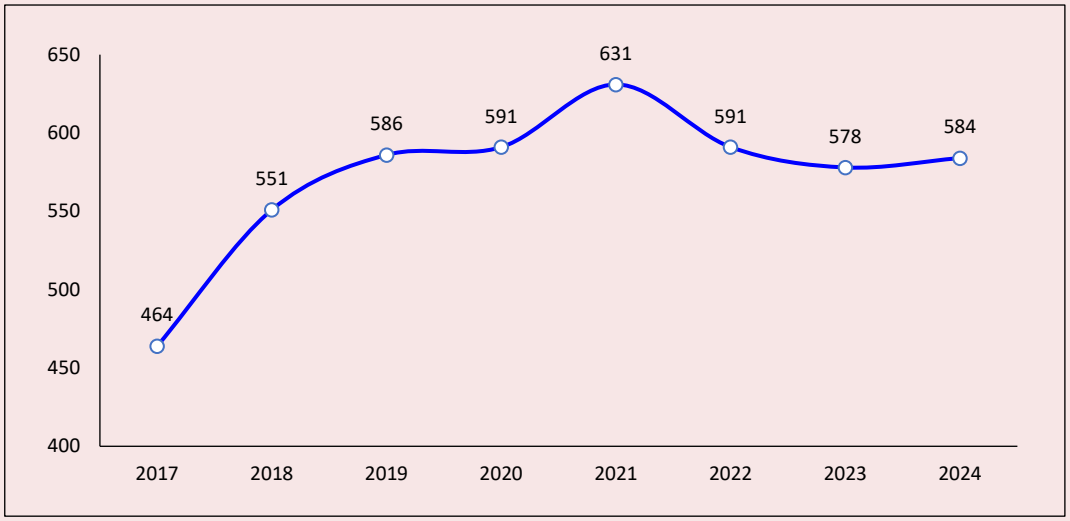
Products	2019	2020	2021	2022	2023	2024
Coefficient of renewal of fixed assets						
Chemicals and chemical products	10.2	13.7	8.1	6.4	0.1	5.0
Rubber and plastic products	5.2	3.4	18.0	26.7	33.0	14.7
Other non-metallic mineral products	9.4	1.9	16.3	4.0	2.7	2.2
Coefficient of liquidation of fixed assets						
Chemicals and chemical products	0.5	0.4	1.5	2.8	0.1	1.4
Rubber and plastic products	0.0	1.3	-	-	-	-
Other non-metallic mineral products	0.9	0.3	4.7	2.0	0.2	0.8
Source: own compilation based on Vologda Statistical Office data.						

Innovative potential. The development of the technological complex, as well as the economy as a whole, the possibilities of transition to a new technological paradigm, and the increase in added value are determined by innovation activities.

The number of personnel engaged in scientific research and development shows a downward trend starting in 2021. Only in 2024 there was a slight increase in the parameter (*Fig. 2*).

The stagnating dynamics is demonstrated by the indicators of the number of organizations engaged in research and development, the number of advanced production technologies developed practically does not change. The level of innovation activity of organizations in the chemical complex is higher than the regional average. In the region as a whole, it amounted to 9.3% in 2022, in the chemical complex – 16.7% (20% in 2023). The share of innovative goods, works, and services in the total volume of shipments in the region has decreased significantly in recent years. This indicates the displacement of innovative products by traditional products. In terms of industries, innovation activity is highly heterogeneous. It is concentrated primarily in industries producing low-grade products.

Figure 2. Number of personnel engaged in scientific research and development in the Vologda Region in 2017–2024, people



Source: own compilation based on Rosstat data.

Thus, the Vologda Region has the resources for the production of forest chemical products, the production of fertilizers is based on imported raw materials. The formation of new industries, especially low-tonnage ones, can also be based on resources supplied from other regions, which is facilitated by the region's location at the intersection of transport routes in different directions. The region has fixed assets for production, but their workload is high, and the degree of wear and tear is significant, primarily in industries producing chemicals and non-metallic mineral products. The innovation potential is insufficiently developed.

At the same time, the urgency of the issue of finding sources of economic growth requires substantiating priorities that can give an impetus to development. Promising specializations of the chemical industry in the region can be considered as such priorities, the formation of a scientifically based list of which should be carried out through an analysis of federal priorities for the development of the industry, taking into account the requirements of the country's economic security. In the context of the development of the chemical complex, the following documents are crucial:

– National Security Strategy[6];

– Economic Security Strategy for the period up to 2030[7];

– Food Security Doctrine[8];

– Strategy for Scientific and Technological Development[9];

– Concept for Technological Development[10];

– "On National Development Goals"[11];

– Decree "Fundamentals of State Policy in the Field of Strategic Planning"[12];

– Strategy for the development of the chemical and petrochemical complex[13].

A critical analysis of the above-mentioned strategic documents led to the conclusion that the following areas of the chemical complex are priorities for development from the point of view of the state:

1) production of highly effective fertilizers and other chemicals for the needs of agriculture in order to ensure food security;

2) production of high-quality fuels and composite materials that ensure the interests of the military-industrial complex;

3) biotechnology and fuel production, as well as energy technologies;

4) release of new materials.

The tasks of increasing exports of non-primary non-energy materials, reducing the share of imports, increasing the density of robotics, and ensuring technological sovereignty are becoming common to different areas of chemical production. In terms of import substitution, the production of composite materials, ingredients of the perfumery and cosmetics industry, household chemicals and other products are seen as promising[14].

[6] On the National Security Strategy of the Russian Federation: Presidential Decree 400, dated July 2, 2021.

[7] On the Strategy of Economic Security of the Russian Federation for the period up to 2030: Presidential Decree 208, dated May 13, 2017.

[8] On the Approval of the Food Security Doctrine of the Russian Federation: Presidential Decree 20, dated January 21, 2020.

[9] On the Strategy of Scientific and Technological Development of the Russian Federation: Presidential Decree 145, dated February 28, 2024.

[10] On the Approval of the Concept of Technological Development for the period up to 2030: RF Government Resolution 1315-r, dated May 20, 2023.

[11] On the National Development Goals of the Russian Federation for the period up to 2030 and for the future up to 2036: Presidential Decree 309, dated May 7, 2024.

[12] On the Approval of the Fundamentals of State Policy in the Field of Strategic Planning in the Russian Federation: Presidential Decree 633, dated November 8, 2021.

[13] On the Approval of the Strategy for the Development of the Chemical and Petrochemical Complex for the period up to 2030: Order 651/172 of the Ministry of Industry and Trade of the Russian Federation and the Ministry of Energy of the Russian Federation, dated April 4, 2014.

[14] Lists of critical industrial products of the Russian Ministry of Industry and Trade. Available at: https://frprf.ru/plany-importozameshcheniya/

Table 5. Assessment of the prospects of the niches of specialization of the Vologda Region's chemical complex

No.	Criteria	Polymer-metal composites	Polymers for additive technologies	Phosphogypsum building materials	Forest chemical products
1.	Compliance with global macro trends	2	2	2	0
2.	Availability of fast-growing product market	1	2	0	0
3.	Compliance with global technological trends	2	2	0	0
4.	Compliance with the strategic plans of the state	2	2	0	0
5.	The need for import substitution	2	2	0	0
6.	Availability of the raw material base in the region	2	0	2	2
7.	Availability of existing production facilities	0	2	2	2
8.	Availability of energy resources for production	2	0	2	2
9.	Availability of logistics facilities for production or sales	2	2	2	2
10.	Compliance with the plans of major industry players	0	2	2	2
11.	Availability of technological competence centers	2	2	2	2
12.	Availability of training opportunities in the region	2	0	2	2
13.	Lack of competitive industries in the country	2	1	1	0
	Total	**21**	**19**	**17**	**14**

Source: own compilation.

Promising specialization niches for the chemical complex

In the course of the research, a list of project initiatives was formed, to assess the feasibility of which a strategic session "Technological future of the Vologda Region economy" was held, where experts were representatives of large industry businesses, science and government authorities[15]. The experts assessed the prospects of the niches specializing in the Vologda Region's chemical complex[16] (*Tab. 5*).

According to the final score, the most promising for the Vologda Region are the production of polymer-metal composites and polymers for additive technologies. Phosphogypsum building materials received the average score, while wood chemical products received the lowest score.

Let us take a closer look at each niche of specialization.

1. Organization of production of polymer-metal composites.

The development of this niche is due to an increase in domestic consumption of metals, as well as the need to develop high-tech materials production in general. According to JEC Group research, the global market of composite materials and products made from them is estimated at 100 billion U.S. dollars. By industry, their main consumers are construction (27%), transport (23%), electronic industry (17%) and energy (13%), which may be used in the manufacture of biomedical equipment in the future. The largest volume of products in this category is used in Asia and North America. In the future, the composite market is expected to grow at a rate of up to 6.5% per year until 2030.

[15] Zhestyannikov: the Vologda Region deputies discussed the region's development strategy. RIA Novosti. Available at: https://ria.ru/20250121/zhestyannikov-1994874926.html

[16] Each of the proposed niches of specialization of the chemical complex is analyzed for compliance with the criteria specified in the methodological part. For this purpose, a scoring system has been formed. For each criterion, a score from 0 to 2 is assigned, among which 0 means complete non–compliance, 1 means partial compliance, that is, the feature is limited, and 2 means full compliance.

Currently, there are no industries in Russia that produce composite materials on an industrial scale. At the same time, there is groundwork in R&D and the creation of prototypes. The market of composite materials has received the greatest development abroad, but their import to Russia is limited, which may be due to two factors: sanctions or inconsistency with the needs of the Russian economy.

2. Organization of polymer production for additive technologies.

The active development of additive technologies and the need to establish these industries actualize the need to form their own production in the Vologda Region. It is one of the fastest growing markets, with an average annual growth rate of 22% until 2030. According to the Russian Association for the Development of Additive Technologies, the volume of their consumption in the country in 2022 amounted to 6.1 billion rubles, and it is projected to increase to 9.8 billion rubles by 2030.

A key component of additive technologies are filaments, which are plastics for printing. At the moment, they are mainly purchased abroad, while domestic demand for them is still low. The production of filaments should be accompanied by an increase in demand for 3D printing in the manufacturing industry, which will make it possible to form production facilities for the production of customized polymer products. The raw materials for the formation of this production can be supplied from the Ust-Luga Gas Chemical Plant, which is provided by the established railway logistics. In the early stages, it is also possible to use ready-made polymer raw materials from other regions.

3. Organization of production of phosphogypsum materials.

The formation of industries in this area is due to a number of factors. The first is associated with the accumulation of large volumes of phosphogypsum, which is a waste product of the production of phosphorous fertilizers. Existing technologies for their processing do not allow the full use of accumulated phosphogypsum waste. The second factor is due to the shortage of building materials in the region and the need to develop the local construction industry (Lebedeva, 2023).

These products can be used in road construction to carry out work on laying highways and strengthening the soil at their base (Lebedeva, 2024). Phosphogypsum can also be used in the production of drywall, gypsum blocks, dry building mixes, etc. The growth rate of the phosphogypsum building materials market is estimated at 5–7% annually.

4. Organization of the production of forest chemical products.

This niche includes the formation of timber chemical plants based on the pulp and paper mill and other enterprises harvesting timber. The established production facilities using waste from the forestry industry will allow the production of high-quality chemical products with high added value. Products such as tall rosin and tall oil fatty acids are a priority for the domestic and Asian markets. It is expected that in the future, until 2027, the average annual growth rate of the global rosin market will be at least 5%. It is also predicted that the consumption of tall oil fatty acids will double by 2030 due to increased consumption of paint and varnish products and the growth of national markets.

Potential sources of financing for the development of the proposed specialization niches may include special investment contracts, funds from the Industrial Development Fund, grant support from the Agency for Technological Development, as well as other funds from the federal and regional budgets, and private investors, including from related sectors of the economy.

Barriers to and effects of the implementation of the proposed niches of specialization

A number of barriers may hinder the formation of designated specialization niches in the region's enterprises. They can be arranged into several

groups. The first group is technological barriers. The most significant limitation of the technological development of chemical industries, as well as the economy as a whole, is the physical and moral deterioration of industrial equipment, which is aggravated by high import dependence. In these conditions, it is necessary to subsidize loans and conclude investment contracts for the modernization of fixed assets, as well as the formation of domestic industries within the framework of import substitution. Another barrier is the disruption of the technology transfer chain from the scientific sector directly to industrial production. To eliminate it, it is necessary to create a special technology transfer center for enterprises that acts as an intermediary between science and business, as well as a fund to support research and development on a project basis.

The second group is economic barriers. First of all, it includes limited domestic demand for products manufactured by the chemical complex, low economic attractiveness of high-grade products, limited financing of promising projects due to the difficulties in predicting future incomes, as well as the high cost of loans and the tax burden on enterprises. To overcome them, export support is needed, including simplification of customs procedures for the supply of promising products to the markets of friendly countries, increased duties on exports of low-grade products, guarantee support for new enterprises, improvement of the investment attractiveness of promising projects, provision of tax incentives, direct reimbursable and gratuitous financing through the provision of concessional loans and loans, subsidies and grants. A possible tool for expanding the domestic market is the restriction and prohibition of purchases of imported products for state and municipal needs.

The third group consists of production barriers. A number of problems are related to the staffing of enterprises. There is not only a shortage of staff in working professions, but also a discrepancy between the professional skills of employees and the requirements imposed by employers. To offset these shortcomings, it is proposed to strengthen cooperation between educational institutions and enterprises to form programs that take into account specific production requirements and offer an extension of the practical training module. It is also important to strengthen the motivation of employees to improve their skills in the workplace. Within this group of barriers, the problem of import dependence outlined above stands out. In the chemical complex as a whole, the share of imports reaches up to a third, while in high-tech products it reaches 60–100% (Abashkin et al., 2018). The production of plastics, paints and synthetic fibers is limited by dependence on imported raw materials (Kruglova, 2016). Production barriers also include high prices for fuel, electricity and transportation, energy and material consumption of chemical production combined with high consumption of process and recycled water[17]. Ways to eliminate them are to provide import substitution enterprises with benefits and subsidies, increase R&D funding, and create new laboratories and research departments at enterprises whose activities will be aimed at accelerating the development and introduction of new technologies into production. The introduction of new types of fuels, the stimulation of waste recycling, and the reduction of the tax burden of enterprises in order to increase investment activities are seen as promising. Bureaucratic barriers limit the development of branches of specialization. The support measures proposed by the government do not meet the needs of enterprises, and there are large time costs for documentation, which is due to the complexity of this process. This indicates the need to take into account the opinions of manufacturers and

[17] Ivanov S.V. Chemical complex of Russia: the state and ways of ensuring sustainable economic development. Available at: https://www.chem.msu.ru/rus/chemr.html (accessed: 19.02.2026).

the specifics of their work, as well as to expand the interaction of industry organizations and representatives of executive authorities.

The fourth group is environmental barriers. The chemical industry is one of the main sources of environmental pollution, and many harmful substances are produced during the production process, which subsequently enter the environment. Due to the increased attention to the issues of sustainable development and the "green economy", environmental requirements for production are being tightened. To minimize the negative impact, a number of legislative acts are being introduced that limit emissions, oblige the disposal of dangerous pollutants, and use technologies that cause the least harm to the environment[18]. In this regard, enterprises are modernizing production facilities and investing in wastewater treatment plants. Those companies that do not have sufficient financial resources are forced to reduce production volumes. Thus, non-compliance with environmental safety requirements can lead to the closure of enterprises, limit the formation of new ones, reduce the output of certain types of products in the absence of modernization of production facilities and reduce their competitiveness (Kulagina, Unik, 2026). Overcoming these barriers is possible through encouraging enterprises to introduce wastewater treatment plants and conduct research within the framework of greening production. Potential tools include the use of tax deductions for enterprises that finance their own research and development, and the provision of preferential loans for retrofitting. It is also possible to hold thematic events and exhibitions in the region aimed at sharing experiences on the introduction of new technologies and addressing industrial safety issues[19].

The removal of the identified barriers will contribute to the development of specialization niches in the region, integrating them into existing value chains, which, in turn, will have a positive effect not only in the chemical complex, but also in related sectors of the economy. In the course of the study, estimates of production multipliers for the branches of the chemical complex in the Vologda Region were obtained (*Tab. 6*).

Table 6. Production multipliers for branches of the Vologda Region chemical complex in 2020

Indicator	Fertilizer production	Production of other chemical products	Production of rubber and plastic products
Direct effect on gross output	1.000	1.000	1.000
Indirect effect on gross output	0.542	0.438	0.080
Induced effect on gross output	0.350	0.319	0.187
Full effect on gross output	**1.891**	**1.756**	**1.267**
Direct effect on GRP	0.337	0.337	0.206
Indirect effect on GRP	0.229	0.185	0.036
Induced effect on GRP	0.176	0.160	0.098
Full effect on GRP	**0.742**	**0.682**	**0.340**
Direct effect on gross output in the manufacturing industry	1.000	1.000	1.000
Indirect effect on gross output in the manufacturing industry	0.179	0.144	0.023
Induced effect on gross output in the manufacturing industry	0.068	0.062	0.032
Full effect on gross output in the manufacturing industry	**1.246**	**1.206**	**1.056**
Source: own compilation based on data from the input–output table of the Vologda Region for 2020.			

[18] On Environmental Protection: Federal Law 7-FZ, dated January 10, 2002 (as amended on December 28, 2025, as amended and supplemented, entered into force March 1, 2026).

[19] Ecology of the chemical industry. Exhibition "Chemistry-2026": Chemical industry and science. Available at: https://www.chemistry-expo.ru/ru/articles/ekologiya-himicheskoj-promyshlennosti/ (accessed: 23.04.2026).

Table 7. Total absolute effects on GRP from the development of specialization niches of the Vologda Region's chemical complex, billion rubles (in 2023 prices)

Scenario	2023–2030	2031–2040	2023–2040
Inertial scenario	11	23	36
Objective scenario	20	39	62
Source: own compilation.			

Based on the data presented in Table 6, the total (direct, indirect, and induced) effects on the Vologda region GRP from the development of the proposed specialization niches are estimated (*Tab. 7*).

The full multiplier effect on GRP from the development of the proposed specialization niches in the chemical complex as a whole for the period up to 2040 reaches 36 billion rubles within the inertial and 62 billion rubles within the objective scenario.

The implementation of new investment projects entails making profits for businesses, the state and the population, which leads to the stimulation of such sectors of the economy as the service sector, the production of consumer and investment products, etc.

Conclusion

The conducted research allows drawing a number of conclusions.

First, the transformational processes leading to a recession in the global economy, a decrease in investment flows, increased instability and instability, on the one hand, and the emergence of new sectors of the economy as a result of a change in technological structure, on the other, are increasingly pressing the issue of finding new sources of economic growth. For the Russian economy, this problem has become particularly acute due to the harsh sanctions imposed by Western countries. These circumstances raise the issue of substantiating the priorities of economic policy, including increasing the level of technological development of the economy and achieving technological independence in key industries.

Second, the chemical industry occupies an important place in the economy of Russia and a number of regions. One of these regions is the Vologda Region, where the industry's share in the total volume of shipped products and tax revenues is very significant. Moreover, the region has significant potential for the development of new high-tech industries and the expansion of the range of chemical products.

Third, the formation of a list of promising specializations in the chemical industry of the region should be carried out taking into account the priorities stated in the strategic documents of the state and in accordance with the requirements of the country's economic security. For the chemical complex, these can be the production of composite materials, ingredients of the perfume and cosmetics industry and household chemicals; highly effective fertilizers and other chemicals for agricultural needs; high-quality fuels and new materials that ensure the interests of the military-industrial complex, etc.

Fourth, in accordance with technological and global trends, strategic plans of the government and large business, the existing potential and economic features of the Vologda Region, the production of polymer-metal composites and polymers for additive technologies, phosphogypsum building materials and forest chemicals are the niches of the promising specialization of the chemical industry in the region.

Fifth, the removal of a number of technological, economic, industrial and environmental barriers that hinder the development of specialization niches will have a very significant positive effect on the

regional economy. According to calculations based on input–output modeling, the development of specialization niches can lead to an increase in gross domestic product by 36–62 billion rubles by 2040.

The scientific novelty of the research consists in identifying niches of promising specialization for the Vologda Region chemical complex based on an approach consisting in analyzing a number of criteria that make it possible to assess the relevance and priority of products in modern economic and geopolitical conditions. The results of the work can be used by regional authorities to substantiate the directions of economic policy.

References

Abashkin V.L., Abdrakhmanova G.I., Veselitskaya N.N. et al. (2018). *Tekhnologicheskoe budushchee rossiiskoi ekonomiki* [The technological Future of the Russian Economy]. Moscow: Natsional'nyi issledovatel'skii universitet "Vysshaya shkola ekonomiki".

Ashinova M.K., Eshugova S.K., Kadakoeva G.V. (2022). Ensuring food security under sanctions pressure. *Novye tekhnologii=New Technologies*, 3, 134–141 (in Russian).

Balassa B. (1965). Trade liberalisation and "revealed" comparative advantage. *The Manchester School*, 33, 99–123. DOI: http://dx.doi.org/1-.1111/j.1467-9957.1965.tb---5-.x

Boero R., Edwards B.K., Rivera M.K. (2006). Regional input–output tables and trade flows: An integrated and interregional non-survey approach. *Regional Studies*, 52(2), 225–238.

Bogachev A.I., Dorofeeva L.N. (2022). The Russian market of mineral fertilizers: Features of functioning in the new realities and metamorphoses of development. *Vestnik OrelGAU*, 3(96), 78–92 (in Russian).

Cheplinskite I.R., Lukin E.V. (2024). Features of export specialization of the Northwestern Federal District regions within the framework of the concept of economic complexity. *Ekonomicheskie i sotsial'nye peremeny: fakty, tendentsii, prognoz=Economic and Social Changes: Facts, Trends, Forecast*, 17(2), 81–95. DOI: 10.15838/esc.2024.2.92.4 (in Russian).

Danilova I.V., Pravdina N.V., Salimonenko E.N. (2021). Industry development centers of monospecialized regions: diagnostics of promising specializations. *Ekonomika ustoichivogo razvitiya*, 2(46), 46–57 (in Russian).

Dietzenbacher E., Guilhoto J.J.-M., Imori D. (2012). The role of Brazilian regions in the global value chain. In: *59th Annual North American Meetings of the Regional Science Association International. Ottawa, Canada.*

Dondokov Z.B.-D., Dyrkheev K.P., Munaev L.A., Abzaev P.B., Rinchino S.V. (2014). Input–output analysis of the economy of the Republic of Buryatia based on input–output tables. *Regional'naya ekonomika: teoriya i praktika,* 28(355), 55–62 (in Russian).

Glazyev S.Yu., Ilyin V.A., Shabunova A.A. et al. (2025). *Strukturno-tekhnologicheskie draivery strategicheskogo razvitiya regiona* [Structural and Technological Drivers of the Strategic Development of the Region]. Moscow: Izdatel'stvo Prospekt.

Hausmann R., Klinger B. (2006). *Structural Transformation and Patterns of Comparative Advantage in the Product Space. Ricardo Hausmann and Bailey Klinger CID Working Paper.*

Hidalgo C.A., Klinger B., Barabási A., Hausmann R. (2007). The product space conditions the development of nations. *Science*, 317, 482–487.

Ilyin V.A., Uskova T.V., Lukin E.V. et al. (2021). *Transformatsiya mezhregional'nykh tsepochek sozdaniya stoimosti: problemy i perspektivy: monografiya* [Transformation of Interregional Value Chains: Problems and Prospects: Monograph]. Vologda: VolNTs RAN.

Ivanter V.V. (2018). The role of input–output balance in macroeconomic analysis and forecasting. *Problemy prognozirovaniya=Studies on Russian Economic Development*, 6(171), 3–6 (in Russian).

Jiang X. (2011). *Statistical and Economic Applications of Chinese Regional Input-Output Tables.* Groningen: University of Groningen.

Kopytova E.D. (2017). *Proizvodstvo mineral'nykh udobrenii v Rossii: rezul'taty, tendentsii i vliyanie na byudzhetnuyu sistemu: preprint* [Production of Mineral Fertilizers in Russia: Results, Trends and Impact on the Budget System: Preprint]. Vologda: VolNTs RAN.

Kruglova Yu.V. (2016). Analysis of the problem of import substitution in the chemical industry and its impact on other sectors of the economy. *Upravlencheskie nauki*, 3. Available at: https://cyberleninka.ru/article/n/analiz-problemy-importozamescheniya-v-himicheskoy-promyshlennosti-i-ee-vliyanie-na-drugie-sektora-ekonomiki (in Russian).

Ksenofontov M.Yu., Shirov A.A., Polzikov D.A., Yantovskii A.A. (2018). Estimation of multiplicative effects in the Russian economy based on input–output tables. *Problemy prognozirovaniya=Studies on Russian Economic Development*, 2(167), 3–13 (in Russian).

Kulagina N.A., Yunik A.V. (2026). Quantitative assessment of the impact barriers on productivity and innovation in the chemical industry. *Innovatsionnaya ekonomika: informatsiya, analitika, prognozy=Innovative Economy: Information, Analysis, Prognoses*, 1, 10–19. DOI: 10.47576/2949-1894.2026.1.1.001 (in Russian).

Kurz H.D., Salvadori N. (2000). The dynamic Leontief model and the theory of endogenous growth. *Economic Systems Research*, 12(2), 255–265.

Lebedeva M.A. (2023). *"Green" projects as a basis for modernization of the region's economy. In: Aktual'nye voprosy ekonomiki i sotsiologii: sbornik statei po materialam XIX Osennei konferentsii molodykh uchenykh v Novosibirskom akademgorodke (11–13 oktyabrya 2023 g.)* [Current Issues of Economics and Sociology: Collection of Articles Based on the Materials of the 19th Autumn Conference of Young Scientists in Novosibirsk Akademgorodok (October 11–13, 2023)]. Novosibirsk: Institut ekonomiki i organizatsii promyshlennogo proizvodstva SO RAN (in Russian).

Lebedeva M.A. (2024). Modernization of the economy of an industrial region based on the basis of using resource-saving technologies. *Problemy razvitiya territorii=Problems of Territory's Development*, 28(2), 40–51. DOI: 10.15838/ptd.2024.2.130.4 (in Russian).

Lukin E.V. (2023). The economy of the Northwest Russia: In search of prospective specialization. *EKO=ECO Journal*, 8, 8–34. DOI: 10.30680/ECO0131-7652-2023-8-8-34 (in Russian).

Lukin E.V. (2025). Structural restructuring of the regional economy in the context of the development of national value chains. *Problemy prognozirovaniya=Studies on Russian Economic Development*, 4(211), 70–84. DOI: 10.47711/0868-6351-211-70-84 (in Russian).

Malsagov A.D. (2022). The current state of the Russian chemical industry. EGI, 44(6), 200–203 (in Russian).

Malyshev M.K. (2023). Tax receipts from large corporations in the metallurgical and chemical industries to the state budget system for 2011–2022. *Voprosy territorial'nogo razvitiya=Territorial Development Issues*, 11(2). DOI: 10.15838/tdi.2023.2.64.2. Available at: http://vtr.isert-ran.ru/article/29834 (in Russian).

Malyshev M.K. (2024). The factors of formation of financial results and the peculiarities of the distribution policy of Russian chemical industry corporations. *Problemy razvitiya territorii=Problems of Territory's Development,* 28(1), 78–97. DOI: 10.15838/ptd.2024.1.129.6 (in Russian).

Malyshev M.K. (2025). Analysis of environmental protection activities of Russian producers of mineral fertilizers. *Problemy razvitiya territorii=Problems of Territory's Development,* 29(2), 60–80. DOI: 10.15838/ptd.2025.2.136.5 (in Russian).

Malyshev M.K., Pechenskaya-Polishchuk M.A. (2024). Dynamics of export-import operations in the Russian chemical industry: Current state of affairs on the threshold of geopolitical shifts. *Ekonomicheskie i sotsial'nye peremeny: fakty, tendentsii, prognoz=Economic and Social Changes: Facts, Trends, Forecast,* 17(4), 109–125. DOI: 10.15838/esc.2024.4.94.6 (in Russian).

Mikheeva N.N. (2024). Regional projection of Russia's economic development in 2022–2023. *Studies on Russian Economic Development*, 35(6), 845–853. DOI: 10.1134/S1075700724700382

Miller R.E., Blair P.D. (2009). *Input-Output Analysis: Foundations and Extensions. 2nd ed.* Cambridge University Press.

Nigmatulin R.I., Sayapova A.R., Mazitova L.D. (2006). Input–output tables of the Republic of Bashkortostan. *EKO=ECO Journal*, 3(381), 90–105 (in Russian).

Nikitenko S.M., Goosen E.V. (2017). Value chains as a tool for the development of the coal industry. *EKO=ECO Journal*, 9, 104–124 (in Russian).

Pilyasov A.N. (2018). Regional investment policy: How to overcome "path dependence"? *Region: ekonomika i sotsiologiya*, 4(100), 134–167 (in Russian).

Porfir'ev B.N., Shirov A.A., Gusev M.S. (2024). Key themes of the long-term socio-economic forecast for the development of the Russian economy. *Ekonomika Severo-Zapada: problemy i perspektivy razvitiya*, 1(76), 12–20. DOI: 10.52897/2411-4588-2024-1-12-20 (in Russian).

Provorova I.P., Zhemerikin O.I. (2020). The results of import substitution in the Russian chemical complex. *Bol'shaya Evraziya: razvitie, bezopasnost', sotrudnichestvo*, 3-1, 374–377 (in Russian).

Razgulina E.D. (2015). The impact of the activities of the largest chemical industry enterprises on the development of the regional economy. *Problemy razvitiya territorii=Problems of Territory's Development,* 6(80), 73–92 (in Russian).

Razgulina E.D., Barabanov A.S. (2014). The influence of the largest chemical industry enterprises on regional development. *Izvestiya vysshikh uchebnykh zavedenii. Seriya: Ekonomika, finansy i upravlenie proizvodstvom*, 2(20), 146–152 (in Russian).

Rumyantsev N.M. (2023). Promising economic specializations within the macro-region (based on the materials of the Northwestern Federal District). *Ekonomicheskie i sotsial'nye peremeny: fakty, tendentsii, prognoz=Economic and Social Changes: Facts, Trends, Forecast,* 16(6), 74–90 (in Russian).

Rumyantsev N.M., Lukin E.V. (2024). Input-output modeling of economic development in the region. *Ekonomicheskie i sotsial'nye peremeny: fakty, tendentsii, prognoz=Economic and Social Changes: Facts, Trends, Forecast,* 17(6), 118–133. DOI: 10.15838/esc.2024.6.96.6 (in Russian).

Sayapova A.R., Shirov A.A. (2019). *Osnovy metoda "zatraty – vypusk"* [The Basics of the Input–Output Method]. Moscow: OOO "MAKS Press". DOI: 10.29003/m801.978-5-317-06263-7 (in Russian).

Sayapova A.R., Shirov A.A. (2025). The role of global value chains in shaping the dynamics of the Russian economy. *Problemy prognozirovaniya=Studies on Russian Economic Development*, 3(210), 6–21. DOI: 10.47711/0868-6351-210-6-21 (in Russian).

Shirokova E.Yu. (2021). Chemical industry as a driver of economic growth in the country and the region. *Problemy razvitiya territorii=Problems of Territory's Development,* 2, 59–72 (in Russian).

Smagulova S.M., Fetisova L.YU. (2023). The impact of anti-Russian sanctions on the foreign trade activities of Russian chemical industry enterprises. *Innovatsii i investitsii*, 7, 406–409 (in Russian).

Suslov V.I., Suspitsyn S.A. (2005). Siberian development strategy: Macroeconomic and territorial projection. *Region: ekonomika i sotsiologiya*, 4, 77–92 (in Russian).

Suvorov A.V., Ivanov V.N., Sukhorukova G.M. (2005). Approaches to assessing the impact of shifts in the level and structure of household income on macroeconomic indicators. *Nauchnye trudy: Institut narodnokhozyaistvennogo prognozirovaniya RAN*, 3, 381–394 (in Russian).

Suvorov N.V., Balashova E.E. (2009). Model toolkit for predictive and analytical studies of the dynamics of input–output relations of the domestic economy. *Problemy prognozirovaniya=Studies on Russian Economic Development*, 6, 16–33 (in Russian).

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