Regional economy: an innovative project for the infrastructural development of the Arctic territories

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Annotation. The presented study on the assessment of the readiness of industrial enterprises in the Arctic zone to develop breakthrough, competitive domestic technological solutions is based on presidential decrees and state programs for the strategic development of Russia. Domestic industry is the main driving force of the economy of the country and its Arctic territories, which should use its production capacities in industries requiring high-tech production projects. Such industries include building sector, transport, the fisheries complex of the Russian Federation and many others, in which there have been no significant changes in the production of environmentally friendly, sustainable and cost-effective materials for a long time. As part of the study, an innovative project for the development of the Arctic territories is presented, which is based on the launch of industrial production of domestic innovative building material "cellular nanocement" / "3C gas-fiber concrete". As part of the solution of the strategic objectives set by the President of the Russian Federation to intensify and accelerate the development and protection of the Arctic territories, the development of science, education, the digital economy, etc., reflected in the Decree of the President of the Russian Federation “On National Goals and Strategic Tasks of the Development of the Russian Federation for the Period until 2024” from May 7, 2018, the interdepartmental integrated target program "Arctic Technologies" developed by the Ministry of Education and Science together with the Ministry of Defense of the Russian Federation in accordance with the instruction of the President of The Russian Federation from May 18, 2017 No. Pr-963. The presented innovative project will make it possible to provide demonstrative comprehensive achievement of goals and objectives as soon as possible, to obtain a full-fledged Arctic technology and product that are the sought-after advanced technological solutions and materials for solving breakthrough scientific, technological, industrial and socio-economic development both in the Arctic zone of the Russian Federation and and in the country as a whole.

1. Introduction
The management of socio-economic transformations in Russia is carried out within the framework of the program-targeted approach, the fundamental regulatory acts of which are the Constitution of the Russian Federation, federal laws, economic development strategies, state programs of the Russian Federation and the Arctic subjects of the Russian Federation, which determine the priorities of the implemented state policy of the Russian Federation not only in the scale of the country, but also in the Arctic [1].

The presented research is based on an innovative project, which in the shortest possible time can really provide demonstrative comprehensive achievement of the goals and objectives set by the President of the Russian Federation V.V. Putin, and reflected in such systemic documents as “The
Strategy for the Development of the Building Materials Industry for the Period Until 2020 and the Future Prospect until 2030” developed in accordance with the order of the Government of the Russian Federation from May 10, 2016 No. 868-p [3]. Decree of the President of the Russian Federation “On National Goals and Strategic Tasks of the Development of the Russian Federation for the Period Until 2024” from May 7, 2018, as well as the interagency integrated target program “Arctic Technologies” developed by the Ministry of Education and Science together with the Ministry of Defense of the Russian Federation in accordance with the instruction of the President Of the Russian Federation from May 18, 2017 No. Pr-963, focused on the implementation of breakthrough scientific, technological, industrial and socio-economic development of Russia, in particular in the Arctic zone of the RF [2].

The aim of the innovation project is the development and subsequent implementation of qualitatively new innovative intersectoral integrated solutions to problems related to environmental safety and negative environmental impact (including cumulative one) in the activities of regional industrial enterprises, the emergence of which will lead to a significant increase in the quality of life and economic efficiency activities in key sectors of the Arctic zone of the Russian Federation [4].

2. Main part
In modern conditions, taking advantage of the existing groundwork of innovative organizations in Russia, there is a need to create and consistently introduce advanced diversification products and technologies that will not only intensify the growth of economic potential by obtaining a product with high added value that is in demand in the world, but also ensure a comfortable living for a person in the Arctic zone of the Russian Federation, including the conditions of the Far North [12].

In the framework of the implementation of the presented project, in order to comprehensively solve the existing problems of socio-economic development of the Murmansk region, it is proposed to consider the possibility of using the potential of technology and the production of innovative building material, which is “cellular nanocement” [6].

Being essentially a regional “anchor” product and technology, while creating the necessary innovation system, it provides not only a solution to environmental problems, but also a qualitatively new level of development of key sectors of the regional economy in the context of intensified development and use of the Arctic, as well as ensuring the security of the Russian Arctic zone Federation.

The production technology of "cellular nanocement" is a unique utilizer of industrial and consumer waste. As a secondary raw material in the production of this innovative building material, ash and slag of metallurgical production, wood processing products in the production of fixed monolithic formwork and other plant waste, as well as petrochemical waste, are used. The use of industrial waste will significantly reduce the consumption of natural resources, eliminates the need to build additional cement plants and develop new quarries, and save and protect the environment by ensuring that territories are cleared of existing accumulated dumps [11]. The problem of expanding intersectoral cooperation is being solved, which in essence is the basis for the production of "cellular nanocement".

Thus, we are talking about the presence in this chain of intersectoral cooperation in the structure of production of “cellular nanocement” a multiplicative model that determines the economic efficiency of this production in the structure of the regional economy.

As a result of the creation of innovative production, it will be possible to obtain a universal product that opens up unlimited possibilities for its application to ensure the development of the Arctic territories and in the areas of industrial production, defense and emergency response, as well as guaranteed improvement in the quality of life of the population living and working in the Arctic zone if it will be used during construction works: [7], [8].

An integrated plan of activities within the framework of the proposed innovative project includes:

a. launch of three stages of production of “cellular nanocement” on the territory of the Arctic zone of the Russian Federation and the corresponding raw material base adapted for solving core tasks;
b. obtaining an industrial design of a product of a given quality within the framework of a specific raw material base for solving research problems, improving and testing industrial application technologies;
c. protection of intellectual property rights, as well as certification of high quality products;
d. on the basis of the launched industrial-experimental site, scientific and industrial potential is involved, the product is modified to obtain the specified characteristics of the material, adapted to solve the problems of development and protection of the Arctic territory;
e. implementation of the list of breakthrough technological developments obtained for the formation of advanced integrated solutions for industrial applications of the obtained universal innovative building material;
f. generalization of the results of practical testing of innovative developments obtained in the joint implementation of construction work with the customer;
g. conducting further research in the field of the entire possible spectrum of application of the obtained technologies and innovative building material, to develop highly environmentally friendly and cost-effective solutions in the field of infrastructure development;
h. development of information and analytical material in the field of supporting industrial applications, as well as informing about the achievements, properties, condition and prospects of development and application;
i. organization of training in working with technology and an innovative product in the field;
j. adaptation and refinement of the technical and technological components of the mobilization of production for the purposes of subsequent replication and the possible conversion of the military-industrial complex;
k. implementation of the produced material to the target customer, represented by specialized construction organizations, as well as the Ministry of Defense and the Ministry of Emergencies in the framework of the development and protection of the Arctic territories, and the prompt emergency response.

The innovative project involves the construction of a plant in the Murmansk region for the production of cellular concrete of the latest generation using the “Composite Cellular Concrete” technology.

The design capacity of the production of dry mixes with a 1-shift operation will be ~ 1.4 thousand tons per month (7 tons / hour).

A promising related activity related to the use of dry building mixes from aerated concrete ZS is the production of wall panels.

The total investment in the project is 113 million rubles.
The composition and structure of investment are presented in tables 1,2.

**Table 1. Investments**

| Project investment                      | Value  |
|----------------------------------------|--------|
| Total, in particular, thousand rub.    | 113262 |
| Preparatory work, thousand rub.        | 20342  |
| Equipment and machinery, thousand rub. | 92149  |
| Current assets, thousand rub.          | 771    |

**Table 2. Indicators of investment and economic efficiency**

| Project Investment Indicators          | Plant dry mixes |
|----------------------------------------|-----------------|
| Net cash flow (FCFF), thousand rub.    | 93823           |
| Net present value of the project (NPV),%| 14637           |
| Internal rate of return (IRR),%        | 24              |
| Discount rate of return (PI), times    | 1.1             |
| Simple payback period (PBP), years     | 4.2             |
| Discount payback period (DPBP), years  | 6.0             |
| Discount rate, %                       | 19.3            |
| The period of calculation of integral indicators, years | 7 |
Table 3. Economic indicators of the project

| Economic indicators                                               | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 |
|------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|
| Sales revenue (excluding VAT), thousand rub.                      | 22259  | 85108  | 94273  | 94273  | 94273  | 94673  | 94273  |
| Production costs (excluding VAT), thousand rub.                   | 2814   | 65165  | 69815  | 69790  | 69765  | 69739  | 69714  |
| Profit before tax,% and amortized one. (EBITDA), thousand rub.   | 6601   | 34256  | 38771  | 38796  | 38822  | 38847  | 38872  |
| Profit before tax and% on loans (EBIT), thousand rub.            | -555   | 19943  | 24458  | 24483  | 2458   | 24534  | 24559  |
| Net profit, thousand rub.                                        | 6601   | 30379  | 33880  | 33900  | 33920  | 33940  | 33961  |
| Net profit margin,%                                              | 19     | 21     | 21     | 21     | 21     | 21     | 21     |
| EBITDA margin,%                                                  | 30     | 40     | 41     | 41     | 41     | 41     | 41     |

The final indicators of the project attest to a high economic and investment attractiveness, as well as the feasibility of its implementation, due to the following parameters being observed:

a. values of the net present value of the project (NPV) and internal rate of return (IRR) are positive values;
b. the project is characterized by a short payback period (PP, DPB) of investments;
c. the internal rate of return (IRR), the rate of return on discounted costs (PI) and other indicators show high values;
d. the project has a sufficient margin of safety.

For example, an innovative product has the following characteristics:

Environmental friendliness. In terms of its environmental characteristics, AP is comparable to the most environmentally friendly material - wood. During the construction of residential and industrial buildings from this material, toxic, fire hazardous materials and heaters (such as polystyrene foam, stone wool, gas silicate block) are not used, which ensures maximum environmental safety of objects (zero MPC). The environmental cleanliness of the raw materials used guarantees the complete safety of products from 3C both for humans and animals.

Moisture resistant. 3C is not afraid of moisture. When properly manufactured, 3C does not pass water through itself, retaining a small amount of moisture in direct contact with water.

Thermal insulation indicators. The use of gas-fiber concrete in the construction of buildings and structures can reduce heat loss by an average of 2 times. This means that heating or cooling a room will require significantly less heat or electricity.

High frost resistance. 3C allows to provide high frost resistance (more than 100 cycles), which will significantly extend the operation of any building, regardless of climatic conditions.

Fire safety. Gas-fiber concrete 3C is an absolutely non-combustible material. Class A-1.

The complete technological chain will consist of organizing a highly environmentally friendly full cycle of production of nanomodified cement - Composite Cellular Concrete - without the need to build a full-scale plant with kilns and quarries within two functioning technological lines, and a technological line for the production of molded wall panels and complex elements, with the delivery system of the finished product to the customer. The raw materials for the production of a unique innovative high-quality building material are planned to be obtained from the existing natural resources base of the project implementation area, including through waste processing and low-quality clinker, which makes the production fully green. In the process of production of innovative building materials, waste will also be used as raw material (their processing will be ensured), and the production itself, in contrast to the work of a traditional cement plant, will be non-waste and completely environmentally friendly.

The use of nanotechnology in the production process allows us to achieve a significant simplification of the technology for producing “cellular nanocement” in any conditions of the Arctic territories, making it possible to manufacture and use concrete at the construction site and to obtain the required concrete
grade only by adjusting the proportions of water. Given the increasing shortage of sources of fresh drinking water, a transition to the use of sea water in construction is provided as a solution implemented in the technology.

For example, imagine the possibility of using an innovative product in such industries as construction and transportation [9], [10].

Construction. Finished cast structures made of this innovative building material can be used for year-round accelerated monolithic construction and the construction of high-strength fortifications, prefabricated roads and airfields, tunnels, bridges, moorings, barrage structures, port infrastructure facilities, protective structures in emergency situations.

Application options: low-rise (including cottage) housing construction; multi-storey housing construction; infrastructure (local area); urban landscaping (small architectural forms).

Advantages of use: a radical increase in speed and quality with a significant reduction in the cost of construction; unique technology allows to make a full construction cycle: from the installation of foundations, the construction of colored walls and flat roofs to the finish with architectural elements.

Housing: the cost of building a low-rise building from 3C: 26% cheaper than from a ceramic block; 22% cheaper than aerated concrete.

A house from the AP is being built: 3 0% faster than a house from a ceramic block; 2 7% faster than aerated concrete house.

Variants of application in low-rise housing construction: a lightweight foundation device in the form of a pillow; basement trim; blind area device; pouring floors; the device of monolithic walls and ceilings; flat roof device; Finishing the finished building with architectural elements.

Variants of application in multi-storey housing construction: arrangement of external walls; pouring floors; internal partitions. Effect: saving materials by reducing the load on the foundation; increase in service life due to decrease in deformation.

Advantages of Composite Cellular Concrete in road construction.

The advantages of AP are obvious and impressive, especially when applied to the foundation of roads on peat-bog soils:

a. capillary interruption. 3C reduces (in some cases completely eliminates) the effect of moisture on the structure (frosty heaving). 3C creates a rather rigid foundation, in comparison with discrete materials, which increases the lifespan of roads;

b. cost reduction. 3C reduces the weight of the structure, it is especially effective on weak and flooded soils, while the thickness of the road "clothing" and its cost are sharply reduced;

c. ease of use. 3C has a liquid consistency and is not affected by surface roughness. Monolithic cellular concrete can be poured and trimmed to the desired thickness.

d. reduction in the volume of work. 3C usually requires 3 to 4 times less thickness compared to traditional materials (sand, gravel) and thus the depth of the trough decreases sharply;

e. protection in bad weather conditions. 3C protects the base from softening during precipitation and when the soil freezes;

f. reduced collateral damage - compaction of bulk materials can disrupt and weaken the base soil. 3C is bottled in liquid form; accordingly, there is no need for pressing or vibrating.

Recommended by The Ministry of Transport. Taking into account the presented advantages of the AP, the Ministry of Transport highly appreciated the prospects for its use and recommended it for use and public procurement as an innovative material, universal in application.

The above examples, not even in full, indicate a pronounced transport and infrastructure component, as key areas of scientific and technological development of the Arctic zone.

3. Conclusion

The implementation of the project will increase the effectiveness of breakthrough scientific and technological developments in the military-industrial complex, the fishery complex (RCC) in the civilian sphere and the country's defense in the interest of creating promising innovative products that can ensure high-quality infrastructure development and implementation of advanced development and
protection of the Arctic territories, while solving a wide range of social and defense tasks assigned to the state as a whole and the armed forces of the Russian Federation.

In the structure of the economy of the Arctic territory, the launch of production and the development of technology of cellular nanocement will allow launching a multiplier effect and ensure intensive economic growth, create jobs, provide gross regional product growth, and provide a solution to the complex of accumulated social problems (dilapidated housing and waiting lists for the new ones). To form an innovative competitive and highly efficient regional industrial building complex that unifies technological solutions for various classes of industry tasks, ensure the development of port infrastructure, and form an innovative production cluster in the region. To ensure high social and economic effects in the shortest possible time, to form a market for unique primary building materials, and to solve infrastructure problems. To provide a positive assessment of regional sectoral development, ensure the development of partnerships and strengthen cooperation with foreign partners and investors. To ensure access to the full implementation in the region of a production development model (in exchange for raw materials) and to increase the export component of a high-quality finished product that has no world analogues when using its own raw materials base (which significantly reduces the cost of production), i.e. adequately and economically use the full potential of the region and its resource base in the manufacture of the finished product. In addition, the implementation of cellular nanocement technology will also make it possible to attract international investment, develop the Arctic territories and gas and oil projects, solve the problems of conservation of abandoned mines and delfs, solve heating problems and heat saving problems, ensure the development of energy-saving technologies and become their foundation.

To ensure the development of transport and port infrastructure, support for innovative enterprises and industries (small businesses). To lay guarantees of safe ecological and sustainable development of the region, where the likelihood of industrial and social disasters and risks is minimized (flooding, breakthroughs of heat communications, collapse of buildings and structures, etc.). To accelerate the pace of construction with low deadlines and minimum resources, significantly (at least 2 times) reduce the cost of construction and reduce the burden on the municipal and regional budget (including the federal one), which will form a positive assessment from the Federal Center. It also ensures the formation of a new construction environment and market in the region (multiplier effect), environmental friendliness of construction and the construction of energy and heat-efficient structures, which is important in the context of the implementation of Arctic projects taking into account climatic conditions and restrictions. Opportunities for reconstruction, restoration and repair (including those in the RCC) appear and they are fully implemented, being based on advanced and highly efficient technological solutions. Innovative building material will provide an opportunity for the implementation of the most daring architectural solutions, with a low cost for the subsequent operation of constructed objects. Moreover, in the production, waste from other industries (ash, slag, etc.) is used as components, which makes it possible to use cheap raw materials, to utilize waste and process waste, which also indicates environmental friendliness and high efficiency and social significance.

During the implementation of the project, a combination of such program areas is ensured as: sustainability of the use of natural resources, environmental friendliness of production and technologies, the formation of revolutionary technology for affordable, highly environmentally friendly construction, waste management and recycling, raw materials and mineral base treatment, research and innovation in new industries and industries that will undoubtedly affect cross-border cooperation, exploration of mineral deposits in order to build the potential of the economy that in the conditions of the Arctic territory, the innovative solution of environmental problems through a new class of high-tech building materials, etc. According to the specifics, features and nature of the project to launch environmentally friendly production, involving the processing of waste, it meets the requirements of the priority national project "Clean Country".

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