PVsyst - Simulation report

Grid-Connected System

Project: Kopellis_ 1 Axis

Variant: 1 axis Vertical 14*4 13*4

Tracking system

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

Tracking system

PV Field Orientation
Orientation
Tracking plane, vertical axis
Plane tilt   25 °

Tracking algorithm
Astronomic calculation

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	199.7 MWh/year	Specific production	1745 kWh/kWp/year	Perf. Ratio PR	83.89 %

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General parameters

Grid-Connected System

Tracking system

PV Field Orientation
Orientation
Tracking plane, vertical axis
Plane tilt   25 °

Tracking algorithm
Astronomic calculation

Trackers configuration
Nb. of trackers   4 units
Sizes
Tracker Spacing   0.00 m
Collector width   15.6 m
Azimut min / max.   -/+ 120.0 °

Models used
Transposition   Perez
Diffuse   Perez, Meteonorm
Circumsolar   separate

Horizon
Average Height   7.4 °

Near Shadings
Linear shadings

User's needs
Unlimited load (grid)

PV Array Characteristics

PV module
Manufacturer   Generic
Model   JKM-530M-72HL4-V
   (Custom parameters definition)
Unit Nom. Power   530 Wp
Number of PV modules   216 units
Nominal (STC)   114 kWp
Modules   8 Strings x 27 In series
At operating cond. (50°C)
Pmpp   104 kWp
U mpp   1002 V
I mpp   104 A

Inverter
Manufacturer   Generic
Model   SG111-HV
   (Original PVsyst database)
Unit Nom. Power   111 kWac
Number of inverters   1 unit
Total power   111 kWac
Operating voltage   780-1450 V
Pnom ratio (DC:AC)   1.03

Total PV power
Nominal (STC)   114 kWp
Total   216 modules
Module area   557 m²

Total inverter power
Total power   111 kWac
Number of inverters   1 unit
Pnom ratio   1.03

Array losses

Array Soiling Losses
Loss Fraction   1.5 %

Thermal Loss factor
Module temperature according to irradiance
Uc (const)   29.0 W/m²K
Uv (wind)   0.0 W/m²K/m/s

DC wiring losses
Global array res.   106 mΩ
Loss Fraction   1.0 % at STC

Module Quality Loss
Loss Fraction   0.0 %

Module mismatch losses
Loss Fraction   0.6 % at MPP

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

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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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Horizon definition

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

Average Height	7.4 °	Albedo Factor	0.40	
Diffuse Factor	0.92	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
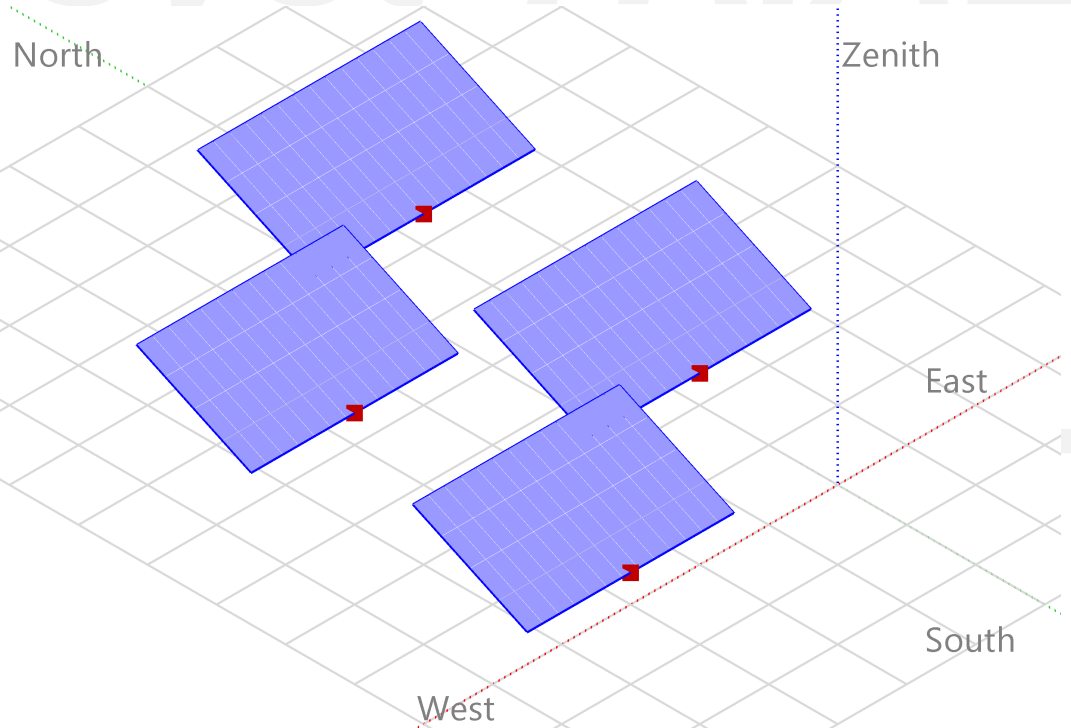5: 21 Feb and 23 Oct
6: 19 Jan and 22 Nov.
7: 22 December
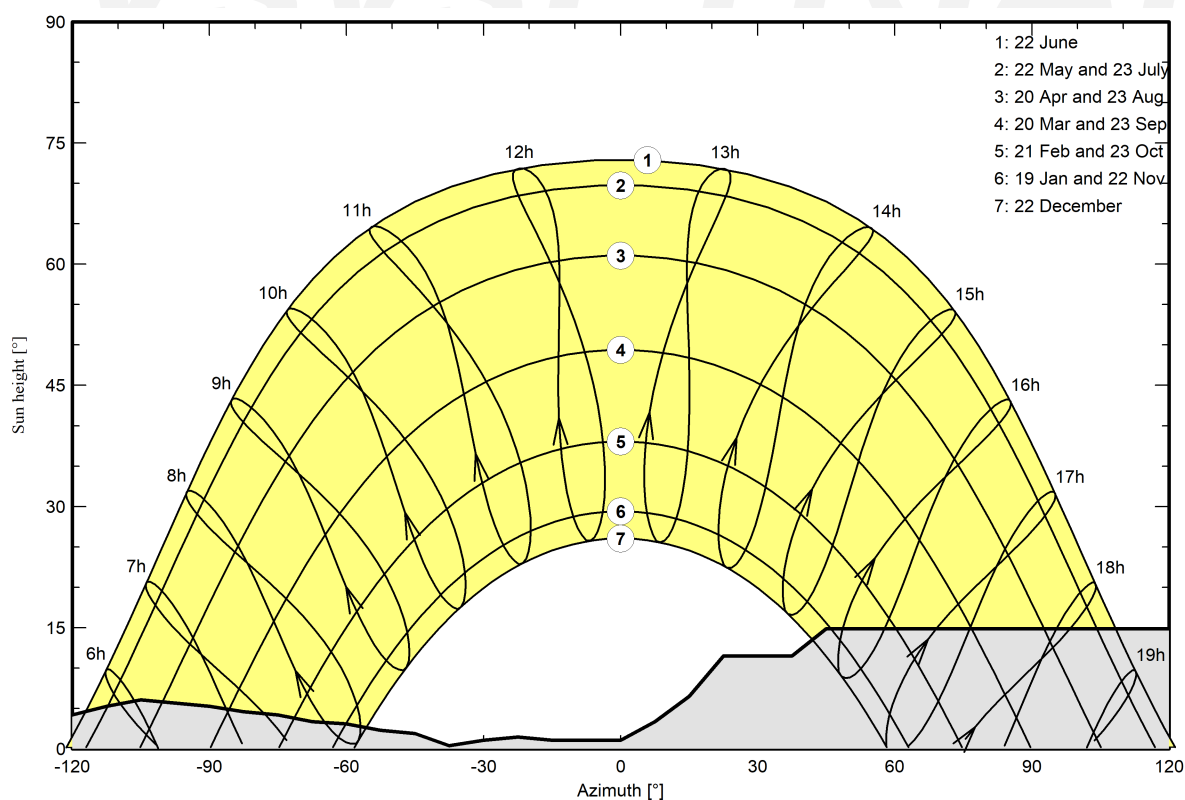
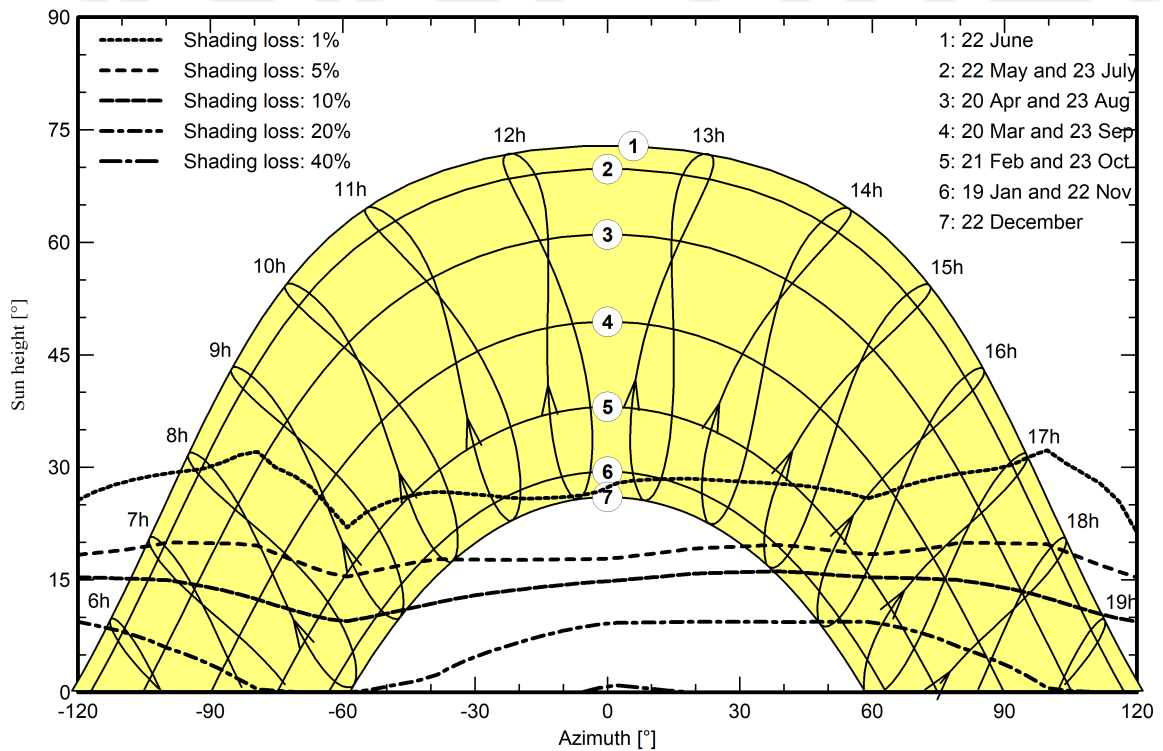**PVsyst V7.2.16**

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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
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Main results

System Production

Produced Energy	199.7 MWh/year	Specific production	1745 kWh/kWp/year
		Performance Ratio PR	83.89 %

Normalized productions (per installed kWp)

Lc: Collection Loss (PV-array losses) 0.78 kWh/kWp/day
Ls: System Loss (inverter, ...) 0.14 kWh/kWp/day
Yf: Produced useful energy (inverter output) 4.78 kWh/kWp/day

Performance Ratio PR

PR: Performance Ratio (Yf / Yr) : 0.839
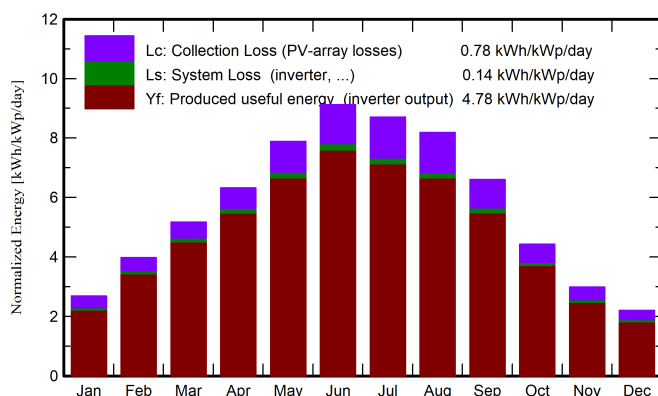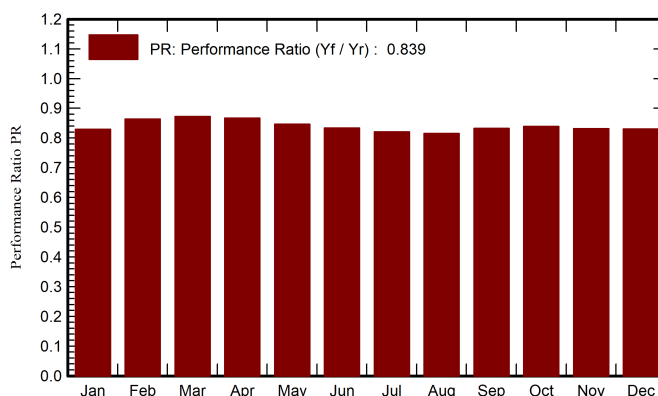
Balances and main results

	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	83.1	71.6	8.17	7.89	0.830
February	76.4	39.36	6.71	111.4	100.6	11.36	11.02	0.864
March	118.0	57.36	9.91	160.5	148.4	16.50	16.04	0.873
April	150.3	77.02	13.73	189.9	177.1	19.38	18.84	0.867
May	195.0	84.41	19.52	244.4	228.4	24.34	23.68	0.846
June	218.4	75.24	24.54	273.8	258.6	26.87	26.13	0.834
July	214.7	82.15	27.83	269.7	253.5	26.06	25.35	0.821
August	194.0	76.29	27.71	253.8	236.1	24.33	23.68	0.815
September	144.2	53.93	21.67	198.1	183.8	19.42	18.88	0.832
October	94.1	43.87	16.53	137.2	124.7	13.59	13.19	0.840
November	57.9	29.79	11.46	89.6	79.3	8.82	8.53	0.832
December	43.4	24.96	6.66	68.2	59.4	6.74	6.49	0.831
Year	1559.1	673.58	15.99	2079.7	1921.5	205.60	199.72	0.839

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
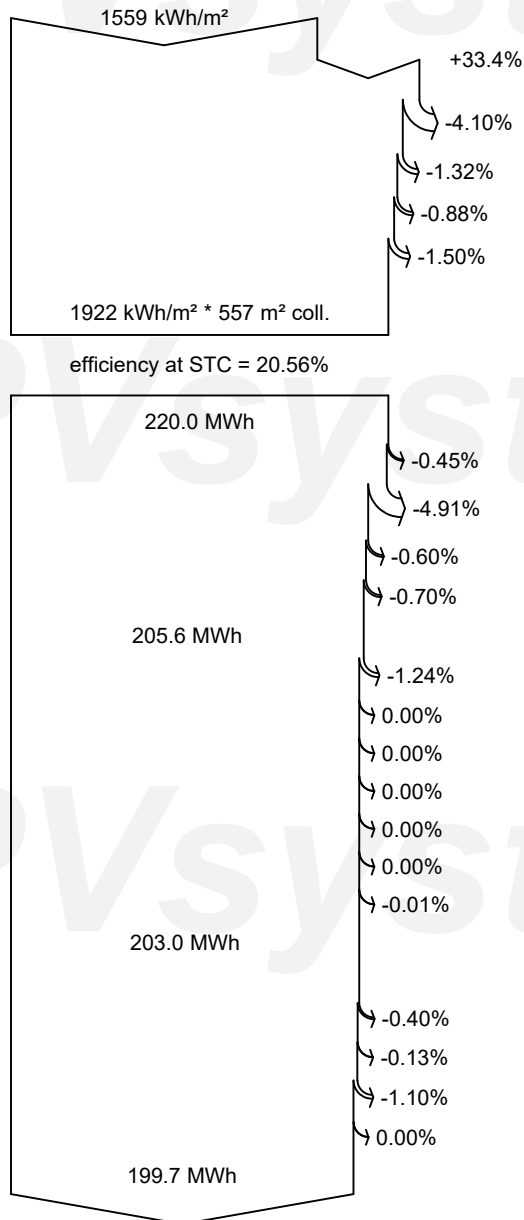
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1559 kWh/m²	**Global horizontal irradiation**
+33.4%	**Global incident in coll. plane**
-4.10%	Far Shadings / Horizon
-1.32%	Near Shadings: irradiance loss
-0.88%	IAM factor on global
-1.50%	Soiling loss factor
1922 kWh/m² * 557 m² coll.	**Effective irradiation on collectors**
efficiency at STC = 20.56%	PV conversion
220.0 MWh	**Array nominal energy (at STC effic.)**
-0.45%	PV loss due to irradiance level
-4.91%	PV loss due to temperature
-0.60%	Module array mismatch loss
-0.70%	Ohmic wiring loss
205.6 MWh	**Array virtual energy at MPP**
-1.24%	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
0.00%	Inverter Loss due to power threshold
0.00%	Inverter Loss due to voltage threshold
-0.01%	Night consumption
203.0 MWh	**Available Energy at Inverter Output**
-0.40%	Auxiliaries (fans, other)
-0.13%	AC ohmic loss
-1.10%	Medium voltage transfo loss
0.00%	MV line ohmic loss
199.7 MWh	**Energy injected into grid**

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Special graphs

Daily Input/Output diagram
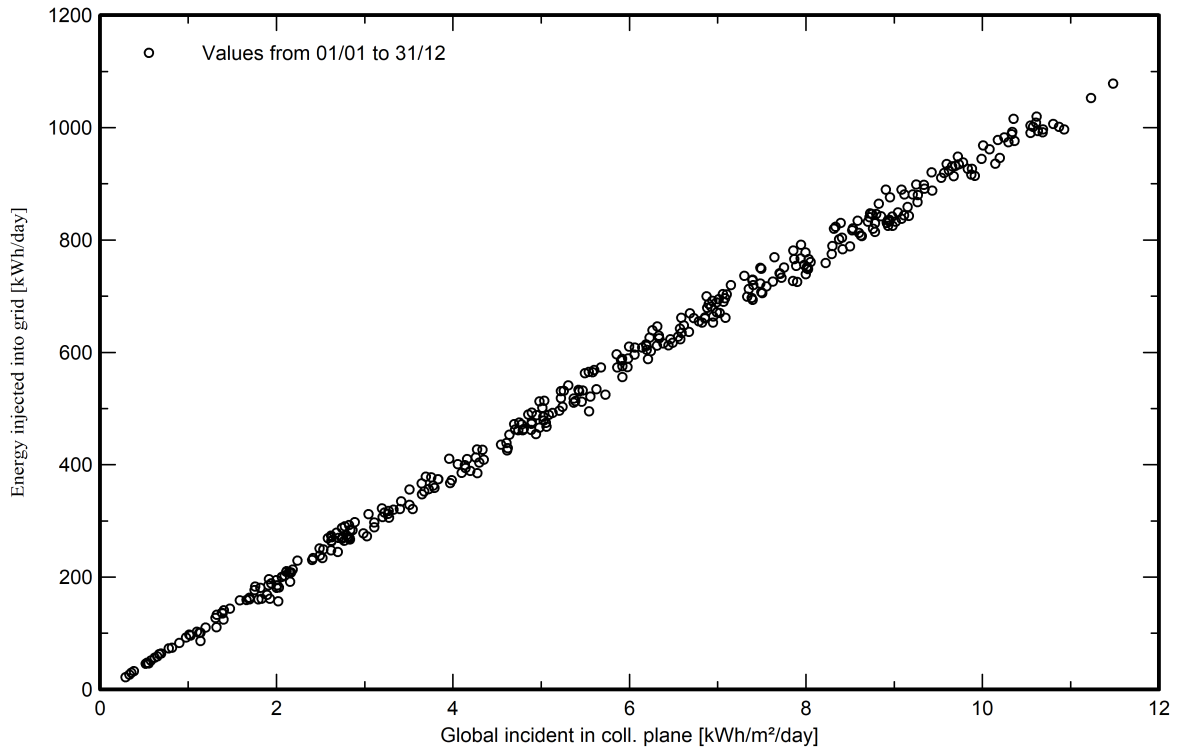
System Output Power Distribution