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Design and performance analysis of 1 mw solar photovoltaic energy system in Iraqi using PVsyst software

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ABSTRACT

Energy is the most important reason for global economic growth namely Required to support modern economic growth The economy depends on long-term access to energy from more reliable sources less cost, and less carbon dioxide emissions and environmentally friendly. The environmental concerns about power plants that run on fossil fuels and high fuel costs, pushing most countries of the world to research and develop renewable energy sources generating electricity using a renewable energy source are the only key to improving Energy efficiency energy quality issues and sustainable energy savings. This goal can be achieved by installing small generators such as photovoltaic systems wind and fuel turbines Cells small turbines and generators of internal combustion engines Renewable energy in the world has many sources that are limited to two types, small and large-small uses of solar generators and wind turbines The large uses of aqueous biomass are geothermal solar energy and wind energy fuel cells. A 1 MW solar photovoltaic (PV) plant system has been installed at Diyala. This paper presents the design and performance analysis of this system using a PVsyst software package. The performance ratio and different losses that occurred in the system are also calculated. The average energy in the network is 1921 MW / H. Based on the simulation results developed in this paper, the practical PV grid-tied system has been implemented in the Diyala site.

Keyword: *Grid-Connected, Power Loss, Solar PV System, PVSYST Software, Performance Ratio*

1. INTRODUCTION

Sustainable electricity and transportation have become the grand challenges of the twenty-first century from the political, economic and societal point of view (**Siva et al., 2018**). The utilization of fossil fuels for transportation and energy-related issues is among the biggest source of anthropogenic carbon emission, accounting for about 60% of the global CO2 emission. Electricity as the backbone of development of any society has already contributed 37.5% of the total CO2 emission in the globe releasing 7700 million tonnes of CO2 annually; this is an indication that serious transition is necessary for decarbonising electricity across the globe (**Jules et al., 2018; Moutinho et al., 2016; Ahmed Shata, 2012; Safari, 2011**). Considering the amount of CO2 from the electricity sector, it is clear that, a sustainable electricity supply is the major challenge of the developed, developing and underdeveloped countries across the globe. Fortunately, several methods of decarbonising electricity generation are already identified in the global energy sector. Among the identified methods includes the use of efficient fossil fuels electricity systems (CHP), conventional fossil fuel electricity generation technologies with carbon capture systems and the use of renewable energy technologies for small, medium and large scale electricity applications (**Siva et al., 2018; Moutinho et al., 2016; Safari, 2011**). Although it can be argued that, what happened to the intermittent nature of renewable energy sources in electricity generation since renewable energy sources depends upon the season of the year. This is the driving factor that makes the globe to look at renewable electricity technologies as failing to be an everlasting solution to the energy supply and security across the globe where renewable energy resources are readily available, and cheaper to explore in comparison to grid expansion (**Camille et al., 2016, Diafa et al., 2013**). In most of the studies explored in the literature, it is clear that investigation of renewable electricity generation potential using substantive evidence derived from meteorological datasets has the potential of providing to the authorities and individuals, clear and concise information in designing policies, for the penetration of renewable energy resources in electricity generation.

2. AIM AND IMPORTANCE OF PRESENT PAPER

The goal of this thesis is to propose setting up a solar power station with a capacity of 1 MW in the city of Diyala. This station aims to fill the power supply in the city by connecting the station to the network and it is useful in times of the day. This station is designed using the PVSyst program. This program is one of the most important programs used in the Design of connected and discrete systems in the network to provide good results. The location of the city of Diyala is a good location to set up the station because this city has radiation and a good temperature throughout the day. This paper aims to explore ways to save more energy in Iraq. The proposal seeks to develop different methods of generating solar energy. When this proposal is used, the people of Diyala will be provided with cheap, reliable and efficient electricity. This is an innovative use of generating electricity as it has many advantages: Non-pollutant, cost of fuel is eliminated, cost effective maintenance, Variety of locations for installation, Reduced electricity tariffs, the payback period is much less than the plant lifespan.

3. GEOGRAPHICAL CONDITIONS

Diyala Governorate is located in the north-eastern part of Iraq within five cities, which are the Governorate of Khalis, Khanqin, Muqdadiyah, and Baladruz.Diyala Province has enough solar radiation to support Building photovoltaic power stations. Data source from National Aviation and Space Web Site (NASA) using geographic coordinates; Longitude 33.7543414 The 44.6421081th latitude shows the mean (22-year period; July 1983 - June 2005) monthly global Horizontal irradiance 5 kWh / m2/ The day and peak hours of the sun are approximately 5 hours per day. The average temperature warmest in the Kirehi area is 35 ° C at longitude33N and latitude 44E. The Solar Exposure curves in Diyala show that radiation levels in June (6.55 Sun) have been shown in Figure 1

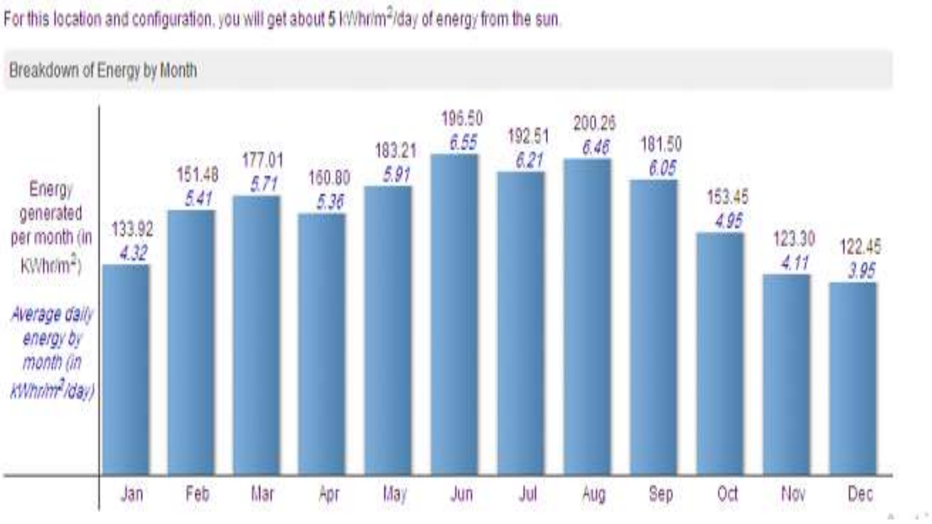

Figure 1 Solar exposure for Diyala city throughout the year

4. THE DEVELOPED PV GRID-TIED SYSTEM

Pv Syst system feature enables you to design your PV system in accordance with your requirements. Detailed information on the desired output power, type of module to be used; Wp manufacturer and output power, type of inverter by manufacturer and size, shading effects, inverter size, economic analysis, etc. should be entered into the system. According to the load estimates made in the previous chapter, a 1000kw photovoltaic power plant needs to be built in diyala. The plant will be made up of modules 1984. The module chosen for the simulation is the Samsung PV-TMS-DE18M-(II)-505: 505W power rating. Open circuit voltage Voc is 51.9V, short circuit current Isc is 12.350A, maximum point current and voltage (Imp, Vmp) are 11.750 and 43V, nominal operating cell temperature is 500C, made up of 150 cells, area is 1098mm (length) x 2176mm (width). A simplified diagram showing the Pvsyst system building blocks is shown below Figure 2 & 3. The user E needed in the diagram refers to the energy used by the plant; lighting, data acquisition and peripheral needs.

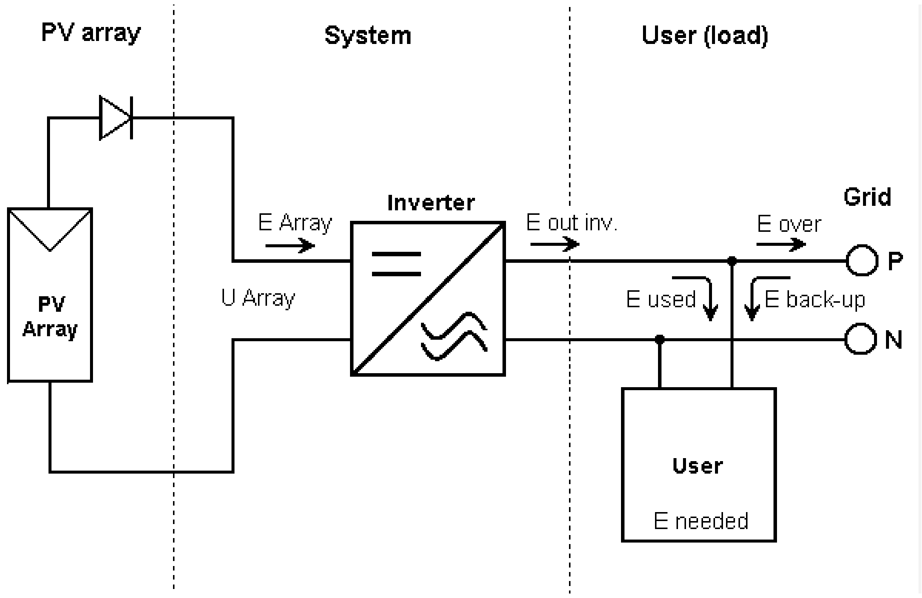

Figure 2 Grid-Connected PV system simulated in PVsyst Software

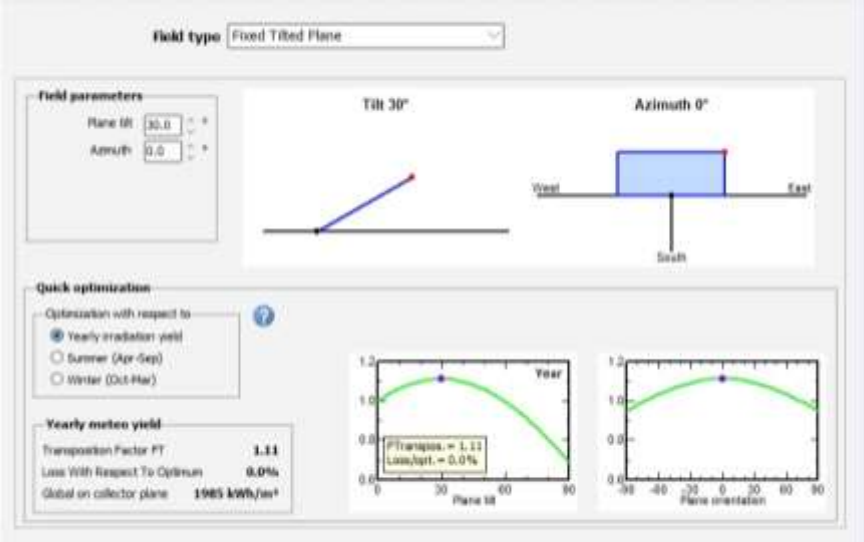

Figure 3 Inclination and Orientation.

5. RESULTS AND DISSECTIONS

Normalized productions will rewrite your text. Start by Normalized productions such as collection losses, system losses and produced useful energy per install ledk Wp/day were evaluated from the simulation study, see in Figure 4. the highest useful energy produced occurred in Apr May Jun, with Apr recording the highest These normalized productions are defined by the IEC norms and are standardized variables for assessing the PV system performance. Lc is the Collection losses or the PV array capture losses i.e. 1.19 kWh/kWp/day. Ls is the system loss i.e. 0.08kWh/kWp/day and the Yf is the produced useful energy i.e. 5.25 kWh/kWp/day. y writing or pasting something here and then press the Paraphrase button.

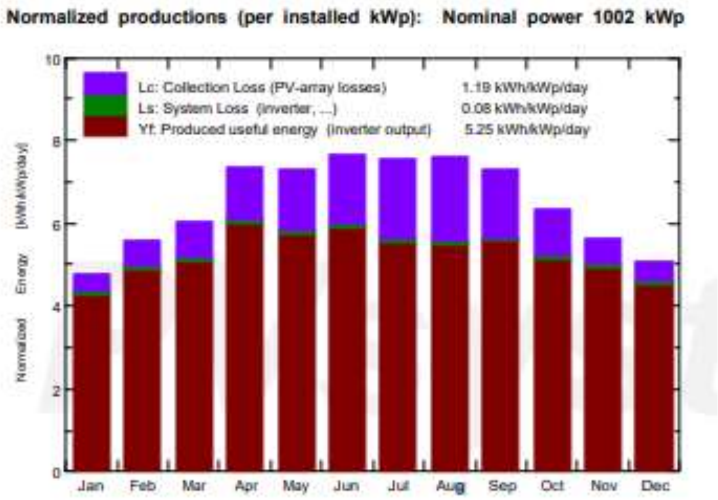

Figure 4 Normalized productions

Performance ratio (PR) for the simulated 100 KWP Si-poly photovoltaic system is 80.0 %, which is the annual average PR value. There is small variation in PR value on monthly basis, which can be seen in Figure 5 and monthly values were tabulated in Table 1.

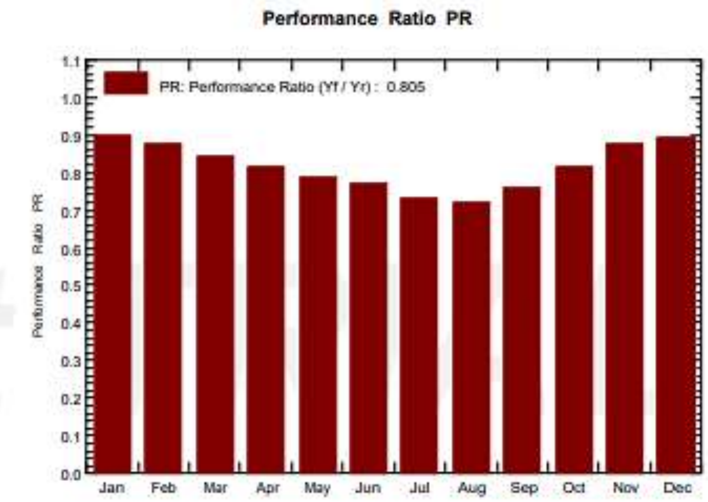

Figure 5 Performance Ratio

Table 1 variation in PR value

	GlobHor kWh/m²	DiffHor kWh/m²	T_Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray MWh	E_Grid MWh	PR ratio
January	99.4	41.85	10.71	148.4	146.1	135.2	133.1	0.895
February	116.1	44.26	12.61	156.1	153.8	139.2	137.1	0.877
March	159.4	67.01	21.24	187.6	184.5	160.5	158.0	0.840
April	208.9	69.05	25.10	220.6	216.6	183.3	180.5	0.816
May	234.4	82.77	31.97	226.0	221.7	181.2	178.4	0.788
June	251.9	72.73	34.60	229.8	224.5	179.9	177.1	0.769
July	251.0	75.16	39.50	234.5	229.1	174.1	171.4	0.730
August	232.3	70.37	39.80	236.1	231.3	172.9	170.2	0.719
September	191.2	58.38	35.12	219.4	215.7	169.7	167.1	0.760
October	151.5	55.03	27.89	196.1	193.0	161.8	159.3	0.811
November	114.3	40.50	14.72	168.7	166.4	150.4	148.1	0.876
December	100.4	37.39	11.63	157.7	155.7	143.3	141.1	0.893
Year	2110.8	714.49	25.49	2381.0	2338.3	1951.4	1921.4	0.805

Arrow loss plot is a useful diagram for analyzing process losses. While installing PV plant or constraints to be considered, they will be encountered.

The diagram for arrow loss can be seen in Figure 6 Which reflects the different losses in the process. On the horizontal plane, global radiance is 2111 kWh/Sq. m. Oh, but the Effective collector irradiance is 2338 kWh/Sq. m. This results in -0.34% energy loss due to irradiance, i.e. Niveau. When this efficient irradiance falls on the surface of a module or array of photovoltaic electricity or electricity energy is generated. After PV conversion, the array nominal power at STC test condition is 2344MWhMegawatt. The PV array efficiency at STC is 21.15%. MPP's annual yield is currently 1986 MWh.

The various losses occur in this stage are -12.68 % losses due to temperature, -12.67 % loss due light induced degradation, 1.0 % loss due to module array mismatch and -1.3 % is the Ohmic writing losses. Available energy on annual basis at the inverter output facility is 1921 MWh and the same is injected to grid. Here two losses were possible, one is inverter loss during inverter operation i.e. -1.49 % and inverter loss over nominal inv. power is 0.0 %

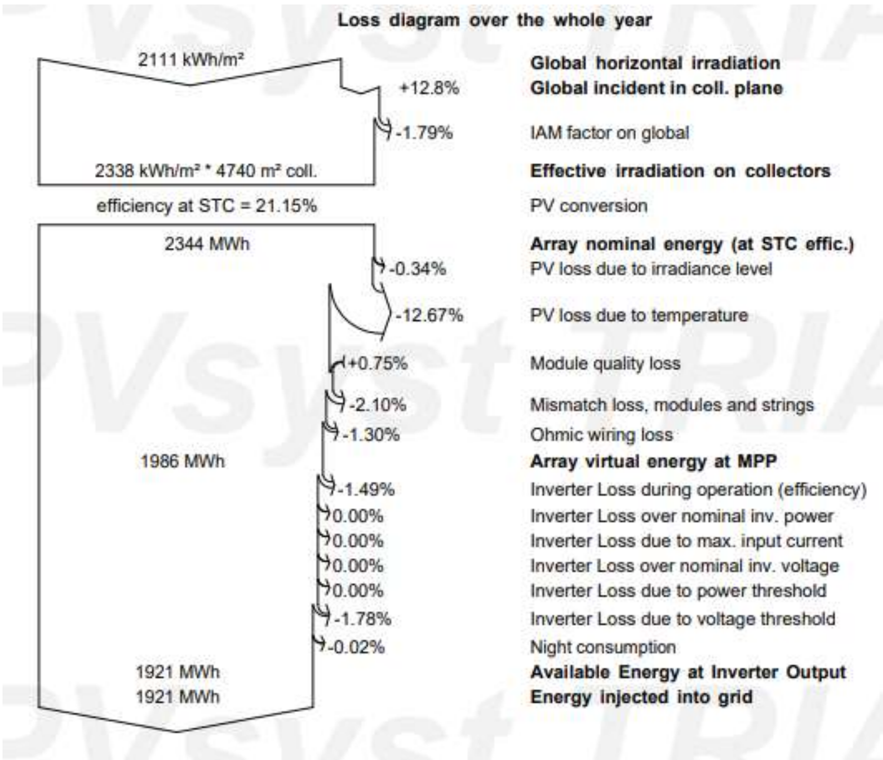

Figure 6 System Losses

Table, Detailed system losses are represented on a monthly basis. 2183023.836kWh is the sum of the various losses (ModQual, MisLoss, OhmLoss, EArMPP and InvLoss). This does not mean that 2183023.836kWh is a "loss," because the fuel is free of irradiance for PV systems, ModQual also represents a loss of module quality and illustrates the percentage of irradiance that can be converted into electricity. While increasing the efficiency of modules, MdQual losses will be greatly reduced, thereby reducing total plant losses.

Table 2 Detailed System Losses

	ModQual kWh	MisLoss kWh	OhmLoss kWh	EArrMPP kWh	InvLoss kWh
January	-1039.115	2931	1428	135228	8110
February	-1071.693	3023	1689	139252	7874
March	-1238.790	3495	2039	160877	9979
April	-1419.752	4005	2596	184119	11201
May	-1417.422	3999	2524	183885	13298
June	-1419.076	4003	2569	184057	14451
July	-1413.601	3988	2611	183295	19024
August	-1417.632	3999	2717	183719	19962
September	-1351.921	3814	2551	175244	14000
October	-1254.909	3540	2176	162860	10080
November	-1156.943	3264	1769	150383	7601
December	-1101.309	3107	1583	143252	7156
Year	-15302.164	43167	26254	1986169	142736

From the main simulation results, three main parameters were assessed. First parameter is the total amount of energy produced from the 1 MWp Si-poly photovoltaic system on annual basis which is referred as produced energy i. e1921 MWh/year. Second parameter is the specific production on annual basis per installed kWp is 1921000kWh/kWp/year. Third parameter is the annual average performance ratio (PR) is 80.5 %. Table 3 show Balances and main results of 1 MWp systems Si-poly photovoltaic

Table 3 Balance and Main results

	GlobHor kWh/m²	DiffHor kWh/m²	T_Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray kWh	E_Grid kWh	PR ratio
January	99.4	41.85	10.71	148.4	146.1	135228	127119	0.855
February	116.1	44.26	12.61	156.1	153.8	139232	131378	0.840
March	159.4	67.01	21.24	187.6	184.5	160488	150898	0.803
April	208.9	69.05	25.10	220.6	216.6	183283	172917	0.782
May	234.4	82.77	31.97	226.0	221.7	181160	170587	0.753
June	251.9	72.73	34.60	229.8	224.5	179948	169605	0.737
July	251.0	75.16	39.50	234.5	229.1	174135	164271	0.699
August	232.3	70.37	39.80	236.1	231.3	172851	163757	0.692
September	191.2	58.38	35.12	219.4	215.7	169690	161243	0.734
October	151.5	55.03	27.89	196.1	193.0	161791	152779	0.778
November	114.3	40.50	14.72	168.7	166.4	150367	142782	0.845
December	100.4	37.39	11.63	157.7	155.7	143250	136097	0.861
Year	2110.8	714.49	25.49	2381.0	2338.3	1951424	1843432	0.773

6.CONCLUSION

Research and studies continue to develop the solar energy cell as it provides sustainable and economical energy in the long term and at the same time is environmentally friendly Where the photoelectric cell can be compared with another system based on solar energy, the photovoltaic cell proved more effective than other systems in generating electrical energy at the lowest cost and ease installation and maintenance.

The national system faces problems in the large volume of electrical energy consumption at the height of the summer season, as temperatures rise in the summer to 50 degrees Celsius during the day, and thus the increased demand for electrical energy, and therefore the national system faces a shortage of hours for preparing electrical energy during the daytime of the summer season The main objective of this thesis is to increase the production of electrical energy by proposing a 1MW photovoltaic power station in Diyala city to support the national system with electrical energy during the daytime period to reduce the power deficit and increase the processing hours This will be achieved by designing and evaluating a 1MW PV plant using one of the most important solar design software, PVSyst. The results and simulations obtained from the photovoltaic station in Diyala Governorate. The average energy in the network is 1921 MW / H Due to the abundance of theories and extensive applications in the research, academic and industrial work of the PV cell, the design of the photovoltaic cell by the PVSyst program can be considered a good choice.

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