

PVsyst - Simulation report

Grid-Connected System

Project: IT22E5 - Ello 5

Variant: Ello5_Tracker_2P48_620Wp_Pitch8.45

Tracking system with backtracking

System power: 19.02 MWp

Castelverde - Italy

**PVsyst V7.2.8**

VC1, Simulation date:
10/06/22 12:45
with v7.2.8

Project summary**Geographical Site**

Castelverde
Italy

Situation

Latitude 41.49 °N
Longitude 12.80 °E
Altitude 27 m
Time zone UTC+1

Project settings

Albedo 0.20

Meteo data

Castelverde
Meteonorm 8.0 (1991-2003), Sat=100% - Sintético

System summary**Grid-Connected System**

Simulation for year no 1

Tracking system 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 30672 units
Pnom total 19.02 MWp

Inverters

Nb. of units 20 units
Pnom total 19.96 MWac
Grid power limit 16.00 MWac
Grid lim. Pnom ratio 1.189

Results summary

Produced Energy 28130 MWh/year Specific production 1479 kWh/kWp/year Perf. Ratio PR 79.62 %

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General parameters

Grid-Connected System		Tracking system with backtracking	
PV Field Orientation		Backtracking strategy	
Orientation		Nb. of trackers	357 units
Tracking plane, horizontal N-S axis		Sizes	
Axis azimuth	0 °	Tracker Spacing	8.45 m
		Collector width	5.03 m
		Ground Cov. Ratio (GCR)	59.6 %
		Phi min / max.	-/+ 60.0 °
		Backtracking limit angle	
		Phi limits	+/- 53.4 °
Horizon		Near Shadings	
Average Height	1.5 °	According to strings	
		Electrical effect	100 %
Bifacial system		User's needs	
Model	2D Calculation	Unlimited load (grid)	
	unlimited trackers		
Bifacial model geometry		Bifacial model definitions	
Tracker Spacing	8.45 m	Ground albedo	0.20
Tracker width	5.03 m	Bifaciality factor	50 %
GCR	59.6 %	Rear shading factor	5.0 %
Axis height above ground	2.10 m	Rear mismatch loss	10.0 %
		Shed transparent fraction	0.0 %
Grid power limitation			
Active Power	16.00 MWac		
Pnom ratio	1.189		

PV Array Characteristics

PV module		Inverter	
Manufacturer	Suntech_Mod.	Manufacturer	Santerno
Model	STP620S-C78/Nmh+	Model	SUNWAY TG 900 1500V TE - 640 EV
(Custom parameters definition)		(Custom parameters definition)	
Unit Nom. Power	620 Wp	Unit Nom. Power	998 kWac
Number of PV modules	30672 units	Number of inverters	20 units
Nominal (STC)	19.02 MWp	Total power	19960 kWac
Modules	1278 Strings x 24 In series	Operating voltage	910-1300 V
At operating cond. (47°C)		Pnom ratio (DC:AC)	0.95
Pmpp	17.74 MWp		
U mpp	1013 V		
I mpp	17509 A		
Total PV power		Total inverter power	
Nominal (STC)	19017 kWp	Total power	19960 kWac
Total	30672 modules	Nb. of inverters	20 units
Module area	84903 m²	Pnom ratio	0.95
Cell area	74165 m²		

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Array losses**Array Soiling Losses**

Loss Fraction 2.0 %

Thermal Loss factor

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

DC wiring losses

Global array res. 0.31 mΩ
Loss Fraction 0.5 % at STC

Serie Diode Loss

Voltage drop 0.7 V
Loss Fraction 0.1 % at STC

LID - Light Induced Degradation

Loss Fraction 0.5 %

Module Quality Loss

Loss Fraction -0.8 %

Module mismatch losses

Loss Fraction 1.0 % 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°	40°	50°	60°	70°	75°	80°	85°	90°
1.000	1.000	0.998	0.992	0.983	0.961	0.933	0.853	0.000

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

Inverter voltage 640 Vac tri
Loss Fraction 0.21 % at STC

Inverter: SUNWAY TG 900 1500V TE - 640 EV

Wire section (20 Inv.) Alu 20 x 3 x 700 mm²
Average wires length 20 m

MV line up to HV Transfo

MV Voltage 30 kV
Wires Alu 3 x 1000 mm²
Length 7300 m
Loss Fraction 0.48 % at STC

HV line up to Injection

HV line voltage 150 kV
Wires Copper 3 x 16 mm²
Length 1500 m
Loss Fraction 0.15 % at STC

AC losses in transformers**MV transfo**

Medium voltage 30 kV

Operating losses at STC

Nominal power at STC 18733 kVA
Iron loss (24/24 Connexion) 18.73 kW
Loss Fraction 0.10 % at STC
Coils equivalent resistance 3 x 0.22 mΩ
Loss Fraction 1.00 % at STC

HV transfo

Grid voltage 150 kV

Transformer from Datasheets

Nominal power 25000 kVA
Iron loss 56.00 kVA
Loss Fraction 0.22 % of PNom
Copper loss 125.00 kVA
Loss Fraction 0.50 % of PNom

Operating losses at STC

Nominal power at STC 18733 kVA
Iron loss (24/24 Connexion) 56.00 kW
Loss Fraction 0.30 % at STC
Coils equivalent resistance 3 x 180.0 mΩ
Loss Fraction 0.37 % at STC



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Horizon definition

Horizon from PVGIS website API, Lat=41°29'25', Long=12°47'51', Alt=27m

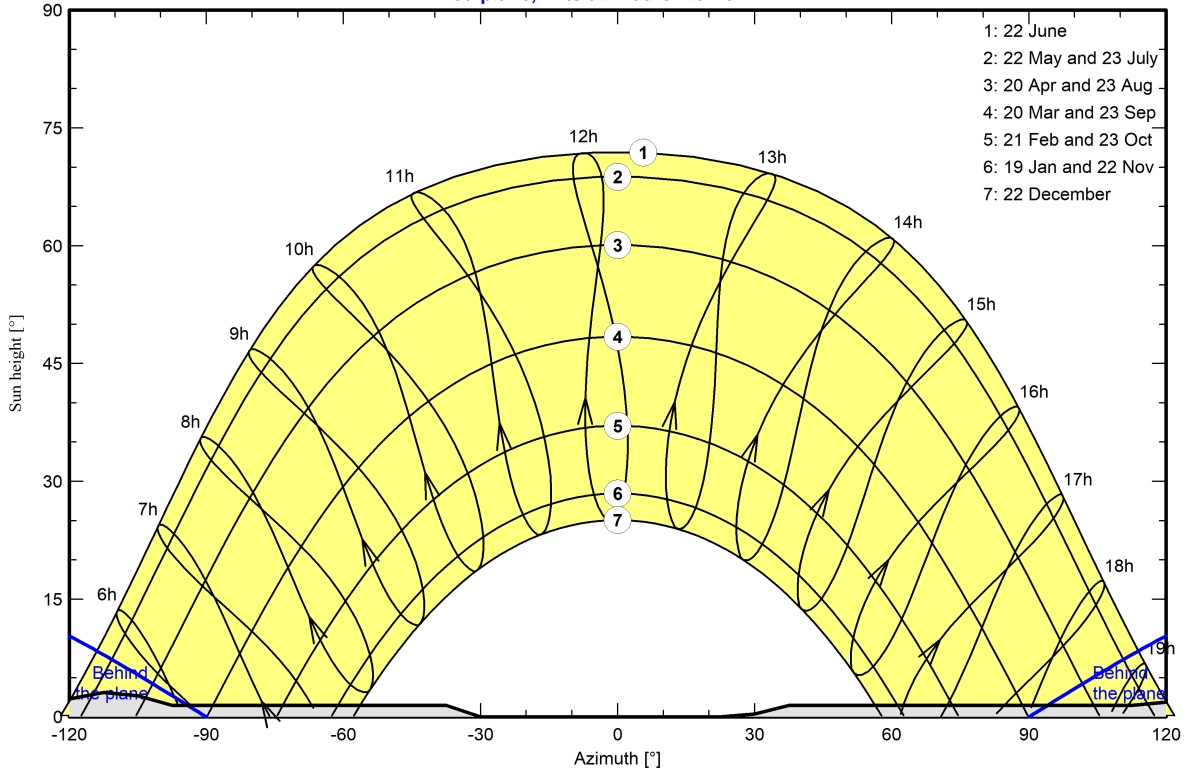
Average Height	1.5 °	Albedo Factor	0.92
Diffuse Factor	0.97	Albedo Fraction	100 %

Horizon profile

Azimuth [°]	-180	-150	-143	-135	-128	-120	-113	-105	-98
Height [°]	1.9	1.9	2.7	2.3	1.9	2.3	3.1	2.7	1.5
Azimuth [°]	-38	-30	23	30	38	113	120	180	
Height [°]	1.5	0.0	0.0	0.4	1.5	1.5	1.9	1.9	

Sun Paths (Height / Azimuth diagram)

Fixed plane, Tilts/azimuths: 20°/ 0°

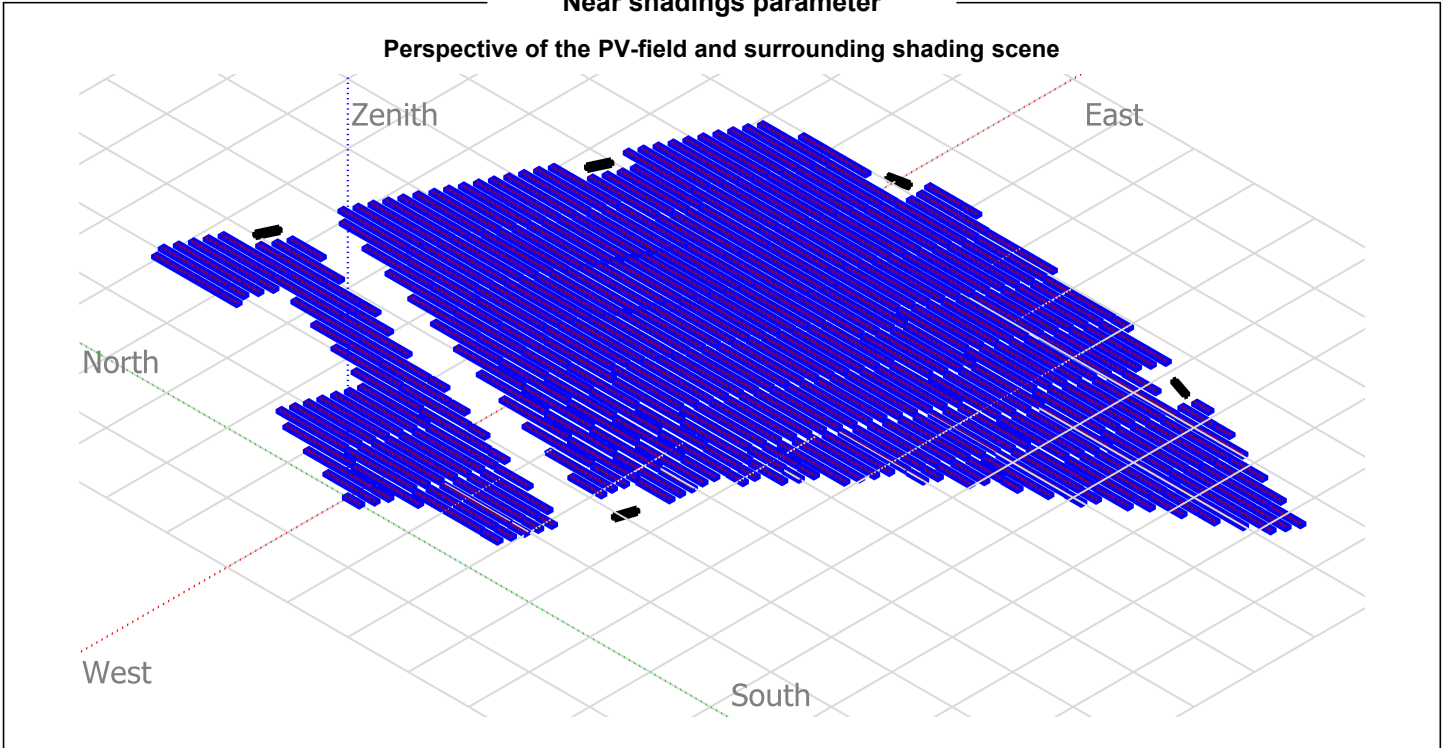




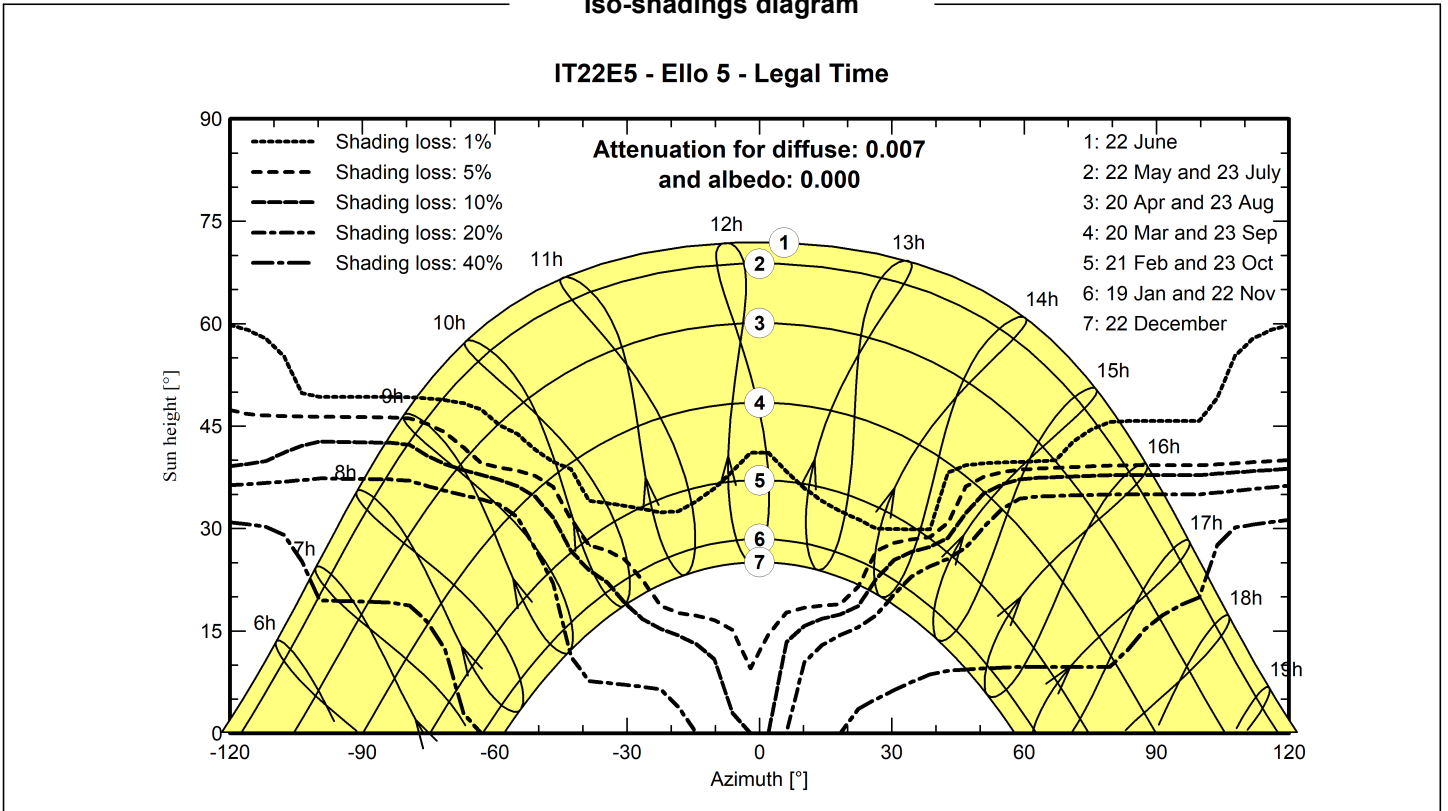
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Near shadings parameter



Iso-shadings diagram





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Main results

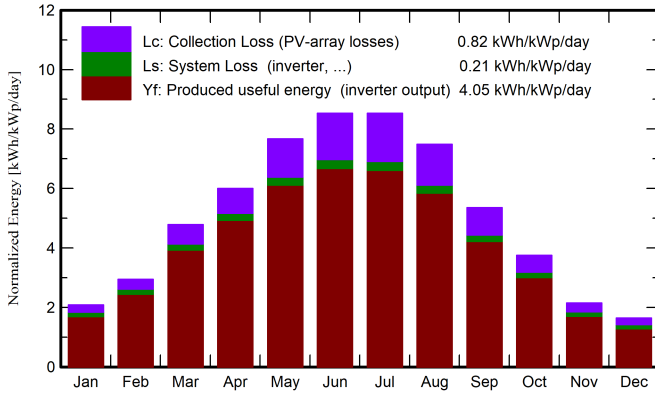
System Production

Produced Energy 28130 MWh/year

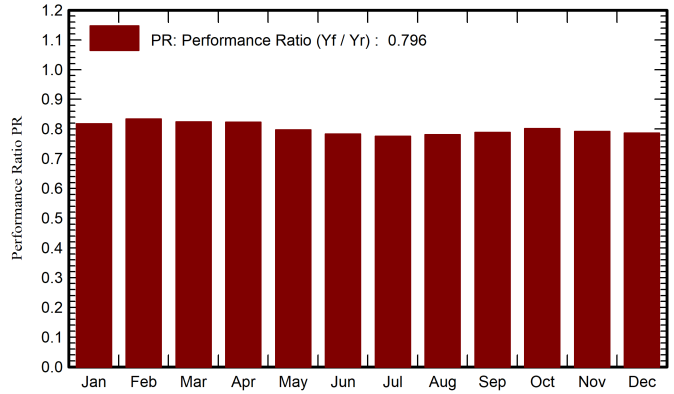
Specific production
Performance Ratio PR

1479 kWh/kWp/year
79.62 %

Normalized productions (per installed kWp)



Performance Ratio PR



Balances and main results

	GlobHor kWh/m ²	DiffHor kWh/m ²	T_Amb °C	GlobInc kWh/m ²	GlobEff kWh/m ²	EArray MWh	E_Grid MWh	PR ratio
January	52.1	24.45	8.94	64.5	60.6	1087	1001	0.817
February	68.5	34.78	9.59	82.4	77.9	1393	1306	0.834
March	122.6	58.61	12.65	148.2	140.6	2441	2321	0.824
April	149.6	70.69	15.59	180.0	171.0	2952	2815	0.823
May	194.6	81.84	20.26	237.7	226.5	3769	3605	0.797
June	209.3	78.88	24.58	256.0	244.8	3983	3813	0.783
July	214.7	78.66	27.45	264.6	252.9	4076	3902	0.776
August	187.3	71.39	27.44	232.1	221.6	3609	3450	0.781
September	132.5	59.96	22.78	160.7	152.8	2532	2411	0.789
October	94.4	41.00	19.22	116.4	110.2	1879	1774	0.802
November	53.0	27.93	14.23	64.6	60.8	1057	973	0.792
December	42.2	23.66	10.39	50.8	47.6	839	760	0.787
Year	1520.8	651.84	17.81	1857.8	1767.3	29617	28130	0.796

Legends

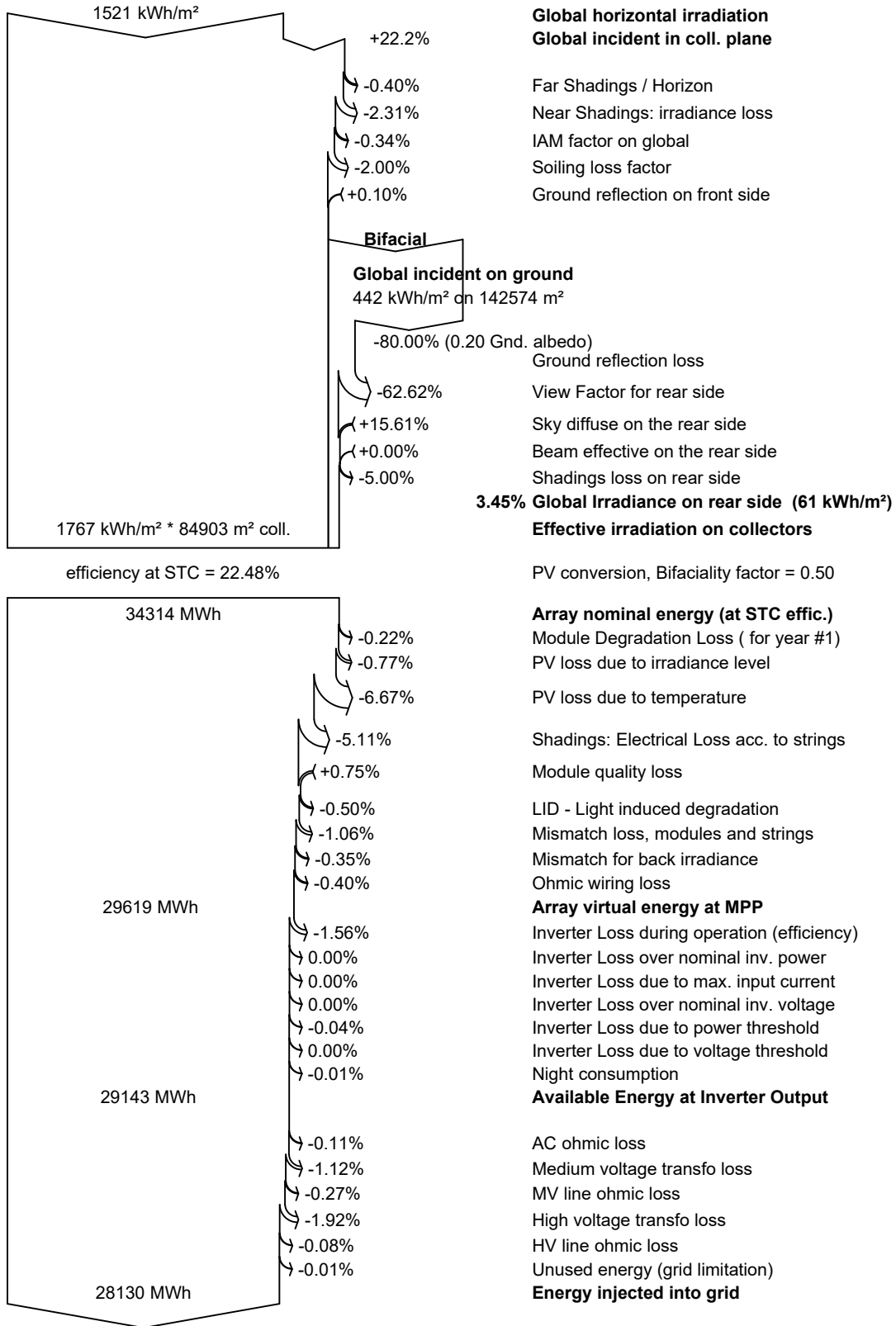
- GlobHor Global horizontal irradiation
- DiffHor Horizontal diffuse irradiation
- T_Amb Ambient Temperature
- GlobInc Global incident in coll. plane
- GlobEff Effective Global, corr. for IAM and shadings
- EArray Effective energy at the output of the array
- E_Grid Energy injected into grid
- PR Performance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



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Loss diagram



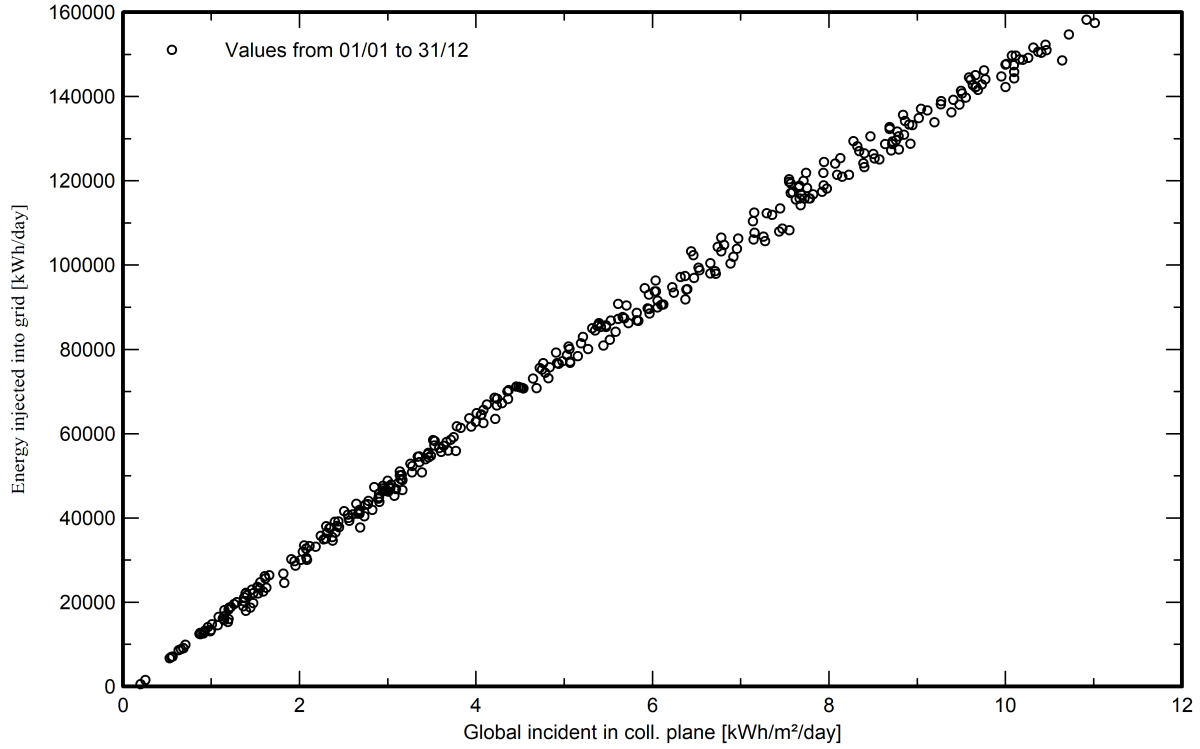


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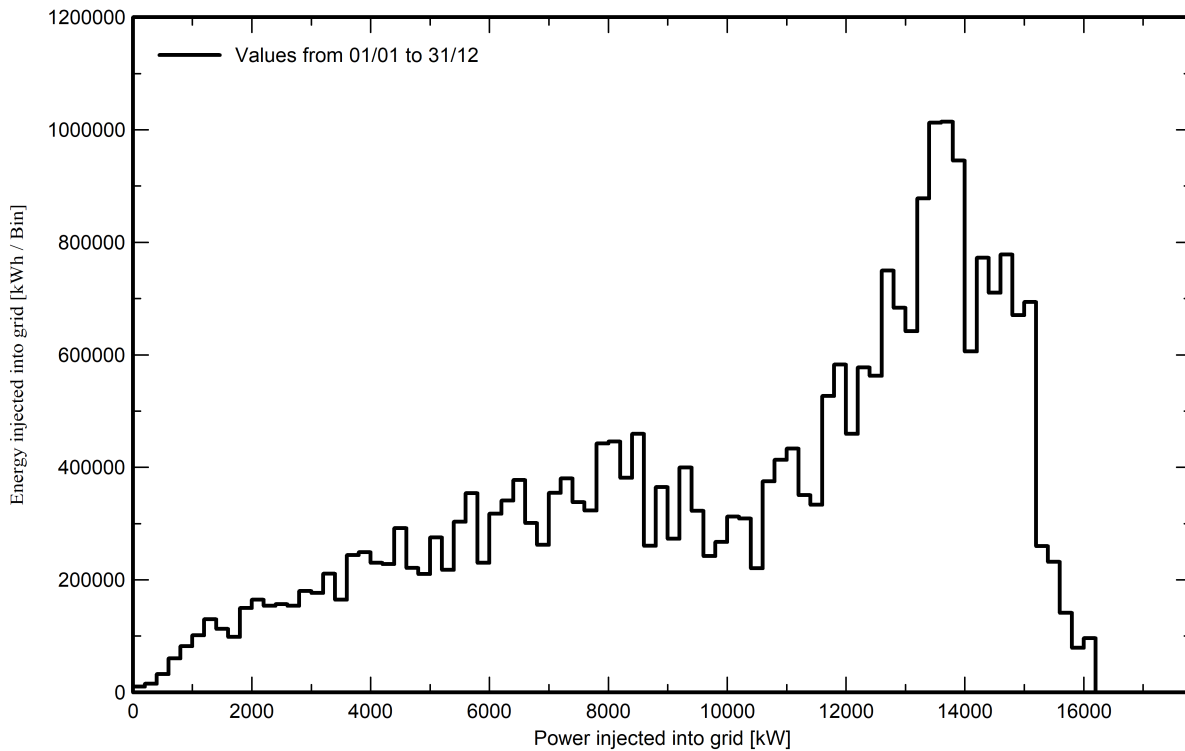
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Special graphs

Diagrama entrada/salida diaria



Distribución de potencia de salida del sistema





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Aging Tool

Aging Parameters

Time span of simulation 30 years

Module average degradation

Loss factor 0.4 %/year

Mismatch due to degradation

Imp RMS dispersion 0.4 %/year
Vmp RMS dispersion 0.4 %/year

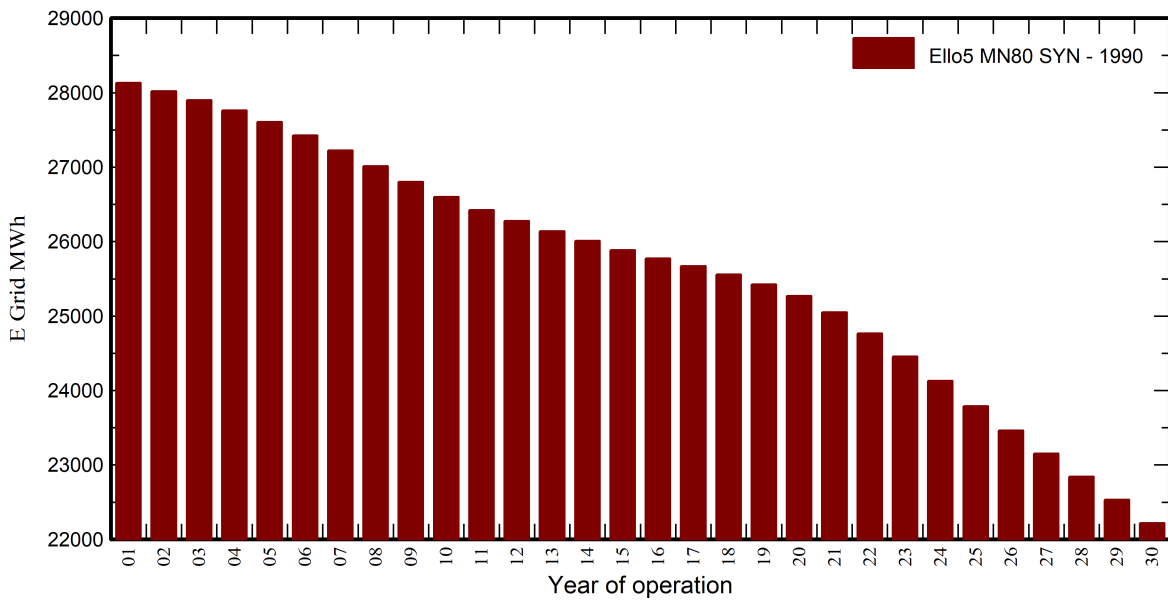
Meteo used in the simulation

#1 Ello5 MN80 SYN

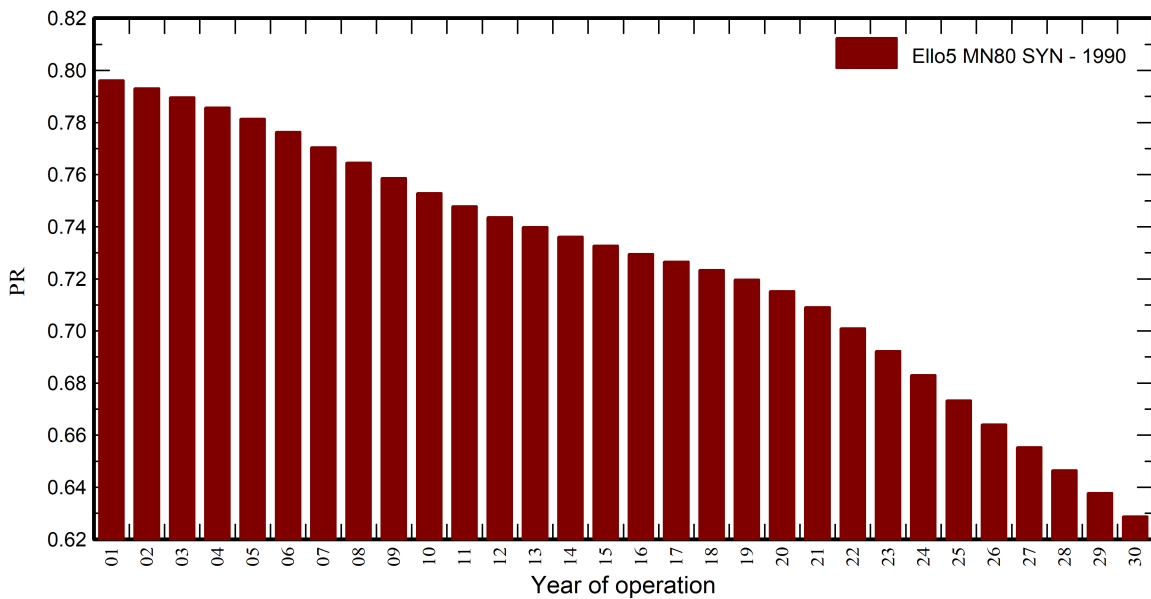
Years 1990 (reference year)

Years simulated 1-30

Energy injected into grid



Performance Ratio





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Aging Tool

Aging Parameters

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Imp RMS dispersion 0.4 %/year

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Meteo used in the simulation

#1 Ello5 MN80 SYN

Years 1990 (reference year)

Years simulated 1-30

Ello5 MN80 SYN

Year	E Grid	PR	PR loss
	MWh		%
1	28130	0.796	0%
2	28021	0.793	-0.4%
3	27898	0.79	-0.8%
4	27760	0.786	-1.3%
5	27607	0.781	-1.9%
6	27427	0.776	-2.5%
7	27223	0.771	-3.2%
8	27012	0.765	-4%
9	26802	0.759	-4.7%
10	26598	0.753	-5.4%
11	26422	0.748	-6.1%
12	26275	0.744	-6.6%
13	26139	0.74	-7.1%
14	26010	0.736	-7.5%
15	25887	0.733	-8%
16	25775	0.73	-8.4%
17	25671	0.727	-8.7%
18	25557	0.723	-9.1%
19	25426	0.72	-9.6%
20	25270	0.715	-10.2%
21	25051	0.709	-10.9%
22	24767	0.701	-12%
23	24458	0.692	-13.1%
24	24130	0.683	-14.2%
25	23790	0.673	-15.4%
26	23462	0.664	-16.6%
27	23153	0.655	-17.7%
28	22843	0.647	-18.8%
29	22531	0.638	-19.9%
30	22217	0.629	-21%



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P50 - P90 evaluation

Meteo data

Source Meteonorm 8.0 (1991-2003), Sat=100%
Kind Monthly averages
Sintético - Multi-year average
Year-to-year variability(Variance) 3.0 %

Specified Deviation

Climate change 0.0 %

Global variability (meteo + system)

Variability (Quadratic sum) 3.5 %

Simulation and parameters uncertainties

PV module modelling/parameters 1.0 %
Inverter efficiency uncertainty 0.5 %
Soiling and mismatch uncertainties 1.0 %
Degradation uncertainty 1.0 %

Annual production probability

Variability 0.98 GWh
P50 28.13 GWh
P90 26.87 GWh
P95 26.51 GWh

Probability distribution

