ENERGY POLICY OF THE FORMER SOVIET UNION REPUBLICS BY THE EXAMPLE OF BELARUS AND AZERBAIJAN

Alexander Mikhalevich[1], Valech Nasibov[2]

[1]Institute of Power Engineering / National Academy of Sciences of Belarus

15-2 Academicheskaya str. Minsk, Rep. of Belarus 220072

[2] Azerbaijan Scientific-Research and Designed-Prospecting Institute of Energetics

Zardabi av.94, Baku, Azerbaijan 1012

Abstract

There was a centralized energy supply policy of the former Soviet republics before the collapse of the USSR. After that these republics became independent states, the situation changed dramatically. Now each country has become forced to conduct its own energy policies. Some countries like Belarus were without significant domestic fuel and energy resources, others such as Azerbaijan, became the exporters of energy resources. Both categories of states set themselves first of all two main objectives: economic growth and energy security.

Key words: *energy policy, energy security, energy efficiency, diversity of supply*

INTRODUCTION

The policy of the centralized energy supply was realized in the USSR for all its republics. For this purpose an extensive network of high-voltage electricity transmission lines, railways, main natural gas and oil pipelines was built (tabl.1).

Table 1. Extent of communications related to the energy supply in the USSR

Type of fuel and energy resources transport	Operating length, thousand km
HV lines	
110 kV	431
150 kV	12.6
220 kV	136.5
330 kV	31.9
750 kV	5
1150kV	1.9
Railways	145
Main gas pipelines	144
Main oil pipelines	86

It should be noted that both power and economic potential of the former soviet republics was substantially different (tabl.2). In Russia, Ukraine, Kazakhstan, Belarus and Baltic republics (Estonia, Latvia, Lithuania) the share of basic production assets more or less corresponded with the share of the population of the USSR, resident in these countries. But if Russia, Ukraine and Kazakhstan were rich in their own fuel and power resources (FPR), Belarus and Baltic republics were FPR poor, but Lithuania and Estonia produced electricity more than it was consumed. Another resources-rich

countries (Azerbaijan, Turkmenistan and Uzbekistan) played a less important role in the industrial production of the USSR.

1. GDP AND POWER CONSUMPTION

Analysts noticed long ago that level of economic development of one or another country correlates the best with the consumption of electricity per capita. Exactly electricity power, but not gross energy consumption. The increase of share of electricity in the and-use consumption of FPR results in improvement of technological level of production and service.

Table 2. The distribution of macroeconomic indexes between the USSR republics

Country	Share of population in the USSR	Share in USSR of, %				
		Basic production assets	Electricity production	Extraction of oil	Extraction of gas	Extraction of coal
USSR	100	100	100	100	100	100
Armenia	1.2	0.8	0.6	-	-	-
Azerbaijan	2.5	1.5	1.3	2.2	1.2	-
Belarus	3.5	3.4	2.3	0.4	-	-
Estonia	0.5	0.7	1.0	-	-	-
Georgia	1.9	1.4	0.8	-	-	0.1
Kazakhstan	5.8	5.7	5.1	4.5	0.9	18.7
Kyrgyzstan	1.5	0.8	0.8	-	-	0.5
Latvia	0.9	1.0	0.4	-	-	-
Lithuania	1.3	1.4	1.6	-	-	-
Moldova	1.5	1.1	0.9	-	-	-
Russia	51.2	62.0	62.7	90.4	78.6	56.2
Tajikistan	1.8	0.7	1.1	-	-	0.1
Turkmenistan	1.3	1.0	0.8	1.0	10.8	-
Ukraine	17.9	15.4	17.3	1.0	3.5	23.5
Uzbekistan	7.1	4.3	3.3	0.5	5.0	0.9

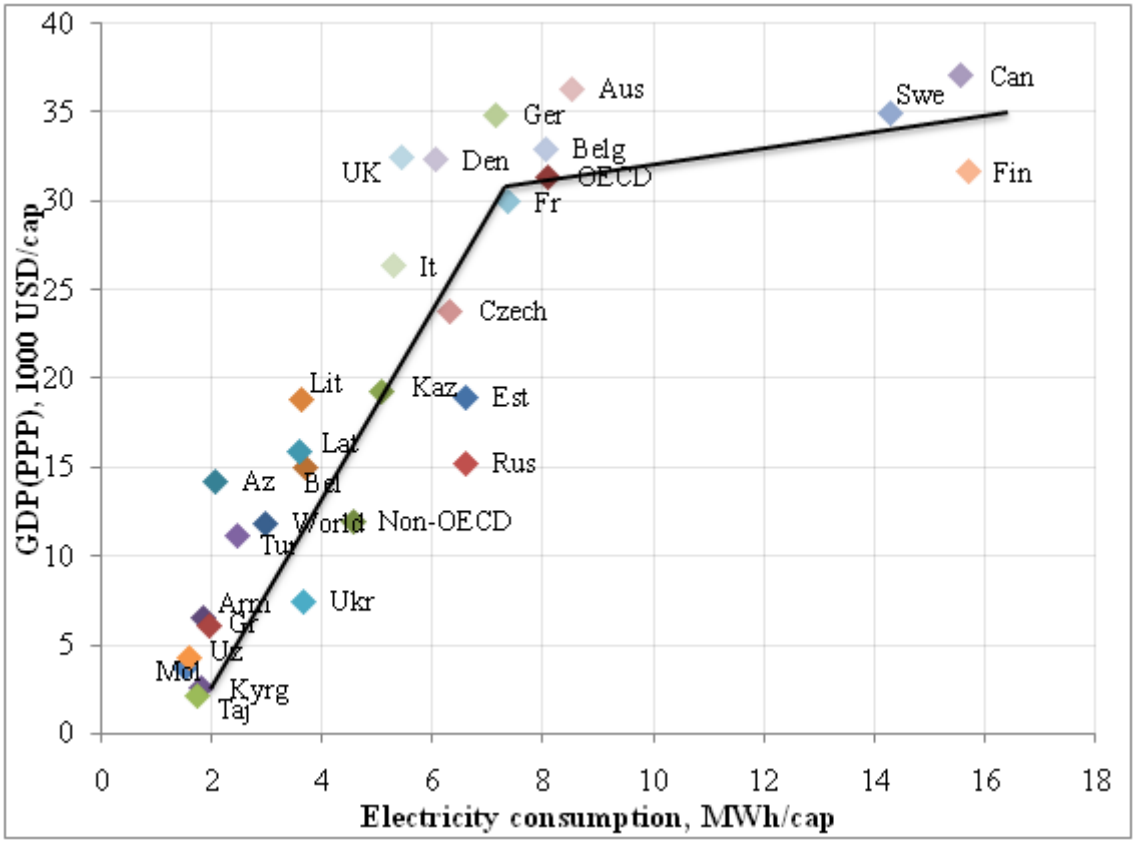


Figure 1. Correlation between GDP and Electricity consumption

Fig. 1 shows the relationship between the specific electricity consumption and GDP at purchasing power parity for the countries of the former Soviet Union in 2012, according to the International Energy Agency.For comparison, the data for some countries of the European Union and the OECD are shown as well.

Growth of electricity consumption up to the level less than 2000 kWh per capita per year practically doesn't influence the change of GDP. The greater part of this electricity is spent on domestic needs. At the excess of the specified level one can observe quite accurately expressed correlation between GDP growth and electricity consumption.

2. ENERGY POLICY OF BELARUS

By the time of the Soviet Union collapse BSSR was one of the most economically developed republics. The power-intensive branches were created in the country: mechanical engineering, metallurgy, oil processing, large-capacity chemistry, production of fertilizers, *etc.* In 1990 specific consumption of primary energy resources, without used as raw materials for not-fuel production, was about 4.2 tons of oil equivalent per person that was higher, than in France or Great Britain. The power consumption developed by accelerated rates. So, during 15 years (1975-1990) the growth of specific electricity consumption was reached 2.4 MWh/capita and also exceeded similar indicators of the USSR and the USA.

Initially the economy of BSSR was focused on nuclear power, but not due to the development of its own power sources. Under different circumstances including subjective ones, four large NPPs with the total capacity of about 12000 MW (Ignalina, Smolensk, Chernobyl and Rovno) were constructed round the republic at a distance from 12 to 60 km from its border. In the republic the capacity of thermal power plants was almost twice less, but in 1983 the construction of Minsk Nuclear CHP was

began (2 units of 1000 MW) and the preliminary construction design of the Belarusian NPP in Vitebsk province was prepared. Accident at the Chernobyl NPP brought both of these projects to a stop.

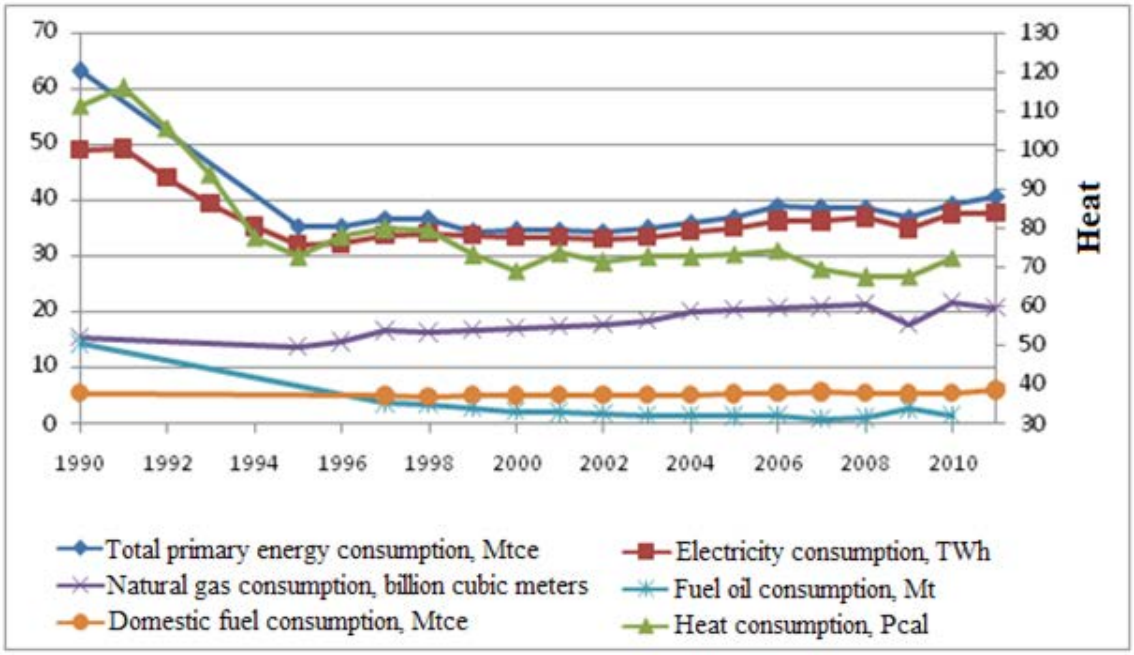


Figure 2. Energy resources consumption in the Republic of Belarus

Having become the independent state, the Republic of Belarus faced with paramount problem: providing for economics and social sphere with energy resources. The established capacity of the Belarusian power plants could provide no more than 80% of needs in the electricity. The energy crisis in the country didn't come due to the recession in the economy. In fig. 2 it is visible that by 1995 the general consumption of fuel and energy resources in the country fell by a factor of 1.8, the consumption of electricity and heat – by 1.5 times. Therefore, from the beginning of the 90th one of the major goals was to work out a strategy of power development and long-term power planning.In 1992 the **"Program of Power and Energy Saving Development of the Republic of Belarus for the Period up to 2010"** was worked out and approved by the Ministry Council of the Republic of Belarus. It was based on the following principles:

- priority of the social purposes over economical or other ones;
- emphasis on energy saving;
- self-repayment of electricity generation and self-sufficiency of power capacities;
- the greatest possible extension of life-time of the existing equipment;
- challenge environment protection requirements.

The Program proceeded from the most considerable unused energy reserves consisted not in production, but in energy consumption. Thus, under the conditions of production decline and other crisis phenomena in the economy an energy efficiency growth (energy saving) became the main issue of the power policy in the Republic of Belarus. Then in 1996 the Government approved **"The Main Directions of the Energy Policy of the Republic of Belarus for the Period up to 2010"** and in 2000 - the new edition of this document for 2001-2005 and for the period up to 2015.

If in the 1992 Program the priority of the social purposes over economic and other ones was the main criterion, then in the subsequent documents the optimum option was accepted on the assumption of the minimum expenses. At the beginning of the XXI century it was became clear that the further development of the energy industry in the country had to proceed from the principle of energy

security. The term ***energy security*** became widely used in discussions of politicians, scientists and experts.

In 2004 in Belarus the decision to develop the Concept of Energy Security was accepted. It was to become the main document defining the strategy of energy development for the long-term period. So the assessment methodology of energy security conditions became the major problem.

The analysis of economic and energy security of the country belongs to the problems of large social, technical and economic systems which are characterized by a variety of properties, parameters and states, complexity of internal and external interrelations, uncertainty of development conditions , *etc*. For such systems the application of the ***indicative analysis theory*** based on mathematical statistics methods is effective. Such approach was used for the assessment of energy security of the Russian Federation and its regions and Moldova as well.

The indicative analysis is based on the indicators which characterize extent of energy security threats. The peculiarities are that economic and energy security is expressed through the system of indicators by values of which it is possible to make the conclusion about security level of the considering system comparing the values of the indicators with the earlier determined ***threshold levels***.

Classification of energy security conditions includes three main qualitative security zones for each of the indicator: ***normal (N), precritical (PC) and critical (C).***

The normal is such a state at which possible threats to security in the fuel and energy sphere can be neutralized or compensated by internal stability of the system or other factors.

The precritical zone is characterized by a state when threats to security start gaining significant importance which is necessary to be dealt with. In case of rejection of measures for neutralization and elimination of threats there is a danger of development of the destabilizing factors influencing security. Precritical condition in itself doesn't mean irreversible deterioration of the state in general but can mean essential deterioration of the certain spheres. However this deterioration can be overcome by acceptance of appropriate correcting actions. Introduction of a precritical zone is necessary to see the arising dangerous tendencies in situation development in time and to prevent their increase. Therefore at this stage preventive measures are mainly applied.

The critical stage is characterized by essential negative tendencies and developing dynamics which even in the initial critical stage threaten sustainable development. When getting in this stage it is impossible to be limited to preventive measures, but more radical measures are required. Such actions demand considerable expenses and can be followed by temporary deterioration of life quality until the system reaches sustainable development.

The first **Concept of Energy Security of the Republic of Belarus** was developed and approved by the President of the Republic of Belarus in 2005 but next year the situation in the market changed seriously (the price for the Russian gas for Belarus grew more than twice, *etc*.) therefore in 2007 the new version of the Concept up to 2020 was developed and approved. Now according to the instructions of the President of the Republic of Belarus the new edition draft of the Concept of energy security up to 2035 is developed.

When working out the draft of the Concept the world energy development tendencies, in particular, prognoses of annual growth rates were considered (tabl. 3). It is supposed that by 2050 the share of electricity in final consumption of energy resources will increase from 17% to 23%, the specific weight of renewables will reach 14%, the share of electric cars and hybrid vehicles will make 50% and biofuels will reach no more than 5%.

Table 3.Prognosis of energy indexes for the world Belarus and Azerbaijan

Index	Prognosis of the IEA for 2050 (world in general)	Prognosis fuel and energy balance of Belarus for 2035	Expected FEB of Azerbaijan for 2030
Average annual growth rates of demand - on primary energy - on electricity	 +1.4% +2.0%	from +1.0 to +1.5 % from +0.5 to +2.5 %	 from +1.0 to +1.5% from +1.6 to +4%
Average annual rates of decrease in energy intensity of GDP	from -1.2 to -2.4 %	-2.0%	-2.0%
Share of nuclear energy in gross consumption of fuel and energy resources	from 6 to 12% (depending on the policy of reducing CO_2 emission)	from 10 to 16%	
Share of RES in gross consumption of fuel and energy resources	up to 14%	not less than 5%	not less than 7% against the current 1.2%
Share of electric cars and hybrids	to 50 % of all cars	about 10%	
Share of biofuel in consumption of liquid hydrocarbons	not exceed 5%	about 8%	
The share of electricity in final consumption of energy resources	increase to 23%	from 11 to 20%	Not less than 20% against the current 16%

Values of some main energy security indicators and their threshold levels are shown in table 4. In 2014 two indicators (3 and 6) were in a critical zone, five (1, 2, 4, 8 and 9) were in a precritical one and only two (5 and 7) were in a normal one. In the Concept the goal by 2035 was to reach the condition in which five indicators (4, 5, 6, 7 and 8) would appear in a normal zone, the others would be in a precritical one.

In the Republic of Belarus the following hierarchical system of power policy prognosis and planning (fig. 3) is accepted. At the top level the prognosis of the energy supply and consumption is defined for the long term in 20-30 years. The document of this level is the Concept of Energy Security the new edition of which is defined for the period up to 2035.At the second level the development strategy on the medium-term prospect of 10-15 years is formed. In Belarus the **Strategy of Energy Potential Development for 2011-2015 and for the period up to 2020** defines the ways by which the challenges determined by the document of the first level will be reached. This Strategy was approved by the Government in 2010.

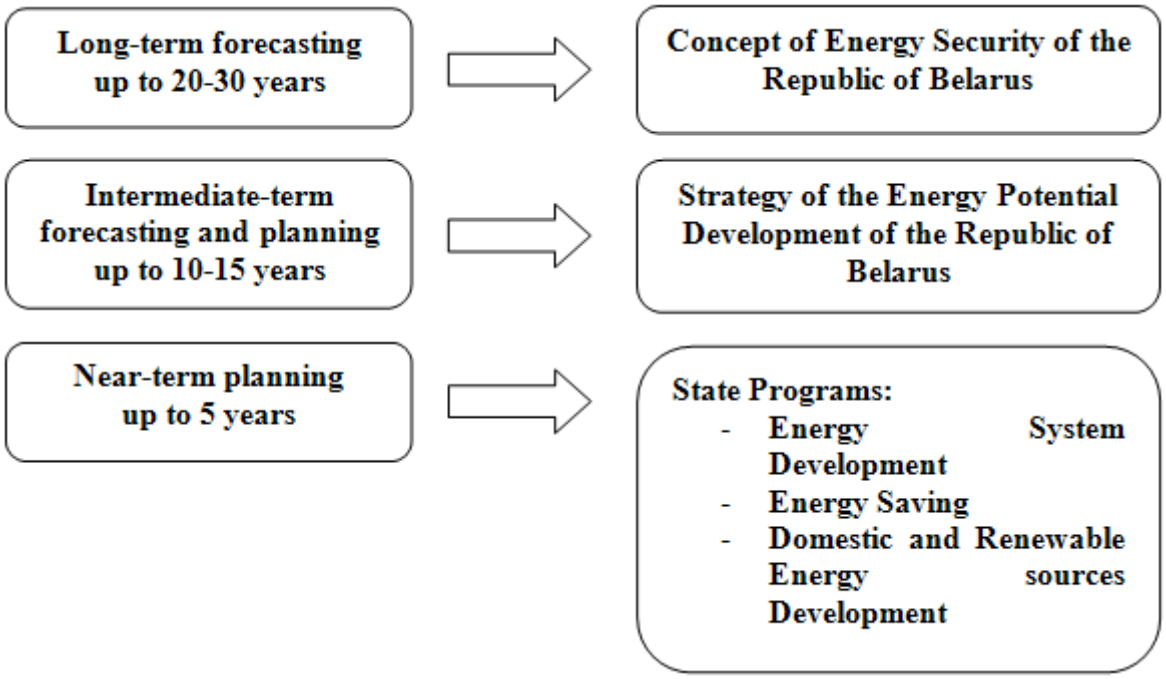


Figure 3. Energy forecasting and planning system in Republic of Belarus

Table 4.The prognosis of energy security indicators of the Republic of Belarus up to 2035

Indicators	Threshold levels		2015	2025	2035
	N	C			
1. Relation of production (extraction) output of primary energy to gross consumption of fuel and power resources, %	30	15	15 PC	17 PC	20 PC
2. Self-sufficiency of the country energy resources for transport, %	50	25	25 PC	35 PC	45 PC
3. Share of the dominating supplier (country) of energy resources in the total import of FPR, %	65	85	90 C	80 PC	70 PC
4. Share of a dominating fuel type in gross consumption of FPR, %	50	70	60 PC	55 PC	50 N
5. Reserve of installed capacity of power plants, %	140	95	130 N	145 N	135 N
6. Share of natural gas in production of heat and power, %	50	80	90 C	60 PC	< 50 N
7. Relation of number of power supply violations in population settlements per a year to the total number of the settlements, %	0.5	2	<0.5	0.4	0.4
8. Energy intensity of GDP, kg oe/mill rubles 2005	160	485	340 PC	245 PC	210 PC

9. Relation of the imported FPR cost to GDP, %	15	30	25	21	15

Finally, at the third level specific programs for the period till 5 years are developed. In our country the main programs setting up the implementation of the Concepts of Energy Security and the Strategy of Energy Potential Development are:

- the State Program of the Belarusian Power System Development;
- the Republican Program of Energy Saving;
- the National Program of Domestic, Renewable and Nonconventional Energy Sources Development.

3. ENERGY POLICY OF AZERBAIJAN

In spite of relatively slow growth of Azerbaijan industrial production in comparison with the other republics of USSR , the power intensity branches in Azerbaijan were sufficiently developed by 1990: metal manufacture, machine construction, chemical and petrochemical industries. In 1990 the power consumption per capita constituted 3021 kWh, which was significantly lower than the similar index of USSR and USA.

After USSR disintegration the system crisis has covered the economy of independent Azerbaijan. In this process the fuel and power complex (FPC) has demonstrated the greatest stability as a branch with the best startup conditions in comparison with other economy branches. It can be stated with certainty that today's high rates of Azerbaijan economy growth are mainly related to the successful development of FPC of Azerbaijan, a foundation of which has been laid by "Century Contract", concluded between the Azerbaijan Government and 11 major foreign companies from 6 states on completion of Azeri-Chirag-Gunashli oil field in Caspian Sea sector of Azerbaijan. Owing to this contract Azerbaijan has become one of the major oil suppliers to world markets. Oil is delivered through the Baku-Tbilisi-Jeykhan" pipeline of 1774 km length putted into operation in 2006 for the construction of which 4 billion dollars were spent. The dynamics of oil and gas production change within the years of independence has shown in Fig. 4.

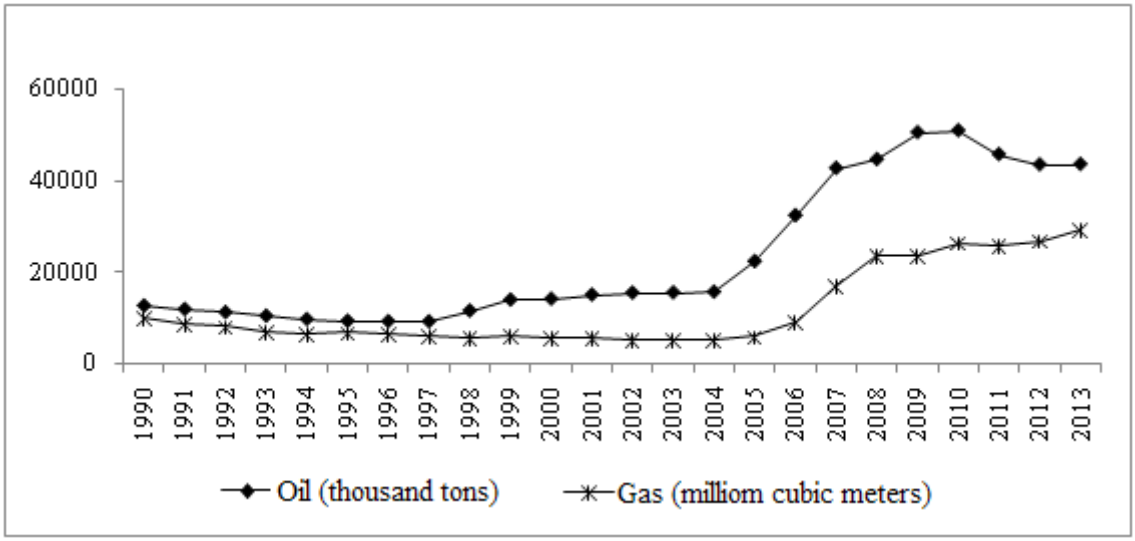


Figure 4. Dynamics of oil and gas production in Azerbaijan

As it is seen from the Fig. 3 the oil production in 1997 increased as much as 5 - 6 times, and reached its historical maximum - 50.8 million tons against 9 million in 2010. Within subsequent years the oil

production decreased slightly, in 2011 - 45.6 million tons, in 2012 - 43.3 million tons and in 2013 oil production slightly increased to 43.5 million tons. Within the years of independence about 500 million tons of oil were produced in Azerbaijan.

For to-day the natural gas reserves of Azerbaijan are estimated at 2.6 trillion.m^3. Within 2004-2013 the natural gas production increased by a factor of 5.9 and reached 29.2 billion m^3. It is planned in nearest future to bring the annual natural gas production up to 50 billion m^3. Transformation of Azerbaijan into the natural gas exporting country is linked with putting into operation the "Shakh Deniz" oilfield with proven gas reserves of 1.2 trillion m^3. Presently gas is exported from "Shakh Deniz" oilfield to Georgia, Greece and the main export market of Turkey. Azerbaijan exports also the natural gas to Russia.In September 2014 a ceremony of laying the foundation of Southern gas corridor was held in Baku, within the framework of which the construction of Trans-Anatolia gas pipeline (TANAP) of about 2000 km length (Turkey) and Trans-Adriatic gas pipeline (Trans Adriatic pipeline, TAP) of 870 km length (Greece, Albania and south of Italy) will be. The resource base of Southern corridor is "Shakh-Denise-2" project. The beginning of natural gas production within the framework of "Shakh-Denise-2" project was planned for 2018. In 2018 the gas supply to Turkey is expected to start, in 2019 - to the European market. The annual volume of gas production within the framework of "Shakh-Denise-2" will total 16 billion cubic meters per year, 10 billion cubic meters of which will be sent to Europe, and 6 billion cubic meters - to Turkey. As a whole, the total gas production from oilfield after beginning the production within the framework of "Shakh-Denise-2" will total 25 billion cubic meters. Out of them 9 billion cubic meters of gas will be produced within the framework of first project stage, and 16 billion cubic meters - within the second one. The total project cost is 45 billion dollars, the one of the turkish part - 12 billion.

Power consumption of Azerbaijan during the independence years is shown in the Fig. 5.

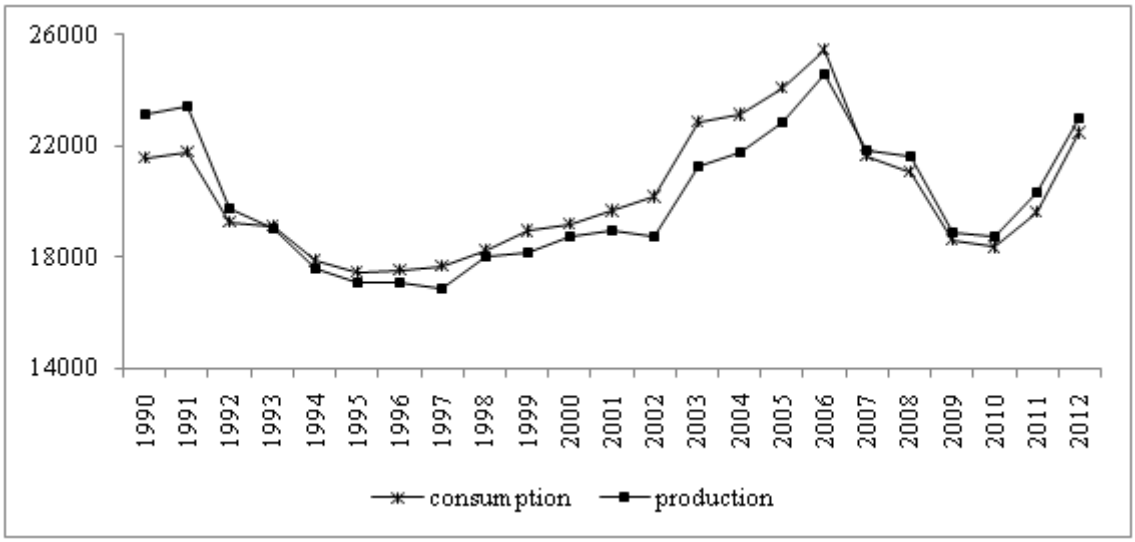


Figure 5. Consumption and production of electricity in Azerbaijan, mill kWh

As it is seen from the fig. 5, the graphs of electric power consumption and production have 2 clearly expressed dips. First minimum is rather long and concerns to the period of Azerbaijan economy adaptation to the conditions of independent functioning, when business-economic links between enterprises of former Soviet republics have been widely violated and the country has undergone the military aggression. The second dip of electric power consumption is attributed to a number of factors: by 3 times increase of electric power tariff installing everywhere the up-to-date electric power meters, revival of heating systems in big cities, intensive gasification of state settlements, *etc*. Peak of electric power consumption in 2006, when it reached the historical maximum, was mainly related with the misuse of electric power, when electricity was mainly used by population for heating needs (more than

60%), and low collection of payments for consumed electric power (20-30%). As it is seen from the fig. 5 since 1994 and up to 2006 Azerbaijan imported electric power. Electric power has been imported from Russia within the hours of evening maximum and on high price. Owing to rapid input the new generating capacities in different regions of Azerbaijan, since 2007 Azerbaijan began exporting the electric power with fully provision its internal consumption.

Input of the new generation capacities over the last 10 years is shows in the Fig. 6. As it is seen from the Fig. 6 within the last 10 years more than 2300 MW capacity were put into operation in Azerbaijan power system which constituted approximately 40% of installed capacity.

For today Azerbaijan electric power system has a high-voltage connections with power systems of neighboring states. The connections of Azerbaijan power system with Russia power systems (110 kV, 330 kV), Georgia (330 kV, 500 kV), Iran (230 kV) and Turkey (154 kV) are shown in the Fig. 7. It needs to make a special emphasis on Azerbaijan-Georgia-Turkey power bridge, via which Azerbaijan intends in the nearest future to supply the electric power through power system of Georgia to Turkey of about 4-4.5 billion kWh per year.

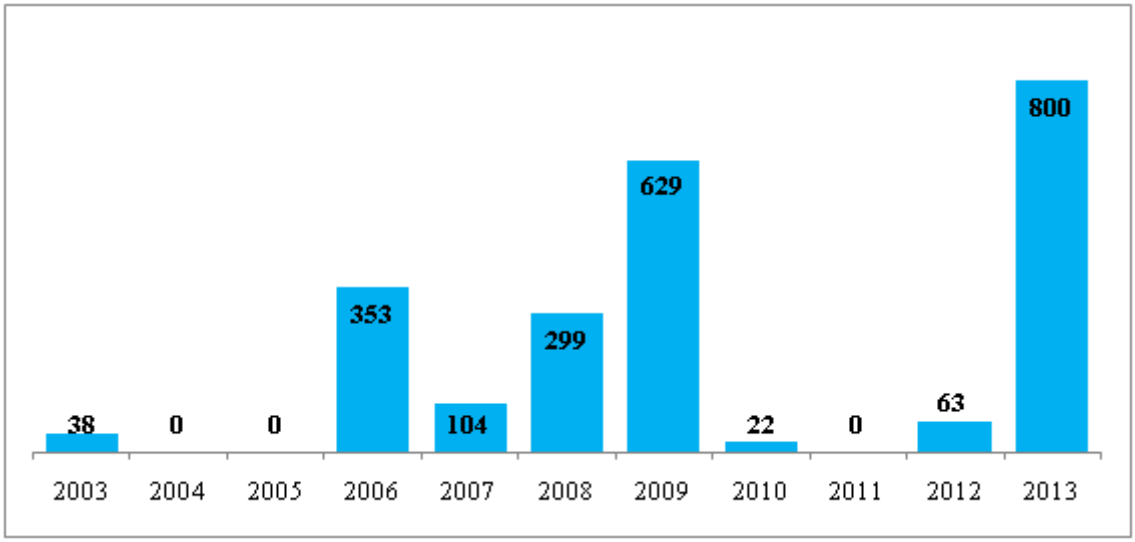


Figure 6. Commissioning of new capacities in Azerbaijan, MW

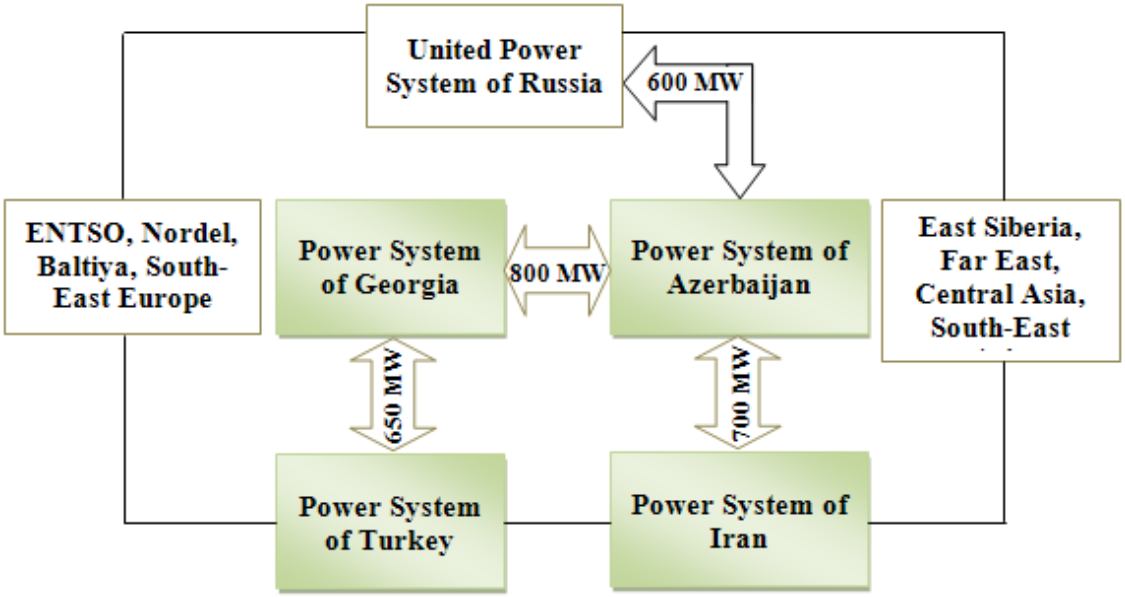


Figure 7. Block diagram of the inter-system links

Forecasting and planning of development of Azerbaijan power sector is carried out in two main directions: international commitments of Azerbaijan under the contracts concluded between the Republic of Azerbaijan and foreign companies, and the government programs, plans, strategies and concepts of energy development.

The most important international contracts in power industry field are the following:

1. **Baku - Tbilisi - Jeykhan oil pipeline**, designed for transportation of Caspian oil to Jeykhan - Turkish port, located on the shore of Mediterranean sea. The official inauguration ceremony of the oil pipeline was held on 13 July 2006 in Jeykhan.
2. **Baku - Tbilisi - Erzurum gas pipeline** (South Caucasian pipeline) was officially opened on 25 March 2007.
3. **Building of TANAP and TAP gas pipelines**, which will connect Azerbaijan with the south of Italy, passing via the territory of Georgia, Turkey, Greece and Albania. The project of gas pipeline from Azerbaijan to Europe was agreed with Turkey in the end of 2012. According to the construction project, the pipe with capacity of 16 billion cubic meters per year will be built by 2018.
4. **Baku - Batumi oil pipeline** - was built in 1928 - 1930 for the transportation of oil from oil production area to the coast of Black sea, Batumi port.
5. **Baku - Novorossiysk oil pipeline** for transportation of Caspian oil to the Russian port of Novorossiysk, located on the Black sea shore. After 2013 year it is controlled by Russian "Transneft" company.

The main legislative acts of Azerbaijan Republic on forecasting and development of the power sector are the following documents, having the three-level hierarchical structure: 1."The Concept for the development of Azerbaijan Republic", 2. National programs, plans and strategies on the prospects of development of Azerbaijan Republic's fuel-power complex, 3. Programs, strategies, plans of development of power industry's individual systems.

The **“Concept of Development of "Azerbaijan - 2020: Glance at the Future"** and the five-year **“Government Programs on Socio-Economic Development of Azerbaijan Republic's Regions (2014-2018)”** are the main documents within the framework of which the specific direction of Azerbaijan Republic's economy are considered, including the fuel-power complex. The main document of second level is **the "State Program on Fuel and Power Complex Development of Azerbaijan Republic (2005-2015)",** within the framework of which the directions of development of fuel and power complex' subsystems are determined, including the ones of oil and gas industry and electric power industry. Presently the new program on development of Azerbaijan FPC is worked out. To the programs of third hierarchical level related the following development programs: **"The State Program on Utilization of Alternative and Renewable Power Sources in Azerbaijan Republic"** (2004), **"Program of Development of Alternative and Renewable Power Sources up to 2020 year", "Strategic Plan of "Azerenerji" JSC 2014-2020", "The General Plan of Development of Azerbaijan Electric Power Industry 2013-2025"** and others. In addition to the above documents, the management of power sector is carried out on the basis of the following laws: **"The Law on the Use of Power Resources", "The Law on Electric Power Industry", "The Law on Electric and Thermal Stations"** and taking into account the tendency of changes of the main world and Azerbaijan power industry factors as well (tabl. 3).

The time history of specific consumption of equivalent fuel for the electric power generation at power plants is shown in the Fig. 8.

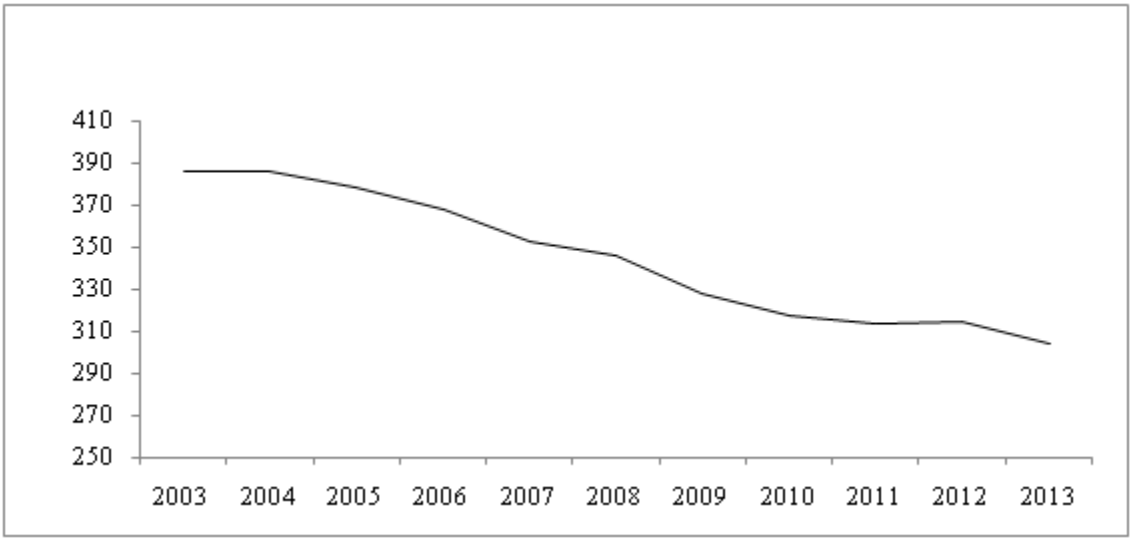


Figure 8. Specific fuel consumption for the production of electricity, gce/kWh

As it is seen from the figure 8, the specific consumption of equivalent fuel decreased within 10 years by 27% from 386.2 to 303.7 gce./kWh, which resulted in savings of about 1 million tons of equivalent fuel.

Taking them into account the above-mentioned programs the current values of some major indicators of energy security and their thresholds and predicted values are developed and shown in the Table 5.

Table 5. The prognosis of energy security indicators of the Republic of Azerbaijan up to 2025

№	Indicators	Threshold levels		2015	2020	2025
		H	K			
1	The share of dominant fuel type in the gross consumption of FER, %	50	70	43	40	40
2	The reserve of power plants' installed capacity,%	20-25	10	35	22	22
3	Power intensity of economy, toe /thous USD	0.2	0.5	0.32	0.3	0.28
4	The ratio of output volume (production) of initial power from the renewable power sources to the gross consumption of FPR, %	14	5	1.2	5	7
5	Wear of the basic production assets (BPA) of FPC enterprises, %	45	75	35	32	30
6	The average number of hours of consumers' cut in a year, h.	36	72	24	20	20
7	Ratio of the volume of investments in FPC development to the initial cost of BPA of FPC, %	6	4	7	7	7
8	Ratio of cost of exported FPR to GDP, %	40	60	43	35	31

9	Installed capacity, kW/ capita	1.5 -2	0.5	0.75	0.78	0.94
10	Electric power consumption in a year, kWh/capita	2500	1700	2200	2500	2700

It should be noted, that the composition of indicators and their threshold values are characterized by energy independence, state of the economy and quality of life of country development. For example, by 2003 the most important indicators of energy security of Azerbaijan were at the level of cross-subsidies, misuse of electric power and the degree of dependence on energy carriers import, which as far as the economy development, including FPC, lost their actuality. By 2025, some of the above mentioned indicators of energy security will lose their actuality, and as one of the most important indicators of energy security will be the indicator - ratio of increase of extracted balance oil reserves to the total volume of its production, which will characterize the degree of oil exhaustion in Azerbaijan.

CONCLUSIONS

1. After Republic of Belarus became independent state it is providing its own energy policy the following main trends of enhancing of energy security:

- improving of energy independency;
- alternatives for fuel supply (diversification);
- upgrading of reliability of energy system;
- improving of energy efficiency (energy saving).

In particular nuclear power would make a contribution into each this direction. The optimal variant for Belarus energy system is commissioning the first NPP unit by 2018 and the second one by 2020.

2. Today's high rates of Azerbaijan economy growth are mainly related to the successful development of FPC of Azerbaijan. Ensuring the internal power needs, Azerbaijan takes a significant place in the energy security of the neighboring states, and Europe. In the future the FPC of Azerbaijan will constitute the significant share in GDP of Azerbaijan (more than 30%). By 2025, one of the most significant indicators of energy security will be the indicator - ratio of increase of extracted balance oil reserves to the total volume of its production.

This work was supported by the Science Development Foundation under the President of the Republic of Azerbaijan – **Grant № EIF-BGM-2-BRFTF-1-2012/2013-07/05/1** and Belarusian Republican Foundation for Fundamental Research - **Grant № T13Az-016.**

REFERENCES

Bykova E.V. Monitoring of Energy Security Indicators // Kishinev. – 2008 .- 164 p. *(in Russian).*

Chapay Sultans. Electric power industry of Azerbaijan // Baku – 2013 – 223 p. (in Russian).

"Energy of Azerbaijan" / Statistical yearbook // Baku – 2014 168 p.

Fedotova G.A., Voropai N.I. Optimisation of Reliability of Power Supply to Consumer // e-journal ”Reliability: Theory & Applications”. –2007. – Vol. 2, № 2. –P. 57–68. – Available from: http://www.gnedenko-forum.org/Journal/index.htm

Key World Energy Statistics // IEA -2014, 80 p.

Mikhalevich A.A, Bykova E.V. and others. Methodological approaches to the solution of energy security of Moldova and Belarus // Kishinev – 2010 – 100 p.

Nasibov V.Kh. Application of the fuzzy-set theory to the tasks of Azerbaijan electroenergetics security for short-term periods // USA, San Diego, Journal is registered in the library of the US congress. – 2014. – Vol 9 № 4(35), P. 37-50.

Senderov.S.M, Rabchuk V.I. The major indicators of energy security of Russia, the approaches to the assessment of the threshold and current values., Methodological issues of reliability research of large power systems, Reliability of liberalized energy systems // Irkutsk, Russia – 2015 – 62-76 p.

The national economy of the USSR in 1990. Statistical Yearbook // Moscow – Finance and statistics, 1991 – 752 p. *(in Russian).*

The Soviet Union and the countries of the world in numbers. Reference book // Moscow, 2014. – 219 p. – Available from: http:// su90.ru *(in Russian).*