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STUDY OF INNOVATIVE TECHNOLOGIES IN THE ENERGY INDUSTRY: NONTRADITIONAL AND RENEWABLE ENERGY SOURCES*

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Abstract. The goal of the article is to carry out a comprehensive study of theoretical and practical development of innovative technologies in the energy industry through the energy trilemma "energy efficiency – energy security – environmental sustainability". Transformation of the world energy industry is accompanied by a change in the dominant types of fuel in the energy balance, technological and organizational innovations, expansion and optimization of the supply chain. The current stage of the international energy market transformation is described by a growth of demand for energy supply, intensified use of renewable energy sources, and increase in the energy efficiency. Respectively, the investments in the energy industry should be spent on the creation and implementation of solutions that will meet the growing demand, compensation of the decline in energy supply production from the existing oil and gas fields, and the development of the infrastructure of traditional and renewable energy resources. The article uses the content, analytical, statistical and functional methods of research to explore the current state and trends in the transformation of the global energy industry, the main areas of which are the development of nontraditional hydrocarbon (shale gas and oil sands) and renewable energy sources (RES); the use of these sources on the basis of technological innovation is considered to be more efficient. The following conclusions have been made based on the materials presented in the article: the use of various nonconventional hydrocarbon fields will spread in the energy industry in the coming decades; the specific weight of new technologies applied to production and consumption of energy derived from renewable sources, in particular, will increase; transition from the use of renewable energy sources of the first order to the use of renewable energy of the second order should be expected in the long term; and new energy servicing technologies based on the concept of smart grids will be introduced, along with the development of technologies for the extraction of energy resources.

Keywords: innovations; innovative technologies; smart technologies; RES; energy industry; energy resources; energy efficiency; energy security; global economy

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1. Introduction

Development of the global energy industry in the period through to 2035 will be primarily focused on meeting the global demand for energy resources for the needs of the growing economy, population and the need to strengthen the fight with climate changes (World Outlook Energy, 2015). Power systems around the world observe dynamic changes, as evidenced by an increase in the share of energy from renewable sources. According to the "2016 global report on the state of the renewable energy sector" (REN21, 2016), the record 147 gigawatts (GW) of renewable energy production facilities were commissioned in 2015. This means that the available capacity of the global renewable energy sector amounted to 1,900 GW. Every year there is a positive development of the sector. The International Energy Agency expects it to grow by another 825 GW by 2021.

Demand for electricity is undergoing significant changes. The developing economies encourage further growth of global power consumption. The annual report "2016 World Energy Outlook" (2015) predicts an increase in power consumption by 48% from 2012 to 2040.

At the same time, it must be noted that 1.2 bln people in the world still do not have access to electricity, as of 2017. Aside from the need to provide energy for all of humanity, digitalization and electrification of new sectors of the economy, in particular transport, are powerful triggers for the development of the modern energy industry. Distributed energy industry and digitalization are important stages in the way towards the abandonment of fossil fuels. A huge leap in the technology development is required to maintain the uninterrupted operation of the decarbonized power system of the future. Many of the innovative solutions have already been developed or are under development.

2. Methods

A comprehensive study of trends and problems of the international energy market development is based on the established ideas about the global energy architecture, which is defined as an integrated system of the following components: energy resources (supply); infrastructure; sectors that generate demand for energy resources, which are united by the activities of the government, production and society (The Global Energy Architecture Performance Index Report 2014, 2013). The main goal of the energy architecture is to provide reliable, uninterrupted and environmentally acceptable supplies of energy resources that include the implementation of some tasks forming the so-called energy triangle:

1. achieving the economic growth and development (reliability of the energy industry defines the economic and social development through increasing productivity and facilitating generation of profits);
2. sustainable development of the environment (since energy production, processing and consumption are associated with a significant negative impact on the environment, the key priority of the energy architecture is to minimize it); and
3. promoting access to energy and achieving energy security (shared access to energy is an important component of strengthening the social and economic development; the energy supply chain is described by some risks and disruptions that often arise due to inconsistencies among the market participants) (The Global Energy Architecture Performance Index Report 2014, 2013).

The study of the energy transition determinants involves the systematization of the main factors (formation of energy supply and demand, energy efficiency) that have impact on optimization, quality production and energy

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mix in a single market system. The transformation of the energy system is regarded as a long process involving the improvement and expansion of the energy supply chain, where the efficient implementation of its stages – upstream, midstream and downstream – ensures a reliable and uninterrupted supply of the energy resource from the producer to the end user.

3. Results

Four global scenarios for the energy development are presented in the world economic outlooks of the International Energy Agency (WEO-2013, WEO-2014, WEO-2015): the Current Policies Scenario, the New Policies Scenario, 450 Scenario, and the Efficient World Scenario, which are presented in Table 1. It must also be noted that a steady increase in energy demand in the emerging markets (India, Malaysia, Indonesia, China, Thailand, Mexico, Brazil, South Africa, etc.) in recent decades has led to an increase in their role as producers of energy products.

Table 1. Global scenarios for the energy development (BP Statistical Review of World Energy, 2016).

Scenario	Areas of development
Current Policies Scenario	continuation of the existing energy policy, where the energy development programs adopted by mid-2012 remain unchanged; the goal is to secure basic indicators for the development of energy markets that maintain the current trends in demand for energy consumption
New Policies Scenario	implementation of measures under the energy saving policy; the goal is to ensure balanced energy development in the context of the relevant climate policy
450 Scenario	implementation of the energy saving and energy efficiency policies, increase in the share of renewable energy sources that ensure the total content of CO2 within 450 PPM (parts per million) in the energy balance; this is a level of greenhouse gases in the air at which the increase in its temperature by the end of the century will not exceed two degrees if the provisions of the Paris Environmental Agreement 2015 are implemented.
Efficient World Scenario	encouragement of the investment policy aimed at eliminating barriers that hamper energy efficiency; the goal is to evaluate the results of energy efficiency to justify the economic benefits

This confirms another area of geographic diversification of the global energy market, which leads to a decrease in the level of territorial concentration of energy resources production with powerful impact on their world trade. It is suggested that the regional energy balance (production less consumption for each region) will substantially change by 2035. For example, it is expected that North America will turn from a net importer of energy into a net exporter in the period from 2018 to 2020; Asia's needs for energy imports will expand (Asia will consume 70% of interregional net imports by 2035). Russia and the countries of the Middle East will remain the largest regional net energy exporters among the export regions, but the share of the latter will decrease from 46% in 2012 to 38% in 2035 (BP Energy Outlook 2030, 2012).

Innovative technologies in the energy industry can be considered from different points of view (for example, in terms of the type of energy produced or the sources of energy used) and can be divided into two broad categories: energy saving technologies (energy saving building materials, energy saving lamps, intelligent metering systems, etc.) and energy producing technologies (efficient boilers, solar collectors, biofuel equipment, etc.). According to the study results, consumption volume of renewable energy sources (RES) was the fastest growing from 2001 to 2014 – 5-fold over the past 13 years, but the share of RES is the smallest in the structure of world consumption (see Figures 1-2).

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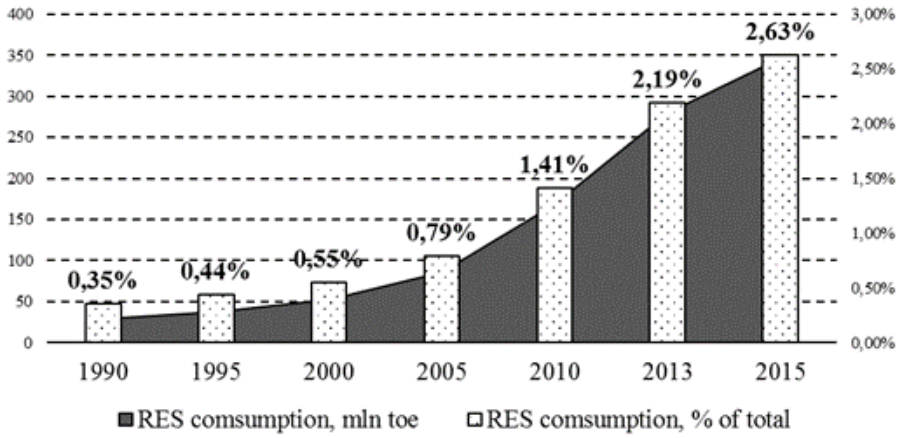

Fig. 1. Dynamics of global consumption of RES (BP Statistical Review of World Energy, 2016)

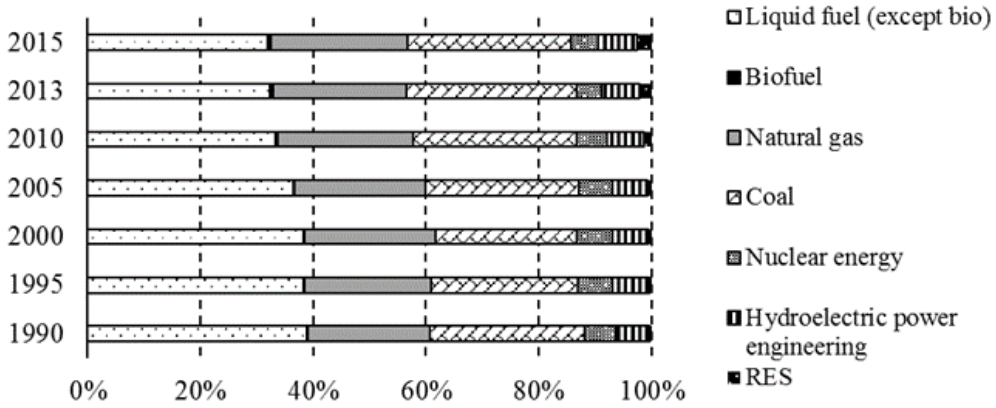

Fig. 2. Structure of global consumption of energy sources, % (BP Statistical Review of World Energy, 2016)

Table 2 contains a description of the expected medium-term trend in the development of renewable energy in the global market.

Table 2. Role and trends of technological development of renewable energy sources in the global energy industry (The Global Energy Architecture Performance Index Report 2014, 2013)

Sources	Description
Energy sources of the first order	renewable energy sources (water energy, biomass, solar, thermal and light energy, wind energy, tidal energy, geothermal energy), renewable energy sources, intermediate energy sources, as well as bitumen, high-viscosity oil and oil shale
Energy sources of the second order	sources (and ways of obtaining and storing) of energy, which can be used due to the current level of equipment development, but will require the development of appropriate infrastructure for their production, storage and consumption, which may demand several decades and significant investments. They may include hydrogen, gas hydrates, and plasma technologies
Energy sources of the third order	sources (and methods of obtaining) of energy that have only a theoretical justification for use today, since the use of such energy sources is impossible in the next few decades without achieving an appropriate level of science, technology and engineering development. This category includes the reaction of thermonuclear fusion (using lithium and deuterium dissolved in seawater), delivery of helium-3 to the Earth from the Moon for the thermonuclear power, launch of energy complexes for electricity production (using solar energy) to the geostationary orbit of the Earth with its subsequent transmission to the Earth, illumination of the Earth's surface using space mirrors, gravitational energy industry, and other methods of obtaining energy

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Overall, according to the forecast, the transformation of the international energy market by 2035 will be accompanied by its expansion due to the use of different types of energy, including its new forms, which will play an increasingly important role. Renewable energy sources, shale gas and other new sources of fuel will demonstrate a total growth of 6.2% per year and will secure 43% of the increase in energy production by 2035. The development of new types of energy sources will necessitate the development of new innovative technologies and should rely on large-scale investments.

At the moment, the largest part of investments in the amount of about $1,100 bln per year is allocated to such areas of the international energy market as extraction and transportation of fossil fuels, oil refining, and development of fossil fuel power plants. An analysis of the areas dealing with the receipt of global investments in the energy sector indicates the growing importance of renewable energy sources (the annual investment volume for the development of such resources amounted to $60 bln in 2000, and to $300 bln in 2011) (Energy Vision 2013 Energy transitions: Past and Future, 2013). It is expected that in order to meet the global energy needs, the volume of investment will increase to $2,000 bln by 2035 (for comparison, this figure was $1,600 bln only 5 years ago, in 2013), while the annual cost of energy efficiency will increase to $550 bln (against $130 bln in 2013) (World Energy Investment Outlook, 2014; Strategic transport infrastructure needs to 2030, 2011).

The main components of investment in energy supply by 2035 will be allocated to the following sectors: extraction and transportation of fossil fuels, oil refining ($23 trln), power plants ($6 trln for those using renewable sources, and $1 trln for nuclear power industry), and development of the system for the transfer and distribution of energy resources ($7 trln). About 60-70% of such investments will be concentrated in energy systems in developing countries and countries with transitive economies: Asia in general and China in particular, Africa and Latin America (World Energy Investment Outlook, 2014). A review of analytical sources reveals that more than half of the investments in energy supply will be allocated to meeting the growing demand, compensating for the decline in energy carriers production from the existing oil and gas fields (80% of investments), replacing and updating power plants that are obsolete both from the infrastructure and technological point of view (60% of investments in the electric power industry of the OECD countries) (World Energy Investment Outlook, 2014; Strategic transport infrastructure needs to 2030, 2011; Ageev, Ovchinnikov, 2016).

Industry and national governments are the main subjects that have significant impact on the development and transformation of the international energy market. On the one hand, the activities of industrial enterprises encourage the development of new ways of safe and reliable energy supply, the introduction of the efficient risk management system, long-term planning, investment and integrated management of systems of energy resources transmission and use. On the other hand, the provisions of political programs are aimed at creation of a flexible approach to the development of competitive investment, innovation and international cooperation of the energy market participants, including through the use of energy diplomacy.

Harmonization, improvement and implementation of fair legislative, tax and regulatory frameworks are supposed to promote support and long-term development of energy based on the mutually beneficial cooperation of market participants (Energy Vision 2013, Energy transitions, 2013). The position of the governments of countries supplying resources to the international energy market is built based on the definition of development priorities and areas of cooperation with other market participants to make energy models contribute to the achievement of economic growth, environmental sustainability and energy security.

4. Discussion

Given the trends of the world energy architecture development, it can be asserted that the abovementioned market participants intensify their efforts towards the development of nontraditional hydrocarbon (shale gas and oil

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sands) and renewable energy sources, the use of which now seems more efficient and acceptable in terms of technological innovation – in particular, for the environment. However, it must be noted that oil and gas will continue to provide about 60% of the world's energy consumption over the next 2 decades. Oil will remain the most common type of fuel, while natural gas consumption will also grow rapidly (the demand for natural gas will increase more than 1.6 times from 2010 to 2040). The use of natural gas as an affordable and efficient means of electricity generation will have positive impact on the environment. The bulk of the production of crude oil and natural gas will continue to be produced from conventional sources, but the specific weight of production of more deep-sea environments and subsoil use in the Arctic will grow (Dudin at al., 2017; Martsinkevich, 2017).

Electric power will be the largest factor of demand in the energy market, which indicates an improvement in living standards, since more consumers and businesses get access to safe and reliable electricity supply. In general, according to the findings published by the International Energy Agency, the electric power industry paves its way to the energy system decarbonization. The main barriers to the implementation of the next stage of the world energy market transformation are the following (Energy Vision 2013 Energy transitions, 2013; Energy infrastructure. Priorities for 2020 and beyond, 2011):

- significant actual demand secured by hydrocarbon energy sources and a high level of development of infrastructure for the transfer of such energy carriers: the structure of energy consumption will not significantly change by 2030;
- innovation and development, pricing and state policy will play an important role in the integration of renewable energy sources into industrial and domestic consumption (it is important to understand the long-term and comprehensive nature of full implementation of such qualitative transformations of the energy market);
- discussion of the expediency of replacing relatively low-cost resources (oil, gas) with wind or solar energy, which is described by high cost and low density of placement;
- biofuels require an additional infrastructure for the transfer of such energy resources.

As such, "... both the introduction of innovations and finding the necessary capital and managerial reserves, ensuring payback prospects and testing ranges for the introduction of versatile innovative solutions become urgent ..." at the present stage for the world energy market (Inshakova at al., 2018).

Energy efficiency plays a key role in limiting the growth of energy consumption. In OECD countries, the implementation of programs to improve energy efficiency will reduce the growth of electricity consumption by 60% from the maximum possible level. Besides, according to WEO 2015, the energy efficiency of new equipment, which will be produced in the world by 2030, can be increased by additional 11%, while an average cost of energy saved will amount to $300 per ton of oil equivalent (toe) at a weighted average price of $1,300/toe. The energy consumption of heavy vehicles is now regulated only in the US, Canada, Japan and China; the European Union also has plans to introduce regulation. Expanding geographic coverage and more stringent standards can reduce fuel demand for new cars by 15% by 2030. Changes in product design, reuse and recycling ("material efficiency") will also help increase the energy saving potential. At the same time, about 60% of investment in new power plants will be spent on renewable energy technologies by 2040, and as a result, the global production of electricity from renewable sources will increase by about 8,300 TWh (more than half of the total production growth), which is equivalent to the present total production of all fossil-fuel power stations in China, the US and the EU member states.

The renewable energy sector is a potential source of a large number of new jobs. About 10 mln jobs have been created in the world coal industry by now. Photovoltaics can create the same number of jobs as soon as in 15 years. The wind energy industry can grow from the current 700,000 jobs to 7.8 mln jobs in 2030 (which is twice as much as now in the global oil and gas industry), but the changes are required right now. The number of employees in the coal industry will significantly decrease by 2030. It is expected that the energy sector in the world will account for 30-35 mln jobs in 2020, this figure can grow up to 45 mln jobs in 2025, and the number of

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jobs will exceed 46 mln by 2030, with up to 86% of jobs in the energy sector attributed to the renewable energy sector by 2030.

As a result, the share of coal in the global electricity production structure will drop from 41% to 30%, while gas, nuclear and hydropower sectors will maintain their current shares in the global energy balance. The renewable energy production in the energy balance will reach 50% in the EU member states, almost 30% in China and Japan, and over 25% in the US and India by 2040.

The introduction of new smart grid technologies will allow to improve the infrastructure operation, increase energy security, reliability and efficiency of energy supply, and support the development of new energy supply models based on distributed generation and renewable energy sources. Intellectual power networks have huge potential. According to the report of the European Commission "Smart Grid projects in Europe: lessons learned and current developments" published in 2011, the volumes of investment in smart grid projects will amount to:

- about 56.5 bln Euros by 2020 in Europe;
- 238 to 334.5 bln Euros by 2030 in the US; and
- about 71 bln Euros by 2020 in China.

According to the 2012 report of the British company Memoori Research, the volume of investments in the global smart grid market by 2030 will amount to $2 trln (Memoori: Smart Grid Research, 2012). The global smart grid market can reach $155 bln in 2018, which is 50% more than the current annual cost of equipment for electricity transmission and distribution. The average annual cost of Smart Grid in the US amounts to $22 bln, and will reach a peak of $35 bln in 2021.

The US is currently the world leader in investing in smart grids. Europe funded smart grids through the relevant programs of the European Union, while some demonstration projects were sponsored within the programs of countries participating in them. China adopts investment plans for nationalized energy enterprises with direct or indirect support at the state level. Due to the introduction of smart grids in the EU countries, it is expected that energy supply through smart grids will account for one-fifth of the total energy supply by 2020.

Return on investments in the implementation of Smart Grid programs is high, especially on investments in the smart systems of metering energy consumption. According to estimates of American specialists, the savings may amount to about $48 bln (including investments) over 20 years of using smart grids. European countries count on annual savings of about 7.5 bln Euros. The introduction of standard smart meters in the commercial or industrial sector in the UK provides return on investment within 10-14 months. According to the study conducted by Navigant Research, the annual global revenue from the introduction of intelligent accounting systems will increase from $4.4 bln in 2013 to $6.6 bln in 2023 (Navigant Research, n.d.).

As of 2017, the largest number of smart metering systems are in Europe and the Asia-Pacific region. It is expected that the number of new smart meters introduced in Western Europe will increase to 93 mln units by the end of 2020. 80 mln new smart meters will be installed in Japan by 2020. The installation of intelligent sensors is being tested in India, and forecasts say that the number of smart meters in this country can reach 150 mln by 2020. Grand View Research estimates the volume of the global smart metering market in 2013 at about $11 bln. According to the forecasts of the research company, the average annual growth rate of the smart metering market in the Asia-Pacific region will amount to 10.4% in the period between 2014 and 2020 (Grand View Research, n.d.). The US, Japan, China, Brazil, India, Britain, France, Germany, Russia, and Mexico will lead by the number of plants generating energy from renewable sources. The aggregate rate of annual growth in these countries is expected at 22%. The total number of smart meters in the world will amount to about 1.1 bln units by 2024, or 57% of the total.

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Conclusion

The observed scientific and technological advances predetermine that further progressive development of the energy industry will be defined by the formation of a new technological order based on scientific developments in biotechnology, genetic engineering, informatics, microelectronics, as well as intensive space exploration and creation of new types of raw materials, resources, and energy. This means that new sources of energy (primarily renewable energy sources) will be widely spread in the long term, and an appropriate infrastructure for their use will be established, which will influence the global consumption of hydrocarbon raw materials. It must be noted that the development of an appropriate infrastructure for the use of new types of energy takes about 25-30 years, since the energy industry is a fairly conservative sector of the economy, while the technological limit of the previously created infrastructure has not yet been achieved.

As such, it can be expected that a trend for a long-term transition to renewable energy will be formed along with the development of nonconventional hydrocarbon deposits (shale gas, oil and oil sands).

Based on the above, the following conclusions about the areas of the innovation-driven growth of the global energy industry can be drawn:

1) the demand for traditional hydrocarbon energy carriers will be quite high in the first half of this century, and they will retain the bulk of the global energy balance by 2050;
2) there will also be an improvement in the technologies for exploration, extraction, production, and consumption of traditional and nontraditional hydrocarbons, as well as nuclear energy industry, energy saving and energy efficiency, in the first half of the XXIst century;
3) renewable energy sources will build up their share in global energy consumption, and the change in the next technological order will lead to an absolute reduction in the consumption of not only oil, coal and gas, but also primary energy in general in many industrialized countries;
4) the advances of science and technology will allow to lay the basis for the transition to a new stage in the development of the energy industry in the coming decades – the widespread use of renewable energy of the second order. The appropriate infrastructure will be gradually built. The use of renewable energy sources of the first and second orders will also lead to a drop in global demand for hydrocarbon raw materials;
5) with the transition of the world economy to the next technological order, further development of the energy industry will be defined by the use of the alternative energy sources of the second and third order and nuclear energy, while the share of oil, gas and coal will gradually decrease to 50-60% of the total consumption of primary energy resources;
6) investments in smart grids have already enabled energy companies to create a whole range of new tools that help improve customer relationships. The service portfolio of energy companies will change accordingly in the process of transformation of customer relationships; and
7) the following services will be in demand in the energy industry in the short and medium term: demand management programs; solutions based on distributed electricity generation and saving; energy saving programs, which also provide financial support and technical advice.

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References

Ageev, A. I., Ovchinnikov, V. V. 2016. Sistemnyye konstruktsii globalnogo rynka nefti i nefteproduktov [Consistent constructions of the global market for oil and oil products]. Economic Strategies 4: 122–133.

BP Energy Outlook 2030. 2012. British Petroleum, London. http://www.bp.com/content/dam/bp/pdf/Energy-economics/Energy-Outlook/BP_World_Energy_Outlook_booklet_2035.pdf

BP Statistical Review of World Energy. 2016. http://www.bp.com/content/dam/bp/pdf/Energy-economics/statistical-review-2016/BP-statistical-review-of-world-energy-2016-full-report.pdf

Dudin, M. N., Frolova, E. E., Sidorenko, V. N., Pogrebinskaya, E. A., Nikishina, I. V. 2017. Energy policy of the European Union: Challenges and possible development paths. *International Journal of Energy Economics and Policy*, 7(3): 294–299.

Energy Infrastructure. Priorities For 2020 And Beyond – A blueprint for an integrated European energy network. 2011. European Commission, Luxemburg: Publications Office of the European Union, 41.

Energy Vision. 2013. Energy Transitions: Past and Future. 2013. World Economic Forum, Geneva. http://www3.weforum.org/docs/WEF_EN_EnergyVision_Report_2013.pdf

Grand View Research. https://www.glassdoor.com/Reviews/Grand-View-Research-Reviews-E866553.htm

Inshakova, A. O., Frolova E. E., Marchukov, I. P. 2018. The general energy policy and ways of development of legal regulation of the foreign trade turnover of energy resources of the Russian Federation and the EU. Energy sector: a systemic analysis of economy, foreign trade and legal regulations, Springer International Publishing AG, 187–206.

Inshakova, A. O., Frolova, E. E., Marchukov, I. P. 2018. TNCs as subjects of economic activity and lawmaking in the sphere of foreign trade in energy resources. Energy sector: a systemic analysis of economy, foreign trade and legal regulations, Springer International Publishing AG, 151–172.

Martsinkevich, B. 2017 Arktika – territoriya razvitiya [The Arctic – a territory of development]. Analytical online magazine "Geoenergetika.Ru". Available online: http://geoenergetics.ru/2017/10/31/arktika-territoriya-razvitiya/

MEMOORI: Smart Grid Research. 2012. https://www.memoori.com/research/

Minasyan, M. V. 2015. Rol neftegazovogo kompleksa v formirovanii innovatsionnoy ekonomiki Rossii [The role of the oil and gas complex in the establishment of the innovative economy of Russia]. International Scientific and Research Journal, 7 (38), Part 3: 81–84.

Navigant Research. https://www.navigantresearch.com/about-navigant-research

Renewables 2016 Global Status Report – REN21. http://www.ren21.net/wp-content/uploads/2016/06/GSR_2016_Full_Report.pdf

Smart Grid Projects in Europe: Lessons Learned and Current Developments. 2011. http://ses.jrc.ec.europa.eu/sites/ses/files/documents/smart_grid_projects_in_europe_lessons_learned_and_current_developments.pdf

Strategic Transport Infrastructure Needs to 2030. 2011. Main findings, OECD Futures Project on Transcontinental Infrastructure Needs to 2030/50/ OECD. Paris. http://www.oecd.org/futures/infrastructureto2030/49094448.pdf

The Global Energy Architecture Performance Index Report 2014. 2013. The World Economic Forum, Geneva. http://www3.weforum.org/docs/WEF_EN_NEA_Report_2014.pdf

World Energy Investment Outlook. 2014. Special Report, International Energy Agency. Paris, 2014. http://www.iea.org/publications/freepublications/publication/ WEIO2014.pdf

World Outlook Energy. 2015. https://www.iea.org/publications/freepublications/publication/WEO2015.pdf

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