



APPLICATION OF RENEWABLE ENERGY SOURCES IN THE CONDITIONS OF KASHKADARYA REGION

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Abstract

The article highlights the available resources of renewable energy sources (solar and wind energy, biogas technology) in the Kashkadarya region and the possibilities of their use.

Keywords: Energy balance, renewable energy sources, hydropower, wind energy, geothermal energy, biomass, solar heat supply, solar electricity supply.

Introduction

According to scientists' forecasts, the growth of the contribution of renewable energy sources (except for large hydropower plants and wind) to the global energy balance will increase until 2030 (Fig. 1) [1,2]. In the future, the growth rate will decrease until the full development of these types of energy sources.

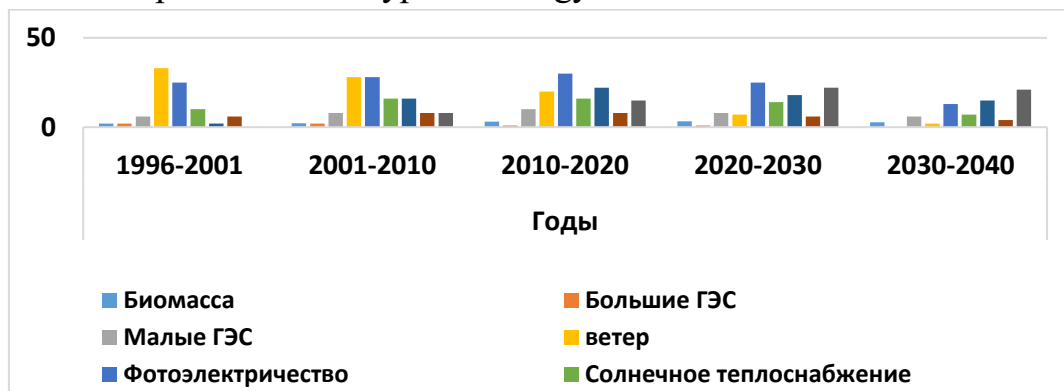


Fig.1. Growth of the contribution of renewable energy sources in the global energy balance (%)



The potential of the explored renewable energy sources (RIF) of Uzbekistan is about 51.0 billion tonnes of oil equivalent (tons of oil equivalent). The technical potential of these renewable energy sources is estimated at 179.3 million tonnes of oil equivalent, of which 0.9 million tonnes of oil equivalent or 0.5% were used for the period of 2010. (Table 1) [2].

Table 1 Potential of renewable energy sources (million tonnes of oil equivalent)

Potential	Always	Energy				
		hydro	Sun	Wind	Geothermal	bio-mass
Gross potential	50986,9	9,2	50973,0	2,2	0,2	2,3
Technical potential	179,3	1,8	176,8	0,4		0,3
Mastered	0,9	0,6	0,3	0,0	0,0	0,0
Always mastered from technical potential (%)	0,5	33,3	0,0	0,0		

Hydropower. At present, the hydropower potential in the republic has been developed by one third. 31 hydroelectric power plants have been built on the rivers and reservoirs of the Republic with an installed capacity of up to (30.0 MW), which is half of the total technical potential of the rivers of the republic (10.4 TWh).

Solar energy. The duration of sunshine in various regions of the republic is 2413...3095 hours per year, the radiation balance is 1718...2722 MJ/(m² year). The gross potential of solar energy is estimated at 50973 million tons of oil equivalent, which is 99.97% of the gross potential of all the studied EIPs in the territory of the republic volume of 176.8 million tonnes of oil equivalent or 98.6% of the total technical potential of EIZ in the republic.

The main areas of use of solar energy are the direct conversion of solar radiation into electrical energy and heat. The potential of solar energy is currently insignificantly developed in the republic and is used mainly for hot water supply and drying of agricultural products.

In the near future, solar energy systems based on photovoltaic converters in the republic do not have much prospects, in addition to the main elements - photovoltaic converters, at least they contain elements of electric storage, conversion of low-voltage direct current (12...48 V) into high-voltage alternating current (110...250 V) and



automatic control. The estimated cost of a solar photovoltaic household power supply system for a three-bedroom house can be 5... 10 million soums.

The most promising, both in world practice (Tables 1 and 2) and in the republic, is the conversion of solar radiation into low-temperature heat for the purposes of heat supply (heating, hot water supply, drying and heat treatment of agricultural products, and other heat and technological needs).

Wind power. In Uzbekistan, wind flows are seasonal due to the peculiarities of their occurrence and the geographical location of the republic. The gross potential of wind energy in the republic is estimated at 22.2 million tons of oil equivalent and is distributed unevenly across the regions [3]. The specific power of the wind flow on average in the republic ranges from 84.0 W/m² to 104 W/m² are 2.0. .5.0 m/s.

In wind energy, areas with an average wind speed of less than 5 m/s are considered to be the most efficient for placing wind turbines, with a speed of 8... 12 m/s is the most effective, speeds above 15...20 m/s can lead to the destruction of a wind turbine [3].

The possibilities of using wind energy in the republic are limited. The placement of wind turbines is most expedient in regions where wind speeds of 6... 12 m/s with an annual recurrence of 40...45 %.

Geothermal energy. According to the classification of geothermal energy, the territory of the republic belongs to a region with normal geothermal potential. Such territories have a geothermal temperature gradient of less than 40°C/km, heat fluxes are approximately 0.06 W/m² [5].

The average temperature of such waters in the republic is 45.5 °C. The gross potential of geothermal waters in the republic is estimated at 170.8 thousand tons of oil equivalent, [3]. Geothermal waters above 40°C are used for low-temperature heating (both without and with the use of heat pumps) [6].

Biomass. The basis of the bioenergy potential in the republic is forestry (reforestation, sanitary and other non-commercial logging), agricultural production, industrial and household waste. All forests in the republic are classified as a group where commercial logging is prohibited [3].

The gross energy potential of the reproduced biomass in the republic is 1.1...2.2 million tons of oil equivalent, the technical potential is 0.13...0.26 million tons of oil equivalent. The deficit of biomass is partially covered by the export of forest and agricultural products (timber, grain crops, etc.).



The basis of bioenergy raw materials (both for direct combustion and for bio and thermochemical transformation of biomass) in the republic are:

- waste from woodworking production and non-commercial deforestation (firewood, brushwood, bark, wood chips, sawdust, shavings);
- agricultural waste (straw, reeds, cotton, rice husks, manure, etc.);
- household waste.

Analysis of the above data allows us to draw the following conclusions: in the conditions of the Kashkadarya region, the most promising types of renewable energy sources for widespread development are solar energy, biomass and wind energy.

In Kashkadarya region, of all forms of practical use of solar energy, the most promising is the conversion of solar radiation into low-temperature heat for the purposes of heat supply: heating and air conditioning, hot water supply, drying and heat treatment of agricultural products, various heat and technological needs.

The widespread use of solar heat supply systems is due to the following factors: 1) full theoretical and practical justification, high technological readiness; 2) Low process cost compared with high-temperature and photovoltaic conversion forms; 3) high autonomy and independence from landscape and relief conditions; 4) ease of operation (not requiring skilled labor), high technical and fire safety, a wide variety and flexibility of design solutions.

The most promising areas of solar heat supply in the near future are:

- solar hot water supply to residential and public buildings, individual and municipal consumers, as well as seasonal facilities (children's, tourism, sports camps, etc.);
- solar heating of low-rise residential and industrial buildings, mainly in rural areas;
- use of solar energy heat in various heat and technological processes (closed ground, drying and heat treatment of agricultural products and building materials, etc.).

There is a wide variety of solar heating systems, based on solar water heaters and air heaters [3,5,6]. 1 m² of an industrially produced solar collector allows you to save 0.15...0.2 tonnes of oil equivalent per year.

The main areas of ensuring the technical and economic efficiency, reliability and stability of solar heat supply systems are:

- use of combined solar-fuel heat supply systems that provide a stable mode of operation regardless of changes in the supply mode in the summer;
- Use of programming, monitoring and automatic control systems;



- the use of solar heat supply systems should be inextricably combined with thermal insulation measures, the widespread use of elements of "solar architecture" that provide maximum capture of solar radiation and minimum heat losses.

As the experience of using solar heat supply systems shows, in the conditions of Kashkadarya region, up to 40...50% of the total heat demand for heating can be compensated by solar radiation energy and up to 60...70% of heat costs for hot water supply.

There are many areas of biomass use in the energy sector: direct combustion, gasification and pyrolysis, alcohol fermentation, anaerobic processing [2,3,6].

In the rural areas of the Kashkadarya region, direct combustion of biomass is widely used to generate heat for domestic purposes (saxaul, juniper, guzapaya, etc.). From one hectare of cotton land, you can get 2.0...4.0 tons of guzapay. Guzapaya can serve as a productive raw material for alcoholic fermentation (ethyl alcohol) and anaerobic processing (biogas) [6].

Industrial conversion of biomass, in order to obtain ethyl alcohol, currently in the Kashkadarya region has no prospects, since there are no sufficient biomass resources for such production (reeds, reeds, goozade, agricultural waste).

In the conditions of the Kashkadarya region, the most promising is the use of the processes of anaerobic decomposition of organic substances with the production of biogas. Biomass processing under anaerobic conditions is carried out in special digesters. Under the influence of methane-forming bacteria in an oxygen-free environment at a temperature of 30...55 °C in the reactor, the process of biomass fermentation takes place with the formation of combustible biogas gas, which is used for technological and domestic needs. From 1 ton of manure with a moisture content of 90%, it is possible to obtain about 20 m² of biogas with a calorific value of 23...25 MJ/m². The remnants of the fermentation mass in digesters are a liquid highly concentrated organic fertilizer (humus) that is easily digestible by plants and devoid of pathogens and weed seeds.

The main elements of biogas plants are a methane tank (fermentation reactor) and a gas holder (biogas storage tank). The design of the digester determines the productivity and economic efficiency of the entire plant. Biogas plants do not require special expensive equipment. The payback period of these installations is 2.. .4 years.



The main factors determining the widespread introduction of the technology of anaerobic decomposition of organic substances with the production of biogas in the southern regions of the republic are:

- high technological readiness and economic profitability;
- Technological and operational simplicity of biogas technology;
- Raw materials for biogas technology are available almost everywhere (organic, agricultural and household waste, manure, etc.);
- climatic conditions ensure the maximum yield of commercial biogas;
- winter temperature regimes allow to provide a mesophilic digestion mode (at 30...40 0C) with minimal biogas costs for heating in methane tanks, and in summer - heating costs disappear;
- wide opportunities for the integrated use of biogas plants in conjunction with solar and wind plants.

The use of biogas plants in small-scale power generation solves the following tasks:

1. Energy. Obtaining both heat and electricity. It creates the energy independence of the object. In remote areas, biogas plants make it possible to provide facilities (autonomous, individual, farmer, industrial) with the necessary energy for technological and household needs, without resorting to expensive fuel delivery, construction of power lines and heating mains.

2. Environmental. To solve the environmental problem of organic waste disposal at a high technological level. Disposal of agricultural and household waste reduces the environmental burden in the region. The use of biofuels saves natural non-renewable energy sources. Provide agriculture with environmentally friendly fertilizers.

The wind energy potential of the Kashkadarya region has not been sufficiently studied. In terms of intensity, direction and recurrence, the wind regime of the region is characterized by high instability. The intensity of spring winds (11...12 m/s) is higher than that of autumn winds (6...8 m/s), and in April the intensity of winds is the highest. Increased intensity is also observed in July, which causes dust winds. In conditions, Kashkadarya region belongs to the zone where in winter it is recommended to take a wind speed of less than 5 m/s in thermal engineering calculations. The most stable nature of the wind regime is observed in the steppe regions. At night, the wind speed is the lowest, and in the afternoon it reaches its maximum.



The use of wind turbines is determined by the following characteristics:

- are used in remote and isolated places, in any climatic conditions with a favorable wind regime, where there is no centralized power supply or its supply irregularly;
- generate direct current with a voltage of 12...24 V, provide electricity to lighting, household appliances, pumps;
- the presence of a storage battery provides power supply to consumers in the absence of wind, the inverter converts a constant voltage of 12...24V into an alternating voltage of 110...220 V, an automatic control unit allows you to connect other power supply systems.

According to UNESCO, for a comfortable stay of a family of 3 people living in a country house, the consumption of electricity generated by a wind turbine with a rated output power of 500 W per day at an average wind speed of 4...5 m/s is quite enough to meet the needs of a family of 3 people for lighting and other household needs.

In the conditions of the Kashkadarya region, the most profitable will be wind power plants with a rated output power of 200...1500 W, designed for power supply to autonomous consumers, raising water from wells and wells, accumulating water and water supply, small irrigation, land reclamation.

The main factors that ensure the acceleration of the mass introduction of solar heating systems, biogas and wind power plants are:

- 1) import of modern high-performance equipment for such systems and installations, organization of their serial production in the republic;
- 2) state economic incentives for producers and consumers of renewable energy sources;
- 3) conducting marketing research, information support (technical and advertising), development of propaganda and training activities.

References

1. Allayev Q.R. Modern energy and prospects of its development. Under the general editorship of academician A.U.Samiev. – T.; "Science and Technology Publishing House Printing House". 2021 c. 952 p.
2. Хайриддинов Б.Э. ва бошқалар. Муқобил энергия манбаларидан фойдаланиш асослари. – Т.: Адабиёт учқунлари, 2017, 422 б.
3. G'. N.Uzoqov, S.M.Khuzhakulov, Y.G'. Fundamentals of Uzoqova Alternative



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Energy Sources - Tashkent – 2017.

4. Avezov R.R., Orlov A.Y. Solar Heating and Hot Water Supply Systems. T.: Fan, 1988. - 282 p.

5. Duffy J.A. Thermal processes using solar energy. - Moscow: Mir, 1977.-419 p.

6. Pantskhava E. Technical Bioenergetics. - Moscow: Znaniye, 1990. - 64 p.