Design and Economic Analysis a 3MW Grid-tied PV System Power Plant for Al-beroni University

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Abstract: *In this paper, the economic design and analysis of a Grid-Tied Photovoltaic Power Plant to supply energy for internal consumption of the university or sales using the renewable energy incentive program by Da Afghanistan Breshna Sherkat of Afghanistan in Al-beroni University in kapisa, Afghanistan has analyzed. In addition, in this study, the policy of net energy metering (determining the amount of energy received from the utility grid and injection excess power to the utility grid) was discussed. The most promising ways to save money on photovoltaic system is the grid. For this purpose, the design of a 3 MW network as a Grid-connected solar photovoltaic power plant to cover the electrical loads of Al-beroni university was designed according the availability of Enough sun irradiation and space for installing Pv panel and energy production. Inverters and panels are the main components of a Grid-tied photovoltaic power plant, and choosing the right capacity and their physical and electrical arrangement will increase the plant's efficiency from the existing solar energy potential and reduce the cost of the entire system. In the design, after selecting the inverter and module and the optimal design of the power plant, taking into account parameters such as optimal use of land area, cost, reliability, increasing the efficiency of the power plant components by determining their operating point range was done using PVeyst software. In this software, the arrangement of solar photovoltaic modules in the array and the number of strings were determined and the shading status of the arrays on the back rows was studied. The required space for installing solar panels and other equipment for the construction of the power plant was estimated and finally the performance coefficient of the power plant was calculated. In the continuation of losses, shading output curves was extracted and analyzed using PVsyst software. The results obtained in the studied plan indicate that the amount of energy consumption of the university is 5384 MWh/year and the energy produced by the solar photovoltaic power plant for the university will be 5499 MWh/year, which completely covers the energy consumption of the university. Also, the efficiency coefficient in the studied plan Reaches 82.08%, which indicates that the system is optimal and desirable. The average lifespan of this solar Grid-tied photovoltaic power plant is 25 years, which will guarantee a return on investment to some extent. The initial cost for the construction of the power plant is (2947494 USD -221062050Afg) and it has been obtained from the software in the repayment period of 5.9 years.*

Key Words: **PVsyst, PV Power plant, economic effectiveness, solar capacity**

1. INTRODUCTION

Around the world, energy plays an important role in human societies. Due to the increasing demand for energy and the development of human societies, the consumption of fossil fuels as a traditional source of electricity production is increasing.

Afghanistan is one of the countries in the Middle East that has a great potential for producing clean renewable energy, but so far not even 5% of these resources have been used. Unfortunately, despite all these resources, the country still has an absolute dependence on neighboring countries in terms of energy supply [1]. Currently, more than 70% of the country's electricity needs are imported, with the bulk of the energy market coming from Uzbekistan and Tajikistan. while, Afghanistan's own renewable energy sources, such as solar, hydropower, wind, and biomass, can generate 398,125 megawatts of electricity [2]. Among these, the potential capacity for the production of hydropower is 23310 MW, wind power 147563 MW, solar power 2222852 MW and electricity generation from biomass sources is about 44000 MW [3], [4].

In Afghanistan, in summer and winter Seasons, due to the sharp rise and fall of air temperature, the use of cooling and heating devices increases and the peak of electricity consumption increases dramatically [5]. which Imported electricity and domestic production of the country cannot meet the peak energy consumption in Afghanistan. Eventually it causes a power outage. Which the Universities are no exception to this power outage. Therefore, universities, factories, households, and all government offices use diesel generators, to supply the energy, which produce energy by them are extremely expensive and environmentally damaging. On the other hand, the

Government of the Islamic Republic of Afghanistan currently is not able to build its hydro power plants due to their high costs.

In this situation, the proposed solution to the power outage crisis is to use clean solar energy to provide energy; therefore, it is felt in universities, factories and households to should use clean solar energy.

Solar energy, as its name implies, is energy from the sun that is converted into heat or electrical energy. This energy is the cleanest and most abundant source of renewable energy. Today, solar technologies can use this energy for various purposes, including power supply for domestic, commercial or industrial use. PV technology generates electricity directly from solar light through an electronic process or a PV_S is a system designed to supply energy that can be used by the sun using photovoltaic technology. Afghanistan has 300 sunny days a year, according to National Renewable Energy Laboratory of USA and calculations of the Ministry of Energy and Water of Afghanistan, has a theoretical potential of 2222852 MW from solar power [6]. The purpose of this study is to design and economically analyses a Grid-tied photovoltaic power plant in order to supply the consumed electrical energy of Al-beroni University and to investigate the parameters affecting on the production of the power plant using PVsyst software.

1. 1 Net Energy Metering

Net-Energy metering is a billing strategy or a tow-way energy net meter that accredits owners of photovoltaic power plants, commercial units, or residential units that generate electricity from Renewable energy (solar, wind) to inject their surplus energy in to the utility grid. This surplus energy is the so-called electrical energy that is produced from renewable energy (PV system, wind), which exceeds the energy consumption of a residential or commercial units. when the renewable system of residential or commercial owners has such conditions. The electricity company or relevant organizations give them credit for the electricity generated injected into the utility grid. This credit is used to cover the cost any amount of electricity consumption, the difference between what they produce and what they consume is a "net" difference.

By using this policy. Customers who inject their excess energy into the utility grid or receive energy from the utility grid when needed, will receive a "Net" fee or "net "bill. The local production utilized ($Putil_{i,j,k}$),surplus energy ($Sur_{i,j,k}$),and net utilization ($Unet_{i,j,k}$)can be formulate as follows[12],[13].

$$Putil_{i,j,k} = Prod_{i,j,k} \text{ for } Ubase_{i,j,k} \geq Prod_{i,j,k} \quad (1)$$

$$Putil_{i,j,k} = Ubase_{i,j,k} \text{ for } Ubase_{i,j,k} < Prod_{i.j.k} \quad (2)$$

$$Sur_{i,j,k} = Prod_{i,j,k} - Ubase_{i,j,k} \text{ for } Ubase_{i,j,k} \leq Prod_{i,j,k} \quad (3)$$

$$Sur_{i,j,k} = 0 \text{ for } Ubase_{i,j,k} > Prod_{i,j,k} \quad (4)$$

$$Unet_{i,j,k} = Ubase_{i,j,k} - Prod_{i,j,k} \text{ for } Ubase_{i,j,k} \geq Prod_{i,j,k} \quad (5)$$

$$Unet_{i,j,k} = 0 \; Ubase_{i,j,k} \geq Prod_{i,j,k} \quad (6)$$

Where

$Ubase$ = is energy utilization

$Prod$ = total production energy

$Putil$ =Production which is utilized locally

Sur =surplus energy is injected into the utility grid (when local utilization is lower production)

$Unet$ =Net utilization by the costumers (when local utilization is higher than production)

And "I" indicates each of the current days of the year, and "j" indicates every moment of a day. For example, for a fifteen-minutes limit "j" ranges from one to Sixty-nine the limit "k" can be one minute, fifteen minutes, one hour or one day.

The formulas (7&8) show the yearly economic interests of the net billing and Net-metering policy.

Net-bling is variation in the net-metering policy where the electricity consumed by the load is kept a disparate record than the surplus electricity imported into the utility grid. Total energy utilized and surplus energy imported to the into the utility grid are evaluated separately and at a disparate price.

$$\mathrm{ImNM}_k = \sum_{i}^{n}\sum_{j}^{mk}\left(Putil_{i,j,k} + Sur_{i,j,k}\right)\times RT1 = \sum_{i}^{n}\sum_{j}^{mk}\left(pro_{i,j,k}\right) \times RT1 \ \forall k \quad (7)$$

$$\mathrm{Im}\,NB_K = \sum_{i}^{n}\sum_{j}^{mk}\left(Putil_{i,j,k} \times RT1 + Sur_{i,j,k} \times RT2\right)\forall k \quad (8)$$

Where RT1 the dealing for total local production in the presence of net-metering. In [the billing policy, RT1 is used to bill the total production utilized and RT2 is used for the excess electricity imported in to the utility grid [7].

The device that measures the difference between the electricity entering to the grid and received from the grid, as well as the difference between the total energy, is called the Net-meter.

Fig-1: Net Energy Meter

1.2 Al-beroni University

ALU is one of the largest public universities in Afghanistan, which was established in 1998 in Mahmud Raqi district of Kapisa province. The university is named after Abu Rihan al-Biruni, a world-renowned scientist and mathematician from the Islamic world. It is one of the top five universities in Afghanistan after Kabul University, Mazar-e-Sharif University, Herat University and Nangarhar University.

ALU Campus from the south and east to Khom Zargar Street from the north of Koh-Sanajn and west to Golbahar Textile Company, which is limited in a total area of 360 acres of land.

School buildings: Engineering, Medicine, Agricultural, Economics,Law and Political Science,Sharia, Journalism,Education,Literature, the building of the central organization of the university, the office of student affairs, the health center of the students of the university , Building number one, number two dormitory for boys and dormitory for girls and mosque are located inside the university [8].

2. Methodology

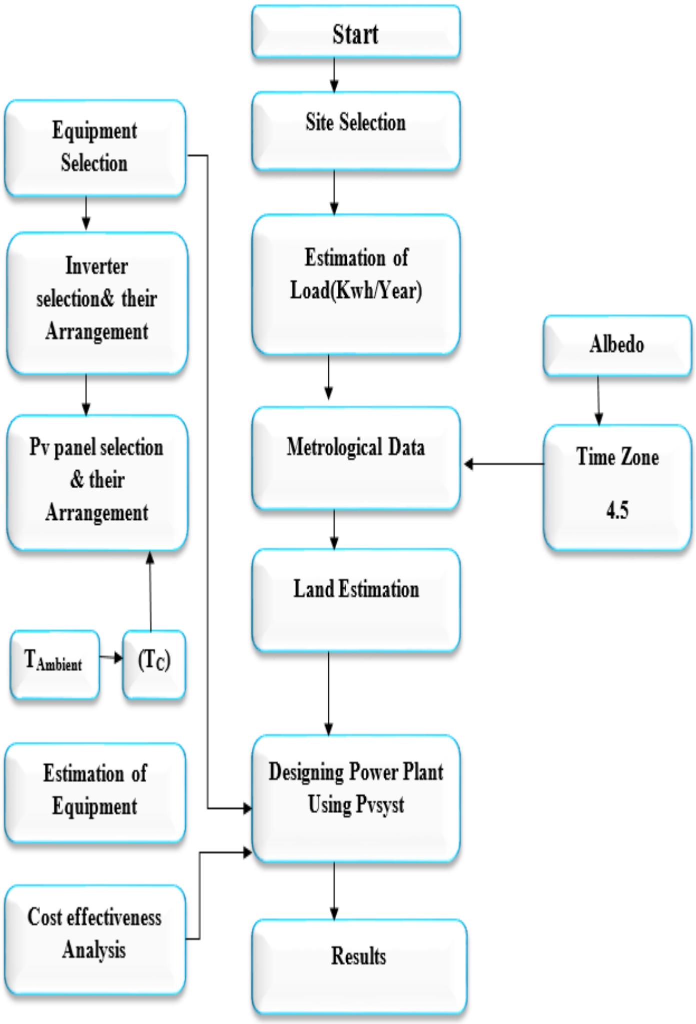


Fig-2: Methodology for Designing and Cos Effeteness

3. Design of the Project and Collection of the Data for it

3.1 Load Estimation & Site Selection

Al-beroni university is located in the northern of Kabul in kapisa province. The GPS point of ALU is 35.13 ºN and 69.32º E. and the altitude is 1583 m from the river. The annual energy consumption of this university is about 4,202,389 kWh per year and its monthly consumption is 805996 kWh per month. The maximum energy consumption is 2637 kWh and its minimum consumption is 37659 kWh. And the cost per kilowatt of energy is 16.25 Afghanis. The construction of a 3 MW power plant can fully supply the consumption energy of this university and the area required for the construction of this power plant is 158764 square kilometers. The university pays about 69,598,458 AFG a year for its energy supply to Da Afghanistan Bereshna Sherkat.

3.2 The Power intended for installation of photovoltaic arrays

The main part of designing a power plant is understanding the nominal amount of the power plant. This means that we need to know, we do design the power plant with what capacity, that meet the consumption energy needs of the university. Since the amount of specific production of panels varies according to the geographical areas and the amount of radiation in each region. Which is the same as the concept of maximum power (Wp). Wp is a standard. This standard indicates the maximum amount of electrical energy obtained from a photovoltaic system installed in an area during the year. It should be noted that the Wp value varies for each geographical region and countries due to the amount of radiation in that region. This amount is 1500 kilowatt hours per year in Afghanistan. That is, to install a panel with a capacity of one kilowatt in Afghanistan, the maximum power produced during the year is 1500 kilowatt hours. Since the energy consumed by the university according to the university tariffs is 4202389 kWh per year, so we need to have the capacity of the power plant. We use the following equation to determine the capacity of the power plant.

$$1KWpPVP.\Pr oduce....1500KWh.E$$
$$...........?.....\Pr oduce....4202389KWh.E$$

Where.

E =Energy

KW_P =Kilowatt-Peak

PVP =Photovoltaic Power Plant

$$PPC = \frac{4202389 * 1KW_p / year}{1500KWh / year}$$
$$PPC = 2801.5KW$$
$$PPC \approx 3MW$$

After the calculation, we found that a 3 MW photovoltaic power plant can supply the energy required by ALU.

3.3 Getting the Basic Parameters for the Design of ALU Grid-tied Photovoltaic Power Plant

Considering several parameters to design of photovoltaic power plant is effective, including climatic and weather conditions, panel orientation, type of modules, inverters and module layout, which is discussed below.

3.3.1 Climatic Conditions and Finding the Maximum and Minimum Temperature of the Solar Panel

Since more radiation increases the efficiency of the power plant and also due to the different reflectance for different surfaces, including asphalt or snow-covered surfaces, and due to the effect of ambient temperature on the performance of the panels, which has been discussed in previous chapters. It can be concluded that the climatic and geographical conditions of the construction site have a significant impact on the performance and efficiency of the photovoltaic plant. This power plant is designed for the geographical coordinates of 35.13 °N, 69.32 °E, Altitude 1583 m and time zone UTC+ 4.5. Solar panel temperature is completely different from ambient temperature and knowing it is one of the serious needs for designing a photovoltaic power plant. The maximum and minimum panel temperatures were obtained using data from the Meteorological Department of Afghanistan (2012-2020) and Formula 6, with a maximum temperature of 69 degrees Celsius and a minimum of 7 degrees Celsius.

$$T_c = T_{amb} + (NOCT - 20)\frac{G}{800}$$

Where

T_c is the temperature of the solar cell

T_{amb} is the ambient temperature

NOCT (Nominal Operation Cell Temperature) = 47

$$T_c = -3.8 + (47 - 20)\frac{336}{800}$$

$$T_c = 68.96 \approx 69$$

$$T_c = 7.01 \approx 7$$

$$T_c = 42.3 + (47 - 20)\frac{790}{800}$$

3.3.2 The Direction of the Panels

To receive the most radiation, the direction of the panels should be to the absolute youth of the geographical direction (azimuth = 0). Also, as a rule of thumb, the optimal slope of the modules is equal to the latitude of the place. This rule has an error for areas whose latitude is more than 45 degrees north or less than 45 degrees [9]. Since our desired latitude is 35 degrees north and this value is less than 45 degrees, so we can consider the slope at the same latitude β op ≈⌀.

3.3.3 Selecting the Type of Module and Inverter

In choosing the module, in addition to matching the inverter and the module, we should also pay attention to the fact that there should be selected brands in the Afghan market. The selected modules are from LG 400 N2T-A5 model and 400 Wp, and since they are used for power plant consumption, it is better to choose them with higher power so that they have a smaller number. Table 1 deals with the specifications of the selected module. To choose the inverter, we used PVS800 model, which is the most famous brand in the market. Which more completely is PVS800-57-1000kW-C. Table 2 shows the specifications of the selected inverter.

3.3.4 The Layout of Modules

At this stage, according to the number of modules and the number of rows suggested by the software, we will have 7506 in 417 rows of 18, which was done using the 3D design software of the modules in such a way that the least shading during Have a day and at the same time make the most of the available space.

Table-1: Specifications of LG 400 N2T-A5 Module [10]

Parameter	Symbol	Unit	Amount
Power output	Pmax	W	400
Voltage at Pmax	Vmpp	V	41.15
Current at Pmax	Impp	A	9.65
Open-circuit voltage	Voc	V	49.7
Short-circuit current	Isc	A	10.22
Module efficiency	η	%	18.9

Table -2: Inverter of ABB_PVS800_57_1000kW_C.OND Inverter [11]

Parameter	Unit	Amount
Input Data (DC)		
Max .DC Voltage	V	1100
Max. DC Current	A	1145
MPP(T) Voltage Range	A	459-825
DC Inputs	A	15
Max .DC Voltage	V	1100
Output Data (AC)		
Max.AC Power	KW	600
Nominal AC Power	KW	500
Nominal AC Voltage	V	300
Max AC current	A	965
Frequency	Hz	50,60
Distoration(THD)	%	<3
Max. Efficiency	%	98.6%

4. Power plant simulation results using PVsyst software

Table-3: Simulation Parameter

Pv array characteristic		
Pv panel	Number of Pv panel	Total number of PV panel
LG 400 N 2 T-A 5 400 Watt	417 string *18 in series	Nb. Pv panel 7506
PV Array loss factors		
Manufacturer	Operating voltage	Inverter pack
ABB PVS 800-57kWac	600-850 V	Nb. Inverter 3 1000kWac
Pv Array loss Factors		
Thermal Loss factor	Uc (const) 20.0 W/m²K Uv (wind) 0.0 W/m²K / m/s	
Wiring Ohmic Loss	Global array res. 0.33 mOhm- Loss Fraction 1.5 % at STC	
Module Quality Loss	Loss Fraction -0.8%	
Module Mismatch Losses	Loss Fraction 2.0 % at MPP	
Strings Mismatch loss	Loss Fraction 0.1 % at STC	

Incidence effect, ASHRAE parametrization	IAM=1-bo(1/cos i-1)bo param. 0.05

Table -4: Simulation parameter

Main simulation result	
Investment	294769 USD
Specific cost	0.93/WP
Running cost	3000 USD
Energy Cost	0.022 USD/kWh
System production	5499 MWh/year
Performance ratio	82.08%

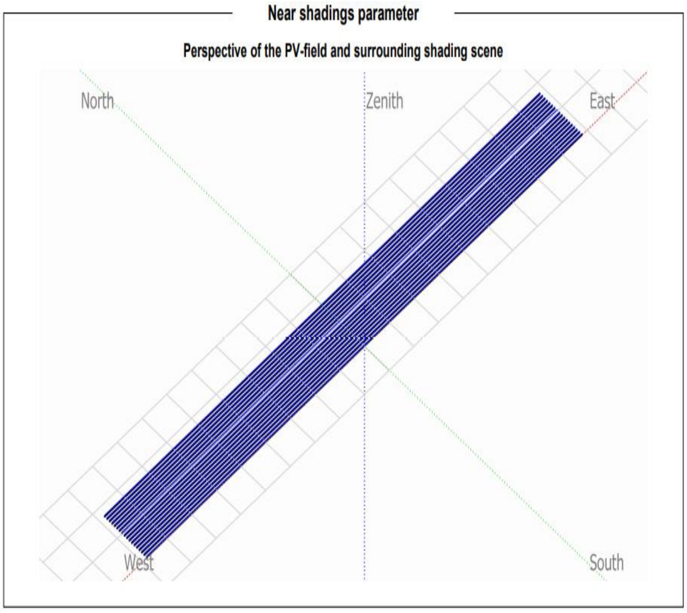


Fig -3: The Arranging the Panels in the Power Plant from The Point of View of Shading

Figure- 3 Shows the position of the power plant in three-dimensional space and determines the optimal distance of parallel rows to have the least amount of shading on each other. The position of the model shown in Figure 24) corresponds exactly to the latitude and longitude of the site.

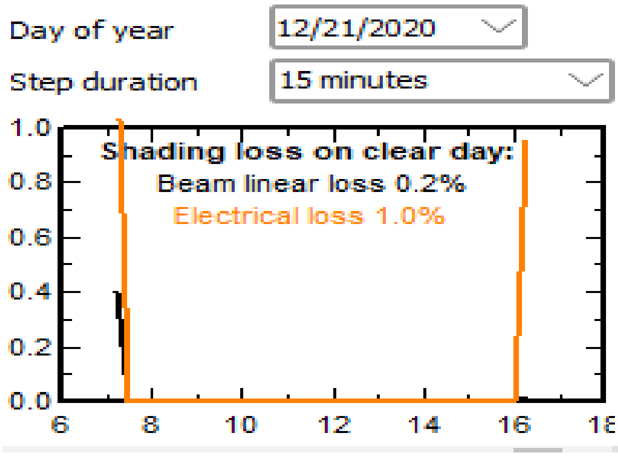


Fig -4: Effect of Shading in the Most Inclined State of Radiation and Its Losses

As in Figure- 4 It can be seen that the amount of shadows observed on the shortest day of the year, which is the most inclined state of the sun, is acceptable, because on other days of the year, the length of the shadows will be shorter. The chart above shows that on December 21st (the shortest day of the year) the shadow appears in a decreasing form on the power plant from 7 am to shortly after 8 am, and from about 8:30 am before 3 pm There is no shadow. From about 3 pm to 4 pm when the sun is setting, the length of the daytime shade increases again, which ultimately results in a loss of 0.2% on power plant production.

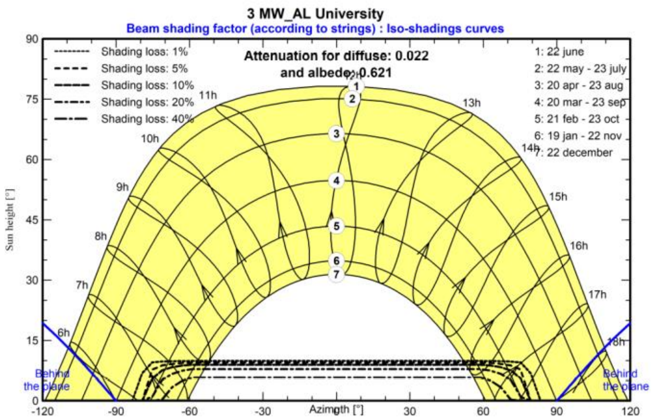


Fig -5: Shading Loss Chart

Figure- 5 Shows how the sun moves in the seasons of the year along with the percentage of losses due to shading at the power plant. As can be seen in the figure, different lines have continuous and dotted the losses from 1 to 40 %In the studied power plant, there is no shadow in the months marked with numbers 1, 2, and 3, in the months marked with the number 4, three groups of losses appear slightly at sunrise and sunset. The amount of these losses as we get closer to the left of the 5, 6 and the shortest day of the year, which is marked with the number 7, the more amplitude of the day is included.

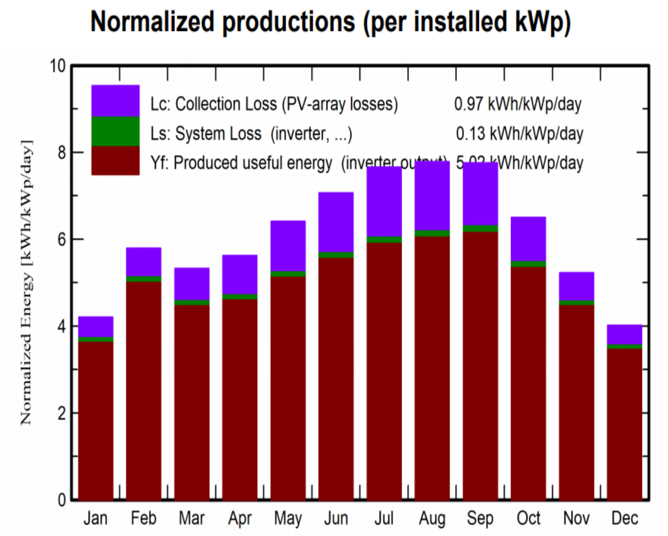


Chart-1: The Ratio of Energy Produced by the Photovoltaic Array to the Nominal Installed Amount

Chart- 1 shows the ratio of the amount of energy produced by a system's photovoltaic solar arrays to the nominal power installed per day during the month and year. In other words, this chart shows the monthly losses of energy received and system equipment in proportion to the energy produced by the inverter. This diagram is equivalent to the daily energy produced by the photovoltaic system designed in different months of the year, which is measured relative to the rated power of the power plant. Some of this energy is wasted in photovoltaic panels, inverters and other system equipment. As can be seen in the diagram, two categories of drops are shown, the green part is related to the system drop (inverter, etc.) and the red part is related to the radiation collection drop, which occurs in photovoltaic arrays. So, according to the observations, we can say that the inverters and the system have operated almost the same in different months, but the drop in arrays in June, September, July and August is the highest due to the hot weather.

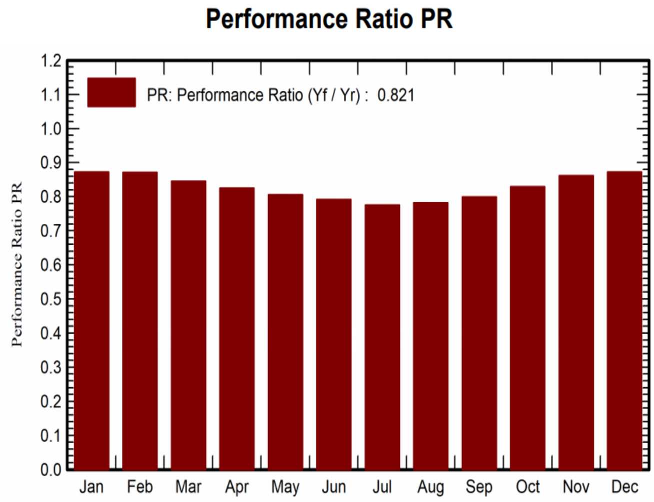


Chart-2: Performance Ratio of Designed Power Plant, In Different Months of the Year

The performance ratio of photovoltaic solar systems is one of the important indicators in evaluating the system. For grid-connected photovoltaic solar systems, the monthly performance ratio for a year between 75 and 85% is desirable. Figure 5.6 shows the performance ratio of the photovoltaic solar system designed in this study. Due to the drops caused by the increase in temperature of the photovoltaic module in summer, the system performance ratio has decreased. The average annual yield is 82.08%. Which is obtained by dividing the amount of energy injected into the grid by the amount of energy received by the panels. However, this grid-connected power plant can maintain its performance ratio up to about 25 well.

Fig-6: Graph of Energy Distribution Injected into the Grid in Relation to the Energy Received Per Unit Area of 35 Degrees

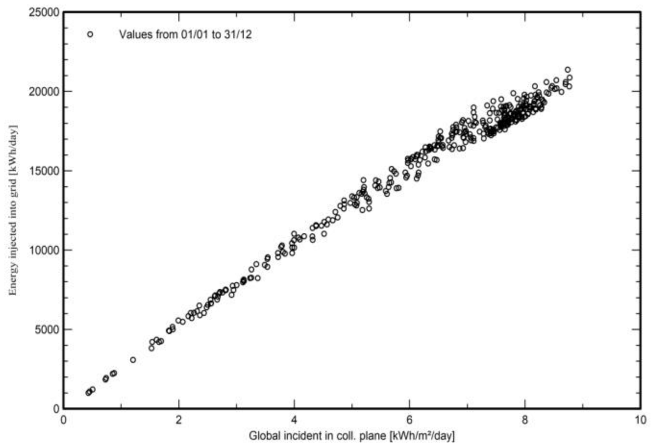


Figure 6 shows the distribution of the energy injected into the grid relative to the energy received per unit area.As in Figure 6 It can be seen that the statistical population is the number of days in which due to the increase in energy intake per square meter in the optimal installation angle of the area (35 degrees), has a high density, especially since the radiation reaches more than 5000 kWh per square meter As a result, the energy injected into the grid increases by 150,000 kilowatt hours.

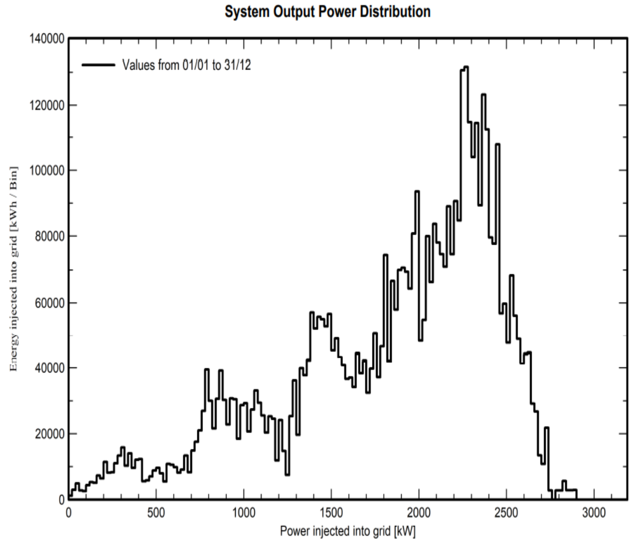


Fig-7: Diagram of Electricity (Kwh) Injection into the Grid From the Power Plant

Meteo data	Meteonorm 7.3 (2002-2012), Sat=100%
Specified Deviation	Climate change 3.0 %
Year-to-year variability	Variance 2.5%
Specified Deviation	• PV panel modelling/parameters 1.0 % • Inverter efficiency uncertainty 0.5% • Soiling and mismatch uncertainties 1.0% • Degradation uncertainty 1.0%
Annul production probability	Variability-0.17GWh P50- 5.50 GWh P90- 5.28GWh P95- 5.22 GWh

Table-5: P50 – P90 evaluation

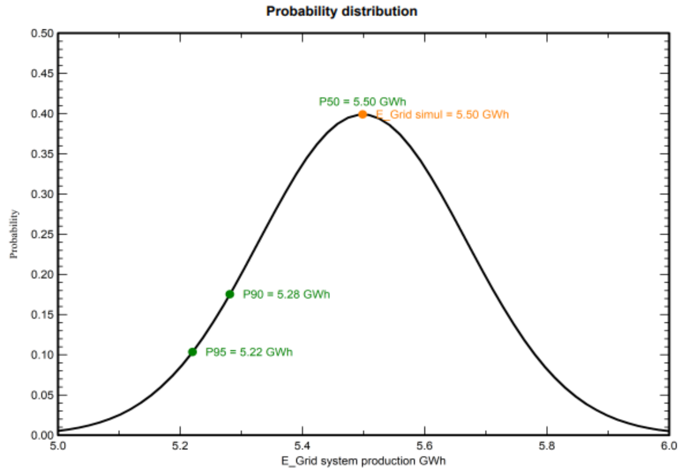
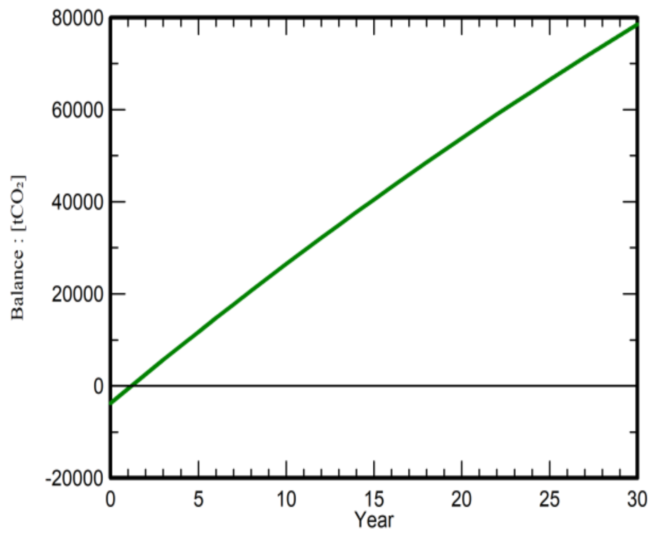


Fig-8: probability distribution

Generated Emissions	78550.3 ton CO_2		
CO2 Emission Balance	3748.68 t on CO2		
System Life Cycle Emission Details			
Item	LEC	Quantity	Subtotal
Modules	117kgCO2/kWP	3002 kWp	3352240 $KgCO_2$
Supports	5.27kgCO2/kWP	75060 kg	395514 $KgCO_2$
Inverters	309 kgCO2/units	3.00 units	928 kg CO_2

Table-6: Carbon dioxide blance

Fig-8: Saved Carbon Dioxide Emissions Vs Time



Balances and main results

	GlobHor kWh/m²	DiffHor kWh/m²	T_Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray MWh	E_Grid MWh	PR ratio
January	80.3	27.83	2.45	130.4	122.7	351.2	341.5	0.872
February	109.5	29.99	5.22	162.2	152.6	435.0	424.1	0.871
March	138.3	57.03	10.37	165.1	154.4	430.4	419.3	0.846
April	164.2	66.15	14.91	168.7	156.5	428.7	418.1	0.825
May	213.4	65.27	20.07	198.8	183.8	492.6	480.6	0.805
June	239.7	61.16	23.81	211.9	195.8	515.9	503.8	0.792
July	264.1	40.17	26.22	237.4	219.9	566.5	553.1	0.776
August	238.8	38.52	24.94	241.2	224.6	580.1	566.5	0.782
September	198.0	35.34	19.76	232.7	218.0	571.7	558.1	0.799
October	145.1	34.38	14.05	201.4	189.4	513.9	501.4	0.829
November	98.6	31.27	7.97	156.9	147.7	415.9	405.8	0.861
December	74.3	28.75	4.08	124.5	116.7	334.9	326.2	0.872
Year	1964.5	515.84	14.54	2231.4	2082.0	5636.9	5498.6	0.821

Table-7: Balance and Main Simulation Results for ALU

Table (7) presents the following results:

- ✓ System efficiency varies between 10.2 and 12.6 percent.
- ✓ The highest efficiency occurs in December and January.
- ✓ Most efficiency occurs where the weather is colder.

Table-8: Economic Evaluation of ALU Pv power plant

No.	Explanation	Unit	Price/USD
Direct cost of P_v power plant			
1	Pv Panels	7506	-
2	Supports for Pv Panels	7506	
3	Inverters	3	
Studies and analysis			
4	Engineering	1	-
5	Permitting and other admin fees		
6	Environmental studies		
7	Economic analysis		
8	Installation		
9	Transport		
10	Accessories, fasteners		
11	Wiring	1514	
12	Settings		-
13	Grid connection		
14	Land cost		
15	Land preparation		
16	Gross investment		2889700
17	Taxes and subsidies		
18	Taxes	2%	57794
19	Net investment		2947494
Operation cost			
20	Maintenance		-
21	Salaries		
22	Reparation		
23	Cleaning		
24	Total		3000
System summary			
25	Net investment		2947494
26	Own funds		2947494
27	Loan		0
28	Total yearly cost		3000
29	Produced Energy		5499 MWh/year
30	Cost of produced energy		0.022USD/KWh
Return on investment			
31	Project lifetime	25 year	-
32	Payback period	5.9 year	-
33	Net profit at end of lifetime		8631862.47
34	Return on investment (ROI)		391.9%

5. Conclusion

Universities and factories, in addition to having the highest electricity consumption compared to households in Afghanistan, also have the largest share in the country's summer and summer electricity peak. Therefore, equipping them with a Grid-Connected solar photovoltaic renewable energy source to produce clean energy can help ensure clean energy sustainability and environmental protection, and reduce the challenge of the electricity crisis in summer and winter. Therefore, installing solar panels to supply electricity to universities can be a way to achieve these goals from a renewable solar energy source, and on the other hand, it can be a way to lead universities to self-sufficiency in terms of electrical energy.

In this paper, the design and economic analysis of a 3 MW Grid-Connected solar power plant for ALU was performed using PVSyst software. The simulation performed using PVSyst software in this study showed that the construction of a Grid-connected photovoltaic solar power plant with a capacity of 3 MW at ALU can produce energy 5499 MWh/ year, while the university consumes energy 5384 MWh/year. So it can be concluded that the maximum production of this power plant corresponds to the energy consumption of ALU. That is, it completely covers the university's electricity consumption. In addition, the solar power plant is capable of preventing an average of more than 78,550.3 tons of carbon dioxide emissions during its lifetime to generate electricity.

The economic analysis of this power plant has shown that the total consumption of the project is 294769 USD, which Payback period is 5.9 year and the life of the power plant is 25 years. This indicates that the construction of a Grid-connected photovoltaic power plant for this university in Kapisa can be a source of stable and reliable income for the university in addition to ensuring the sustainability of university energy and environmental protection in Kapisa.

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