Assessment of the Production Potential of the Arctic Mining Sector

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Abstract. It is defined that the development of the world economic system in modern conditions is largely determined by the consumption of natural and, first of all, mineral resources. The process of exploiting Arctic mineral resources is complicated by specific features associated with taking into account climatic features, increased costs and conditions of economic activity. It is shown that in recent years experts showed increased interest in assessing industrial potential which is determined by the need to increase the pace of territorial innovation and industrial development. In this regard the aim of the work is to assess the production potential of the mining sector of the Arctic economy which determines the possibilities of using the entire set of resources for effective growth. The performed analysis of the production potential of the Arctic mining sector showed significant differences in the functioning of industrial enterprises in the Arctic regions. It is determined that the Arctic regions are characterized by raw materials specialization. The extraction and processing of minerals in the Arctic regions accounts for more than 50% of the added value and about 60% of tax revenues to the budgetary system of the Russian Federation.

It is concluded that the most significant production potential of the Arctic mining sector is typical for the Nenets Autonomous Okrug and the minimum - for the Murmansk Region and the Chukotka Autonomous Okrug. It is shown that in terms of production potential the Arctic regions are ahead of the average Russian values but at the same time they are characterized by a low level of innovation activity.

To increase the production potential of the Arctic mining sector it is necessary to conduct scientific research in the direction of ensuring the competitiveness of industry sectors and greening production primarily through the development and implementation of modern innovation technologies.

1. Introduction
The development of the world economic system in modern conditions is largely determined by the consumption of natural and, first of all, mineral resources. Globally mineral resources are used in most industries and the increased steady demand for them predetermines the priorities in the field of increasing the extraction and processing of raw materials, the development of new deposits of minerals.
The process of exploiting Arctic mineral resources is complicated by several specific features. First, super-high capital investments in the exploitation of Arctic deposits. Second, a sensitive ecological system which means high requirements for the environmental friendliness of production. The third problem is the insufficient level of scientific and technological research aimed at increasing the production potential of mining companies. Fourth, the assessment of the raw material potential of the Arctic territories taking into account climatic features, increased costs and specific conditions of economic activity is not carried out at the proper level. Fifth, insufficient development of innovation infrastructure aimed at increasing the efficiency of mining and processing of mineral raw materials, including those related to solving transport problems.

2. Materials and methods
In recent years experts showed increased interest in assessing industrial potential which is determined by the need to increase the pace of territorial innovation and industrial development. Scientists present different points of view on the concept of industrial potential and its constituents and elements. [1-7].

The level of industrial potential is inextricably linked with innovation activity [8, 9]. The specific task of this paper is to assess the production potential of the mining sector of the Arctic economy which determines the possibilities of using the entire set of resources for effective growth. To achieve the goal set in the paper various methods of economic and system analysis were used. Taking into account the high degree of industrial production uncertainty and socio-economic differences the authors applied expert methods.

To assess the production potential of the Arctic mining sector the paper analyzes the subjects whose territories fully belong to the Arctic zone of Russia [10]: Murmansk Region, Nenets Autonomous Okrug, Chukotka Autonomous Okrug and Yamalo-Nenets Autonomous Okrug.

Taking into account the specific conditions of economic activity in the Arctic zone of Russia the methodology of T.G. Smirnova was used [3]. Data from official statistics were used for calculations. [11].

Assessment of indicators for calculations is carried out according to the formulas (1) and (2):

\[ K_i = \frac{x_i}{\text{max}} \]  
\[ K_j = \frac{\text{min}(x_i)}{x_i} \]

where \( x_i \) – value of the indicator in the region; \( \text{max}(x_i), \text{min}(x_i) \) – standard indicator as which the largest (smallest) values of development indicators are selected.

Formula (1) is used to calculate most indicators except for the "Degree of depreciation of fixed assets" for which the formula (2) is provided.

The integral indicator of production potential is determined by the sum of the normalized components:
- cost of fixed assets by type of activity "Mining" per 1000 people;
- share of organizations that performed research and development in the total number of organizations;
- efficiency of capital;
- the degree of depreciation of fixed assets by type of activity "Mining".

3. Results
The sectoral structure of the gross value added of the considered subjects is presented in Table 1.

In general, the Arctic regions are characterized by raw materials specialization. The added value for mining in recent years increased (in 2013 - 34.5%, in 2019 - 51%), while in Nenets Autonomous Okrug and Yamalo-Nenets Autonomous Okrug this indicator reached 79 and 71%, respectively.
On average the extraction of minerals from the Arctic regions accounts for 61% of the receipts of taxes and fees in the budgetary system of the Russian Federation (Table 2).

**Table 1.** Industrial structure of gross value added in 2019 (in current prices; percentage of total) [12].

| Economic activities                                                                 | Agriculture, forestry, hunting, fishing and fish farming | Mining | Processing industries | Provision of electricity, gas and steam; air conditioning | Other activities |
|-------------------------------------------------------------------------------------|----------------------------------------------------------|--------|------------------------|----------------------------------------------------------|------------------|
| Nenets Autonomous Okrug                                                              | 0.3                                                      | 79.2   | 0.2                    | 0.8                                                      | 19.5             |
| Murmansk Region                                                                      | 12.4                                                     | 10.3   | 17.9                   | 3.3                                                      | 56.1             |
| Yamalo-Nenets Autonomous Okrug                                                       | 0.1                                                      | 71.3   | 4.8                    | 1.2                                                      | 22.6             |
| Chukotka Autonomous Okrug                                                            | 3.4                                                      | 39.6   | 0.3                    | 11.4                                                     | 45.3             |
| Russian Federation                                                                   | 4.1                                                      | 13.5   | 16.8                   | 2.9                                                      | 62.7             |

**Table 2.** Receipt of taxes and fees to the budgetary system of the Russian Federation by main types of economic activity in 2018, % [13].

| Economic activities                                                                 | Mining | Processing industries | Water supply, sewerage, organization of waste collection and disposal, elimination of pollution | Other activities |
|-------------------------------------------------------------------------------------|--------|------------------------|-------------------------------------------------------------------------------------------------|------------------|
| Nenets Autonomous Okrug                                                              | 94.2   | 0.2                    | 0.0                                                                                             | 5.6              |
| Murmansk Region                                                                     | 16.1   | 4.8                    | 1.3                                                                                             | 77.8             |
| Yamalo-Nenets Autonomous Okrug                                                      | 87.1   | 2.1                    | 0.0                                                                                             | 10.8             |
| Chukotka Autonomous Okrug                                                           | 48.5   | 0.3                    | 0.1                                                                                             | 51.0             |
| Russian Federation                                                                  | 37.1   | 16.4                   | 0.5                                                                                             | 46.0             |

The dynamics of industrial production growth of the Arctic regions (mainly associated with the extraction and processing of mineral raw materials) is significantly higher than the Russian Federation (Figure 1).

![Figure 1](image-url)
Studies showed that the growth of industrial production of the Arctic is mainly due to an increase in volume rather than the development and implementation of innovation technologies. [14].

An important economic indicator characterizing the efficiency of the use of fixed assets of mining enterprises is the level of efficiency of capital. Efficiency of capital of the Arctic regions is presented in Table 3.

**Table 3. Comparative dynamics of efficiency of capital of the Arctic regions by type of activity "Mining", rubles.**

| Regions                      | 2016 | 2017 | 2018 | 2019 |
|------------------------------|------|------|------|------|
| Nenets Autonomous Okrug      | 0.35 | 0.36 | 0.41 | 0.37 |
| Murmansk Region              | 0.53 | 0.42 | 0.37 | 0.49 |
| Yamalo-Nenets Autonomous Okrug | 0.29 | 0.31 | 0.35 | 0.33 |
| Chukotka Autonomous Okrug    | 1.64 | 1.19 | 1.15 | 0.24 |
| Russian Federation           | 0.55 | 0.58 | 0.68 | 0.62 |

It should be noted that for the period 2016-2019 three Arctic regions (Nenets Autonomous Okrug, Yamalo-Nenets Autonomous Okrug and Murmansk region) lag behind the indicators of the Russian Federation. For the Chukotka Autonomous Okrug the lag from the national average values is typical in 2019 which can be explained by a decrease of the volume of shipped goods of its own production, performed work and services by the type of activity "Mining" by 82.7%.

An equally important indicator that determines the efficiency of mining and processing of minerals is the degree of depreciation of fixed assets. Data for the Arctic regions for this indicator are presented in Table 4.

The minimum depreciation of fixed assets among the Arctic regions is typical for the Nenets Autonomous Okrug and the Yamalo-Nenets Autonomous Okrug (in 2019) the maximum - for the Chukotka Autonomous Okrug which is characterized by an excess of the national average values.

**Table 4. Depreciation of fixed assets of the Arctic by type of activity "Mining" (at the end of the year; percentage) [11].**

| Regions                      | 2016 | 2017 | 2018 | 2019 |
|------------------------------|------|------|------|------|
| Nenets Autonomous Okrug      | 43.1 | 45.4 | 50.1 | 52.0 |
| Murmansk Region              | 53.3 | 53.0 | 53.9 | 52.0 |
| Yamalo-Nenets Autonomous Okrug | 47.1 | 49.5 | 51.5 | 50.7 |
| Chukotka Autonomous Okrug    | 57.8 | 51.7 | 59.5 | 65.1 |
| Russian Federation           | 54.9 | 56.4 | 57.8 | 58.4 |

The results of calculating the development level of the production potential of the Arctic mining sector are presented in Figure 2.
Figure 2. Production potential of the Arctic mining sector.

The highest value of the production potential is typical for the Nenets Autonomous Okrug, the lowest for the Murmansk Region and the Chukotka Autonomous Okrug (in 2019). For the analyzed period only the Chukotka Autonomous Okrug was characterized by negative dynamics of production potential.

It should be noted that in terms of production potential the Arctic regions are ahead of the average Russian values. At the same time the Arctic regions are characterized by a low level of innovation activity (Table 5).

Despite the growth in the share of innovation products in the Murmansk region and the Yamalo-Nenets Autonomous Okrug the values are lower than the national average. Chukotka Autonomous Okrug is characterized by negative dynamics of the volume of innovation products.

Table 5. Share of innovation goods, works, services in the total volume of goods shipped, works performed, services of industrial organizations.

| Years       | 2016 | 2017 | 2018 | 2019 |
|-------------|------|------|------|------|
| Nenets Autonomous Okrug | 0.0  | 0.0  | 0.0  | 0.0  |
| Murmansk Region      | 1.1  | 0.9  | 0.5  | 5.6  |
| Yamalo-Nenets Autonomous Okrug | 0.1  | 0.0  | -    | 0.4  |
| Chukotka Autonomous Okrug | 0.7  | 1.0  | 0.5  | 0.4  |
| Russian Federation   | 8.4  | 6.7  | 6.0  | 6.1  |

Among the key problems and risks characterizing the current state of the Arctic mining sector one can note the insufficient level of implementation of innovation technologies and technical means for prospecting, exploration and enrichment of minerals in relation to northern conditions requiring the development of a paradigm of a complex balanced mechanism for the implementation of scientific and technological development [16-19].

For the implementation of innovation projects in the mining sector of the Arctic economy it is necessary to conduct scientific research for the expansion and complex exploitation of the subsoil resources, develop and introduce low-waste resource-saving technologies, greening production and
ensuring the competitiveness of the mining sector. The introduction of modern innovation technologies is of great importance for mining enterprises [20].

4. Conclusions
The performed analysis of the production potential of the Arctic mining sector showed significant differences in the functioning of industrial enterprises in the Arctic regions. Thus, the extraction and processing of minerals in the Arctic regions accounts for more than 50% of the added value and about 60% of tax revenues to the budgetary system of the Russian Federation.

It is determined that the most significant production potential of the Arctic mining sector is typical for the Nenets Autonomous Okrug and the minimum - for the Murmansk Region and the Chukotka Autonomous Okrug. At the same time, it is shown that in terms of production potential the Arctic regions are ahead of the average national values but are characterized by a low level of innovation activity.

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