

Renewable Energy Country Profile Version 0.6b

These profiles are a work in progress. They are presented to the international community for review and comment. The profiles are undergoing continual updating for technical content, formatting, grammar, and other issues. Each country profile will be modified on a continuous basis as new information is made available.

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24.0 Tajikistan

24.1 Overview of Electricity Supply

Electricity generation in Tajikistan is heavily dependent upon hydroelectric, about 98% of the electricity generated in 2000, with the balance in fossil fuel generation. Hydro-power has taken a dominant role with a country that is 93% mountainous and an estimated potential of over 300 billion kWh per year in generation. The current utilization, however, is about 15 billion kWh in potential.

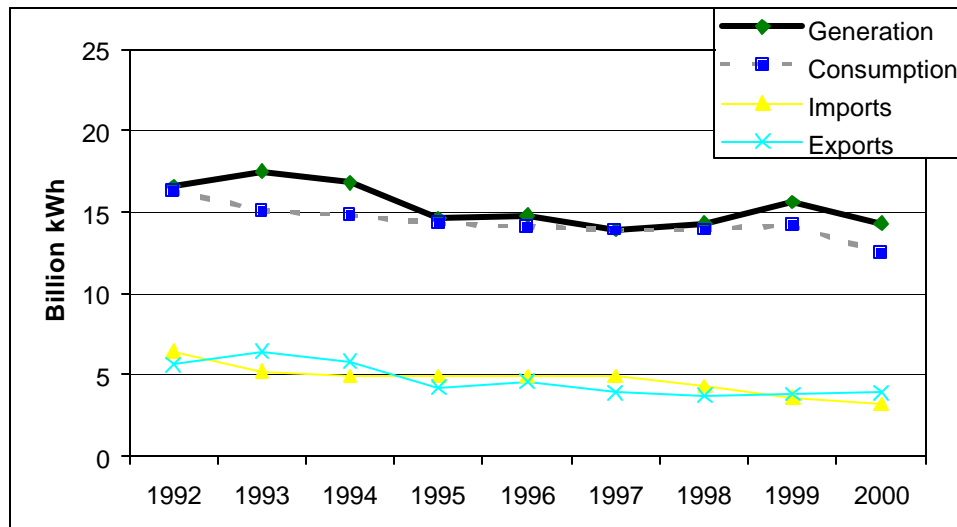
Fuel	Number of Facilities	Capacity (MWe)	Percent of Total
Nuclear	--	--	
Fossil Fuel	2	400	8.7%
Major Hydro*	10	4,179	91.3%
Other Renewables	--	--	
Total	12	4,579	100%

Currently there is a significant push to utilize the vast potential for hydroelectric energy with nearly 10,000 MWe of capacity in the planning and construction phases.

However, many of the projects currently under construction have not seen progress for nearly a decade as funding dried up at the fall of the Soviet Union. Some projects, like the Roghun Dam, a 335 meter high dam that will be the highest in the world when completed, has remained unfinished and will remain so until significant engineering and financing issues have been resolved. Significant work has been done to date to move towards full utilization of the hydroelectric resources, as financing becomes available from international banks like the EBRD or Asian Development Bank, these projects will begin to see fruition.

The electric transmission and distribution system is currently in serious need of improvement and modernization. The electricity grid is currently divided into a northern and southern network, with both networks connected to [Uzbekistan](#). As a result, Tajikistan both imports and exports a significant amount of power. This divided system has also led to inconsistent power supply to remote areas.

The generation capacity in Tajikistan has been adequate to satisfy the demand over the course of the 1990's, however the structure of the electricity grid has led to a dependence on foreign sources of power.



Privatization is still in its infancy in Tajikistan. To date only about 11% of medium to large enterprises have been privatized, while the private sector only contributes about 20 – 30% to GDP. The state-owned electric utility, Barqi Tojik, is a joint-stock company that controls all elements of generation, transmission, and distribution. There are currently no plans to privatize the electric or energy sector until significant economic improvement is achieved.

1.1.1 Wind Resources

Current Status of Wind Energy³

There is no operational wind energy capacity in Tajikistan.

Power industry of Tajikistan is planned to be developed by hydropower, which makes up 90% of total installed capacity of the electric power plants.

A country wide wind-atlas is available, which indicates wind speeds of 4-5 m/s at 30 m height in 3 areas and one area with wind speeds of 5 - 6 m/s.

No industry association, or manufacturer was identified.

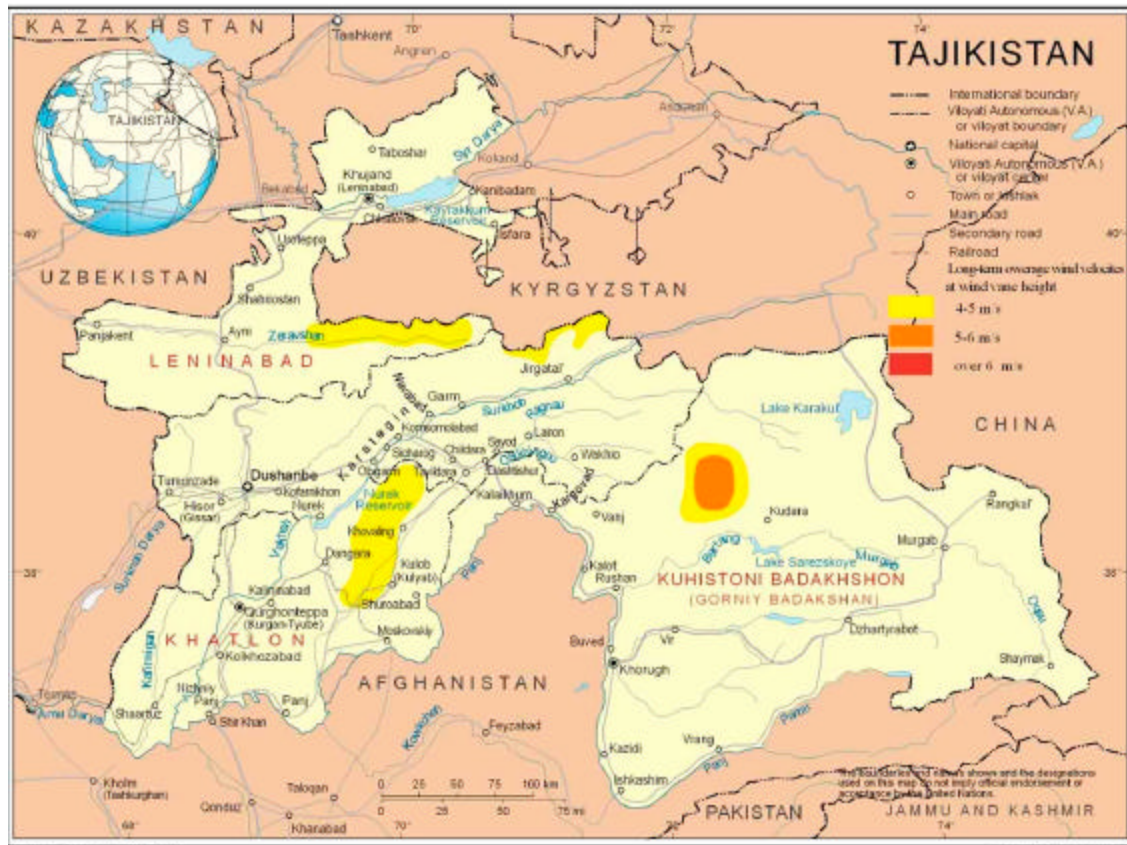
No projects were identified.

Wind Energy Resource Potential^{1, 2}

“Master Plan of Wind Power Development of the USSR till 2010”, 1989 (MPWD) included a country-level wind map. The terrain of Tajikistan is 93% mountainous and it includes the foothills of the Himalayas. Pamir and Alay mountains dominate landscape; western Fergana Valley in north, Kofarnihon and Vakhsh Valleys in southwest. Complicated alpine relief of the country dictates diversity of wind regimes. The existing meteorological stations are located at the altitude of 2 km and above, therefore the data of observations are difficult to compare. The wind potential suitable for power utilization (peaks and slopes of mountains) seems likely to be about 10-15% of the territory.

Identification of Areas/Projects with High Potential for Wind Energy²

The most promising areas are the Pamirs northward the Sarez Lake in the Gorno-Badakshan, Turkmenistan ridge in the Zeravshan river headwater and the region from the Vakhsh ridge to the boundary with Afghanistan.



Map No. 3763 Rev. 6 UNITED NATIONS October 1987

Department of Public Information Cartographic Section

Wind atlas of Tajikistan

Table 1-2 Tajikistan Areas/Projects with High Potential for Wind Energy.

Project Name and Location	Size (MW)	Description
Eastern region of the country		The Pamirs northward the Sarez Lake in the Gorno-Badakhshan.
Northern region of the country		Turkmenistan ridge in the Zeravshan river headwater.
Western region of the country		Region from the Vakhsh ridge to the boundary with Afghanistan.

Barriers/Incentives for Wind Energy^{2 3}

Specific incentives for the implementation of wind projects in Tajikistan include:

- Tajikistan produces practically no oil, gas, or coal of its own. However, Tajikistan imports 37 billion cubic feet of natural gas per year, mostly from Uzbekistan.

Specific barriers to the implementation of wind projects in Tajikistan include:

- The low prices of conventional energy sources.
- Absence of legislative support.
- Lack of financing for new technologies.
- Lack of awareness of renewable energy sources by the population.
- Unstable political situation in the country.
- Low level of current tariffs for electric power.

- Absence of a united coordinating state body responsible for RES development in the country
- Lack of finance and absence of investors interested in investing in these technologies
- Lack of information and a population that is not aware of the opportunities of RES.

Table 1-3. Tajikistan Wind Energy Profile.

Current status of wind energy	
Installed capacity	None
Projects under construction	None
Supporting regulations?	None
Industry association?	No
Wind energy resource potential	
Level of information available	Good
Highest wind class	Class 3 (300 W/m ²)
Country -level wind atlas available?	Yes.
Estimated potential (MPWD)	15*10 ¹² kWh/annum, gross (theoretical) potential 70*10 ⁹ kWh/annum, technical potential 100*10 ⁶ kWh/annum, economic potential
Estimated potential (Interwind)	1'000 MW
Target established?	No
High wind speed locations	Viloyati Mukhtori Viloyati Leninobod Viloyati Khatlon
Identification of areas/projects with high potential for wind energy	
Recommended strategic assessments	Study 1 : Country wide appraisal of wind resources, by state of the art wind measurements at 50 m Study 2 : an appraisal of legal and economical frame work
Identified areas/projects	None
Incentives/barriers for wind energy	
Significant incentives	<ul style="list-style-type: none"> • No fossil fuel resources
Significant barriers	<ul style="list-style-type: none"> • Large hydro resources • Low Energy Prices
Overall Prospects	<p>Poor</p> <p>Tajikistan may have large wind energy resources, but obviously hydro resources are even larger. Combined with the complexity of the terrain the country does not seem to be particularly suited for wind energy development, except for some autonomous systems in the remote areas. This does not exclude though the possibility that there is a potential for large scale wind energy development in the long-term.</p>

¹ “Master Plan of Wind Power Development of the USSR till 2010”, 1989

² “Opportunities for renewable energy sources in Central Asia Countries“, Alaibek J. Obozov, Project Kun Kyrgyzstan, July 1998

³ “An Energy Overview of the Republic of Tajikistan“, www.fe.doe.gov

5.23 Tajikistan Renewable Energy Profile

5.23.3 Solar Resources

Current Status of Solar Energy

In spite of very favorable climatic conditions in Republic Tajikistan the using of solar energy is practically absent. At present any large projects in the field of solar energy are not under consideration in Tajikistan. It is supposed to pay the main attention to the application of solar plants to daily life for using, first of all, in the mountain regions [1].

Solar Energy Resource Potential

The climatic conditions of Tajikistan are very favorable for using solar energy. However the mountain relief and a small number of points, where the measurements of solar radiation take place, don't allow to compile the map of incident solar radiation distribution at the territory of Republic. Therefore we will be limited by the Tables of monthly and annual incidence of total solar radiation on a horizontal surface and of direct solar radiation on a surface normal to beams for two points – Dushanbe (a capital) and meteorological station named after Academician Gorbunov. The first point characterizes a country's part of the plains, while the second one located at the Pamirs – the high mountain one.

Table 1

Monthly and annual total solar radiation incident on horizontal surface, MJ/m²

Name of place	I	II	II	IY	Y	YI	YII	YII	IX	X	XI	XII	Yearly
Dushanbe	222	270	400	522	700	820	840	762	616	419	265	197	6033
Gorbunov meteorological station	287	343	532	691	866	904	906	833	628	462	329	251	7032

Table 2

Monthly and annual direct solar radiation incident on surface normal to sunlight beams, MJ/m²

Name of place	I	II	II	IY	Y	YI	YII	YII	IX	X	XI	XII	Yearly
Dushanbe	265	266	344	402	631	775	792	737	650	463	3464	247	5928
Gorbunov meteorological station	289	248	317	399	600	837	941	966	822	600	430	251	6694

The data averaged for measurements period of many years are presented in Tables 1 and 2 [2]. As it follows from these data, the annual course of solar radiation has the sharply expressed summer maximum that is typical for the regions with continental climate.

Identification of Areas/Projects with High Technical Potential for Solar Energy

As it follows from the data of Tables 1 and 2, the high mountain regions possess the largest potential of solar energy that is quite natural. At the same time just the high mountain regions have no stable power supply. Therefore the usage of solar energy is primarily relevant for the mountain regions of Tajikistan [2].

Barriers/Incentives for Solar Energy

The main barrier for using solar energy is a considerable weakness of economy in the country, which has as a sequence the low life standard of population [1], the extremely low solvent demand and the absence of investments. Correspondingly there are no serious incentives on developing solar energy on the part of State organs and all the more - on the part of private sector.

Table 23-3. Tajikistan Solar Energy Profile.

Current status of solar energy	
Installed capacity	Is practically absent.
Projects under construction	Is absent.
Supporting regulations?	Are absent.
Industry association?	Are absent.
Solar energy resource potential	
Level of information available	Poor
High range of solar insolation	3.5 – 4.5 kWh/m ² /day (worst month, [3]); up to 5.3 kWh/m ² /day (year average [2])
Country-level solar atlas available?	No.
Target established?	No data.
High solar insolation locations	High mountain regions of the Republic, especially the Pamirs.
Identification of areas/projects with high potential for solar energy	
Recommended strategic assessments	Development of the program for autonomous power supply of mountain regions of the country where the centralized power supply is absent. It should be done by means of solar energy.
Identified areas/projects	Development of experimental project for power supply of high-mountain settlement on the basis of using solar energy.
Incentives/barriers for solar energy	
Significant incentives	Quite favorable solar climate. Shortage of own traditional energy resources. Difficulties with power supply of mountain regions.
Significant barriers	Total absence of inner sources of investments in solar energy.
Overall Prospects	Poor because of economic difficulties.

References

1. Kh.S.Karimov, R.Marupov, N.N.Nasirov. “Renewable energy sources and stable development of mountain regions in Tajikistan”. Proceedings of the International congress “Business and investments for renewable energy in Russia”, Moscow, 1999.
2. Applied scientific reference book on climate of the USSR. Hydrometheoizdat, L., Issue 31, 1988.
3. Internet site: www.bpsolar.com/ContentDocuments/17/PVSystemSizingTools.zip

5.23.4 Geothermal Resources

Current Status of Geothermal Energy

The geothermal resources are small and poorly studied in Tajikistan. Data about using thermal water are absent. It is planned to use the thermal water in vicinity of Khodja-Obi-Garm [1].

Geothermal Energy Resource Potential

Geothermal resources are concentrated in convective hydrothermal systems of Tien Shan foothills. Evaluation of the resources of one thermal water field was carried out:

- Khodja -Obi-Garm; temperature 90 °C, TDS 0.5 g/l; total flow rate 280 l/s.

Total thermal water resources in Tadjikistan have not been estimated.

Identification of Areas/Projects with High Potential for Geothermal Energy

High potential geothermal resources for electricity production have not been identified.

Barriers/Incentives for Geothermal Energy

Specific incentives to the implementation of geothermal projects in Tadjikistan include:

- Insufficient resources of organic fuel.

Specific barriers to the implementation of geothermal projects in Tajikistan include:

- Low geothermal resources.
- Low electricity and heat tariffs.

Table 23-4. Tajikistan Geothermal Energy Profile

Current status of geothermal energy	
Installed capacity (electric)	0
Installed capacity (thermal)	No data
Projects under construction (electric)	0
Supporting regulations?	No
Industry association?	No
Geothermal energy resource potential	
Level of information available	Poor
Country geothermal atlas available?	No. Atlas of Thermal water Resources of the USSR contains only local resources estimation for one field
Estimated potential (electric)	0
Target established?	No
High enthalpy geothermal locations	No
Identification of areas/projects with high potential for geothermal energy	
Recommended strategic assessments	No
Identified areas/projects (electric)	No
Incentives/barriers for geothermal energy	
Significant incentives	1. Lack of organic fuel resources.
Significant barriers	1. Small identified geothermal resources. 2. Low electricity and heat tariffs.
Overall Prospects	
Poor . Insignificant geothermal resources of thermal water and low heat tariffs make not prospective the geothermal heat supply.	

References

1.G.Kulikov, B.Mavritsky *et al.* Atlas of Thermal Water Resources of the USSR. Moscow, 1984.

5.23.5 Biomass Resources

Current Status of Biomass Energy

The references of information don't contain the data on realized projects of using biomass for energy Production in Tajikistan.

.Biomass Energy Resource Potential

Table shows the overall biomass resource data for Tajikistan.

Tajikistan Biomass Resource Data (FAO 2002a, FAO 2002b).

Biomass resource type	Total production	Production density
Primary crop production, tonne	(avg. 1999-2001, tonne)	(tonne /1000 Ha)
Total primary crops (rank among COO)	5,346,275 (22)	380 (24)
Top 10 primary crops		
Mixed Grasses, Legumes	3,100,000	220
Maize for Forage & Silage	393,333	28
Seed Cotton	368,103	26
Wheat	294,667	21
Potatoes	281,933	20
Tomatoes	176,100	13
Vegetables and Roots, Fodder	156,667	11
Onions, Dry	127,667	9
Watermelons	89,022	6
Apples	52,000	4
Animal units, number	(number)	(number / 1000 Ha)
Cattle	1,039,500	74
Poultry	750,000	53
Pigs	960	0
Equivalent animal units	1,047,384	74
Forest products, cubic meters	(avg 1999-2000, cu m eters)	(cubic meters /1000 Ha)
Wood fuel and charcoal	NA	NA
Wood residues	NA	NA

Identification of Areas/Projects with High Technical Potential for Biomass Energy

The references of information don't contain the data on new projects of using biomass for energy Production in Tajikistan.

Barriers/Incentives for Biomass Energy

The main barrier for using biomass for energy production is the poverty of state and population.

Table 23-5. Tajikistan Biomass Energy Profile.

<i>Current status of biomass energy</i>	
Installed capacity	No data
Projects under construction	No data
Supporting regulations?	No

Industry association?	No
Biomass energy resource potential	
Level of information available	Poor
Relative biomass potential (total / density)	Total: 1%; Density: 6%
Country-level biomass investigations available?	No
Estimated potential	No data
Target established?	No
High density biomass areas	No data
Identification of areas/projects with high potential for biomass energy	
Recommended strategic assessments	Study 1 Detailed evaluation of biomass potential for using in energy purposes
Identified areas/projects	No data
Incentives/barriers for biomass energy	
Significant incentives	Serious incentives for using biomass in Republic are absent
Significant barriers	<ol style="list-style-type: none"> 1. The main barrier for using biomass for energy production is the poverty of state and population. 2. The Republic possesses the excess potential of hydro resources.
Overall Prospects	Poor

References

1. Economy of the USSR in 1990. Statistical yearbook/Goscomstat of the USSR. – Finances and Statistics, 1991.
2. Journal of abstracts/ Nontraditional and renewable energy sources. VINITI, Moscow, 1990-2002.

Renewable Energy Profile (draft)

REPUBLIC OF TAJIKISTAN

HYDRO POWER POTENTIAL FOR DEVELOPMENT OF SMALL AND MEDIUM SIZE HYDRO

According to the adopted classification, small HPPs are of capacity up to 30 MW, medium-size HPPs are of capacity up to 100 MW.

1. Current State of Hydro Power

Hydropower plays the main role in power sector of Tajikistan.

Hydropower accounts for 90% of total generating capacity. Average annual hydro-power generation in Tajikistan amounts to 16.9 billion kWh. Hydro installed capacity totals 4.1 million kWh.

Existing Hydro Power Plants in Tajikistan

Hydro power plants	Installed capacity, MW	Share of HPPs in hydro power, %
Large HPPs		97.5
Including: Nurek	3000	
Baipasin	600	
Golovnaya	240	
Kairakkuma	126	
Small HPPs	101	2.5

2. Hydro Power Resources of Tajikistan

By absolute indices of potential hydro resources Tajikistan is the second (after Russia) among the CIS countries and by concentration of potential hydro resources on the territory Tajikistan is one of the first in the world.

Hydropower resources of Tajikistan

Characteristics	Indices		Share of HPPs, % from the total
	Total	Including small HPPs of capacity up to 30 MW	
Gross theoretical hydropower potential, - Billion kWh/year - concentration of power resources on the territory, thou.kWh/km ²	300 2094	79 552	26
Technically feasible hydropower capability, Billion kWh/year - concentration of power resources on the territory, thou.kWh/km ²	144 1003	21 150	15
Economically feasible hydropower capability, Billion kWh/year	85	1,55	1.8
Power generated by existing HPPs, - Billion kWh/year - per cent of economic potential, %	16.9 20	0.44 29	2.6

Most of hydropower potential is concentrated in Vahsh, Panj, Amudaria, Syrdaria and Zeravshan river basins.

At estimation of total hydropower potential of Tajikistan small hydropower were singled out. Most of small hydropower potential is concentrated in the western regions of the Republic.

3. Plans for Development of Hydropower Potential

Abundant hydropower resources of Tajikistan condition first priority development of large hydro.

Programs of small hydropower development in Tajikistan include reconstruction and renovation of previously constructed small HPPs, adding small HPPs to water management projects with already existing water retaining structures with the aim of utilizing waste releases, and construction of new small HPPs for power supply of users in the outlying districts of the power system.

Proposed Program of Small Hydro Development

Type of construction	Quantity	Installed capacity, MW	Average over-year power output, Million kWh	Note	Region
Reconstruction and rehabilitation of existing small HPPs	13	78,0	406,0	Mostly former rural HPPs of capacity within 0.5-30 MW	Western regions of Tajikistan.
	7	16,0	46,0	Mostly former rural HPPs of capacity within 0,2-8,7 MW	Gorniy Badakshan Autonomous oblast
Adding HPPs to water management projects	2	8,0	27,0	Small HPPs of capacity within 1.5-6.5MW	Western regions of Tajikistan
New construction	29	590,0	3450,0	Small HPPs of capacity within 6.6-30 MW	Western regions of Tajikistan
	36	280,0	1980,0	Small HPPs of capacity within 0.2-30 MW	Gorniy Badakshan Autonomous oblast
Total	87	972	5909		

Gorniy Badakshan Autonomous oblast, a part of Tajikistan is a region of isolated power supply. It is urgent to start new construction of small HPPs on the territory of Gorniy Badakshan Autonomous oblast. The Gunt river was selected to be the first water body for construction of a cascade of 13 small HPPs with 256 MW combined installed capacity and 1.76 billion kWh/year average annual power output.

First Priority Potential Small Hydro Power Projects

Projects	Installed capacity, MW	Location
New construction: Pamir HPPs 1-3	62	Gunt River, Gorniy Badakshan Autonomous oblast

4. Unfavorable Factors for Development of Hydro Potential

- Lack of internal funds for construction;
- Absence of clear normative and legal base, regulating terms and conditions for realization of projects, possibilities to get any privileges for clients and investors;
- Low electricity rates

Bibliography

1. Power Resources of the USSR. Hydropower Resources. A.N.Voznesensky et al.,1967
2. Small Hydropower, L.P.Michailov et al, 1989
3. Periodicals: Hydraulic Construction, Power Stations, etc

Zones of location of planned small HPSs

