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Sustainable Development of the Russian Arctic zone energy shelf: the Role of the Quintuple Innovation Helix Model

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Abstract Russia is one of the most important players in the Arctic zone energy shelf with significant economic, security, and political interests in the region. This is primarily because of significant natural resources, in particular oil and gas, on the Russian Arctic territories. Arctic has considerable strategic importance to the national economy. The objective of this paper is to develop the concept of sustainable development of the Russian Arctic zone energy shelf within the framework of the Quintuple Innovation Helix Model which focuses on university-industry-government relations, public and civil society, and the natural environment. The paper presents main characteristics of the Russian Arctic and Arctic's oil and gas recourses. We determined the strategic importance of the Russian Arctic as a wealth of petroleum and mineral resources. We offered economic and socioecological approach to the Arctic's sustainable development and paid special attention to the creation of centers of economic growth through the public-private initiatives aimed at knowledge and innovation production and transfer. We estimated social and economic potential of oil and gas shelf projects through the analysis of the possible risks and expectations of main stakeholders. The sustainable development of the Russian Arctic zone energy shelf represents an area of economic, ecological, and social concern, to which the Quintuple Helix innovation model can be applied with greater potential. The Quintuple Helix supports here the formation of a win-win situation between ecology, knowledge, and

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innovation, creating synergies between economy, society, and democracy, what is the good basis for sustainable development of the Arctic territories and implementation of Arctic Shelf projects.

Keywords Arctic · Sustainable development · Arctic Energy Shelf · Russia · Oil and gas · Shelf projects · Quintuple Helix · Innovations

Introduction

Russian Arctic zone energy shelf is a major area. The continental shelf of Russia is one of the longest in the world. Its area is more than 5 million square kilometers. From being regarded almost like a restricted area, the Arctic has become a global concern (Moe 2016).

The majority of the proven reserves and forecast resources of Russia is located on the Arctic territory. It produces more than 96% of the platinum metals and more than 90% of nickel and cobalt; it is extracted about 80% of Russian gas and 60% of oil, about 60% of copper. In different raw material production (nickel, cobalt, diamonds, platinum metals, oil and gas, rare earth metals, etc.), the Russian Arctic plays a significant role in the world (Pavlenko 2013).

In 2008, the United States Geological Survey (USGS) estimated that the Arctic might contain 13% of the world's undiscovered oil and 30% of its undiscovered gas (Gautier et al. 2009). Of these hydrocarbon resources, 84% were believed to be offshore and most of them are not distributed: the highest concentrations are expected to be in north of Alaska and in the western part of Russia (Moe 2016).

Russia is highly dependent on petroleum revenues (Moe 2016). Oil and gas resources are vital to Russian national security and economy; oil and gas alone account for roughly 20–25% of Russian GDP (Simola et al. 2013). Russia's domestic social programs, infrastructure investments, and military modernization are all critically dependent on revenues from natural resource export (Kapyla and Mikkola 2013).

Arctic has been proclaimed as the resource base of the twenty-first century (Moe 2016). As it was noted above, Arctic plays an increasing role as a strategically vital resource base for Russia (Kapyla and Mikkola 2013). The Russian Arctic Shelf in the future can become the main source of hydrocarbons for both Russia and the world market in the whole. Its industrial development in some circumstances of oil and gas price increasing as well as in terms of emerging of new knowledge and technologies may compensate decrease in oil and gas production in the old deposits in Russia. The special role in this issue is assigned to up-to-date extraction technologies and oil and gas recovery technologies, providing energy effectiveness and ecology safety (Cherepovitsyn and Ilinova 2016; Ilinova and Dmitrieva 2016a, b; Zyrin and Ilinova 2016), and also to the sustainable development of the Arctic zone energy shelf, based on innovations and economic and socioecological approach to rational subsoil usage. Due to the fact that Russia's mature hydrocarbon sources in Western Siberia are slowly drying up, extensive strategic importance of the Arctic hydrocarbons considerably increases.

Sustainable development of the Arctic Shelf puts on a par with the development of space technologies and nanoindustry, because the Arctic territories development in general and implementation of large-scale oil and gas shelf projects in particular will require cutting-edge technologies and knowledge, and sophisticated advanced technical equipment, which includes ships, drilling platforms, underwater mining complexes, various geophysical and navigational instruments, and others; and long-term geological exploration is required to actually locate hydrocarbon resources and confirm reserves (Moe 2016). Nowadays, Russia aims to develop critical infrastructure in the Northern Sea Route, including ports, search-and-rescue centers, ice-breaking capability, and oil spill response capabilities. In addition, non-maritime parts of the Arctic transport system—pipelines, aviation routes, railways, and roads—and the overall socio-economic conditions of the region require development and modernization (Kapyla and Mikkola 2013).

Development of the Russian Arctic Shelf, characterized by really high capital intensity (for example, drilling offshore in 3–5 times more expensive than on land), requires new scientific based approaches to sustainable long-term development of the Arctic territories in the light of economic, environmental, and social issues.

But it is important to note that in Russia, national policy is crucial, pushing, or holding back development of oil and gas shelf projects, and each major oil and gas investment project has its specifics (Moe 2016). The comparative look at offshore and onshore oil and gas projects presents in Table 1.

The latest hydrocarbon activities in the Russian Arctic zone have taken place primarily through onshore projects in Yamal Peninsula and in emerging offshore

Table 1 Comparative look at offshore and onshore oil and gas projects

Components of the project	Onshore project (old deposits in West Siberia)	Offshore project (Arctic Shelf project)
Geological exploration	High degree of geological exploration; general tendency to exhaustibility of reserves; as a rule additional exploration is required	Low degree of geological exploration; seasonality of activity
Development and operation	Relative stability of weather conditions; existence of standard technical and technological decisions depending on geological and working conditions	Ongoing monitoring of weather conditions and conditions of technical and technological systems (wave forces, icing, icebergs and ice pack); complicated processes of towage and installation of a platforms and well-drilling. The limited number of personnel on a platform
Logistics	Balanced system of oil gathering and transportation (availability of pipelines systems) and transportation of personnel and materials. Availability of highways (winter roads) and railway transport	Important role of a sea transport; lack of a railway transport; complicated and dangerous process of transportation of personnel and materials
Infrastructure	Developed in the majority of regions	Is absent or requires reconstruction and expansion (social infrastructure, airports, ports, railway system, plants and storages, and others)
Ecology	Wide experience of elimination of oil spills. Emergencies have influence only one region	Large-scale consequences of possible technogenic accidents (Arctic region influences an ecosystem of the whole world). Existence of natural and fishery reservations

projects on the Arctic seas such as Barents, Pechora, and Kara Seas. These offshore projects have often connected with joint ventures between Russian and other countries (Kapyla and Mikkola 2013).

The commercial attractiveness of many Arctic projects is questioned (Laruelle 2014); economic efficiency of offshore oil and gas projects in the current conditions is low. Research conducted by the authors of this paper in 2011–2012 proved that these projects can be marginally profitable. The detailed calculations obtained on the basis of data of the Gazprom company present that in case of oil price, about 80–90 dollars for barrel internal rate of return (IRR) of main oil and gas shelf projects is around 6–10%. The effectiveness of the shelf projects was estimated by region. For example, in Barents Sea region, IRR of shelf projects was around 10%, in Pechora Sea region—around 7%, and in Kara Sea region—around 6%. Considering the oil price nowadays (50–55 dollars for barrel), it is logical that IRR considerably decreased.

The Soviet Union started seismic surveying in the Barents Sea in the 1970s. In the 1980s, gas fields in the «super-giant» category in the Russian Barents Sea were revealed. In the Pechora Sea, a number of promising geological structures were identified. In the 1990s, exploration activity declined dramatically for both financial and organizational reasons (Austvik and Moe 2016).

The degree of oil and gas fields' exploration and the ratio of reserves and resources by three seas having the largest hydrocarbon deposits are shown in Fig. 1.

As we can see from the diagram, the degree of exploration on the North seas is low (around 10–16%). Now therefore, the most part of the Russian Arctic Shelf is explored poorly that means need of intensification of large-scale exploration activity and huge investments.

But there can be no doubt that resources are one important driver of Arctic development, which depends on the world oil prices and development of marine and non-maritime parts of the Arctic transport infrastructure, as well as on innovative technologies in geological exploration, oil and gas production, and transportation. Thereby, it is possible to assume that Russian Arctic zone energy shelf will be locally developed from the most profitable oil and gas projects in the

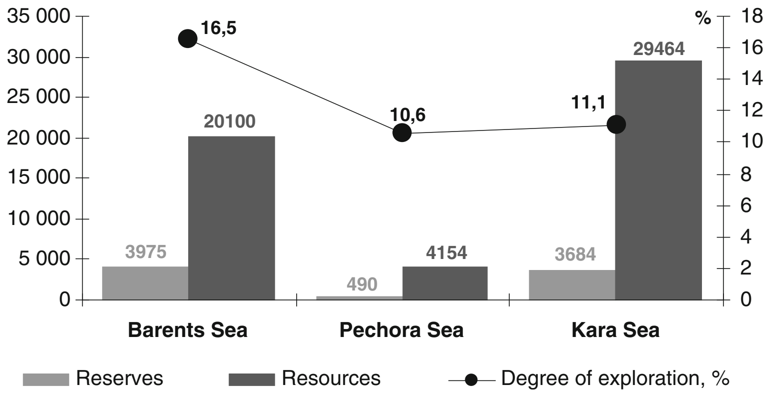


Fig. 1 Reserves and resources on the North seas. Source: basic framework of the program of complex development of hydrocarbon resources of the northwest region of Russia till 2020. Russian Petroleum Geological Institute

Western part of the Arctic to the remote fields in East Arctic. Many promising investment opportunities remain, but they require advanced technologies, capital, and skillful management.

Considering the facts that there are a fragile ecosystem in the Arctic and also undeveloped transport system, low level of economic development, and other complexities, it is necessary to estimate possible influence of oil and gas projects on ecological, social, and economic environment. And also, it is necessary to estimate main risks and expectations of stakeholders in the Arctic and the role of innovations in oil and gas projects' implementation.

Literature Review

Despite the wide range of existing papers devoted to different aspects of Arctic zone development (Howard 2009; Henderson and Loe 2014; Austvik and Moe 2016; Moe 2016, among many others), no optimal strategic approach that takes into account peculiarities of the Arctic territories and necessity of their sustainable development focused on environment, innovations, and society has been found.

Previous studies have addressed geopolitics issues on Arctic territories (Blunden 2009; Claes and Osterud 2010; Blunden 2012; Rowe and Blakkisrud 2014; Tamnes and Offerdal 2014), policy interests of different countries in the Arctic (Conley and Kraut 2010; Heininen 2012; Kapyla and Mikkola 2013), Arctic energy policy and energy security (Overland 2010, Peimani 2013, Tamnes and Offerdal 2014), oil and gas perspectives in the Arctic (Zysk 2011; Keil 2012; Conley and et al. 2013; Henderson 2014; Austvik and Moe 2016), Russian thinking, policies, and challenges in the Arctic (Laruelle 2014), and others. Previous research has also addressed questions concerning Arctic economics (Conley and et al. 2013).

From the point of view of government regulation, many state documents have considered strategies of different countries in the Arctic (Finland's Strategy for the Arctic Region 2010, Kingdom of Denmark Strategy for the Arctic 2011–2020; Norwegian Government's High North strategy 2006; Sweden's Strategy for the Arctic region 2011, and US National Strategy for the Arctic Region 2013).

The development of the Arctic region in Russia is governed at the state level by a set of different legal documents. The main document is "The Strategy of developing the Arctic zone of the Russian Federation and national security system for the period till 2020." Analyzing the main acts and documenting it are possible to conclude that most likely, it has a theoretical character than practical. So, for example, according to the mentioned strategy of Arctic region's development till 2020 as in many other documents, there are the main aims, tasks, methods, and directions of the strategy's realization in a form of thesis; however, there are not clear specific activities and measures which could lead to the goal achievement. In addition, the weakness is a monitoring providing and a control of goal realization and appointing people who will be in charge of achievement of declared results (Ilinova and Dmitrieva 2016a, b). Russia does not have a comprehensive strategy in the form of an integrated and coordinated policy in the Arctic (Laruelle 2014). Even though a document entitled "Strategy for development of Russia's Arctic zone" was adopted in 2013, this observation still stands.

Many papers present case descriptions related to the Arctic and discuss such issues as geopolitics, politics interests, energy security, and others. A lot of papers devoted to oil and gas projects also are narrative and many papers are op-ed articles. However, there are no research papers focusing specifically on sustainable development of the Arctic with suggesting certain science-based approach to this issue.

Many papers use simplistic underlying approaches and assumptions, taking a one-size approach to a very complex issue like the increasing economic development of the Arctic region. In fact, activities such as increasing oil and gas development in the Arctic have different underlying issues that could be taken into account. They thus demand different scientific and academic approaches in order to guarantee sustainable development of the Russian Arctic. This paper sets out to offer a comprehensive approach to sustainable development of the Russian Arctic Shelf, based on innovations, ecology, and social environment.

Methodology

Russia has a primarily economically related interest in Arctic research, for example in studying its continental shelf. But Russia has been less concerned than Western nations with the theme of "sustainability" in its Arctic policy (Kapyla and Mikkola 2013). Offshore hydrocarbon deposits are becoming increasingly important in the handling of economic and environmental challenges.

Sustainable development concerns us all and takes place on the local as well as global level. Hence, sustainable development has to be understood in the context of economy, innovations, and society (Carayannis and von Zedtwitz 2005; Carayannis and Alexander 2006; Carayannis and Campbell 2011).

In the current academic debate, there is the concept of Triple Helix innovation model focuses on university-industry-government relations. The Triple Helix model (Etzkowitz and Leydesdorff 1995; Etzkowitz and Leydesdorff 1997; Etzkowitz 2008) has been used by many researchers and policy makers for understanding interactions between key actors in innovation systems. As sustainable development of the Russian Arctic Shelf should based on innovations and at the same time should focuses on ecology and social environment, the Triple Helix innovation model cannot be used as a methodological base for our research. A little later in academic debate appeared the Quadruple Helix Model which embeds the Triple Helix by adding as a fourth helix the media-based and culture-based public and civil society (Carayannis and Campbell 2009). The Quintuple Helix innovation model is even broader and more comprehensive by adding the helix of the natural environments of society (Carayannis and Barth 2012). The Quintuple Helix stresses the necessary socioecological transition of society and economy in the twenty-first century; therefore, the Quintuple Helix is ecologically sensitive (Carayannis and Barth 2012).

The nonlinear innovation model of the Quintuple Helix, which combines knowledge, know-how, and the natural environment system together into one framework, can provide a step-by-step model to comprehend the quality-based management of effective development, recover a balance with nature, and allow future generations a life of plurality and diversity on earth. The Quintuple Helix can be proposed as a framework for transdisciplinary (and interdisciplinary) analysis of sustainable development and social ecology (Carayannis and Campbell 2010; Barth 2011). These facts play a special role in sustainable development of the Arctic zone energy shelf. Thus, the goal of the Helix conception is accomplished through the resource of knowledge which produces additional value for society in order to lead in the field of sustainable development (Carayannis and Barth 2012).

The additional concerns raised by increased petroleum activity in the Arctic are currently leading to calls for greater attention to ecology and society. The Quintuple Helix supports here the formation of a win-win situation between ecology, knowledge, and innovation, creating synergies between economy, society, and democracy (Carayannis and Barth 2012). The importance of ecological aspect in sustainable development of the Arctic Energy Shelf cannot be overestimated. So, the sustainable development of the Arctic Shelf represents an area of ecological concern, to which the Quintuple Helix innovation model can be applied with greater potential.

Discussion and Main Results

Economic and Socioecological Approach to Arctic's Shelf Sustainable Development

Nowadays, the environmental opposition to Arctic oil and gas projects is minimal in Russia (Moe 2016). In the past, Russia has not given environmental problems as much attention as many Western countries have, but an energy policy has now been presented for the public discussion as a project of energy strategy of the Russian Federation for the period till 2035 (edition of February 1, 2017). The Strategy objectives include improved energy efficiency as well as limitation of the impact of the fuel and energy complex on the environment and climate. In this context, the concept of the Quintuple Helix innovation system is being analytically applied to the ecological (socioecological) issues of sustainable development of the Arctic Shelf. Socioecological approach to the Arctic offshore development can only be applied within a comprehensive program of Arctic zone development. Considering the low level of shelf exploration degree and low level of knowledge and technologies production related to Arctic in Russia, the program has to include intensive research and development (R&D) activity. The long-term program of Arctic zone development should consist of several subprograms aimed at comprehensive exploration of marine resources, reproduction and sustainable usage of bioresources, minimization of environmental impact during the geological exploration and oil and gas production and transportation, protection of the shelf against pollution, socio-economic and socioecological development of the Arctic zone, etc.

Economic and socioecological approach to Arctic's Shelf sustainable development is the only acceptable. In this case, there is a need to develop special forms and frameworks of regional environmental forecasts and environmental regulation of industrial activity in the Arctic.

Offshore recourse usage could be present as a set of specialized activities that are aimed at balanced economic development and achievements of sustainability of the ecosystems in the Arctic. We can mark three interrelated aspects of sustainable development of the Arctic Shelf in the context of offshore resource development (Fig. 2).

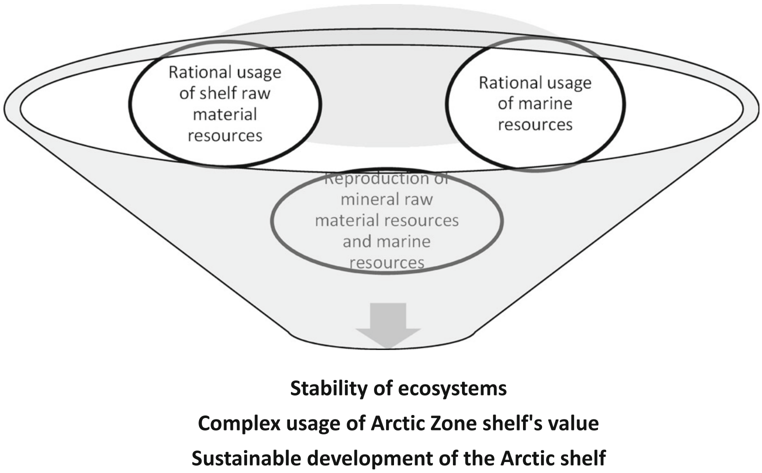


Fig. 2 Sustainable development of the Arctic Shelf

There are big differences in the role of the government as well as organization of offshore petroleum activity in the various Arctic countries. In the US, Canada, and Greenland, the initiative is clearly in the private sector. In Norway and Russia, the state is more directly involved, through its ownership in dominant companies as well as state development priorities (Moe 2016). That is why economic and socioecological approach should be the important part of policy regulation at the state level in Russia. In all Arctic countries, national policies are important, especially in Russia, pushing or holding back sustainable development of the Arctic zone.

Centers of Economic Growth and Interaction of Stakeholders

For sustainable development of the Arctic Energy Shelf, let us consider the possible scheme of interaction of main participants of its development. As it was mentioned above, the basis for Arctic's development has to be a comprehensive program which should include a set of subprograms related to oil and gas exploration and production, and processing and transport facilities, as well as development of different infrastructures (scientific, educational, innovative, and social). Within the concept of Quintuple Helix innovation model, such subprograms should serve interests of the government, local and international business, and educational and scientific organizations, as well as interests of civil society and environmental organizations.

Sustainable development of the Arctic Shelf should be directed to the creation of the centers for economic development (CED) (oil and gas business clusters). Creating of CED is possible through the public-private initiatives aimed at knowledge and innovation production and transfer. For example, the integration of local business with foreign companies that are involved in high-tech projects may be an effective channel for the knowledge transfer to local enterprises (Fig. 3). In many ways, the CED also initiates various forms of partnership between the government, universities, and local and international business in many sectors, and CED is capable to accelerate the implementation of technological and organizational innovations in difficult Arctic's conditions.

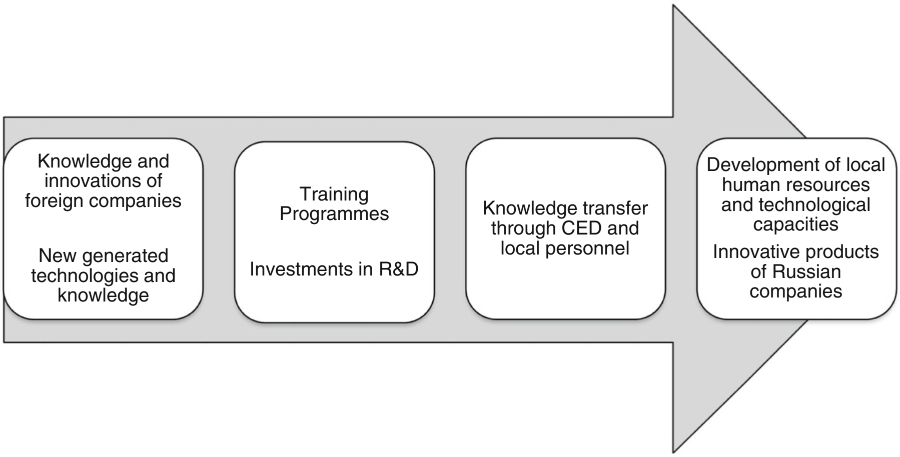


Fig. 3 Knowledge transfer through the CED and human resources in the Arctic zone

Development of the Arctic zone is connected with formation of direct and indirect effects within the CED. Macroeconomic effects appear in the following forms: attraction of investments to the region, development of innovative technologies, increase in budgetary revenues, indirect effect from various contracts in the region, and reduction of unemployment in the region. All of these effects are the building blocks of the economic multiplier effect, which was first designed by a team of scientists led by A. Arbatov (Arbatov 1988).

The principle of the multiplier is based on the interaction of different sectors and industries in the economy. In a simplified form, it can be described as follows: an increase in demand in one sector will automatically cause an increase in demand in other sectors that are technologically linked (Table 2).

Oil and gas shelf projects will give impetus to the activities of suppliers, shipbuilders, oil and gas service companies, transport companies, energy companies, and others. There is a series of «investment pulses» that intensifies economic development of the coastal areas in the Arctic. Foreign experience proved that the large oil and gas projects promote the rapid development of regional economy, because during projects' implementation, up to 80% of the activity connected with supplier and contractor companies in such sectors as metalworking, construction business, and engineering, as well as suppliers of equipment, materials, and other services. These facts proved by the oil and gas projects in Norway, the USA (Houston), and the UK (Aberdeen). (Cherepovitsyn 2011; Fadeev et al. 2012).

The main opportunities for the region and local business in the CED based on the criteria of economic, social, environmental, and technological efficiency are presented in Table 3.

Potential of Oil and Gas Shelf Projects

In implementation of oil and gas projects on the Arctic Shelf, the most important stakeholders are the local business (companies), federal and regional government, and local public. Economic and socioecological potential of shelf oil and gas projects can

Table 2 Characteristics of the multiplier effect

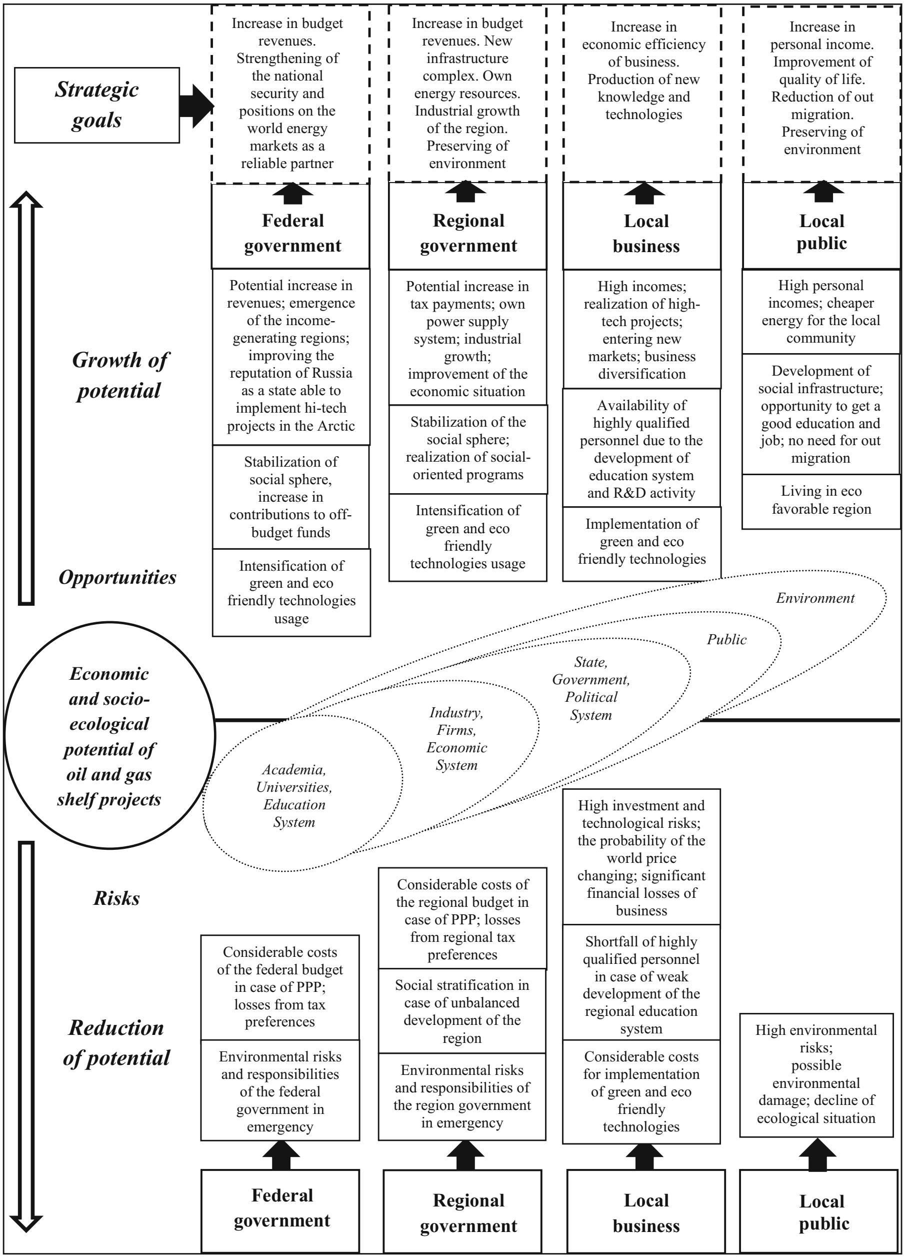
Basic characteristics	Multiplier effect
The content of the effect	Set of indirect effects which turn up in ability of oil and gas sector to cause intensive development of related industries, such as energy supply sector, transport, social services, and service business
Forms of effect's expression	Sales multiplier is formed by the use of common sales channels, common transport, and logistics infrastructure
	Production multiplier is formed by the increase of supply and demand on the resources and means of production in the region
	Income multiplier is formed by the increased wages, number of lease agreements, profits, etc.
	Employment multiplier is formed by the growth of industrial production and other spheres and by the growth of employment in the region

be estimated by the analysis of possible expectations and risks of main stakeholders (Fig. 4). Special attention in this scheme is paid to the Quintuple Helix innovation model which promotes growth of potential of oil and gas shelf projects. The goal and interest of the Quintuple Helix are to include public and natural environment as new subsystems for knowledge and innovation models. The natural environment is for the process of knowledge and innovation production, and their creation is particularly important because it serves for the preservation, survival, and vitalization of humanity (for the public) and the making of new green and eco-technologies. The Quintuple Helix model furthermore outlines what sustainable development might mean and imply for eco-innovation and eco-entrepreneurship in the current situation and for our future (Carayannis and Campbell 2010).

As it was noted above, oil and gas shelf projects have strategic importance for the world energy market and for the national economy as a whole. Such projects can become an essential source of budgeting in Russia. Let us now have a closer look at multiplier effect, which was presented above in our paper.

Table 3 Opportunities of the region and local business in the CED

Sphere	Region	Local business
Economic	Creation of competitive environment in the region. Increase of tax revenues and a number of profitable enterprises. Decrease of unemployment	Increase of productivity in a competitive environment. Enhancement of the cost optimization. A high probability of entering to the foreign markets
Public (social)	Intensification of the social programs. Development of social infrastructure for civil society. Improvement of quality of life	New jobs. Higher wages. Improving the ergonomics of work. New objects of industrial and social infrastructure
Environmental	Reduction of environmental damage because of development of high-tech energy-saving and eco-friendly industries	Increasing the implementation of energy-saving and eco-friendly technologies
Technological	Appears of high-tech industries and innovation-oriented companies in the region	Growth of innovative potential of the companies and its realization. The revival of R&D and high-tech business.



*PPP - public-private partnerships

Fig. 4 Economic and socioecological potential of oil and gas shelf projects

In Table 4, you can see the assessment of the total budgetary effect from the implementation of the two biggest shelf projects (Shtokman gas-condensate field and Prirazlomnoye oil field). The amount of the total direct budgetary effect was obtained from the program of development of resources of hydrocarbons on the shelf of the Russian Federation till 2030 (the program was developed by request of Gazprom

Table 4 Total effect at all-level budgets from shelf projects (Shtokman and Prirazlomnoye fields, West Arctic) by 2030, USD billion

Budget	Direct effect	Associated sector effect	Indirect effect	Total
Federal budget	4.1	4.92	0.9	9.92
Regional budget	1.05	1.26	0.23	2.54
Total	5.15	6.18	1.13	12.46

company). Distribution of budgetary revenues (federal and regional budget) is made in compliance with the operating tax system in Russia. The calculations of the total direct effect have been made for the 10-year period, based on the presumption that the large-scale production in two deposits starts in 2020. It is also supposed that the oil price is higher, in the range of 60 to 80 USD per barrel.

Then we applied the method suggested by Russian scientists (Arbatov 1988; Atnasheva and Konoplyanik 2001). Thus, by techniques of an assessment of multiplicative effect, 1 US dollar of the income from oil and gas production gives 1.2–1.5 US dollars of the income in the related industries (associated sectors). The related industries are manufacturing industries (metal working industry, mechanical engineering, shipbuilding, etc.). Indirect effects are consulting and services, social sector, etc. In general, indirect effect is on average estimated from 10 to 15% of the cumulative multiplicative effect.

Conclusions

The aim of this paper has been to go a bit beyond general sweeping statements about Arctic Shelf sustainable development, when it comes to dealing with the new issues, tasks, or challenges.

The challenges and opportunities of the Arctic Shelf development outlined above can be better understood and operationalized from a theory, policy, and practice set of perspectives via the Quintuple Innovation Helix Model which is a model of triple-bottom-line sustainable innovation and socio-economic development. The Quintuple Innovation Helix Model can tackle existing challenges of Arctic zone development through the application of knowledge and know-how as it focuses on the social (societal) exchange and transfer of knowledge inside the subsystems of a specific state or nation-state (Barth 2011). The "nonlinear" innovation model of the Quintuple Helix, which combines knowledge, know-how, and the natural environment system together into one "interdisciplinary" and "transdisciplinary" framework, can provide a step-by-step model to comprehend the quality-based management of effective Arctic development, recover a balance with nature, and allow future generations a life of plurality and diversity on earth (Carayannis and Campbell 2010; Barth 2011).

In the context of our case in point, the Arctic Shelf development should be based on the following issues:

- Creation of favorable investment and economic-right climate
- Environmentally balanced development of the shelf and coastal areas

- Coordinating the interests of all participants in the oil and gas project's implementation
- Development of regional innovative infrastructure to enable the innovation and knowledge production and transfer
- Creation of a scheme for risk sharing between the government, investors, and business
- Orientation on socioecological approach
- Accelerate technology commercialization (Carayannis et al. 2016), etc.

In summary, it should be noted that introduction and implementation of Arctic oil and gas projects strongly depend on tendencies of the world market of energy resources, in particular on prices of oil and gas. Therefore, large-scale development of Arctic oil and gas fields will be substantially connected with stable prices of oil, more than 80 US dollars for barrel.

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