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## Article

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## Problems and Prospects of Innovative Development of Petrochemical Enterprises

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### ABSTRACT

The article reveals that the petrochemical sector of the Russian economy has great potential for development while remaining one of the most underperforming sectors of the domestic economy compared to the world level. Under the current conditions, the most significant task of the state and top management of petrochemical companies is innovative development of oil and gas chemistry with the purpose of improving the competitiveness of domestic products on the world markets. Findings of the analysis of conditions and factors that result in the low level of development of the Russian chemical industry are provided in order to substantiate the possibilities for the further development of petrochemistry. The factors defining the innovative activity of enterprises in the sector are indicated. Perspective tasks and problems that need to be solved to bring petrochemistry in Russia to the innovative path are presented. Sectoral specifics of petrochemical enterprises and their current state are indicated as the main reasons that hamper this process. The need for significant investment for a long period of time makes the companies unattractive to potential investors and necessitates the use of state regulation measures in innovative processes in petrochemistry.

**Keywords:** Innovative Development, Petrochemical Enterprise, Problems, Prospects

**JEL Classifications:** O31, O32

### 1. INTRODUCTION

Problems and prospects for the innovative development of petrochemical enterprises are largely determined by the state and situation of the modern oil and gas chemistry, since the areas and tasks of innovative development of companies are based on the general situation in the sector.

The current state of petrochemical industry in Russia is far from unambiguous. A country with the world's largest reserves of hydrocarbons and a world leader in hydrocarbon production and export has a small share in the global production of chemical products, which ranges from 1% to 2%.

Two main reasons explain the failure in development of the Russian petrochemical industry in the 1990s and a too slow growth in the following decade:

1. Sharply narrowed domestic demand as a result of a deep transformation crisis;
2. Effect of institutional factors (abandonment of the administrative system of economic regulation amid the vacuum of market regulation tools, privatization, change and redistribution of the property ownership and areas of influence, monopolistic trends).

At present, the domestic chemical industry is at the level of 1990. Only three out of all major subsectors of the chemical

profile managed to surpass the peaks of the Soviet period in 2008: Production of mineral fertilizers, synthetic resins and plastics, and the processing of plastics. At the same time, several important segments of Russian chemistry (production of synthetic and artificial fibers, chemical plant protection products, paints and varnishes) saw a 10-20 times drop in production volumes, i.e., the Russian economy has virtually lost entire subsectors of the chemical industry and is almost entirely dependent on the imports of these chemical products. All Russian chemical companies are players within the framework of individual regional or narrow product markets. The key components of success of potential competitors of Russian oil and gas chemical enterprises are the technological novelty and high concentration of production capacities, while the Middle East competitors also offer low prices for hydrocarbons. Several systemic barriers hamper the development of the Russian oil and gas chemical industry, each of which implies its own solutions and ways of innovative development.

## 2. METHODS

Factors that currently influence the innovative activity of the Russian petrochemical enterprises can be divided into seven groups:

1. Political and legal: Imperfection of legislation (tax, patent and licensing, depreciation, antitrust), which hinders the establishment of a regulatory and legal framework that could promote support, regulation and stimulation of the innovative activity of oil and gas chemical enterprises;
2. Financial and economic: Insufficient available funds to finance innovative projects, dominance of tactical interests over prospective ones, weakness of material, technical and scientific research base, insufficient reserves, focus on short-term payback, weak investment support from the parent company in the context of corporatization;
3. Organizational and management: Obsolete, often rigid rather than flexible organizational management structures, authoritarian (bureaucratic) management style, departmental isolation, excessive centralism, weak industry-wise and regional-wise interaction;
4. Social and psychological: Obsolete stereotypes, uncertainty and unpredictability of behavior, resistance to changes;
5. Scientific and educational: Insufficient education of managers of all levels in the field of innovative management, lack of an integrated system of training and retraining of personnel and advanced innovative development;
6. Technical and technological: Obsolete equipment and technology that do not allow to use many innovations, lack of a unified and efficient infrastructure, weak provision of resources;
7. Research: Insufficient funding of fundamental and applied research and development in the field of the oil and gas chemistry, weak state support for R and D, insufficient involvement of university academics in the procedure of scientific research, etc.

The problems of transition of the Russian petrochemical industry to the innovative path are largely determined by the technical,

technological and scientific research factors. As the petrochemical industry has been establishing as an industry, a special structure of production assets has formed: The existing capacities of refining the primary petroleum products are focused on the internal needs for basic chemical products, while the range of products does not correspond to internal and external demand and the requirements of international standards. The prolonged transition of the domestic economy to the market framework slowed down processes of modernization and renewal of fixed production assets: Wear of the industry capacities is more than 40%.

Many foreign countries conduct an active transition to the production of polymers, while there is virtually no pyrolysis production of monomeric compounds that would allow the production of several groups of monomers in the Russian petrochemical sector. Production of monomers in the Russian Federation is mostly represented by the technology of propane dehydrogenation, which results in one final product only. Pyrolysis production enables enterprises to react quickly to changing market conditions. The Russian oil and gas chemistry occupies 3.89% of the global volume of ethylene production by volume of production of monomeric compounds. Russian companies produce only 2,810 thousand tons of ethylene per year and 1,403 thousand tons of propylene per year. If compared with the leading country for pyrolysis products (ethylene production figures in the US amount to 27,653 thousand tons per year), the introduction of this technology is one of the priority areas of innovative development for Russian petrochemistry. Global petrochemistry requires that the countries producing the final product comply with certain requirements to the quality of products and technologies and equipment used. Obsolete technology is described by high specific indicators of raw materials and energy resources consumption, as well as narrow assortment and low quality of products. There is a gap between the development of the domestic market and the area of consumption of petrochemical products, lack of own technology for large-tonnage production of virtually all types of chemical products from hydrocarbons. The unit capacities of processing stations have grown 2-3 times on average across the world since the commissioning of most of the oil and gas chemical enterprises in Russia.

Lack of facilities for production of modern chemical and petrochemical equipment is one of the constraints of the innovative development of the industry. There are many obstacles to eliminating this negative factor, including a complex certification procedure and the need to recognize the applicability of equipment for use in relevant technological processes by foreign licensors. Cooperation and combination of technological chains is possible only on the basis of an adequate industrial infrastructure, i.e. the system of specialized transport communications, which allows to arrange rational flows of raw materials and semi-products at minimal costs.

In result of comparison of the conditions for operation of foreign and domestic petrochemical enterprises, it can be concluded that the lack of a purposeful policy of state participation in the development of the petrochemical industry is the second most important factor that hinders the innovative activity of

industry enterprises. The state policy in the field of innovative development of the economy, including the petrochemical sector, is currently limited to the description of the core strategic benchmarks only. At the same time, it does not cover such areas of regulation as integration of supply chains in the oil and gas chemical industry, choice of development projects, funding of processing development (taking into account the capital intensity and long-term investment), development of the national transport infrastructure for the flows of raw materials and semi-products.

In addition, there is no efficient legislative framework in the Russian Federation to promote innovative activities. Taxation in the Russian Federation does not take into account the innovative activity of industry enterprises; there is no efficient taxation system for enterprises that produce high-tech products. The inefficiency of regulation of intellectual property rights created entirely or partially at the expense of budgetary funds also hinders the innovative activity of petrochemical companies. The influence of social, psychological, scientific and educational factors is manifested in the difficulty of inflow of human resources into innovative production. Low wage level in the field of R and D is a setback to the development of innovative production, which can result in losses in human potential as the core factor of innovative development.

The industry experiences an acute shortage of qualified human resources that meet the requirements of a dynamically developing labor market in the context of excess of specialists with higher education. The world petrochemical industry observes a trend of active migration processes and transfer of petrochemical industries from developed countries to countries with developing economies. This trend is associated with the prospective inflows of foreign direct investment and technological cooperation with the world market leaders. While this trend was gaining momentum around the world, there were no financially strong players in the Russian petrochemical market to carry out international cooperation in this field.

### 3. RESULTS

The perspective objectives of the innovative development of the petrochemical sector of the economy, as well as the problems of their implementation, systematized in terms of the identified systemic barriers that impede the innovative development of petrochemicals in Russia, can serve as the results of the presented study (Table 1).

As can be seen from the table, low attractiveness of domestic petrochemistry for potential investors and an urgent need at the serious inadequate state support are the key problems on the way of its development.

### 4. DISCUSSION

At present, there are quite many sources devoted to consideration of the issues of innovative development of countries, regions, industries and enterprises in domestic and foreign literature. In particular, there

are many papers containing the findings of research on the problems of establishment of innovative policies of enterprises in general (Afonin, 2005; Gulmagomedov, 2010; Kozhukhar, 2011; Morozov, 2009; Platonov, 2010; Fedoseyev and Vasilyeva, 2010; Zobolotskiy, 2010). Special attention should be paid to academic papers devoted to the development of petrochemistry in Russia and the world and to consideration of successful practices of implementation of innovative development scenarios (Arutyunyan et al., 2015; Braginskiy, 2009; Kapustin, 2014; Kolobov, 2013a; Kryukov, 2010a, Kryukov, 2010b). Meanwhile, some authors consider the problems of transition to an innovative development path at the macrolevel (Anosova, 2010; Dvoretzkaya, 2010), and innovative processes are considered at the level of sectoral development in some cases (Bikchentyeva, 2010; Deberdiyeva, 2015; Ignatenko, 2011). Along with that, a significant number of authors consider the possibility of innovative development of certain petrochemical enterprises (Andreyev and Sinelnikov, 2008; Andrianov, 2013; Lenkova and Deberdiyeva, 2014).

At the same time, the applied aspect covered in the article is considered through the prism of the theory of innovative and sectoral management simultaneously, irrespective of the level of the object of research (macro-, meso-, micro).

### 5. CONCLUSION

In conclusion, it can be noted that the stated goal of this research, which is to identify problems and outline the prospects for the development of Russian petrochemistry, has been achieved. The petrochemical sector in Russia is one of the most innovatively promising, while remaining one of the most underperforming sectors of the domestic economy compared to the world level. Under the current conditions, the most significant task of the state and top management of petrochemical companies is innovative development of oil and gas chemistry with the purpose of improving the competitiveness of domestic products on the world markets.

The core systemic barriers to the innovative development of petrochemical enterprises identified during the research are currently the following:

1. Depreciation of fixed production assets.
2. Low level of development of pyrolysis production of monomers in Russia.
3. Inconsistency of the technical level of the sector with current requirements.
4. Lack of capacities for production of modern chemical and petrochemical equipment.
5. Difficulties in the inflow of human resources to innovative production.
6. Limited opportunities for cooperation and combination of technological chains in the framework of individual enterprises of the sector due to the undeveloped transport system of the petrochemical sector.
7. Lack of the efficient legislative framework to promote innovative activity in the Russian Federation.

At the same time, elimination of these problems is hampered by sectoral specifics that are characteristic of the industry and

**Table 1: Problems and prospects of innovative development of petrochemical enterprises**

<b>Systemic barriers</b>	<b>Prospective objectives of innovative development in the framework of elimination of the barrier</b>	<b>Problems of implementation of objectives of innovative development</b>
Specifics of the fixed assets	Construction of new technologically advanced productions	Significant capital intensity of production and, as a consequence, the need for additional investment
Depreciation of fixed production assets	Renewal of existing capacities through the development of objectively new parts and units of equipment in operation	The option is very capital intensive. Highly qualified human resources are required to design new plant units
Low level of development of pyrolysis production of monomers in Russia	Introduction of pyrolysis technology through obtaining licenses for this technology for the production of thermoplastics. Obtaining a license. Stimulating the machine-building sector in the field of petrochemical equipment production	Expensive equipment. It is necessary to form a developed technological infrastructure, which involves significant capital investment
Inconsistency of the technical level of the sector with current requirements	Two options for alternative use of APG are available: (1) Injection back into the shelf to maintain reservoir pressure; (2) combustion for electricity generation	Problems of implementing the options for alternative use of APG: (1) Almost undeveloped technology in Russia; (2) Russian power plants are currently not technologically adapted to APG combustion; installation of special equipment is needed. All options of innovative development in this area require significant investment
Lack of capacities for production of modern chemical and petrochemical equipment	It is needed to import modern technology of mechanical engineering through the acquisition of licenses or through the state stimulation of domestic mechanical engineering	Purchase of new technology from developed countries requires significant capital investment from producers
Limited opportunities for cooperation and combination of technological chains in the framework of individual enterprises of the sector due to the undeveloped transport system of the petrochemical sector	It is needed to build new specialized product pipelines that will be focused on transportation of oil and gas chemical products both within the country and for export	It is needed to attract investment for a long time. The long period of payback of investment in the petrochemical sector significantly reduces the attractiveness of investment for Russian petrochemical companies
Lack of a focused policy of state participation in the development of the petrochemical industry	Targeted state support for innovative activity in the long term must include the following aspects: The state should make direct investment in infrastructure; reduction/elimination of customs duties for imported technological equipment that is not produced in Russia; coordination of projects in the field of oil and gas transport with the strategy of oil and gas chemistry (selection of target components before export); targeted lowest capacity and minimum integration of new production facilities established within the framework of state policy, as well as preparation of large complex sites and their provision with infrastructure for the deployment of other industries with the specified characteristics and parameters by other investors; optimization of taxation - creation of a flexible taxation mechanism (for example, depending on the project payback)	Considerable time is required to develop appropriate instruments for the policy of innovative development of the industry, during which technical and regulatory regulations, norms and rules will be developed and adopted
Lack of the efficient legislative framework to promote innovative activity in the Russian Federation	Introduction of special taxation in the field of research and development. Introduction of privileges and preferences for innovatively active enterprises of the sector at the legislative level. Limitation of transportation and electricity tariffs. Tax incentives to separate ethane from natural gas for its use as a raw material. Creation of the efficient tax base for the protection of intellectual property	Temporary expenses are required for the development and adoption of a new tax policy relevant to the current state of the industry, a policy of regulating the know-how rights and rights to other intellectual property objects in the industrial operation of petrochemical companies

(Contd...)



**Table 1: (Continued)**

Systemic barriers	Prospective objectives of innovative development in the framework of elimination of the barrier	Problems of implementation of objectives of innovative development
Difficulties in the inflow of human resources to innovative production	Modernization of personnel training through institutional restructuring, creation of new types of educational institutions. Access to the innovative model of continuous formation with personnel certification in accordance with professional standards of employers	New system of network interaction of educational institutions of primary, secondary and higher education is required, with personnel certification in accordance with the standards of large companies
Insignificant participation of Russia in active migration processes in transferring petrochemical industries from the developed countries to developing ones	Creation of joint ventures on the territory of the Russian Federation, which will contribute to attracting necessary investment and new technology to the petrochemical industry	Establishment of international cooperation is required. Low attractiveness of the Russian petrochemical sector for foreign partners

APG: Associated petroleum gas

its current state. For example, it is indicated that the innovative development of petrochemistry requires significant capital investment for long periods. This, in turn, makes this area of business less attractive for potential private investors and necessitates the state support for the development of sectoral companies. At the same time, the set of measures on the part of the state should be systemic in nature and requires the diversion of significant budgetary resources, which is also challenging.

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