Comparative Analysis of Some Types of Renewable Energy Sources

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Abstract: The article discusses the current state and possibilities of using renewable types of energy in Kyrgyzstan. The efficient assessment is given for using of non-traditional renewable energy sources. The main advantages of using the energy in the national economy are also indicated in the given article. The problem of introduction and use of alternative energy sources, the factors that impede the widespread introduction of new types of facilities in the country are analyzed. On the base of reviewed material, the conclusions are formulated to improve the situation on using renewable energy sources.

1 INTRODUCTION

At present day, the supply of consumers by electricity, heat and other types of energy has become one of the factors, showing the level of social, technical and economic development of any country. Its absence or deficiency directly affects the vital activity of the population, industrial establishments and other organizations.

In this connection, the question of saving and maximally rational consumption of energy resources in production, everyday life and social security is in the first place. It is safe to say that energy saving is one of the global problems of our time.

The Kyrgyz Republic has sufficient proven reserves of hydrocarbons: coal – 1,34 billion tons, oil – 11,5 million tons, gas 6,54 billion cubic meters. [1]. In addition, Kyrgyzstan, as one of the Central Asian countries, has a huge potential of renewable energy (solar energy, wind energy, biomass energy, etc.) and a significant hydro power potential of watercourses (hydro energy – 81 billion kwh/year. [2]. Electricity is one of the basic sectors of the economy of the Kyrgyz Republic and an important factor in its development is small energy, which includes non – traditional types of energy. In this aspect, Kyrgyzstan has already been defined as a country that has developed strategy of the energy sector, which is engaged in legislative activity for its legal protection, attracts investments to improve work in this direction. However, it is the development of renewable energy that allows us to solve the most important tasks at the moment:

- Increasing the reliability of power supply and economy of fossil fuel;
- Solving problems of local energy and water supply;
- Improving living standards and employment of local population;
- Ensuring sustainable development of remote areas in the desert and mountain zones;
- Enhancing the country's commitment in fulfilling international agreements on environmental protection.

Potential energy resources of the NRES of the Republic, which are actually available at the current level and development of techniques and technology, are 840 million tons of fuel equivalents in a year. Thanks to scientific and technical progress, electric and thermal energy can be extracted locally, directly on site, using renewable energy sources (RES). It will not adversely affect the environment, because the energy of solid and liquid fuels is not used [1].

Up to now, there has undertaken a small practical study of the potential of renewable energy (their immediate share in the country's energy balance is less than 1 %). There are various reasons for this, the main one being the lack of an effective

economic incentive mechanism for using of renewable energy [2].

The use of renewable energy "dictates" the very natural specifics of Kyrgyzstan, since almost 90% of the total area of the country is covered by mountains. The majority of the population, almost 60%, lives in rural areas; in the foothills and mountain areas, where the delivery of traditional fuels is very difficult. It makes profitable useof local autonomous systems of renewable energy sources that do not require connection to existing electrical networks [3]. We will analyze some types of renewable energy sources based on the factors indicated below:

- Energy potential;
- Ease of maintenance;
- Portability (mobility);
- Economic efficiency and payback period;
- Impact on the environment.

2 ENERGY POTENTIAL

2.1 Wind energy

The total annual energy potential of wind flows in Kyrgyzstan is 2 billion MWh per year.

The potential of wind energy in the regions of the republic is different. The average annual specific energy of the wind flow is from 170 to 1300 kWh / m^2. Comparing the needs of small objects for electric energy with wind inventory data shows that the wind energy potential is sufficient and can be successfully used to cover the needs for energy [3, 4].

Analysis of the wind flow features showed that more than 50 % of wind flows in Kyrgyzstan fall on light wind and calm, 30-40% on light wind (2-5 m/s) and the rest on moderate and fresh wind (6-10 m/s) [3, 4].

On a large part of the lowland and foothill zones, where the main low-power consumers are located, wind energy potential is low. In the same zones where the winds are blowing at a speed of 8-12 m/s, with high energy potential, consumers are practically absent. That's why, the development of small wind energy (1-10 kW unit) seems to be promising, and, first of all, for the supply of electricity to remote low-power autonomous consumers located in the foothill and mountain regions [3-4].

2.2 Biomass energy

Local biomass sources include biomass from livestock and straw cultivation, the potential using is estimated at 9,732 thousand TJ per year. However, the level of their use is extremely low and is usually limited to the heating of residential premises with dry manure (kizyak). The estimated energy potential of agricultural biomass available for use is more than 12,0 thousand TJ per year [5].

2.3 Solar energy

Due to its favorable geographical location and climatic conditions, the territory of Kyrgyzstan receives an average of 4,64 billion MWh of radiant solar energy per year, or 23,4 kWh per 1 square meter, although there is a regional change in the intensity of solar radiation. A significant difference in the thermal energy coming from the sun is made by the mountain relief, which characterizes 90 % of the country's territory.

The technical annual potential of solar heating plants under these conditions can
reach 1,7 million MJ [3, 4, 6].

2.4 Energy of low-power water flows

The total hydropower potential surveyed in the territory of the republic is 172 rivers and streams with oxen consumption from 0,5 to 50 cubic meters m/s, more than 80 billion kW / h per year. Experts believe that now there is the possibility of building 92 new small hydropower plants with a total capacity of 178 MW and an average annual output of up to1.1 billion kW / h of electricity. 39 previously existing small hydropower plants with a total capacity of 22 MW and average annual output of up to 100 million kW/h of electricity can be restored [2]. One of the factors of hydropower development should be the reconstruction and building of small hydropower plants, as the centralized system of power supply requires the large capital investments.

3 PROSTATE MAINTENANCE

3.1 Wind energy

Maintenance of low-power wind installation of generators does not require much experience and profound technological knowledge from the user, the knowledge obtained in the form of consultation

is sufficient. Regular maintenance, as well as the use of modern technologies – allows not only to extend the period of trouble-free operation, but also to avoid unintended downtime of wind turbines [3, 4].

The repairing works of blade and parts is performed by specialists who have received specialized training in working with composite materials (fiber and epoxy resins) and parts replacement.

3.2 Biomass energy

During the operation of biogas plants (BGP), the daily dose of fresh manure loading and its periodic introduction into the installation are of great importance. Loading dose is a variable value and depends on various subjective - objective factors. The daily dose should be introduced into the reactor not entirely, but gradually, in equal portions at single intervals of 4-6 times per day. The load portion must be heated. The use of BGP, which is considered to be the simplest in its design, in contrast to other sources of renewable energy requires more attention during operation, reliable fastening of all parts of the installation. Replacing the material in the installation requires a person to be attached to it, monitoring the condition and maintaining the required temperature of the organic material. This whole procedure will be easy for a farm or a family with a large number of members, but not for families that mostly work in the fields.

3.3 Solar energy

The solar maintenance, regardless of their number, is extremely simple and reduces to periodic (just a few times a year, with the exception of snowy days) surface cleaning, which can be done by everyone, regardless of qualifications and professional skills. You should also take into account the fact that the strength of tempered glass, which is covered with panels, is so great that it can withstand large hail (up to 2,5 cm in diameter), therefore, it is rather difficult to damage or damage the panel. At the same time, maintenance of solar panels is much simpler than heating and air-conditioning systems, which today are present in almost every private house.

3.4 Energy of low-power water flows

For maintenance of micro HPSs, special knowledge is not required, as they have a simple structure consisting of a base, a water wheel, a generator and an electrical panel.

After installation, micro HPS can operate autonomously for a long time. Repair can be reduced to the replacement of component parts.

4 PORTABILITY (MOBILITY)

4.1 Wind energy

Wind turbine must be installed permanently, because it can be up to several meters high and have a lot of weight, so there is no possibility for its constant movement. To move the wind turbines, it must first be disassembled in parts, then move it to the right place and disassemble it again. The above works on the transfer and installation of equipment can be performed only by specialists in this field.

4.2 Biomass energy

Biogas plant with a large reactor volume is installed above the ground. The reactor is attached to the ground with a concrete surface and is not subject to movement. Carrying a biogas plant will require special equipment and specialists in this field. A lot of efforts can be spent on the movement of biogas plant and this can take indefinite time specialists.

4.3 Solar energy

Solar energy converters - installation can be installed almost anywhere. To move the solar installation doesn’t require specialists. As solar plants usually have a small weight, the movement can’t be carried out by a non-specialist person who doesn’t belong to this area; and also it doesn’t require time and physical assistance.

4.4 Energy of low-power water flows

Hydroelectric power plants are installed stationary, in the stream of the water flow.

However, if necessary, it is possible to disassemble the installation into separate

component parts with subsequent transfer to a new location

5 ECONOMIC EFFICIENCY AND PAYBACK PERIOD

The following table 1 shows the data on capital investments, costs and payback periods of installations [3, 4, 6, 7].

Table 1: The data on capital investments.

n/n	Kind of energy	Specific capital investment, $/kW	Cost of installation on1 kWh, cent/kW	Payback period (year)
1	Wind power	600-1200	4-5	5-7
2	Biomass energy	700-1600	8-9	3-7
3	Solar power	1500-2500	2-16	3-6
4	Energy of low-power water flows	700-1000	3-4	2-7

As can be seen from the table, the economic indicators and payback periods of the above types of energy have on average similar data.

6 ENVIRONMENTAL IMPACT, SAFETY

6.1 Wind energy

Environmental problems associated with the construction and commissioning of wind power facilities may include noise and vibration, soil erosion and threat to biological species, including habitat change and impact on wildlife, deterioration of water quality, and impact on visual perception. [3, 4].

Studies conducted by experts in this field have shown that for low-powered wind installations the above problems practically do not exist, and are not the greatest harm for ecology and fauna. Noise during operation of low voltage generators with low-power generators is hardly noticeable.

Using the wind generators reduces the annual emissions into the atmosphere thousands of tons of carbon dioxide, sulfur oxide, nitrogen oxide. It affects the rate of decrease of the ozone layer, accordingly to the rate of global warming. In addition, they produce electricity without using water, which will reduce the exploitation of water resources, and without burning traditional fuels, and this reduces the demand and prices for fuel.

Wind turbine is dangerous to life and the environment, only when exposed to external factors and the device breaks (blades).

6.2 Energy biomass

As far as the degree of fermentation, i.e. decomposition of organic matter, reaches 30-40 % and because of it, the decomposition of biologically unstable organic compounds occurs mainly, the sludge is devoid of the smell characteristic of the original substrate [5].

The hygienic effect of anaerobic fermentation is primarily due to heat exposure for a certain length of time. For the destruction of individual pathogens required in each case a certain minimum temperature and the minimum duration of their stay at this temperature [5].

During the operation of the equipment, there may be consequences and malfunctions. The consequences can be a gas leak. Using of open flames to detect gas leaks is prohibited, as it is explosive. Gas pipes must be regularly checked for leaks and protected from damage.

6.3 Solar energy

In comparison with other types of energy, solar energy is the most pure in ecological attitude. The use of solar collectors is the most promising for reducing social tensions, as the huge potential of solar energy, in combination with relatively low capital investment and operating costs in the future, can cover 50 % of the republic's needs for thermal energy. However, it is practically impossible to completely avoid the harmful effects of solar energy on humans and the environment, if you take account of the whole process chain from obtaining the required materials to energy production.

6.4 Energy of low-power water flows

MicroHPS practically doesn’t harm the ecology environment. However, the generated voltage of 220 V can be dangerous to humans, and therefore

it is necessary to follow the safety regulations when working with electrical equipment.

CONCLUSION

Kyrgyzstan together with the traditional energy (HPS, CHE), at this time is developing electricity and heat supply on the base of non-traditional sources of energy. With for that purpose, the government promotes the programs of NGOs of international organizations, establishes the Agency for the development of non-traditional types of energy, and adopts laws to promote and protect the interests of people engaged in non-traditional energy sources. This contributed to the emergence of interests from legal and private individuals on the use of objects of non-renewable sources of energy. In addition, the geographical feature (the complexity of laying electrical lines, the location of consumers at large distances from each other), territorial features (delivery of energy from neighboring countries and high prices) also have an impact on increasing demand for non-renewable sources of energy.

The use of renewable energy sources in Kyrgyzstan as well as throughout the world has its advantages:

- Independent of the central power system, its own source of electrical and thermal energy;
- Long shelf life of installations;
- Economic benefit (low cost per unit of energy);
- Minimal environmental impact;
- the use of local materials for the construction of power plants;
- Ease of maintenance of power plants;
- A relatively unlimited amount of energy.

In addition, each type of renewable energy has its advantages in different areas of the country: for hot and warm southern areas biogas plants (excellent fermentation effect), micro hydro (maximum use of time) and solar plants for heat and electricity; the use of wind energy for the northern regions, which give a large efficiency in contrast to the southern regions. But this does not mean that the use of other types of renewable energy does not make sense.

The reason for the inefficient use of renewable energy in Kyrgyzstan can be explained by the following reasons:

- Lack of interest: poor public awareness; high cost of electrical energy, technical illiteracy in the use of power plants; geographical distance from energy resources.
- Weak promotion of products on the market by business structures: a limited number of assortments of renewable energy; no technical support for the operation of power plants; small return of the spent means.
- Technical and technological unpreparedness of the country: the use of morally and physically obsolete technologies and technology, lack of qualified specialists (technicians, craftsmen).

These problems can be solved by holding seminars, trainings, consultations and visual advertisements, inviting the necessary specialists, perhaps even from abroad. Production of plants such as micro hydro, wind turbines (wind power plant), biogas plants, and solar thermal converters does not require high technology. The industry of the Kyrgyz Republic is able to master the production of these installations in regional centers, as well as industrial cities.

The calculations show that the renewable energy sources are quite competitive, as their cost is 1,5-4 lower in comparison with the traditional energy sources. One of the advantages of installations using renewable energy sources is that they don't require significant maintenance costs, in most cases they are less than 3-5% of the equipment cost. The organization of the production of converters of alternative renewable energy will create additional jobs. Integrated use of renewable energy will help to improve the life of inhabitants of mountainous and foothill regions, and to solve a number of problems associated with the migration of people to cities and abroad. Alternative energy supply will help preserve the ecosystem of the Kyrgyz Republic and reduce the negative impact of human activity on the environment. It will help to preserve the balance of rational recovery of the health of glaciers, which are a source of moisture, energy and stability in the Central Asian region.

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