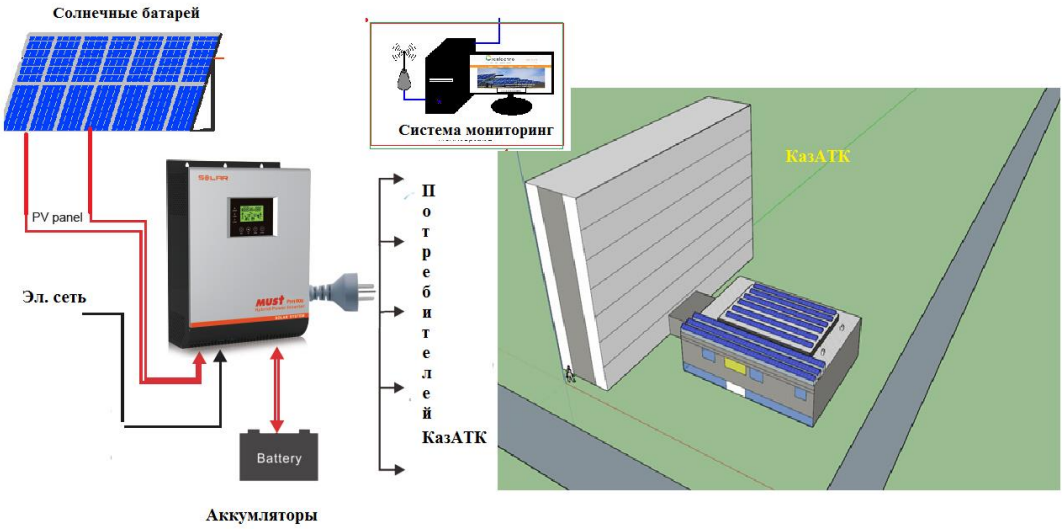
Academy of Logistics and Transport

Institute of Automation and Telecommunications

CREATION OF AN AUTONOMOUS SOLAR POWER PLANT WITH A CAPACITY OF 10 kW ON THE BASIS OF THE LOGISTICS AND TRANSPORT ACADEMY



Developers:
Doctor of T.Sc, Professor **Koishiev T.K.**
Doctor of Phys.Maths, Professor **Amirgalieva S.N.**
Doctor, PhD **Kaliev Zh.Zh**

Almaty 2022

SUBSTANTIATION

Currently, the development of renewable energy is one of the priority areas for the formation of the branches of the "Economy of the Future", designated in the State Program of the Republic of Kazakhstan for accelerated industrial and innovative development.

Along with this, the use of renewable energy sources is provided for by the sectoral program for the development of the electric power industry of the Republic of Kazakhstan and is regulated by the Law of the Republic of Kazakhstan "On Support for the use of renewable energy sources" adopted in 2009.

An autonomous solar power plant with a capacity of 10 kW will be used:

1. To reduce your own electricity consumption from the grid. (figure 1).

2. On the basis of the created ALT solar station, in the future, it is possible to create a Green Energy Training and Research Center (The presence of such a center will develop the ALT research sector in the field of renewable energy use.

The educational process will be closely connected with the preparation of bachelors, masters and doctors, and on its basis, advanced training courses in the field of development and use of renewable energy can be organized.

The Concept of Transition of the Republic of Kazakhstan to Sustainable Development for 2007-2024 sets the following tasks:

- stimulating the rational use of energy resources;
- introduction of solar and wind energy facilities and other renewable resources into power supply systems;
- creation of centers for the dissemination of international experience in energy and resource conservation, as well as the use of renewable energy sources (RES).

Therefore, the establishment of the Green Energy Center at ALT will play a significant role in the implementation of the above-mentioned programs through the development of research activities in the field of renewable energy.

There is a sufficient reason to create such a center for the development of renewable energy in ALT:

- highly qualified specialists of the above direction work at the Faculty of Automation and Telecommunications and at the Department of Electric Power Engineering, for a number of years RES issues have been introduced into the educational process, lectures have been given and diploma and master's theses have been carried out;
- at the department, much attention is paid to energy conservation issues in order to train specialists in this profile.

The presence of such a center will develop the research sector of ALT

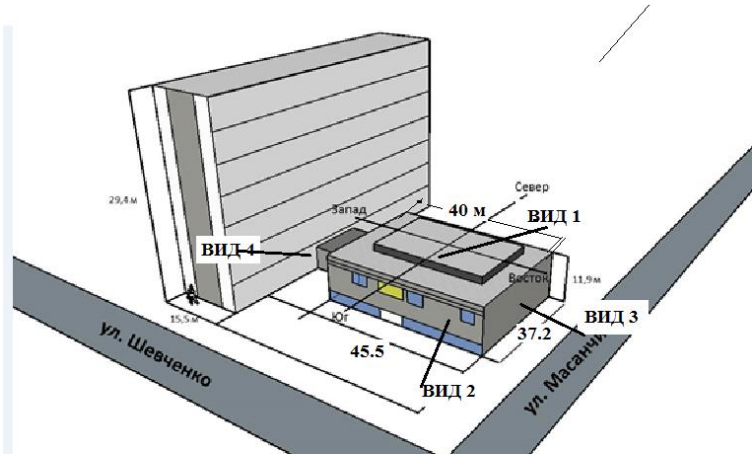
Autonomous solar station 10 kW

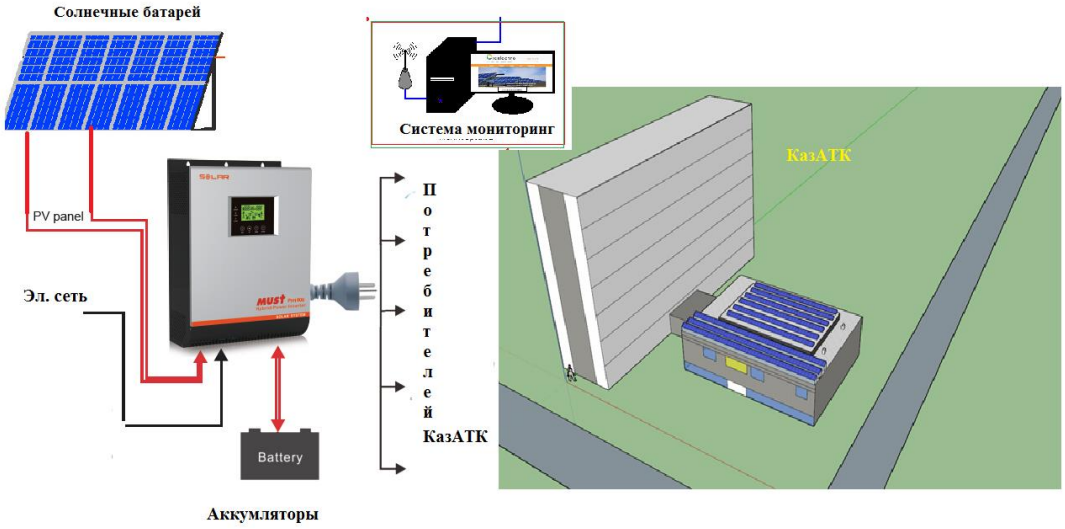
The selected object is the buildings of the first povilon ALT in Almaty

Technical calculation

Geographic coordinates of ALT
Latitude: 43°15'24" s.w.
Longitude: 76°55'42" v.d
The roof of the object is smooth W/w (see figure)
Orientation to the South

plan





Brief description and general scheme of the grid solar power plant based on ALT

Ground-based solar power plants are located on permanently installed modular structures oriented to the south, combining into rows, arrays and fields. It is very important to install solar panels so that they received direct sun and are as efficient as possible in terms of performance all year round.

Under the influence of solar radiation, direct current electrical energy, which is generated in a photovoltaic module (FEM), enters the inverter through a switching

device, where it is converted into alternating current electrical energy. Before switching on, the inverter monitors the parameters of the external power grid.

Results of the technical calculation of the solar station

The selected object is the buildings of the first pavilion ALT in Almaty
Geographical coordinates
Latitude: 43°15'24" s.w.
Longitude: 76°55'42" w.d
Altitude above sea level: 787 м

1. ***Determination of energy consumption and power (first povilon ALT)***

The total AC power consumed per week (for floodlights, lightboxes and volumetric light letters ALT is equal to W).week= 207,917 watts hour/week

Per month $W_{пер.мес}$= *207 917 X4$_{нед}$= 831 668 W*
Per year $W_{пер.год}$= *831 668X12мес= 9 980 016 = 9 981 kW*

The scheme of the location and orientation of solar panels strictly south

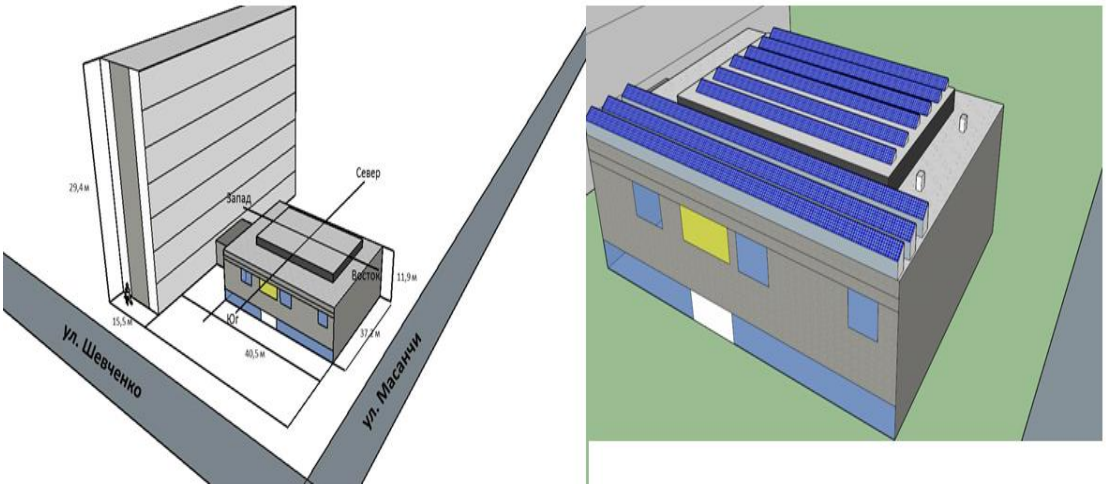


Figure 2. Layout of the solar panel

Using the data from the NASA solar radiation database and the Almaty meteorological data (GMO Table 1), we calculate the total monthly and annual arrival of solar radiation on the horizontal surface for the Almaty ALT terrain.

For our solar station, we plan to use solar modules manufactured by ASTANA SOLAR LP, with a capacity of 275 watts

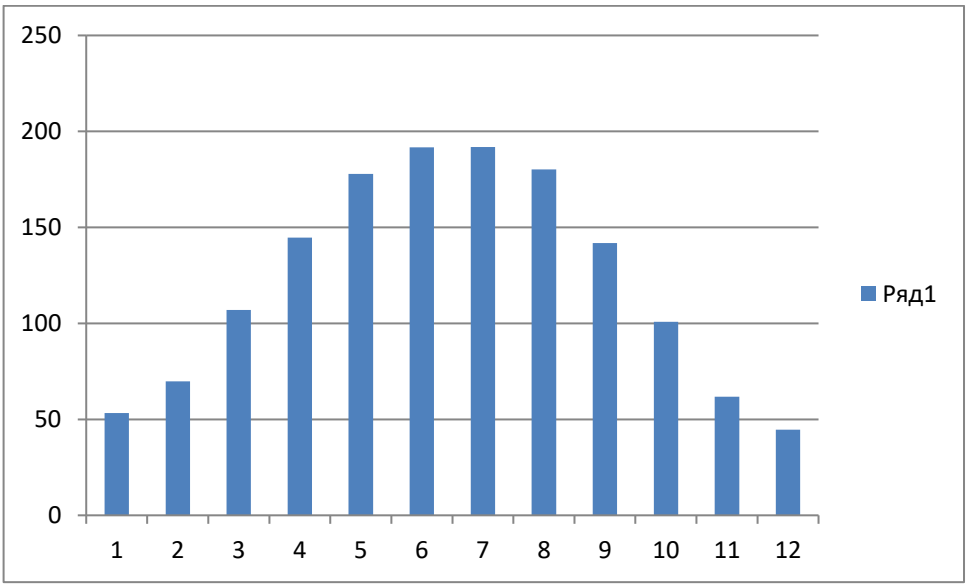
Determination of monthly and annual arrival of total solar radiation on an inclined surface

To determine the monthly and annual arrival of total solar radiation on the horizontal surface, we use NASA solar radiation databases and data from the Almaty weather station and then recalculate on the inclined surface of the solar panel.

Table 1. – Monthly and annual arrivals of total radiation on the inclined surface (kWh/m2) according to the calculated data of the NASA agency and the data of the Almaty weather station.

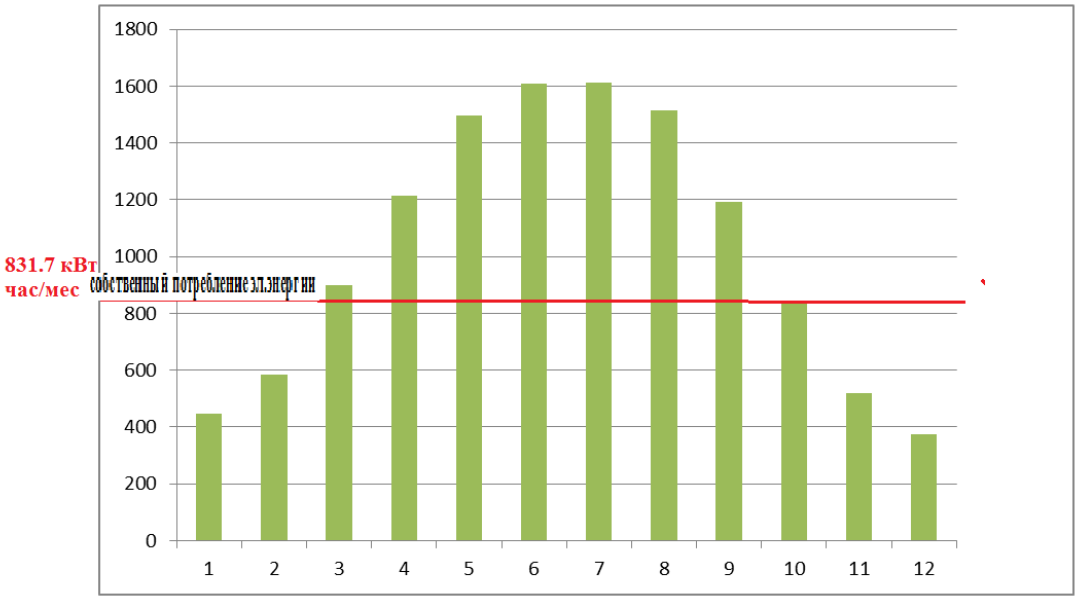
I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	ГОД
53,32	69,72	106,95	144,6	177,94	191,7	191,89	180,11	141,9	100,75	61,8	44,64	1465,32

Calculation results monthly arrival of total radiation on the inclined surface of the solar battery (kWh/m2)



Average monthly electricity generation of the autonomous solar station ALT, kWh/month

kWh/month



Month	**Average monthly electricity generation, kWh**
January	448,0
February	585,64
March	898,38
April	1214,64
May	1494,69
June	1610,28
July	1611,87
August	1512,92
September	1191,96
October	845,88
November	519,12
December	374,9
Total:	**12308,28**

Table 3 ECONOMIC INDICATORS

Месяц	**production [kWh]**	**Own consumption [kWh]**
Month	448,0	**831.7**
January	585,64	**831.7**
February	898,38	**831.7**
March	1214,64	**831.7**
April	1494,69	**831.7**
May	1610,28	**831.7**
June	1611,87	**831.7**
July	1512,92	**831.7**
August	1191,96	**831.7**
September	845,88	**831.7**
October	519,12	**831.7**
November	374,9	**831.7**
December	**12 308,28**	**9 980.40**
Total:		

Annual electric power generation - 12 308.28
Annual own electric energy consumption - 9 980.40