



UDC 621.311.25, 502

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ROLE OF ALTERNATIVE AND RENEWABLE ENERGY SOURCES IN THE IMPROVEMENT OF THE ECOLOGY OF SHIRVAN CITY

Останнім часом країни світу намагаються залучити до збалансування нетрадиційні джерела енергії, які відрізняються екологічною чистотою, зменшують використання органічного палива та покращують екологічний стан у паливно-енергетичній сфері. XXI століття визнане в історії людства як період переходу до альтернативної енергії. Під час розрахунку індексу людського розвитку як основні показники враховуються стан екологічного середовища, енергоносії, їх безпека для біосфери та здоров'я людини з екологічної позиції. У цьому разі перевага надається екологічно й енергетично чистим ресурсам. Використання альтернативних і відновлюваних джерел енергії дає змогу скоротити кількість скинутих у навколишнє середовище небезпечних відходів разом з економією великої кількості палива, спаленого на теплоелектростанції.

Ключові слова: екологічна ситуація, енергетика, альтернативні та відновлювані джерела енергії, сталий розвиток.

В последнее время страны мира пытаются привлечь к сбалансированию нетрадиционные источники энергии, которые отличаются экологической чистотой, уменьшают использование органического топлива и улучшают экологическое состояние в топливно-энергетической сфере. XXI век был признан в истории человечества как период перехода к альтернативной энергии. При расчете индекса человеческого развития как основные показатели учитываются состояние экологической среды, энергоносители, их безопасность для биосферы и здоровья человека с экологической точки зрения. В этом случае предпочтение отдается экологически и энергетически чистым ресурсам. Использование альтернативных и возобновляемых источников энергии позволяет сократить количество сброшенных в окружающую среду опасных отходов вместе с экономией большого количества топлива, сожженного на теплоэлектростанции.

Ключевые слова: экологическая ситуация, энергетика, альтернативные и возобновляемые источники энергии, устойчивое развитие.

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Recently, the world countries try to involve balance the unconventional energy sources which are distinguished for their ecological cleanliness, reduce the use of organic fuel and improve ecological state in their fuel-energy. XXI century was acknowledged in the history of humanity as a period of transition to alternative energy. When calculating Human Development Index, condition of ecological state, energy resources, their harmlessness for the biosphere and human health from the ecological standpoint are taken into consideration as the main indicator. In this case, preference is given to ecologically clean and pure energy resources. The use of alternative and renewable energy sources allows for reducing the quantity of hazardous waste thrown into the environment alongside with the economy of great amount of fuel burnt in the thermoelectric power plant.

From the standpoint of its geographical position, climate and economical infrastructure, Azerbaijan has a great potential for the development of renewable energy sources. Especially, Shirvan city has a favorable climate from this standpoint. Shirvan city is situated in the Kur-Araz lowland where sunny days constitute 2000-2500 hours and total annual quantity of radiation constitutes 125-135 kkal/sm². The climate of Shirvan city is mild-warm, and belongs to semi-desert and dry steppe climate having dry summer.

Key words: ecological situation, energetics, alternative and renewable energy sources, sustainable development.

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where sunny days constitute 2000–2500 hours and total annual quantity of radiation constitutes 125–135 kkal/sm². The climate of Shirvan city is mild-warm, and belongs to semi-desert and dry steppe climate having dry summer. The main features of this climate type are characterized by



Fig. 1. The new “Janub” Power Plant

the high average annual temperature, very little atmospheric condensation and very high humidity lack. Abundance of natural energy potential lay the foundation for application and development of alternative energy sources in the energy supply of Shirvan city. It should also be noted that Shirvan city plays an important role in the energy supply of our Republic. Power networks were created in Shirvan city in the middle of the XX century mainly during the Soviet period due to the development of oil production in this area. Construction of the first powerful Thermal Power Plant in Europe in the open arrangement of the main equipment – Ali Bayramli SRES started in 1959 and in 1962 it was put into operation. With the commissioning of this plant, it became possible to transfer electricity of up to 2 billion kW to the neighboring republics having fully satisfied electricity demand of the Azerbaijan Republic. With the construction of the old “Shirvan TPP” in the southern zone of the city, supply networks of the city were accepted as 110/35 kW, and the major distribution networks have been carried out in 6 kW. Its main reason was that most of the oil industry consumers (pump plants, etc.) were feeding directly with 6 kW.

As the key source of generation for the power supply of Shirvan city there was used “Shirvan TPP” (former name “Ali-Bayramli TPP”) consisting of 7 blocks, with the total installed capacity of 1050 MW, with the real capacity power with restrictions of 590 MW that has been in operation for over 50 years. The “Janub” SS of 110/35/6 kV and “Jihazlar zavodu” SS of 110/10/10 kV that are considered the main supporting substations of Shirvan city are feeding from this power plant.

Due to wearing of “Shirvan TPP” and the end of its shelf life related problems arose in the power supply of Shirvan city.

In accordance with the State Program № 635 of the President of the Republic of Azerbaijan dated 14.02.2005 on “The development of fuel-energy complex of the Azerbaijan Republic (2005–2015)”, near the old “Shirvan TPP” there commenced the construction of the new “Shirvan TPP” consisting of 6 blocks, with the total installed capacity of 780 MW and on July 1, 2013 “Janub” power plant was launched by the head of state. Unlike other similar plants, three types of fuel – gas, oil and diesel fuel can be used here. The activity of the plant is distinguished by the high quality, as well as by economy. With the launch of this huge infrastructural facility it became possible to save 780 million cubic meters of gas and 650 thousand tons of fuel per year. The Plant will allow for production of 6 billion kilowatt/hours of electricity per year (figure 1) [3, p. 344].

However, environmentally hazardous thermal power plant negatively influenced ecological situation of Shirvan. During the production of every kilowatt of energy 30 kg of sulfur oxide, 3 kg of carbon monoxide and 2,4 t of ash mixing in the atmosphere pollute the air, damage ozone layer and create heat effect. For the sake of environmental protection to eliminate ecological problems, the use of other generation sources (alternative and renewable) in the city of Shirvan is expedient. It should be noted that the use of ARES has got many advantages compared to the use of traditional energy carriers. The most important of them is the reduction of the use of organic and non-organic energy carriers which its natural resources gradually deplete. On the one hand, it leads to rational use of natural resources, and on the other hand to reduction of the part of the carbon gas thrown into the atmosphere during burning of organic fuels. And this allows to prevent the approaching global warming to some extent and to avoid the

cataclysm that can arise due to this reason [1, p. 827]. Another positive feature of the application of AES is that they are ecologically clean. For example, during the production of the energy derived from the Sun, wind, hydro resources and other such kind of energy no waste polluting the environment or polluting emissions are derived and it shows that they are ecologically clean. On the other hand, expenses spent during the production of some of these types of energy also decrease. Due to the continuous increase in the prices of the energy carriers throughout the world, economical effectiveness of the use of AES also increases. For example, prime cost of the electricity power received from the water power plants built on the rivers that are considered inexhaustible renewable energy source is much lower than the prime cost of the electricity power received from the thermal power plants. Although for the present the use of AES is expensive, but as the science and machinery develop, the installations which are necessary to use these types of energy and materials from which they are made become cheaper, the resources of the natural fuel exhaust and the prices increase, the use of those types of AES will become economically favorable. The use of some AES also creates conditions for utilization of waste thrown into the environment. The waste undergoing certain changes turn into the substances suitable for use and as a result of the reaction that happen at that time valuable energy carrier is obtained. The main sources of renewable energy are as follow:

- the sun (solar energy);
- the wind (wind power);
- moving water (hydroenergetics, wave and high tide and low tide energy);
- the heat below the surface of the Earth (geo-thermal energy);
- bio-mass (wood, waste, energy crops).

With the purpose of improving country management system in the sphere of alternative and renewable energy, there was established the State Agency for Alternative and Renewable Energy Sources by the Decree of the President of the Republic of Azerbaijan dated February 1, 2013. Current activity on the use of AES in the Republic of Azerbaijan is based on the Order № 462 of the President of the Republic of Azerbaijan on “The State Program on the use of alternative and renewable energy sources in the Republic of Azerbaijan” dated October 21,

2004 [4]. In order to achieve the production of electric and heat power through extensive application of ARES, effective use of energy, increase of effectiveness of power supply and sustainable power supply for consumers, the State Strategy project was developed by SAARES on “The use of alternative and renewable energy sources 2015–2020”. Necessary measures will be taken in connection with the development of distributed structure of generation powers through the use of ARES, diversification of energy sources, reduction of gas waste creating heat effect, application of ARES in all the spheres of economy and to raise the production share of ARES through the generation powers to be newly created to 20 percent by 2020. In this sense, “Strategy” targets have been adapted to the Directive № 2012/27/EU of the European Union on the “Energy efficiency” [2, p. 121].

Purpose and objectives of the realization of State strategy are as follows:

- determination of ARES, calculation of its potential throughout the republic and creation of the state cadastre on energy resources;
- creation of the standard legal base for the sphere, as well as preparation of legislation acts governing the activity;
- formation of the guaranteed tariff policy, stimulating actions and state innovation policy for the sphere;
- creation of new generation powers through ARES and arrangement of its effective use;
- organization of centralized management structures for the sphere and creation of mutual activity with public authorities;
- organization of training process at the educational institutions and scientific research centers with the purpose of creating specialized staff potential for the sphere;
- fulfillment of these actions will create grounds for the creation of new work places and improvement of the social life conditions of the population, more effective use of natural resources along with the expansion of the use of ARES in the republic and taking the rightful place among the developed countries of the world.

To ensure longstanding and effective activity in all the regions of Azerbaijan in the sphere of ARES, to realize the projects in the planned manner and according to the energy requirements of the regions there were developed “The develop-

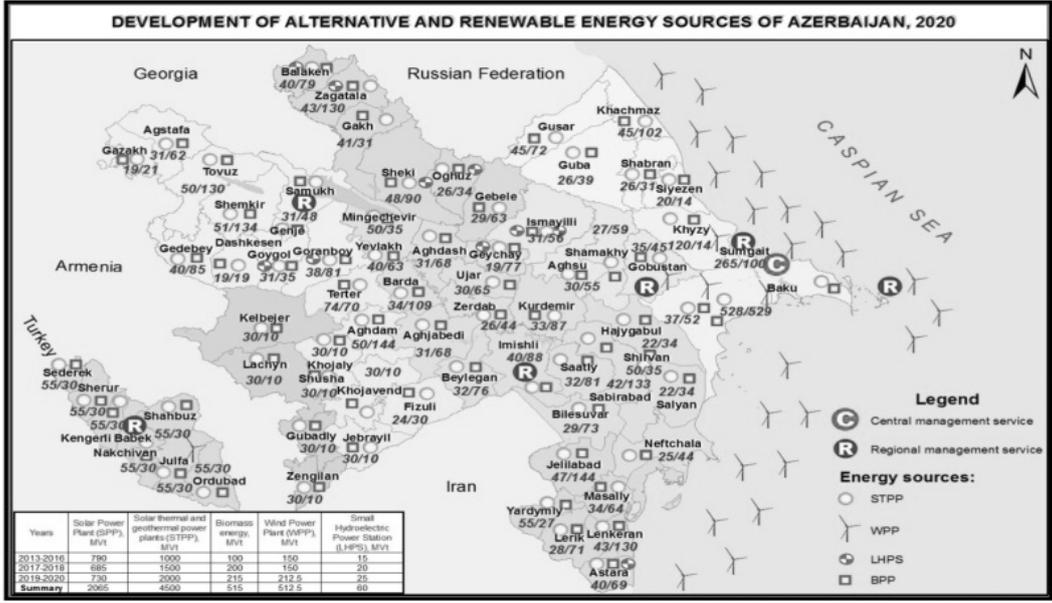


Fig. 2. The development map for ARES for the Republic of Azerbaijan 2020

ment map of the Azerbaijan Republic on ARES 2020”, “Development maps of ARES by 2020 for the cities and regions of the Azerbaijan Republic” and “The management scheme for ARES of the Azerbaijan Republic” on the basis of the strategic plan adopted by the State Agency (2015–2020). Distribution of alternative and renewable energy plants to be installed in the Azerbaijan Republic in the years of 2020–2030 was conducted according to economic and administrative regions. The power of the plants to be installed in the economic and administrative regions was determined and distributed according to the types of ARES. It is known that the share of the alternative and renewable energy in the production of general electricity power through the plants to be installed by 2020 will be raised to 20%. After the installation of these plants in 2020–2030, the share of the alternative and renewable energy in the production of general electricity power will increase to 50%.

According to the development map for ARES, there was envisaged installation of electric power (60 MW Solar Power Plant and 9 MW Biomass ES) plants of 69 MW and thermal power (for direct acquisition of hot water and heating of houses) plants of 49 MW through ARES in order to improve electricity and heat energy supply of the city of Shirvan. State Agency on ARES referring to the experience of the developed foreign countries considers it expedient to install electric power

(30 MW Solar Power Plant and 5 MW Biomass ES) plants of 35 MW and thermal power plants of 25 MW in the city of Shirvan in 2020–2033 according to the energy consumption per capita in the industrial cities (Figure 2).

A special attention was also drawn to the issues of the management of solid and industrial waste emerging in the regions and extension of use of the alternative and renewable energy sources for the sake of restoring ecological balance in “The State Program on socio-economic development of the regions of the Republic of Azerbaijan in 2014–2018” approved by Decree № 118 of the President of the Republic of Azerbaijan dated February 27, 2014 [6, p. 27].

Taking into account that the State strategy on “ARES” has not been approved yet, there was envisaged construction of 1st “Gunash” electric plant with the power of 10 MW and the 1st “Biogas” power plant with the power of 1 MW included in “The State Program on socio-economic development of the regions of Azerbaijan in 2014–2018” in the city of Shirvan by 2020. As mentioned above, the climate of the city of Shirvan creates favorable conditions for the development of the solar energy here. Also, Shirvan city is an industrial city, and as biomass substances constitute the main part of the waste in the industrial areas, production of biogas with the purpose of producing electricity is more expedient. Biogas production is cheaper both

Table 1

№	The name of generation sources	01.01.2013 (actual)		2020 (I shift)		2033 (for perspective period)	
		Power capacity, MWt	Annual electricity production Mln. kWt. h	Power capacity, MWt	Annual electricity production, Mln. kWt. h	Power capacity, MWt	Annual electricity production, Mln. kWt. h
1	Old "Shirvan-TPP"	$\frac{1050}{590}$	2749,0	- Nonactioned	- Nonactioned	- Nonactioned	- Nonactioned
2	New "Shirvan-TPP"	-	-	$\frac{780}{741}$	3430,8	$\frac{780}{780}$	3600,0
	Summary for TPP	$\frac{1050}{590}$	2749,0	$\frac{780}{741}$	3430,8	$\frac{780}{780}$	3600,0
3	Alternative energy sources:						
3.1	Solar Power Plant-1	-	-	$\frac{10}{8}$	45,0	$\frac{10}{10}$	50,0
3.2	Solar Power Plant-2	-	-	-	-	$\frac{10}{8}$	45,0
3.3	Biogas Power Plant-1	-	-	$\frac{1}{0,8}$	2,4	$\frac{1}{1}$	3,5
3.4	Biogas Power Plant-2	-	-	-	-	$\frac{1}{0,8}$	2,4
	Summary for Alternative energy sources	-	-	$\frac{11}{8,8}$	47,4	$\frac{22,0}{19,8}$	100,9
	Summary	$\frac{1050}{590}$	2749,0	$\frac{791}{749,8}$	3477,4	$\frac{802,0}{799,3}$	3710,9

environmentally and economically; it also reduces the amount of waste and ensures their processing. Processing of combustion industrial waste, municipal waste, waste generated in areas contaminated by oil and oil products will yield positive results in improving the environment of the city of Shirvan. Only for 2014, the amount of household waste collected by public utilities in the city of Shirvan constituted 66,4 thousand cubic meters. Disposal of this waste will help in the supply of the city of Shirvan with electric and thermal power [5].

It should be noted that the area of 2 hectares is required for obtaining of 1 MW of solar energy and the area of 20 hectares for the Solar ES of 10 MW. Taking into account this condition and according to initial reports 1st Solar ES of 10 MW and bio-

gas ES of 1 MW are supposed to be located in the eastern part of the city on the empty land. If the 1st Solar and 1st Biogas power plants are successfully commissioned, it will be expedient to construct the 2nd Solar (10MW) and 2nd Biogas (1MW) power plants in the city of Shirvan till 2033 on the basis of their experience. It is proposed to locate these plants in the western part of the city of Shirvan (Figure 3).

One of the renewable and environmentally friendly energy sources on the territory of Shirvan city could be wind power stations. However, on the results of the work conducted by the research and design institutions it was indicated that construction of such power plants in this zone is not possible due to less windy days and low parameters of

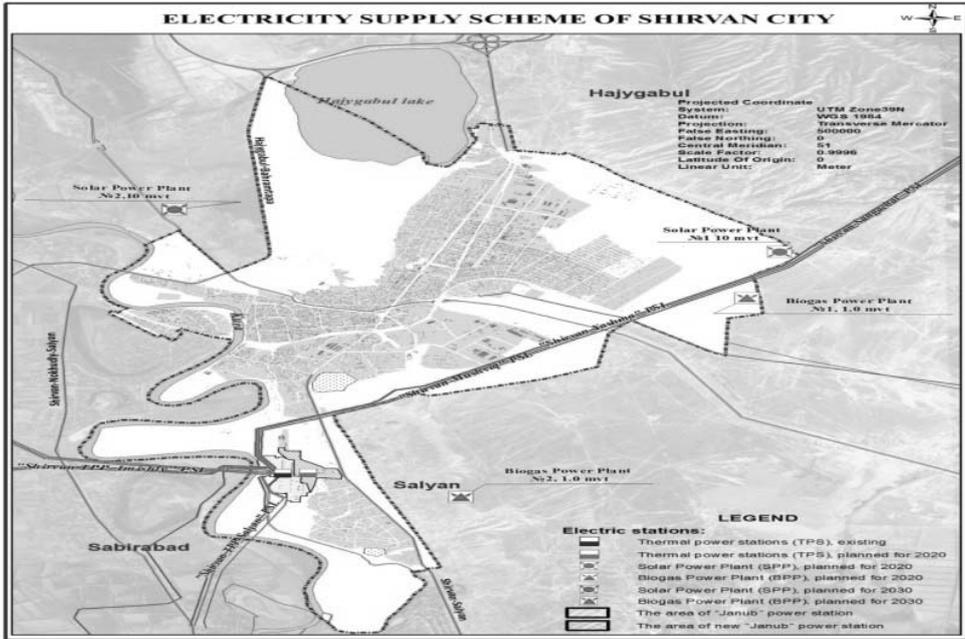


Fig. 3. Existing energy supply of Shirvan city and location of power plants according to ARES

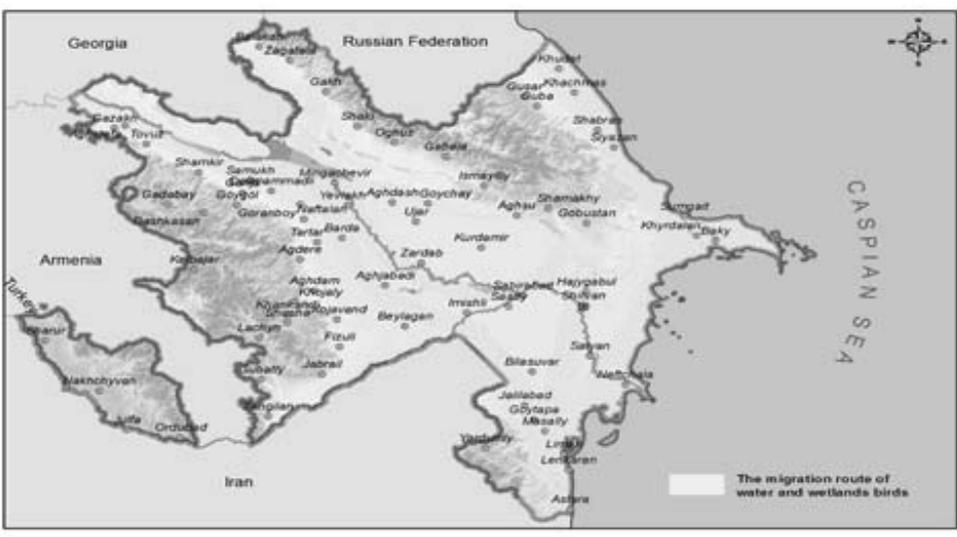
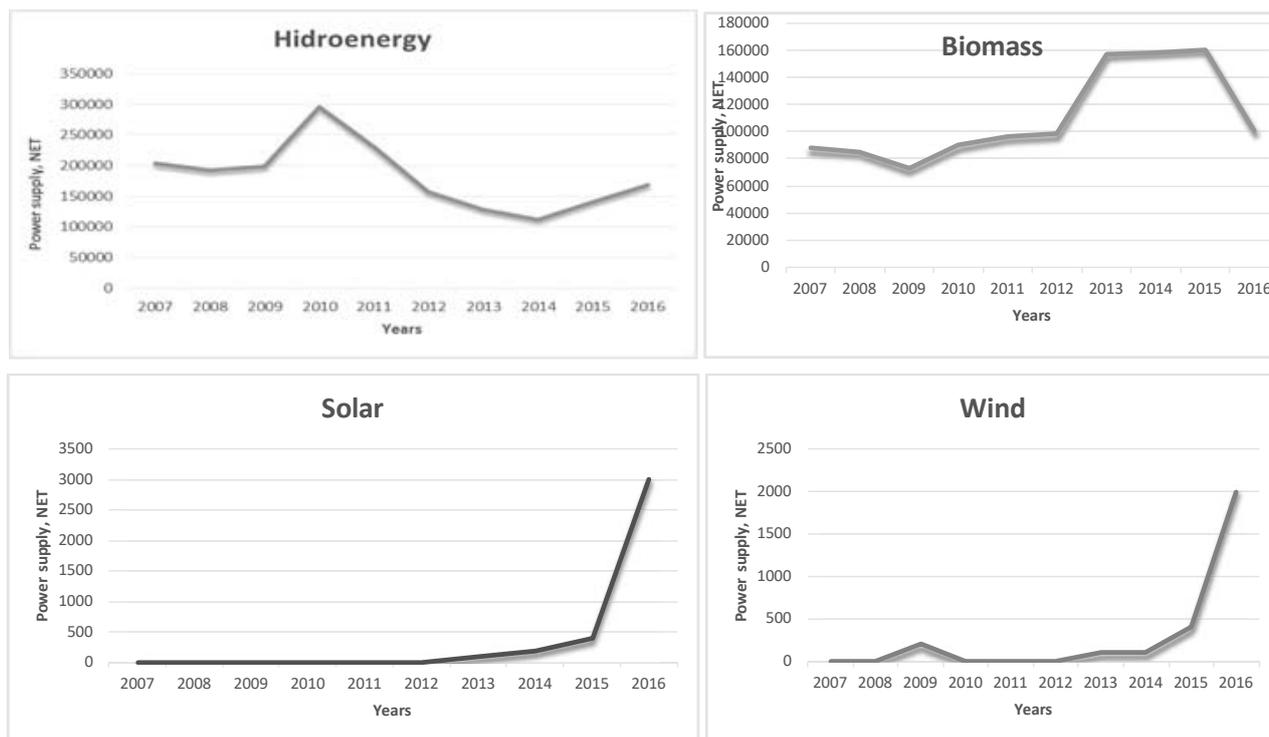


Fig. 4. The migration route of water and wetlands birds

the wind. Also, WPP facilities may impact to the environment by noise, vibration and infrasound waves. It can cause the birds death and change of migration routes. According to this, use of WPP facilities around of Shirvan city should be avoided. So, only solar and biomass energy can be used for the city of Shirvan (Figure 4).

According to the information of the State Agency on ARES in 2013–2020 and 2020–2033, with the purpose of more efficient use of solar energy in the

city of Shirvan it is projected to install the devices on buildings (roofs) and in the yards within the framework of the project “1 House 1 power plant”. In this way it is supposed to obtain 50 MW out of the total power of 60 MW from the solar power plants to be purchased and full power from the thermal power plants of 49 MW till 2013–2020. In 2020–2033, it is projected to obtain 20 MW out of the total power of 30 MW from the envisaged solar power plants and full power from the thermal



power plants of 25 MW in this way as well. Transfer of the electric energy produced by such solar power plants to consumers and certain part of it to the energy system will be taken into account in the specially developed project on local 0.4÷10 kV networks of Shirvan city.

The main technical indicators on the main energy sources used till 01.01.2013 in the city of Shirvan and on generation sources the use of which is envisaged in 2020 (I shift) and 2033 are listed in Table 1.

Conclusion. Despite to the plan about to increasing the share of alternative and renewable energy sources in the total energy supply to 50% in 2020–2030 years it is not observed growth dynamics not only in Shirvan city, in whole republic. In 2007, the share of energy supply from renewable sources in the total energy supply was 2,2%, while in 2016 it decreased to 1,8%. Indicators are calculated for country.

Based on these results I would like to say our researches with experts have not realized in Shirvan city yet. Because these projects are country-specific projects. Although my research is informative, but for the first time alternative and renewable energy sources power plants have been

projected and mapped based on GIS for Shirvan city in Azerbaijan. Thus, there is no doubt for the existence of great potential of renewable and alternative energy sources in Azerbaijan and especially in Shirvan city. I hope the use of this potential should be realized taking into account technical aspects, in terms of economic, legal, administrative and confidential issues in Shirvan city. Solution of such problems in the policy conducted in the sphere of renewable and alternative energy will lead our country to the same position as the governments of developed countries.

REFERENCES:

1. Aliyev F., Badalov A., Huseynov E., Aliyev F. Ecology. Baku: Elm, 2012. 850 p.
2. Strategy "On the use of Alternative and Renewable Energy sources 2015–2020".
3. "Creation of State City Planning Cadastre of the city of Shirvan". Integris LLC, Explanation of the draft of General plan. Baku, 2014. 350 p.
4. State Agency for Alternative and Renewable Energy Sources. URL: <http://area.gov.az/>.
5. The State Statistics Committee of the Republic of Azerbaijan. URL: <http://stat.gov.az/>.
6. State Program on socio-economic development of the regions of the Republic of Azerbaijan in 2014–2018 (February 27, 2014).