COMPLEX EVALUATION OF SOLAR AND WIND ENERGY RESOURCES OF TURKMENISTAN

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The deep solution of major issue is related to effectiveness and reliability of energy consumers of renewable energy resources. As well as, it leads arising of complex issues to solve such as designing and creating of energy collectors in order to adjust the variability of productivity according to the time and variability of renewable energy resource flow and energy consuming rate by energy consumers, it is firstly connected with solar and wind energy installments and it is characterized with the direct connection of produced capacity with natural conditions.

Being scientific and technical sector of Solar energy, its function includes to generate power, heat and other types of energy by using solar energy emission on the Earth and to draw scientific principles, methods and technical means to determine effectively consumable scope of solar energy for gaining economic advancement of state. Solar energy emission has several different characteristics on the Earth. Thus, being an endless resource of applied renewable energy; solar energy emission has several more advantages than other existing energy resources.

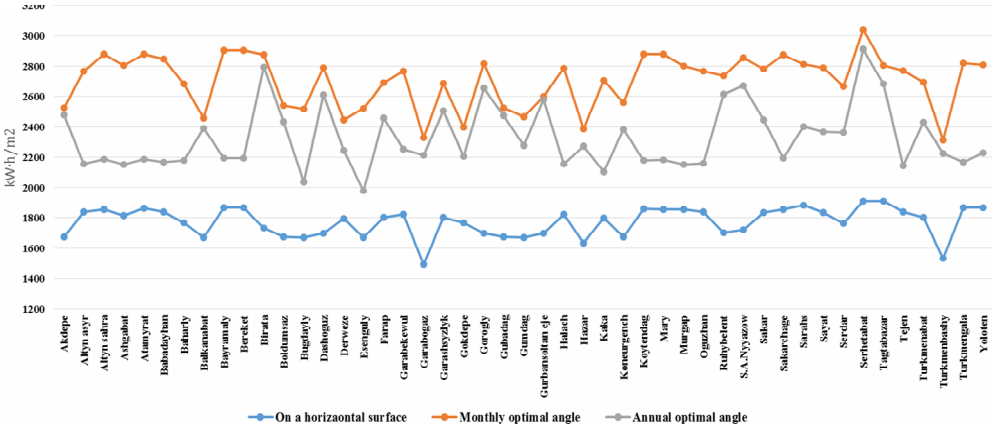
If we refer to the information given in the scientific resources, the duration of sun glint equals to 2500–3100 hours annually, and the duration of solar day equals to 16 hours in June, in summer days and it equals to 8–10 hours in December, in winter days. So, there are nearly 300 solar days in a year. In the territory of Turkmenistan, annual average rate of solar emission intensity equals to 700–800 Wt/m^2. And it is a clear evidence that 1800–2000 $kWt \cdot h/m^2$ energy emits to 1 m^2 area annually [1], [2].

About 40 % of territory of Turkmenistan is considered favorable to use wind energy. It is the most favorable to consume the wind energy in the north-west regions. In these regions, annual average value of wind velocity is higher than 4 m/s. Specific power of weather flow is high in the north coasts of the Caspian Sea, its value equals to 110–135 Wt/m^2. There is a considerable potential of wind energy in Balkan and Kopetdag passages and its value is even more than 150 Wt/m^2. Specific power of wind is not higher than 100 Wt/m^2 between the areas of Central provinces and north territories [3], [4].

Method of scientific research. Solar and wind energy, the endless type of renewable energy is deemed as ecologically clean and waste-free source which gives opportunity to save the energy. Thus, these types of energy have wide consumption to supply the residential houses in major and minor populated areas, manufacturing plants and facilities with power energy [3], [4].

To support sustainable development in economic sectors of Turkmenistan, promotion of alternative energy not only gives opportunity to diversify the fuel-energy means but also it will reduce the emission of carbon dioxide (CO_2) to the environment and will support to place the advanced innovation technologies to the production sectors.

Results of experiments. As a result of scientific-analysis, it is taken into account that the angle which hits the surface changes monthly on the determined point when the solar energy sources are consumed and it is considered that it leads to increasing of productivity of solar installments in case the solar installation will be changed according to the suitable angles monthly.



Picture 1. Comparison graph of intensity of Solar radiation that reaches into the various surfaces during the year for regions of Turkmenistan

In the various regions of Turkmenistan, intensity of Solar radiation hits the horizontal plain surface and the surface inclined towards monthly suitable angle according to the horizontal plane and also the surface inclined towards the annual suitable angle according to the horizontal plane during the average year is determined (Picture 1).

In the various regions of Turkmenistan, intensity values of Solar radiation that reaches to the surface at the suitable inclination angle during the average year for annual binding situation according to the horizontal plane are determined.

In addition, to guide from the consumed power energy during the day and night for residential house which is under the supplement of independent energy, the capacity and amounts of generated power energy of photoelectric solar station are determined for territories of respective regions of Turkmenistan (Table 1).

Table 1

Capacity and amount of generated power energy of station for territories of respective regions of Turkmenistan

Districts	Suitable inclination angle, in degrees	Number of solar panels	Amount of annual production capacity of power energy of photoelectric solar station, kW · h	Full capacity of photoelectric solar station, kW
Garabogaz	41,5	12	10163,72	5,4
Esenguly	37,99	9	6806,36	4,05
Baharly	38,4	9	7494,77	4,05
Sarahs	36,52	9	8266,28	4,05
Serhetabat	35,19	8	8901,03	3,6
Tagtabazar	35,91	8	8199,87	3,6
Koytendag	37,55	9	7490,4	4,05
Birata	41,07	9	9608,84	4,05
Koneurgench	42,33	10	9111,54	4,5
Gorogly	41,61	9	9132,77	4,05

It is defined that the annual highest value of solar radiation(kWt · h/m^2) is in the Serhetabat district according to the horizontal surface for solar installations of regions of Turkmenistan and the amount of generated power energy of solar panel with model (HT72-166M) and nominal capacity 450 Wt for Serhetabat district is determined (Table 2).

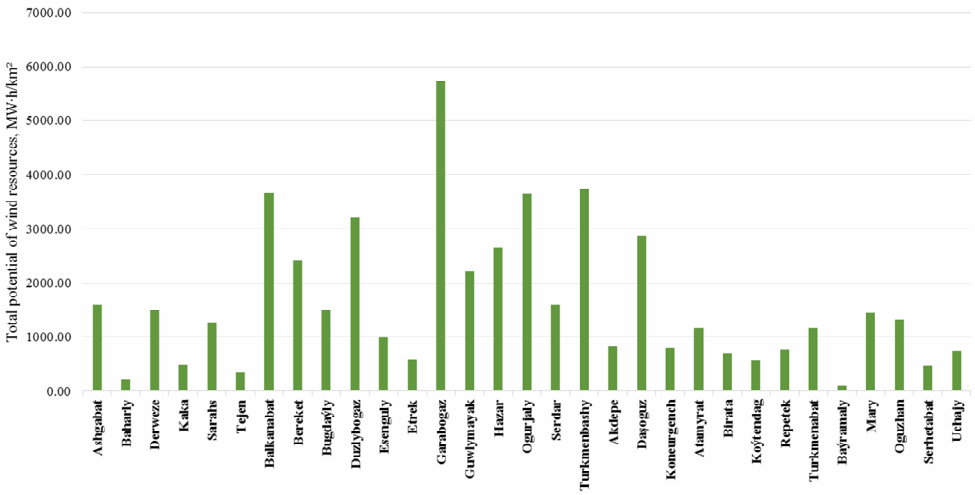
Table 2

Amount of generated power energy of solar panel with nominal capacity 450 W and model (HT72-166M) for Serhetabat district

Months	Intensity of solar radiation reaches to the horizontal surface for one day kW · h/m²	Annual optimal angle on horizontal surface		
		Intensity of solar radiation for one day, kW · h/m²	Productivity for one day, kW · h	Productivity for one month kW · h
January	2,50	5,12	1,96	60,64
February	3,26	5,64	2,15	60,33
March	4,29	6,46	2,47	76,51
April	5,73	7,88	3,01	90,31
May	7,28	9,60	3,67	113,69
June	8,11	10,56	4,03	121,03
Jule	7,90	10,43	3,98	123,52
August	7,30	10,31	3,94	122,10
September	6,20	9,79	3,74	112,20
October	4,60	8,30	3,17	98,30
November	3,11	6,34	2,42	72,66
December	2,35	5,18	1,98	61,35

It is obtained the gathered information as the major sources of initially given information to work out the wind energy cadaster, on the basis of wind observation in the hydrometeorology observation towers. In the Research work, it is benefited from the gathered information in the hydrometeorology service about the wind speed and wind directions in the years of 2000–2020 in order to evaluate the wind energy sources in Turkmenistan [6]. Obtained information has been compared with information gathered from NASA data sources for years and calculations have been made. These observations were undertaken for several times during the day and night and include the periods of decades. Its advantageous side is that it is done on the single method and the lookout places are classified into groups according to the clarity level of local conditions for observed region. In the effective consuming from the wind energy source, the key feature of wind is its average speed in course of definite time (in round the clock, monthly, annually).

As a result of Research work total opportunity of wind source flows through 1 m^2 square are defined (Picture 2).



Picture 2. Total opportunity of wind source that flows through 1 m^2 square in a year at the 50 m height on the regions of Turkmenistan

On the basis of done calculations, solar and wind energy sources of Turkmenistan are evaluated.

Obtained information can be used to value the solar and wind energy sources as well as to determine the installation places of solar and wind energy installments.

Obtained values for regions can be used to determine the production capacity of solar and wind power stations with various capacity.

On the basis of gathered information from the meteorological stations in the provinces, an average values of wind are compared and drawn up the graphs of wind blowing directions.

Reference

1. National strategy for the development of renewable energy in Turkmenistan until 2030. – A., 2020.
2. The program for the development of energy diplomacy of Turkmenistan for 2021–2025. – A., 2020.
3. Jumaýew, A. Türkmenistanda Gün energetikasynyň resurslarynyň we ösüşiniň ylmy-tehniki hem-de usuly seljermesi. Ýokary okuw mekdepleriniň talyplary üçin okuw gollanma / A. Jumaýew. – A., 2016ý.
4. Солнечная энергетика : учеб. пособие для вузов / В. И. Виссарионов [и др.]. – М. : МЭИ, 2008. – 276 с.
5. Зубарев, В. В. Использование энергии ветра в районах Севера. Состояние, условия эффективности, перспективы / В. В. Зубарев, В. А. Минин, И. Р. Степанов. – Л. : Наука. 1989.
6. Ветроэнергетика руководство по применению ветроустановок малой и средней мощности / В. М. Каргиев [и др.]. – М., 2001.

ЭЛЕКТРОСНАБЖЕНИЕ МАЛЫХ СТАД С ИСПОЛЬЗОВАНИЕМ СОЛНЕЧНОЙ ЭНЕРГИИ

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В Туркменистане развитию сельского хозяйства и животноводческого комплекса уделяется большое внимание, а электроснабжение малых и больших стад представляет особый научный интерес. С одной стороны, надежность и экономическая эффективность, с другой стороны – мобильность и экологическая безопасность.