SOLAR ENERGY ASSESSMENT REPORT

For 3.454 MWp

Name of Place
Telangana

Meteorological Data Source
Meteonorm

Date
18 October, 2014

Client
abc

Email
ezysolare@gmail.com

Address
India,
Telangana, Telangana,
India
000000

Capacity
3.453 MW

Order No.
#1410180004

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ABOUT EZYSOLARE

ezysolare is dedicated to making the journey of going solar easy. Starting from decision making to design, ezysolare breaks the process into 2 simple steps. We assist in ascertaining the feasibility of a solar project through SEAR (Solar Energy Assessment Report), while LAYOUT (Solar Module Layout) details the placement of modules and other key equipment of a solar power plant. Both our offerings are designed for all possible variations of projects - rooftop and ground mounted, MW and kW scale, crystalline and thin film modules promising users a tailor made solution to their unique requirements.

DISCLAIMER AND LEGAL INFORMATION:

Considering the nature of climate variation, inter-annual and long-term changes, as well as uncertainty of measurements and calculations, ezysolare cannot take full guarantee of the accuracy of estimates. The maximum possible has been done for the assessment of climate conditions based on the best available data, software and knowledge. Ezysolare shall not be liable for any direct, incidental, consequential, indirect or punitive damages arising or alleged to have arisen out of use of the provided report.

CONTENT OF A FORM

Geo Coordinates

Latitude 17.6000003815 North
Longitude 77.9000015259 East

Technical Specifications

Capacity 3.453 MW
Shadow Free Area -
Type of Area Ground

Modules & Inverters

Set #	Item	Type	Make	Capacity
Set	Module	Polycrystalline	Canadian Solar	250.000 Wp
	Inverter	Central	ABB	630.000 kW
	Remarks	-		

Electricity Tariff

Tariff / kWH 6.63 INR
Remarks -

Type of SEAR

Provider Meteonorm

1. METHODOLOGY OF SEAR

The SEAR report consists of highest accuracy data from multiple databases based on customer requirement. The general information, which we put in, our report comes from Meteonorm, NASA-SSE, SolarGIS database and PVsyst.

Meteonorm database:

Meteonorm data is a climatologic database for solar energy applications combined with a synthetic weather generator. It contains a large database of ground station measurements collected from various sources.

PVsyst:

The PVsyst software offers resource assessment solutions for grid connected, off-grid, and DC grid based systems based on an extensive set of database consisting of solar modules, invert-ers and other BoS components. Its calculation of energy generation is based on Meteorological data.

Process:

The Process we follow to create your Energy Assessment report is as follows:

- Specify the geographical location and the meteorological data for the irradiance & temperature of a particular site.
- Define a basic system variant, including the orientation of the PV modules, the required power or available area and the type of PV modules and inverters that is required.
- PVsyst will propose a basic configuration for this choice and set reasonable default values for all parameters that are required for a first calculation.
- We define successive variants by progressively adding far shadings, near shadings, specific loss parameters, economic evaluation, probability exceedance etc.

2. SUMMARY

This assessment report is carried out to generate renewable energy through Solar Photovoltaic Technology. The proposed solar PV energy project is located at India, Telangana. The project is aimed to produce electricity from photovoltaic panels and is defined to have 3.454 MWp installed capacity.

The project site can be traced by geographical co-ordinates of Latitude and Longitude. As per the analysis, this project can generate 5909 MWh/annum.

3. PROJECT FEATURES

Project Location	Telangana
Address	India
Latitude	17.600 North
Longitude	77.900 East
Altitude	548 m
Azimuth (0=South)	0
Tilt Angle	21°
Type of System	On Grid
Installed Capacity (kWp/MWp)	3.454 MWp
Type of PV Module	Polycrystalline
Module Make	Canadian Solar
Capacity of Module (Wp)	250
Total number of Modules	13816
Number of PV Module	22 Modules in Series, 628 Strings in Parallel
Total Rated Power P_{DC}(kWp)	3454
Type of Inverter	Central
Inverter	ABB
Inverter Capacity (kW/MW)	630kW
Number of Inverters	5
Total Inverter Power P_{AC}(kW)	3150
Ratio (P_{DC}/P_{AC})	1.10
Annual Energy Generation	5909 MWh/annum
Specification Production	1711 kWh/kWp/annum

4. CHARACTERISTIC OF SITE

5. SOLAR RADIATION RESOURCE ASSESSMENT

The yearly global solar radiation in Telangana (on horizontal plane) is 2018.40-kWh/sq.m., the average maximum solar radiation being 206.10-kWh/sq.m. in May and the average minimum being 139.10-kWh/sq.m. in July. The weather file for the locations of Telangana has been selected from Meteonorm database.

Month	GlobHor kWh/m^2	Ambient Temperature °C	GlobInc kWh/m^2	Wind Velocity (m/s)	E_Array kWh	E_Grid kWh	Performance Ratio %
January	158.50	23.10	198.00	1.80	570859	553186	80.90
February	164.60	25.80	192.10	2.00	542365	525699	79.20
March	203.90	29.20	218.40	1.90	606796	588293	78.00
April	202.30	31.50	198.10	2.00	546694	530523	77.50
May	206.10	32.60	189.00	2.90	521026	505737	77.50
June	161.30	29.20	146.10	3.70	414720	402127	79.70
July	139.10	26.80	128.30	3.60	373080	361300	81.50
August	146.60	25.80	139.70	3.50	405443	392664	81.40
September	162.70	26.10	166.40	2.20	477258	462398	80.40
October	166.70	25.60	185.40	1.80	528581	511906	80.00
November	152.60	24.10	186.40	1.60	535114	518415	80.50
December	154.00	22.20	197.90	1.40	574071	556333	81.40
Year	2018.40	26.83	2145.80	2.40	6096009	5908581	79.70

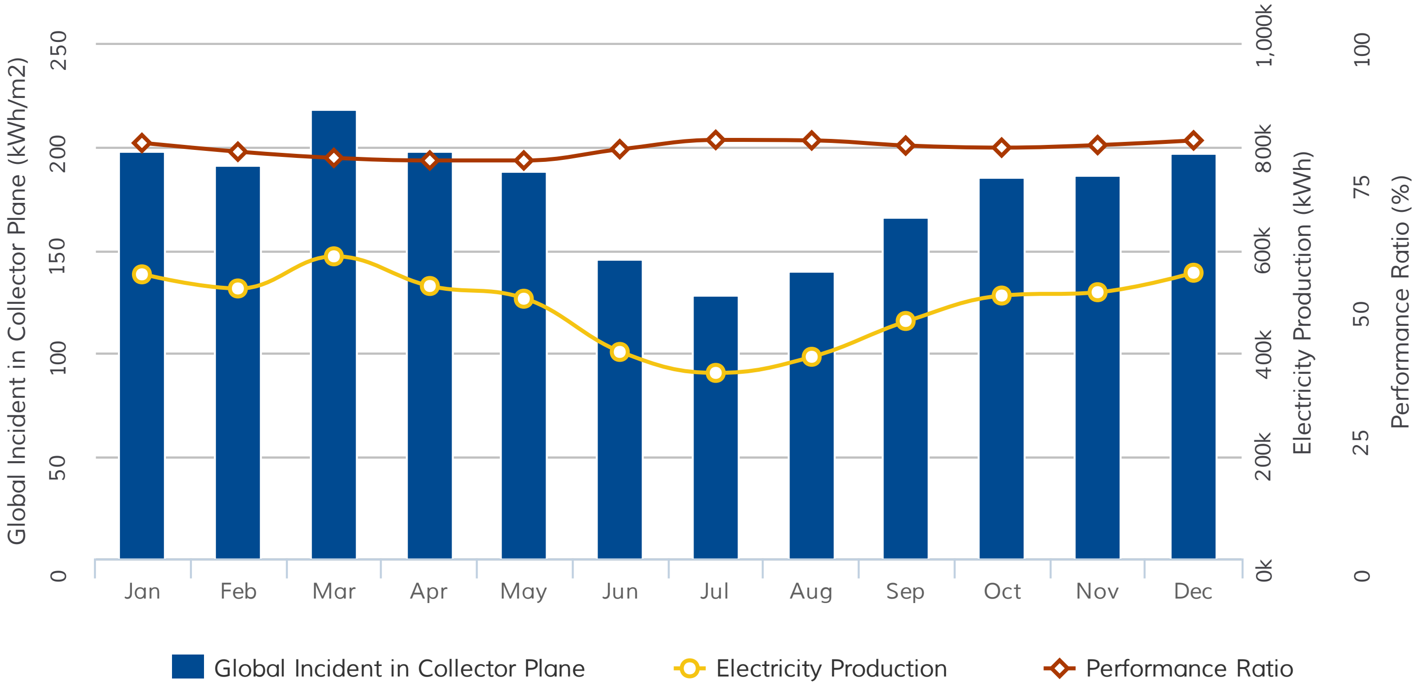
*GlobHor: Horizontal global irradiation

*E_Array: Effective energy at the output of the array

*GlobInc: Global Incident in coll. Plane

*E_Grid: Energy injected into grid

6. IRRADIATION, ELECTRICITY PRODUCTION & PERFORMANCE RATIO



7. GENERATION ANALYSIS

The yield calculation was performed using the PVsyst software. The yield values listed in the following were produced.

Technical Parameters	Value Gain/Loss (%)
Horizontal Global Irradiation	2018 kWh/m^2
Global Incident in coll. plane	6.3%
Incident angle modifier	-2.90%
PV loss due to irradiance level	-0.10%
PV loss due to temperature	-10.20%
Array Soiling	-2.00%
Module quality loss	-1.50%
Module array mismatch	-1.00%
Ohmic wiring loss	-1.10%
Inverter loss during operation	-1.80%
External transformer losses	-1.10%
AC Ohmic Losses	-0.30%
PV SYST Generation	5908581 kWh kWh/annum

8. UNCERTAINTY OF ESTIMATES

Financial institute use statistical methods to determine the likelihood that a power plant will generate a certain amount of energy in any given year over the plant's 20- to 30- year life.

An exceedance probability has been used in a solar industry to describe the probability that a particular location will experience sufficient solar energy for a proposed area to be financially sound.

Banks and investment firms working on energy generation projects often require P50, P75 & P90 values of the solar resource at a location to determine the risk associated with a project's ability to service its debt obligations and other operating costs.

P50 Generation Expected	5908581.000 kWh
P50 PLF Expected	19.520 %
P75 Generation Expected	5767748.000 kWh
P75 PLF Expected	19.060 %
P90 Generation Expected	5640711.000 kWh
P90 PLF Expected	18.640%

9. SAVINGS/EARNINGS

Cut your electricity bills and get paid for the electricity you generate.

Number of units	Tariff	Savings
5908581 kWh	6.63/kWh	39173892.03 INR/annum

10. GLOSSARY OF TERMS

Global Horizontal Irradiation

It is the total amount of shortwave radiation received from above by a surface horizontal to the ground. This value is of particular interest to photovoltaic installations and includes both Direct Normal Irradiance (DNI) and Diffuse Horizontal Irradiance (DIF).

Global Incident in Collector Plane

The Global incident is computed from the Horizontal Global and Diffuse irradiance in hourly values, using a model.

Performance Ratio

Performance Ratio (PR) of a plant for a period of time =Energy measured (kWh)/(Irradiance (kWh/m^2) on the panel x Active area of PV module (m^2) x PV module efficiency)

PLF - Power Load Factor

Plant Load Factor is the ratio of annual energy output of solar power plant to the maximum output that plant could generate in a given year. PLF = kWh/(365 x 24 x Installed capacity).

Losses:

Incident angle modifier

The Incident angle modifier corresponds to the weakening of irradiation reaching the PV cells surface, with respect to irradiance under normal incidence, due to reflexions increasing with the incidence angle. In practice, this is commonly calculated using the ASHRAE-model, defined by the American Society of Heating, Refrigerating and Air-conditioning Engineers as it has become standard in America.

PV loss due to irradiance level

This loss is the difference between efficiency at 1,000 W/m^2 conditions) and actual irradiance within each hour. It is typically recommended to use detailed information on the electrical parameters for the PV modules selected to estimate this loss.

PV loss due to temperature

Whenever there is increase in ambient temperature, the temperature of the PV module also increases, resulting in reduction of power output from the PV module. This depends on the temperature coefficient of the PV module as specified by the manufacturer.

Array Soiling

Dust and Soil can accumulate on the solar module surface, blocking some of the sunlight and reducing output. It is weather and location dependent.

Module quality loss

Module quality loss is the matching of real module set performance, with respect to the manufacturer's specification. It at half the inferior tolerance, meaning that the real delivered module sample can have an average power between the lower tolerance and the nominal value.

Module array mismatch

The maximum power output of the total PV array is always less than the sum of the maximum output of the individual modules. This difference is a result of slight inconsistencies in performance from one module to the next and is called module mismatch.

Ohmic wiring loss

The wires regardless of its compositions (copper, aluminium) or gauge (size, cross sectional area) exhibit ohmic losses. Ohmic losses causes voltage drop in the wiring proportional to its length and current being carried .

Inverter loss during operation

Inverter losses the output power while converting DC into AC due to variation in ambient operating condition power threshold upper and lower MPPT ranges.

External transformer losses

In some PV installations (in the MWp range), the transformer is not part of the inverter, but an external device directly connected to the MW grid. The main losses associated with transformer are:

The Iron Losses: As we have a constant grid voltage, this is considered as a constant loss with a default value of 0.1% of the nominal power.

The Ohmic Losses either in the primary or in the secondary windings.

AC Ohmic Losses

The AC wiring losses may simply be defined by the distance between the inverter output and the injection point.

Plant Load Factor (PLF)

Plant load factor is the ratio of annual energy output of solar power plant to the maximum output that plant could generate in a given year. PLF= kWh / (365 X 24 X Installed Capacity)

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