Kapitonov, Ivan A.; Vološin, Vladimir I.

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Strategic Directions for Increasing the Share of Renewable Energy Sources in the Structure of Energy Consumption

Ivan A. Kapitonov[1]*, Vladimir I. Voloshin[2]

[1]Institute of Economy, Russian Academy of Sciences, 117218, Nakhimovsky Ave. 32, Moscow, Russian Federation, [2]Institute of Economy, Russian Academy of Sciences, 117218, Nakhimovsky Ave. 32, Moscow, Russian Federation.
*Email: kapitonov_ivan@mail.ru

ABSTRACT

In recent decades, the European energy sector is transforming due to the growing demand for electricity and increased requirements for ensuring the continuity of supply. In the European Union (EU), almost 50% of energy consumption is provided through energy imports. One of the main conditions for the continuity of supply is the diversification of their sources, considered as an important prerequisite for energy security. The EU government has serious hopes for the development of alternative energy and believes that in the future "green" energy will play a significant role in the structure of energy consumption. The object of this study is renewable energy sources. The subject of the research is the problems of increasing the share of renewable energy sources in the structure of energy consumption.

Keywords: Electric Power Industry, Alternative Energy, The Electricity Consumers
JEL Classifications: K32, O13, P48

1. INTRODUCTION

In the field of efficiency of use of wind energy leading position occupied by companies from the USA (2 788.5 kWh/kWh share installed capacity of 31.8%). Among European countries, the leader was British enterprises (2 758.6 kWh/kW and 31.5%), while the second position was occupied by companies of Portugal (2 645.7 kWh/kW and 30.2%).

Among the leading manufacturers of wind energy equipment in the top ten in 2014 included the following: Vestas (Denmark, 11.6% of global production), Siemens (Germany, 9.5%), Goldwind (China, 9.0%) and GE Wind (USA, 8.7%), Enercon (Germany, 7.3 per cent), Suzlon Group, India (5.5%), United Power (China, 4.8%), Gamesa (Spain, 4.5%), Mingyang (China, 3.9%), Envision (China, 3.7%).

The first position among leading manufacturers of wind energy equipment, the Danish company Vestas continues to keep with the 80ies. 20th century this situation is due to the fact that Denmark was one of the first to actively develop the technology of wind power and on the state level, wind power development has been significant support (Bye and Klemetsen, 2016). Each of the countries-leaders of global wind power (installed capacity) has its own manufacturers of wind power equipment in the world top ten rankings (Chyou et al., 2016).

The analysis of existing methodological approaches to assessing the level of competitiveness at different hierarchical levels (state, region, industry, businesses, products) (Han and Ji, 2016). Methodical approaches to evaluation of competitiveness of power generating enterprises which work in the field of alternative energy (international renewable energy agency) and energy agencies and research institutions in individual countries (U.S. Department of Energy, The Fraunhofer Institute for Solar Energy Systems (Germany). Determined that the most common approach to evaluation of competitiveness of power generating enterprises is the competitiveness of their products (Sharif et al., 2016).

The main drawback of existing approaches to assessing the level of competitiveness is an incomplete list of expenses. In most cases, the list of no liquidation costs and external costs. It distorts the real cost of energy generated by enterprises, especially with the use of conventional energy technologies (fossil and nuclear) and the relevant components of the costs are passed on to other payers. The vast majority of cases, such expenses shall be reimbursed from the state budget, from local budgets or at the expense of individual citizens (Kapitonov et al., 2017).

2. LITERATURE REVIEW

The authors summarized scientific approaches to the formation of conceptual-categorical apparatus of the theory of competition technologies in the energy sector (Mishra and Chand, 2016), the classification of traditional and alternative sources and energy technologies, analyzed the organizational and economic maintenance of regulation of the energy market (Enteria et al., 2016).

Based on the study of scientific works of foreign and domestic authors analyzed the essence of the concepts “competition” and “competitiveness” and “competitiveness of enterprises” (Izadi et al., 2016). Determined that the concept of competitiveness has a multi-level (hierarchical) structure, and the importance of the influence of the technological component on the economic development of the country (Braun-Unkhoff et al., 2016).

The definition of concepts such as competitiveness of power generating enterprises is its ability to produce energy (electrical or thermal) with lower costs per unit of production compared to competitors, and the competitiveness of energy technologies is able to provide production units of electric and (or) heat energy with minimal costs relative to other types of technological equipment of the enterprise (There is no alternative, 2016). An important component of competitiveness in the energy sector is the modular nature of the capacity (Nguyen et al., 2016).

Analyzed the existing classification of revenues the primary energy on Earth with the separation of the solar radiation, geothermal energy and gravitational energy and classifications of energy sources according to the world energy council and international energy agency, with a division into renewable and non-renewable sources of energy or on conventional and unconventional (alternative) sources of energy (Abeelen et al., 2016). It is indicated that when assessing the level of competitiveness of enterprises in the energy sector, emphasis should focus not on the energy sources and conversion technology of energy derived from conventional or unconventional sources into electrical, thermal or mechanical energy (Kirsten et al., 2016). On the basis of the analysis developed classification scheme for traditional and alternative sources and technologies of energy conversion for energy enterprises (Raheem et al., 2016).

Based on the processing of legal acts, which regulate entrepreneurial activities in the energy sector (Montajabiha, 2016), it is determined that the transition from a monopoly market to a competitive relationship happened since the 90-ies of the 20th century, by separating generation, transmission and distribution of electricity and energy resources (Peng et al., 2016). Production and sales were attributed to the competitive relations, and the transfer and regulation remained a monopoly (Dong et al., 2016).

Analyzes the functioning of alternative energy enterprises in the global and European energy markets and the competitive environment in the market of alternative energy, the approaches and methods of evaluation of the competitiveness of the sector (Aref et al., 2016).

Based on the analysis of statistical reports of international organizations established since the beginning of the 21st century. Alternative energy in the total input capacity of enterprises began to outpace traditional energy (Krishnan et al., 2016). Among European countries in the traditional energy sector to build the capacity of energy enterprises is only based on technologies using natural gas (de Sousa et al., 2016). Energy companies based on technologies using coal, refined petroleum products and nuclear technology in Europe, by contrast, are experiencing a gradual reduction in generating capacity (Vine et al., 2016). That is, the share of traditional energy is gradually reduced (Afsordegan et al., 2016). Among the leading directions of development of alternative energy should be allocated to wind power and solar energy.

3. MATERIALS AND METHODS

Despite attempts to overcome from the fall in prices for energy carriers, the Russian energy sector has being in crisis during quite a long time. The system of indicators of efficiency of functioning of power generation facility consists of four groups that include ten indicators (Table 1).

The first group of indicators (the consumer aspect) needs to reflect advantages and disadvantages inherent in various types of electricity generating technologies for consumers. One of the main indicators is the cost of electricity because it shows the amount of funds must be expended per unit of electricity generated for different types of technologies. Stability of supply confirms the possibility of continuous operation and a safety issue primarily concerns harm to the environment and accidents.

The second group of indicators (internal business processes) considers the question regarding the owners and producers of electricity. The construction period will be most important to investors because it indicates how long a power plant can be commissioned, will produce electricity and return on investment. The lowest possible installed power at input of object in operation in addition to the component business processes, also affects the financial aspect as it describes what is the minimum amount of funds needed for the production of electricity by one or another technology. Productivity (the number of service workers per unit of power) is important for the operating organization. Fewer working indicates a lower cost associated with labor, as well as simplified management due to reduced number of management levels (Nakhratova and Prytova, 2016).

The third group of indicators (the development dimension) characterizes the pace of the developing technology of electricity production. For the analysis, we selected the market of the European Union (EU) as the most competitive for the production of electricity. Competition in production on the EU market started to take root since the late 80’s early 90-ies of the 20th century, much earlier than in other regions and countries of the world. Measure of growth (decline) of generating capacity reflects the changes of the absolute values and the change in the share of different technologies in total generation reflects the transformation of the structure of electricity production in the EU market.

The fourth group of indicators (financial aspect) characterizes the level of investment costs required for the commissioning generation facilities, and the level of electricity tariffs notes how quickly to return the invested funds relative to other types of technologies.

Information data to assess the competitiveness of energy technologies placed in Table 2.

The components of the aspect of the consumer was calculated as follows: The cost of electricity into account the division of costs into five components such as, investment, operation, fuel, external, liquidation; stability of supply, based on the results of energy facilities, the data of the International organizations working in the field of alternative energy renewable energy policy network for the 21st century (REN 21); the safety record on the results of the study (the true cost of electric power. Resources for the foture) that covered a significant range of work in this direction in different countries for more than 10 years.

The components of the internal business processes based on real data, in particular, the construction time take into account international experience and the results of the construction of conventional energy alternative energy facilities and in recent years, and the minimum possible power and productivity (the number of service workers per unit of power) correspond to indicators of energy equipment in the energy sector.

Components of the development dimension into account developments in the energy sector of the EU. Considering the

Table 1: A set of indicators and their rationale

The groups of indicators	Indicators (units of measure)	Justification
The aspect of the consumer	The cost of electricity (Cents/kW*year)	The average cost at which a power plant can generate electricity during the useful period of use
	Stability of supply (%)	The possibility of producing electricity in the required quantities and at the right time (used to calculate coefficient of utilization of installed capacity)
	Safety: Harm, the accident rate (US $/kW*year)	The set of characteristics, taking into account the harmful effects on the environment and possible consequences of emergency situations
Internal business processes	The construction period (months, years)	The time required for the input energy of the object from the start of construction until the production of electricity
	The lowest possible installed capacity (MW)	The minimum capacity of the plant (plant unit), which can be commissioned and to start production of electricity
	Productivity (people/GWh)	The number of employees (service workers) on GW of installed capacity
The development dimension	Increase (decrease) in installed capacity (MW)	The growth or decline in capacity over the period 2000-2014 for the EU market as the most competitive market for the production of electricity
	Changes in the share of generating capacity (%)	Share changes (structure) of generating capacity over the period 2000-2014 for the EU market as the most competitive market for the production of electricity
The financial aspect	Investment costs (US $/kW)	Investment costs for the commissioning of generating facility into operation
	Electricity tariffs (RUB/MW*year)	Existing electricity tariffs for its producers

EU: European Union

Table 2: Data to assess the competitiveness of energy technologies

The groups of indicators	Indicators (units of measure)	Power system	Nuclear energy	Wind power	Solar energy
The aspect of the consumer	The cost of electricity (Cents/kW*year)	10.45-228.91	7.1-24.8	3.69-12.51	7.12-40.04
	Stability of supply (%)	50-70	70-90	25-40	10-30
	Safety: Harm, the accident rate (US $/kWh)	0.0139-2.1583	0.0019-0.1004	0-0.034	0-0.081
Internal business process	The construction period (months, years)	3-6 year	5-8 year	6-12 months	2-12 months
	The lowest possible installed capacity (MW)	100 МВт	1000 МВт	2 МВт	30 кВт
	Productivity (people/GWh)	500-1400	2300-2865	80-100	180-200
The development dimension	Increase (decrease) in installed capacity (MW)	−24745.7	−13190.0	116759.6	87 926.0
	Changing the proportion of generating capacity (%)	−6.2	−9.2	+11.7	+9.68
The financial aspect	Investment costs (US $/kW)	2218-2590	3000-5530	900-1500	1200-1950
	Electricity tariffs (RUB/MW*h)	1031.46	426.24	2798.57	7201.19

situation on the energy market, the benefit of alternative energy would be no less compelling because it is, albeit slowly, but growing. In the traditional energy sector the situation is critical, as shown at the beginning of the article. So, the last unit at the plant was commissioned in 2010. Its construction began in Soviet times and continued for about 20 years.

Components of the financial aspect to take into account the international experience and Russian specifics in relation to the investment costs, and as tariffs, they correspond to the real rates at which the electricity producers supply it.

The results of the evaluation of competitiveness of traditional (Table 3) and alternative (Table 4) of energy technologies has shown benefits, it is alternative energy.

The first position of wind energy received. Among its main competitive advantages should be mentioned are: The cost of electricity, safety, minimum possible power, labor productivity, both measures of aspect development, investment expenses. Regarding the timing of construction for powerful objects (50-100 MW or more), they are comparable to solar energy. An additional advantage of wind energy is that it can accommodate wind in the fields, where there is agricultural work, there are pastures. Withdrawal of land from use in this case is minimal (within 1-2% of the total area of the placement of the wind Park). For Russia as a large agricultural country, where agricultural land accounts for more than 1/3 of the total area of the country, this is a significant advantage.

The second position of solar energy due to minimal construction time, minimal power and the highest tariff for purchase of electricity among all the compared technological solutions. Now, high tariffs for purchase of electricity paid for by the state, but this situation should persist until 2030, which is confirmed at the legislative level. In the future these prices could be reduced. The

Table 3: Evaluation of the competitiveness of energy technologies on the basis of a balanced scorecard

The groups of indicators	Indicators	The weight of indicators	The technology of producing electricity			
			The heat energy		Nuclear energy	
			Scoring	Weighted estimate	Scoring	Weighted estimate
The aspect of the consumer	The cost of electricity	0.3	0.068	0.02	0.508	0.152
	Stability of supply	0.2	0.135	0.027	1	0.2
	Safety: Hazards, accidents	0.5	0.0157	0.008	0.332	0.166
	Total	1	-	0.055	-	0.518
Internal business processes	The construction period	0.3	0.13	0.039	0.09	0.027
	The lowest possible installed capacity	0.2	0.01	0.002	0.001	0
	Productivity	0.5	0.095	0.048	0.035	0.018
	Total	1	-	0.089	-	0.045
The development dimension	Growth (decline) of installed capacity	0.5	0.004	0.002	0.085	0.043
	Changing the proportion of generating capacity	0.5	0.286	0.143	0.424	0.212
	Total	1	-	0.145	-	0.255
The financial aspect	Investment costs	0.6	0.499	0.299	0.281	0.169
	Electricity tariffs	0.4	0.143	0.057	0.059	0.024
	Total	1	-	0.356	-	0.193
Just technology			-	0.645	-	1.011

Table 4: Evaluation of the competitiveness of energy technologies on the basis of the balanced system of indicators for the alternative energy

The groups of indicators	Indicators	The weight of indicators	The technology of producing electricity			
			The heat energy		Nuclear energy	
			Scoring	Weighted estimate	Scoring	Weighted estimate
The aspect of the consumer	The cost of electricity	0.3	1	0.3	0.344	0.103
	Stability of supply	0.2	0.406	0.081	0.169	0.034
	Safety: Hazards, accidents	0.5	1	0.5	0.42	0.21
	Total	1	-	0.881	-	0.347
Internal business processes	The construction period	0.3	0.777	0.233	1	0.3
	The lowest possible installed capacity	0.2	0.5	0.1	1	0.2
	Productivity	0.5	1	0.5	0.474	0.237
	Total	1	-	0.833	-	0.737
The development dimension	Growth (decline) of installed capacity	0.5	1	0.5	0.797	0.399
	Changing the proportion of generating capacity	0.5	1	0.5	0.907	0.454
	Total	1	-	1	-	0.853
The financial aspect	Investment costs	0.6	1	0.6	0.762	0.457
	Electricity tariffs	0.4	0.389	0.156	1	0.4
	Total	1	-	0.756	-	0.857
Just technology			-	3.47	-	2.794

U.S. experience shows that due to the construction of powerful facilities (economies of scale) wind power across the country, and solar power in the regions with the highest intensity of solar radiation are already competitive and can develop without state support. An important component that may further strengthen the position of solar energy is its modular nature and proximity to the consumer. Solar energy facilities, subject to availability of space you can build in close proximity to the consumer and in such quantities that are required.

The main advantage of nuclear energy is the stability of the electricity supply. Although the utilization rate of the installed capacity of domestic nuclear power plants is about 70%, and for comparison, nuclear power plants in the United States - about 90%. But the other side of this advantage is that nuclear power plants cannot adapt to the variations in loads. It cannot be turned off at night, when there is a decrease in the load on the grid and re-enable the day when the load increases. Therefore, she, like most other types of energy technologies should combine their work. Significant disadvantages of nuclear power are the high investment costs and long construction time, which in many cases significantly exceed the planned figures. Last known evidence of a significant delay in construction is the construction of a nuclear power plant in Finland (third nuclear power plant unit Olkiluoto). The construction of the station began in 2004 and commissioning was scheduled for 2009, it is now postponed to 2018, but the initial investment has increased by more than two billion euros.

Thermal power based on coal took the last position. The most problematic issues of her work is environmental pollution, long construction period and a significant number of service workers compared with alternative energy facilities. This influenced the fact that in the EU the number of coal-fired plants in the last time, only reduced. In the conditions that prevailed in Russia, in thermal power engineering, at the forefront of the shortage of coal, and stopping the existing power plants (Rogach and Ryabova, 2015).

Appropriate should consider a comprehensive energy development through the modernization of existing capacities in the traditional energy sector and the introduction of new capacity in alternative energy. Regarding the development of alternative energy, it is useful to introduce additional capacity in those regions where there is a shortage of electricity. Thus it is possible to reach the proximity of production to consumption and to reduce losses in the networks, reaching up to 20% of generated electricity.

4. RESULTS

The development of electricity in 2015 was held under the issues of improving access to energy infrastructure; transition to long-term capacity market; increase of payment discipline; improvement of the regulatory framework and the development of renewable energy sources.

The main event can be considered the launch of a new model of competitive selection of capacity on the wholesale market, through which is implemented by more than 60% of the installed capacity in the Unified energy system of Russia. The changes, according to market participants, make the model more flexible to the demand and projected, contribute to withdrawal from the market of inefficient generating capacity that will improve the stability of the power system.

The most important event was the commencement in December 2015 integration of the power system of the Crimea in the Unified power system of Russia which allowed to reduce more than 60% power shortage in the region and to provide up to 18-20 h of power supply. Completion of works is planned in 2017.

A positive trend for the year is to improve the discipline of fulfillment of investment programs: Reducing fine volume capacity contracts for the supply of power, reduction in the proportion of worn-out fixed assets.

At the same time, payment discipline, despite the launch in 2013 of a mechanism of financial guarantees, showed deterioration. In 2015, the debt increased both on wholesale and retail electricity market. With the aim of reducing arrears was adopted the Federal law (307-FZ of 03.11.2015). In 2016 it is planned to continue work in this direction.

The power sector of Russia is a combination of natural monopoly (transmission, distribution) and competitive activities (production and marketing). Includes a two-tier system of markets: Wholesale and retail market, which is implemented in two products: Electricity and capacity.

Power is a commodity the purchase of which gives to the participant of the wholesale market the right to require the sellers to maintain the power generating equipment in a ready state for power generation.

At the end of 2015 the total installed capacity of generating facilities in Russia, according to the Ministry of energy of the Russian Federation, increased by 1.22% to 243.19 GW, including 235.31 GW of installed capacity of power plants of UES of Russia (68.2% from thermal power plants [TPP], 20.6% - hydropower plants [HPP] and 11.2% of the nuclear power plant [NPP]).

The commissioning of new generating equipment in Russia in 2015 to 4.8 GW and was carried out mainly by TPP during implementation of the power distribution module (PDM): 76% of the total input, of which 61% is PDM. Due to the NPP was 18% of capacity. Enter the remaining necessary inputs are outside of the UES of Russia (2.9%), hydroelectric (2.1%) and renewables (1.1%).

In addition to the introduction of new capacity of 317 MW (or 10.8% increase in capacity) was introduced at the expense of modernization of operating facilities. Modernization of generating equipment allowed to reduce specific costs for electric energy 319.8 in 2014 to 317.6 grams.t./kWh in 2015. These indicators are the lowest in the last 15 years. In value by the end of 2015, an Industry report terms, the fuel savings amounted to more than 3.5 billion rubles from the level of 2014.

Out of service in 2015 were derived 1.0% or 2.4 GW installed at the beginning of year power.

The most effective use of the installed capacity takes place at the plant. Coefficient of installed capacity utilization (capacity factor) as a whole in 2015 was higher than in 2014, the maximum level was reached in the 1st quarter of 2015 at the level of 93-96%; a minimum level in May 2015 (74%). In thermal energy storage increased capacity factor was varied at the level of 37% (June) and 60% (February) and were largely worse than in 2014 In HPP index ranged from 31% (1st quarter) - 48% (May) and in the whole duration remained higher than in 2014 (Table 5).

Low efficiency of capacity utilization is explained, including the depreciation of fixed assets, which affects the techno-economic inefficiency. However, in this case as a positive tendency it is necessary to note a steady decline in depreciation of fixed assets from 51.1% in 2010 to 47.3% in 2014, reflecting the strength of the implementation of investment programs.

The investment mechanism to ensure the upgrading of generating capacity, are contracts for the supply of power (PDM) for which the state guarantees payment and profitability of these projects. At the end of 2015 through the PDM was introduced 3319 MW of capacity (+1.5% by 2014) (Figure 1).

A positive trend is a systematic increase in discipline, fulfillment of obligations under capacity supply agreements, as evidenced by a fairly smooth downward trend in the total fine amount of power for PSC (Table 6).

In 2015, electricity production in Russia amounted to 1049.9 billion kWh, including in the framework of the Unified energy system of Russia - 1026.9 billion kWh, higher than in 2014, 0.2% (Table 7).

The total production of electricity by type of generation has changed: Increased the share of nuclear generation to 19% (+1.4 p. p. 2014) in that time, the share of thermal and HPP decreased. In the long term, by 2030 the share of nuclear generation should reach 25-35% of the total generation. Also worth noting is getting in 2015, electricity from renewable energy sources such as wind (windmills) and solar power plants.

The decrease in electricity production in HPP is explained by a decrease in 2015 compared to 2014 water reserves in the reservoirs, which are located on the main hydroelectric power station of Russia.

In regional structure of electricity production in the framework of UES of Russia almost half (48.2 per cent) of electricity generated falls on the United energy system of the center (ECO Center) and the Urals (UES of Ural). The data grid along with the IPS of North-West (9.9% in the total structure of production) showed a decrease in production in 2015 for the other four energy systems recorded a slight increase.

In 2015, started the integration of the Crimean energy system in UES of Russia. As a result of deliberate undermining the supports of power transmission lines in Kherson region, 22 November 2015, the Crimea was disconnected from the Ukrainian energy system. To restore power supply work was carried out in several ways:

1. Restoration of power supply in emergency situation through diesel generator units;
2. Connection of the Crimean energy system for UES of Russia by laying cable lines through the Kerch Strait (the bridge);

Figure 1: Schedule of inputs generating equipment MW

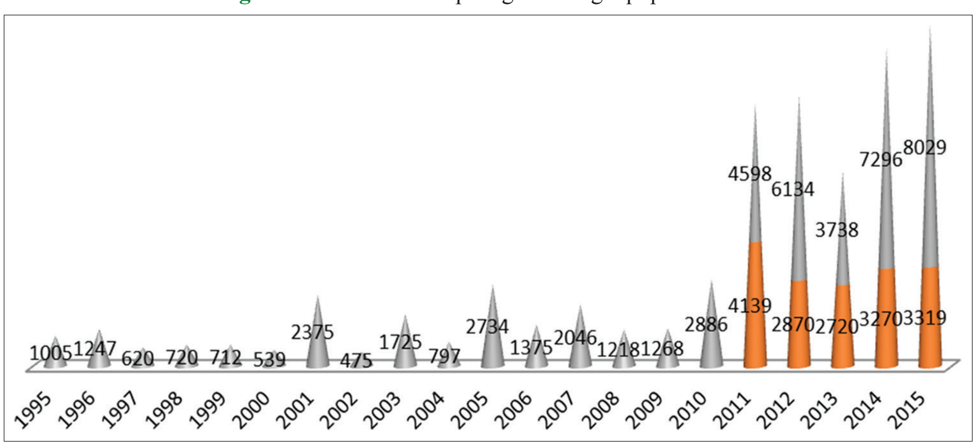

Table 5: The efficiency of capacity utilization in the framework of UES of Russia in 2015

Type of power plants	Installed capacity		Coefficient of installed capacity utilization, %		
	GW	Share in the UES of Russia, %	2015	2014	2015/2014
TES	160.2	68.1	47.21	48.59	–1.38
HPP	47.9	20.3	38.29	40.53	–2.24
Nuclear power plant	27.1	11.53	84.65	81.61	3.04
WES	0.01	<1	6.75	-	-
SES	0.06	<1	8.43	-	-

TES: Thermal energy storage, HPP: Hydropower plants, WES: Wind Energy, SES: Solar energy

3. Increase our own sources of generation at the expense of input of new generating capacities;
4. Restoration of electricity supply from Ukraine.

December 2 launched the first stage of the power bridge from the Krasnodar region, which ensured the flow of power from UES of Russia to 260 MW (about 25% of the required amount). Was restored to the transmission line of 220 kWt between Crimea and Ukraine, which allowed to transfer 160 MW capacity commissioned solar generating capacity to 180 MW; launched Taman substation (220 kW), introduced at the 122 km transmission line (from the crossing point to the substation "Kafa").

December 15 was launched the same second chain bridge, which allowed to increase the transmission power of 400 MW and supply of electricity to consumers with 12-15 h to 18-20 h a day.

By May 2016, the second phase of work was launched 2 lines of the bridge of the UES of Russia (3rd and 4th circuit), having increased thus the power flow to 850 MW and the total private power of the Crimea to 1300 MW. This helped to ensure energy independence of Crimea from Ukraine and to fully cover the need for power supply of consumers from the core network. Reserve capacity is also planned commissioning of 940 MW of generating capacity: 470 MW - September 2017, 470 MW - March 2018.

In late December 2015 - early January 2016 at the initiative of the President of the Russian Federation among the residents of the Crimean Federal district VTsIOM conducted a sociological survey of the population, the results of which showed that 94% of residents are willing to temporary difficulties in the supply instead of signing the commercial contract with Ukraine for the supply of electricity to the Crimea.

By the end of 2015 the share energozone of the Crimea in the total electricity production was 0.2% (1.6 billion kW.h).

In 2015, electricity consumption in Russia compared to 2014 decreased by 0.4% (0.6% - on UES of Russia) to 1036.4 billion kWh (for UES of Russia - 1008,3 billion kWh). The main factor reducing consumption of steel to the warm weather conditions in winter, leading to reduction of power consumption in the power system by 2.3%, mainly due to the unified power systems of the middle Volga and Siberia.

Table 6: Fine amount of power for PSC

Year	Fine total capacity, MW	Changes to previous year, %
2015	6501.3	64.2
2014	10119.5	85.0
2013	11906.0	84.8
2012	14037.3	97.0
2011	14467.8	-

PSC: Power Supply Contracts

In regional structure of electricity consumption reduction was noted in all of the United energy systems of UES of Russia, with the exception of the UES of South and the ECO of the East, which together account for only 12.1% of the electricity consumption within the UES of Russia.

The excess of electricity production over its consumption within the UES of Russia at the end of 2015 amounted to 18.6 billion kWh.h (or 1.8%) higher than in 2014, by 0.7 percentage points as a result of 23.8% rise in electricity exports (Table 8).

The focus in the development of the power grid in 2015 was aimed at improving the efficiency of power grid companies, the development of competition and reduction of non-payments. To reduce the operating and unit costs were revised level of losses of territorial grid organizations (TSO) and approved a methodology to determine operating costs on the basis of comparative analysis. With the aim of reducing cross-subsidies and reducing inefficient network organizations were approved by the new criteria of TSO and quantitative indicators aimed at improving the reliability and security of power supply.

By the end of 2015, was introduced by 26 802 km of power lines (118.8% of the plan). Of them of 87.9% - at the expense of JSC "rosseti." The input power transformer equipment amounted to 10.4 thousand MVA (104% of plan), of which 81.6% by PJSC "FGC UES" and JSC "rosseti."

5. DISCUSSION

The topic of energy efficiency is being actively developed all over the world. Russia is cooperating with Germany, in which energy efficiency holds a lea]ding position in the world. Actively implemented the cooperation with Japan, especially in terms of sustainable development and energy efficiency of cities, as well as South Korea and many other countries. Professional cooperation in various fields of energy efficiency and energy saving, including renewable energy sources. Serious international cooperation on the development of energy-efficient infrastructure through the introduction of new technologies for sparsely populated and remote areas, which in Russia abound. Traditionally sparsely populated areas of the Murmansk region, Krasnoyarsk territory, the

Table 7: The production of electricity in the UES of Russia in 2015 (including power plants, industrial enterprises)

Form of energy	Production, billion kW.h	Structure, %		2015/2014, %
	2015	2015 г	2014 г	
Electricity	1026.9	100.0	100.0	100.2
TES	671.4	65.4	66.1	99.13
HPP	160.2	15.6	16.3	95.87
Nuclear power plant	195.3	19.0	17.6	108.2
VES	0.0061	<1	-	-
SES	0.0073	<1	-	-

TES: Thermal energy storage, HPP: Hydropower plants, WES: Wind Energy, SES: Solar energy

Table 8: Indicators electricity market

Indicator	2015	2014	2015/2014 (%)
The production of electricity	1049.9	1047.8	100.2
Including in the framework of the EEC	1026.9	1024.8	100.2
The power consumption	1036.4	1040.6	99.6
Including in the framework of the EEC	1008.3	1013.8	99.45
The export of electricity	18.2	14.7	123.8
The import of electricity	6.7	6.5	103.1

EEC: The European Economic Community

far North in General, Far East, etc., where the "Northern delivery" associated with delivery of coal and fuel oil, extremely expensive, energy efficiency is particularly relevant.

If we talk about multilateral international cooperation, our country quite successfully carried out by the international partnership in the framework of IPEEC. And also the G20, where on a regular basis develops diversified cooperation and it is planned to come out with the initiative to hold the G20 Festival of energy conservation. Large projects planned in the framework of BRICS, where the topic of energy efficiency is allowed to make a breakthrough in cooperation. In 2015, Russia proposed the theme of energy efficiency, which was supported by all participants of the BRICS. Now prorabatyvayutsya to establish an Energy Agency which would be engaged in selection of projects in the energy sector, and, possibly, analysis of energy scenarios.

Also there is cooperation with the International energy Agency, which is a lot of potential. Very interesting site clean energy ministerial (CEM) is a Ministerial meeting for clean energy. Such a meeting is already passed in the US, where Russia offered next year at the CEM meeting, which will be held in China, to come up with the initiative on sustainable development of energy systems of cities. The initiative aims to develop the short list of smart, modern, innovative technologies that the countries participating in the initiative will be able to implement in their countries. As such, innovation platforms for sustainable development of the energy system is considered in Moscow.

There are serious reasons to believe that in the electricity market state administrative regulation will be replaced by competitive market mechanisms and self-regulation of market participants (subject to the general logic of the development of Western civilization, demonstrating the trend towards the abolition of institutions hindering the operation of the market economy).

Thus, in the current circumstances, it becomes obvious that the main supporters interested in the development of competition on the Russian electricity market are not suppliers of electric energy and services in this market (maybe with the exception of THC, which was in the position artificially discriminated against actors in the market), and those organizations who, because of artificially imposed restrictions, are unable to fully realize their commercial potential in this market.

Such organizations are primarily entrepreneurs that use distributed generation and financially sustainable and successful consumers who have a commercial interest and financial ability to diversify their activities, including in the electricity sector.

These organizations and can be the major force able to initiate and implement long-overdue measures for the development of modern Russian electric power market.

The ministry of energy of Russia pays great attention to energy conservation and efficiency, deeply interested in the development of innovative technologies and production of principally new equipment, so carefully refers to all activities relating to these areas. The theme of energy saving and energy efficiency is so important to our country that is already at anybody does not cause doubts. The development and introduction of new available technologies is not a fad, but one of the conditions of the socio-economic wellbeing of the country.

6. CONCLUSION

In assessing the competitiveness of energy technologies used balanced scorecard. The indicators were divided into four groups: From the perspective of the consumer, internal business processes, the development aspect, the financial aspect. Were analyzed indicators of the four technologies, two of which are the most common traditional types of technologies (thermal energy based on coal and nuclear power), and two of the most promising alternative technologies (wind power and solar energy).

The results of the evaluation of the position was as follows: First place - wind power (cumulative - 3.47), second place - solar energy (2.794), third place - nuclear power (1.011), fourth place - the thermal energy (0.645). Advantages wind energy is the cost of electricity, safety, minimum possible power, productivity and performance development aspect and financial aspect. Advantages of solar energy is the minimum possible power and high tariffs compared to other types of generation that can provide a quick return on investment and higher profits. A disadvantage of both of the technologies is the instability in electricity production, although at a sufficiently uniform placement of wind energy facilities on a large site this disadvantage to a certain extent kompensiruet, and for solar energy the period of production of electricity (in the daytime) coincides with the growth of load in the networks. Advantages of nuclear energy is the high rate of utilization of installed capacity, but it has significant drawbacks, namely, safety performance, high investment costs and long construction period. Thermal power based on coal is a significant environmental pollutant and coal shortage, which is observed lately has a negative impact on the stability of the work of TPP.

Subsequent research should focus on integrated development of power. To consider the possibility of combining regional power plants generating facilities, using various technologies of energy production. You should also pay more attention to the use of local energy resources. This should improve the efficiency of the energy sector in general, to reduce losses in the networks, reduce the purchase of imported energy, which should lead to a real reduction of energy dependence.

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