PVsyst

PHOTOVOLTAIC SOFTWARE

PVsyst - Simulation report

Grid-Connected System

Project: Kopellis_ 1 Axis

Variant: 1 axis E-W 114 kW 10m Pitch
Trackers single array, with backtracking
System power: 114 kWp
Thessaloniki/Livadákion - Greece

Author

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Project summary

Geographical Site
Thessaloniki/Livadákion
Greece

Situation
Latitude	40.52 °N
Longitude	22.97 °E
Altitude	4 m
Time zone	UTC+2

Project settings
Albedo	0.20

Meteo data
Thessaloniki/Livadákion
Meteonorm 8.0 (1994-2006), Sat=14% - Synthetic

System summary

Grid-Connected System   **Trackers single array, with backtracking**

PV Field Orientation
Orientation
Tracking plane, horizontal E-W axis
Normal azimuth to axis   0 °

Tracking algorithm
Astronomic calculation
Backtracking activated

Near Shadings
Linear shadings

System information
PV Array		Inverters	
Nb. of modules	216 units	Nb. of units	1 unit
Pnom total	114 kWp	Pnom total	111 kWac
		Pnom ratio	1.031

User's needs
Unlimited load (grid)

Results summary

Produced Energy	176.6 MWh/year	Specific production	1543 kWh/kWp/year	Perf. Ratio PR	84.50 %

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General parameters

Grid-Connected System   **Trackers single array, with backtracking**

PV Field Orientation

Orientation	Tracking algorithm	Backtracking array	
Tracking plane, horizontal E-W axis	Astronomic calculation	Nb. of trackers	4 units
Normal azimuth to axis 0 °	Backtracking activated	Single array	

Sizes

Tracker Spacing	10.00 m
Collector width	4.57 m
Ground Cov. Ratio (GCR)	45.7 %
Tilt min / max.	20.0 / 80.0 °

Backtracking strategy

Phi limits	+/- 62.7 °
Backtracking pitch	10.00 m
Backtracking width	4.57 m

Models used

Transposition	Perez
Diffuse	Perez, Meteonorm
Circumsolar	separate

Horizon   **Near Shadings**   **User's needs**

Average Height	7.4 °	Linear shadings	Unlimited load (grid)

PV Array Characteristics

PV module

		Inverter	
Manufacturer	Generic	Manufacturer	Generic
Model	JKM-530M-72HL4-V	Model	SG111-HV
(Custom parameters definition)		(Original PVsyst database)	
Unit Nom. Power	530 Wp	Unit Nom. Power	111 kWac
Number of PV modules	216 units	Number of inverters	1 unit
Nominal (STC)	114 kWp	Total power	111 kWac
Modules	8 Strings x 27 In series	Operating voltage	780-1450 V
At operating cond. (50°C)		Pnom ratio (DC:AC)	1.03
Pmpp	104 kWp		
U mpp	1002 V		
I mpp	104 A		

Total PV power

		Total inverter power	
Nominal (STC)	114 kWp	Total power	111 kWac
Total	216 modules	Number of inverters	1 unit
Module area	557 m²	Pnom ratio	1.03

Array losses

Array Soiling Losses   **Thermal Loss factor**   **DC wiring losses**

Loss Fraction	1.5 %	Module temperature according to irradiance		Global array res.	106 mΩ
		Uc (const)	29.0 W/m²K	Loss Fraction	1.0 % at STC
		Uv (wind)	0.0 W/m²K/m/s		

Module Quality Loss   **Module mismatch losses**

Loss Fraction	0.0 %	Loss Fraction	0.6 % at MPP

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Array losses

IAM loss factor

Incidence effect (IAM): Fresnel, AR coating, n(glass)=1.526, n(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

System losses

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   540 Vac tri
Loss Fraction   0.21 % at STC
Inverter: SG111-HV
Wire section (1 Inv.)   Copper 1 x 3 x 240 mm²
Wires length   70 m

AC losses in transformers

MV transfo
Grid voltage   20 kV
Operating losses at STC
Nominal power at STC   113 kVA
Iron loss (24/24 Connexion)   0.11 kW
Loss Fraction   0.10 % at STC
Coils equivalent resistance   3 x 25.76 mΩ
Loss Fraction   1.00 % at STC

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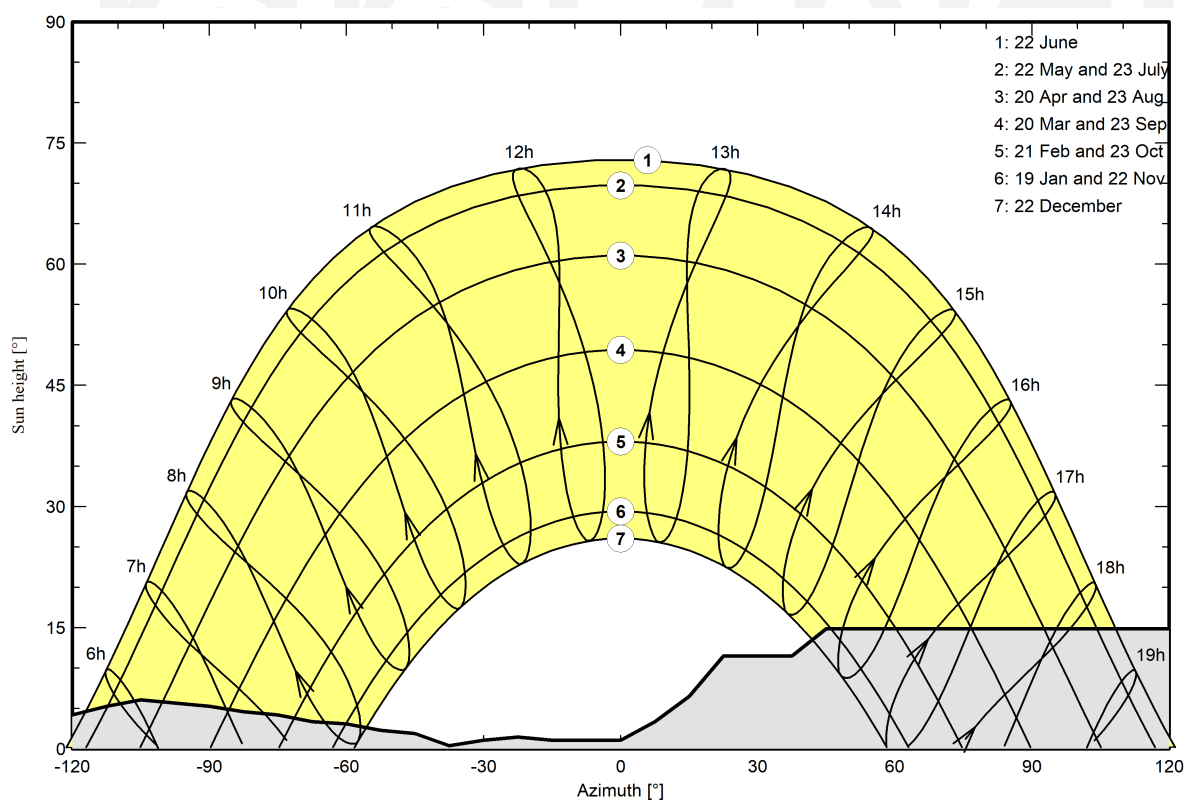with v7.2.16

Horizon definition

Horizon from PVGIS website API, Lat=39°37"58', Long=22°13"41', Alt=153m

Average Height	7.4 °	Albedo Factor	0.71
Diffuse Factor	0.89	Albedo Fraction	100 %

Horizon profile

Azimuth [°]	-180	-173	-165	-158	-143	-135	-128	-120	-113	-105	-98	-90
Height [°]	1.9	3.4	4.6	5.7	7.3	6.5	4.6	4.2	5.3	6.1	5.7	5.3
Azimuth [°]	-83	-75	-68	-60	-53	-45	-38	-30	-23	-15	0	8
Height [°]	4.6	4.2	3.4	3.1	2.3	1.9	0.4	1.1	1.5	1.1	1.1	3.4
Azimuth [°]	15	23	38	45	135	143	150	158	165	173	180	
Height [°]	6.5	11.5	11.5	14.9	14.9	8.0	8.0	5.3	1.9	1.5	1.9	

Sun Paths (Height / Azimuth diagram)

1: 22 June
2: 22 May and 23 July
3: 20 Apr and 23 Aug.
4: 20 Mar and 23 Sep
5: 21 Feb and 23 Oct
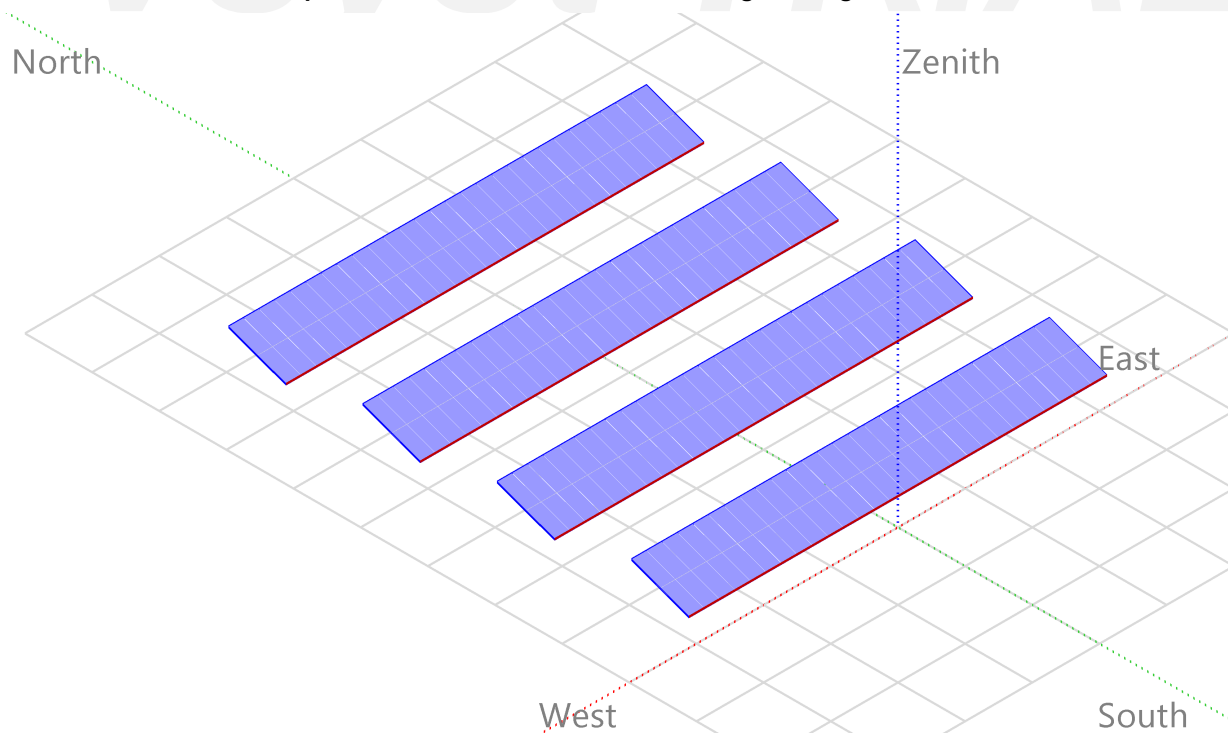6: 19 Jan and 22 Nov.
7: 22 December

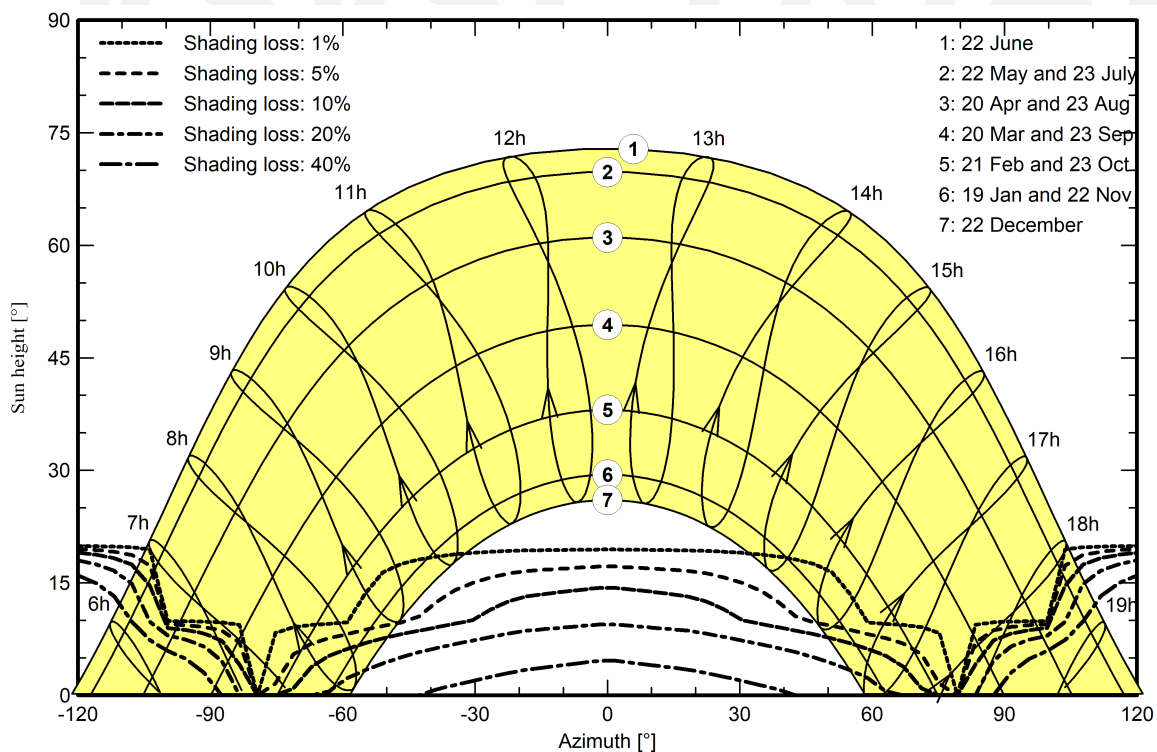**PVsyst V7.2.16**
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Near shadings parameter

Perspective of the PV-field and surrounding shading scene

Iso-shadings diagram

Orientation #1

Legend:
- Shading loss: 1%
- Shading loss: 5%
- Shading loss: 10%
- Shading loss: 20%
- Shading loss: 40%

1: 22 June
2: 22 May and 23 July
3: 20 Apr and 23 Aug
4: 20 Mar and 23 Sep
5: 21 Feb and 23 Oct.
6: 19 Jan and 22 Nov
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Main results

System Production

Produced Energy	176.6 MWh/year	Specific production	1543 kWh/kWp/year
		Performance Ratio PR	84.50 %

Normalized productions (per installed kWp)

Lc: Collection Loss (PV-array losses) 0.65 kWh/kWp/day
Ls: System Loss (inverter, ...) 0.13 kWh/kWp/day
Yf: Produced useful energy (inverter output) 4.23 kWh/kWp/day

Performance Ratio PR

PR: Performance Ratio (Yf / Yr) : 0.845
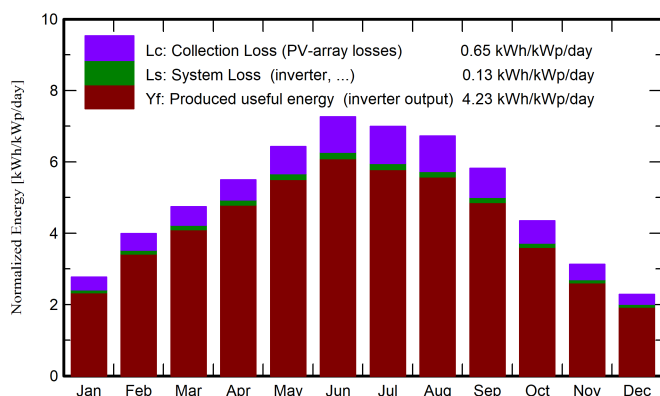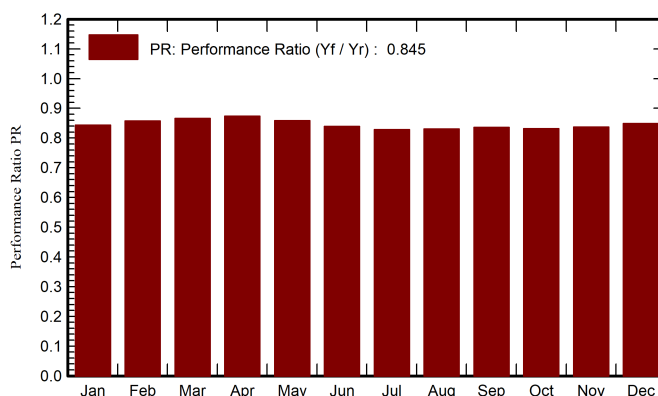
Balances and main results

	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_Grid	PR
	kWh/m²	kWh/m²	°C	kWh/m²	kWh/m²	MWh	MWh	ratio
January	52.6	29.21	4.95	85.7	75.7	8.57	8.28	0.843
February	76.4	39.36	6.71	111.7	100.5	11.31	10.96	0.857
March	118.0	57.36	9.91	147.0	135.2	15.02	14.58	0.866
April	150.3	77.02	13.73	164.8	154.6	16.95	16.47	0.873
May	195.0	84.41	19.52	199.3	188.4	20.14	19.58	0.858
June	218.4	75.24	24.54	218.0	206.6	21.56	20.95	0.840
July	214.7	82.15	27.83	216.8	205.1	21.15	20.56	0.829
August	194.0	76.29	27.71	208.4	197.2	20.37	19.81	0.830
September	144.2	53.93	21.67	174.7	162.8	17.21	16.72	0.836
October	94.1	43.87	16.53	134.7	121.8	13.22	12.82	0.832
November	57.9	29.79	11.46	93.7	84.1	9.29	8.98	0.837
December	43.4	24.96	6.66	70.8	63.4	7.15	6.88	0.848
Year	1559.1	673.58	15.99	1825.6	1695.4	181.94	176.59	0.845

Legends

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

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Loss diagram
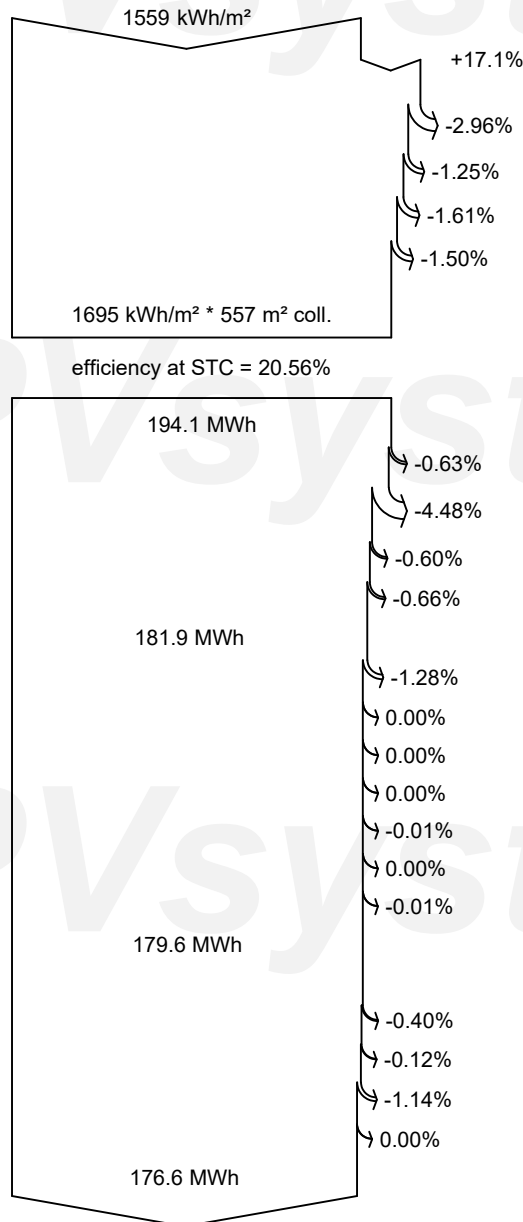
1559 kWh/m²	**Global horizontal irradiation**
+17.1%	**Global incident in coll. plane**
-2.96%	Far Shadings / Horizon
-1.25%	Near Shadings: irradiance loss
-1.61%	IAM factor on global
-1.50%	Soiling loss factor
1695 kWh/m² * 557 m² coll.	**Effective irradiation on collectors**
efficiency at STC = 20.56%	PV conversion
194.1 MWh	**Array nominal energy (at STC effic.)**
-0.63%	PV loss due to irradiance level
-4.48%	PV loss due to temperature
-0.60%	Module array mismatch loss
-0.66%	Ohmic wiring loss
181.9 MWh	**Array virtual energy at MPP**
-1.28%	Inverter Loss during operation (efficiency)
0.00%	Inverter Loss over nominal inv. power
0.00%	Inverter Loss due to max. input current
0.00%	Inverter Loss over nominal inv. voltage
-0.01%	Inverter Loss due to power threshold
0.00%	Inverter Loss due to voltage threshold
-0.01%	Night consumption
179.6 MWh	**Available Energy at Inverter Output**
-0.40%	Auxiliaries (fans, other)
-0.12%	AC ohmic loss
-1.14%	Medium voltage transfo loss
0.00%	MV line ohmic loss
176.6 MWh	**Energy injected into grid**

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Special graphs

Daily Input/Output diagram

Values from 01/01 to 31/12

Y-axis: Energy injected into grid [kWh/day]
X-axis: Global incident in coll. plane [kWh/m²/day]
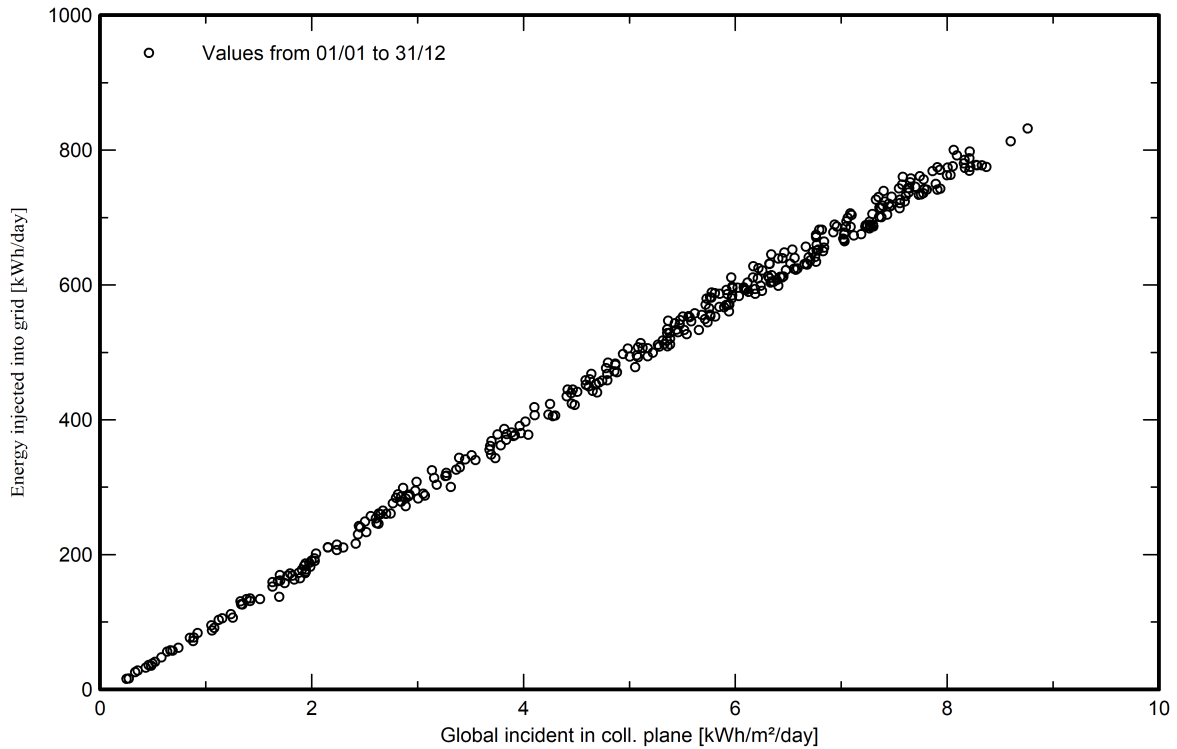
System Output Power Distribution

Values from 01/01 to 31/12

Y-axis: Energy injected into grid [kWh / Bin]
X-axis: Power injected into grid [kW]