SCIENTIFIC RESEARCH ON THE USE OF SOLAR BATTERIES IN A CHANGING CLIMATE

Safarov Alisher Bekmurodovich
Associate professor, department of "Energoaudit" Bukhara engineering technological institute
O'lmasov Qudrat Norqul o`g`li
Doctoral student, department of "Energoaudit" Bukhara engineering technological institute
https://doi.org/10.5281/zenodo.8336894

Abstract. In this article, the potential of solar energy resources of Bukhara region has been assessed using geographic information systems technology (GIS), and areas with opportunities for using solar energy in the region have been identified. A solar battery adapted to climatic conditions for regions with low reliability of electricity supply has been developed and the results of experimental studies are presented.

Key words: solar energy, geographic information systems technology, solar cell, comparative solar energy, solar radiation.

Introduction. Scientific research aimed at increasing the use of renewable energy sources in the world energy system, saving hydrocarbon fuel resources, stabilizing global warming, pollution and other environmental problems, as well as problems related to economic, social, political and energy security is important. is gaining importance. Based on this, in the long-term national energy programs of developed countries, "... in the period from 2021 to 2030, reduce greenhouse gases and emissions by at least 40% (compared to the situation in 1990), increase the share of renewable energy sources by 32%, and increase energy efficiency It is planned to increase by 35.5%" [1]. In global practice, the use of solar energy, which is a renewable energy source, in providing consumers with reliable and environmentally friendly electricity, is developing rapidly, and a large amount of investment is directed to this field, and promising development and research are supported.

In the world, a lot of research is being done to develop and introduce solar batteries adapted to the climatic conditions of our region for small power consumers. In this direction, the scientific research carried out in the directions of increasing the efficiency of operation and analytical modeling of the dependence of the structural dimensions and energy parameters of solar cells on solar radiation, temperature, dustiness level is considered relevant.

In the Strategy of Actions for the Development of the Republic of Uzbekistan for 2017-2021, in particular, "...in the near future, as a priority task, expansion of the use of renewable energy sources, reduction of the energy capacity of production, innovative technologies in the field of development of renewable energy sources, scientific and technical implementation of developments and improvement of energy efficiency..." tasks are defined [2].

VV Elistratov, EV Solomin, RA Zahidov, R. Avezov, G'N. Research was conducted by Uzokov et al. The possibilities of using solar energy in the Bukhara region have not been sufficiently explored in the conducted researches. By determining the technical and economic potential of using solar batteries in the Bukhara region, it is possible to develop social and

economic spheres by scientifically justifying the use of solar energy in the energy supply of areas with a shortage of electricity.

Although the energy of sunlight actually decreases when it reaches the earth's surface, the energy of sunlight received by the earth's surface in a year is estimated to be $1{,}2 \cdot 10^{17}$It is W or $1{,}05 \cdot 10^{18}$kWh . This is 20,000 times more energy than the world consumes [3]. But it is very difficult to collect all the energy from the sun. In order not to damage the ecological environment, $1{,}62 \cdot 10^{16}$it is possible to use 1.5% of all solar energy that falls on the earth, that is, 1 kWh of energy per year. It is approximately $2 \cdot 10^{12}$equal to t.sh.yo. The distribution of sunlight on the surface of the earth is not uniform. During the year , solar energy corresponding to 1 m ^{2} of the earth's surface varies from 3000 MJ/m ^{2} to 8000 MJ/m ^{2} . The average annual amount of solar energy that falls on 1 m ^{2} of the Earth's surface in one day varies from 7.2 MJ/m ^{2} in the north to 21.4 MJ/m ^{2} in the desert. The average annual density of sunlight is 210-250 W/m ^{2} in subtropics and deserts, 130-210 W/m ^{2} in Central Asian countries , and 80-130 W/m ^{2} in the north . The highest density of solar energy flow increases to 1 kW/m ^{2} [4].

Scattered solar energy is 3100 hours in Turkmenistan, 2815-2830 hours in Uzbekistan and Tajikistan, 2575 hours in Kazakhstan and Kyrgyzstan, 2125-2520 hours in Armenia, Georgia and Azerbaijan, 2005-2080 hours in Ukraine and Moldova [5] . The conditions for using solar energy in the Central Asian Republics are also very good, because the length of daylight in June is 16 hours, and in December it is 8-10 hours. There are 300 days a year, 320-400 hours of open sunlight per month in summer [6].

The gross solar energy potential of Uzbekistan was estimated at 50,973 million tne, and its technical potential was equal to 176.8 million tne. So, the solar energy falling on the land of Uzbekistan in one year is much more than the verified hydrocarbon raw materials of the country according to the absolute value. Currently, only 0.3% of solar energy is used [7].

shows the value of the amount of monthly direct radiation (MJ/m ^{2}) falling on the horizontal surface during clear weather for some weather stations located in the regions of our region. Based on the analysis of the given data, it is possible to stabilize the energy-related problems of our region, that the possibilities of using solar energy are high in the regions of our republic.

Table 1

Metrological stations	**Months**											
	I	II	II	IA	V	VI	VII	III	IX	X	XI	XII
Karakalpakstan	202	295	466	611	768	787	772	672	512	397	244	184
Tashkent	223	302	488	584	728	745	733	647	497	367	263	149
Fergana	193	263	439	560	688	700	686	604	461	340	216	174

Samarkand	274	344	533	626	744	723	739	656	507	404	283	235

Bukhara in picture 1 province climate temperature yearly average pointers given . Quoted to information basically Bukhara 300 days in the region sunny day is the temperature Summer months average 35 ^{0}C to be defined [8].

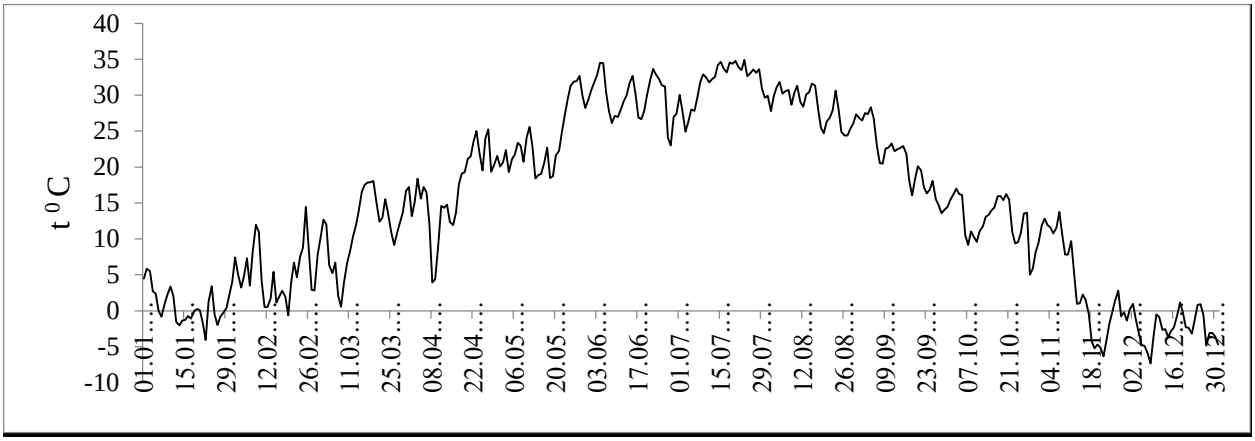


Figure 1. Annual average of Bukhara region climate temperature indicators (2020).

Figure 2 shows the daily comparative energy indicators (2020) obtained from solar cells in Bukhara region. It was determined that the average daily solar energy is 4.5 kWh/m ^{2} /day [9]. This, in turn, means that the region has high potential for using solar energy.

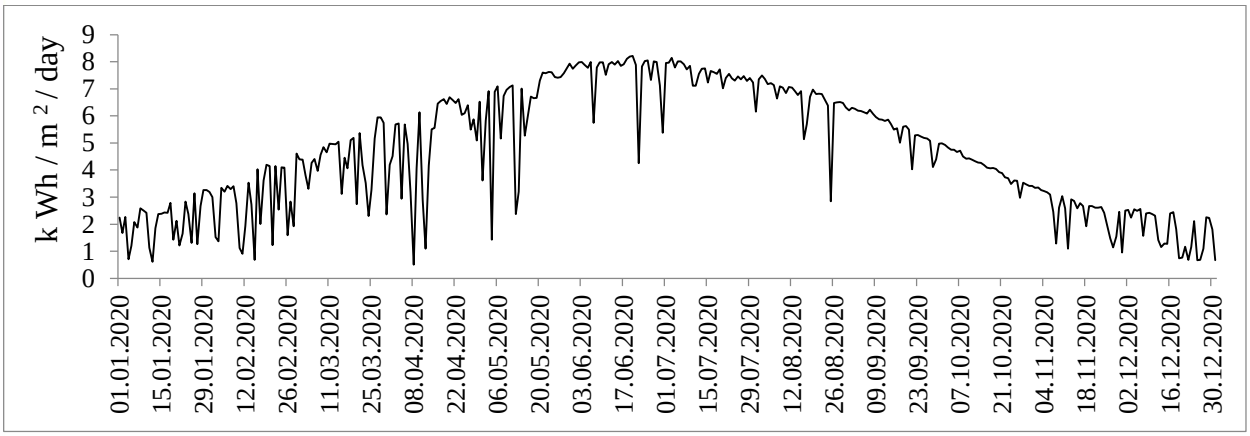


Figure 2. Bukhara in the region the sun from batteries removable daily comparison energy indicators (2020) .

Figure 3 shows the amount of total solar radiation falling on the horizontal surface in Uzbekistan. According to the results of the conducted theoretical and practical research, the gross (theoretical) specific energy of solar energy of Bukhara region is equal to 1750-1800 kWh/m ^{2} per year and the average annual energy in the region is 4.72 kWh/m ^{2} /day it was found that it is possible to get it. The technical potential of using solar panels with a useful efficiency of 12% in the regions of Bukhara region was estimated to be equal to 3.5 TWh/year.

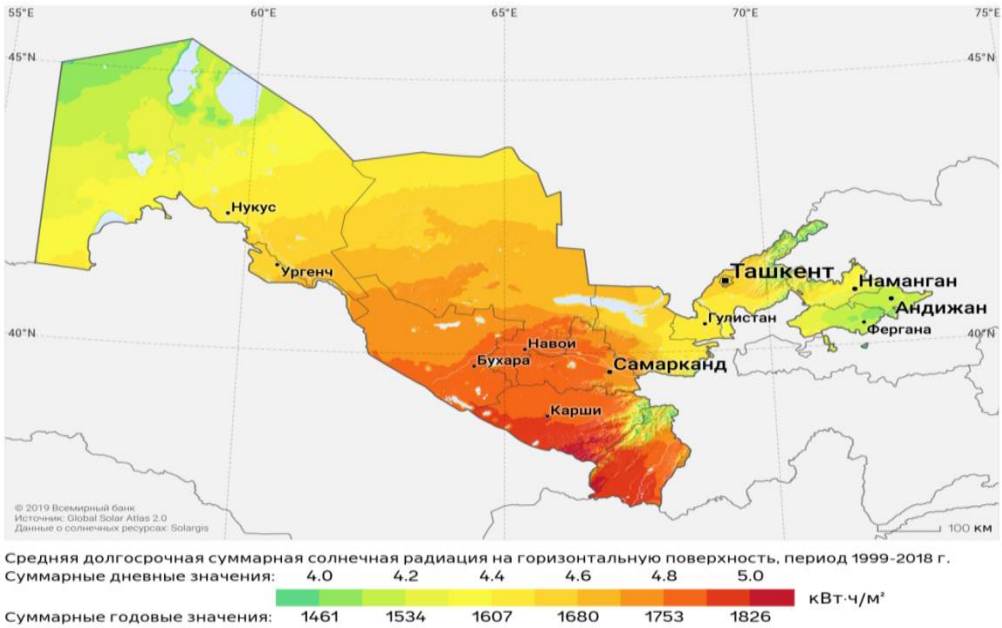
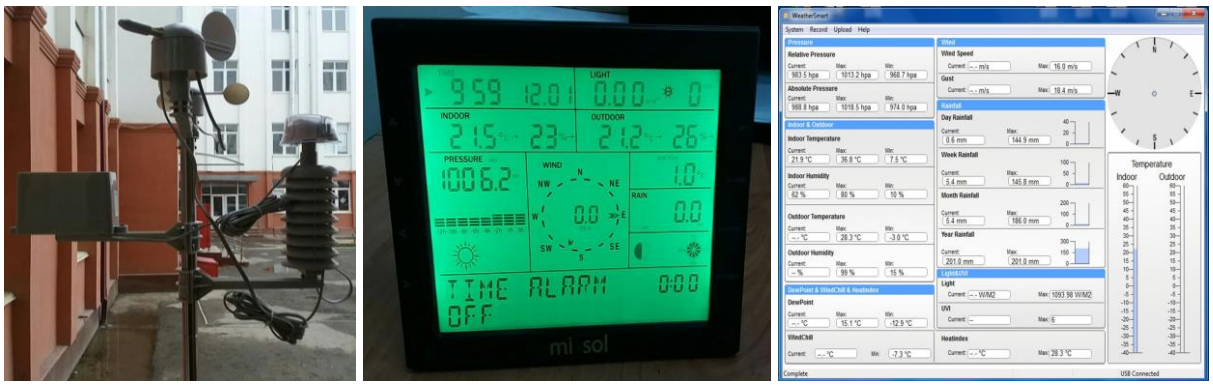


Figure 3. in Uzbekistan horizontal surface descender total the sun of radiation amounts given map .

The sun panel on take went theoretical the results check accuracy check experimental of research main purpose organize is enough of the device experiential research his natural conditions at work advantages and disadvantages about to information accuracy input with organic depends.

Theoretical to accounts confession not done the sun radiation and of temperature approximate changes the sun of the battery exit to parameters how effect that it will observation experience of transfer the most important of duties is one Experience research of transfer main purpose the sun batteries Bukhara jurisdiction climate conditions work efficiency from detection consists of The sun radiation , temperature and the sun of the battery exit parameters measurer of devices description cause let 's go

" M ISOL" complete meteostat device is widely used in measuring metrological data (wind speed direction, temperature, humidity, relative solar radiation, illumination, etc.). This device has an automatic recording system, it is possible to store metrological data in the interval from 1 to 240 min and to receive the measured data at a distance of 100 m (see Fig. 4).



a) b) c)

Figure 4. External appearance of "MISOL" weather station device (a), displays of remotely transmitted data on the monitor (b), data viewing and storage program (c).

5 shows the developed solar cell experimental research conducted at the Bukhara Institute of Engineering and Technology on a solar power plant. The results of the experimental studies were obtained at different times, i.e. between 8:00 and 18:00.

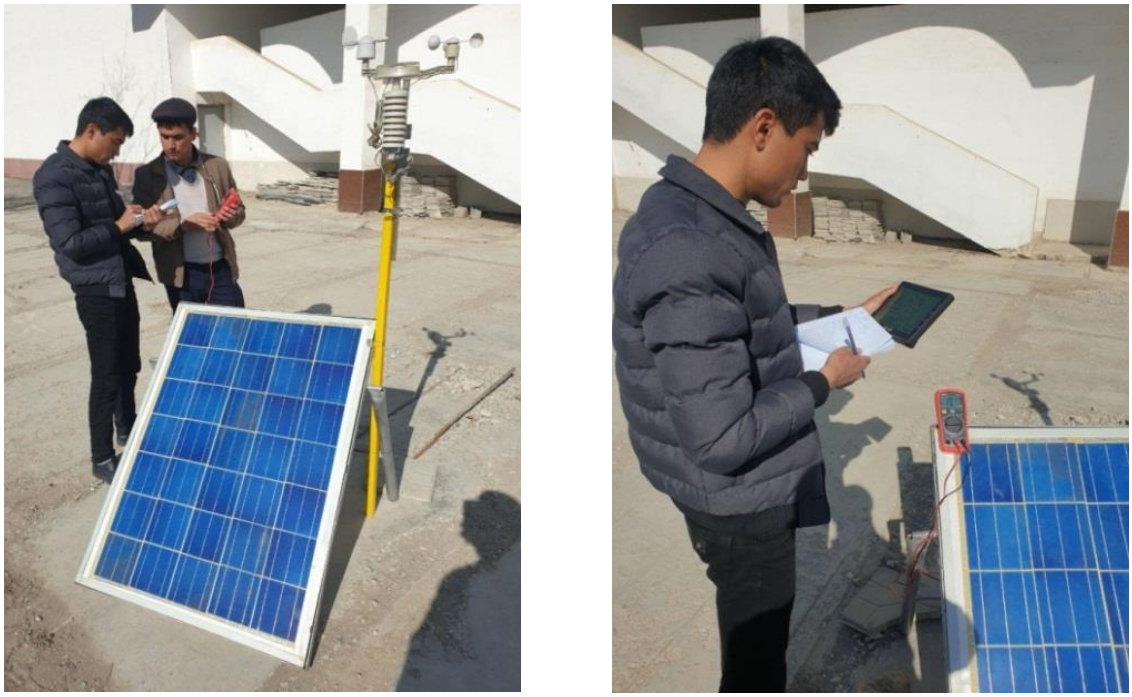


Figure 5. Conducted on a solar energy device experimental studies.

Figure 6 shows the short-circuit current readings obtained from the solar power plant determined in the experimental studies. It was studied that the short-circuit current of the solar module depends on the solar radiation and does not depend on the temperature change. When the solar radiation reaches 600-800 W/m ^{2}, it was found that the short-circuit current from the solar module is about 8 A.

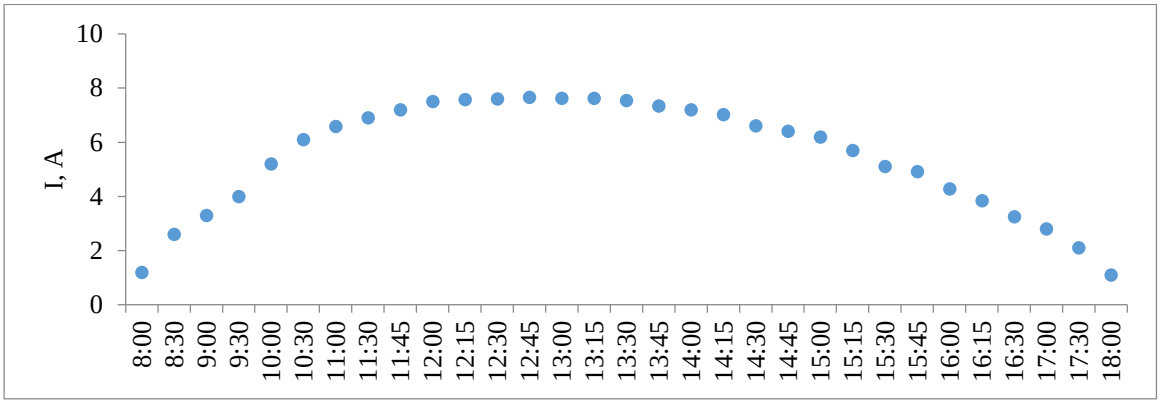


Figure 6. Solar energy identified in experimental studies from the device received short connection until indicators (17.02.2021).

In Fig. 7 temperature and the sun radiation when it changes through the solar module tension change and the sun of the module Voltage the sun of light to radiation depends without, temperature to change dependence was studied. The sun from the module at a temperature of 20 ^{0} C removable voltage 18-20 V organize to do was determined.

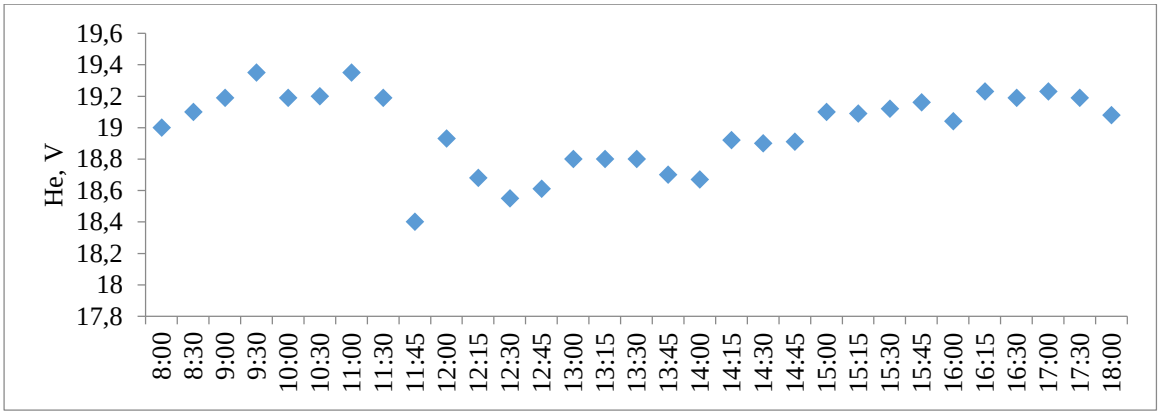


Figure 7. Experience in his studies determined the sun energetic from the device the received salt performance Voltage indicators (17.02.2021).

In the Figure 8 "EXAMPLE" is metrological station through extinguished the sun radiation daily pointers given. Measured data to the analysis basically of the day it was 12:00 to 14:00 in between the sun radiation maximum the value acceptance to do was determined .

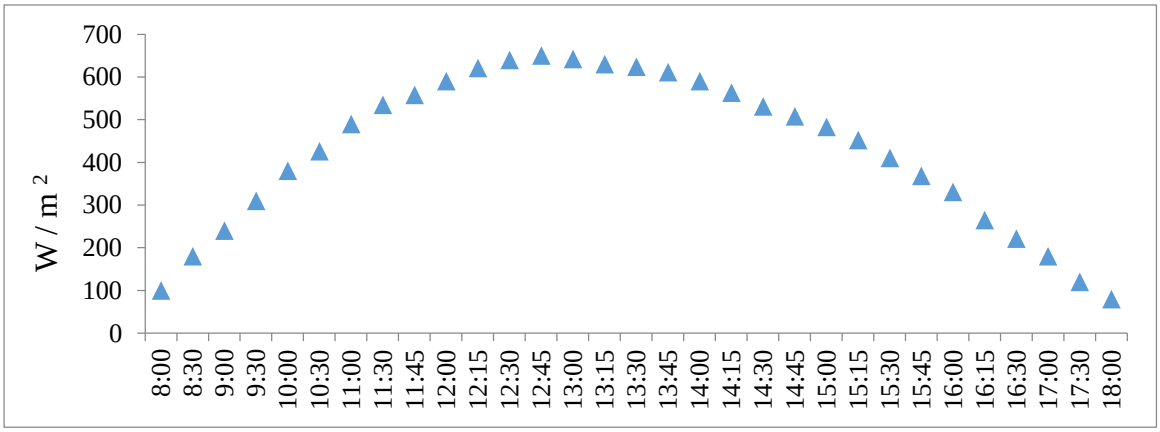


Figure 8. Solar radiation indicators determined in experimental studies (17.02.2021).

Figure 9 shows daily temperature changes. Based on the conducted research, it was determined that the efficiency of solar cells decreases with increasing temperature. It was studied that the efficiency of using solar batteries is high when the temperature is 20 ^{0} C and solar radiation is 1000 W/m ^{2}.

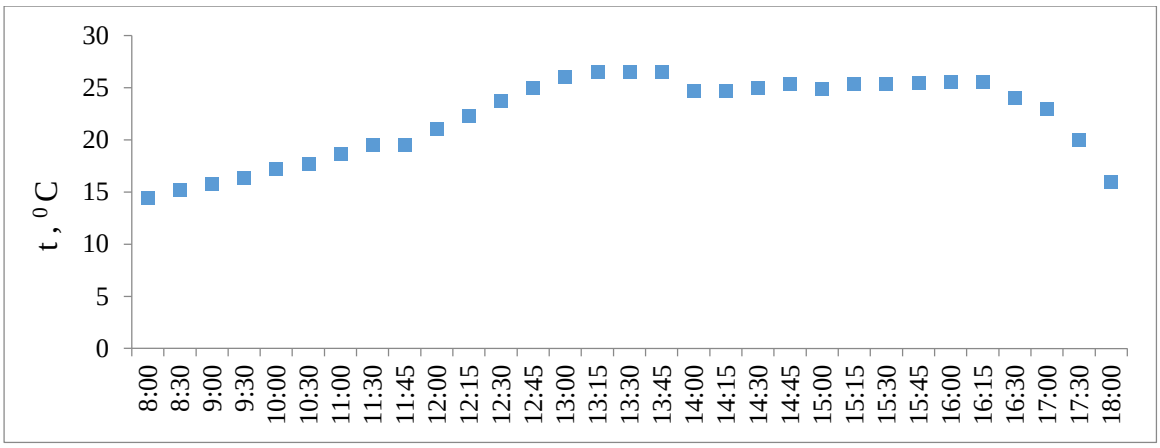


Figure 9. Experience in his studies determined temperature indicators (17.02.2021).

200 V solar battery adapted to the climatic conditions of the Bukhara region has been developed, and it has been determined that it produces approximately 360 k W · h of electricity per year.

Conclusion. The use of renewable energy sources in the world has shown that it is one of the important strategic directions in stabilizing environmental problems, saving energy resources, and developing economic and social spheres. The southern regions of our republic, especially in the Bukhara region, have been found to have high potential for using solar batteries, and it has been determined that they are of great importance in stabilizing the problems of energy insecurity and ecology. The total (theoretical) comparative energy of solar energy of Bukhara region is equal to 1750-1800 kWh/m ^{2} per year and it has been determined that there is an opportunity to obtain energy in the region on average of 4.72 kWh/m 2/day per year · When we use solar cells with a useful efficiency of 12% in the regions of Bukhara region, the technical potential is estimated to be 3.5 TWh/year. Due to the introduction of the developed 200 W solar battery , approximately 0.6 t.sh. was saved and more than 1.2 tons of carbon dioxide (SO_2) gas was prevented from being released into the atmosphere.

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