5.1. Renewable energy potential

Estimates put Uzbekistan's huge renewable energy potential at nearly 51 billion t.o.e (Box 5.1). If today's global engineering and technological know-how were in place in Uzbekistan, it would be possible to produce 179 million t.o.e. using renewable energy - more than triple the amount of fossil fuel the country now produces annually (Table 5.1, [24]). At the same time, no assessment of the economic potential of renewable energy sources has been made.

Box 5.1

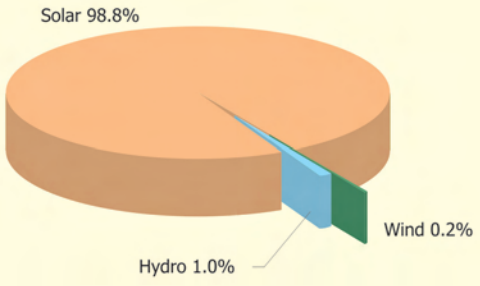
Gross potential – the theoretical amount of energy acquired or produced on a given territory.

Technical potential – that part of gross potential which can be harnessed using existing technologies.

This assessment of renewable energy technical potential (Figure 5.1) omits biomass resources: plant, livestock, industrial and household wastes. An assessment of biomass resources should be made in the near future. For example, two to four tons of stalks ('gusapaya' in Uzbek) left on one hectare of land where cotton was gown can yield from one to two million t.o.e. [25].

Figure 5.1

Structure of Uzbekistan's renewable energy sources potential



Necessary prerequisites for the successful development of the renewable energy sector are that there must be a substantial renewable energy potential consisting of every type of renewable energy sources and favorable economic conditions must be created in Uzbekistan conducive to harnessing a significant part of the technical potential.

Table 5.1

Uzbekistan's renewable energy sources potential

Potential	Total (millions of t.o.e.)	including types of energy (millions of t.o.e.)			
		Hydro	Solar	Wind	Geothermal waters
Gross	50,984.6	9.2	50,973.0	2.2	0.2
Technical	179.0	1.8	176.8	0.4	-
Harnessed	0.6	0.6	-	-	-

5.2. Uses of renewable energy sources technologies in Uzbekistan

Of all of Uzbekistan's renewable energy resources, the one that is being most successfully harnessed is the energy potential of its rivers. In addition, a number of solar and wind energy projects have been implemented in recent years, although they have tended to be more on the order of demonstra-

tion projects.

At the same time, the Republic of Uzbekistan already has the capability and rationale for making broader use of renewable energy technologies, such as:

1. solar panels for heating water;
2. solar photovoltaic systems for producing electricity;
3. micro hydro power plants for producing electricity;
4. wind-driven generators for producing electricity; and
5. biogas plants for producing electricity and heat.

Looking ahead to the future, prospects for using other technologies should be studied, as well, e.g.:

- using household wastes in large trash incinerators and in centralized heating systems in large cities such as Tashkent and Samarkand;
- using solar electric power plants; and
- using geothermal energy.

In using renewable energy sources, it must be borne in mind that renewable energy sources can not be considered guaranteed sources of energy because energy flow density from renewable energy sources depends significantly on the time of year, time of day, and climatic conditions. For example, photovoltaic stations can not function at night, wind-driven generators do not produce electricity when there is no wind or when wind velocity is too low, etc. For these reasons, backup power sources are generally required, meaning that renewable energy sources essentially serve as a supplement to traditional sources of energy.

Solar water heaters

As indicated above, the technical potential of solar energy far exceeds Uzbekistan's annual output of fossil fuels and as far as solar water heaters and photovoltaic systems go, there are no resource restrictions affecting their use at all.

The most serious barriers are the price of such systems and the public's lack of purchasing power to pay for the services they provide.

Modern solar water heating systems can be used:

- to economize on natural gas in areas supplied with natural gas. Rationale: to improve gas supply reliability (in areas where gas service is constantly interrupted due to insufficient supplies of gas or technical problems); to resolve environmental issues; to resolve economic issues;
- to replace, partially, wood fuel in remote areas with no gas supply. Rationale: to increase comfort level and energy supply reliability; and
- at very large centralized steam heat plants. Rationale: to save natural gas and reduce greenhouse gas emissions.

Additional prospects for increasing the use of renewable energy sources along these lines are related to the fact that Uzbekistan has a water heater manufacturing industry in place that is just as good as foreign analogues (Box 5.2). Uzbekistan's leading manufacturers of solar panels for water heaters are:

- The Kurilishgelioservis Company
- The Encom Scientific and Production Enterprise
- The Foton Open Joint Stock Company.

Uzbekistan has specialists qualified to install and maintain solar water heating systems. What is more, many system components could be produced in-country, including: solar panels, absorbers, wires and cables, pipes, glass, insulating materials, support structures, and other components (Table 5.2). The total area of installed solar collectors is approaching 40,000 m^2. Solar collectors have also been installed in a number of automotive transportation and medical facilities, at Ministry of Defense of Uzbekistan facilities, at Stock Company Uztransgaz, at the State Stock Railway Company Uzbekistan temir jullari, at Almalyk and Navoi mining and metallurgical company and other facilities.

Box 5.2

UZBEKISTAN:

Technology transfer for local production of solar water heating panels

The main objective of the Technology Transfer Project For Local Production Of Solar Water Heating Panels, funded by the Government of Denmark and the Scandinavian Trust Fund and implemented jointly by UNDP and the Khokimiyat of the city of Tashkent, was to provide capacity building for the production of solar panels in Uzbekistan by assisting local manufacturers in gaining access to relevant European solar technologies. The project continued the work of and was based on the results of earlier projects funded by other international donor organizations (Tacis Program projects).

As part of the Project, European technology and equipment for the manufacture of solar water heating systems to supply hot water and heat were transferred to Foton Open Joint Stock Company and Encom Scientific and Production Enterprise, two local enterprises. They developed a solar panel design adapted to local conditions and produced them using local materials; their new design of solar panels went into production with a total of 300 m^2 (75 panels) of solar paneling being produced and installed at the Vodnik Boiler Plant's solar testing field.

Local specialists were trained to use the equipment and taught the production and work cycles for installing and servicing solar hot water and heating supply systems. A public awareness campaign was organized to better acquaint the public with renewable energy sources and ways to save energy.

A strategy for replicating the experience was developed and policy recommendations were made on how to improve the use of solar energy for heating water.

The manufacture of solar panels using the latest European technology (solar strips) was a first, not just in Uzbekistan but in Central Asia as well and made a practical contribution toward further developing the renewable energy potential and market not just in Uzbekistan but in other Central Asian countries as well.

UNDP/DANIDA

Table 5.2

Solar water heaters in Uzbekistan

Technology	Equipment manufacturer	Systems made and sold to customers	Parts and accessories producible in Uzbekistan	Potential customers
Solar water heaters	Encom Foton	300 $м^2$ of solar panels installed at Vodnik Boiler Plant (Khokimiyat, Tashkent city)	Solar panels, wires and cable, pipes, glass, insulating materials, basic rubber accessories, support structures	Steam plants, individual living quarters, medical facilities, enterprise and organization administrative offices, children's and educational institutions, canning industry
	Kurilishgelioservis	Systems installed in a number of Uzbek organizations		

Source: UNDP Project Report: Review Studies for National Strategy on Renewable Energy in Uzbekistan

Solar photovoltaic systems

In recent years the cost of photovoltaic systems has dropped significantly worldwide, sharply increasing their economic potential.

Their rather high cost aside, these systems can be very useful for increasing comfort level and power supply reliability (failure to deliver diesel fuel) in the stark realities presented by hard to reach remote areas with no access to electricity grids (Box 5.3). The only alternatives to solar photovoltaic systems in such circumstances are either diesel electricity generators or no electricity at all.

The open joint stock company Foton and the Physics-Engineering Institute of the Academy of Sciences of Uzbekistan are working on producing photovoltaic systems using imported parts and accessories. Those systems Foton has produced have gone through the process of being certified as meeting the Agency Uzstandart's standards [24].

The photovoltaic systems made in the Republic cost less than counterparts made in other countries do and in the future may cost even less thanks to localization of production of individual photovoltaic system components (Table 5.3). The total capacity of photovoltaic systems now installed in Uzbekistan does not exceed 10 kW. Photovoltaic systems have been installed in the village of Kostruba, at a tourism complex in Karakalpakstan, at the Stock Company Uztransgaz facilities, at individual 'chaban' farms in the republic and at other sites.

Box 5.3

UZBEKISTAN:

Clean energy for the rural communities of Karakalpakstan

Uzbekistan has about 1,500 rural settlements that are not connected to a centralized electricity supply. Small rural villages in remote hard to reach places are not going to have an electricity infrastructure built for them because that is not an economically feasible option. Consequently, people in these remote villages face various adversities, one of which is the lack of potable water.

This problem is acutest in the Republic of Karakalpakstan where, by the same token, the solar energy potential is great. UNDP, in partnership with the State Environmental Protection Committee of Uzbekistan and Karakalpakstan, conducted the Clean Energy for the Rural Communities of Karakalpakstan Project over the period 2002-2006.

As part of the first phase of the project, people living on remote 'chaban' (shepherd) farms and in the village of Kostruba were provided with 25 photovoltaic systems: 10 to operate pumps to pump well water for cattle, 13 to produce electricity for the household needs of 'chaban' families, one for the local school and one for the village council. Although the capacity of the installed PV systems is low, 10 – 200 W of electricity, it is sufficient to power a standard set of electrical appliances: an energy efficient black and white television set (connected to a satellite antenna also fed by one of the PV systems), a cassette player and four energy saving fluorescent light bulbs.

The photovoltaic systems installed during the first phase of the project were produced using photovoltaic cells made of amorphous silicon to produce direct current with which only special household appliances and electric light bulbs can be used. When tests of these systems were completed during the second phase of the project, it was decided to outfit the new photovoltaic systems with inverters to provide the capability of converting direct current into alternating current used everywhere by consumers and which works for regular household appliances and energy saving light bulbs available on the local market. The Uzbek photovoltaic system manufacturer OJSC Foton, in cooperation with the Technology Transfer Agency, installed the monocrystalline silicon photovoltaic systems on a turnkey basis during the second phase of the project.

Source: UNDP

Table 5.3

Solar photovoltaic systems in Uzbekistan

Technology	Equipment producers	Annual production output	Parts and accessories producible in Uzbekistan	Potential customers
PVS - 100 PVS - 200	Opened Joint stock Company Foton Up to 50 kW	Up to 50 kW	Photovoltaic panels (monocrystalline silicon based), controllers, inverters, storage batteries, connector wires, junction boxes, mounting and anchoring frames and framework structures, energy efficient light bulbs	Small-scale electricity consumers
PVB-15 SPO-20 SPO-100 PVD-150 PVD-500 APVD–1000	Physics-Engineering Institute	Up to 10 kW		

Source: UNDP Project Report: Review Studies for National Strategy on Renewable Energy in Uzbekistan

Small and micro hydro power plants

With an installed hydro power plant capacity exceeding 1.7 GW, Uzbekistan is able to produce over 6 TWh of cheap energy annually. Another six hydro power plants, some large and some small, are currently under construction in Uzbekistan with an installed capacity of nearly 300 MW. Construction of nine more hydro power plants has been proposed. Their combined capacity would exceed 520 MW, including the very large Pskem hydro power plant (400 MW) [22, 24].

The resources of the 650 rivers that course through Uzbekistan and its abundant irrigation canals and reservoirs provide the technical potential for constructing a significant number of hydro power plants with an annual electricity output of 21 TWh, not counting micro hydropower potential which has not been assessed yet [22, 24].

Small and micro hydro power plants can be used in remote areas without access to electric power grids.

Although local enterprises and organizations, which at the present time do not manufacture hydro power plant equipment, largely do construction-installation work, the potential does exist for local production of individual components, for example, metal structures, cables and wire, testing equipment, batteries, etc.

Looking ahead, it should be possible to consider the possibility of organizing local production of standard equipment for small and micro hydro power plants, including flow-type cross-jet hydro-turbines with a wide range of pressure and output capacity instead of the various types of classical turbines now in use in Uzbekistan.

Wind-driven generators

Wind conditions in Uzbekistan are such that the country's winds are describable as generally low-velocity and highly variable [26], although Uzbekistan has certain wind zones where wind velocities are suitable for operating modern wind-driven generators with towers at least 50 m high.

Uzbekistan's wind energy potential has been assessed at weather stations using wind velocity observation data made only a few meters off the ground– 10 m [24]. However, to be able to determine the feasibility of installing modern wind-driven generators at a specific location more detailed wind velocity observations must be made at various heights aboveground and a wind speed atlas must be compiled. This is required to assess wind velocity conditions for modern wind-driven generators and to be able to match periods of peak wind velocity with consumer load demands.

Wind energy can be used to produce electricity:

- To replace electricity supplied by electric power grids. Rationale: to reduce greenhouse

gas emissions, to compensate for otherwise inadequate local electricity supply;

- In combination with diesel generators or solar photovoltaic systems in remote areas without access to electric power grids. Diesel generators are an alternative for producing electricity. Rationale: to raise comfort level and energy supply reliability.

Wind-driven generators with capacities ranging from hundreds of watts to several dozen kilowatts do not differ in design from large capacity generators. They can be used by individual consumers for various purposes (lifting water, serving as a stand-alone source of electricity, etc.) and, in places where local ground winds are constant, for supplying electricity to power various devices, for example, meteorological equipment, communications equipment, etc.

Wind generators of this kind have been tried out in Uzbekistan at, for example, a poultry plant in Karakalpakstan and an experimental hybrid solar-wind generator for a television transmission station near Charvak in Tashkent Oblast.

Providing local electricity using such technology is particularly urgent in remote hard to reach areas where it is not economically feasible to bring in electric transmission lines.

At present local enterprises do not produce equipment or parts and accessories for wind-driven generators, although looking ahead there are prospects for local production of individual wind-driven generator components and for local enterprises to do construction-installation work.

Biomass technologies

No official information is available about Uzbekistan's biomass resources useable for energy purposes (gasification or direct combustion to produce energy).

A thorough assessment of biomass's energy potential needs to be done taking into consideration that guzapaya (Uzbek term for stalks left after cotton harvest) is traditionally used in rural areas for cooking and that stalks and straw from grain crops and other farm plants are used as fodder for livestock and in construction materials.

Resources from livestock and poultry wastes as well as household and industrial wastes must be part of the assessment as well because today's biogas plants make it possible to obtain valuable fertilizer and biogas (mainly methane) from such wastes. Biogas can be used as fuel for cooking and, if high volumes of waste are available, it can be used to supply electricity and heat. In the latter case, the technology can be used most efficiently on farms where large herds of cattle are kept in stanchions.

Biomass resources can be used:

- To replace natural gas on farms in areas supplied with natural gas. Rationale: to improve energy supply reliability in areas where gas service is constantly interrupted due to insufficient supplies of gas or due to technical problems; to produce fertilizer for one's own use or to sell; for environmental and economic reasons;

- To replace natural gas for heating purposes in rural areas. Rationale: to improve energy supply reliability in areas where gas service is constantly interrupted due to insufficient supplies of gas or due to technical problems; for environmental and economic reasons; and

- To produce and use gas at garbage dumps.

There are no manufacturers of biogas equipment in Uzbekistan. But Uzbekistan has the technical potential not only to install and maintain biogas plants but also to do the planning and organizing to put them into production or to localize production of individual biogas plant components, such as pipe fittings, metal structures, wire and cable, basic mechanical and rubber articles, and testing equipment.

Other renewable energy technologies

The following renewable energy technologies can also be used:

- In addition to converting solar energy in solar water heaters and photovoltaic systems, solar energy can be used to produce electricity by concentrating solar radiation at solar electricity plants;
- When geothermal sources are located near the consumer, they can be used to heat living quarters and greenhouses during cold periods of the year, and at sufficiently high temperatures, they can be used for converting thermal energy into electricity.

In order to make use of these resources further in-depth research is necessary.