

Comune di Cerignola, Ascoli Satriano, Melfi
Provincia di Foggia e Potenza, Regione Puglia e Basilicata

ASCOLI SATRIANO SOLAR PARK S.R.L.



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Impianto Agrivoltaico "ASCOLI SATRIANO 29.9"

PD01_21 – SIMULAZIONE ENERGETICA (PVSYSY)

PROGETTISTI		IL PROPONENTE
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GIUGNO 2023

PVsyst - Simulation report

Grid-Connected System

Project: IT21A2 - Ascoli Satriano 29.9

Variant: Ascoli Satriano 29.9_ Tracker 2P(15-30)_600Wp_Pitch=8.15

Tracking system with backtracking

System power: 30.04 MWp

San Carlo d'Ascoli - Italy



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06/06/23 08:48
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Project summary

Geographical Site		Situation		Project settings	
San Carlo d'Ascoli		Latitude	41.13 °N	Albedo	0.20
Italy		Longitude	15.72 °E		
		Altitude	253 m		
		Time zone	UTC+1		
Meteo data					
San Nicola					
Meteonorm 8.0 (1986-2005), Sat=100% - Sintético					

System summary

Grid-Connected System		Tracking system with backtracking			
Simulation for year no 1					
PV Field Orientation		Tracking algorithm		Near Shadings	
Orientation		Irradiance optimization		According to strings	
Tracking plane, tilted axis		Backtracking activated		Electrical effect	
Avg axis tilt	1.4 °			100 %	
Avg axis azim.	0 °				
System information					
PV Array					
Nb. of modules		50070 units	Inverters		
Pnom total		30.04 MWp	Nb. of units	92 units	
			Pnom total	30.36 MWac	
			Grid power limit	23.50 MWac	
			Grid lim. Pnom ratio	1.278	
User's needs					
Unlimited load (grid)					

Results summary

Produced Energy	45481 MWh/year	Specific production	1514 kWh/kWp/year	Perf. Ratio PR	81.38 %
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General parameters

Grid-Connected System		Tracking system with backtracking	
PV Field Orientation		Tracking algorithm	
Orientation		Irradiance optimization	
Tracking plane, tilted axis		Backtracking activated	
Avg axis tilt	1.4 °		
Avg axis azim.	0 °		
		Backtracking array	
		Nb. of trackers	902 units
		Identical arrays	
		Sizes	
		Tracker Spacing	8.15 m
		Collector width	4.48 m
		Ground Cov. Ratio (GCR)	55.0 %
		Phi min / max.	-/+ 60.0 °
		Backtracking strategy	
		Phi limits for BT	-/+ 79.9 °
		Backtracking pitch	8.15 m
		Backtracking width	4.48 m
Models used		Near Shadings	
Transposition	Perez	According to strings	
Diffuse	Perez, Meteonorm	Electrical effect	100 %
Circumsolar	separate		
Horizon		User's needs	
Average Height	2.3 °	Unlimited load (grid)	
Bifacial system			
Model	2D Calculation unlimited trackers		
Bifacial model geometry		Bifacial model definitions	
Tracker Spacing	8.15 m	Ground albedo	0.20
Tracker width	4.48 m	Bifaciality factor	70 %
GCR	55.0 %	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	23.50 MWac		
Pnom ratio	1.278		

PV Array Characteristics

PV module		Inverter	
Manufacturer	Trina Solar	Manufacturer	Huawei Technologies
Model	TSM-600DEG20C.20	Model	SUN2000-330KTL-H1-Preliminary V0.1
(Custom parameters definition)		(Custom parameters definition)	
Unit Nom. Power	600 Wp	Unit Nom. Power	330 kWac
Number of PV modules	50070 units	Number of inverters	92 units
Nominal (STC)	30.04 MWp	Total power	30360 kWac
Modules	1669 Strings x 30 In series	Operating voltage	500-1500 V
At operating cond. (51°C)		Pnom ratio (DC:AC)	0.99
Pmpp	27.40 MWp	Power sharing within this inverter	
U mpp	934 V		
I mpp	29328 A		



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PV Array Characteristics

Total PV power		Total inverter power	
Nominal (STC)	30042 kWp	Total power	30360 kWac
Total	50070 modules	Number of inverters	92 units
Module area	141704 m ²	Pnom ratio	0.99
Cell area	132485 m ²		

Array losses

Array Soiling Losses		Thermal Loss factor		DC wiring losses				
Loss Fraction	3.0 %	Module temperature according to irradiance		Global array res.	0.53 mΩ			
		Uc (const)	29.0 W/m ² K	Loss Fraction	1.5 % at STC			
		Uv (wind)	0.0 W/m ² K/m/s					
Serie Diode Loss		LID - Light Induced Degradation		Module Quality Loss				
Voltage drop	0.7 V	Loss Fraction	1.5 %	Loss Fraction	-0.8 %			
Loss Fraction	0.1 % at STC							
Module mismatch losses		Strings Mismatch loss		Module average degradation				
Loss Fraction	1.5 % at MPP	Loss Fraction	0.1 %	Year no	1			
				Loss factor	0.45 %/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

System losses

Auxiliaries loss	
constant (fans)	10.00 kW
0.0 kW from Power thresh.	
Night aux. cons.	17.00 kW

AC wiring losses

Inv. output line up to MV transfo	
Inverter voltage	800 Vac tri
Loss Fraction	1.32 % at STC
Inverter: SUN2000-330KTL-H1-Preliminary V0.1	
Wire section (92 Inv.)	Alu 92 x 3 x 240 mm ²
Average wires length	200 m
MV line up to Injection	
MV Voltage	36 kV
Wires	Alu 3 x 1200 mm ²
Length	20773 m
Loss Fraction	1.24 % at STC



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AC losses in transformers

MV transfo

Medium voltage 36 kV

Transformer parameters

Nominal power at STC 29.52 MVA

Iron Loss (24/24 Connexion) 34.24 kVA

Iron loss fraction 0.12 % at STC

Copper loss 255.31 kVA

Copper loss fraction 0.87 % at STC

Coils equivalent resistance 3 x 0.19 mΩ



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Horizon definition

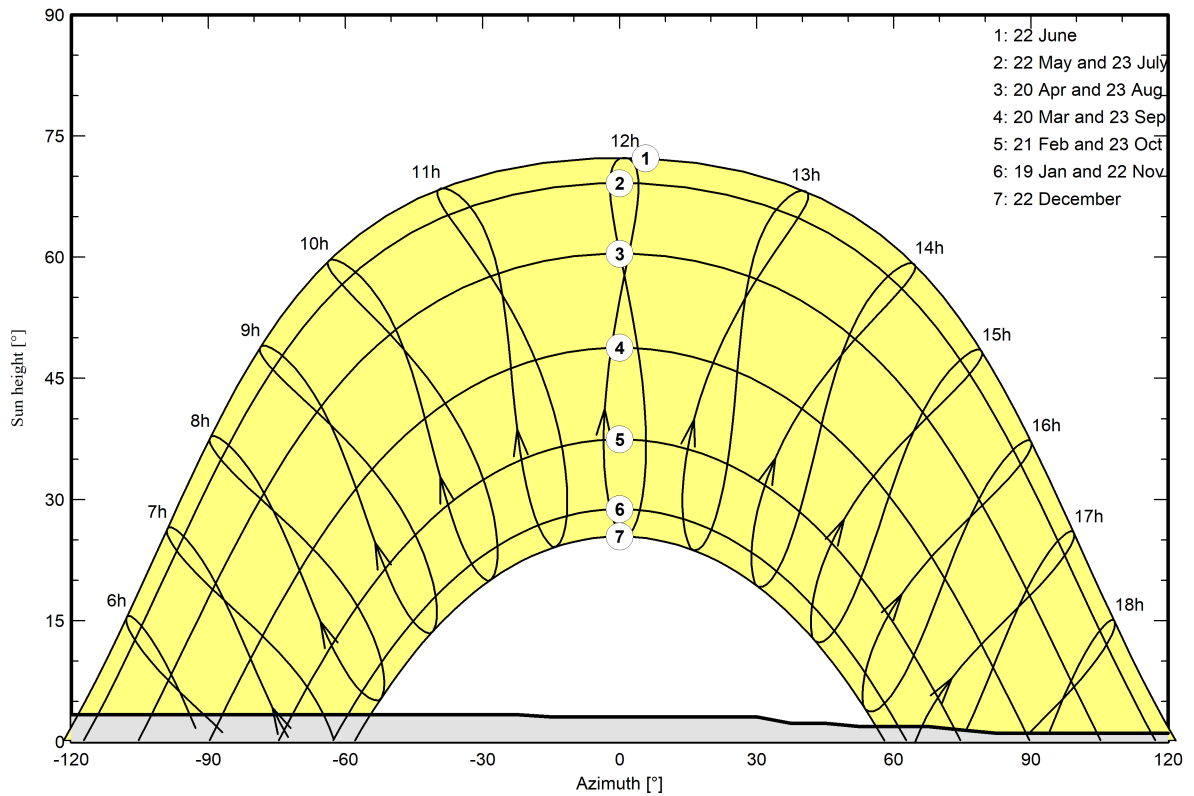
Horizon from PVGIS website API, Lat=41°7'45', Long=15°43'22', Alt=253m

Average Height	2.3 °	Albedo Factor	0.93
Diffuse Factor	0.98	Albedo Fraction	100 %

Horizon profile

Azimuth [°]	-180	-173	-158	-143	-135	-23	-15	30	38
Height [°]	1.5	1.5	0.8	0.8	3.4	3.4	3.1	3.1	2.3
Azimuth [°]	45	53	68	75	83	143	150	180	
Height [°]	2.3	1.9	1.9	1.5	1.1	1.1	1.5	1.5	

Sun Paths (Height / Azimuth diagram)

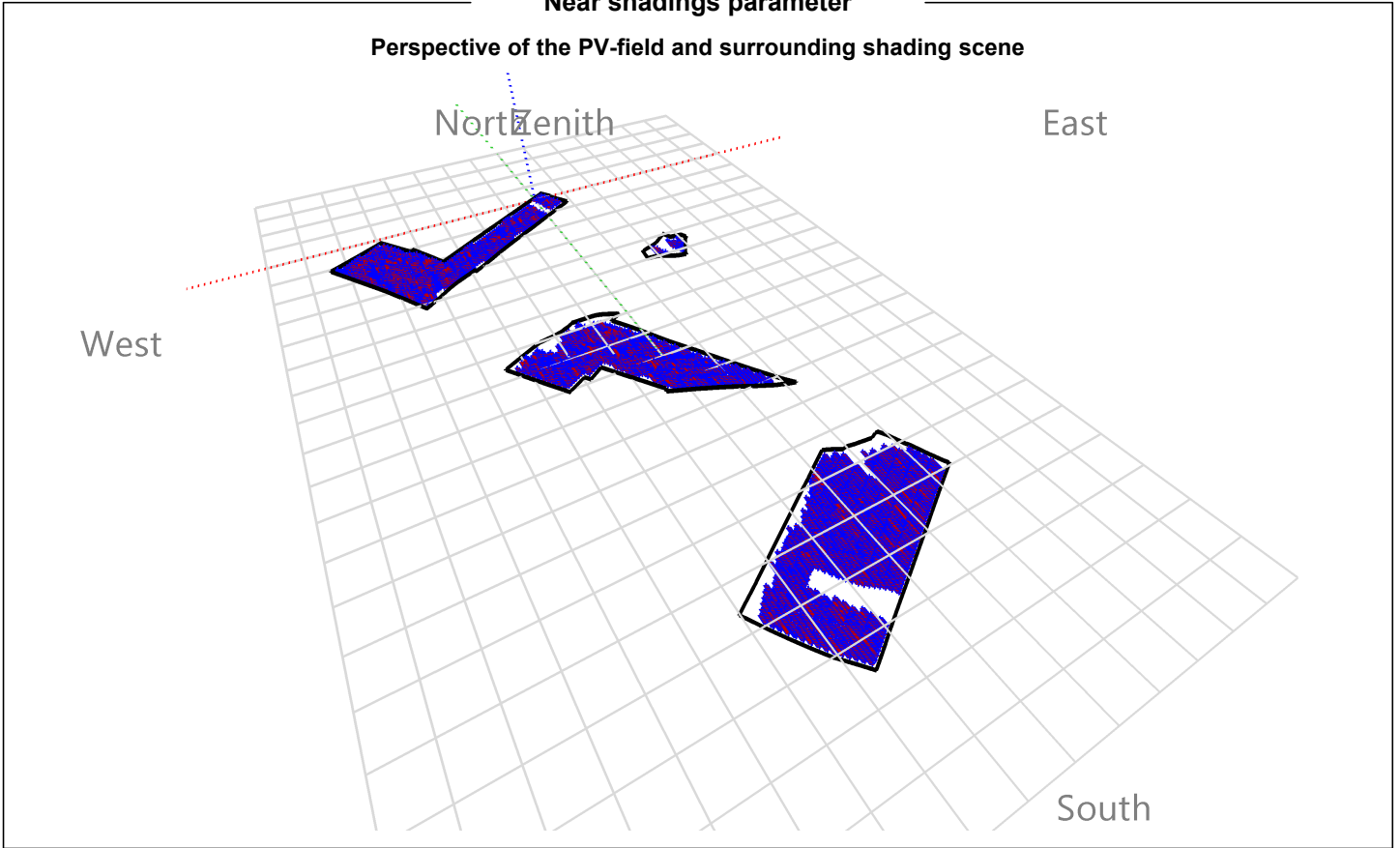




PVsyst V7.3.1

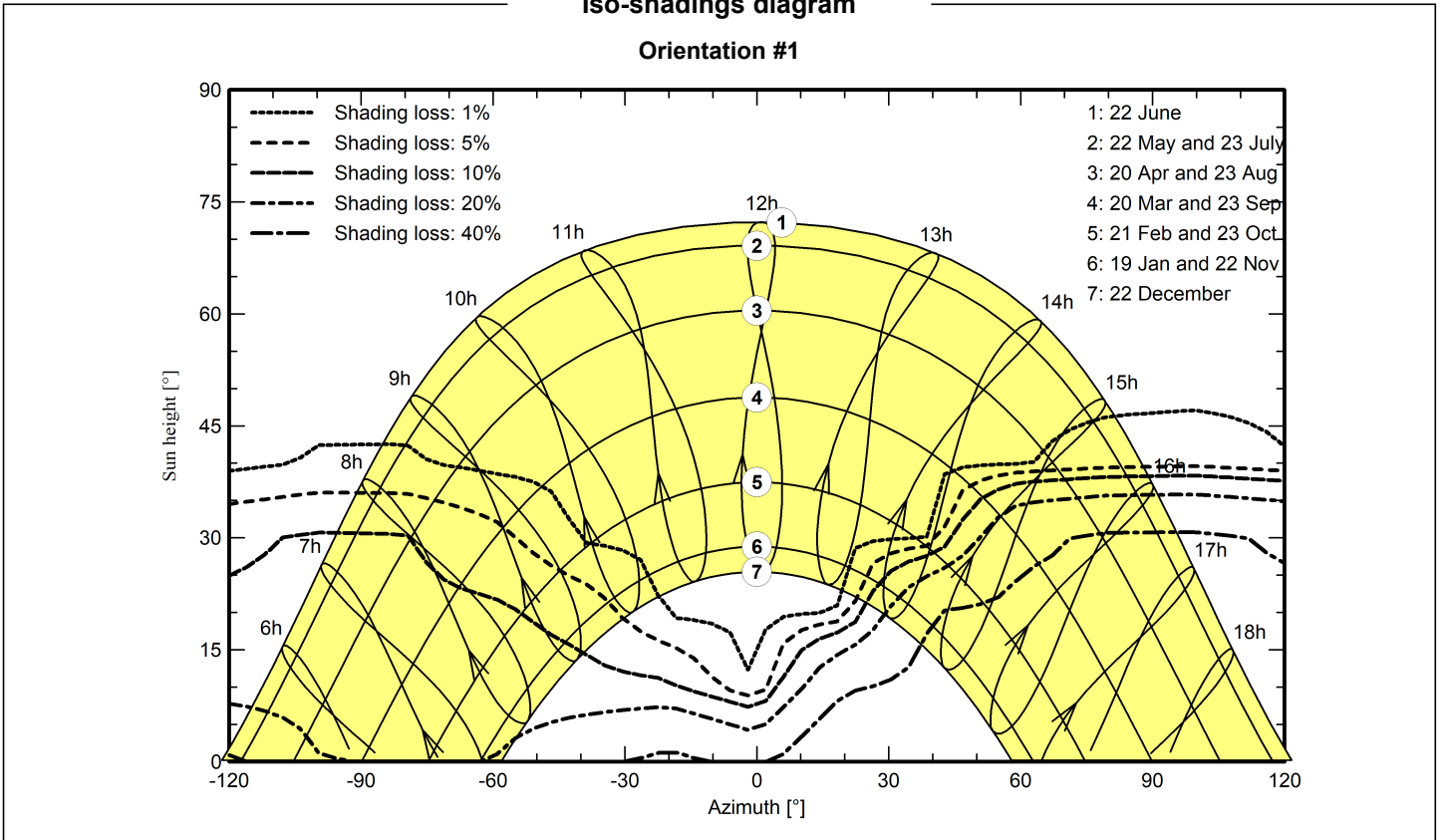
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Near shadings parameter



Iso-shadings diagram

Orientation #1





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Main results

System Production

Produced Energy 45481 MWh/year

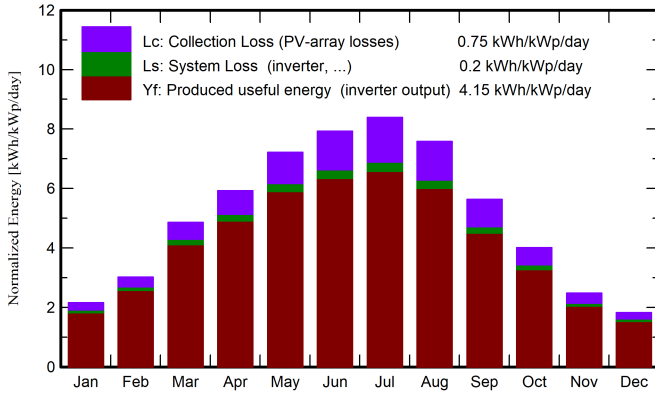
Specific production

1514 kWh/kWp/year

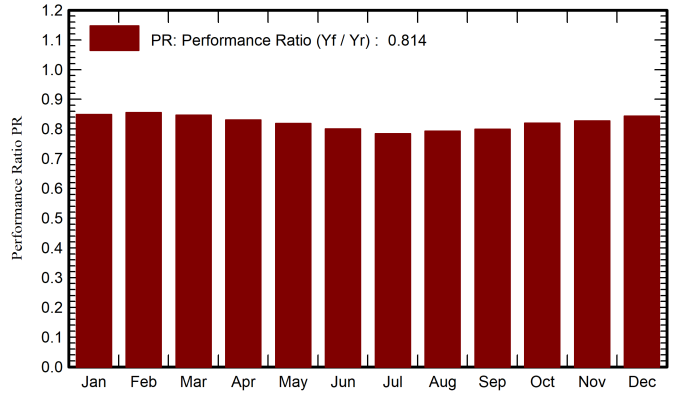
Performance Ratio PR

81.38 %

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	51.3	23.20	7.94	66.8	62.5	1791	1703	0.848
February	66.5	33.07	8.35	84.5	78.9	2273	2172	0.855
March	119.8	54.39	11.29	150.7	141.5	4005	3832	0.846
April	144.5	66.20	14.26	177.7	167.4	4637	4430	0.830
May	182.5	85.57	19.23	223.6	210.7	5754	5500	0.819
June	193.6	81.38	23.84	237.8	224.6	5986	5716	0.800
July	208.3	73.98	26.67	260.1	245.5	6424	6129	0.785
August	186.2	73.18	26.38	235.0	221.4	5863	5601	0.793
September	131.6	46.78	21.42	169.1	158.9	4253	4061	0.800
October	96.8	40.73	17.60	124.2	116.4	3199	3058	0.819
November	57.6	28.34	12.81	74.3	69.1	1938	1847	0.827
December	43.9	22.83	9.14	56.4	52.4	1508	1431	0.844
Year	1482.5	629.67	16.63	1860.3	1749.4	47631	45481	0.814

Legends

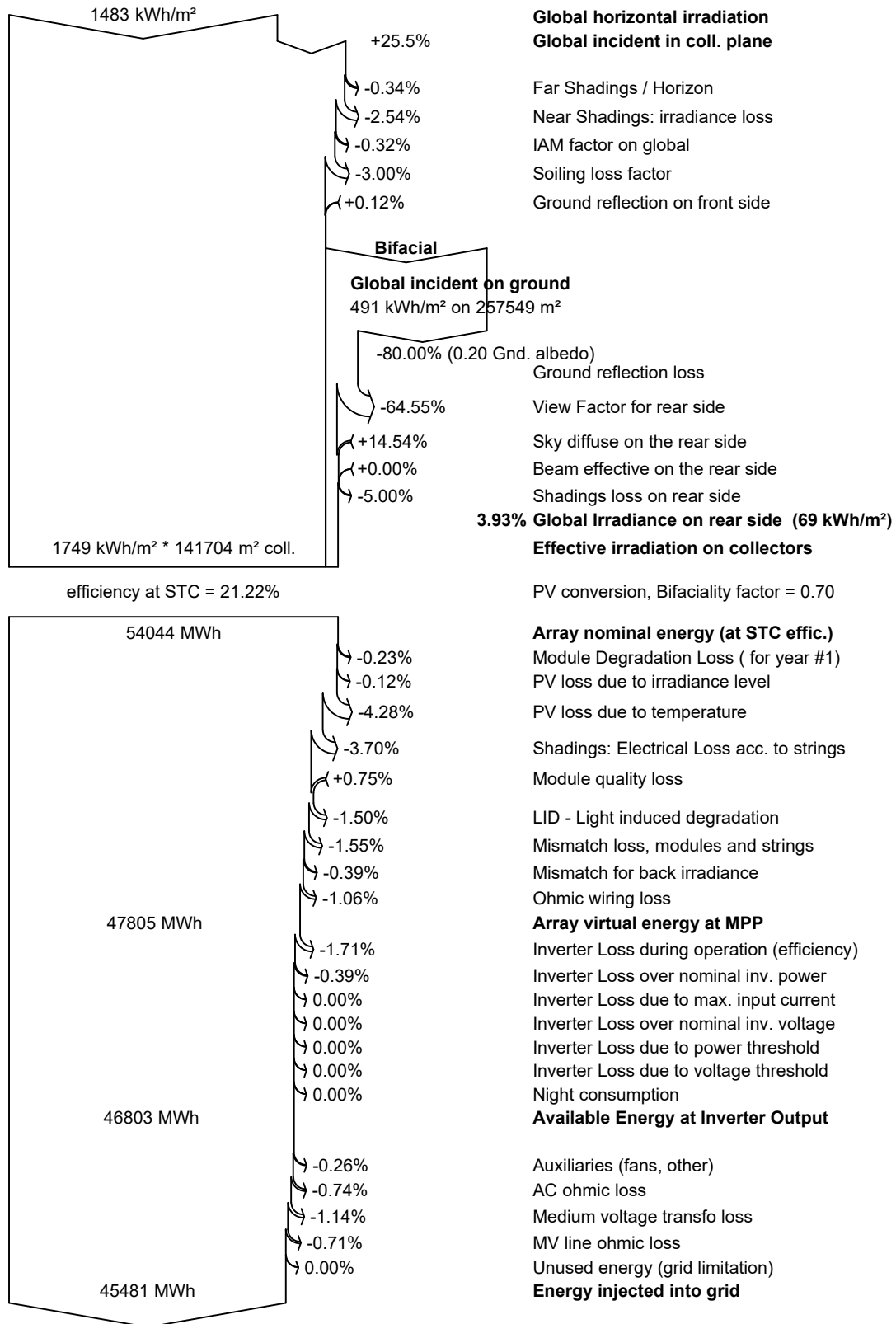
GlobHor	Global horizontal irradiation	EArray	Effective energy at the output of the array
DiffHor	Horizontal diffuse irradiation	E_Grid	Energy injected into grid
T_Amb	Ambient Temperature	PR	Performance Ratio
GlobInc	Global incident in coll. plane		
GlobEff	Effective Global, corr. for IAM and shadings		



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Loss diagram



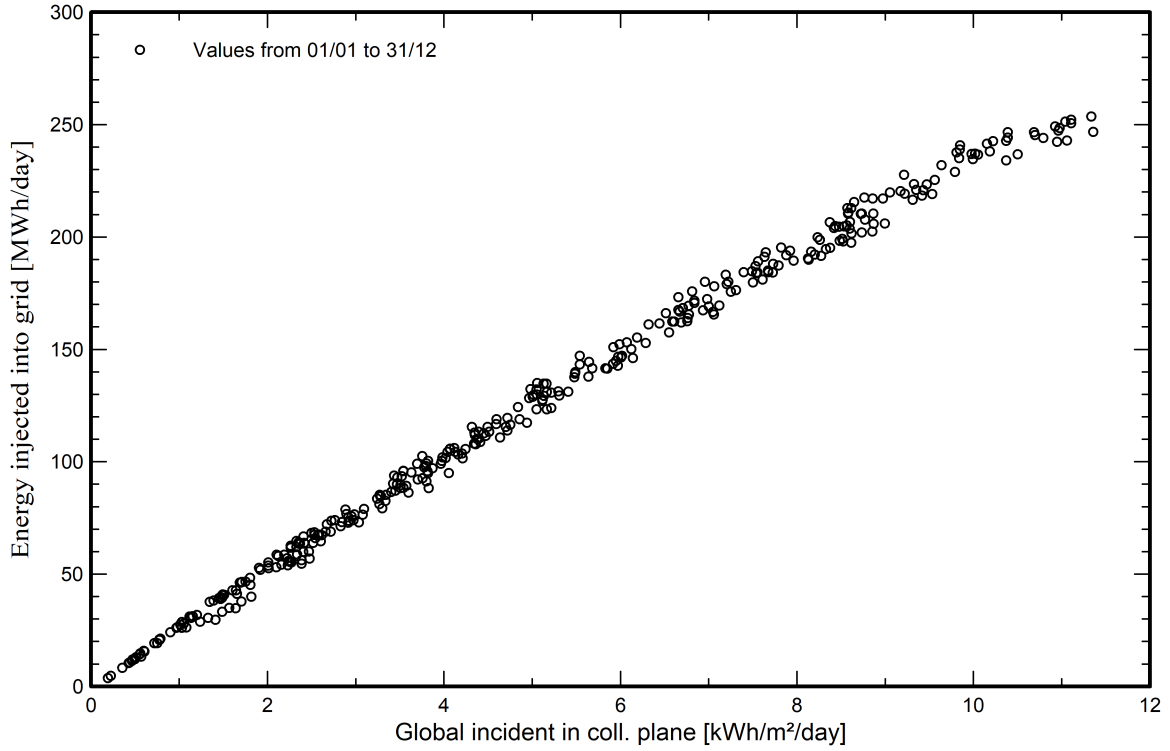


PVsyst V7.3.1

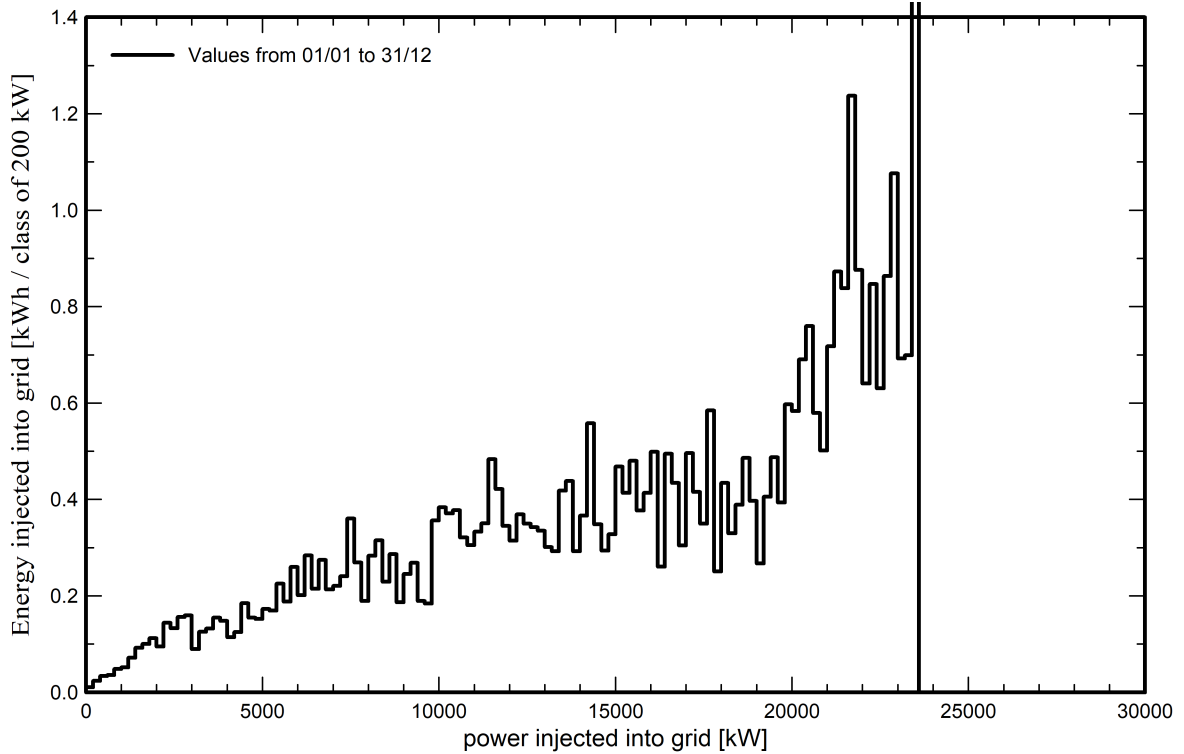
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Predef. graphs

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 0.45 %/year

Mismatch due to degradation

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

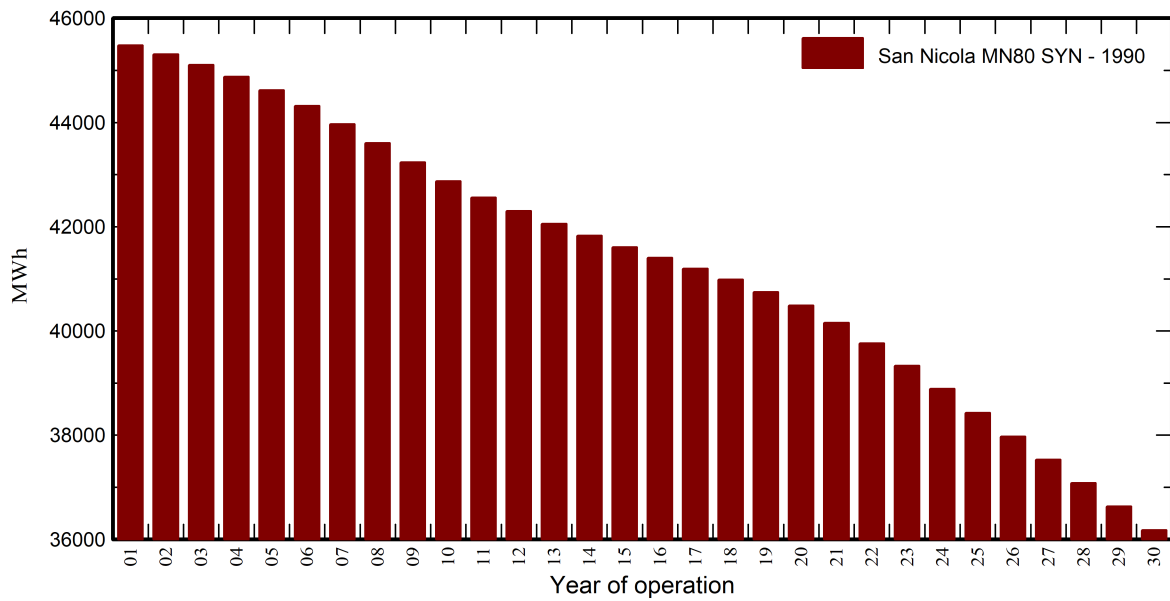
Meteo used in the simulation

#1 San Nicola MN80 SYN

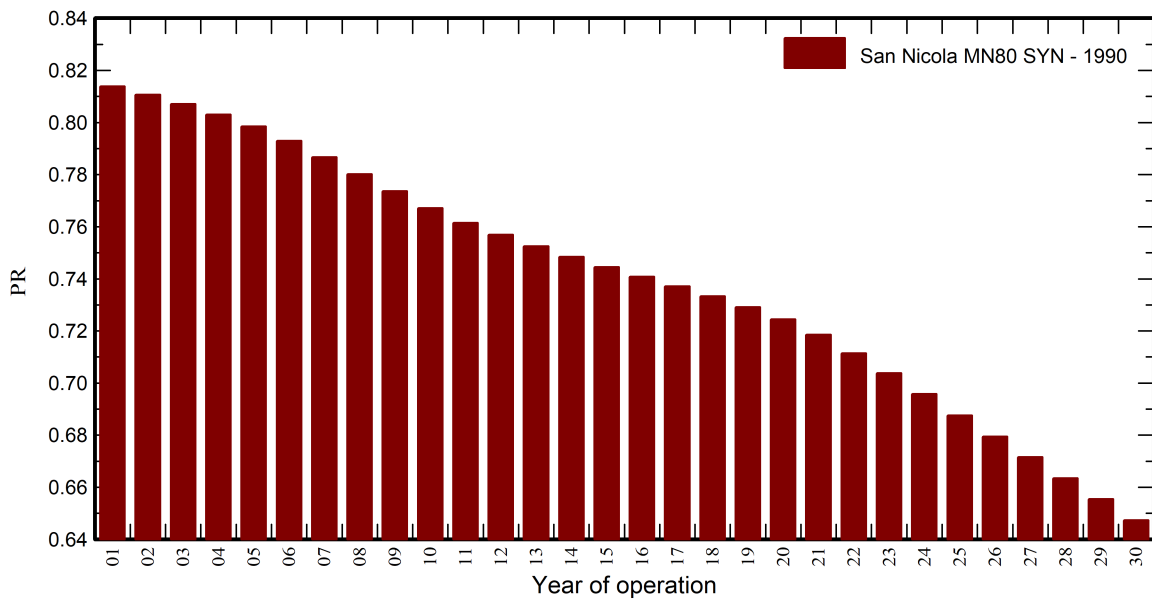
Years 1990 (reference year)

Years simulated 1-30

System output energy



Performance Ratio





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Aging Tool

Aging Parameters

Time span of simulation 30 years

Module average degradation

Loss factor 0.45 %/year

Mismatch due to degradation

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

Meteo used in the simulation

#1 San Nicola MN80 SYN

Years 1990 (reference year)

Years simulated 1-30

San Nicola MN80 SYN

Year	System output	PR	PR loss
	MWh		%
1	45481	0.814	0%
2	45307	0.811	-0.4%
3	45105	0.807	-0.8%
4	44877	0.803	-1.3%
5	44621	0.798	-1.9%
6	44317	0.793	-2.6%
7	43967	0.787	-3.3%
8	43603	0.78	-4.1%
9	43234	0.774	-4.9%
10	42871	0.767	-5.7%
11	42559	0.762	-6.4%
12	42299	0.757	-7%
13	42057	0.753	-7.5%
14	41829	0.748	-8%
15	41608	0.745	-8.5%
16	41400	0.741	-9%
17	41197	0.737	-9.4%
18	40982	0.733	-9.9%
19	40748	0.729	-10.4%
20	40486	0.724	-11%
21	40156	0.719	-11.7%
22	39759	0.711	-12.6%
23	39334	0.704	-13.5%
24	38887	0.696	-14.5%
25	38427	0.688	-15.5%
26	37973	0.679	-16.5%
27	37529	0.672	-17.5%
28	37082	0.664	-18.5%
29	36631	0.655	-19.5%
30	36176	0.647	-20.5%



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P50 - P90 evaluation

Meteo data

Source Meteonorm 8.0 (1986-2005), 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 1.59 GWh
P50 45.48 GWh
P90 43.44 GWh
P95 42.87 GWh

Probability distribution

