ISTANZA VIA

Presentata al

Ministero della Transizione Ecologica

e al Ministero della Cultura

(art. 23 del D. Lgs 152/2006 e ss. mm. ii)

PROGETTO

IMPIANTO FOTOVOLTAICO A TERRA (AGRIVOLTAICO) COLLEGATO ALLA RTN POTENZA NOMINALE 28,48 MWp – AC 24,96 MVA

Località C. Giacconi – Comune di Appignano (MC)

CALCOLO PRODUCIBILITA'

21-00005-IT-APPIGNANO_PI-R02

PROPONENTE:

TEP RENEWABLES (APPIGNANO PV) S.R.L.
Via Giorgio Castriota, 9 – 90139 - Palermo
P. IVA e C.F. 06983520823 – REA PA - 429399

PROGETTISTI:

ING. GIULIA GIOMBINI
Iscritta all' Ordine degli Ingegneri della Provincia di Viterbo al n. A-1009

Data	Rev.	Tipo revisione	Redatto	Verificato	Approvato
03/2022	0	Prima emissione	MSA	GG	F.Battafarano

Version 7.2.8

PVsyst - Simulation report

Grid-Connected System

Project: APPIGNANO

Variant: APPIGNANO - 545 Wp, 9.5 m pitch

Unlimited Trackers with backtracking

System power: 28.48 MWp

APPIGNANO - Italy

Project summary

Geographical Site
APPIGNANO
Italy

Situation

Latitude	43.39 °N
Longitude	13.36 °E
Altitude	0 m
Time zone	UTC

Project settings
Albedo 0.20

Meteo data
APPIGNANO
Meteonorm 8.0 (1991-2002), Sat=100% - Synthetic

System summary

Grid-Connected System
Simulation for year no 1

Unlimited Trackers with backtracking

PV Field Orientation
Orientation
Tracking horizontal axis

Tracking algorithm
Irradiance optimization
Backtracking activated

Near Shadings
No Shadings

System information

PV Array		Inverters	
Nb. of modules	52248 units	Nb. of units	116 units
Pnom total	28.48 MWp	Pnom total	23.20 MWac
		Pnom ratio	1.227

User's needs
Unlimited load (grid)

Results summary

Produced Energy	42034 MWh/year	Specific production	1476 kWh/kWp/year	Perf. Ratio PR	82.63 %

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General parameters

Grid-Connected System — **Unlimited Trackers with backtracking**

PV Field Orientation

Orientation
Tracking horizontal axis

Tracking algorithm
Irradiance optimization
Backtracking activated

Backtracking strategy

Nb. of trackers	10 units
Unlimited trackers	

Sizes

Tracker Spacing	9.50 m
Collector width	4.66 m
Ground Cov. Ratio (GCR)	49.1 %
Left inactive band	0.02 m
Right inactive band	0.02 m
Phi min / max.	-/+ 55.0 °

Backtracking limit angle
Phi limits +/- 60.2 °

Models used

Transposition	Perez
Diffuse	Perez, Meteonorm
Circumsolar	separate

Horizon
Free Horizon

Near Shadings
No Shadings

User's needs
Unlimited load (grid)

Bifacial system

Model 2D Calculation
unlimited trackers

Bifacial model geometry

Tracker Spacing	9.50 m
Tracker width	4.70 m
GCR	49.5 %
Axis height above ground	2.50 m

Bifacial model definitions

Ground albedo	0.20
Bifaciality factor	70 %
Rear shading factor	5.0 %
Rear mismatch loss	10.0 %
Shed transparent fraction	0.0 %

PV Array Characteristics

PV module

Manufacturer	Longi Solar
Model	LR5-72 HBD 545 M Bifacial
(Custom parameters definition)	
Unit Nom. Power	545 Wp
Number of PV modules	52248 units
Nominal (STC)	28.48 MWp

Inverter

Manufacturer	Huawei Technologies
Model	SUN2000-215KTL-H0
(Custom parameters definition)	
Unit Nom. Power	200 kWac
Number of inverters	116 units
Total power	23200 kWac

Array #1 - Sub-array #1

Number of PV modules	3724 units	Number of inverters	8 units
Nominal (STC)	2030 kWp	Total power	1600 kWac
Modules	133 Strings x 28 In series		
At operating cond. (50°C)		Operating voltage	500-1500 V
Pmpp	1854 kWp	Max. power (=>33°C)	215 kWac
U mpp	1049 V	Pnom ratio (DC:AC)	1.27
I mpp	1767 A		

PV Array Characteristics

Array #2 - Sub-array #2

Number of PV modules	3724 units	Number of inverters	8 units
Nominal (STC)	2030 kWp	Total power	1600 kWac
Modules	133 Strings x 28 In series		
At operating cond. (50°C)		Operating voltage	500-1500 V
Pmpp	1854 kWp	Max. power (=>33°C)	215 kWac
U mpp	1049 V	Pnom ratio (DC:AC)	1.27
I mpp	1767 A		

Array #3 - Sub-array #3

Number of PV modules	3752 units	Number of inverters	8 units
Nominal (STC)	2045 kWp	Total power	1600 kWac
Modules	134 Strings x 28 In series		
At operating cond. (50°C)		Operating voltage	500-1500 V
Pmpp	1868 kWp	Max. power (=>33°C)	215 kWac
U mpp	1049 V	Pnom ratio (DC:AC)	1.28
I mpp	1780 A		

Array #4 - Sub-array #4

Number of PV modules	3724 units	Number of inverters	8 units
Nominal (STC)	2030 kWp	Total power	1600 kWac
Modules	133 Strings x 28 In series		
At operating cond. (50°C)		Operating voltage	500-1500 V
Pmpp	1854 kWp	Max. power (=>33°C)	215 kWac
U mpp	1049 V	Pnom ratio (DC:AC)	1.27
I mpp	1767 A		

Array #5 - Sub-array #5

Number of PV modules	3752 units	Number of inverters	8 units
Nominal (STC)	2045 kWp	Total power	1600 kWac
Modules	134 Strings x 28 In series		
At operating cond. (50°C)		Operating voltage	500-1500 V
Pmpp	1868 kWp	Max. power (=>33°C)	215 kWac
U mpp	1049 V	Pnom ratio (DC:AC)	1.28
I mpp	1780 A		

Array #6 - Sub-array #6

Number of PV modules	3752 units	Number of inverters	8 units
Nominal (STC)	2045 kWp	Total power	1600 kWac
Modules	134 Strings x 28 In series		
At operating cond. (50°C)		Operating voltage	500-1500 V
Pmpp	1868 kWp	Max. power (=>33°C)	215 kWac
U mpp	1049 V	Pnom ratio (DC:AC)	1.28
I mpp	1780 A		

Array #7 - Sub-array #7

Number of PV modules	3752 units	Number of inverters	8 units
Nominal (STC)	2045 kWp	Total power	1600 kWac
Modules	134 Strings x 28 In series		
At operating cond. (50°C)		Operating voltage	500-1500 V
Pmpp	1868 kWp	Max. power (=>33°C)	215 kWac
U mpp	1049 V	Pnom ratio (DC:AC)	1.28
I mpp	1780 A		

PV Array Characteristics

Array #8 - Sub-array #8

Number of PV modules	2660 units	Number of inverters	8 units
Nominal (STC)	1450 kWp	Total power	1600 kWac
Modules	95 Strings x 28 In series		
At operating cond. (50°C)		Operating voltage	500-1500 V
Pmpp	1324 kWp	Max. power (=>33°C)	215 kWac
U mpp	1049 V	Pnom ratio (DC:AC)	0.91
I mpp	1262 A		

Array #9 - Sub-array #9

Number of PV modules	3752 units	Number of inverters	9 units
Nominal (STC)	2045 kWp	Total power	1800 kWac
Modules	134 Strings x 28 In series		
At operating cond. (50°C)		Operating voltage	500-1500 V
Pmpp	1868 kWp	Max. power (=>33°C)	215 kWac
U mpp	1049 V	Pnom ratio (DC:AC)	1.14
I mpp	1780 A		

Array #10 - Sub-array #10

Number of PV modules	3752 units	Number of inverters	8 units
Nominal (STC)	2045 kWp	Total power	1600 kWac
Modules	134 Strings x 28 In series		
At operating cond. (50°C)		Operating voltage	500-1500 V
Pmpp	1868 kWp	Max. power (=>33°C)	215 kWac
U mpp	1049 V	Pnom ratio (DC:AC)	1.28
I mpp	1780 A		

Array #11 - Sub-array #11

Number of PV modules	3584 units	Number of inverters	8 units
Nominal (STC)	1953 kWp	Total power	1600 kWac
Modules	128 Strings x 28 In series		
At operating cond. (50°C)		Operating voltage	500-1500 V
Pmpp	1784 kWp	Max. power (=>33°C)	215 kWac
U mpp	1049 V	Pnom ratio (DC:AC)	1.22
I mpp	1701 A		

Array #12 - Sub-array #12

Number of PV modules	3976 units	Number of inverters	9 units
Nominal (STC)	2167 kWp	Total power	1800 kWac
Modules	142 Strings x 28 In series		
At operating cond. (50°C)		Operating voltage	500-1500 V
Pmpp	1979 kWp	Max. power (=>33°C)	215 kWac
U mpp	1049 V	Pnom ratio (DC:AC)	1.20
I mpp	1886 A		

Array #13 - Sub-array #13

Number of PV modules	3920 units	Number of inverters	9 units
Nominal (STC)	2136 kWp	Total power	1800 kWac
Modules	140 Strings x 28 In series		
At operating cond. (50°C)		Operating voltage	500-1500 V
Pmpp	1952 kWp	Max. power (=>33°C)	215 kWac
U mpp	1049 V	Pnom ratio (DC:AC)	1.19
I mpp	1860 A		

PV Array Characteristics

Array #14 - Sub-array #14

Number of PV modules	4424 units	Number of inverters	9 units
Nominal (STC)	2411 kWp	Total power	1800 kWac
Modules	158 Strings x 28 In series		
At operating cond. (50°C)		Operating voltage	500-1500 V
Pmpp	2203 kWp	Max. power (=>33°C)	215 kWac
U mpp	1049 V	Pnom ratio (DC:AC)	1.34
I mpp	2099 A		

Total PV power		**Total inverter power**	
Nominal (STC)	28475 kWp	Total power	23200 kWac
Total	52248 modules	Nb. of inverters	116 units
Module area	133548 m²	Pnom ratio	1.23
Cell area	121132 m²		

Array losses

Array Soiling Losses
Loss Fraction 3.0 %

Thermal Loss factor
Module temperature according to irradiance
Uc (const) 20.0 W/m²K
Uv (wind) 0.0 W/m²K/m/s

Serie Diode Loss
Voltage drop 0.7 V
Loss Fraction 0.1 % at STC

LID - Light Induced Degradation
Loss Fraction 2.0 %

Module Quality Loss
Loss Fraction -0.3 %

Module mismatch losses
Loss Fraction 2.0 % at MPP

Strings Mismatch loss
Loss Fraction 0.1 %

Module average degradation
Year no 1
Loss factor 0.4 %/year
Mismatch due to degradation
Imp RMS dispersion 0.4 %/year
Vmp RMS dispersion 0.4 %/year

IAM loss factor
Incidence effect (IAM): User defined profile

0°	25°	45°	60°	65°	70°	75°	80°	90°
1.000	1.000	0.995	0.962	0.936	0.903	0.851	0.754	0.000

DC wiring losses

Global wiring resistance 0.70 mΩ
Loss Fraction 1.5 % at STC

Array #1 - Sub-array #1
Global array res. 9.8 mΩ
Loss Fraction 1.5 % at STC

Array #2 - Sub-array #2
Global array res. 9.8 mΩ
Loss Fraction 1.5 % at STC

Array #3 - Sub-array #3
Global array res. 9.8 mΩ
Loss Fraction 1.5 % at STC

Array #4 - Sub-array #4
Global array res. 9.8 mΩ
Loss Fraction 1.5 % at STC

Array #5 - Sub-array #5
Global array res. 9.8 mΩ
Loss Fraction 1.5 % at STC

Array #6 - Sub-array #6
Global array res. 9.8 mΩ
Loss Fraction 1.5 % at STC

Array #7 - Sub-array #7
Global array res. 9.8 mΩ
Loss Fraction 1.5 % at STC

Array #8 - Sub-array #8
Global array res. 14 mΩ
Loss Fraction 1.5 % at STC

Array #9 - Sub-array #9
Global array res. 9.8 mΩ
Loss Fraction 1.5 % at STC

Array #10 - Sub-array #10
Global array res. 9.8 mΩ
Loss Fraction 1.5 % at STC

Array #11 - Sub-array #11
Global array res. 10 mΩ
Loss Fraction 1.5 % at STC

Array #12 - Sub-array #12
Global array res. 9.2 mΩ
Loss Fraction 1.5 % at STC

Array #13 - Sub-array #13
Global array res. 9.4 mΩ
Loss Fraction 1.5 % at STC

Array #14 - Sub-array #14
Global array res. 8.3 mΩ
Loss Fraction 1.5 % at STC

System losses

Unavailability of the system
Time fraction 2.0 %
7.3 days,
3 periods

Auxiliaries loss
constant (fans) 20.0 kW
20000.0 kW from Power thresh.
Night aux. cons. 18.0 kW

Main results

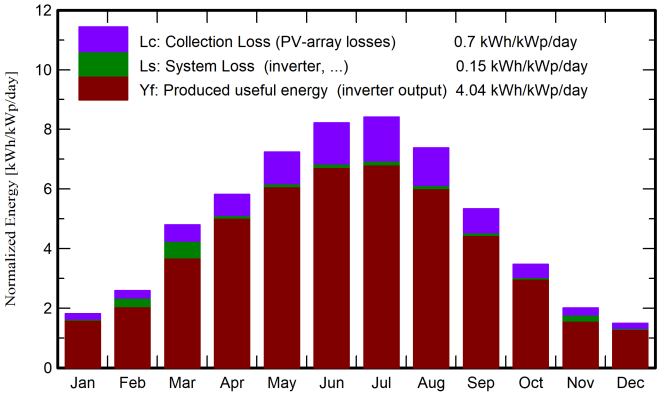
System Production

Produced Energy 42034 MWh/year

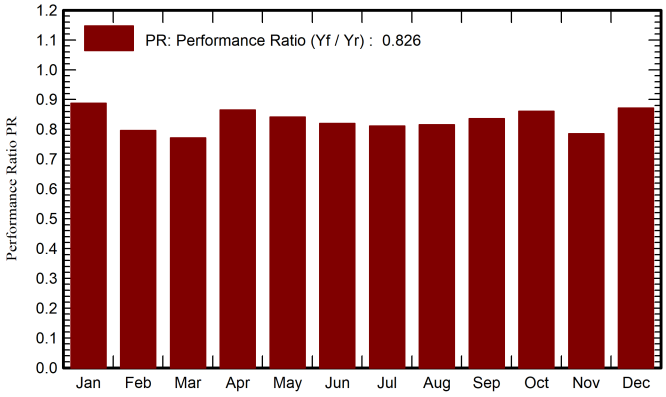
Specific production 1476 kWh/kWp/year

Performance Ratio PR 82.63 %

Normalized productions (per installed kWp)



Performance Ratio PR



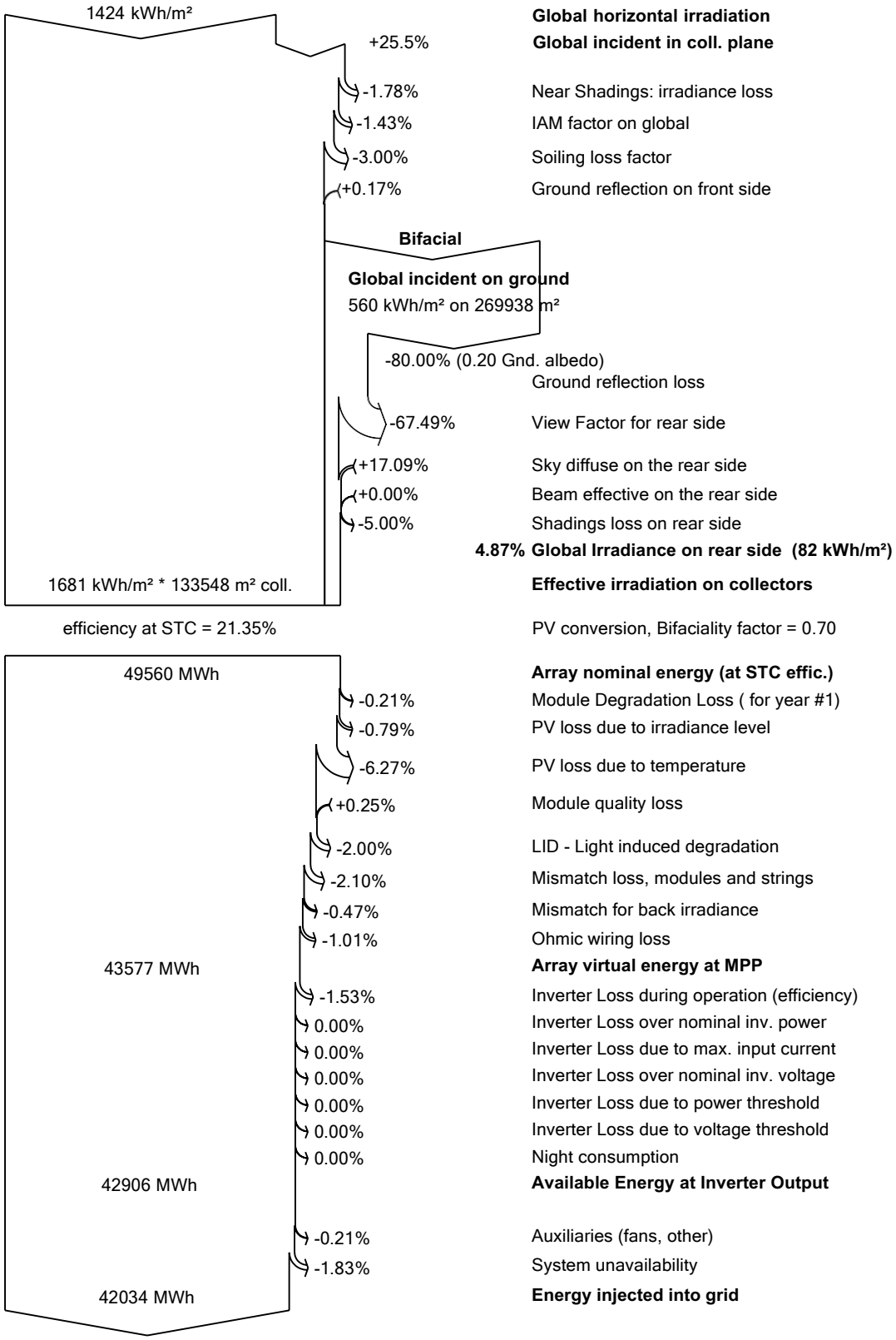
Balances and main results

	GlobHor kWh/m²	DiffHor kWh/m²	T_Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray MWh	E_Grid MWh	PR ratio
January	46.0	28.32	5.59	56.4	51.6	1451	1424	0.887
February	59.2	34.16	6.61	72.6	67.5	1877	1646	0.796
March	116.8	50.52	10.02	148.8	140.1	3760	3267	0.771
April	141.6	74.02	13.25	174.6	164.4	4374	4302	0.865
May	180.7	83.86	17.90	224.3	211.8	5464	5371	0.841
June	197.8	80.30	22.31	246.6	233.5	5858	5753	0.819
July	204.6	82.05	25.19	260.7	246.7	6130	6022	0.811
August	179.2	72.08	24.86	228.8	216.4	5409	5315	0.816
September	124.5	52.33	19.86	159.9	150.6	3874	3807	0.836
October	86.2	43.93	15.96	107.5	100.5	2681	2635	0.861
November	50.1	30.77	11.25	60.1	55.3	1525	1345	0.785
December	37.2	21.34	6.91	46.2	42.1	1172	1147	0.872
Year	1424.0	653.69	15.03	1786.5	1680.6	43575	42034	0.826

Legends

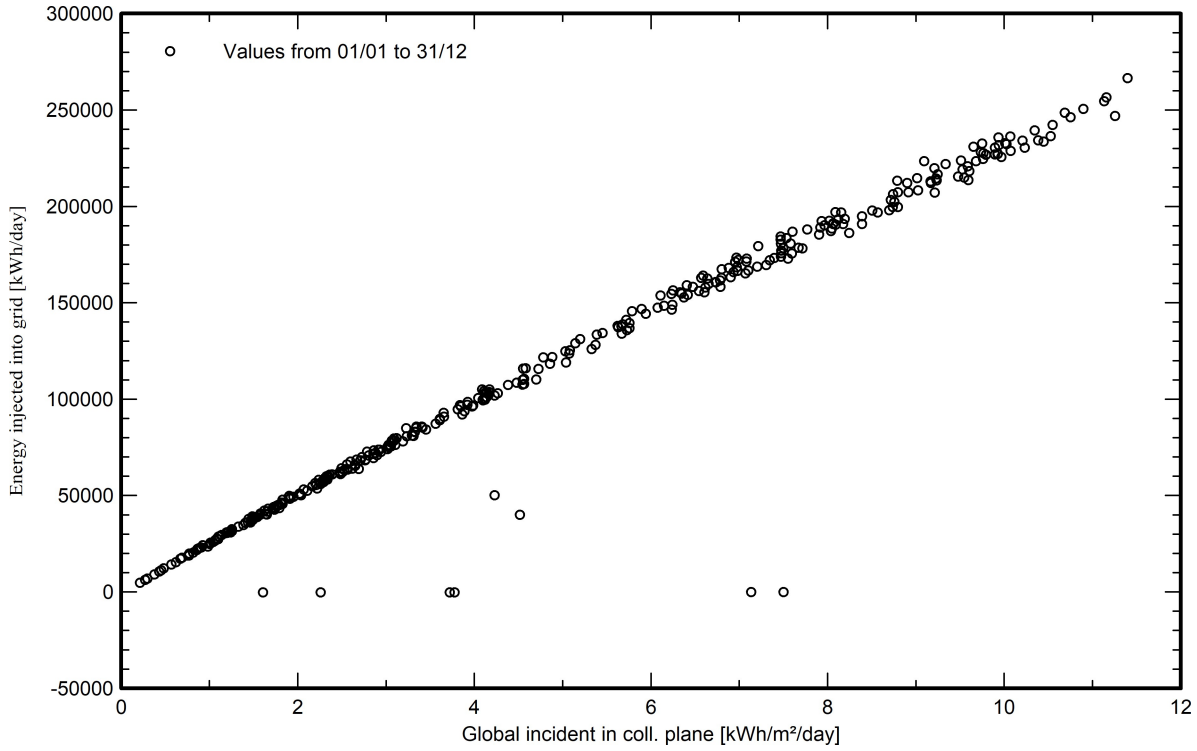
GlobHor	Global horizontal irradiation
DiffHor	Horizontal diffuse irradiation
T_Amb	Ambient Temperature
GlobInc	Global incident in coll. plane
GlobEff	Effective Global, corr. for IAM and shadings
EArray	Effective energy at the output of the array
E_Grid	Energy injected into grid
PR	Performance Ratio

Loss diagram



Special graphs

Daily Input/Output diagram



System Output Power Distribution