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# Rooftop Solar Photovoltaic System Design Using PVSYS Software

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## Abstract

The aim of this project is to calculate solar panels for a shortlisted region using PVSyst software. The present study includes the feasibility analysis of rooftop solar panels to fulfill the electrical power requirements of a shortlisted region in Nampally, Hyderabad. The performance analysis is done by assessing solar irradiance, electricity consumption, system design, and inverter efficiencies.

Index Terms— Rooftop Solar PV, PVSyst, Renewable Energy, Photovoltaic System

## I. INTRODUCTION

The usage of solar energy to generate electricity has gained much importance due to the ever-increasing demand for clean and renewable form of energy. The photovoltaic cell converts solar energy directly into electrical energy using semiconductor materials. It requires proper orientation to gain maximum efficiency.

# II. FIGURES AND SYSTEM CONFIGURATION

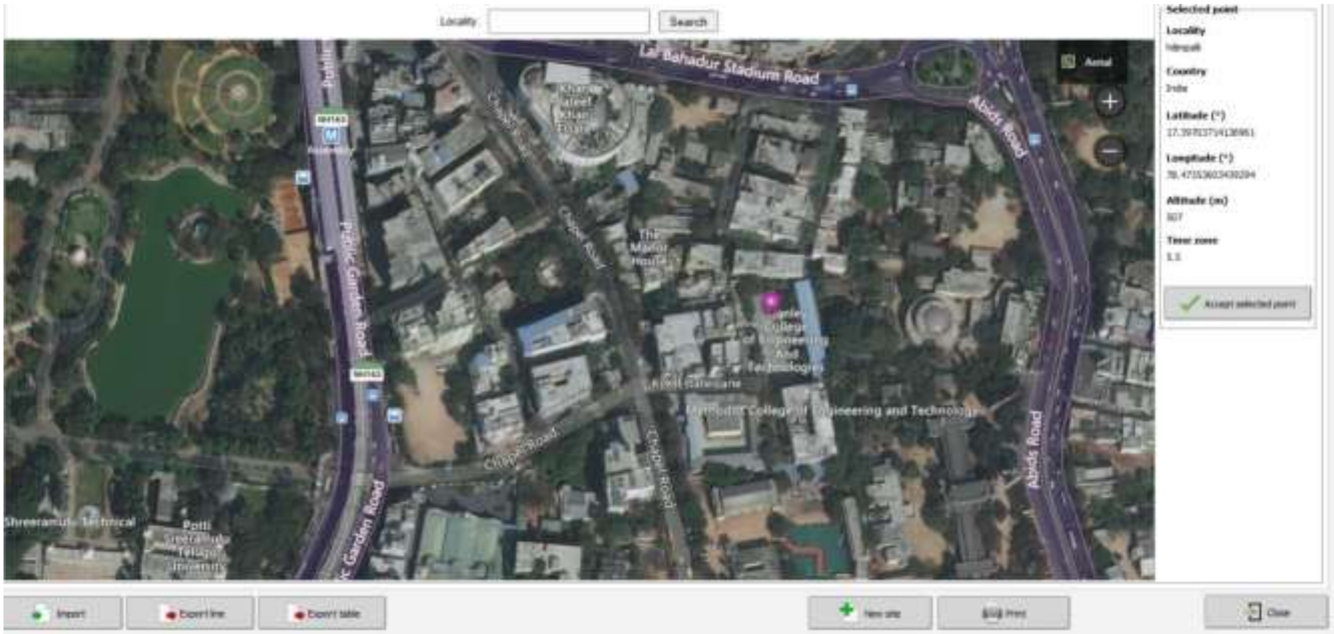
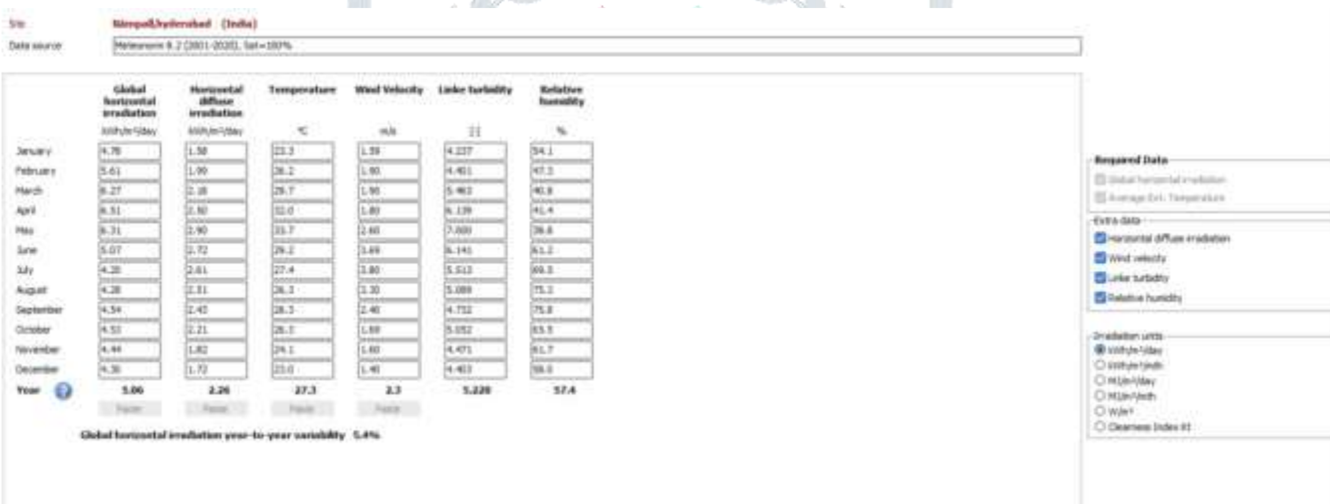



Fig. 2: Monthly solar irradiance data

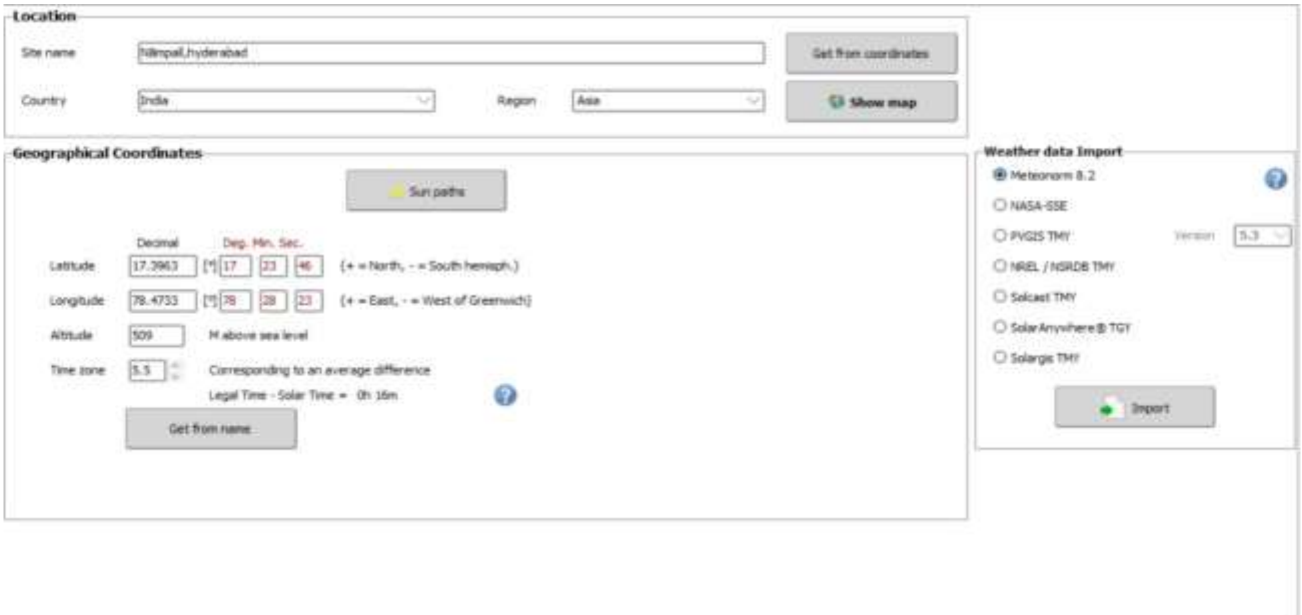


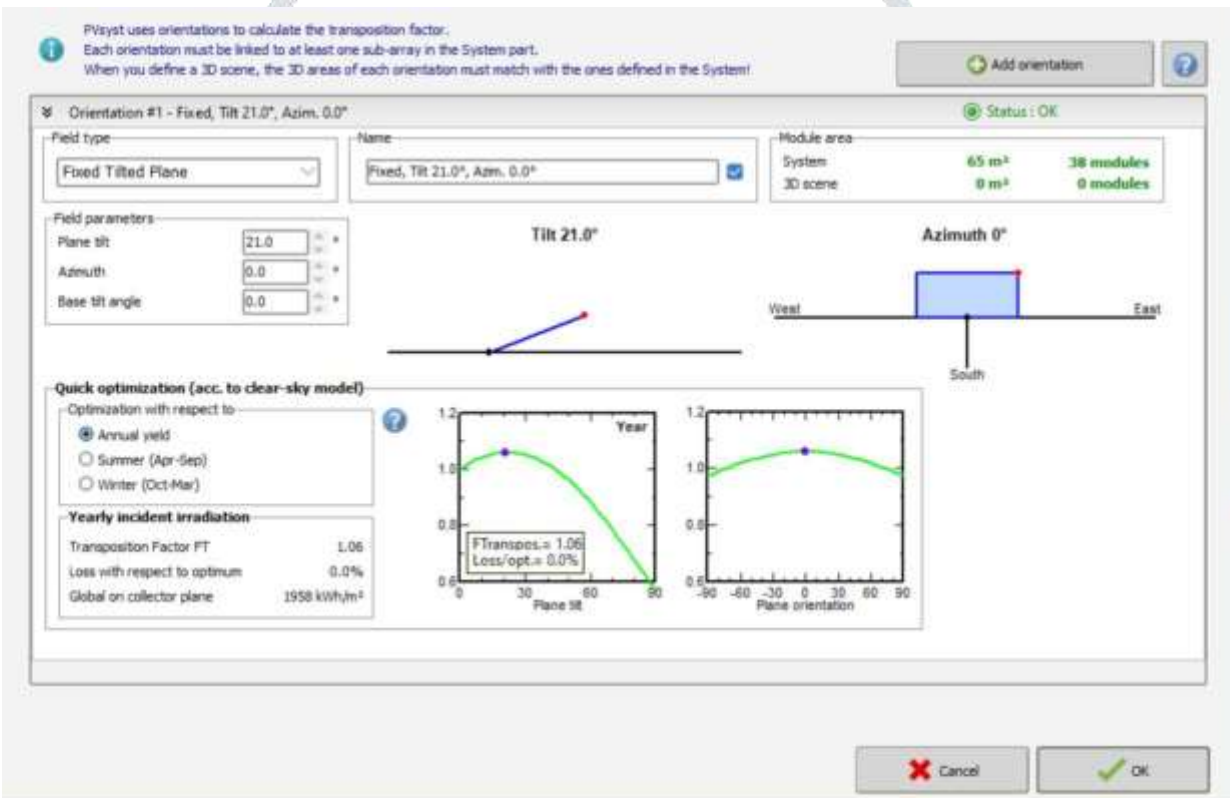
| | Global horizontal irradiation | Horizontal diffuse irradiation | Temperature | Wind Velocity | Linke turbidity | Relative humidity |
|---|---|---|---|---|---|---|
| | kWh/m²/day | kWh/m²/day | °C | m/s | [-] | % |
| January | 4.78 | 1.58 | 23.3 | 1.59 | 4.237 | 54.1 |
| February | 5.61 | 1.99 | 26.2 | 1.90 | 4.401 | 47.3 |
| March | 6.27 | 2.18 | 29.7 | 1.90 | 5.463 | 40.8 |
| April | 6.51 | 2.50 | 32.0 | 1.80 | 6.139 | 41.4 |
| May | 6.31 | 2.90 | 33.7 | 2.60 | 7.000 | 39.8 |
| June | 5.07 | 2.72 | 29.2 | 3.69 | 6.141 | 61.2 |
| July | 4.20 | 2.61 | 27.4 | 3.80 | 5.512 | 69.3 |
| August | 4.28 | 2.51 | 26.3 | 3.30 | 5.089 | 75.2 |
| September | 4.54 | 2.45 | 28.3 | 2.40 | 4.732 | 75.8 |
| October | 4.53 | 2.21 | 26.3 | 1.69 | 5.052 | 63.5 |
| November | 4.44 | 1.82 | 24.1 | 1.60 | 4.471 | 61.7 |
| December | 4.38 | 1.72 | 23.0 | 1.40 | 4.403 | 58.0 |
| Year | 5.06 | 2.26 | 27.3 | 2.3 | 5.228 | 57.4 |

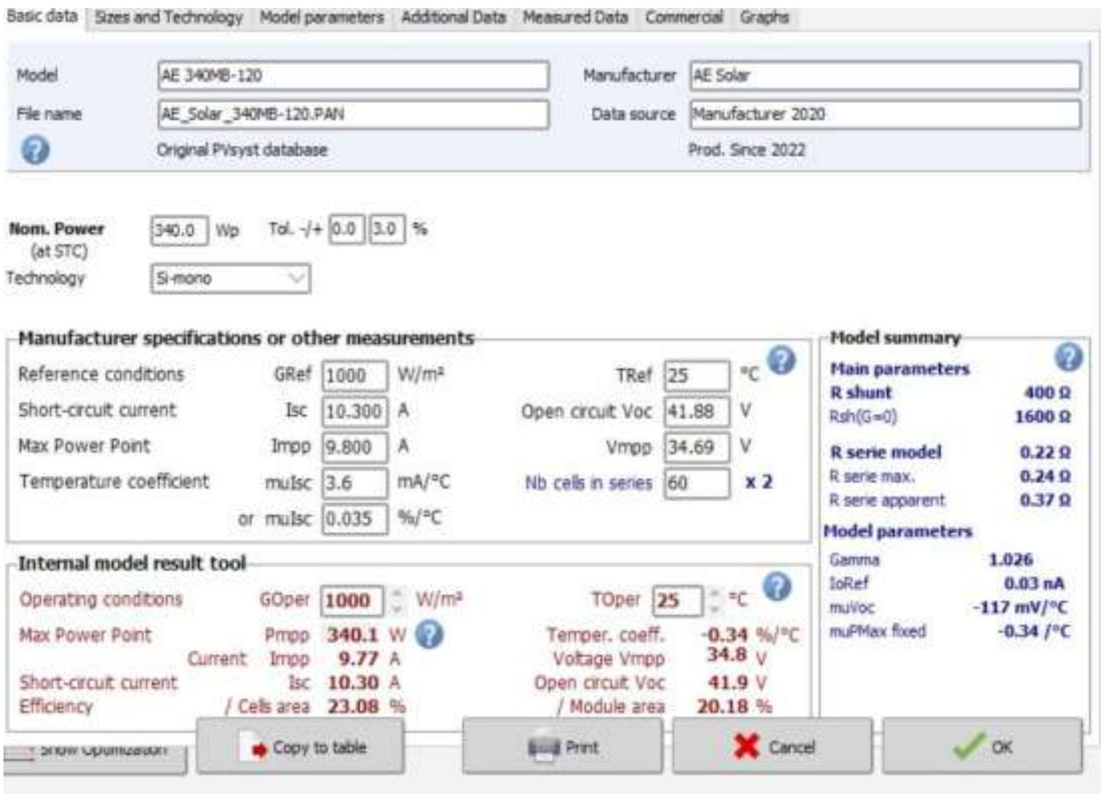
Global horizontal irradiation year-to-year variability 5.4%

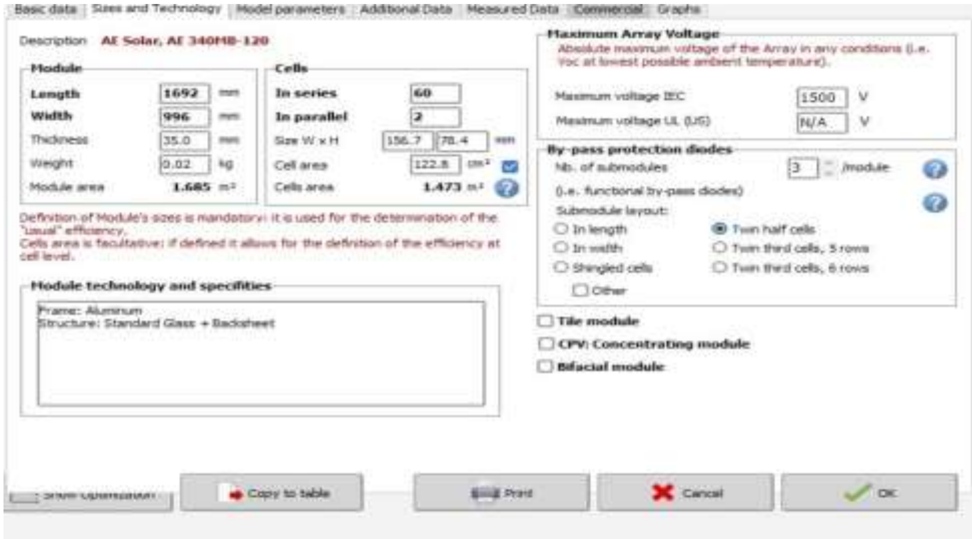


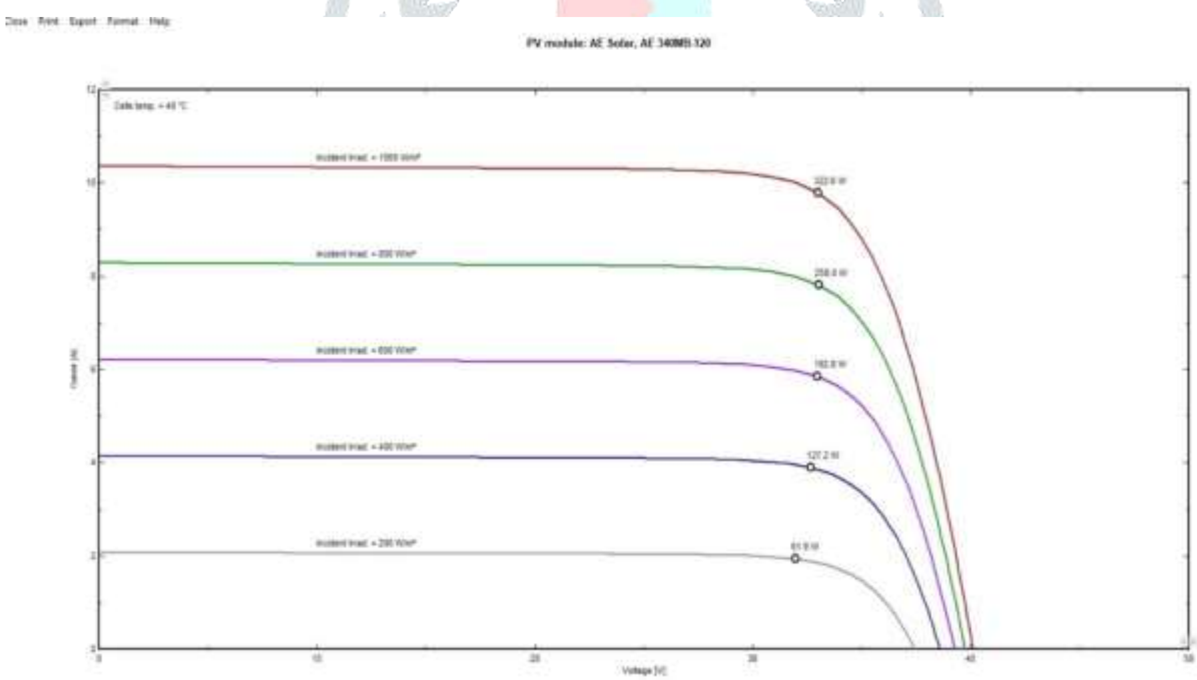
Fig. 3: Panel orientation and tilt angle

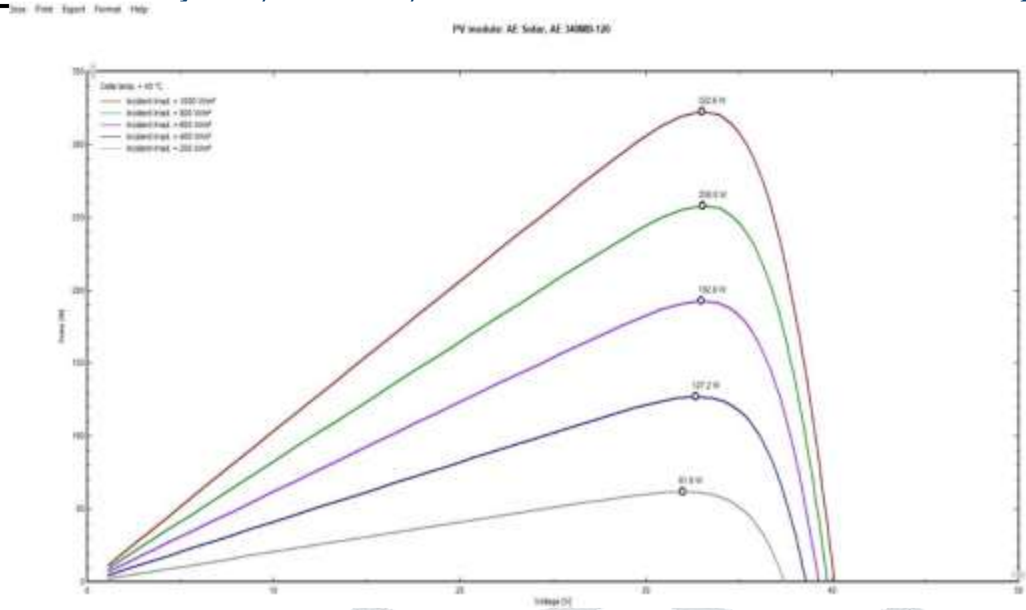

Location
Site name
Get from coordinates
Country
India
Region
Asia
Show map
Geographical Coordinates
Sun paths
Decimal
Deg. Min. Sec.
Latitude 17.3963 [°] 17 23 46 (+ = North, - = South hemisph.)
Longitude 78.4733 [°] 78 28 23 (+ = East, - = West of Greenwich)
Altitude 509 M above sea level
Time zone 5.5 Corresponding to an average difference
Legal Time - Solar Time = 0h 16m
Get from name
Weather data Import
Meteonorm 8.2
NASA-SSE
PVGIS TMY
Version 5.3
NREL / NSRDB TMY
Solcast TMY
SolarAnywhere® TGY
Solargis TMY
Import

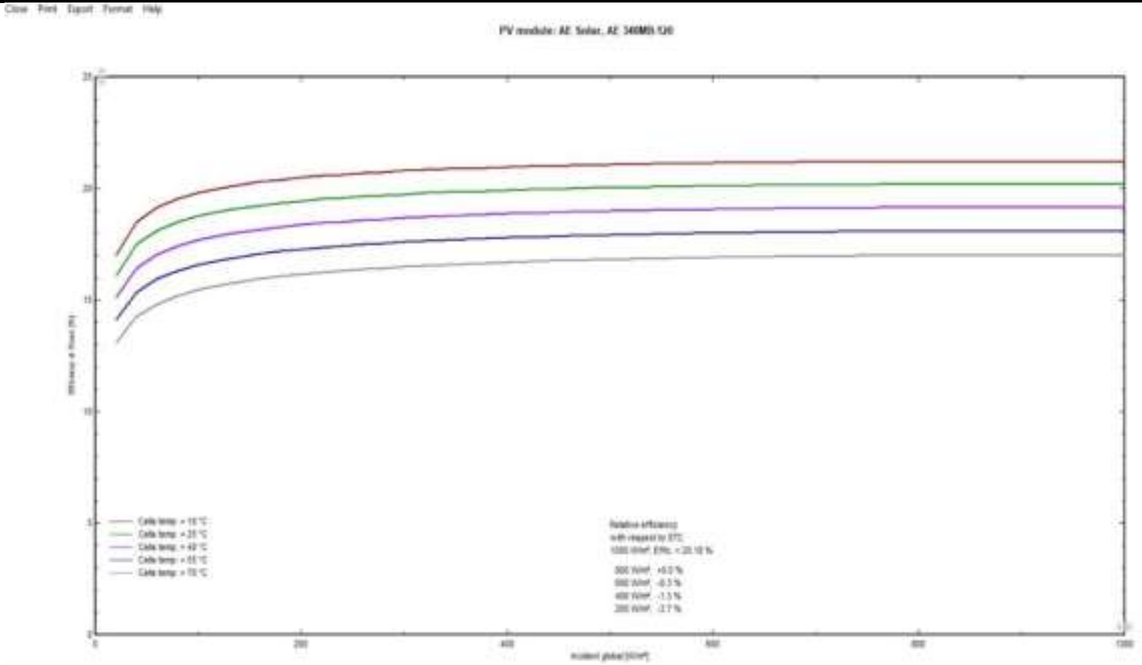

PVsyst uses orientations to calculate the transposition factor.
Each orientation must be linked to at least one sub-array in the System part.
When you define a 3D scene, the 3D areas of each orientation must match with the ones defined in the System!
Add orientation
Orientation #1 - Fixed, Tilt 21.0°, Azim. 0.0°
Status : OK
Field type
Fixed Tilted Plane
Name
Fixed, Tilt 21.0°, Azim. 0.0°
Module area
System 65 m² 38 modules
3D scene 0 m² 0 modules
Field parameters
Plane tilt 21.0 °
Azimuth 0.0 °
Base tilt angle 0.0 °
Tilt 21.0°
Azimuth 0°
West
East
South
Quick optimization (acc. to clear-sky model)
Optimization with respect to
Annual yield
Summer (Apr-Sep)
Winter (Oct-Mar)
Yearly incident irradiation
Transposition Factor FT 1.06
Loss with respect to optimum 0.0%
Global on collector plane 1958 kWh/m²
Year
FTranspos.= 1.06
Loss/opt.= 0.0%
Plane tilt
Plane orientation
Cancel
OK

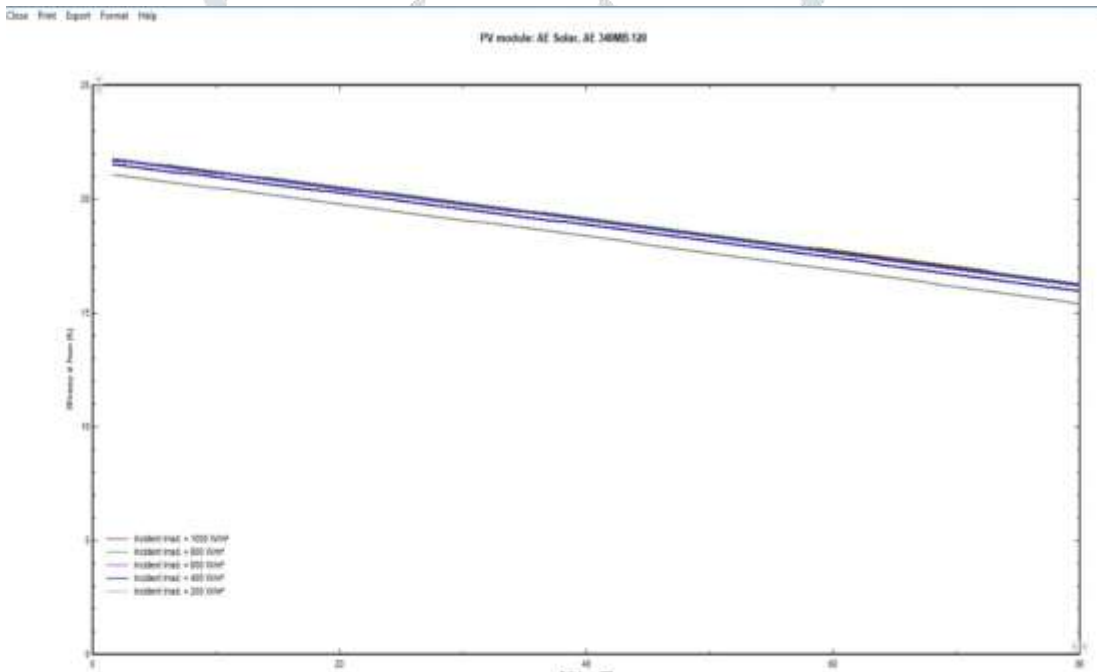

Basic data
Sizes and Technology
Model parameters
Additional Data
Measured Data
Commercial
Graphs
Model
AE 340MB-120
Manufacturer
AE Solar
File name
AE_Solar_340MB-120.PAN
Data source
Manufacturer 2020
Original PVsyst database
Prod. Since 2022
Nom. Power (at STC)
340.0 Wp
Tol. -/+ 0.0 3.0 %
Technology
Si-mono
Manufacturer specifications or other measurements
Reference conditions GRef 1000 W/m²
TRef 25 °C
Short-circuit current Isc 10.300 A
Open circuit Voc 41.88 V
Max Power Point Impp 9.800 A
Vmpp 34.69 V
Temperature coefficient muIsc 3.6 mA/°C
Nb cells in series 60 x 2
or muIsc 0.035 %/°C
Internal model result tool
Operating conditions GOper 1000 W/m²
TOper 25 °C
Max Power Point Pmpp 340.1 W
Temper. coeff. -0.34 %/°C
Current Impp 9.77 A
Voltage Vmpp 34.8 V
Short-circuit current Isc 10.30 A
Open circuit Voc 41.9 V
Efficiency / Cells area 23.08 %
/ Module area 20.18 %
Model summary
Main parameters
R shunt 400 Ω
Rsh(G=0) 1600 Ω
R serie model 0.22 Ω
R serie max. 0.24 Ω
R serie apparent 0.37 Ω
Model parameters
Gamma 1.026
IoRef 0.03 nA
muVoc -117 mV/°C
muPMax fixed -0.34 /°C
Print
Cancel
OK

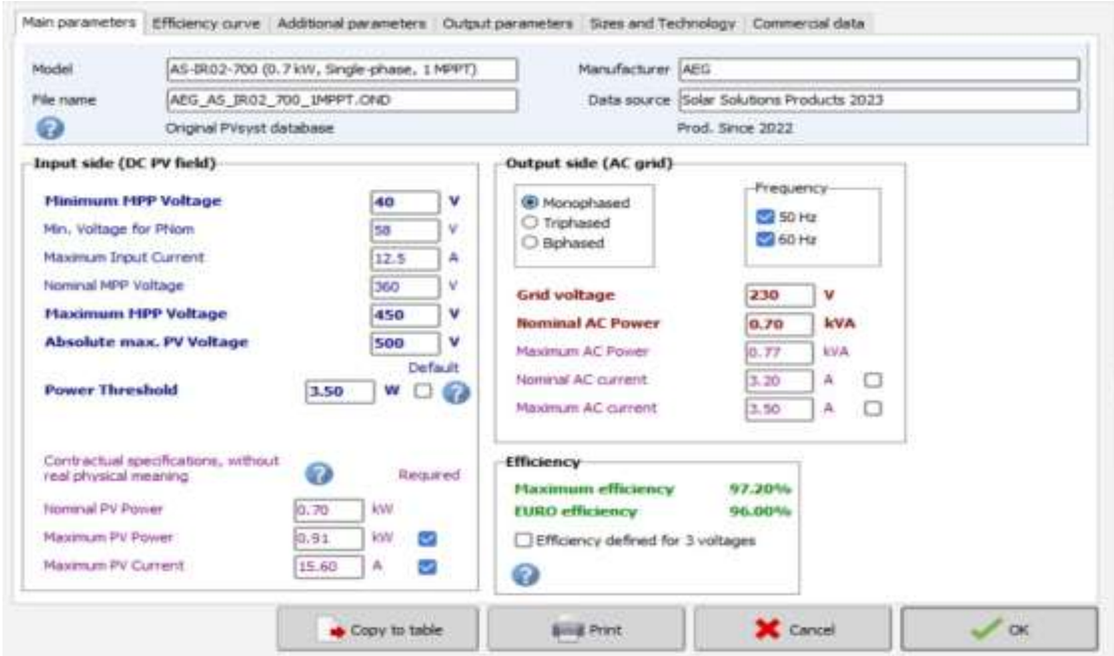

Basic data
Sizes and Technology
Model parameters
Additional Data
Measured Data
Commercial
Graphs
Description AE Solar, AE 340MB-120
Module
Length 1692 mm
Width 996 mm
Thickness 35.0 mm
Weight 0.02 kg
Module area 1.685 m²
Cells
In series 60
In parallel 2
Size W x H 156.7 78.4 mm
Cell area 122.8 cm²
Cells area 1.473 m²
Definition of Module's sizes is mandatory: it is used for the determination of the "usual" efficiency.
Cells area is facultative: if defined it allows for the definition of the efficiency at cell level.
Module technology and specifities
Frame: Aluminum
Structure: Standard Glass + Backsheet
Maximum Array Voltage
Absolute maximum voltage of the Array in any conditions (i.e. Voc at lowest possible ambient temperature).
Maximum voltage IEC 1500 V
Maximum voltage UL (US) N/A V
By-pass protection diodes
Nb. of submodules 3 /module
(i.e. functional by-pass diodes)
Submodule layout:
In length
In width
Shingled cells
Other
Twin half cells
Twin third cells, 5 rows
Twin third cells, 6 rows
Tile module
CPV: Concentrating module
Bifacial module
Copy to table
Print
Cancel
OK


Close Print Export Format Help
PV module: AE Solar, AE 340MB-120
Voltage [V]




PV module: AE Solar, AE 340MB-120


PV module: AE Solar, AE 340MB-120




## III. RESULTS AND DISCUSSION

The results of the simulation present that the chosen configuration of PV is able to provide the demand of energy required. High efficiency with minimum losses from the entire system points out that this system is well prepared. Energy production on a monthly basis is dependent on solar irradiance, which again proves the importance of geographical selection with proper orientation.

## IV. CONCLUSION

Roof-top solar photovoltaic system was modeled successfully using the PVSyst software. It is made clear from this paper that roof-top solar photovoltaic systems are an excellent solution for meeting demands in urban areas. Proper size, orientation, and choice of components make the efficiency of the system better.

## REFERENCES

[1] A. K. Das et al., "Integrated modeling and feasibility analysis of rooftop photovoltaic systems," 2021.
[2] Panicker et al., "Assessment of Building Energy Performance Integrated with Solar PV," 2022.
[3] Analysis and Design of Solar PV System using PVSyst Software, 2022.