

Kambar Musabekov¹, Gulmira Azretbergenova², Ruzalia Saygaparova³

MODERNIZATION OF THE ENERGY SECTOR IN THE CONTEXT OF SUSTAINABLE DEVELOPMENT OF NATIONAL ECONOMY

The article deals with the problem of modernization of energy supply industry and its decision on the basis of the proposed methods of using renewable energy sources (RES). The ways to use RES applying the latest technology are considered.

Keywords: modernization; power supply; renewable energy; industry.

КАМБАР МУСАБЕКОВ, ГУЛЬМИРА АЗРЕТБЕРГЕНОВА, РУЗАЛИЯ САЙГАПАРОВА МОДЕРНІЗАЦІЯ ЕНЕРГЕТИЧНОГО СЕКТОРУ У КОНТЕКСТІ СТІЙКОГО РОЗВИТКУ НАЦІОНАЛЬНОЇ ЕКОНОМІКИ

У статті розглянуто проблему модернізації енергозабезпечення промисловості та її вирішення на основі використання відновлюваних джерел енергії (ВДЕ). Розглянуто шляхи використання ВДЕ із застосуванням новітніх технологій.

Ключові слова: модернізація; енергозабезпечення; відновлювані джерела енергії; промисловість.

Табл. 2. Рис. 2. Літ. 19.

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В статье рассмотрена проблема модернизации энергообеспечения промышленности и предложено ее решение на основе использования возобновляемых источников энергии (ВИЭ). Рассмотрены пути использования ВИЭ с применением новейших технологий.

Ключевые слова: модернизация; энергообеспечение; возобновляемые источники энергии; промышленность.

Problem statement. All the problems in the world economy development are associated with the resources expenditure. K.R. Macconnell and S.L. Brue (2003) considered that the solution of these problems is based on the two fundamental economic axioms. The first — the needs of society (both individuals and institutions) are endless. The second — the resources are limited.

The history of any society is the history of energy. The problem of energy supply has always been an urgent task in the development of society. Today we are dealing with a permanent high demand for energy. According to the International Atomic Energy Agency, the modern world community uses energy on a vast scale, and the size of energy consumption increases with tremendous speed. In the near future, while the majority of countries do not approach the level of energy consumption to the value of 10 kW per person, saving will not have a noticeable effect on the growth of the world energy production. Therefore, one of the key issues of this century will be the energy problem.

Nowadays, the energy supply industry is facing the problem of obsolescence of fixed assets, and the physical deterioration of production facilities, the usage of not yesterday's, but the-day-before-yesterday's technologies.

¹ K.A. Yassawi International Kazakh-Turkish University, Turkestan, Republic of Kazakhstan.

² K.A. Yassawi International Kazakh-Turkish University, Turkestan, Republic of Kazakhstan.

³ K.A. Yassawi International Kazakh-Turkish University, Turkestan, Republic of Kazakhstan.

Recent research and publications analysis. Theoretical and practical issues of modernization of the fuel and energy complex (FEC) are reflected in the works by foreign and domestic researchers: S. Vermeulen (2010), V. Andrianov (2001), N. Baykov et al. (2007), J. Swofford and M. Slattery (2010), V. Drel (2011), O. Sabden et al. (2011), J. Munksgaard and P.E. Morthorst (2008), G. Higgs et al. (2008), B. Irishev (2012), C. Ohla and M. Eichhornb (2010) and others.

The research objective is to show the perspectives for modernization of the energy supply industry, with the modernization and transition to renewable energy as a key factor in enhancing the competitiveness.

Key research findings. The world energy sector is now passing from the centuries-old dominant model of extensive development to the maximum utilization of mineral resources to the model of reasonable combination of economic and environmental needs of society. Therefore, the involvement of renewable energy at the competitive market will be a multilevel system of measures. The energy sector of the country is characterized by a natural monopoly and the presence of systemic barriers to the development of new technologies based on renewable energy.

Referring to S. Vermeulen (2010) we can consider that the analysis of the increase of the alternative energy share in the energy mix will allow reducing the excessive centralization grid.

Thus, in the long-term the development of renewable energy sources becomes a factor providing energy security for sustainable development of the national economy.

The trend of development of fuel and energy resources (FER) shows that the production of all energy resources is growing slower than the growth of consumption. In developing countries, industrial production is energy-intensive (Figure 1). This suggests that with economic growth in all developing countries, the problem should have special attention now.

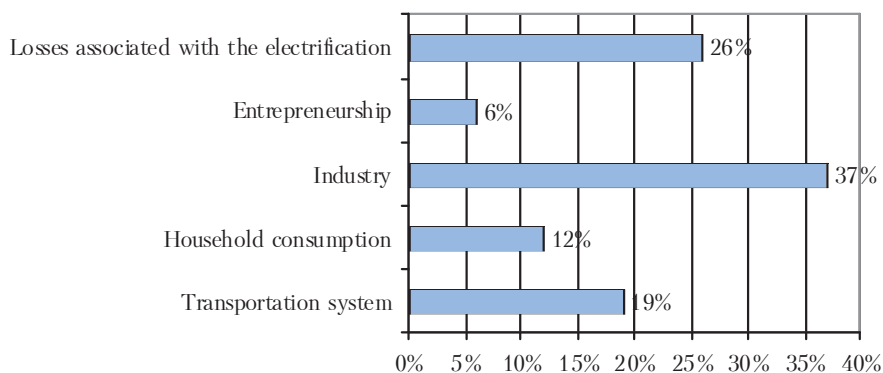


Figure 1. The world total energy consumption by sectors in 2007, %, based on the data by N.A. Nazarbaev (2011)

According to V. Andrianov (2001) the most important condition for the development of the world economy is the supply of energy resources. World output growth is only possible with an increase in energy production. However, the characteristic feature of the energy in the second half of the twentieth century is lower growth rates

compared to the overall increase in production. The reasons for the development of power are, first, that the scientific and technological progress has created conditions for the development of energy-saving technologies, especially in energy-intensive manufacturing industries. The energy crisis of the mid 1970s has added impetus to the energy savings issue.

In the last decade, oil production is growing more slowly than the production of other energy resources, deposits are depleted, oil production rate drops, the environment in the areas of oil production is deteriorating. Scientists estimate that in 20 years the world's oil consumption, compared to the current volume will increase by 40%. At the current stage, only 10% of raw materials turn into finished products. 50 years ago, the amount of energy contained in one barrel (159 liters) of oil was sufficient for the extraction of 50 barrels (1:50), that is, for the production of 50 kg of oil, the energy use was equal to 1 kg. In the mid 1980's, the energy efficiency of oil dropped to 1:8, and with the delivery to consumers – to 1:5. According to experts in the near future, this ratio may be 1:1, i.e. the energy of crude oil is equal to the energy required for its production and transportation (Nadyrov and Nizovkin, 2006).

The petroleum crises of the 1970s, accompanied by a 10-fold increase in nominal prices and nearly 5-fold in relative ones forced developed countries to switch to energy saving. National programs on the conservation and rational use of energy have been developed contributing to a significant reduction in energy intensity of material production. Growth was fueled by energy efficiency policies: 1% of GDP growth had averaged only 0.4% of the increase in energy consumption (Baykov et al., 2007).

As a result, the total energy consumption of one GDP point in industrial countries during the last 20 years have decreased by 22% and the oil intensity went nearly 38%.

According to J. Swofford and M. Slattery (2010), energy conservation is an additional energy resource in itself and an effective model containing a tight schedule to reduce energy consumption and harmful emissions without reducing the pace of growth of the national economy.

It is estimated that one monetary unit invested in energy saving is equal to the effectiveness increase in 3–5 times. Thus, energy saving is currently the most effective alternative source of energy. Energy efficiency is an important indicator of economic, scientific and technical potential. Currently, the level of energy efficiency in Kazakhstan is lagging behind the average world standards and is lower than it was in 1990. It is characterized by extremely high energy intensity of the economy. If you compare the energy consumption levels of developed countries and Kazakhstan, the energy intensity of our GDP exceeds world figures several times. Currently, 1 USD of GDP in Kazakhstan consumes 3.34 kilowatt-hours of electricity, in Russia it is 2.0 for USD – 0.44. Table 1 traces the difference in the cost of electricity for the last 3 years.

Table 1. The dynamics of electricity prices for industrial consumers, based on the data from the Statistic Agency of Kazakh Republic and V. Drel (2011)

Year	The average selling price for industrial consumers, EUR/kWt-h		
	USA	Russia	Kazakhstan
2008	0,0497	0,0358	0,0625
2009	0,0491	0,0453	0,0765
2010	0,0512	0,0525	0,0915

High oil prices, pressure on the environment by using hydrocarbons, and especially coal, led many countries to seek ways of accelerating the use of non-conventional renewable energy sources. If now such sources cover about 2% of the global primary energy needs, in 2020 non-carbon energy can provide up to 20%, according to forecasts. This is due to the fact that many countries are moving or are searching for ways of transition to new alternative energy sources.

Economic efficiency of renewable energy sources available to small and medium-sized businesses can be built quickly and independently by using the inexhaustible energy of mountain rivers and winds, which are not affected by price increases. Such companies would not have high-priced fuel within their electricity costs in production, while at thermal power stations the fuel component of such costs is more than 50%. Such stations reduce losses by 8–12% points of consumption in grids. This will reduce the tariffs for transportation of electricity in regional and inter-regional power grid, which eventually will bring a double effect. The cost of saving per ton of fuel through the use of renewable energy is two to four times less than production and transportation costs. The use of renewable energy is a real alternative to centralized energy supply, especially for remote areas often experiencing power shortages.

At present, the installed capacity of wind power plants (WPP) is about 1.5% of the global generating capacity. Wind power shows a constant increase, up to 20–30% per year. At the same time, the cost of 1 kWh of wind power in the US has fallen from 0,060 in the early 1990s to the present level of 0,044–0,037 (Figure 2).

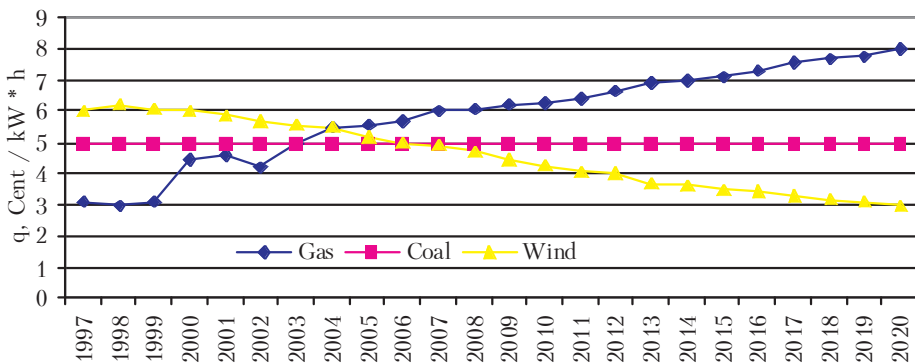


Figure 2. The dependence of the cost of electricity produced from organic utilities and wind, authors' development

As a part of the overall energy strategy of the European Union, the share of electricity produced from renewable energy sources reached 22% in 2010. Within alternative sources of energy wind energy shows the most dynamic development. Due to the improvement of wind energy production equipment and technology over the past decade the cost of wind energy reduced by average 40% with the increase simultaneous of energy turbine power capacity during the last 10 years: from 75 to 5000 kW. Plus their reliability is now nearly 99%; the average energy output of wind power plants increased by 55%. Its efficiency coefficient is now reaching 50% as compared to the theoretical limit of 59%.

Conforming B. Irishev's research (2012) for some countries, the figure is closer to that of the cost of electricity generated by power plants running on fossil fuels.

Among the Commonwealth countries the most prepared for large-scale development of renewable energy sources is Ukraine, which has a strong scientific and technological potential. A role in this was played by the fact that basic scientific research in the field of development of renewable energy sources in the former Soviet Union was concentrated in Ukraine. Currently in Ukraine, the total installed capacity of wind power network is more than 86 MW.

In the "Strategy-2050" Kazakhstan set a task of the energy sector development: in 2014 – to bring the share of non-oil exports up to 40% as well as to reduce energy intensity by 10% from the 2008 level. By 2020 the share of renewable energy should increase by 13%, and by 2050 – by half of the total generating capacity.

Energy security issues are of primary importance for any country. There is an objective measure for this – the coefficient of self-reliance (CSR), defined as the ratio of energy produced for consumption. If $CSR < 1$, the country imports energy resources, if $CSR > 1$, then trade balance is dominated by exports. Some countries are exporting one type of energy and importing another, but the general outcome of CSR is important here. The analysis of the dynamics of self-sufficiency in energy resources of G8 members showed that only Russia, UK and Canada are energy-independent. Within the former Soviet republics energy independent are Russia ($CSR = 1.57$), Kazakhstan (2), Azerbaijan (1.62), Turkmenistan (3.31) and Uzbekistan (1.1). Self-sufficiency in other republics, especially Moldova (0.02) and Belarus (0.14) is very low.

Russia has the largest energy reserves within the former Soviet space (Table 2). So, in terms of natural gas, Russia is in the first place in the world, coal and hydropower – the second one, uranium ore – the fourth, oil – the seventh.

Table 2. The energy resources of the CIS (2010 estimate),
based on the data P.S. Neporozhy et al. (1982)

Country	Territory, ths km	Population, mln	Oil, k ton	Coal, k ton	Gas, bln m ³	Uranium, k ton	Hydropotential, TWh/year		
							gross	technical	economic
Azerbaijan	86,6	8,9	1000	n/a	1310	n/a	43,5	16	7
Armenia	29,7	3,2	Studied*	100	Minor**	Studied	21,8	8,6	6
Belarus	207,6	9,6	28	150	3,5	n/a	7,6	3,1	0,9
Georgia	69,9	4,4	35	200	8,5	n/a	159,4	67,9	32
Kazakhstan	2724,9	15,4	5300	31300	1820	651,8	198,6	61,9	27
Kyrgyzstan	199,9	5,4	11,5	1340	6,5	Studied	142,5	72,9	48
Moldova	33,8	3,6	0,5	402	n/a	n/a	2,1	1,2	0,7
Russia	17075,4	140	10200	157010	44380	480,3	2896	1670	852
Tadzhikistan	143,1	7,3	5,4	670	9,2	Minor	299,6	143,6	85
Turkmenistan	488,1	4,9	100	Studied	8100	Minor	23,9	4,8	1,7
Uzbekistan	447,4	27,6	100	2000	1680	114,6	88,5	27,4	11
Ukraine	603,7	46	55	33873	980	105	44,7	21,5	17

Note: * proved reserves; ** known reserves of uranium extraction costs to 130 USD/kg; n/a – no available; studied; minor.

The explored oil reserves of the Commonwealth countries are estimated at 16.8 bln tons, including in Russia which concentrates 60.6%, Kazakhstan – 31.5% and

Azerbaijan – 5.9%. Apart from the named countries, the following countries also have significant oil reserves (in descending order): Turkmenistan, Uzbekistan, Kyrgyzstan. Small oil fields are also in Belarus and Ukraine.

Russia accounts for 69.3% of the total coal resources of the CIS, Ukraine – 14.9%, Kazakhstan – 13.8%. In Georgia, Uzbekistan and Kyrgyzstan coal reserves are insignificant. Russia also has 76.3% of all explored natural gas reserves in the CIS, followed by Turkmenistan (13.9%), Kazakhstan (3.1%), Uzbekistan, Azerbaijan, and Ukraine (less than 3%). Small gas reserves are present in Tajikistan, Georgia, Kyrgyzstan and Belarus.

The fields of uranium ores are concentrated in Kazakhstan, Russia, Ukraine and Uzbekistan. Russia's share is around 35.5%. Nuclear power is the most developed in Russia and Ukraine.

According to E. Volkhova et al. (2011) the most supplied by hydropower are Russia, Tajikistan and Kazakhstan. Russia accounts for 77.8% of the total economic potential of hydropower resources of the former Soviet Union. The share of Tajikistan is 7.8%. In terms of hydropower resources Kazakhstan is in the third place among the CIS countries, after Russia and Tajikistan. In Central Asia, water resources are mainly used for irrigation.

Kazakhstan for all types of primary energy refers to as an energy independent country, the reserves of which far exceed its own demands for many years. The energy sector is one of the most developed sectors of the economy of Kazakhstan. By hydrocarbon reserves the Republic of Kazakhstan is in the top 10 countries in the world, which is about 4% of the world reserves of fuel. Kazakhstan has the second largest world reserves of uranium, accounting for 48.2% of the reserves of the Commonwealth countries.

Active participation in the integration process, the positive dynamics of economic growth, significant progress in economy stabilization and the implementation of structural reforms will allow Kazakhstan solve the strategic target of entering the top 30 most competitive countries in the world.

The analysis of the resource-rich countries with different strategies of development shows that resources are not an obstacle for successful economic development, neither are they the cause for a fatal crisis. Profit from mineral resources are heavily dependent on the world energy prices, which affects the stability of all national economies. In addition, hydrocarbon resources are non-renewable, which might create a problem in the energy policy implementation in the long run.

Given these facts, it is possible to identify the main recommendations for effective modernization of the energy industry:

First, a World Energy Bank needs to be created, which would supervise modernization programs in the energy sectors. The basis for this bank functioning can be the experience of the World Bank.

Secondly, it is necessary to rely on the experience of field leaders from developed countries, which in the medium term is an example of an acceptable policy priority. For example, Germany nowadays is reaching the level of energy consumption per GDP unit for 20% below the global average while at the same time Germany is intensively developing renewable energy high power sector (Ohla and Eichhornb, 2010).

The policy of modernization of the energy sector should include the diversification of electricity production with the development of renewable energy and ensuring efficient energy-saving technologies to reduce the consumption of fossil fuels and reduce greenhouse gas emissions. An important aspect of the modernization of the energy sector is the refusal of "raw model" and the redistribution of the income from the commodity sector (meaning raw materials) to the industrial development of the real economy.

Conclusion. The analysis showed that the modernization of energy supply based on renewable energy industry in the long term is the only way to increase the energy efficiency of the national economy and overcome energy shortages. The widespread introduction of renewable energy sources will not only reduce the negative impact on the environment, but also boost the development of other related areas of science and industry. The use of only a few percent of renewable energy would save more than 100 bln USD, eliminate the dependence on imported energy, raise to a higher level the industrial production and alleviate environmental problems.

Reaching the mass production of renewable energy at affordable prices will lead to the following beneficial effects: stable sales at reasonable and stable prices, favorable effects on social and economic development of countries, generation of sustainable profits.

In general, the relevance and the importance of early involvement in the competitive energy market of renewable energy sources can be seen in the following aspects:

- Economic: currently, the cost of energy produced by alternative sources is lower than the cost of energy from the conventional sources. The payback period of the construction of renewable energy facilities is significantly shorter than the construction of power plants based on fossil fuels.
- Environmental: increased environmental pollution, the costs of nuclear wastes causes higher competition for renewable energy.
- Political: the energy potential determines the economic potential of a country. The development of alternative energy at a competitive market will strengthen the political independence and national security.

Thus, the modernization of the energy sector can solve the two strategic issues — maintaining macroeconomic stability and competitiveness of the national economy.

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Стаття надійшла до редакції 17.06.2013.

КНИЖКОВИЙ СВІТ



СУЧАСНА ЕКОНОМІЧНА ТА ЮРИДИЧНА ОСВІТА
ПРЕСТИЖНИЙ ВИЩИЙ НАВЧАЛЬНИЙ ЗАКЛАД

НАЦІОНАЛЬНА АКАДЕМІЯ УПРАВЛІННЯ

Україна, 01011, м. Київ, вул. Панаса Мирного, 26

E-mail: book@nam.kiev.ua

тел./факс 288-94-98, 280-80-56



Організаційно-економічні аспекти інноваційного оновлення національного господарства: Наук. монографія / М.М. Єрмошенко, С.А. Єрохін, В.М. Шандра, О.І. Гуменюк та інші; За наук. ред. д.е.н., проф. М.М. Єрмошенка і д.е.н., проф. С.А. Єрохіна. – К.: Національна академія управління, 2008. – 216 с. Ціна без доставки – 22 грн.

У монографії проаналізовано стан технологічного оновлення національної економіки на інноваційних засадах, виявлено позитивні сторони і недоліки цього процесу і розроблено організаційно-економічні основи формування механізму інноваційного оновлення економіки України, її окремих галузей та підприємств.