

Power supply system of Azerbaijan in new conditions of economic development

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Abstract. In the report: state of economy and power supply system of the Azerbaijan Republic is analyzed on the basis of the most important indicators of development; main principles, put in the basis of the power supply system development, the tasks of immediate prospects in the interrelation with economic development of the Republic are presented.

Index terms: economy, power supply system, diversification, distributed generation, macro-indexes, technical and economic indicators, non renewable energy sources.

I INTRODUCTION

During the last 10 years the economy of the Azerbaijan Republic shows positive dynamics in almost all macro-indexes. GDP has increased more than 9 times, and GDP per capita has increased more than 8 times, being respectively 50.6 billion US dollars, and 5.68 thousand USD per person. (table 1) /1/.

In the conditions of world crisis, when GDP in all developed countries in 2009 practically had a tendency toward the decrease, in Azerbaijan it has increased by 9.3 % in comparison with 2008, and among the countries of CIS Azerbaijan .Is the power intensity of GDP, which in the last 10 years

decreased almost 4 times and reached the level of 1,28 thousand dollars, has a tendency toward the decrease; inflation composed 1.5. These and other macro- Indices from one side many times exceed (on the GDP 20 times) and do not go into comparison with the same indices of the last years of the USSR (1990-1991), and from another side - yet they did not reach the level of the indices of the developed countries (on the rating by IMF and IFD correspond to a position 73 of 186). But, positive dynamics has important feature: it has been largely achieved through the contribution of oil and gas sector, approximately 60% of which is export. With the expected stabilization of the contribution from this sector (tentatively beyond 2011) Republic enters a new phase of sustainable economic development that is based on promoting competitiveness (clusters) in industries. The electric power industry as the major branch of economy, should be ready to this stage of development and meet the basic requirements of energy efficiency: profitability, reliability, energy security, environmental friendliness.

Tab. 1. DYNAMICS OF MACRO-INDICES (1995 – 2009).

	united of measurements	1995	2000	2005	2006	2007	2008	2009
GDP	bil \$	2,42	5,27	13,24	20,98	33,05	46,26	50,6
GDP/per head	thsd \$	0,019	0,665	1,60	2,56	3,91	5,40	5,61
Power intensity	$\frac{\text{toe}}{\text{thsd \$}}$		5,43	2,814	2,32	1,91	1,37	1,28
Electro capacity	$\frac{\text{KWh}}{\$}$	7,0	3,53	1,69	1,13	0,65	0,46	0,35
electricity consumption / per head	$\frac{\text{KWh}}{\text{per}}$	2,255	2,563	2,790	2,892	2,454	2,357	2,0

II POWER SUPPLY SYSTEM OF THE REPUBLIC 2000-2009

The strategy of government in power industry is reflected in a number of government programs and documents, which not only provide the energy balance at certain stages of economic development (2005, 2010, 2015), but also take into account the criteria and principles that meet the requirements of energy efficiency. Scientific support of these programs is carried out by Energy Institute which since 2006 operates as a Research Design and Survey Institute. As the major, providing effective functioning and power supply system development (PSSD), principles of a diversification of generating capacities and their distribution are put. (table 2). /2,3,4/.

Before 2000, the power supply system of Azerbaijan Republic had only two types of generating facilities: thermal power plant (TPP), hydraulic turbine, and TPP produced some 80 % of all the energy with an efficiency of 32%.

In 2001 two gas power plants (GPP) installations of firm "Allstom" by the general capacity of 110 MW have been entered into operation. In 2002 thermal gas power plant with capacity of 400 MW single-shaft in the performance of the company "Mitsubishi" and 4 turbines with total capacity of 150 MW were introduced, in 2009 – TGP – 525 MW.

was commissioned same time five power plants (power module) based on the diesel engines of the company "Wartsila" of a total capacity of 1,150 MW were commissioned in accordance with development programs of different regions

By the end of 2010 a new thermal power plant with four TGP total capacity of 760 MW will be introduced.

Simultaneously, the reconstruction of a number of blocks is being held, and the result of this will be the increase in capacity of 300 MW.

Even now, the installed capacity of units is about 6,500 MW and with a system with no blocks left with worn-out or uneconomic equipment, with a high specific fuel consumption.

The implementation of this strategy has led to an improvement of a number of indicators of energy efficiency: energy security, environmental friendliness, efficiency (1-4, 5-9, 10-14 table 3). System efficiency increased from 30% in 2000 to 37,5% in 2009, specific fuel consumption has decreased over the same period from 411 to 327 g / kWh (pic. 1.), while the losses in the power grid - from 15 to 8,5%.

TAB.2. DYNAMICS OF THE STRUCTURE OF GENERATING UNITS (1995 – 2015), MWT/%

	1995	2002	2006	2009	2010	2015
TPP	<u>4124</u> 82,9	<u>4124</u> 73,2	<u>3450</u> 64,7	<u>3450</u> 51,8	<u>2640</u> 39,8	<u>2690</u> 29,9
GPP	-	<u>107</u> 1,9	<u>107</u> 2,0	<u>107</u> 1,6	<u>107</u> 1,6	<u>107</u> 1,2
TGPP	-	<u>400</u> 7,1	<u>400</u> 7,5	<u>925</u> 13,9	<u>1705</u> 25,7	<u>2405</u> 26,7
HPP	<u>828,5</u> 16,8	<u>982,6</u> 17,4	<u>1025</u> 19,3	<u>1025</u> 15,4	<u>1025</u> 15,5	<u>1450</u> 16,1
DPP	-	-	<u>348</u> 6,5	<u>1155</u> 17,3	<u>1155</u> 17,4	<u>1255</u> 13,9
Small HPP	<u>19,4</u> 0,4	<u>19,4</u> 0,4	-	-	-	<u>700</u> 7,8
WPP	-	-	-	-	-	<u>400</u> 4,4
Σ	4972	5633	5330	6662	6692	9007

Even more significant results were obtained with the implementation of activities in the field of electricity consumption. In 2006 electricity consumption amounted to 24.7 billion kWh, which is 3.2 billion kWh of electricity consumption higher than in 1990. Changes in tariffs, improving of accounting and control systems (in 2007-2008 in various industries has identified about 1 million energy meters) resulted in reduction of electricity consumption in 2008 by 16.6% compared to 2006, and the collection rate for the consumption brought from 40 % to 100%.

As it is shown in chart 2, whereas in 2006 the production of electricity has reached 1990 levels, in subsequent years it decreased as a result of energy saving measures in the spheres of production and consumption. For the first time of the 20-year period in 2007 appeared surplus (exports) of electricity. Due to the realized projects, the total value of more than \$ 2 billion, now the ES is redundant and is ready, as before, to perform a dominant role in the South Caucasus region. Export potential of Azerbaijan ES nowadays amounts to 5-6 billion kWh and in the near future will go to further increase by 3.2 billion kWh.

TAB. 3. DYNAMICS OF TECHNICAL-ECONOMIC AND OF SOME OTHER INDICATORS OF POWER SAFETY (1995 – 2009)

	showing	Ед. изм	1995	2000	2005	2006	2007	2008	2009
1	Portion of mast powerful plant	%	48,3	46,4	45,3	43,2	42,4	40,2	36,4
2	Portion of mast powerful unit in whole installed capacity power system	%	6,0	5,8	5,7	7,2	7,0	6,7	6,3
3	Average capacity of PP	MW	832	867	800	556	517	470	353
4	Average capacity of unite	MW	192	200	186,7	73	79	67	52
5	Oxid – sulfur SO ₂	thsd. t	4,0	39,7	11,5	9,4	6,4	3,4	0,97
6	Nitric-oxide NO ₂	thsd. t	38,9	40,8	19,6	22,5	16,5	13,7	12,5
7	Outgoing ash	thsd. t	16,9	16,4	0,5	0,4	0,3	0,1	0,041
8	Carbonic acid CO ₂	thsd. t	15389	15657	16332	17487	14461	13815	11378
9	Oxide carbon	thsd. t	-	-	0,4	1,2	2,99	2,36	4,35
10	Fued rate	gct/kWh	385	411	379	368	353	346	327,9
11	Used full ratio gas/heasy oil	%	18,9 81,1	22,6 77,4	67 33	76,5 23,5	78,9 21,1	90,4 9,6	96,6 4,4
12	Share units taking part in satisfying peak demand	-	17,0	19,2	18,0	24,6	26,0	29,8	15,3
13	Share of unite distributed generation	-	-	-	-	6,3	8,0	12,6	17,3
14	Efficient Power Sistem	%	31,9	29,9	32,4	33,4	34,8	35,5	37,5

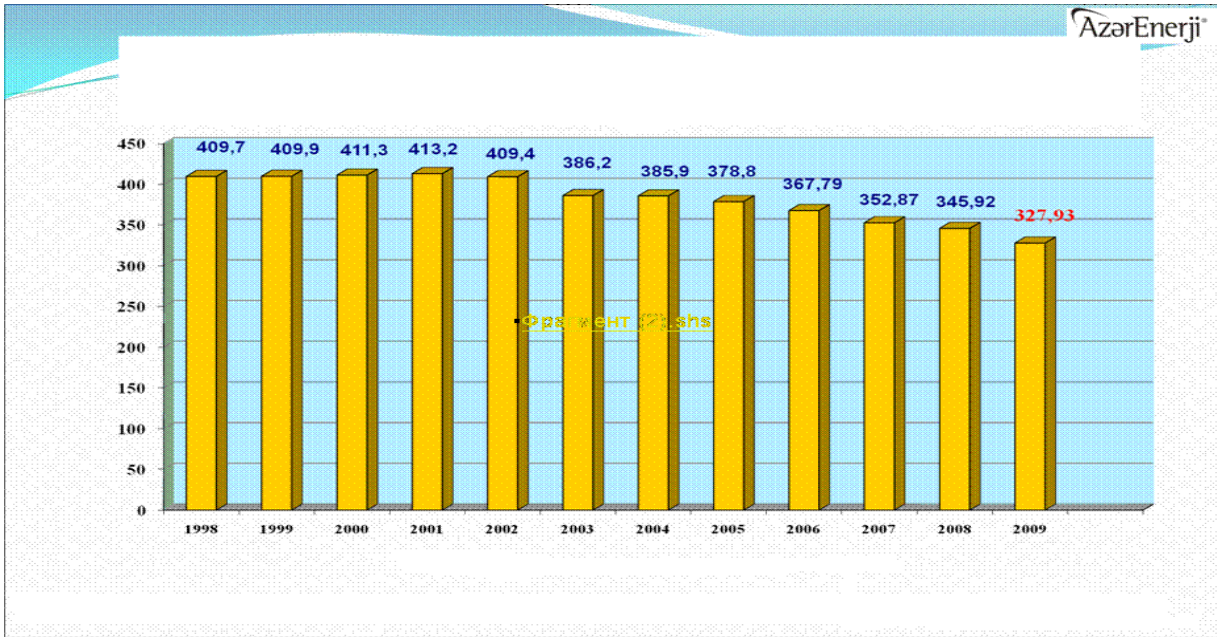


Fig. 1. The for specific consumption of fuel (in condition units) for production of 1 kWh in the Power system for 1998-2009 years.

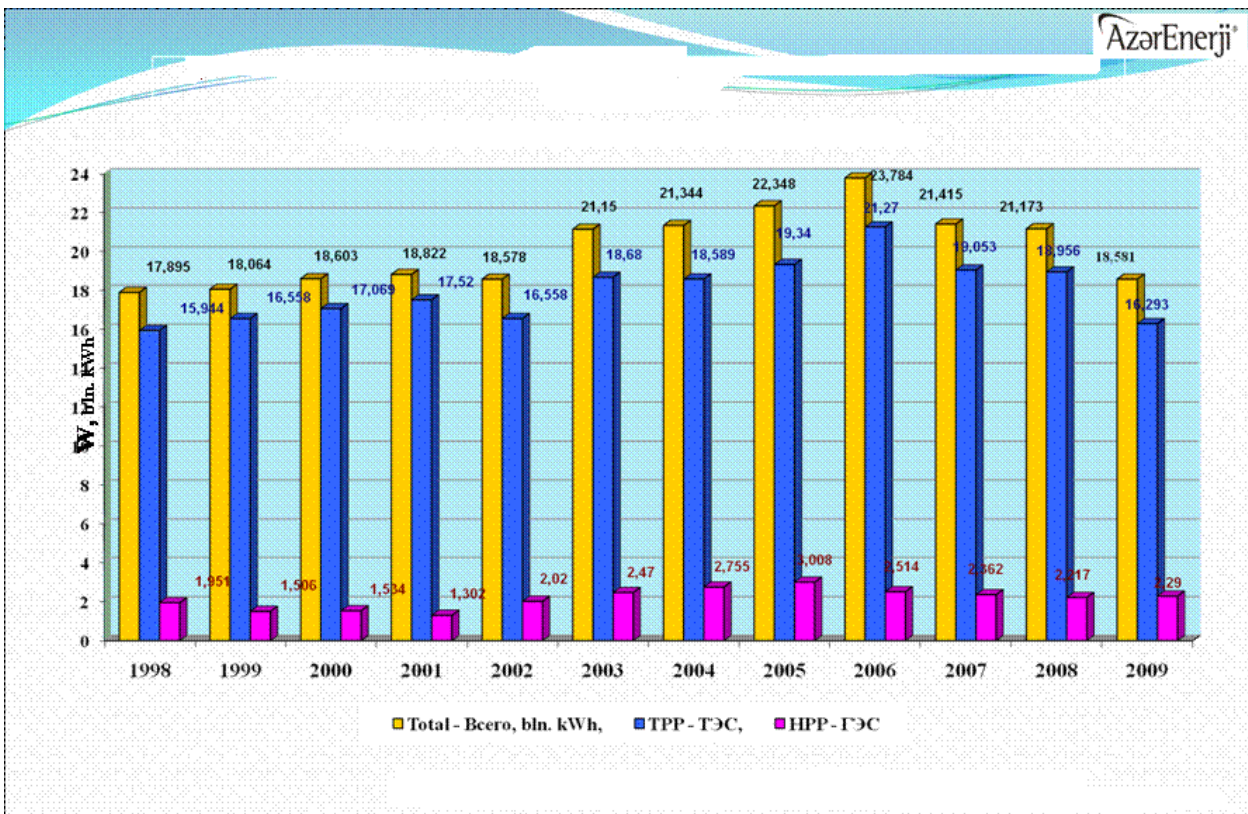


Fig.2. Trend of power production for 1998-2009 years

III SHORT TERM PROSPECT OF DEVELOPMENT

The strategy of the ES development and enhancement of its effectiveness in the short term The following approaches are important: the widespread use of the potential of

renewable energy sources, introduction of modern management systems and automatics, providing all the complex conditions of parallel operation with power systems of neighboring countries (Russia, GH, IRI, TR),

creating its own industrial and technical base of power Industry etc.

The potential of renewable energy sources in the Republic has been studied long since /5/. But in the fuel and energy “self-sufficient” republic there hasn’t been given proper attention to development of this potential. However, the previously completed studies, multiple measurements allowed now to begin large-scale work on the feasibility study, design and construction of small HPP (10 MW) and WPP (20 MW) /6/. Potential of the first is 3,5 - 4 billion kWh, and of the second 4,5 - 5 billion kWh. The road map of a place of placing and building of the most effective small HPP and WPP has been developed. At the level of 2015 in the balance of power share of renewable energies can reach up to 20%. On the agenda there will be questions of their effective utilization in a context of optimization of a mode of all ES. The development of generation capacity and backbone network configuration change has necessitated the replacement of obsolete and

outdated equipment ADA. The process of reconstruction and technical re-equipment of ADA has been started. Information base microprocessor will be used in the SCADA System at PDC “Azerenerji”.

On programs of economic development of regions construction of technic-parks, is foreseen in the city of Sumgait where IT-manufacture for electric power industry, including for the equipment of small power (RES) systems will be carried out. Last creates attractive conditions for foreign investors and more effective implementation of development plans of RES. One of the priorities of development for energy efficiency of energy system of Azerbaijan Republic considers the expansion of interstate power lines with the power systems of neighboring states.

Azerbaijan ES is currently operating interstate electrical connection with the ES in Russia (North Caucasus), the Islamic Republic of Iran, Republic of Georgia. (pic. 3.)

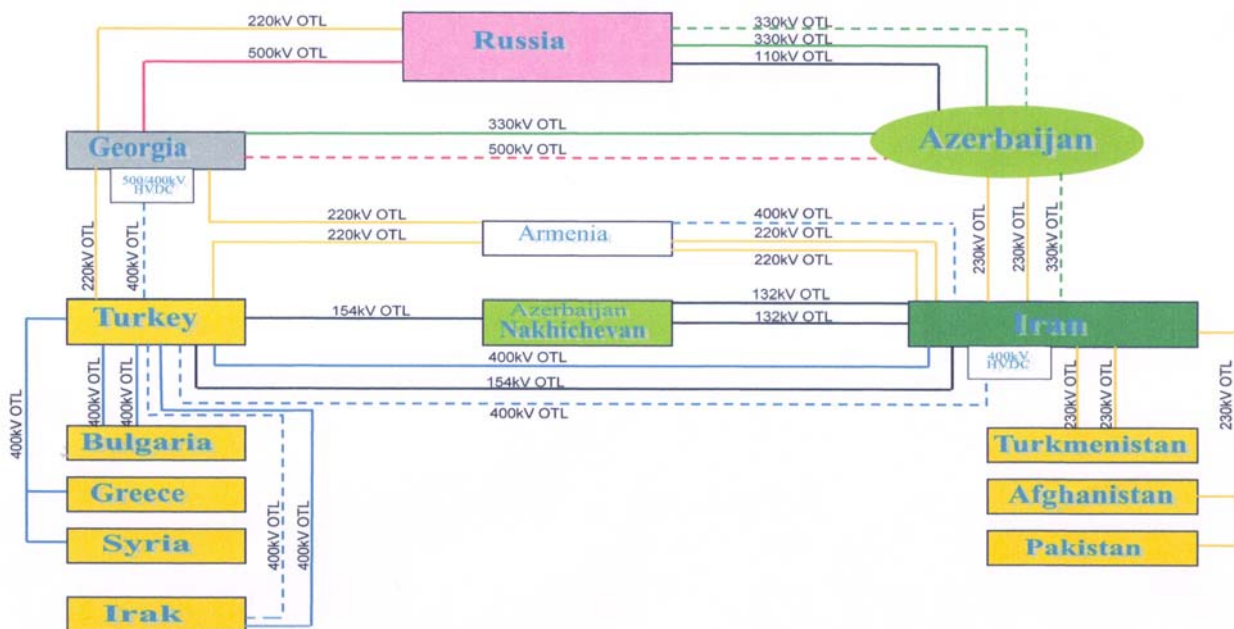


Fig.3. Diagram of power international in the Caucasus region

The construction of substations and power lines 330 and 220 kV with a total length of 340 km, which will create the possibility of

increasing the energy exchange between Iran and Azerbaijan with the EC 240 to 600 MW,

with an annual capacity of about 4,2-4,5 billion kWh of electricity is being completed.

One important project, which will not only provide significant economic benefits, but also raise to a qualitatively new level of power generation in the region, could be called the project of a large-scale exports of electricity and power from Azerbaijan to Turkey via "the energy bridge Azerbaijan-Georgia-Turkey".

Growth of power complex in the Republic of Azerbaijan can afford to export electricity to Turkey in the amount of up to 3,5-4,0 billion kWh per year and the power of 600-700 MW. Substation "Khachmaz" with voltage 330/110 kV in the north of Azerbaijan with calling-out of interstate VL-330 kV Derbent is ready for commissioning, thereby significantly improve the reliability of electric modes of transit "UES Russia-Azerbaijan Dagenergo-ES". Actual to date, single-chain connection VL-330 kW is clearly insufficient.

With the implementation of plans to strengthen bilateral VL, ES of Azerbaijan will become not only an exporter, but also an important transit path of electric energy.

Thus, the 2010 ES Azerbaijan has ceased to be scarce and demonstrates the positive dynamics of key indicators. Sometimes this was achieved by high costs, but was dictated by the requirements of the post-crisis development of the economy of the Republic. In the stabilization rate of economic development, the main attention should be focused on energy efficiency and energy security. At a joint meeting of the NTS "JSC Azerenergy" with EA, ministries and departments, the framework for priority research directions in the field of energy efficiency and energy security was discussed and adopted (pic.4.). Power Institute is charged with the work in this direction. Understanding the complexity and importance of the tasks requires the coordination of internal and inter-regional efforts to develop scientific criteria and methods of objective measurement and comparison of quantitative and qualitative indicators of energy security and efficiency. From these positions institute goes on creative collaboration with the Academy of Sciences and universities of the Republic, as well as with relevant organizations of Iran, Korea, Russia, Turkey, Japan and other countries in the Eurasian area.

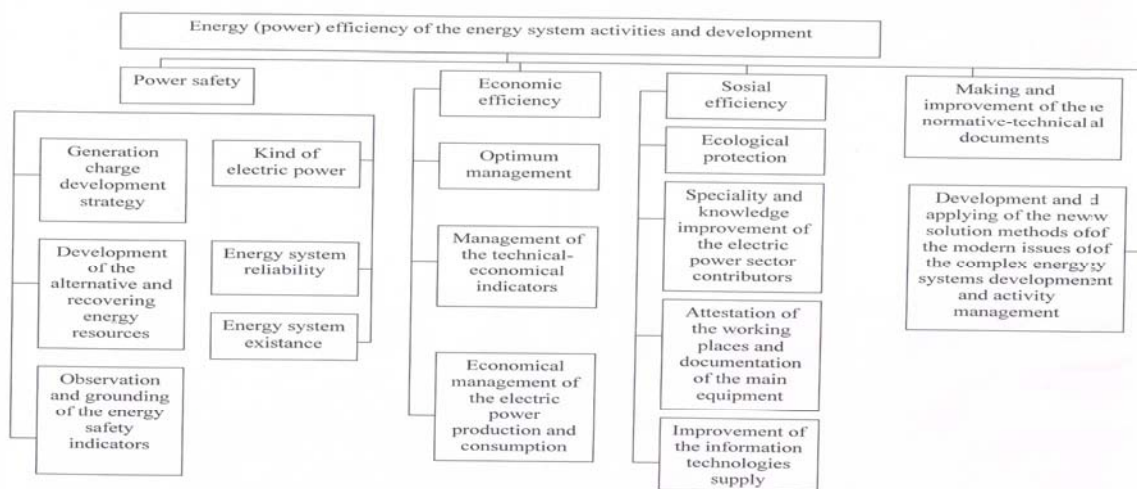


Fig. 4. Structure of the priority directions of the scientific-research work for 2010 in the electricity power system.

IV CONCLUSIONS

Economy of AR and its ES have positive developments on the basic macro and techno-economic indicators. In economics, this has been achieved to a significant extent due to the development of oil and gas sector, in power - at the expense of commitment to the principles of diversification and distributed generation facilities and the development of a network structure. In the new stabilized rate of sustainable economic development priority for scientific support of the ES is to ensure energy efficiency and energy security, including the introduction of renewable energy systems AA, based on microprocessor technology, the development of transmission interconnections, strengthening coordination in the field of systems research at the international level.

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