



Città metropolitana
di Roma Capitale



PROVINCIA
DI FROSINONE



Comune di Gavignano



Comune di Paliano



Comune di Anagni

Committente:

GRUPOTEC SOLAR ITALIA 15 SRL



Via Statuto, 10 - 20121 Milano - Italy
pec: grupotecsolaritalia15srl@legalmail.it

PROCEDIMENTO VIA NAZIONALE

ai sensi dell'art. 23 bis del D.Lgs. 152/06 e s.m.i.

Denominazione progetto:

REALIZZAZIONE IMPIANTO AGRIVOLTAICO "GAVIGNANO"

Potenza nominale complessiva = 17.263,8 kWp

Sito in:

COMUNI DI GAVIGNANO (RM), PALIANO (FR) E ANAGNI (FR)

Titolo elaborato:

Stima di Producibilità dell'Impianto



Elaborato n.

EL10

Scala -

Responsabile Coordinamento e revisione progetto : Ing. Nicodemo Agostino

TIMBRI E FIRME:

Progettisti : Grupotec Solar Italia 15 S.r.l.

Collaboratori : -



REV.:	REDAZIONE:	CONTROLLO:	APPROVAZIONE :	DATA:
01	Maria Dolores Torregrosa	Ing. Nicodemo Agostino	Ing. Nicodemo Agostino	02/11/2021
02	Maria Dolores Torregrosa	Ing. Nicodemo Agostino	Ing. Nicodemo Agostino	13/12/2021
03				

FIRMA/TIMBRO
COMMITTENTE:



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PVsyst - Simulation report

Grid-Connected System

Project: Gavignano - Lazio - Italy

Variant: VC1_Gavignano_REV T-B-S-72M-60°-5-SG (AU)

Trackers single array, with backtracking

System power: 17.26 MWp

Gavignano_Lazio - Italy

Author

Grupotec UK (United Kingdom)



Project: Gavignano - Lazio - Italy

Variant: VC1_Gavignano_REV T-B-S-72M-60°-5-SG (AU)

PVsyst V7.2.8

VC1, Simulation date:
10/12/21 11:55
with v7.2.8

Grupotec UK (United Kingdom)

Project summary

Geographical Site

Gavignano_Lazio

Italy

Situation

Latitude 41.72 °N

Longitude 13.07 °E

Altitude 211 m

Time zone UTC+1

Project settings

Albedo 0.20

Meteo data

Gavignano_Lazio

SolarGIS Monthly aver. , period not spec. - Synthetic

System summary

Grid-Connected System

Simulation for year no 1

Trackers single array, with backtracking

PV Field Orientation

Tracking plane, horizontal N-S axis

Axis azimuth 0 °

Near Shadings

According to strings

Electrical effect 100 %

User's needs

Unlimited load (grid)

System information

PV Array

Nb. of modules 30024 units

Pnom total 17.26 MWp

Inverters

Nb. of units 86 units

Pnom total 15.05 MWac

Pnom ratio 1.147

Results summary

Produced Energy 29453 MWh/year Specific production 1706 kWh/kWp/year Perf. Ratio PR 84.53 %

Table of contents

Project and results summary	2
General parameters, PV Array Characteristics, System losses	3
Horizon definition	6
Near shading definition - Iso-shadings diagram	7
Main results	8
Loss diagram	9
Special graphs	10



PVsyst V7.2.8

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General parameters

Grid-Connected System

PV Field Orientation

Orientation

Tracking plane, horizontal N-S axis
Axis azimuth 0 °

Horizon

Average Height 3.4 °

Trackers single array, with backtracking

Backtracking strategy

Nb. of trackers 120 units

Single array

Sizes

Tracker Spacing 5.00 m

Collector width 2.41 m

Ground Cov. Ratio (GCR) 48.2 %

Left inactive band 0.02 m

Right inactive band 0.02 m

Phi min / max. -/+ 55.0 °

Backtracking limit angle

Phi limits +/- 60.5 °

Near Shadings

According to strings

Electrical effect 100 %

Models used

Transposition Perez

Diffuse Perez, Meteonorm

Circumsolar separate

User's needs

Unlimited load (grid)

PV Array Characteristics

PV module

Manufacturer Jinkosolar

Model JKM575M-7RL4-V

(Original PVsyst database)

Unit Nom. Power 575 Wp

Number of PV modules 30024 units

Nominal (STC) 17.26 MWp

Modules 1112 Strings x 27 In series

At operating cond. (50°C)

Pmpp 15.75 MWp

U mpp 1082 V

I mpp 14553 A

Total PV power

Nominal (STC) 17264 kWp

Total 30024 modules

Module area 82088 m²

Inverter

Manufacturer Huawei Technologies

Model SUN2000-185KTL-H1@40C

(Custom parameters definition)

Unit Nom. Power 175 kWac

Number of inverters 86 units

Total power 15050 kWac

Operating voltage 500-1500 V

Max. power (=>30°C) 185 kWac

Pnom ratio (DC:AC) 1.15

Total inverter power

Total power 15050 kWac

Nb. of inverters 86 units

Pnom ratio 1.15

Array losses

Array Soiling Losses

Loss Fraction 1.5 %

LID - Light Induced Degradation

Loss Fraction 1.5 %

Strings Mismatch loss

Loss Fraction 0.1 %

Thermal Loss factor

Module temperature according to irradiance

Uc (const) 29.0 W/m²K

Uv (wind) 0.0 W/m²K/m/s

Module Quality Loss

Loss Fraction -0.8 %

Module average degradation

Year no 1

Loss factor 0.5 %/year

Mismatch due to degradation

Imp RMS dispersion 0.4 %/year

Vmp RMS dispersion 0.4 %/year

DC wiring losses

Global array res. 0.41 mΩ

Loss Fraction 0.5 % at STC

Module mismatch losses

Loss Fraction 0.5 % at MPP



Array losses

IAM loss factor

Incidence effect (IAM): Fresnel AR coating, $n(\text{glass})=1.526$, $n(\text{AR})=1.290$

0°	30°	50°	60°	70°	75°	80°	85°	90°
1.000	0.999	0.987	0.962	0.892	0.816	0.681	0.440	0.000

**PVsyst V7.2.8**

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System losses**Unavailability of the system**

Time fraction 1.0 %
3.7 days,
3 periods

Auxiliaries loss

Proportionnal to Power 4.0 W/kW
0.0 kW from Power thresh.

AC wiring losses**Inv. output line up to MV transfo**

Inverter voltage 800 Vac tri
Loss Fraction 2.00 % at STC

Inverter: SUN2000-185KTL-H1@40C

Wire section (86 Inv.) Copper 86 x 3 x 10000 mm²
Average wires length 34540 m

MV line up to Injection

MV Voltage 20 kV
Wires Copper 3 x 500 mm²
Length 3150 m
Loss Fraction 0.50 % at STC

AC losses in transformers**MV transfo**

Grid voltage 20 kV

Operating losses at STC

Nominal power at STC 16953 kVA
Iron loss (night disconnect) 16.95 kW
Loss Fraction 0.10 % at STC
Coils equivalent resistance 3 x 0.38 mΩ
Loss Fraction 1.00 % at STC



Horizon definition

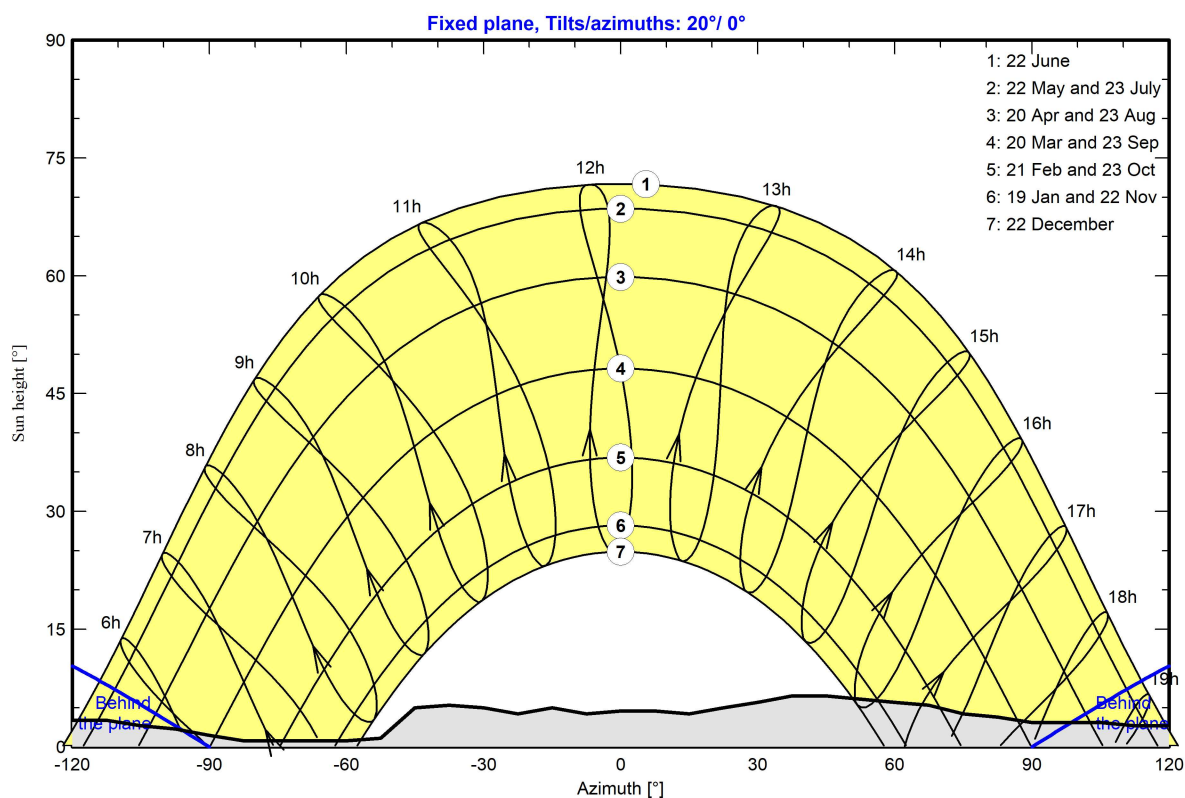
Horizon from PVGIS website API, Lat=41°43'7", Long=13°4'4", Alt=211m

Average Height 3.4 ° Albedo Factor 0.80
Diffuse Factor 0.95 Albedo Fraction 100 %

Horizon profile

Azimuth [°]	-180	-173	-165	-158	-150	-143	-135	-128	-120	-113	-105	-98	-90	-83
Height [°]	1.9	3.1	4.2	3.8	3.4	3.4	3.1	3.1	3.4	3.4	2.7	2.3	1.5	0.8
Azimuth [°]	-60	-53	-45	-38	-30	-23	-15	-8	0	8	15	23	30	38
Height [°]	0.8	1.1	5.0	5.3	5.0	4.2	5.0	4.2	4.6	4.6	4.2	5.0	5.7	6.5
Azimuth [°]	45	53	60	68	75	83	90	105	113	143	158	173	180	
Height [°]	6.5	6.1	5.7	5.3	4.2	3.8	3.1	3.1	2.7	2.7	1.5	1.5	1.9	

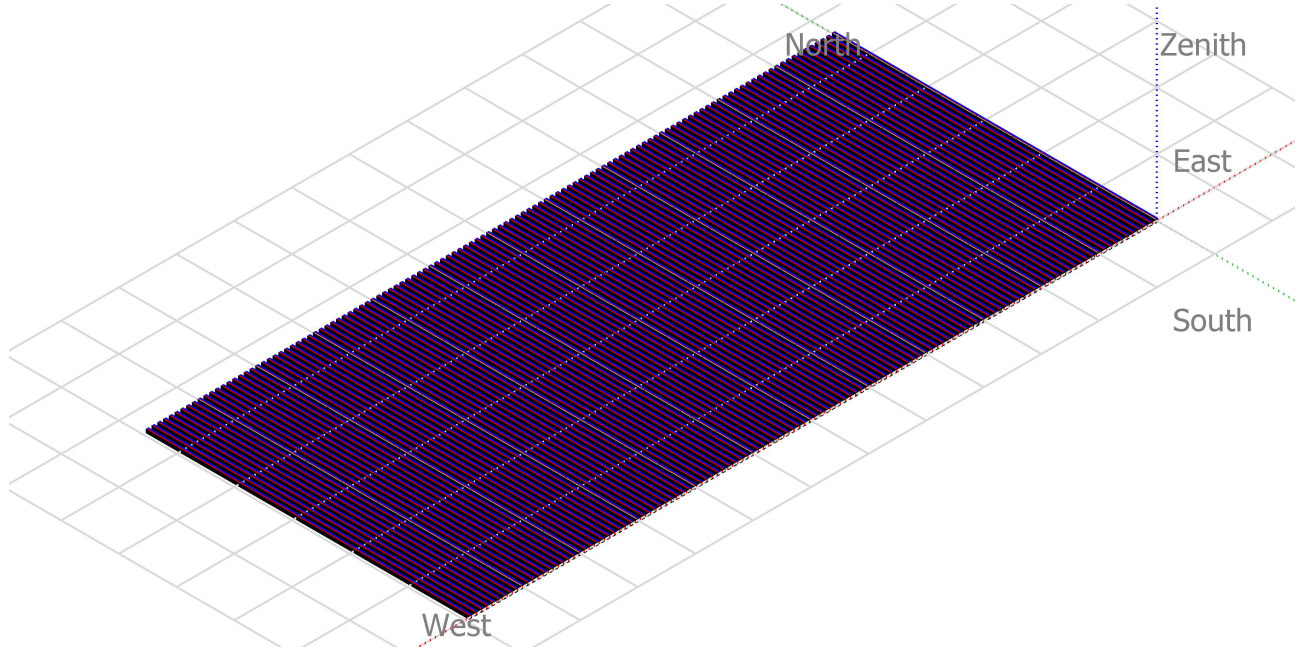
Sun Paths (Height / Azimuth diagram)





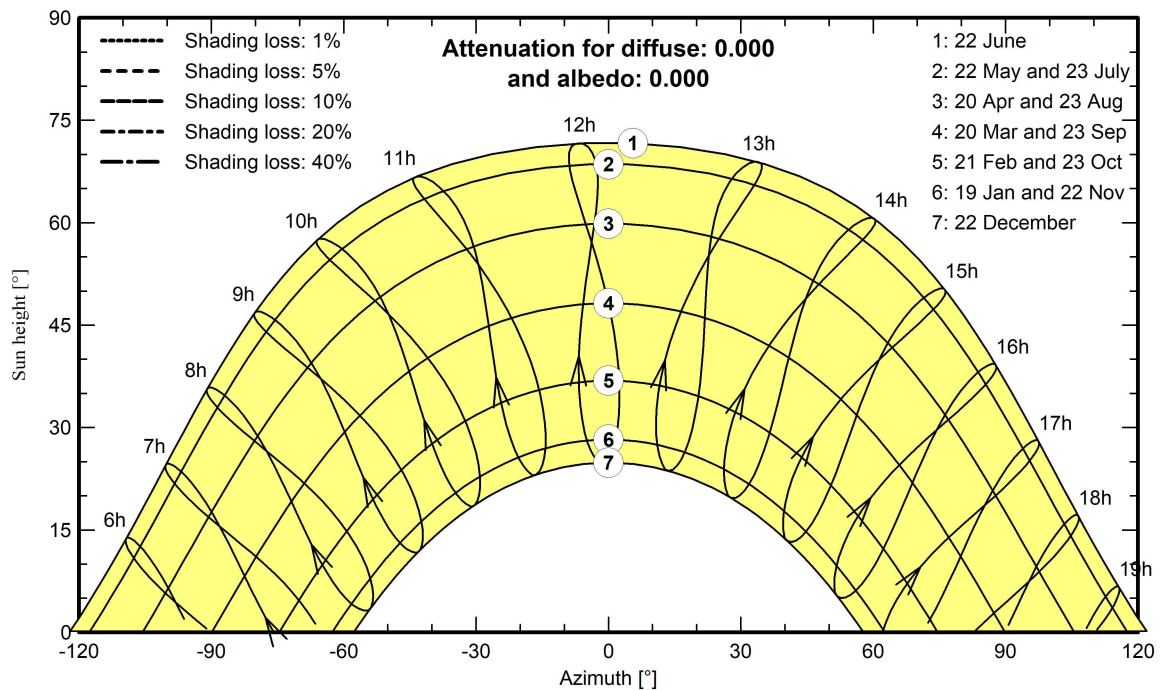
Near shadings parameter

Perspective of the PV-field and surrounding shading scene



Iso-shadings diagram

Gavignano - Lazio - Italy - Legal Time





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Main results

System Production

Produced Energy

29453 MWh/year

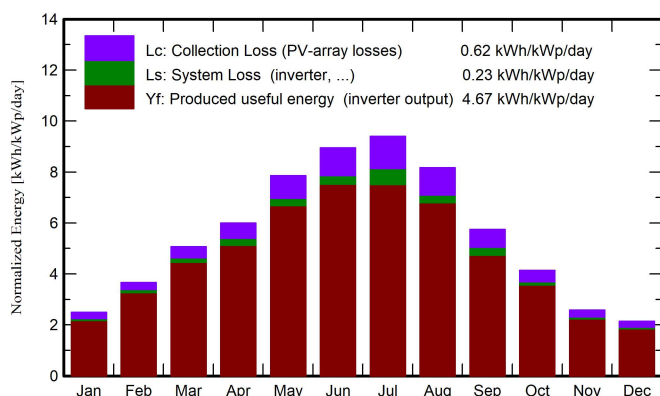
Specific production

1706 kWh/kWp/year

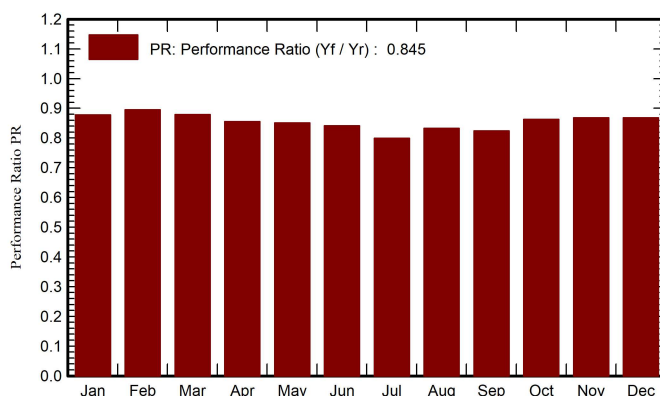
Performance Ratio PR

84.53 %

Normalized productions (per installed kWp)



Performance Ratio PR



Balances and main results

	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_Grid	PR
	kWh/m ²	kWh/m ²	°C	kWh/m ²	kWh/m ²	MWh	MWh	ratio
January	58.0	25.00	6.30	77.1	70.8	1208	1169	0.878
February	78.0	31.00	6.40	102.5	96.2	1640	1583	0.895
March	123.0	51.00	8.80	157.2	148.8	2484	2387	0.879
April	145.0	64.00	11.40	179.9	170.4	2802	2657	0.855
May	191.0	77.00	16.60	243.6	231.9	3737	3578	0.851
June	209.0	76.00	21.10	268.5	256.8	4073	3898	0.841
July	225.0	72.00	24.20	291.6	279.2	4359	4024	0.799
August	195.0	68.00	23.80	253.1	242.1	3799	3638	0.832
September	136.0	57.00	19.00	172.5	163.3	2618	2454	0.824
October	100.0	43.00	15.30	128.3	120.5	1982	1910	0.862
November	60.0	28.00	10.60	77.5	71.8	1203	1163	0.869
December	50.0	22.00	7.40	66.3	60.5	1026	994	0.868
Year	1570.0	614.00	14.29	2018.2	1912.4	30932	29453	0.845

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

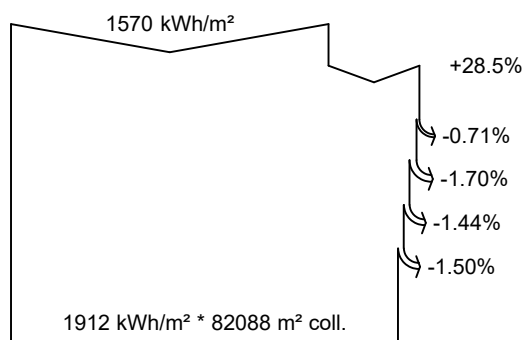
EArray Effective energy at the output of the array

E_Grid Energy injected into grid

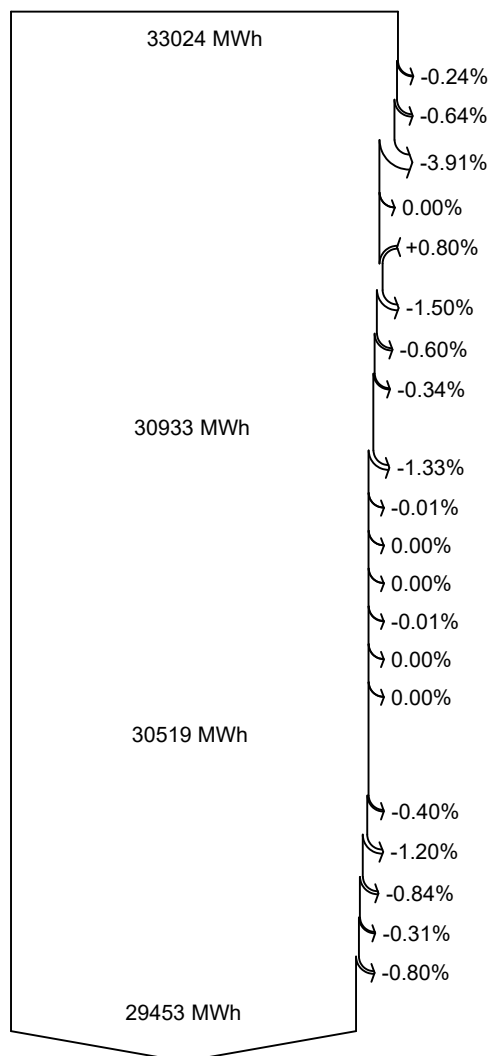
PR Performance Ratio



Loss diagram



efficiency at STC = 21.04%



Global horizontal irradiation

Global incident in coll. plane

Far Shadings / Horizon

Near Shadings: irradiance loss

IAM factor on global

Soiling loss factor

Effective irradiation on collectors

PV conversion

Array nominal energy (at STC effic.)

Module Degradation Loss (for year #1)

PV loss due to irradiance level

PV loss due to temperature

Shadings: Electrical Loss acc. to strings

Module quality loss

LID - Light induced degradation

Mismatch loss, modules and strings

Ohmic wiring loss

Array virtual energy at MPP

Inverter Loss during operation (efficiency)

Inverter Loss over nominal inv. power

Inverter Loss due to max. input current

Inverter Loss over nominal inv. voltage

Inverter Loss due to power threshold

Inverter Loss due to voltage threshold

Night consumption

Available Energy at Inverter Output

Auxiliaries (fans, other)

AC ohmic loss

Medium voltage transfo loss

MV line ohmic loss

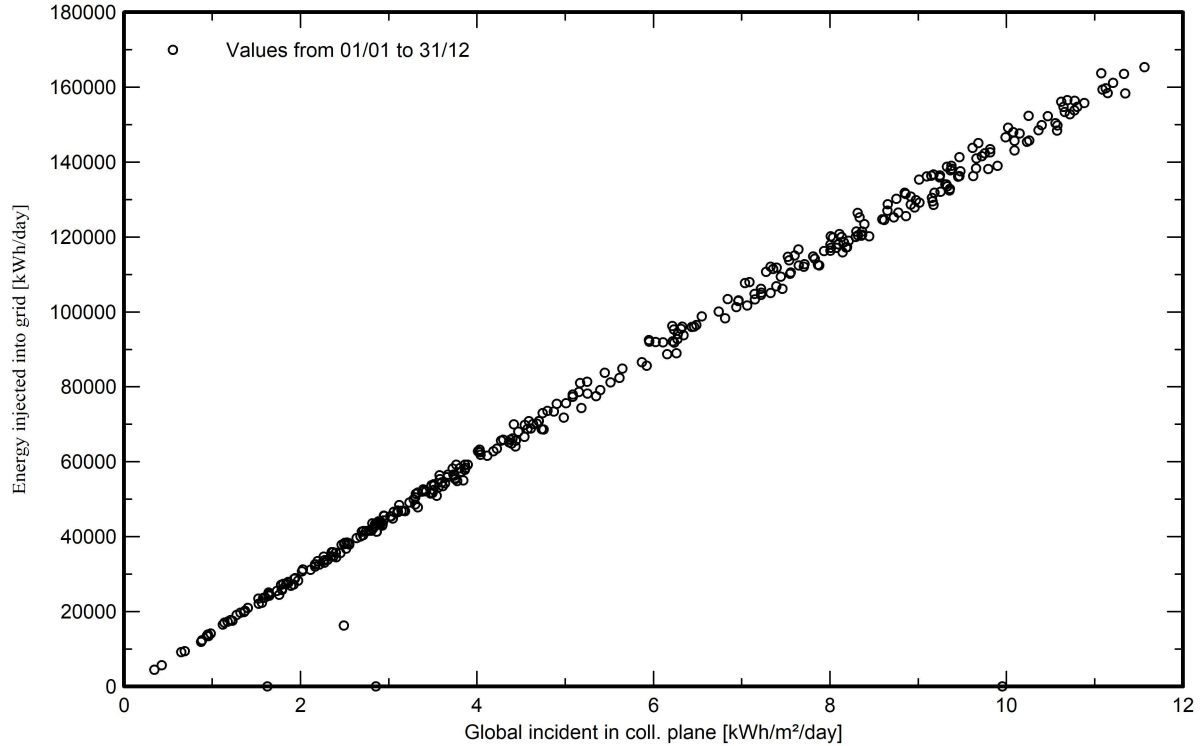
System unavailability

Energy injected into grid



Special graphs

Daily Input/Output diagram



System Output Power Distribution

