

Renewable Energy Country Profile Version 0.6b

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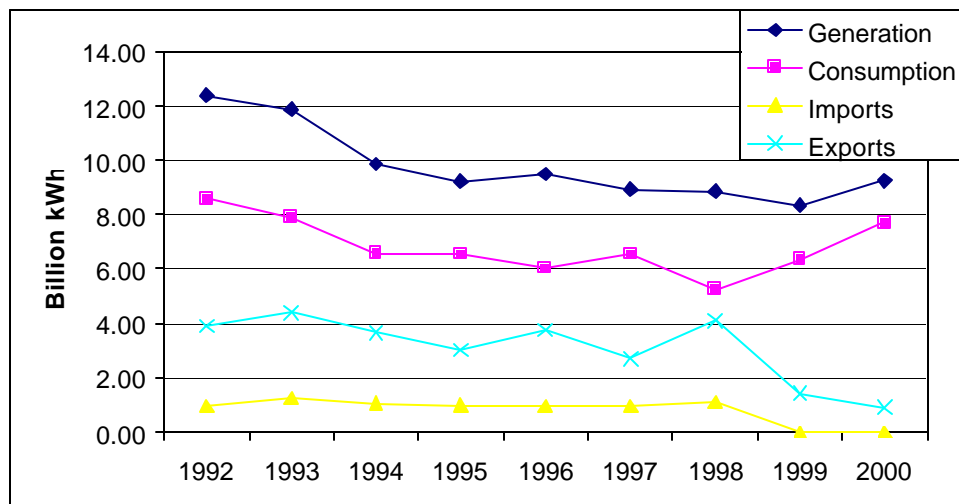
Interwind, Wind Energy Issues
Black & Veatch, Project Coordinator

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25.0 Turkmenistan

25.1 Overview of Electricity Supply

Fuel	Number of Facilities	Capacity (MWe)	Percent of Total
Nuclear	--	--	--
Thermal	N/A	3,920	99.8%
Hydro	N/A	10	0.2%
Other Renewables	--	--	--
Total	N/A	3,930	100%



1.1.1 Wind Resources

Current Status of Wind Energy²

There is no operational wind energy capacity in Turkmenistan.

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. However, in Turkmenistan, specialists in the development of solar and wind energies for energy and water supply for small consumers in the desert regions work at the Desert Institute, Turkmenistan Academy of Sciences. Their appraisal is that the potential for RES in the region is very high.

It is in so far interesting to find such activities in a country like Turkmenistan, with huge natural gas reserves and one of the lowest electricity prices world wide.

No projects were identified.

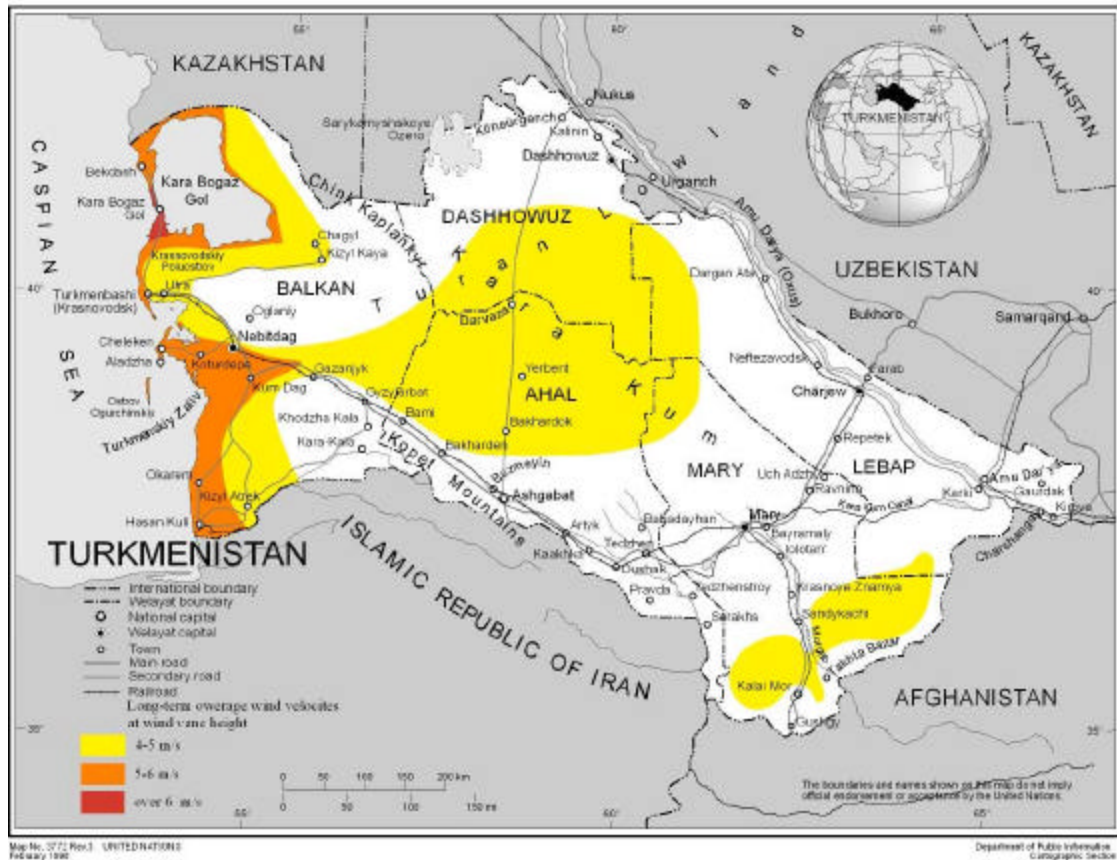
Wind Energy Resource Potential¹

“Master Plan of Wind Power Development of the USSR till 2010”, 1989 (MPWD) included a country-level wind map. Turkmenistan is characterized by high wind power potential. The wind regimes are dictated by topography peculiarities: vast desert zone and the Caspian Sea impact. As moving father from the Caspian Sea coastal zone eastwards the wind intensity decreases. In the whole wind potential is suitable for power utilization more than on 40% of the territory.

In summary, Turkmenistan has one of the highest wind energy resource potentials in this study.

Identification of Areas/Projects with High Potential for Wind Energy²

The most promising areas are Kara Bogaz Gol Bay coastal zone. Krasnovodsk plateau and a strip of the Caspian Sea coast almost to the boundary with Iran, Region of the Kara Kum desert and headwaters of the Murghab river on the Kara Bil Hills near the Afghanistan border.



Wind atlas of Turkmenistan

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

Project Name and Location	Size (MW)	Description
The Caspian Sea regions		Kara Bogaz Gol Bay coastal zone. Krasnovodsk plateau and a strip of the Caspian Sea coast almost to the boundary with Iran.
Central region of the country		Region of the Kara Kum desert.
Southern-eastern region of the country		Headwater of the Murghab river on the Kara Bil Hills near the boundary with Afghanistan.

Barriers/Incentives for Wind Energy

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

- Huge wind resources.
- Economic utilization of the lands does not interfere with construction of wind farms on large area.

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

- Wind power development is of no interest because of the power and fuel balance in the country
- The low prices of conventional energy sources.

- Absence of legislative support.
- Lack of financing and absence of investors interested in investing in these technologies.
- Lack of awareness of renewable energy sources by the population.
- Absence of a united coordinating state body responsible for RES development in the country
- Lack of public and governmental awareness

Table 1-3. Turkmenistan Wind Energy Profile.

Current status of wind energy	
Installed capacity	None
Projects under construction	None
Supporting regulations?	None
Industry association?	No, but Turkmenistan Academy of Sciences a good source
Wind energy resource potential	
Level of information available	Good
Highest wind class	Class 7 ($> 1'000 \text{ W/m}^2$)
Country -level wind atlas available?	Yes
Estimated potential (MPWD)	70*10 ¹² kWh/annum, gross (theoretical) potential 1500*10 ⁹ kWh/annum, technical potential
Estimated potential (Interwind)	10'000 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 : Detailed 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"> • Huge wind resources
Significant barriers	<ul style="list-style-type: none"> • Large natural gas resources • Extremely low energy prices • Lack of legal frame work
Overall Prospects	<p>Fair</p> <p>Turkmenistan has huge wind resources comparable to, if not larger than their natural gas resources. However extremely low energy prices and lack of proper legal frame work makes it quite unlikely that wind energy will be developed in this country in the mid-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

5.24 Turkmenistan Renewable Energy Profile

5.24.3 Solar Resources

Current Status of Solar Energy

At present the solar power engineering has no development in Turkmenistan. The scientific-production association “Sun”, which existed before in city Ashkhabad and carried out R&D in this area and introduced in practice the solar plant of different purposes, was disbanded.

Solar Energy Resource Potential

The climatic conditions in Turkmenistan are extremely favorable for using solar energy. The solar energy resource potential is very high in Republic and is characterized by the data presented in Tables 1 and 2 for three points at territory of Turkmenistan – Gasan-Kuli, Ashkhabad (a capital) and Chardzhou. The first point is located at Southwest of the country, the second one - at the South of Central part and the third one – at East near the border with Uzbekistan. The data presented in Tables 1 and 2 were borrowed from [1] and are the averaged values for observations' period of many years.

Table 1

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

Name of place	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yearly
Gasan-Kuli	264	332	453	560	744	796	774	707	579	454	319	244	6226
Ashkhabad	226	284	395	536	722	818	839	777	623	449	275	195	6139
Chardzhou	249	324	474	607	812	904	920	845	668	490	310	213	6816

Table 2

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

Name of place	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yearly
Gasan-Kuli	387	392	405	451	652	722	659	626	584	546	458	378	6260
Ashkhabad	285	305	340	454	648	818	848	850	730	543	402	264	6487
Chardzhou	306	366	433	520	776	965	1010	985	845	680	469	276	7631

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

As it follows from the data presented in Tables 1 and 2, with the high overall solar energy resource potential is increased at the territory of Turkmenistan in the direction from West to East. The eastern and south-eastern part of Turkmenistan territory along with the southern regions of Uzbekistan possess the record solar energy resource potential for all territory of the former USSR. Therefore the eastern and south-eastern part of Turkmenistan territory are most prospective for the application of solar energy, though it's using is efficient everywhere at the territory of Republic.

Barriers/Incentives for Solar Energy

The main barrier creating the braking obstacles to development of solar power engineering is the economic one connected with the weakness of the country, the low solvent demand and the absence of investments.

The usage of electricity and communal services is established in Turkmenia as free of charge for the majority of population categories. It doesn't promote also to the fulfillment of any energy-saving measures including to the utilization of solar energy.

The main attention on the part of state organs is paid to the development of gas complex, mainly from the viewpoint of widening the export opportunities. It is unknown about the incentives in the field of using solar energy.

Table 24-3. Turkmenistan Solar Energy Profile.

Current status of solar energy	
Installed capacity	Solar water-heating plants with total power about 1-2 MW (term).
Projects under construction	Are absent.
Supporting regulations?	Are absent
Industry association?	Are absent.
Solar energy resource potential	
Level of information available	Fair
High range of solar insolation	3.5 – 4.0 kWh/m ² /day [2] (worst month.); up to 5.2 kWh/m ² /day (year average [1])
Country-level solar atlas available?	No.
Target established?	No data.
High solar insolation locations	Southeast regions of the country.
Identification of areas/projects with high potential for solar energy	
Recommended strategic assessments	Technical-and economic evaluation of possibilities of using solar energy under modern economic conditions.
Identified areas/projects	Restoration of developed before projects on creating the livestock breeding complexes in desert Kara-Kum with power supply from solar energy.
Incentives/barriers for solar energy	
Significant incentives	Quite favorable solar climate.
Significant barriers	The centralized power supply covers only a small territory of the country. Free of charge consumption of electricity and communal utilities for the majority of population categories. Considerable own resources of hydrocarbon fuel (gas, oil) that significantly exceed the inside demands. Liquidation of former scientific-technical potential. Absence of inner sources of investments in solar energy.
Overall Prospects	Very poor because of negative factors pointed out in item 4.2 in spite of extremely favorable climate.

References

1. Applied scientific reference book on climate of the USSR. Hydrometheoizdat, 1., Issue 30, 1989.
2. Internet site: [www.bpsolar.com/ContentDocuments/17/PV System Sizing Tools.zip](http://www.bpsolar.com/ContentDocuments/17/PV%20System%20Sizing%20Tools.zip)

5.24.4 Geothermal Resources

Current Status of Geothermal Energy

Geothermal resources of Turkmenistan are poorly studied and only due to the tests of numerous exploration and productive oil and gas wells. At present thermal water is not used for heat supply. The geothermal brines are used at Peninsula Cheleken (Caspian Sea) for extracting halogens (iodine, bromine), lead, zinc and copper [1].

Geothermal Energy Resource Potential

Geothermal reservoirs have been discovered in Upper and Lower Cretaceous formations at Kara-Kum Basin and Caspian Sea Coast. Convective hydrothermal systems have been investigated in the foothills of Kopet-Dag (South-West of Turkmenistan). Main geothermal areas:

- Caspian Coast; thermal brines with temperature 80^oC, TDS 50-100 g/l, high flow rates 250-1400 l/s
- Darvaza Region (Central Kara-Kum); depth 3000-3500 m, temperature up to 100^oC, TDS 150 g/l
- Kopet-Dag Foothills; depth 2000-2500 m, temperature 70-80^oC, flow rates 15-55 l/s.

Total theoretical heat capacity of reservoirs in Upper and Lower Cretaceous formations have been estimated as 6600 MWt for pumping operation [2].

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 Turkmenistan don't exist.

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

- High resources of natural gas.
- Very low electricity and heat tariffs.

Table 24-4. Turkmenistan 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	Fair
Country geothermal atlas available?	No. Atlas of Thermal water Resources of the USSR contains only regional resources estimations
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	Absent
Significant barriers	1. High resources of natural gas. 2. Very low electricity and heat tariffs.
Overall Prospects	Poor. Large volumes of gas production and proven resources of natural gas eliminate the possible utilization of geothermal energy.

References

1. Strategic Plan for the Development of European Geothermal Sector. *Blue Book on Geothermal Resources*, European Communities, 1999.
2. G.Kulikoy, B.Mavritsky *et al.* Atlas of Thermal Water Resources of the USSR. Moscow, 1984.

5.24.5 Biomass Resources

Current Status of Biomass Energy

In Turkmenistan the wastes from livestock breeding are used as fertilizers. The references of information don't contain the data on projects realized for using biomass for energy purposes.

Biomass Energy Resource Potential

Table shows the overall biomass resource data for Turkmenistan.

Turkmenistan 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)	7,280,347 (20)	155 (27)
Top 10 primary crops		
Mixed Grasses, Legumes	2,333,333	50
Seed Cotton	1,376,667	29
Wheat	1,285,267	27
Grasses (misc), Forage & Silage	831,667	18
Maize for Forage & Silage	468,333	10
Watermelons	239,667	5
Vegetables and Roots, Fodder	149,333	3
Tomatoes	146,333	3
Grapes	140,000	3
Onions, Dry	50,233	1
Animal units, number	(number)	(number / 1000 Ha)
Cattle	865,000	18
Poultry	4,150,000	88
Pigs	47,000	1
Equivalent animal units	925,300	20
Forest products, cubic meters	(avg 1999-2000, cu m eters)	(cubic meters /1000 Ha)
Wood fuel and charcoal	NA	NA
Wood residues	NA	NA

According to official statistics the area of forests in Turkmenistan constitutes 19,761 km² that corresponds to 0.04% of Republic territory. 95% of this territory is occupied by saxaul (tree native to Central Asia). At present the decree of Republic government forbids the cutting of forests.

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

The references of information don't contain the data on new projects for using biomass as energy source in Turkmenistan.

Barriers/Incentives for Biomass Energy

All thermal power plants in Republic are operating with natural gas. The housing-public utilities as well as the rural populated settlements are fully gasified. The natural gas is practically free of charge for population.

Table 24-5. Turkmenistan Biomass Energy Profile.

Current status of biomass energy	
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: 2%
Country-level biomass investigations available?	Yes
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	Low price of natural gas for energy production and population
Overall Prospects	Poor

References

1. Turkmenistan: Initial National Communication of Climate Change, 2000.
2. Economy of the USSR in 1990. Statistical yearbook/Goscomstat of the USSR. – Finances and Statistics, 1991.
3. Journal of abstracts/ Nontraditional and renewable energy sources. VINITI, Moscow, 1990-2002.
4. Renewable energy. Quarterly Information Bulletin published by Russian Center on Solar Energy “Intersolarcenter”, Moscow, 1997-2002.

Renewable Energy Profile (draft)

REPUBLIC OF TURKMENISTAN

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

There is only one existing hydropower plant in Turkmenistan with 1.2 thou.kW installed capacity.

Existing Hydro Power Plants in Turkmenistan

Hydro power plants	Installed capacity, MW
Mary HPP	1.2

2. Hydro Power Resources of Turkmenistan

By absolute indices of potential hydro resources and by concentration of potential hydro resources on the territory of Turkmenistan it is one of the last among the CIS countries.

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	23.9 49	3.8	16
Technically feasible hydropower capability, Billion kWh/year	4.8	0.9	18
Economically feasible hydropower capability, Billion kWh/year	1.7	Not determined	
Power generated by existing HPPs, - Billion kWh/year - per cent of economic potential, %	0.6 35	0.6	100

Most of hydropower potential is concentrated in Murgab and Amu-Daria river basins.

At estimation of total hydropower potential of Turkmenistan small hydropower were singled out. The largest small hydropower potential is concentrated in the southern part of the Republic on the Murgab and Tejen rivers and Karakumy canal.

3. Plans for Development of Hydropower Potential

Programs of small hydropower development envisage development of small hydro by adding small HPPs to existing water management projects.

Proposed Program of Small Hydro Development

Type of construction	Quantity	Installed capacity, MW	Average overyear power output, Million kWh	Note	Region
Reconstruction and rehabilitation of existing small HPPs	3	4.7	15	Mostly former rural HPPs of capacity within 0.8-2.7 MW	Iolontan region on the Murgab river
Adding HPPs to water management projects	6	52.3	167.5	Small HPPs of capacity within 2.6-15MW	Southern Turkmenistan. Karakumy canal, Murgab and Tenjen Rivers.
Total	9	57	182.5		

First Priority Potential Small Hydro Power Projects

Projects	Installed capacity, MW	Location
Adding to water management projects:		
Hauznan reservoir HPP	11.7	Karakumy Canal, Mary oblast
Kopetdag reservoir HPP	15	Karakumy Canal, Ashkhabad oblast
Saryyazin reservoir HPP	12	Murgab River, Mary oblast
Tashkeprin HPP	7	Murgab River, Mary oblast

4. Unfavorable Factors for Development of Hydro Potential

- Large available deposits of natural oil and gas permit existing co-generation plants to meet full electric power consumption of the country

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



The boundaries and names shown on this map do not imply official endorsement or acceptance by the United Nations.