SOI: 1.1/TAS DOI: 10.15863/TAS
International Scientific Journal
Theoretical & Applied Science

p-ISSN: 2308-4944 (print) **e-ISSN:** 2409-0085 (online)

Year: 2022 **Issue:** 04 **Volume:** 108

Published: 18.04.2022 http://T-Science.org

Issue Article

Donyorbek Dilshodovich Alijanov
Andijan Machine-Building Institute
Ph.D., docent in technical sciences

Nodirbek Abdulhamid o'g'li Topvoldiyev
Andijan Machine-Building Institute
Assistant teacher at the Department of
alternative energy sources, Uzbekistan

PHYSICAL AND TECHNICAL FUNDAMENTALS OF PHOTOELECTRIC SOLAR PANELS ENERGY

Abstract*: In recent decades, global solar energy has been developing at a rapid pace, with solar power plants becoming part of the energy infrastructure of many countries. The development of solar technology has a significant impact on the economy. In the coming decades, solar energy can be expected to be a stimulus for the economic development of countries and regions with maximum "solar" resources.*

Key words*: Solar collector, solar energy, spectral distribution, air mass, solar radiation.*
Language*: English*
Citation: Alijanov, D. D., & Topvoldiyev, N. A. (2022). Physical and technical fundamentals of photoelectric solar panels energy. *ISJ Theoretical & Applied Science, 04 (108),* 501-505.
Soi: http://s-o-i.org/1.1/TAS-04-108-55 ***Doi***: crossref https://dx.doi.org/10.15863/TAS.2022.04.108.55
Scopus ASCC*: 2200.*

Introduction

Only a fraction of the energy produced by the sun reaches the earth. Calculations show that the technical potential of solar energy entering the planet each year (calculated using existing technical and technological means) is several times higher than the proven reserves of all fossil fuels (coal, peat, oil, natural gas). If the energy supplied to the planet by the Sun per year is converted into conventional fuel, this figure will be about 100 trillion tons. That's ten thousand times more than we need.

Improvements in solar energy technology have led to the fact that the cost of generating 1 kWh of energy in solar power plants is equal to or less than the cost of generating energy from "non-conventional" sources of hydrocarbons. It is also necessary to take into account the anthropogenic impact of fossil fuels burned for energy purposes, which has led to changes in the biosphere of the planet.

One of the technical problems in the oil and gas industry is the use of energy, including alternative and renewable energy, in the production, processing, and refining of hydrocarbons, which is the main goal of saving hydrocarbons, which depends on their efficiency and effectiveness.

The amount of energy coming from the sun to the earth's surface is enormous. For example, the power of the solar current, which covers an area of 10 km2, reaches 7-9 million kW per day on a cloudless day [5-7].

Main part.

Solar energy technology converts electromagnetic radiation from the sun into heat and electricity.

There are three main technologies for using solar energy:

• Solar collectors for heating liquid or gaseous refrigerant.

• Concentrated solar energy technology, in which steam is generated from solar heat, turbines generate electricity.

• Photoelectric technologies that convert sunlight directly into electricity.

Today, solar electricity is widely used to supply electricity to homes, offices, and other buildings in remote areas where there is no centralized power supply or where there is a centralized power supply network. In recent years, it is this program that provides about 90 percent of the solar panel market. In most cases, solar panels operate in parallel with the grid and generate clean electricity for district power grids. Many countries have special mechanisms to support solar energy, such as special increased tariffs for the supply of electricity from solar panels to the grid, tax breaks, incentives to obtain credit for the purchase of equipment, and more. During the formation phase of photovoltaics, such mechanisms have worked in Europe, the United States, Japan, China, India, and other countries. At present, solar energy provides slightly more than 1% of the electricity generated worldwide. However, in several European countries, this ratio is significantly higher. In Germany, for example, the figure is about 6%.

The intensity of sunlight reaching the earth varies depending on the day, year, location, and weather conditions. The total amount of energy calculated in a day or year is called radiation (or “unwanted solar radiation”) and indicates how strong the solar radiation is. Radiation is measured in [W* h/ m^2] per day or another period.

The intensity of solar radiation in free space at a distance equal to the average distance between the Earth and the Sun is called the solar constant. Its value is 1353 W / m^2 [3]. When sunlight passes through the atmosphere, it is weakened mainly by the absorption of infrared radiation by water vapor, the absorption of ultraviolet radiation by ozone, and the scattering of radiation by atmospheric dust particles and aerosols. The measure of the effect of the atmosphere on the intensity of solar radiation reaching the earth's surface is called the “air mass” (AM) [12-13].

Figure 1 shows the spectral distribution of solar radiation intensity under different conditions. The upper curve (AM0) corresponds to the spectrum of the sun outside the Earth's atmosphere (e.g., in a spacecraft), i.e., the mass of air is zero. It is estimated by the intensity distribution of the radiation coming from the black body at a temperature of 5800 K. The curves AM1 and AM2 show the spectral distribution of solar radiation on the Earth's surface when the Sun is at its zenith and an angle of 60 ° between the Sun and the zenith, respectively. In this case, the total radiation power is about 925 and 691 W / m^2. The average radiation intensity on Earth is approximately equal to the radiation intensity at AM1.5 (the Sun is at an angle of 45 ° to the horizon) [3].

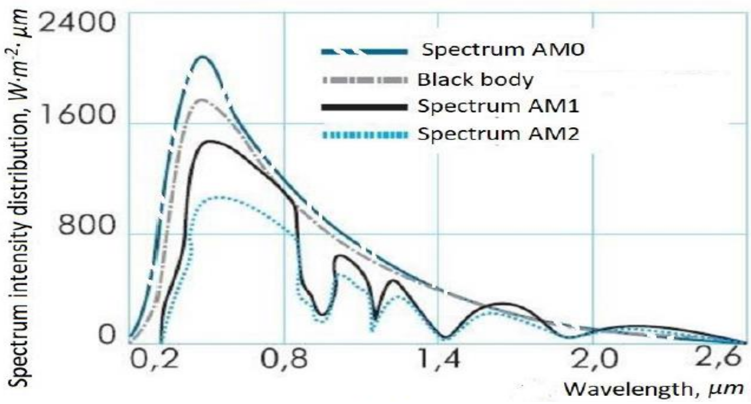

Figure 1: Spectral distribution of the intensity of solar radiation in various conditions.

The average intensity of solar radiation near the surface can be 635 W / m^2; On a very clear sunny day, this value ranges from 950 W / m^2 to 1220 W / m2, with an average value of about 1000 W / m2. [3].

Example 1. Total radiation intensity in Zurich (47 ° 30 'N, 400 m above sea level) on a surface perpendicular to the radiation: May 1, 12:00 p.m. - 1080 W / m^2; December 21, 12:00 - 930 W / m^2 [4].

To simplify the calculation of the arrival of solar energy, it is usually expressed in solar hours with an intensity of 1000 W / m^2. In other words, 1 hour corresponds to 1000 W / m^2 of solar radiation. This roughly coincides with the time when the sun shines on a surface perpendicular to the sun's rays in the middle of a sunless cloudless day in summer[6].

Radiation varies throughout the day and from place to place, especially in mountainous areas. For Northern European countries, it varies from an average of 1,000 kW / m^2 per year in the desert to 2,000 to 2,500 kW / m^2 per year. Weather conditions and solar deflection (depending on the latitude of the area) also lead to differences in the arrival of solar radiation.

The potential of solar energy in Uzbekistan has been studied in detail. The country surpasses Spain in the number of sunny days per year. Programs to develop solar energy technologies in the Central Asian republics were adopted in the USSR in the middle of the last century. Scientific institutions of Uzbekistan, Turkmenistan, and Armenia have been dealing with these issues. V.A. Baum, a well-known Soviet scientist, studied the possibility of desalination of seawater using renewable energy sources at the Academy of Sciences of the Turkmen SSR. In the

Uzbek SSR, work was carried out in two main areas: thermal power generation and high-temperature materials science.

In 1943, the Institute of Physics and Technology (the largest PTI in Central Asia) was established in Tashkent - the first academic institute, which was tasked with conducting fundamental and applied research in the field of physical sciences and engineering. From 1981-to 1987, the Institute of Solar Physics was established and the unique object "Big Solar Furnace" - a systemic solar concentrator with 10,700 mirrors - was built. In different years of the 20th century, several industrial facilities (used in animal husbandry), autonomous heated residential buildings, and a plant for the production of solar concentrators were launched to desalinate mineralized groundwater.

In 2003, a special unit, the Heliopoligon, was established at the Physics-Sun NPO research base (part of the FTI), with priorities:

- Carrying out fundamental and applied research on the conversion of solar energy into other types of energy;

- Development of experimental models of thermal, photovoltaic, and power plants;

- Development of technologies for the synthesis of high-temperature oxide materials.

The following figure shows a schematic map describing solar energy potential in different regions of the country.

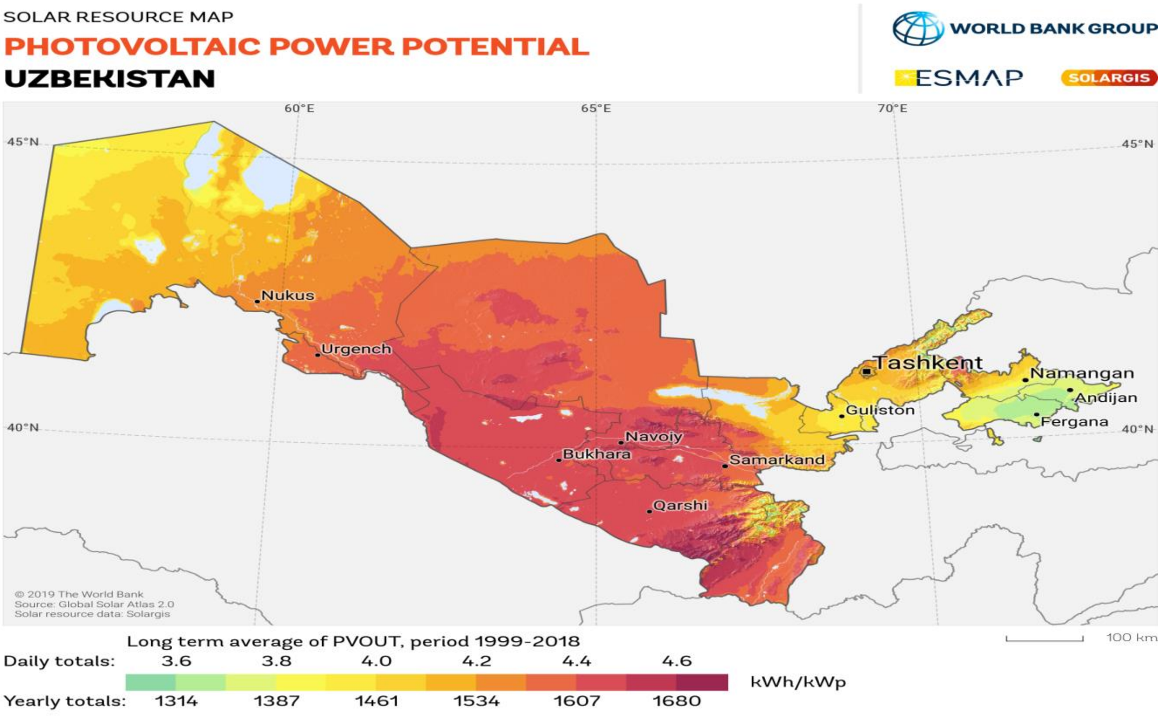

Figure 2: Solar energy potential in Uzbekistan, kW * h / kW.

In 2012, with the support of the Asian Development Bank, the International Solar Energy Institute (ISE) was established per the Decree of the President of Uzbekistan "On the establishment of the International Solar Energy Institute".

In the second decade of the new century, the Decree of the President of the Republic of Uzbekistan dated March 31, 2013 "On measures to develop alternative energy sources" was adopted, which sets out the main directions for the development of renewable energy and solar energy. was given. in the medium and long term. Continued construction of plants for the production of renewable energy equipment, expansion of solar power plants and water heating systems (collectors), and low-capacity hydroelectric power plants (collectors) are among the priority measures.

In the new century, several practical measures have been taken in our country to develop solar energy. From 2008-to 2018, projects with the participation of foreign capital were implemented to create mining enterprises and plants for the production of silicon, solar panels, solar concentrators, and several solar power plants were built[9].

It should be noted that taking into account the natural and climatic factors, Guzar district of Kashkadarya region, Sherabad district of Surkhandarya region, Pop district of Namangan region are among the most promising areas for the development of solar energy.

In 2008, the State Committee for Geology and Mineral Resources of Uzbekistan and Neoplant (Republic of Korea) established a joint venture Uz-Kor Silicon to develop quartz and quartzite deposits in

Kashkadarya and Samarkand regions. In 2012, the participants of the joint venture in the Navoi region built the first complex in the country for the extraction of 39,000 tons of quartz ore per year and the production of 12,000 tons of technical silicon (mainly grade 441 for export).

In 2013, Uzbekenergo and China's Suntech Power Co. Agreed to jointly (in equal shares) plan to build a plant for the production of photovoltaic modules (average annual production capacity - 100 MW) in the Navoi Free Industrial and Economic Zone. As of 2018, the project was not implemented due to the bankruptcy of Suntech Power Holdings Co., possibly unable to compete with Chinese companies in the field [10].

In 2014, the participants of the Uz-Shindong Silicon Joint Venture (Uzbekistan-Republic of Korea) commissioned the second plant in the country to produce 5-5 units of technical silicon in the Angren Special Industrial Zone. 6,000 tons per year (raw materials are imported from the Jizzakh region). In the same year, the Jizzakh SEZ completed the construction of a wide range of solar water heating systems, including vacuum tubular water heating systems (factory capacity up to 15,000). product per year).

In 2015, a low-capacity (130 kW) solar power plant was launched in the Namangan region in collaboration with Korean experts. In 2016, a 1.2 MW solar power plant was commissioned at the Lukoil facility in the Bukhara region.

In the medium term, it is planned to build several large solar power plants (100 MW each) in the Namangan region and the Sherabad district of the Surkhandarya region. Like the Million Solar Roofs program (USA) and similar programs, it is planned to expand the capacity of renewable energy devices in real estate through the installation of public facilities - preschools and about 2,000 solar concentrators (solar panels and concentrators). school facilities, medical facilities, and other state-owned facilities located in remote and inaccessible areas.

In the long run (until 2025) it is planned per the “Solar Road Map” (developed by experts of the Physics-Sun NPO, experts of the Asian Development Bank, agreed with the government). Construction of several hydropower plants in Guzar district of Kashkadarya region (FGU, 100 MW), Navoi city (combined, 130 MW), MISE landfill (combined, 10 MW) in Qibray district of Tashkent region [8].

In May 2018, the President signed a resolution “On additional measures for the implementation of investment projects in the field of renewable energy sources”, according to which Uzbekenergo JSC SkyPower Global (Registered in the Cayman Islands) to begin construction of solar power plants with a total capacity of 1 GW (SkyPower Global Contribution - $ 1.3 billion). The foreign parent company and its subsidiaries in the regions are expected to receive tax and customs benefits. In addition, the Uzbek government has guaranteed payment for solar electricity from future energy facilities to the public grid, and if the solar power plant is not self-sufficient, the procurement will be funded from the state budget.

In early 2018, the Government of the Republic of Uzbekistan and the International Finance Corporation (IFC, World Bank Group) signed an agreement on attracting foreign capital and providing consulting services for the development of solar energy based on PPP mechanisms. First, a project to build and operate a 100 MW solar power plant to replicate the experiment and increase the total capacity of future solar power plants to 1 GW is under consideration [11].

The media is less aware of the implementation of government plans to develop the renewable energy sector, so it is difficult to assess the success and challenges of relevant national projects today.

CONCLUSION

In general, the country is developing along the trajectory of solar energy growth. Enterprises producing solar modules and various types of concentrators have been established in our country, the professional level of specialists is constantly increasing, and foreign investments and technologies are entering the industry. Currently, this RES network is in the process of transition to the implementation of a wide range of tasks using various mechanisms of state support from experimental and first experimental models of solar power plants (generators of electricity and/or thermal energy): benefits, connectivity through warranties. Procurement of thermal power plants and electricity for the general electricity network, compensation for losses in the event of reduced competitiveness of electricity prices, implementation of programs to equip state-owned facilities with solar panels and enrichment plants, implementation of projects; principles of public-private partnership. Problems of network development are related to the technical performance of converters (low efficiency, relatively short service life, long payback period of equipment in domestic and industrial networks, estimated at 13-16 years at current gas and electricity tariffs).

References:

1. Yuldashev, I.A., Tursunov, M.N., Shog`o`chqorov, S.Q., & Jamolov, T.R. (2019). *Quyosh energetikasi. O`quv qo`llanma*. "Sano-standard", Toshkent.
2. Saitov, E.B., & Yuldashev, I.A. (2017). *Quyosh panellarini o`rnatish, sozlash va ishlatish// O`quv qo`llanma*. Toshkent: "Noshir" nashriyoti.
3. Bahodirxonov, M.S., Zaynobidiavtonov, S.Z., & Madaminov, X.M. (2016). *Elektron texnikasi moddalari*. Toshkent: "Yangi Nashr".
4. Alijanov, D.D., & Boltaboyev, I.M. (2020). Photosensitive sensors in automated systems. *Photosensitive sensors in automated systems. Internauka: elektron. nauchn. jurn.*, № 23(152).
5. Alijanov, D.D. (2021). B. I. Receiver For Registration Of X-Ray And Ultraviolet Radiation. *The American Journal of Engineering and Technology*, 23-27.
6. Alijanov, D. D., & Topvoldiyev, N. A. (2021). Solar tracker system using arduino. *Theoretical & applied science*, (9), 249-253.
7. Alijanov, D.D., & Boltaboyev, I.M. Photosensitive Sensors in Automated Systems. *International Journal of Research Studies in Electrical and Electronics Engineering (IJRSEEE)*, Volume 6, Issue 2, pp.33-34.
8. Alizhanov, D.D., & Ahmadaliev, U.A. (2021). Ўzbekistonda kajta tiklanadigan jenergetikani rivozhlantirishning xukukij asoslari. *"Ўzbekgidrojenergetika" ilmij-tehnik zhurnali*, №2 (10), 58-59.
9. Alijanov, D.D., Axmadaliyev, U.A., & Topvoldiyev, N.A. (2021). *Types of silicon-international scientific journal «global science and innovations 2021: central asia».* Types of silicon-based solar elements and their effectiveness (стр. 73-76).
10. Zhalilov, R.R. (2022). "magnitnye nanochasticy-polimer gibridnye materialy." *Oriental renaissance: Innovative, educational, natural and social sciences*, 2.3 : 704-709.
11. Topvoldiyev, N.A. (n.d.). Fotoelektrik quyosh elektr stansiyalari texnologiyalari. *Namangan muxandislik- tehnologija instituti ilmij-tehnika zhurnali.* (pp. 471-475).
12. Komilov, M. Modeling the photoelectric parameters of thin silicon-based solar cells using the sentaurus tcad. Norwegian Journal of development of the International Science (стр. 62-65)
13. Komilov, M., Aliev, R., Abduvoxidov, M., Xudoynazarov, A., & Jo'raboyev, B. (n.d.). *Fotoelektrik energetik qurilmalarni volt amper xarakteristikasini aniqlash.* Josh olimlar va fizik talabalarning i respublika ilmij anzhumani (jooftria-I). (pp. 182-184).