Developing and Evaluation Metrics of 8 KWP Electricity Supply Berbera Area Photovoltaic by using Pvsyst Software

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Abstract:- Because of its dependability and effectiveness, grid-connected photovoltaic systems constitute the majority of the market for this technology. It is currently of utmost importance to have a system that can supply an adequate amount of power under ideal circumstances and deliver a considerable level of performance over time. This Photovoltaic array system that is connected to the grid is examined in the following study. It is planned to produce a nominal power of 8kWp at STC, and its design is simulated with PVsyst software. The study concentrates on important aspects such as system production, output power losses with a Sankey diagram, performance ratio (PR), and output energy of the system to be located, analyzing the output of PV modules, adjusting the field type, and sketching curves of power distribution and temperature distribution. system production, output power losses with a Sankey diagram, performance ratio (PR), and output energy of the system to be located. In addition to that, the findings of this study show how power is distributed during output and highlight how necessary it is to pay attention to module connections throughout the design phase of string construction.

Keywords:- PVsyst, Tilt Angle, STC, Performance Ratio, Inverter, Berbera.

I. INTRODUCTION

Having enough power to go through the day-to-day grind in today's environment is a need. The rise in population hurts energy use. The expansion of the human population brings with it an increase in the demand for energy; consequently, the state of the world's energy supplies is deteriorating. In order to satisfy the growing need for energy, which is mostly met by the production of carbon-rich fossil fuels such as petroleum, coal, and natural gas.

With limited availability, low efficiency, and unfavorable effects on the climate as a result of climate change, Researchers sought to replace carbon-rich fossil fuels with renewable energy sources[1]. In the wake of the discovery of the photovoltaic (PV) cell, solar energy became a major power source. As a result of its ability to convert solar radiation directly into electricity, solar energy is presently the world's third largest generator of electric power. With a 25% stake in energy production, solar photovoltaic energy is a fast-evolving power source. [2] Industries, institutions, and homes are all now using solar panels. [3] Solar cell efficiency and power production is a separate scientific issue that is being explored. The most important problem currently is to maximize the use of the existing solar energy source so that it yields the most efficiency possible. Photovoltaic (PV) systems need to be set up in order for solar radiation to be converted into usable electricity. Because they are easy to set up and do not need for the use of a battery, grid-connected photovoltaic (PV) systems are preferred. A stand-alone system around the world has just 1% of this system's storage capacity. This system has no storage losses and has a long lifespan.

Nevertheless, a grid's great photon penetration can have deleterious impacts [4], [5]. Energy consumption can be reduced and power generation boards can be supplied through bidirectional net energy metering, which is available. For isolated locations, a Standalone photovoltaic system is a viable option, but it requires energy storage. Because of storage losses and inefficiency, they're also very expensive. [4] and [6]. With the help of PVSYST software, 8 kWp nominal power solar system that is connected to the grid is studied in this instance.

II. PVSYST SIMULATION

PVSYST software is one of several types of PV simulation software available for assessing how well a Solar photovoltaic functions under different conditions of use. Grid-connected, Stand-alone, Pumping, and DC Grid photovoltaic systems, preliminary and proa Solar photovoltaic functionject design as well as the economic evaluation parameters, it provides a huge amount of meteorological and component data. Some researchers have used PVSYST simulation software to describe the The energy yield and economic properties of a PV system that is connected to the grid [7]. The PVSYST simulation software has been utilized by a select group of researchers in order to explore multiple varieties of solar cells, such as amorphous silicon, polycrystalline, and monocrystalline varieties. Altering the tilt angle of the solar panels and inverters was something that was done by other authors as well. [8]

III. SITE AND METEOROLOGICAL DATA SELECTION

When it comes to the location and the identity of the area, the installation of the photovoltaic power plant is essential. PVSYST makes available a vast quantity of meteorological data from a variety of sources, including Meteonorm, NASA-SSE, and PVGIS TMY, which may be linked to the geographical region of our choosing. A location with the coordinates (10.44 degrees' north latitude and 45.01 degrees East longitude) is being looked at for this study. This region is close to the city of Berbera, which is in the north of Somalia. The site receives direct sunlight for a minimum of five hours on each of the 365 days of the year, with a high of fourteen hours on any given summer day [11]. Table 1 represents the information that was derived from the Meteonorm data source using PVSYST software. This data was used to create the monthly geographical conditions of Berbera. Fig1 illustrates the Berbera geographical map.

Table 1 Monthly Geographical Conditions

Month	Global Horizontal irradiation (KWh/m2)	Diffuse Horizontal irradiation (kWh/m2)	Temperature (°C)
January	171.5	58.9	25.5
February	167.0	60.8	26.4
March	213.4	66.7	28.3
April	198.2	74.9	30.1
May	210.6	75.2	33.6
June	177.8	87.5	36.4
July	185.3	94.6	36.5
August	192.3	91.8	36.2
September	190.5	72.9	34.2
October	190.0	71.3	30.5
November	179.3	53.1	27.8
December	166.0	58.5	26.7
	2241.9	866.3	31.0

Fig 1 Berbera City Geographical Location

IV. GRID CONNECTED PHOTOVOLTAIC SYSTEM SCHEMATIC DIAGRAM

In this computer-generated design, photovoltaic panels are linked to an inverter, which is linked to the grid. The concept does not include a battery storage system because The power that is produced is then distributed throughout the larger grid system. As shown in this diagram, solar power is created at a solar power plant and then distributed to customers.

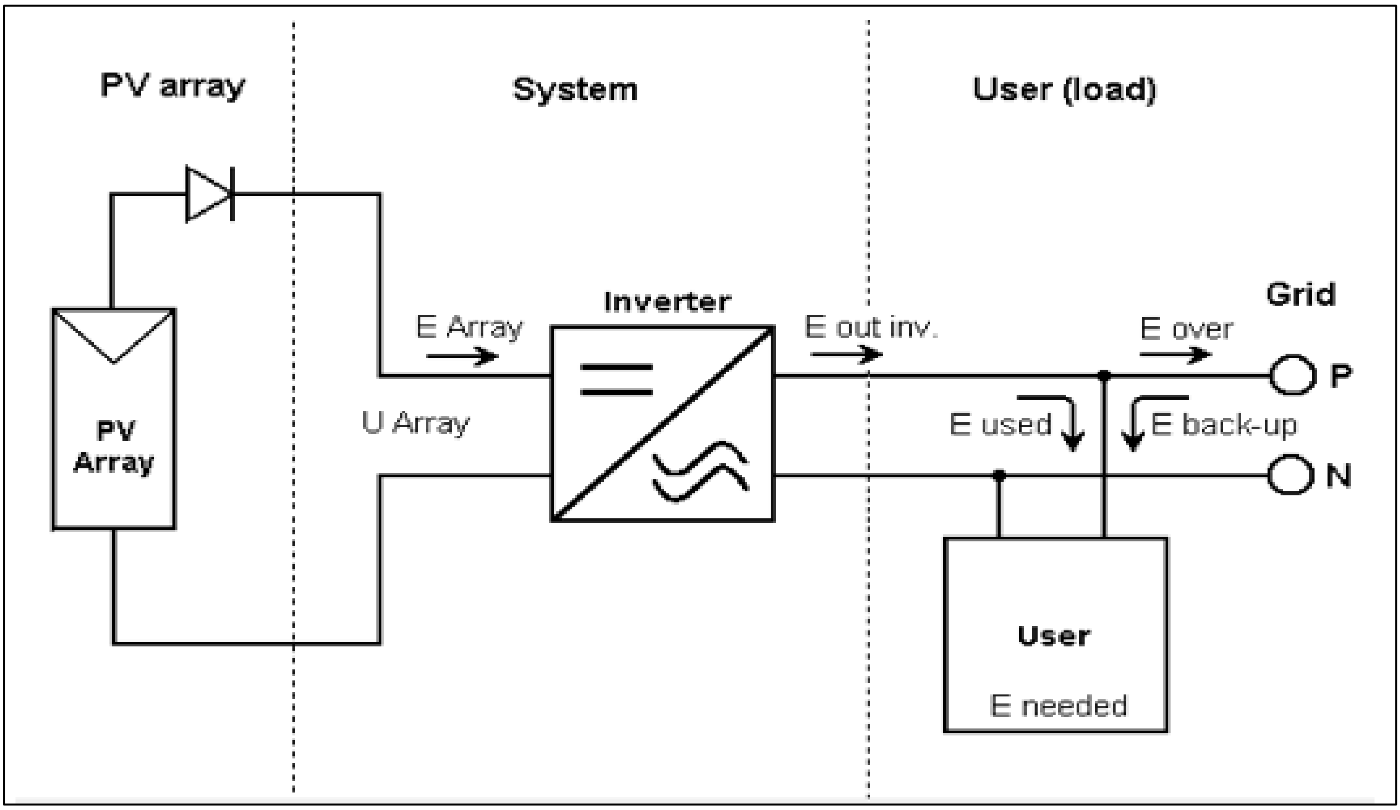

Fig 2 Schematic Diagram of Grid Connected PV System

PV Array Characteristics					
PV module	Si-mono	Model	**LG 250 S1C-G3**		
Original PVsyst database		Manufacturer	LG Electronics		
Number of PV modules		In series	16 modules	In parallel	2 strings
Total number of PV modules		Nb. modules	32	Unit Nom. Power	250 Wp
Array global power		Nominal (STC)	**8.00 kWp**	At operating cond.	7.08 kWp (50°C)
Array operating characteristics (50°C)		U mpp	422 V	I mpp	17 A
Total area		Module area	**52.5 m²**	Cell area	45.9 m²
Inverter		Model	**Sunny Mini Central 8000 TL**		
Original PVsyst database		Manufacturer	SMA		
Characteristics		Operating Voltage	333-500 V	Unit Nom. Power	8.00 kWac
Inverter pack		Nb. of inverters	1 units	Total Power	8.0 kWac
				Pnom ratio	1.00

Fig 3 PV Module and Inverter Characteristics

V. SELECTION OF PV MODULE AND INVERTER

The kind of module, its energy output, its efficiency, and its cost are the primary considerations that guide the selection of a photovoltaic device. These features differ depending on the type of module being used, which can be either crystallographic orientations include mono-, poly-, and amorphous [8, 9]. Throughout of this investigation, several number of distinct modules have been analyzed. From among the modules that are currently supported by the PVSYST software, the 250Wp Si-mono silicon PV module has been selected as the most advantageous choice. This module is

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made up of thirty-two solar cells that were manufactured by generic. Table2 presents the relevant specifications for this topic. The software suggests connecting 16 PV modules in series and 2 strings in parallel to achieve the highest possible level of performance from the chosen module. Fig4 illustrates the variance in the effectiveness of a particular PV module as a function of the global incoming radiation experienced at different temperatures. With the assistance of an inverter, the direct current (DC) that is produced by the photovoltaic module is changed into alternating current (AC). For the simulation employing the solar modules, a Generic 8-kilowatt maximum power point tracker (MPPT) inverter with one (1 unit) maximum power point tracker was utilized. This inverter was chosen based on the inverters that were analyzed and made accessible by the PVSYST software. Any solar system must have a photovoltaic module as well as a converter. These are the two most important parts. In Fig5 The current-voltage curve illustrates the size of the array's voltage, whereas the output energy vs array power diagram in Fig6 illustrates the array's output energy. As can be seen down below.

Table 2 Manufacturer Specification and another Measurement of PV Module

Type	**Si-Mono Crystalline**
Number of Modules	32
Maximum Power	250 Wp
Maximum Voltage	29.80 V
Open-Circuit Voltage	37.5
Maximum Current	8.38 A
Short-Circuit Current	9 A
Efficiency	17.44 %

Table 3 Specification of Inverter

Type	**Grid inverter**
Input Voltage (DC)	333-500 V
Input Current (DC)	25 A
Number of Phases	3Phase
Number of inverters	1
O output Voltage (AC)	228.5
Efficiency	98 %

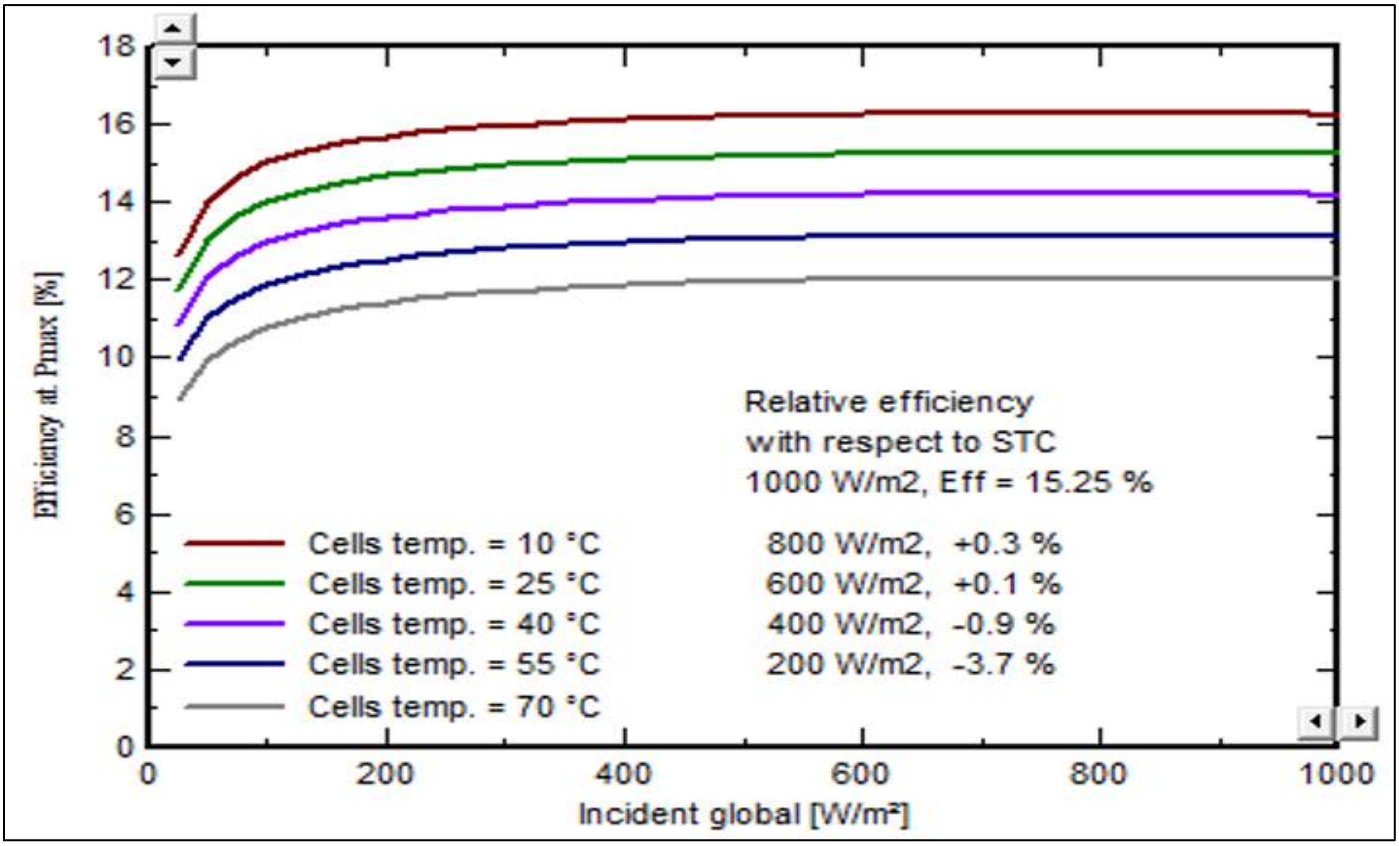

Fig 4 PV Module LG Electronic Si-mono 250Wp, 32 cells

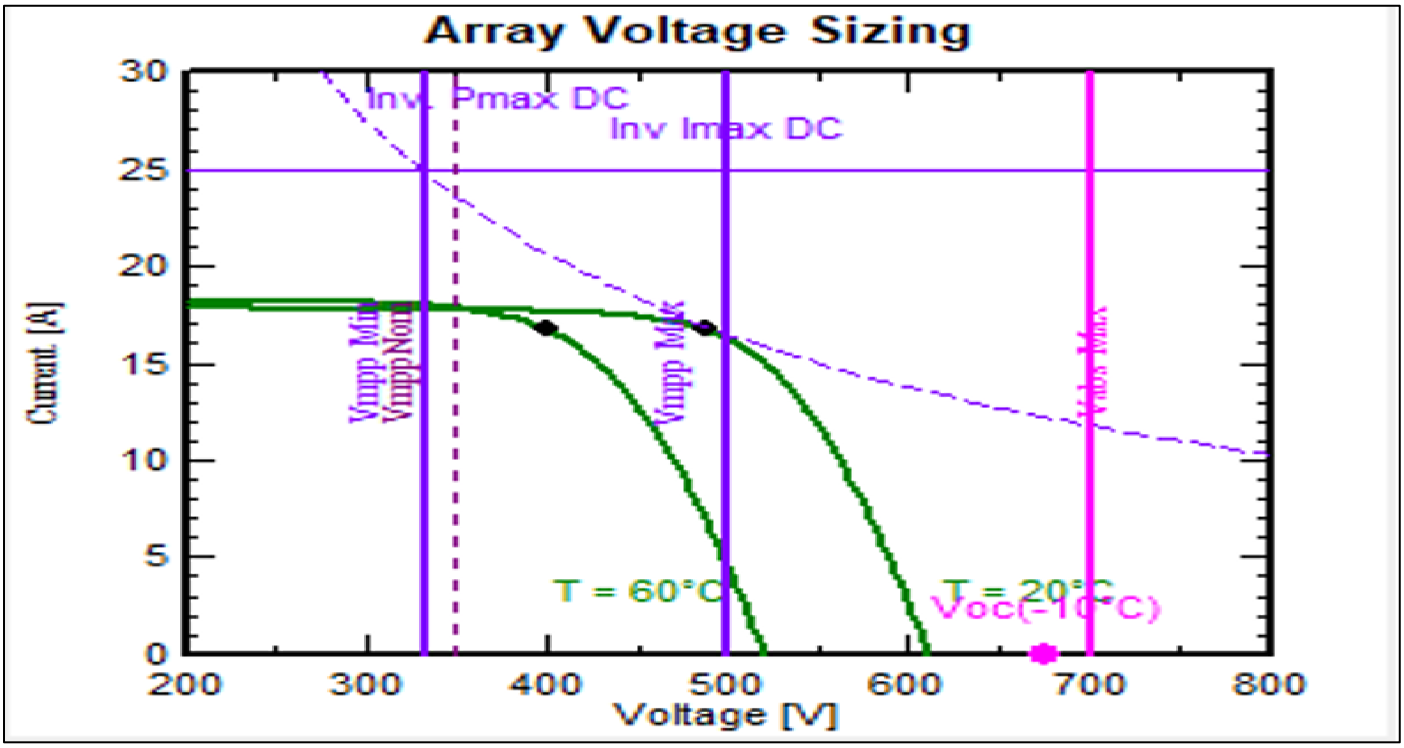

Fig 5 Array Voltage Sizing

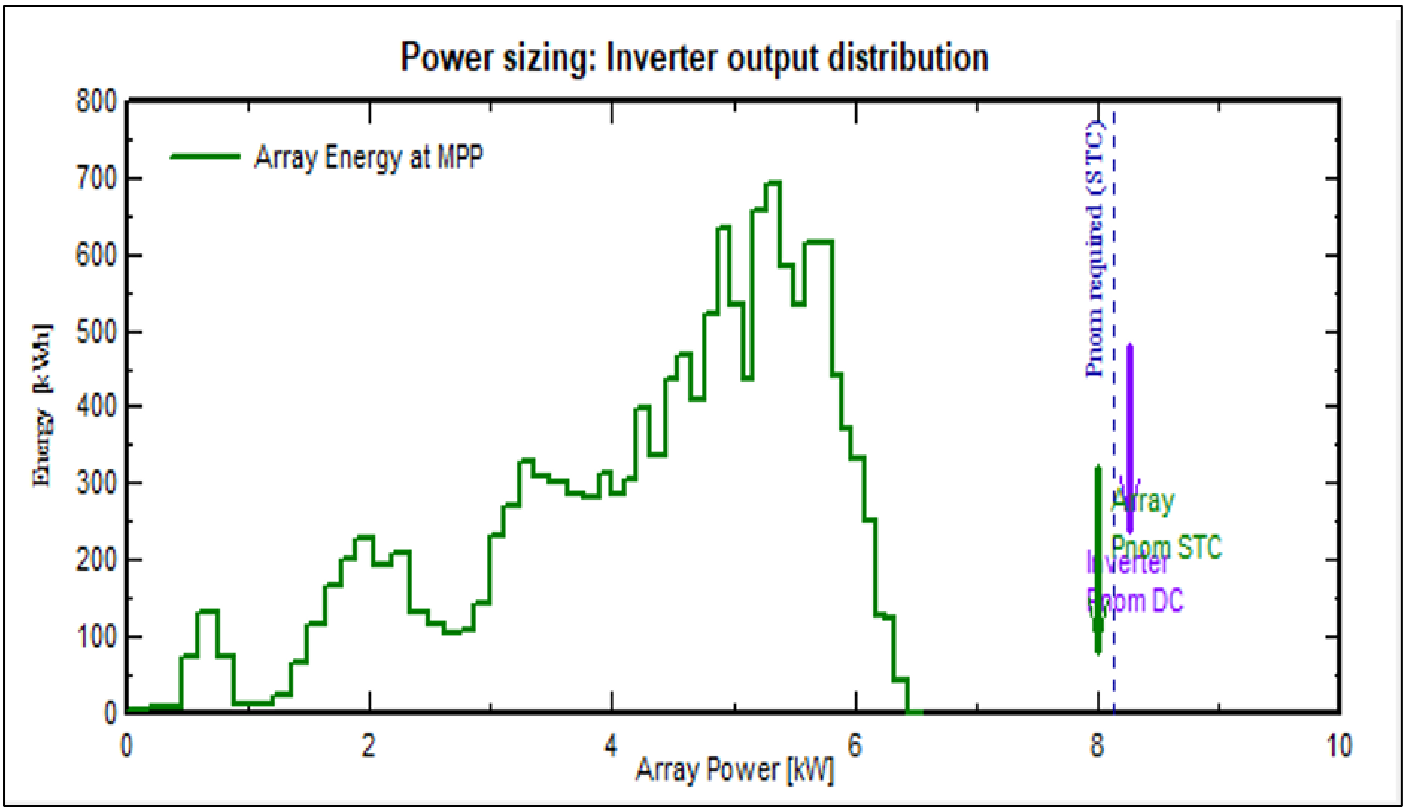

Fig 6 Power Sizing- Inverter Output Distribution

VI. RESULTS AND DISCUSSION

After taking into account the many parameters and doing an in-depth analysis of the proposed system, this step will simulate the design and generate the findings. The detailed examined the PVSYST software was used to model the proposed 250Wp monocrystalline, dual axis tracking PV module system's performance. The software displays the input and output energy diagram, daily normalized production, daily output energy, performance ratio, and Sankey diagram in addition to the balance and primary findings. The 8kWp Monocrystalline PV system's total power and performance ratio are evaluated in Fig9 financial statement and key outcomes.

	Horizontal global irradiation	Horizontal diffuse irradiation	Temperature	Wind Velocity	Linke Turbidity	Relative Humidity
	kWh/m².mth	kWh/m².mth	°C	m/s	[-]	%
January	171.5	58.9	25.5	3.60	3.885	72.8
February	167.0	60.8	26.4	3.10	3.831	71.5
March	213.4	66.7	28.3	3.10	4.236	69.8
April	198.2	74.9	30.1	2.60	4.236	69.8
May	210.6	75.2	33.6	2.60	4.744	63.4
June	177.8	87.5	36.4	3.10	6.947	52.1
July	185.3	94.6	36.5	4.69	7.000	47.2
August	192.3	91.8	36.2	4.69	6.693	47.9
September	190.5	72.9	34.2	2.61	5.168	62.2
October	190.0	71.3	30.5	3.10	3.987	65.1
November	179.3	53.1	27.8	3.10	3.776	67.1
December	166.0	58.5	26.7	3.09	3.776	69.3
Year ?	**2241.9**	**866.2**	**31.0**	**3.3**	**4.857**	**63.2**
	Paste	Paste	Paste	Paste		

Horizontal global irradiation year-to-year variability 5.2%

Fig 7 Balance and Yearly Result

Fig. 3. Simulaon block diagram of the Power System without F GlobHor: Horizontal global irradiation DiffHor: Horizontal diffuse irradiation T_Amb: Temperature ambient Globinc: Global incident in coll. Plane GlobEff: Effective Global, corr. for IAM and shadings E_Grid: Energy injected into the grid Array: Effective energy at the output of the array PR: Performance Ratio.

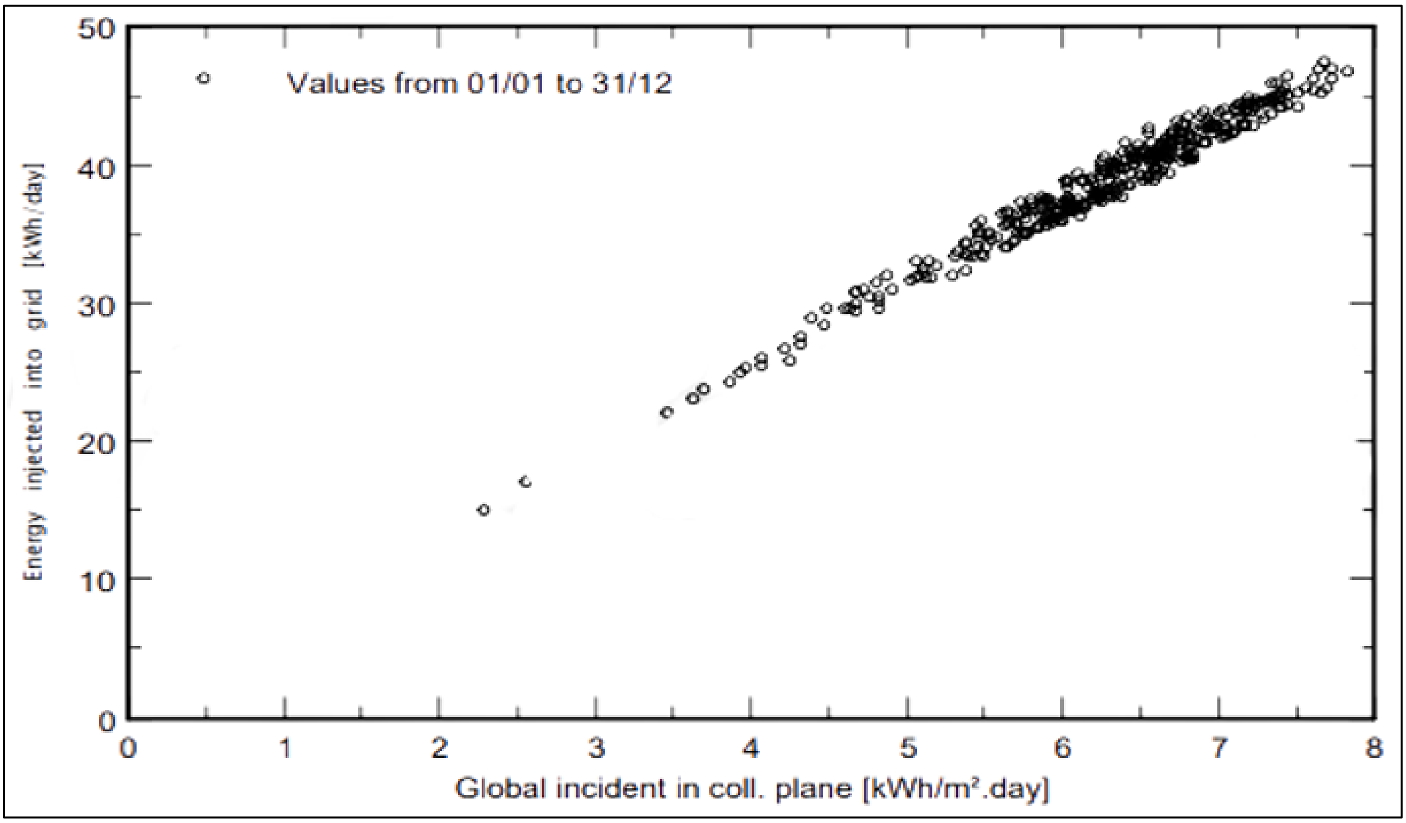

Fig 8 Daily input/output Energy Diagram

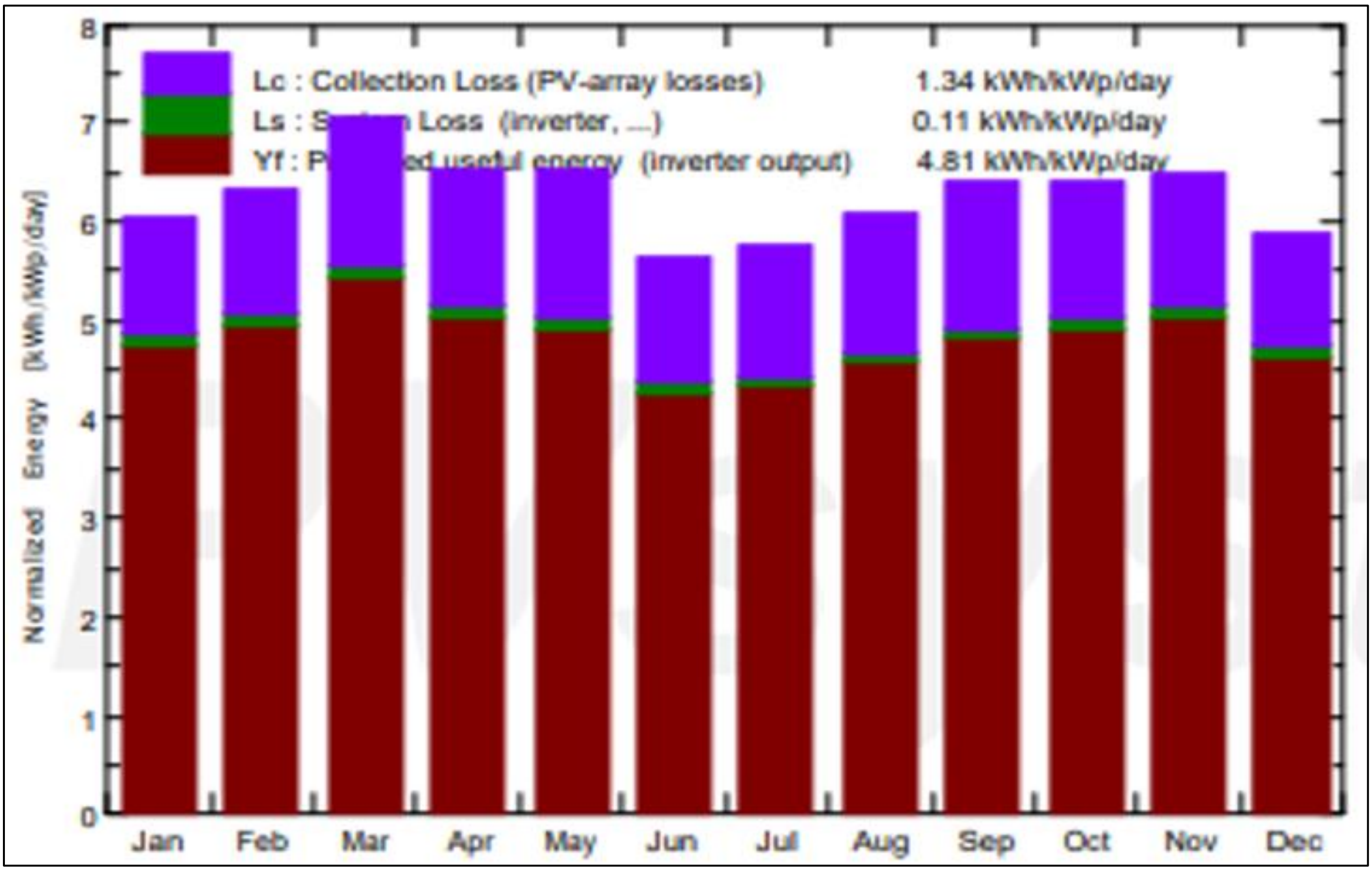

Fig 9 Normalized Power

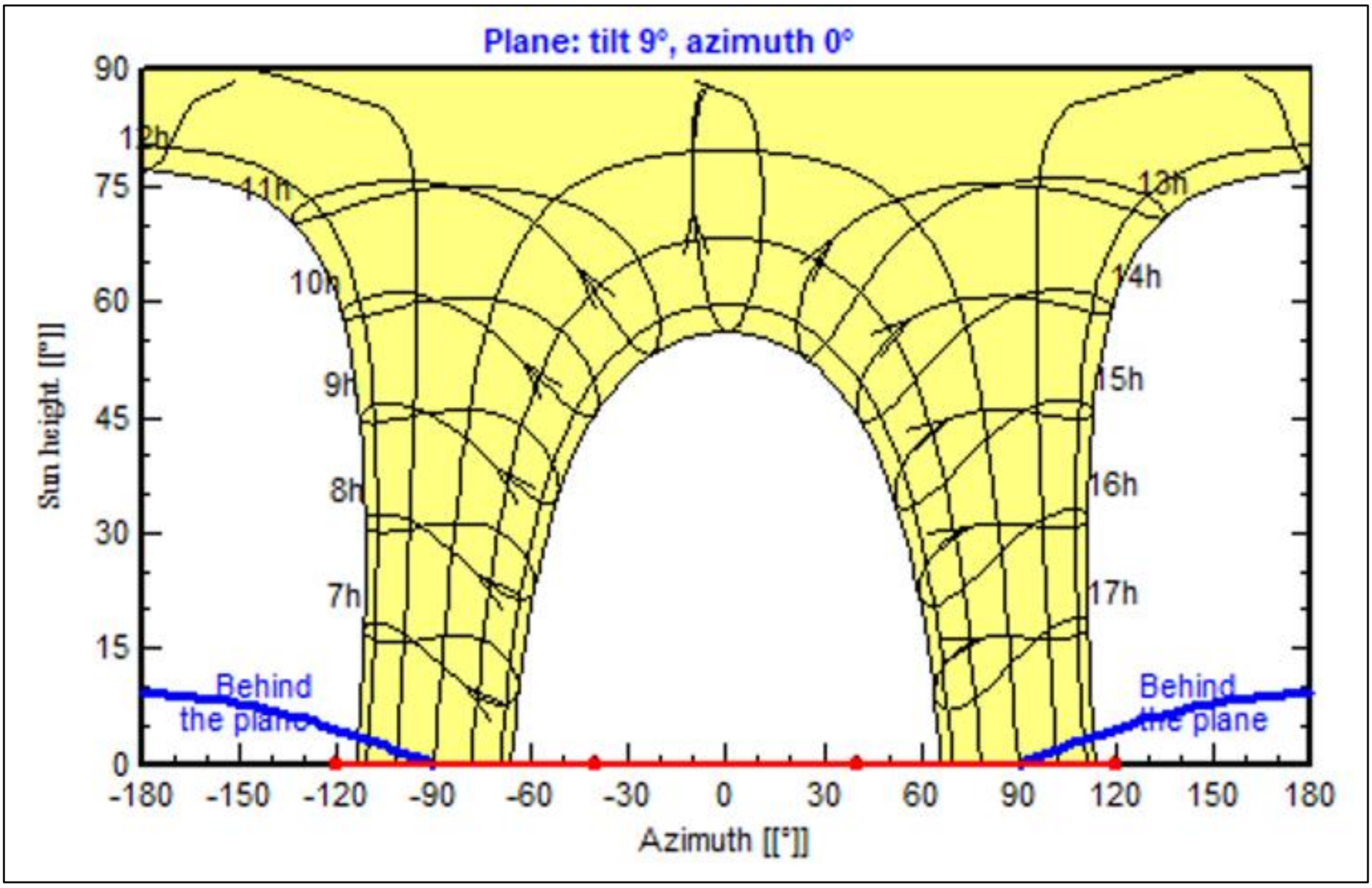

Fig 10 System Output Power Distribution

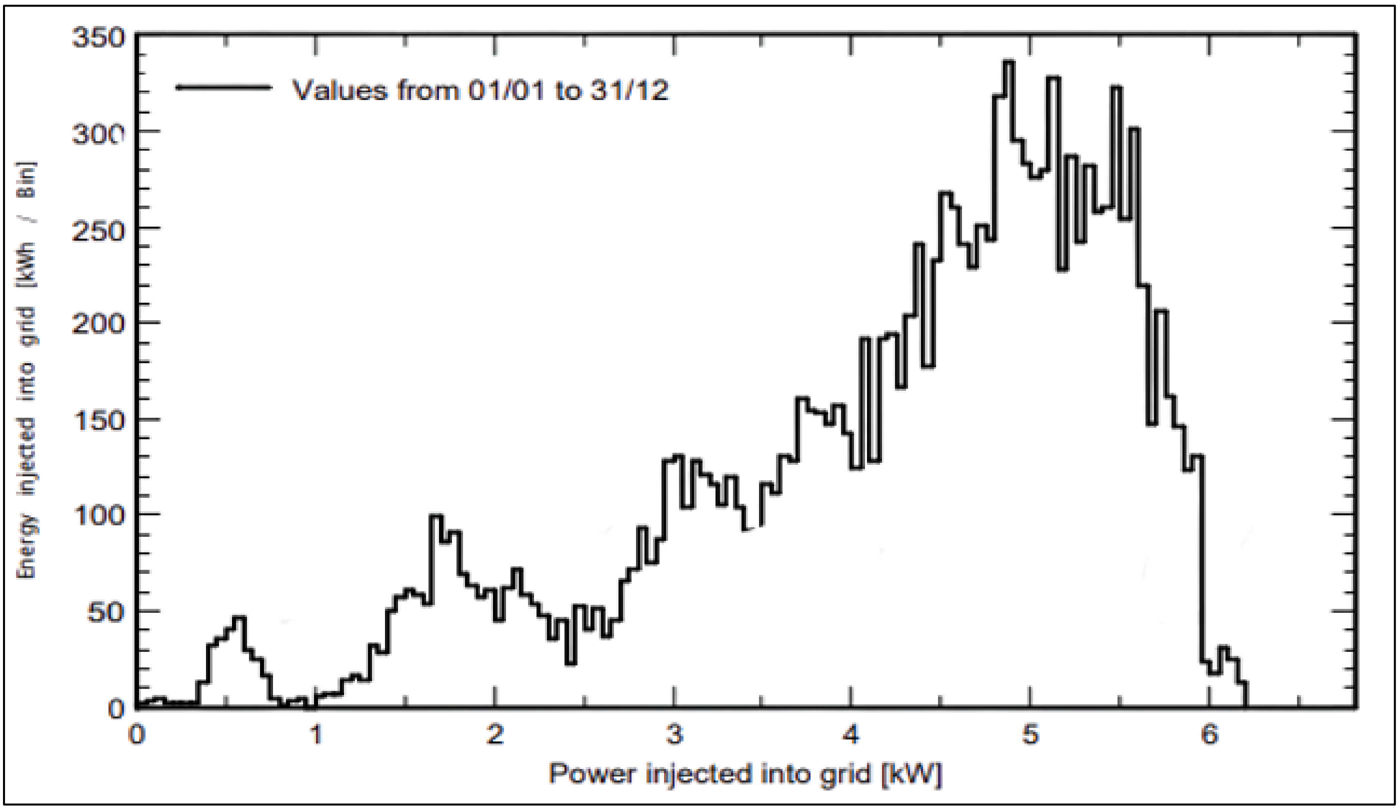

Fig11.Performance Ratio

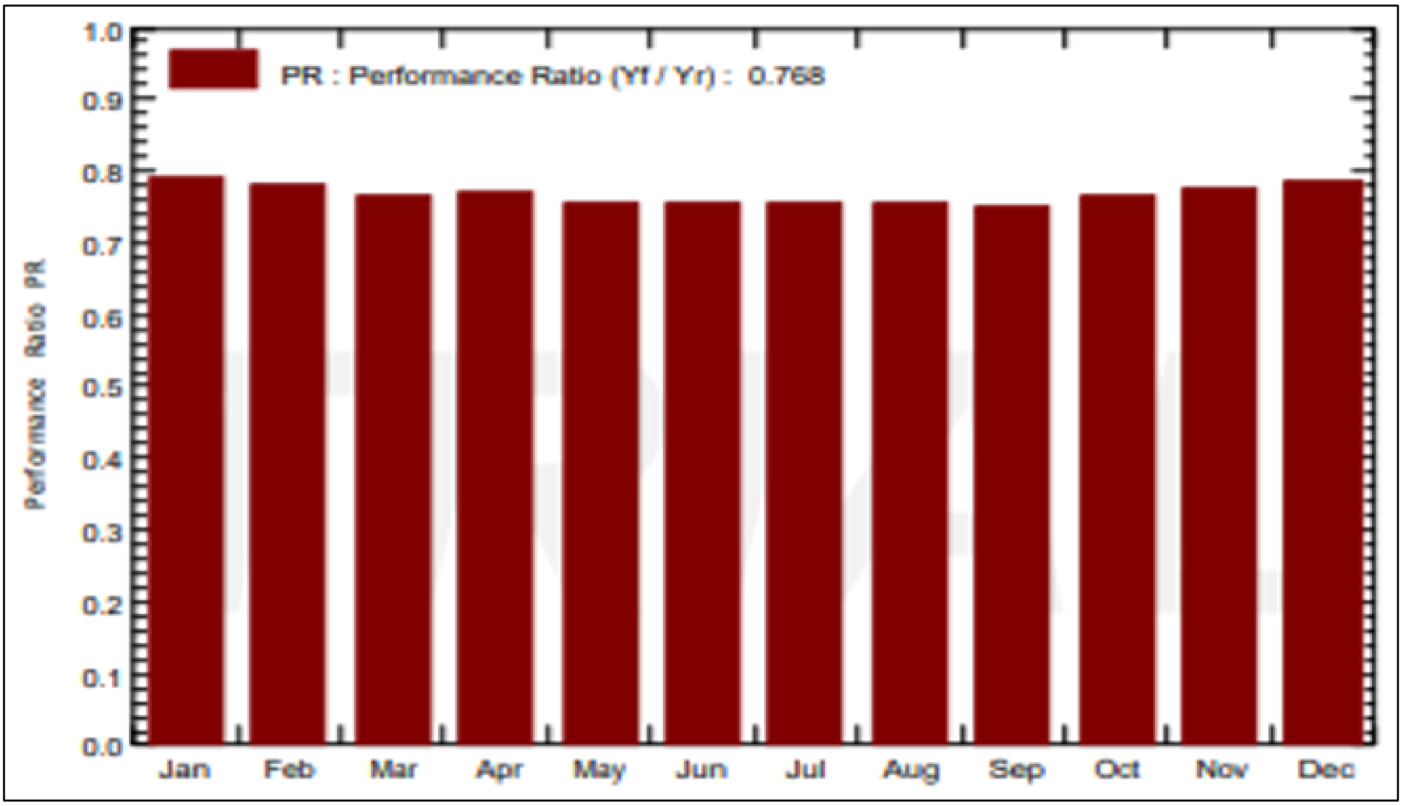

Fig 12 ISO-shading diagram

The Sankey diagram is a type of deficit diagram that is used to show the flow of power in a photovoltaic system, beginning with irradiation and ending with the output power that is being fed into the grid after having suffered a number of different losses. According to Fig. 13, the difference between the nominal energy of the Array and the energy that was injected into the grid is approximately equivalent to 3.7 MWh, which indicates the overall The discrepancy can be equated to the quantity of energy that was wasted in this process. schematic of.

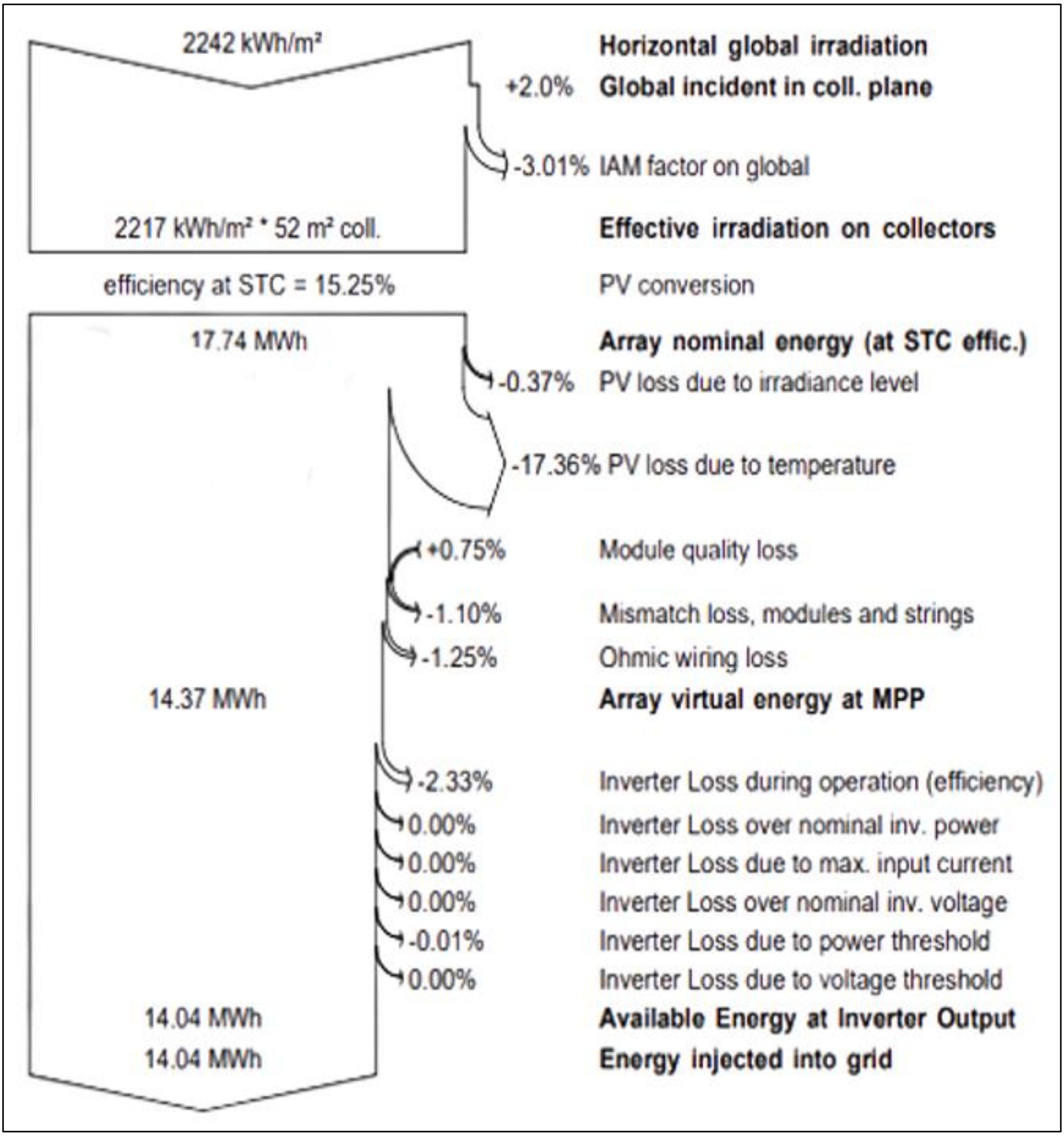

Fig13 Sankey during the course of the year

VII. CONCLUSION

Within the scope of this investigation, a connected photovoltaic solar power system of 8 watts was investigated. Location of the installation zone in Berbera, Somalia is indicated by the coordinates 10.44 degrees' north latitude and 45.01 degrees' east longitude. In order to develop the system, it was decided to make use of a Generic Manufactured Si-mono Dual Axis PV Module with 250 Watts Peak Power and 32 Cells in addition to a Generic manufactured 8.0kWac inverter. Both of these components were manufactured by Generic. In order to obtain the actual outputs, the solar tracker modules were additionally put through a linear shading construction. This was done for the goal of improving efficiency. The simulation came out with a performance ratio of 76.76 percent, and it was able to accomplish an annual production power of 14.04MWh into the grid while suffering a radiation loss of 3.3 percent due to linear shading. Additionally, it was able to accomplish these feats despite the fact that it was able to achieve these results while suffering from linear shading. The amount of energy that is produced and added to the grid varies from a low of 1.212 MWh in

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November to a high of 3.699 MWh in July. The least amount of energy produced is in November. The highest performance ratio of any other month is achieved in December, which is 87.30 percent, making it the best month overall. It has been demonstrated that when temperatures are reduced, solar modules achieve higher levels of performance efficiency. [Citation needed] PVSYST is a program that has.

In this study, a connected 15-watt photovoltaic solar power system was analyzed. The installation zone can be found in Seville, Spain, at a latitude of 10.43 degrees north and a longitude of 45.01 degrees east. For the design of the system, the decision was made to use a Generic manufactured 250Wp, 32 cells Si-mono Dual axis PV module as well as a Generic manufactured 8.0kWac inverter. For the purpose of gaining the actual outputs, the solar tracker modules were also subjected to linear shading construction. The simulation came out with a performance ratio of 76.76 percent, and it was able to accomplish a yearly production power of 14.04MWh into the grid while suffering a radiation loss of 3.3 percent owing to linear shading. The amount of energy that is produced and put into the grid ranges from a minimum of 1.212 MWh in November to a maximum of 3.699 MWh in July. In December, a performance ratio of 87.30 percent is attained, which is the greatest of any other month. It has been shown that lower temperatures result in the photovoltaic module achieving higher levels of performance

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