
Enhancing the Efficiency of Oil and Gas Complex as a Basis for Ensuring Energy Safety

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Abstract:

Global development becomes more and more contradictory and dynamical. Russian oil and gas industry (OGI) work now in exhausted industrial potential mode. It faces significant problems preventing its development and threatening the Russia's energy security.

This article aims to discover ways to enhance efficiency of functioning of the OGI as the basis for ensuring of Russian energy security.

Findings and conclusions of the paper may be used in developing and enhancing both state and industrial instruments of enhancing efficiency of Russian OGI functioning.

Ways to address the main conflict of interests in the OGI between the state and the subsurface user, the elaborated system of administrative and economic measures aimed at increasing efficiency of the OGI functioning as the basis of Russia's energy security, ways to improve the organizational and managerial mechanism to enhance efficiency of the OGI functioning, as the authors suggest herein, are recommended for practical implementation.

Keywords: *Russian oil and gas industry (OGI), ways to enhance efficiency of functioning, innovation technologies, innovation strategy, energy security, conflict of interests.*

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1. Introduction

The authors consider useful and interesting to perform analysis of main approaches to enhancing the efficiency of the Russian OGI functioning, to elaborate ways of improving the organizational and management mechanism of increasing the efficiency of the OGI functioning based on the system approach as the factor of the country's energy security, to suggest priority measures of state regulation and stimulation of the Russian OGI development, to determine and substantiate the necessary conditions for realization of the OGI development innovation strategy with due account of the membership of Russia in the international economic organizations, to suggest and justify the priority ways to enhance the efficiency of the OGI functioning from the perspective of ensuring of the Russian energy security (Chernyaev, 2014; Rodionova *et al.*, 2017; Kreidenko *et al.*, 2017; Chernyaev and Rodionova 2017; Kovalev *et al.*, 2017; Kuznetsov *et al.*, 2017; Kuznetsov *et al.*, 2016; Chernyaev *et al.*, 2017).

The oil and gas industry and its role in Russia's energy security shall be the object of research. The complex of economic relations being formed in the process of discovering and realization of the main ways to enhance the efficiency of the OGI functioning as the basis to ensure the country's energy security shall be the subject matter of study. The anticipation of this research is based on the conviction that the efficiency of the OGI functioning in Russia is possible through the resolution of the conflict of interests between the state and a subsurface user (Ageev and Chernyaev 2012) more heavy state regulation of and control over the oil and gas industry (tax, customs, technical and environmental regulation); use of the potential of the public-private partnership (PPP) in implementation of innovative oil and gas projects; renewal of the legal framework regulating relations in the Industry; renewal of the organizational and management mechanism in the OGI; the development and implementation of new Innovation Strategy of the Industry development; increase of the oil recovery factor; the scientifically well-grounded integration of capabilities of open energy market, methods of state regulation, use of corporate instruments increasing economic efficiency in the Industry; recovery of public control over the system-forming companies; support of small and medium service companies in the OGI; identification of ways to enhance the efficiency of its functioning as the basis for the Russia's energy security.

2. Methods

In this study the system of methods that has been used includes the historical, comparative, systematic, statistical, normative analysis and forecast. We also used economic and mathematical methods and the expert's assessment methods. The alleged novelty of this article is in development of theoretical, methodical and conceptual ideas, and practical recommendations concerning development and enhancement of the efficiency of the oil and gas industry functioning as the factor

ensuring the Russia's energy security in the context of the world energy market changing.

Being governed in methods by the principles of the system approach and comparative analysis the authors suggested resolution of the primary conflict of interests in the OGI between the state and a subsurface user. Mining companies are interested in fast gaining of maximum profits, whilst the state, being the owner of subsoil resources, is interested in maximum possible efficient development of fields, in rational and environmentally sound approach to usage of natural resources. This conflict is supposed to be resolved through implementation of innovation technologies in the OGI.

There were also determined conceptual conditions for enhancing the efficiency of the oil and gas industry functioning connected with improvement of measures for government incentives of new technologies implementation, with development of new and abandoned fields with hard-to-recover resources of oil and gas, with implementation of major integrated organizational forms of doing oil-and-gas business, with support of small and medium service business in the OGI. The necessary conditions for implementation of the OGI development innovation strategy have been substantiated with due account of Russian membership in the international economic organizations. Main approaches to enhancing the efficiency of Russia's OGI functioning have been analyzed (Chernyaev, 2016).

Ways of enhancing the organizational and management mechanism increasing the efficiency of the OGI functioning based on the system approach as the factor of the country's energy security have been developed, which included determination of the OGI development strategy; modernization of geological prospecting operations; activation of national innovation potential; eco-economic innovations.

3. Results

Domestic practices of the OGI management are characterized by the stable structure of public regulation based on structural and functional approach that involves market regulation of the OGI. To build a complete picture the authors of the article suggested the following classification of approaches to increasing the efficiency of the OGI functioning in Russia: technical and process, financial and economic, and organizational approaches.

The financial and economic approach to enhancing the efficiency of the OGI functioning involves development of the existing and implementation of new mechanisms and instruments well-proved in the world's practice of the industry management. Development and government support of small and medium enterprises in the OGI must become a guideline to increasing the efficiency of the OGI functioning. Functioning of small oil and gas companies is based on the new structure of raw material base. Development towards that is only possible through

establishment of flexible and differential taxation system. This will enable to bring together a subsurface user and the state, being the subsoil owner, in issues of economic efficiency.

Today, Russia performs active design and development of such technologies. But conservativeness of the oil industry, which is quite understandable in present-day conditions, slows down the testing, follow-up and implementation thereof (Ageev and Chernyaev, 2010). Integration with foreign oil-and-gas companies helps to some extent but doesn't eliminate the problem. Attracting investments to innovation technologies is a main precondition of increasing the efficiency of functioning of both the oil and gas complex in whole, and vertically oriented national companies.

Diversification of the oil and gas industry through modernization of refining capacities is one of the most important components of stable long-term development of the OGI, of increasing its economic efficiency and, thus, ensuring the country's energy security. However, the low-pressure gas shall be the basic raw material for gas processing. For this purpose, large investment and development and implementation of innovative technologies will be required. Increase of relative capital investments into vertically integrated oil companies and the market demand in innovative solutions are explained by several factors, as named in Table 1 below.

Table 1. *Factors underlying increase of relative capital investments into vertically integrated companies and the market demand in innovative technologies*

No.	Description
1	Exploration and development of new fields in permafrost and in complicated natural climatic and subsurface conditions
2	Depletion of raw material base of the valid fields, growth of the share of wet and low-pressure gases
3	Demand in additional capital investments for building of both new and upkeep of already existing production and transport infrastructure
4	Support of the course towards stronger ruble against foreign currencies results in increase of prime costs
5	In the context of Russian membership in the World Trade Organization there is a threat of outrunning growth of factor costs

Source: Compiled by the authors.

Monetary funds for investments into fixed assets are to be mainly generated based on the equity capital of companies – that is from amortization and reinvestment of a part of profit. On stages of exploration and further development of new fields the borrowed funds are to be more efficiently used. Investments into innovation projects to be obtained thanks to project financing (on the security of the money flow created during project development).

The above preconditions will give significant growth in efficiency of functioning of both vertically oriented and independent oil companies. Thanks to their strengthening the oil recovery ratio will be able to grow by 4-5%.

The technical process approach to enhance the OGI functioning involves increasing the efficiency of usage of its existing and generation of new technical and processing base. Subject to the availability of infrastructure on the existing field, 1% increase of the oil recovery ratio in the industry in whole is consistent with opening of a new major field previously unknown. But to open a new field it is necessary to build infrastructure; thanks to inflow intensification and oil reservoir recovery increase methods with usage of new process solutions it is possible to significantly increase the oil recovery ratio both on the already being developed fields and on the abandoned and suspended ones.

Rational subsoil usage is no less important task than increase of oil output. On the territory of the Russian Federation the deep reserves in Achimovsky and Tumensky reservoirs of the West Siberia (more than 5 km), reserves in the argillaceous deposits of Stavropol Region, worked-out deposits in Volga River basin (4-5 km) fall into category of difficult-to-recover hydrocarbons. Table 2 presents the now-used technologies of oil recovery on the territory of Russia.

Table 2. *Methods of intensification of inflow from oil and gas vertical and horizontal wells used on Russian market*

Technologies available on the market	Price per one borehole operation (for Russia), \$	Selective action	Eco-friendliness	Mobility	Efficiency
Hydraulic fracturing	150 000-200 000	+	-	-	High
Acid stimulation	25 000-30 000	-	-	+	Low

Source: Compiled by the authors.

Market analysis shows there is need in technology characterized with cost effectiveness, high mobility, high-accuracy selective action and eco-friendliness. Plasma impulse excitation (PIE) technology obtains all the above listed qualities. Plasma impulse excitation (PIE) technology obtains all the above listed qualities. The now-available experience in PIE technology implementation on vertical oil drills, and the laboratory studies on core samples of various types show high process and economic potential of the development. Performance on vertical holes shows that the process efficiency of PIE technology exceeds that of acid stimulation and bottom-hole area hydraulic fracturing methods. Moreover, application of hydraulic fracturing and acid stimulation on horizontal holes is less environmentally sound and more expensive and difficult due to horizontal orientation and large length of production range (Table 3). Producing companies will obtain the maximum profit from a field, and the state as the subsurface owner will obtain the technology based on rational and environmentally sound approach to usage of natural resources enabling to work out the field more efficiently, which will strengthen the country's energy security. Moreover, the conflict of interests between the state and a subsurface user will be resolved.

Table 3. Price comparison of PIE technology with analogues available on the domestic oil and gas recovery market

Technologies available on the market	Price per a borehole operation (for Russia), \$	Selective action	Eco-friendliness	Mobility	Efficiency
Plasma impulse excitation	20 000-30 000	+	+	+	Medium
Hydraulic fracturing	150 000-200 000	+	-	-	High
Acid stimulation	35 000-45 000	-	-	+	Low

Source: Compiled by the authors.

The organizational approach to increasing the efficiency of the OGI functioning pays special attention to development of vertical integration of economic entities and oil and gas industry members. The current structure of the global oil business was formed as early as in the 30s of the last centuries. And now vertically integrated oil companies dominate in it.

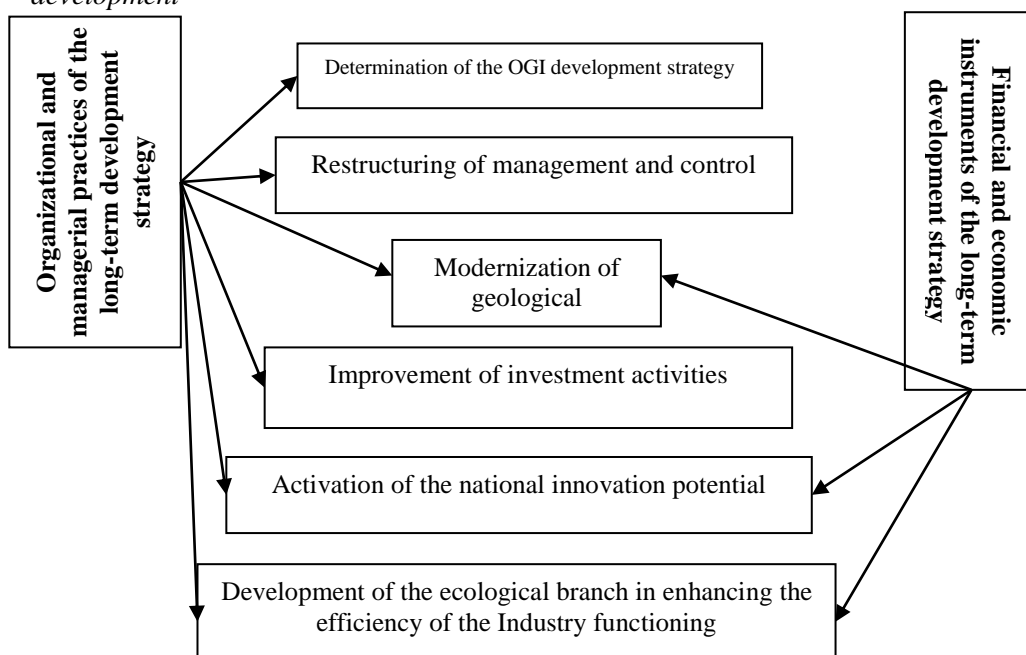
The authors identify the following enterprise development stages, during which, considering the certain goals and objectives, the organizational charts are being formed. *First stage:* In the process of establishment of a new enterprise quite moderate objectives are usually formed, which are confined to production and realization of produced goods on local and regional markets. On the *second stage* the national market is attempted to be won, which makes management operation more difficult, as permanent control is required on various directions of business, namely marketing, production, research and development, finance, human resources. *The third stage* of development relates to entering the global market, which leads to organization of the international department in the firm's chart. Development of international business requires availability of subdivisions organized on a geographical basis – that is, work with separate regions. *The fourth stage* – diversification of the company's activities on the national market. *The fifth stage.* The company realizes a strategic task of entering the global market with a wide range of products. This will require a more complicated organizational chart. It may be organized on a product-by-product or geographical basis. Analysis of operation of the companies of the global market has shown that there are no rules determining the choice of a certain type of the organization chart. Thus, implementation of various combinations of product and geographical principles would be the most practicable. *The sixth stage.* Provided that the company successfully enters the global market, the number of its foreign branches is naturally increasing. This will result in necessity to change the company's organizational chart, which will be realized in creation of mechanisms integrating new foreign subsidiaries into the whole corporate management system.

4. Discussion

The now-used organizational economic mechanism of the national OGI management in Russia involves the following: close collaboration between the subjects and objects within the priorities of enhancing the efficiency of the Industry functioning, considering its peculiarities and laws of development, as well as the goals and objectives to be achieved based on the current principles (through using of a certain set of instruments).

However, this mechanism fails to address the present-day economic and political challenges in required and enough degree. In this regard, for its improvement it is expected, considering the main functions of the OGI in Russian economy, to take into account that the improvement of the industry, which will practically be the change of paradigm, will positively influence the national economy and energy security of the country. The main goal of such mechanism should be stated as maintenance and strengthening of Russia’s energy security, and, as a result, identification of the priorities of enhancing the efficiency of the national OGI functioning.

Table 4. *Priorities in enhancing the efficiency of the OGI functioning and the financial and economic instruments of the long-term strategy of Russian OGI development*



Source: Compiled by the authors.

The procedure of enhancing the efficiency of existing organizational economic mechanism of the national OGI modernization management, as proposed by the

authors, includes both priorities in enhancing the efficiency of national OGI functioning and the financial and economic instruments of the long-term development strategy (Table 4). The OGI Innovation Development Strategy must also consider the internal and external challenges Russia faces in present-day conditions as it pertains to the development of the oil and gas sector of economy.

Among the external challenges the most significant are: - technical and technological breakthrough in recovery of difficult-to-recover hydrocarbons in world energy sector, - principal improvement of logistic and infrastructural and, as such, transport technologies of energy resources transportation, - increase of energy efficiency of the major economies of the world. The internal challenges include the following: - reduction of viable reserves in traditional oil and gas production regions with the developed infrastructure (West Siberia, the Urals, Volga Basin region), - complicated natural conditions and poor infrastructure development in new regions of recovery (East Siberia, Far East, the Extreme North), - low level of resources development and lack of experience for realization of the offshore and other complicated projects and megaprojects having a significant impact on the economy of both regions and the country as a whole.

Identification of ways of increasing the efficiency of the Industry functioning is a primary task of ensuring the country's energy security. Public property management and privatization measures, structural optimization, coordination of public-private partnership, licensing of activities, control over the fields development and monitoring of subsurface users, and coordination of research and development are to form the basis of future oil and gas industry development strategy of Russia.

Public property management and privatization measures. The state is directly responsible for efficient usage and management of subsurface resources for the benefit of the citizens of the country. However, analysis of the problem reveals that in the context of the world energy globalization Russia faces technological gap of the oil and gas sector with similar foreign social and economic complexes, the increase of our dependence from foreign scientific and technological products and services, the loss of traditionally high qualitative characteristics of Russian labour forces involved into oil and gas and associated industries (including knowledge-intensive ones).

Starting from the year 2010, the state (Executive Order of the Government of the Russian Federation N 2102-p, 2013) has more actively performs as exerciser of its property rights, including process of the federal property privatization. Taking into account the priorities of Russian economic development, the main objectives of the state policy in the field of the federal property privatization (Decree of the President of the Russian Federation d/d August 4th, 2004 N 1009) for the period 2011-2013 are as follows: - arrangement of conditions for attraction of extra-budgetary investments into development of joint-stock companies based on new technologies; - reduction of public sector of economy for the purpose of development and stimulation of the

innovation initiatives of private investors; - enhancement of corporate management; - equity market development stimulation; - formation of integrated structures in strategic industries of economy; - federal budget income generation.

The objective of the structural policy of the state in the field of regulation of the oil and gas sector of the economy on the present-day stage consists in creation of conditions for development of efficient production and management structure. Coordination of public-private partnership is necessary since in realization of major-scale economic projects the state lacks resources, and business lacks guaranties of investment refund, especially as it pertains to financing of long-term projects in the field of the OGI.

Licensing process in oil and gas industry is now performed in several areas. The first one is licensing of development of oil and gas fields, notably in geographically hard-to-reach districts, including offshore oil and gas fields of Russia. The second area of licensing activities shall include development of subsoil usage licensing practice. As it pertains to the development of the system of public control over the fulfillment of license conditions by companies of all types of ownership, it is suggested to put into practice civic supervision hearing that is not to be limited to environmental issues but should pertain to observation of rights of the native minorities of the North, Siberia and the Far East.

This problem is pressing due to the requirements of federal legislation (Federal Law "Concerning Subsurface Resources", 1992) that a subsurface user in development of oil and gas fields must ensure compliance with the requirements of technical projects. Due to these requirements works on a field are to be performed, which is not realized in practice. To minimize violations, it is suggested, firstly, to restore the rights of the Central Development Commission, and, secondly, to systemize control over the fields based on the information technologies.

Still there is no unified center performing planning and coordination of research and development of public and private companies for the benefit of the whole oil and gas complex of the country. This not only hampers consolidation and concentration of research and development, but also makes it much more expensive. In this regard the world practices suggest innovative solutions in the form of technology platforms, which have proved their value as efficient forms of technology-science-business consolidation. In Russia within performance of the Government Commission for Advanced Technology and Innovation, the Records No. d/d April 01st, 2011 and No. 3 d/d July 05th, 2011 approved technology platforms in energy industry "Intellectual Power System of Russia", "Eco-Friendly Highly-Efficient Thermal Power Solutions", "Advanced Technologies of Renewal Power Generation", "Small-Scale Distributed Power Generation". The authors believe that the said technology platforms are aimed at medium-term perspective.

Lack of flexibility in taxation brings an independent manufacturer in OGI into the rigid framework. Such rigid approach to taxation in oil and gas industry is aimed primarily at maximization of fiscal revenues and hardly considers the interests in taxation of independent manufacturers in oil and gas sector. Investment stimulation is on a minimum level and is aimed primarily at new field development projects. Conceptually, the authors suggest: tax burden differentiation method, which will depend on the field development stage; gradual transition to flexible scale of the reserves production tax; tax regulation based upon the rental subsoil user taxation scheme; stimulation of small and medium service business; stimulation of investment activity by means of adoption of profit tax privileges. The main problem in customs regulation of oil and gas raw materials and products export from Russia is that the customs duties play only fiscal role, and not restrictive one. It finally results in periodical shortage of oil products on the domestic market and the price increase for end users.

The legal basis for enhancement of technical regulation system for the purpose of increasing the efficiency of the OGI functioning is a corpus of statutory and other regulatory acts (Federal Law d/d May 04th, 1999 No. 96-FZ “Concerning Protection of Atmospheric Air”, 1999; Federal Law d/d August 08th, 2001 No. 128-FZ “Concerning Licensing of Certain Types of Activity”, 2001; Energy Strategy of Russia, 2003; Russian Oil and Gas Industry Development Strategy until 2020, 2003; Federal Law No. 184-FZ “Concerning Technical Regulation”, 2002; Federal Law No. 116-FZ “Concerning the Industrial Safety of Hazardous Production Facilities”, 1997; Federal Law No. 69-FZ “Concerning Fire Safety”, 1994; Federal Law No. 7-FZ “Concerning the Environment Protection”, 2002). This system includes special technical guidelines regulating 3 OGI components out of 4 (Table 5).

Table 5. Attribution of technical guidelines to the OGI components

OGI component	Technical Guideline name
Recovery	<ul style="list-style-type: none"> • Geological prospecting, drilling, field casing both onshore and offshore; • HC raw materials production onshore and offshore; • Equipment for OG industry onshore; • Equipment for arrangement off marine fields.
Reprocessing	<ul style="list-style-type: none"> • Reprocessing of the oil and gas + petro-chemistry; • Fuel and petroleum, oil, lubricants.
Transportation and storage of HC raw materials and other OG products	<ul style="list-style-type: none"> • Transport and storage of HC raw materials and finished products; • Gas supply systems and process.
Sale of HC raw materials and other oil and gas products	<p>Not provided for by the Concept of technical regulation system (2006)</p> <ul style="list-style-type: none"> → Equipment of shopping facilities for direct sales of HC raw materials and oil and gas products. → Sale of fuel and petroleum, oil, lubricants.

Source: Compiled by the authors.

The relevance of and necessity in state regulation in the field of environment protection (environmental regulation) is determined by reduction of its capabilities to assimilate emission, contamination and wastes without any further harm for the environment. Now there seems to be a decrease in public attention to ecological problems. For example, 2010 was the year when the Federal Target Program “Russian Environment and Natural Resources for 2002-2010” ended, and the new program has not been adopted. Issues of environmental regulation in oil and gas sector are not being discussed on the federal level, notwithstanding the problems existing.

5. Conclusion

Thus, generation and implementation of new oil-and-gas innovation strategy that takes into account Russian membership in WTO, Customs Union and the Common Free Market Zone, improvement of public property management in the context of transparent privatization of the federal oil and gas sector property, change of the state’s structural policy for the purpose of development of the efficient production and management structure of the industry, using of public-private partnership potential in implementation of innovative oil and gas projects, tax regulation, customs regulation, technical regulation, environmental regulation, establishment of the unified Federal Energy Industry Research and Development Coordination Center, liberalization of licensing in regards to private oil and gas companies, including small and medium enterprises, concentration of tax incentive measures to innovation and investment projects of new and suspended fields development in hard-to-reach regions in collaboration with federal, regional and municipal executive bodies, and increase of social responsibility of oil and gas companies – these are the main ways to enhance the efficiency of the OGI functioning for the purpose of ensuring of Russia’s energy security.

Based on implementation of the innovation way to enhancing the efficiency of the Industry functioning it was determined and suggested to resolve the main “energy dilemma” of Russia, namely existence of two oppositely directed tendencies in one process: the intention to reduce dependence of the country’s economy from the oil and gas sector at the account of its structural transformations, on the one hand, and the adoption of measures for comprehensive development of the country’s oil and gas sector, on the other hand; solution of the main conflict of interest in the oil and gas industry between the state and a subsurface user has also been suggested. The authors identified and structured the previously insufficiently studied basic economic indices of efficiency of oil and gas industry functioning, in whole, and its components characterizing the stability of recovery, reprocessing, transportation and sales of oil and gas sector products as the factor of Russia’s energy security in the context of the world energy globalization. The types of main approaches to efficient OGI management in Russia have been determined, reviewed and described. The ways of enhancing the organizational and management mechanism increasing the

efficiency of the OGI functioning have been developed based on the system approach as the factor of the country's energy security.

In the function of the organizational structure it is suggested to establish the permanently acting Commission for the OGI Strategic Development attached to the Government of the Russian Federation ensuring collaboration of the executive bodies concerned, business communities (OGI companies) and non-governmental organizations, including relevant self-regulated organizations, based on the principles of "tripartism". The said body is to function under governmental, parliamentary and public control as a strategically significant authority managing the efficiency of the OGI functioning as a factor of ensuring Russia's energy security.

For proper control over the OGI it is suggested to restore the original functions of the Central Development Commission or to establish a similar body in order a subsurface user to be able to coordinate its plans for development and using of fields and public subsoil resources. To systemize control over the fields based on information technologies. In this regard the factors of oil field development and using performance and reserve recovery state, as specified in the licensing agreements, are to become the objects of control and monitoring. There have been determined the conceptual conditions of enhancing the efficiency of oil and gas industry functioning that are connected with improvement of Government incentives for innovation technologies implementation, with development of new and abandoned fields with hard-to-recovery oil and gas reserves, with implementation of major integrated organizational forms of carrying on oil and gas business, with support of small and medium OGI servicing enterprises, with necessity to develop new innovative oil and gas strategy in the light of Russian membership in WTO, the Customs Union and the Common Free Market Zone. Primary ways to enhancing the efficiency of the OGI functioning for ensuring Russia's energy security have been identified, substantiated and recommended.

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