DEVELOPMENT OF NEW ENERGY TECHNOLOGIES IN RUSSIAN INTERNATIONAL COOPERATION WITH PROMISING PARTNER-COUNTRIES

Maria Vyacheslavovna Glinskaya[1]

[1] https://orcid.org/0000-0003-3299-5324
RUDN University
Institute of International Economy and Business
Miklukho-Maklaya str.6, 117198, Moscow, Russia
E-mail: glinskaya_mv@pfur.ru

Abstract: *There is a rapid increase in activity in new energy technologies in most EU countries. Research in hydrogen energy and the development of fuel cells, primarily fuel cells with solid polymer electrolyte, molten carbonate and solid oxide, are developing.*

Industrial companies of European countries work in this area much more actively than Russian ones. Such cooperation is relevant for Russia as it will allow joint efforts to use the scientific and industrial potential available in various countries more effectively and to use hydrogen energy. Energy cooperation between Russia and the United States are associated with companies engaged in processing and trade. They are implementing an optimization system. IBM has started to develop a project for automated oil production management. IBM Intelligent Oil Field technology allows oil and gas companies to monitor oil deposits and manage oil fields and production in real time.

The goal of the article is to analyze the development of new energy technologies and to show their significance for Russia in the context of its cooperation with partners.

The world has seen a sharp increase in interest in biofuels-a renewable alternative to oil. Using biofuels, Western countries introduce the concepts of economy and ecology into the population, slowing the growth of oil consumption. Both export and development of technologies for the production and supply of biofuels to the domestic market are relevant for Russia.

The problem of continuous operation of power grids remains unsolved around the world: even in relatively prosperous countries, 100% fault tolerance of networks cannot be achieved. Smart Grid technologies are used to solve this problem. In fact, it is a less centralized, more manageable automated infrastructure built on the basis of several actively developed concepts today.

The development of revolutionary energy technologies, for atmospheric electricity or economical autonomous generation, has previously been blocked by governments and corporations. New energy

technologies of the latest generation will allow businesses and people to autonomously receive cheap electricity.

Key words: *International financial markets, International agreements and compliance, World economic order, International investment, Energy technologies*
JEL codes: *G15, F53, F02, F50, F21*

1. Introduction

Energy security at the end of the XX century - the beginning of the XXI century became the factor influencing the international economy, which showed the whole world that Russia, thanks to its rich natural energy resources, is able to exercise economic power on its territory effectively, influence the energy potential of the whole world and help to promote its ideas in the international political and economic arena . By the middle of the first decade of the XXI century, Russia in 90% of oil and 100% of gas was limited by one market - the European one. Moreover, in a number of segments of this market, in particular in Eastern Europe, due to unfair trade discounts, Russian companies lose, according to some estimates, about 6-7 billion dollars annually, selling oil at a discount. The reorientation of oil supplies from Russia and other CIS countries to Asian markets avoids mixing Siberian low-grained oil with Volgo-Urals sulphurous oil and can bring the price of Russian oil to the level of Brent crude oil.

A lot of authors researched energy and energy security. Some of them created a special field of knowledge – energy technologies. Among them: those who developed renewable and alternative energy sources (Nezhnikova, Papelniuk & Dudin, 2019; Cruz-Romero, Arcia-Garibaldi & Gómez-Expósito, 2018), the authors, who wrote about innovation in usage of renewable energy sources (Balsalobre-Lorente & Alvarez-Herranz, 2017; Inmaculada & Iban, 2017; Richmond & Singh, 2019), the other authors focus on energy security (Sovacool, 2011). The author of this article considers not only new energy technologies, but also cooperation in the field of energy with partner countries from the point of view of ensuring energy security in the world.

In most EU countries, there has been a rapid increase in activity in the field of new technologies in the energy sector, in particular, in this region, research is being developed in the field of hydrogen energy and the development of fuel cells, primarily fuel cells with solid polymer electrolyte, melt carbonate and solid oxide. Industrial companies work in this area much more actively than Russian ones. Daimler-Chrysler has invested € 1,600 million in the hydrogen program over 4 years. [15] According to rough estimates, the volume of financing of

these research and development by industrial firms is 2-3 times higher than the amount of government investment.

Unfortunately, the level of international cooperation in this area is still not high enough. However, such cooperation is relevant for Russia, as it will allow joint efforts to more effectively use the scientific and industrial potential available in various countries of the continent and use hydrogen energy. The energy strategy of Russia for the period until 2030 develops and concretizes the provision on the need for accelerated development of energy in the East of Russia. Within its framework, it is planned to create new energy centers in Eastern Siberia and the Far East, to build new linear objects of energy infrastructure and to develop energy in the eastern regions of Russia. This means that measures are already being taken to improve energy security, the effectiveness of interaction with energy resources and the active development of relations with Japan, China and other potential partners.

2. Methodology and Data

The article includes theoretical and practical methods used in the research of the author: comparative method is used in the Introduction where the problem of energy sphere and security in the world and Russia are considered. Analysis is used when the author analyses new energy technologies in different countries, Russian interests in energy sphere and its following development in the world. Besides the author used methods of synthesis, logical generalization and induction to obtain the results of the research.

3. Results and Discussion

Russia has a lot of energy interests in cooperation with various countries. With regard to Russian energy interests in the United States, it should be noted that US companies involved in processing and trade are introducing the so-called optimization system. IBM has begun developing a project for automated oil production management.

IBM Intelligent Oil Field technology enables oil and gas companies to monitor oil deposits and manage oil fields and oil production in real time, adjusting production based on market demand across the entire oil field network. This project is an innovation for the oil industry, which will allow combining oil and gas production with advanced information technologies and advanced analysis tools in order to get real competitive advantages. During the project, the

following solutions and innovations will be developed and implemented: collection of information from sensors; integration; teamwork.

In recent years, the world has seen a sharp increase in interest in biofuels - a renewable alternative to oil. Meanwhile, in Russia, the biofuel market does not exist as such, and the legislation only aggravates this situation. Firstly, the law "On Biofuels" has not yet been adopted, which introduces the basic concepts in this matter, and secondly, it is necessary to amend the law "On Ethanol Traffic", where the concept of "fuel ethanol" should appear , which must be deducted for excise taxes and remove problems with the restriction of turnover. Biofuel is any fuel from renewable raw materials. It is divided into solid and liquid; solid is, for example, firewood. If we talk about liquid biofuels, then it exists, by and large, two types - it is bioethanol and biodiesel. There are other types of "second generation" liquid biofuels - biobutanol, biofuels obtained by gasification technology, etc., but it is too early to talk about their widespread use. Of course, it is completely impossible to replace oil, but it makes sense to use biofuel as an additive to gasoline and diesel fuel, since biofuel is still a renewable energy source, unlike oil, whose reserves will someday run out. The maximum share of biofuels in the future is predicted to be 25-30% if some breakthrough technologies do not appear.

The biofuel economy is very complex compared to conventional fuels. According to the international statistical portal (Shaposhnikov, 2017.), economic competition between biofuels and conventional fuels occurs at a price of $ 80 per barrel. At the same time, the desire of aviation industry consumers to use biofuels arises at a price of $ 100 per barrel or more. By this time, 64 countries have either already issued certain protectionist measures for the use of biofuels, or are planning to do so. These include the countries of the European Union, USA, Asia. They provide tax incentives, subsidies, and establish mandatory quotas for biofuel use in aviation companies. Since 2015, the United States has operated such a tool as touches credit - subsidies of 27 cents per liter, which are paid to biofuel producers. Thanks to subsidies and government support measures, the average monthly biofuel production in the USA in 2016 increased by 10% to 130 million gallons per year [18]. Biofuel is a reserve in energy supply of those countries that have excess agricultural potential, but they cannot be a solution to the fuel problem, since there is a shortage of food in the world. Using biofuels, Western countries introduce the concepts of economy and ecology into the population, slowing the growth of oil consumption.

Russia, which has the richest agricultural potential (2nd place in the world in terms of farmland per capita), could provide almost 40-50% of the agricultural demand for energy with

rapeseed oil. (Huseynov, 2008). In Russia, rape is recognized as the most profitable crop for biofuels. In most regions of the country, there are conditions for cultivating this crop and producing rapeseed oil and methyl ether to replace traditional motor fuels and electricity in agricultural production. Diesel motor biofuel is formed as a mixture of 75% rapeseed oil and 25% diesel fuel. It has an order of magnitude higher viscosity than diesel fuel, and is inferior to the latter in energy content (by 11%). However, when working on biofuel, the concentration of harmful emissions decreases: carbon monoxide by 55%, hydrocarbons by 2-5 times. (Khoruzhenko. & Dorogov, 2017). The benefits of using rapeseed biofuel in Russian agriculture, for which raw materials are grown on the farm and fuel is produced here, is obvious. The cost of biofuels is much lower than petroleum products. Vegetable oils are used in diesel engines, alcohols and ethers - in spark ignition engines.

For Russia, both export and development of technologies for the manufacture and supply of biofuels to the domestic market are relevant. Export is already resolved, Russian business has several problems as any business, but ethanol can be exported to the West and Japan.

Heat located deep in the earth can be a significant source for the production of electricity, since this energy is available 24 hours a day. Innovative technologies in the extraction of energy resources and energy production are also very relevant for Russia, which, in turn, is of direct interest in cooperation with the United States in this area. The development of economic relations with the Asia-Pacific countries is a necessary condition for ensuring the energy security of Russia. In addition, cooperation with Asia-Pacific countries in the energy sector is also a priority for Russia because it will contribute to solving the internal problems of Eastern Siberia and the Far East: investments will be attracted to develop the region's infrastructure, healthcare, education and environmental protection, and increased employment in the region. All this will reduce the backlog of the eastern regions of the Russian Federation in socio-economic development. Expanding the circle of consumers of natural gas, oil and electricity requires a significant expansion of the network of power lines and the pipeline network. Improving the quality of life of the population cannot be imagined in the context of a shortage of motor fuel - to avoid it, it is necessary to develop oil refining capacities in the region; Also, for the production of household and industrial products, it is necessary to actively develop the petrochemical industry.(Matsarenko & Ponomarev, 2017)

Building mutually beneficial relations in the energy sector with southern and eastern partners is not a new idea and has objective prerequisites. Russia has been trying to convince European partners to switch to a broader interpretation of the term "energy security" for a long

time, explaining that export diversification is no less important for the energy supplier than the issue of the variability of supply channels for the importer. In most Asia-Pacific countries, oil and gas are not used and are not consumed in the same way as in Russia. It is not just exported goods there and is not burned for nothing. Japan, Korea, Malaysia, Taiwan, Indonesia have long lived according to the precepts of the Russian chemist Dmitry Mendeleev and do not burn oil in the furnaces. A powerful petrochemical complex for deep oil refining has been created in these countries.

A powerful gas processing and gas chemical complex has also been created. APR is a world leader in the production and consumption of liquefied natural gas. For Russia, it is necessary to pay attention to technologies in these areas, which have been used for several years in the Asia-Pacific countries. Since our country is now actively cooperating with these countries in the field of exporting its energy resources, it would be useful to focus on importing new technologies in the energy field and adopt the experience of Asian countries in order to improve the functioning of the Russian energy sector.

Not so long ago, the first Russian plant for the production of liquefied gas (LNG), built as part of the Sakhalin-2 project, was launched. The implementation of this project will strengthen the position of Gazprom in the global energy market, will contribute to the development of trade and economic relations between Russia and the Asia-Pacific countries, diversification of sources of gas supplies to this region and thereby increase its energy security. The LNG plant uses a specially developed gas liquefaction technology using double mixed refrigerant, which increases the energy efficiency of production by taking advantage of the cold Sakhalin climate. The LNG plant was built as part of the world's largest integrated oil and gas project, Sakhalin-2. The project includes the development of two oil and gas fields on the northeast shelf of about. Sakhalin (Piltun-Astokhskoye and Lunskoye), oil production and production of liquefied natural gas and their export. To the north at the beginning of the XXI century.

The problems of the Arctic region have become the object of active foreign policy of many countries. In addition to the Arctic powers, these problems are of great concern to countries located outside the region. Among the main problems, first of all, is the definition of the current international legal status and regime of the Arctic. The area of the Arctic territories of Russia is “3.1 million square kilometers, or 18% of the territory of the Russian Federation. The Arctic accounts for 90 percent of the recoverable hydrocarbon resources of the entire continental shelf of Russia, 85 percent of the reserves of nickel, more than 50 percent of the reserves of copper

and tungsten, about 90 percent of the reserves of rare earth elements, mercury, gold, silver, and diamonds " (Arbatov, Belova & Feigin, 2005).

Despite the fact that the population of the region is only 1% of the total Russian, the products produced in the Arctic provide 11% of Russia's national income; besides, there is also the Northern Sea Route - the shortest route from Asia to Europe. No other shipping route has such an economic potential, cannot pass so many ships. According to geologists, 13% of the world's oil reserves and 30% of the world's natural gas reserves are located under the seabed in the Arctic (Borgerson, 2009). Over time, the importance of these resources for the global energy balance will only increase. At the same time, "climate change is gradually opening up the Arctic waters not only for the development of new resources, but also for new shipping routes that can change the global transport system"(Samsonov, 2018) . It is also in Russia's interests to ensure conditions for the development of international trade and economic ties, including the modernization of the Northern Sea Route and the formation of new transport corridors, which is also impossible to do without the help and active participation of the state. Given the importance of energy in the modern global economy, "it is possible that the world expects a global energy crisis, and then the Arctic oil and gas reserves will play a decisive role. But by this moment, appropriate modern transport and supporting infrastructure should be deployed "(Skripkin & Krylov, 2017).

The oil and gas complex is capable of becoming a catalyst for the development of high technologies. In Russian society, there is an archaic attitude towards the oil and gas industry, according to which oil and gas extraction is a primitive occupation that must be abandoned by betting on the development of other more technological sectors. In reality, offshore projects, gas liquefaction and transportation, exploration and drilling in difficult geological conditions are enormous technological challenges.

The oil and gas industry is a modern and high-tech industry, which creates excellent prerequisites for the development of other segments of the economy: the pipe industry, engineering, etc. The money that the state receives from the export of crude oil needs to be invested, including in the development of the processing industry.

Internet of things (IoT) — the concept of a computer network of physical objects ("things"), equipped with built-in technologies to interact with each other or with the environment, considering the organization of such networks as a phenomenon that can restructure economic and social processes, eliminating the need for human participation from the part of actions and operations. The Internet of things today is one of the most promising technologies, which is

used not only in "smart" homes, but also in the energy sector. Modern electric companies are implementing a solution for the digitalization of the electric power industry based on the Internet of things (IoT) technology. As for the sphere of electricity production, the use of IoT there will reduce fuel consumption, which currently accounts for more than half of the station's operating costs. Such projects will help reduce operating and repair costs while preventing technological and commercial losses. The overall economic effect from the introduction of IoT in the electric power industry until 2025, according to experts, will reach 532 billion rubles, of which 180 billion will be prevented energy losses. (Egorov, 2019).

Solutions based on IoT in the energy sector are increasingly combined with the functionality of artificial intelligence (AI) and machine learning for processing and analysis of large data arrays generated during the operation of equipment. From examples of successful IoT projects in the Russian electric power industry, one can cite the project at Inter RAO Electric Power Plants. The system of collection, transmission and calculation of technological information (SPRTI), implemented in the company, helps to reduce fuel burns and increases reliability. The payback period of the project is estimated at 5–7 years, taking into account the fact that the system allows saving 130 billion rubles on fuel. annually. Investments are being made in the electric power industry to create a new level of a safe working environment for power plant personnel, and one of the leading directions here is the commercialization of robots that are resistant to extreme working conditions and remotely controlled. Similar solutions are also tied to AI / IoT technologies, and recently augmented reality (AR) functionality has been added to their capabilities, through which the image from the cameras on the robot receives an interactive component.

In Europe and the USA, robots are developed and implemented that perform the functions of diagnostics and maintenance of high-voltage power lines. Such mechanisms are suspended from the line wires, and their actions from the ground by the controller are controlled by the operator. Robots are equipped with sensors and video cameras to detect problem areas on the wires. In areas with a long winter period, cleaning robots are used that remove snow and ice from power lines, and some models are able to unscrew and tighten bolts and nuts, remove foreign objects from wires. Nuclear power plants are also being robotic: for example, robots are given the task of testing the primary reactor loops using ultrasound. The problem of continuous operation of electric networks remains unresolved all over the world: even in relatively prosperous countries, 100% network fault tolerance cannot be

achieved. In the United States, this indicator is 99.97%, only a few failures per year can lead to losses of $ 100-150 billion [18].

To solve this problem, the technology of the Smart Grid family is used - “smart grid”. In fact, this is a less centralized, more manageable automated infrastructure built on the basis of several concepts that are being actively developed today. Among them are the Advanced metering infrastructure (AMI) and various solutions for visualizing the load distribution and available network resource in real time. The first concept involves the instantaneous calculation of the cost of energy consumed by an enterprise or household, up to the conclusion of the exact cost of daily consumption on a special panel or on mobile devices of consumers. The second is to create and use an interactive network resource control panel that real-time optimizes load balancing to prevent blackouts. Smart Grid is being implemented today by energy companies around the world. Rosseti is introducing Smart Grid technology in Russia in 10 pilot projects: this is the company's own solution, which is expected to reduce electricity losses by 225.3 million kWh and achieve a level of repair optimization of 35.8 billion rubles. Artificial intelligence, IoT and other digitalization technologies, combined with the computing power of modern IT platforms, have enormous potential for releasing hidden and irrationally used resources in various parts of the production cycle of the energy industry. At the production stage, the most modern IT solutions are already applied today, evolution in the same direction of the sphere of generation and distribution of electric energy follows from the general logic of the process and supplements it.

In addition to the above innovations, recently renewable energy sources have also become relevant. Such sources are replenished in nature in a natural way and are, by the standards of human needs, inexhaustible. These include: sunlight; ebbs and flows (kinetics of the Earth's rotation); geothermal heat (energy of the bowels of the earth); wind energy; biomaterials; water currents, including waves. The light of the Sun is converted into electrical energy by means of special batteries, the energy of tides is realized by tidal power plants, and geothermal energy - by GeoTES. Wind potential is used by wind farms, the installation site of which is determined by intense wind zones. The analysis suggests that by 2040, wind farms will compete with hydroelectric power stations in terms of electricity generated. The use of renewable resources is on the rise: the United States is generating 15% of the energy in the country with their help, and an increase of 3% is possible in the coming years. In addition to the United States, Germany, Italy, Great Britain, China and India are called leaders in this area.

Large corporations are developing new energy technologies, for example, Google has proposed an airplane, like a kite flying in a circle at an altitude where the wind is stronger. Such an airplane produces 600 kW. In Russia, Rosatom is building wind farms. And, for example, private investors and large technology companies such as Microsoft, General Electric, united in a coalition to realize the energy of the future without carbon dioxide emissions into the atmosphere. The coalition works in all areas of alternative and traditional energy.

4. Conclusions

For a long time, the world economy did without innovations in the energy sector. Progress in the information sphere of the 1970-2000s was coupled with stagnation in the field of energy. The so-called “alternative sources” did not create a real substitute for the burning of hydrocarbon fuels. Biofuels, wind and solar generators did not jeopardize the old energy industry. The development of revolutionary technologies in the energy sector, to produce atmospheric electricity or economical autonomous generation, was blocked by governments and corporations. New technologies in the energy sector of the last generation will allow enterprises and people to independently receive cheap electricity. An integral part of the global economic crisis is the energy crisis, expressed in the rise in price of key energy resources, oil and gas. A sharp reduction in the cost of electricity is one of the necessary conditions for overcoming the global crisis and launching a new recovery in the economy. And the sooner it is completed, the sooner the further scientific, cultural, social, political and economic progress of mankind will go.

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