Importance and prospects of bioenergy in Turkmenistan

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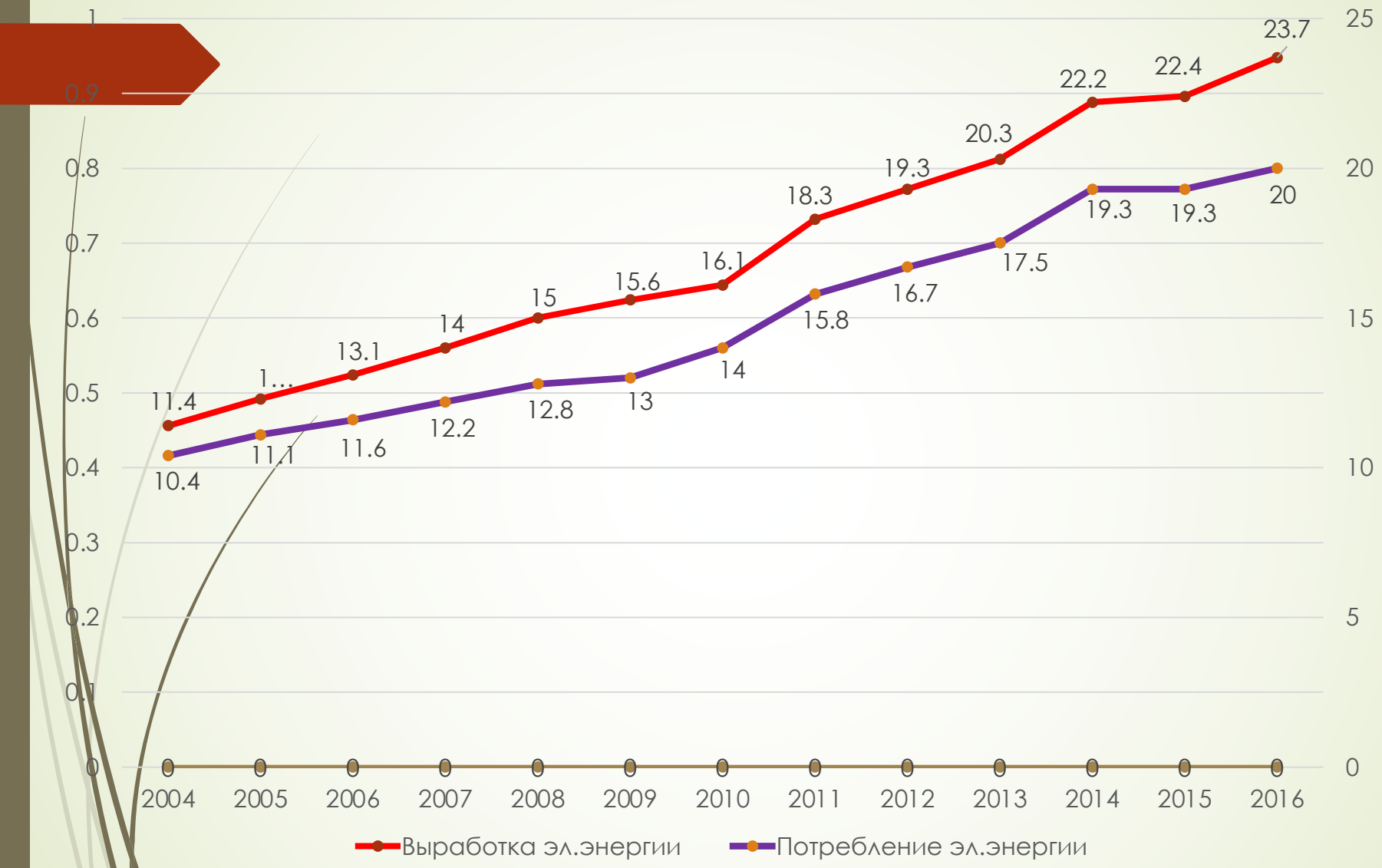
As one of the world's largest energy exporters, Turkmenistan makes a significant contribution to achieving the country's sustainable development goals, providing access to reliable and modern energy not only to consumers in Turkmenistan, but also to consumers from neighboring countries.

Electricity generation and consumption, billion kWh



Generation Consumption

At the same time, Turkmenistan is suffering from the consequences of climate change. Over the past 55 years, the average air temperature in the country has increased by 1.4°C, while the global temperature has grown by an average of 0.8°C over the past 100 years.

In this regard, the country has adopted several programs and strategies for the sustainable energy sector development and measures to adapt to climate change. These include:

- State energy saving program for 2018-2024;
- Program for the development of energy diplomacy of Turkmenistan for 2021-2025;
- National strategy for the development of renewable energy in Turkmenistan until 2030;
- “Revival of a new era of a powerful state: the National program of socio-economic development of Turkmenistan for 2022-2052”
- National action plan to improve the health of the population of Turkmenistan, taking into account climate change and its adverse consequences, for 2020–2025.

Main objectives of these programs and strategies:

- Ensuring country's sustained economic development through the rational use of natural energy resources.
- Preserving fuel reserves of Turkmenistan and increasing the share of renewable energy sources, non-traditional energy resources, selecting secondary fuels, as well as secondary energy sources.
- Ensuring environmental protection, protection of life and health of the population.
- Developing innovative and resource-saving technologies suitable for country´s climatic conditions.

These programs and strategies outline the key areas of cooperation with specialized UN agencies, the International Energy Agency, the Energy Charter Secretariat and other relevant international structures. Turkmenistan pays great attention to the issues of rational use of natural resources, increasing energy efficiency, strengthening and actively utilizing the potential of alternative “green” energy.

The potential of renewable energy sources is estimated at about 110 billion tons of equivalent fuel per year. The most promising renewable energy sources are solar, wind energy, and biomass energy. The solar energy potential in Turkmenistan is estimated at 1.4 billion tons of equivalent fuel per year. There are about 300 clear days throughout the year. The average annual solar radiation is about 700-800 W/m2, which is equivalent to an energy input of 2000 kW/m2 per year. Turkmenistan is also considering the possibility of using wind energy, the potential of which is 640 billion kWh.

Being one of the world's most resource-rich countries and fully aware of its responsibility in this regard, Turkmenistan is making every effort to maintain a balance between production goals and environmental protection objectives and the conservation of fuel resources. In connection with this goal, Turkmenistan is studying world experience and is actively introducing bioenergy resources in the energy sector.

Bioenergy is a form of energy that is derived from biomass. The development of bioenergy is feasible if there is cheap biomass available in significant amounts (Table 1).

Comparison of biomass resource potential of some countries

Table 1

Country	Biomass type	Amount, million tons/year
Russia	forest and farm waste	170
Kyrgyzstan	hay	1,8
Uzbekistan	industrial and household waste	130
Vietnam	waste from canteens and markets	57,451
China	hay	800
Turkmenistan	organic waste	235, 79

As we can see, biomass resources are an effective renewable energy source, and its various types are available in almost all regions of the world.

In Turkmenistan every family keeps cattle, sheep and chickens. A small farm contains 8 heads of cattle, 10 sheep and 30 chickens. During the night every head of cattle produces 55 kg of manure (moisture is 85%), every sheep produces 0.6 kg (moisture is 50%) and a chicken - 0.2 kg (moisture is 75%). That is, 440 kg (8·55) of cattle manure, 6 kg (0.6·10) of sheep manure and 6 kg (30·0.2) of poultry manure are produced per day. Now we can calculate the amount of dry mass in manure:

$$M_{cattle}=440\cdot0.15=66 \text{ kg}$$
$$M_{sheep}=6\cdot0.5=3 \text{ kg}$$
$$M_{poultry}=6\cdot0.25=1.5 \text{ kg}$$

From 1 kg of dry matter of cattle manure we can get on average 0.3 m3 of biogas, from 1 kg of dry matter of sheep manure - 0.4 m3 of biogas and from 1 kg of dry matter of chicken manure we can get 0.5 m3 of biogas. Daily biogas production is:

$$V_б=0.3\cdot66+0.4\cdot3+0.5\cdot1.5=19.8+1.2+0.75=21,75m^3$$

Table 2

Source	Comparison of composition and energy indicators								
	CH_4	C_2H_6	CO_2	N_2	H_2	H_2S	Ar	$\rho_р$, kg/m3	$Q_н^р$, kJ/m3
Natural gas, %									
Orta Aziýa	93,8	3,6	0,84	1,05	-	-	-	0.77	35570
Biogas, %									
Organic waste	65,77	-	30,36	24,75	9,35	0,11	0,18	1,1	23195
Sewage	67,75	-	31,75	0,48	-	-	-	1,05	22412
Sugar factory waste	69,3	-	30,2	0,2	-	-	-	1,1	23492

As can be seen from the table, the composition of biogas depending on the type of raw material is different and we can calculate the calorific value of biogas when the percentage of components is known:

$$Q_{\text{н}}^{\text{p}} = 128\text{CO} + 108\text{H}_2 + 234\text{H}_2\text{S} + 339\text{CH}_4 + 589\text{C}_\text{n}\text{H}_\text{m} =$$

$$128 \cdot 0 + 108 \cdot 9{,}35 + 234 \cdot 0{,}11 + 339 \cdot 65{,}37 + 589 \cdot 0 = 23195{,}97 \text{ kJ/m3}$$

Where Q_p - lower calorific value of biogas, kJ/m3; CO, H2, H2S, CH4, CnHm - composition of gaseous fuel, percentage by volume under normal conditions.

According to calculations, the lower calorific value of biogas obtained from organic waste is 23195.97 kJ/m3. The lower calorific value of natural gas is 35570 kJ/m3. From here you can determine the correction factor k, which will take into account the ratio of the amount of fuel:

$$\kappa = 35570 / 23195{,}97 = 1{,}52.$$

From the above calculations we can see how important bioenergy is.

Importance of bioenergy?

- Ensures the production of electricity, heat, fuel, and waste disposal.
- Significantly improves environmental situation.
- It has a significant potential to improve economies in the region.
- Develops three important economic segments: energy, agriculture and forestry.
- It is an additional mechanism for enhancing economic growth by producing high-value products.
- Provides integrated production of bio fertilizers to improve soil.

The number of developing countries in the world is increasing every day, and the number of manufacturing enterprises is also increasing. They allow us to improve our living standards. But, unfortunately, manufacturing enterprises also have a negative impact on the environment.

Stages of waste management

By sorting waste and preventing it from being buried, the enterprise saves about 400 rubles per ton of environmental fee.

If waste has been generated, then at further stages it is necessary to solve the problems of handling it.

The task of the authorities is to create conditions for coordinating the work of various entities interested in participating

Association of enterprises and entrepreneurs in the field of waste management in Tomsk region. GOALS:
-Development of solutions improving the efficiency of waste management decisions in the region;
- Coordination of business activities carried out by the members of the Association and protection of their interests in the field of collection, transportation, processing, disposal of waste, as well as in the field of sales of secondary raw materials (commercial products).

We are all responsible for preserving Earth´s biodiversity, taking care and protecting the environment from pollution, reducing the amount of emissions of harmful substances, rational and careful use of energy resources.

CONCLUSIONS:

1. The introduction of bioenergy makes it possible to increase electricity exports and create new jobs.
2. Thanks to resource-saving technologies, it is possible to reduce the annual amount of harmful emissions into the atmosphere.
3. Turkmenistan has all the opportunities to develop bioenergy.
4. The development and implementation of bioenergy projects in Central Asia will allow solving problems associated with climate change, taking into account the characteristics of ecosystems and reducing climate risks, and will also allow implementing an action plan to combat desertification through the use of biofuels.

Thank you for attention!