

PVsyst - Simulation report

Grid-Connected System

Project: Proyecto Ascoli Satriano

Variant: Proyecto Ascoli Satriano 550_1-30

Tracking system with backtracking

System power: 39.89 MWp

IT2_Ascoli Satriano - Italy

RENERGEIA S.A



**PVsyst V7.2.8**

VC2, Simulation date:
 30/12/21 10:57
 with v7.2.8

Project summary

Geographical Site IT2_Ascoli Satriano Italy	Situation Latitude 41.19 °N Longitude 15.61 °E Altitude 313 m Time zone UTC+1	Project settings Albedo 0.20
Meteo data IT2_Ascoli Satriano Meteonorm 8.0 (1986-2005), Sat=100% - Sintético		

System summary

Grid-Connected System Simulation for year no 1	Tracking system with backtracking	
PV Field Orientation Orientation Tracking plane, tilted axis Avg axis tilt 0.8 ° Avg axis azim. 0.0 °	Tracking algorithm Astronomic calculation Backtracking activated	Near Shadings Linear shadings
System information PV Array Nb. of modules 72520 units Pnom total 39.89 MWp	Inverters Nb. of units 185 units Pnom total 37.74 MWac Grid power limit 30.07 MWac Grid lim. Pnom ratio 1.326	
User's needs Unlimited load (grid)		

Results summary

Produced Energy	64098 MWh/year	Specific production	1607 kWh/kWp/year	Perf. Ratio PR	85.59 %
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General parameters

Grid-Connected System		Tracking system with backtracking	
PV Field Orientation		Tracking algorithm	
Orientation		Astronomic calculation	
Tracking plane, tilted axis		Backtracking activated	
Avg axis tilt	0.8 °		
Avg axis azim.	0.0 °		
Models used		Backtracking strategy	
Transposition	Hay	Nb. of trackers	750 units
Diffuse	Perez, Meteonorm	Sizes	
Circumsolar	separate	Tracker Spacing	10.5 m
		Collector width	4.53 m
		Ground Cov. Ratio (GCR)	43.2 %
		Phi min / max.	-/+ 60.0 °
		Backtracking limit angle	
		Phi limits	+/- 64.3 °
Horizon		Near Shadings	
Average Height	3.5 °	Linear shadings	
Bifacial system		User's needs	
Model	2D Calculation unlimited trackers	Unlimited load (grid)	
Bifacial model geometry		Bifacial model definitions	
Tracker Spacing	10.50 m	Ground albedo	0.20
Tracker width	4.53 m	Bifaciality factor	70 %
GCR	43.2 %	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	30.07 MWac		
Pnom ratio	1.326		

PV Array Characteristics

PV module		Inverter	
Manufacturer	Longi Solar	Manufacturer	Huawei Technologies
Model	18X-LR5-72HBD-550M	Model	SUN2000-215KTL-H0
(Custom parameters definition)		(Custom parameters definition)	
Unit Nom. Power	550 Wp	Unit Nom. Power	204 kWac
Number of PV modules	72520 units	Number of inverters	185 units
Nominal (STC)	39.89 MWp	Total power	37740 kWac
Modules	2590 Strings x 28 In series	Operating voltage	500-1500 V
At operating cond. (54°C)		Max. power (=>33°C)	215 kWac
Pmpp	35.86 MWp	Pnom ratio (DC:AC)	1.06
U mpp	1038 V		
I mpp	34551 A		
Total PV power		Total inverter power	
Nominal (STC)	39886 kWp	Total power	37740 kWac
Total	72520 modules	Nb. of inverters	185 units
Module area	185365 m²	Pnom ratio	1.06
Cell area	171994 m²		

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Array losses

Array Soiling Losses		Thermal Loss factor		DC wiring losses				
Loss Fraction	3.0 %	Module temperature according to irradiance		Global array res.	0.51 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	0.7 %	Loss Fraction	-0.2 %			
Loss Fraction	0.1 % at STC							
Module mismatch losses		Strings Mismatch loss		Module average degradation				
Loss Fraction	2.0 % 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

AC wiring losses

Inv. output line up to MV transfo	
Inverter voltage	800 Vac tri
Loss Fraction	1.13 % at STC
Inverter: SUN2000-215KTL-H0	
Wire section (185 Inv.)	Alu 185 x 3 x 185 mm ²
Average wires length	200 m
MV line up to Injection	
MV Voltage	30 kV
Wires	Alu 3 x 700 mm ²
Length	4500 m
Loss Fraction	0.88 % at STC

AC losses in transformers

MV transfo	
Grid voltage	30 kV
Operating losses at STC	
Nominal power at STC	39163 kVA
Iron loss (24/24 Connexion)	52.09 kW
Loss Fraction	0.13 % at STC
Coils equivalent resistance	3 x 0.16 mΩ
Loss Fraction	1.00 % at STC

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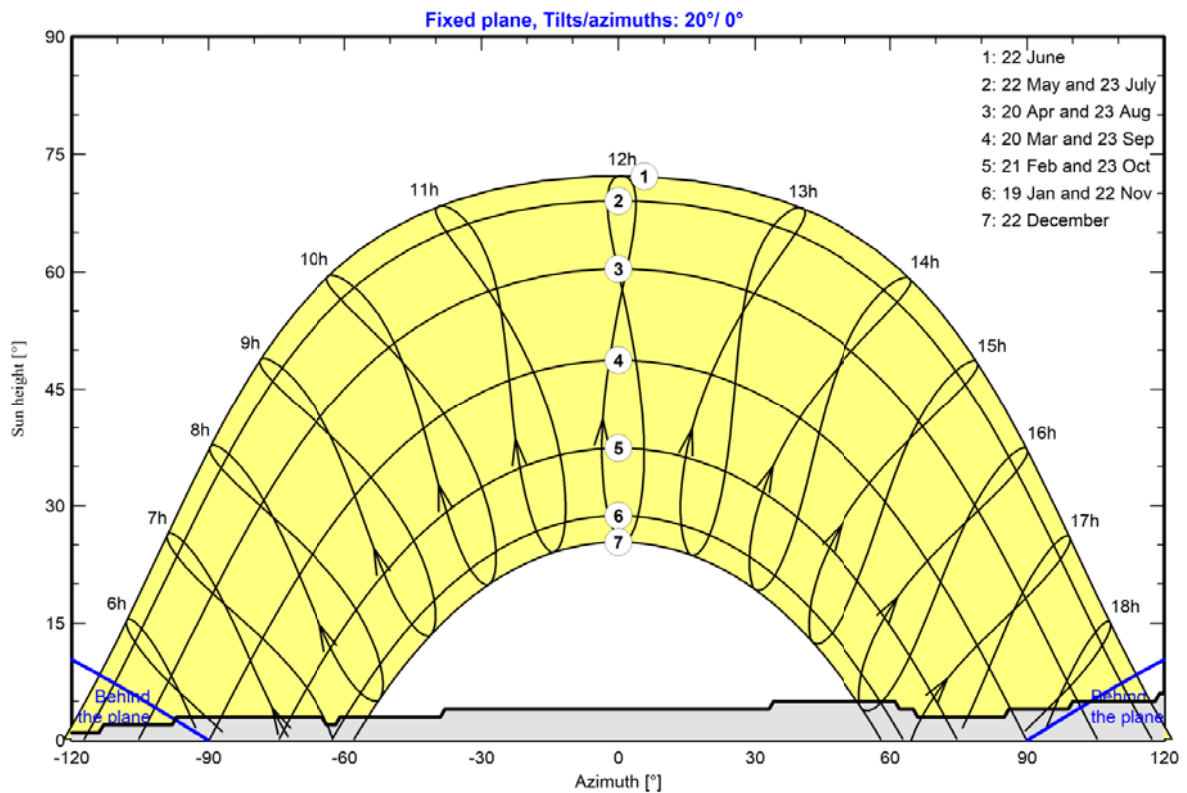
Horizon definition

Horizonte del servicio web de Meteonorm, lat=41,19, lon=15,61

Average Height 3.5 ° Albedo Factor 0.78
 Diffuse Factor 0.94 Albedo Fraction 100 %

Horizon profile

Azimuth [°]	-180	-173	-172	-158	-157	-151	-150	-142	-141	-121	-120	-114	-113
Height [°]	4.0	4.0	3.0	3.0	2.0	2.0	1.0	1.0	0.0	0.0	1.0	1.0	2.0
Azimuth [°]	-98	-97	-65	-64	-62	-61	-39	-38	33	34	61	62	65
Height [°]	2.0	3.0	3.0	2.0	2.0	3.0	3.0	4.0	4.0	5.0	5.0	4.0	4.0
Azimuth [°]	66	85	86	99	100	118	119	128	129	170	171	179	
Height [°]	3.0	3.0	4.0	4.0	5.0	5.0	6.0	6.0	5.0	5.0	4.0	4.0	

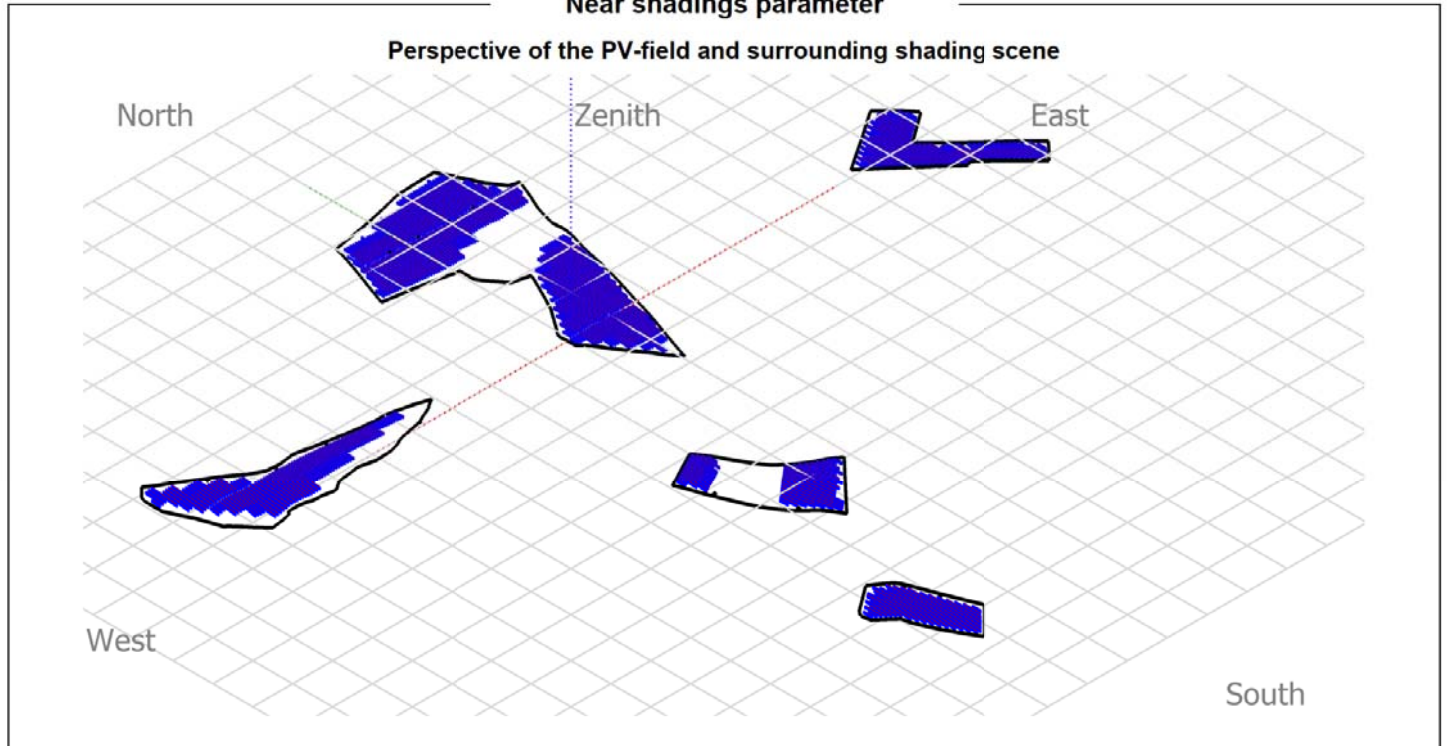
Sun Paths (Height / Azimuth diagram)



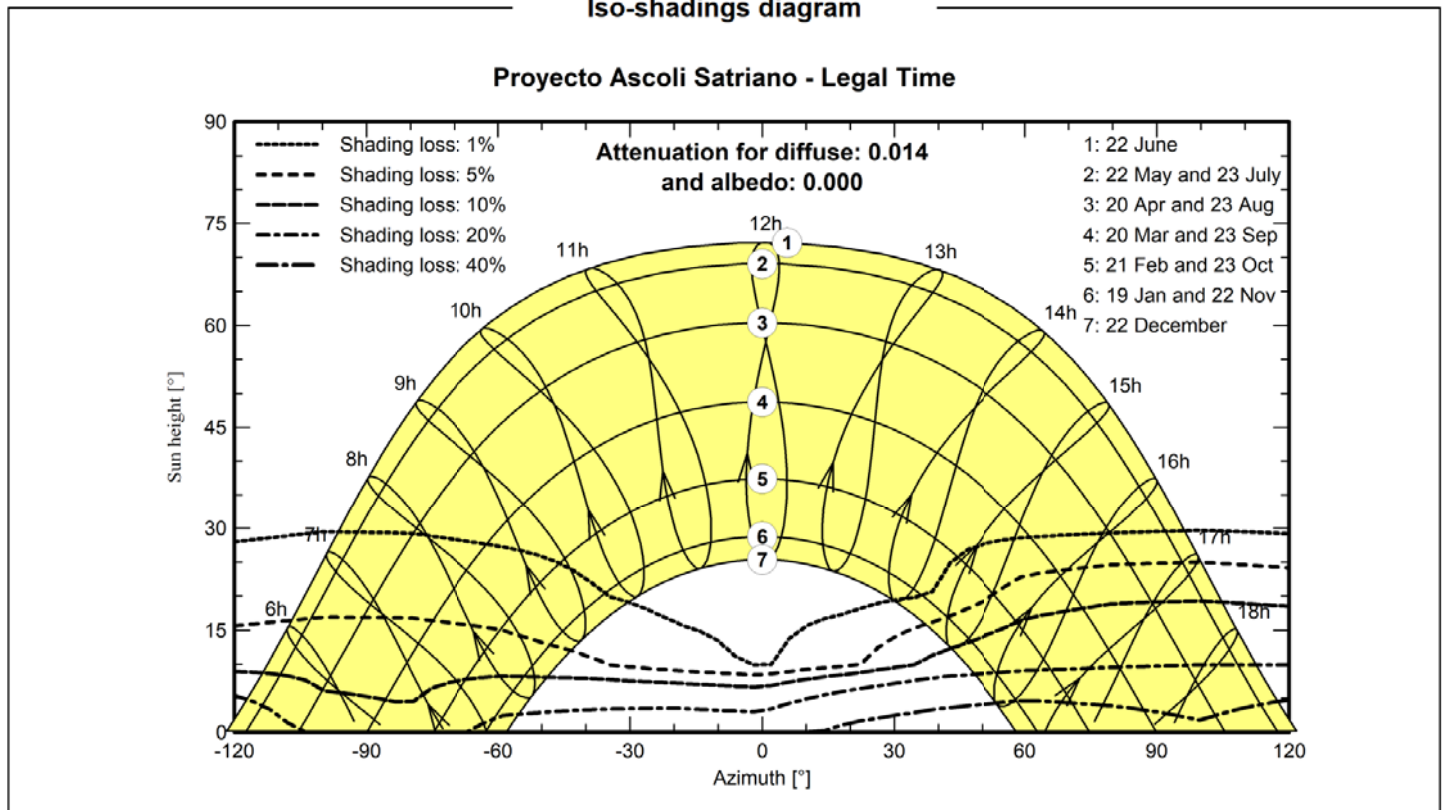
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Near shadings parameter



Iso-shadings diagram





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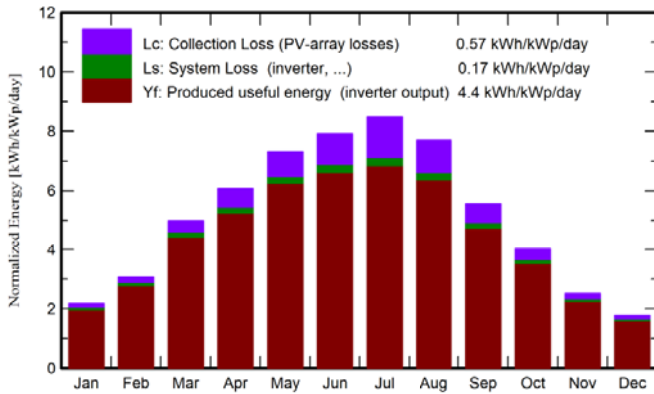
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Main results

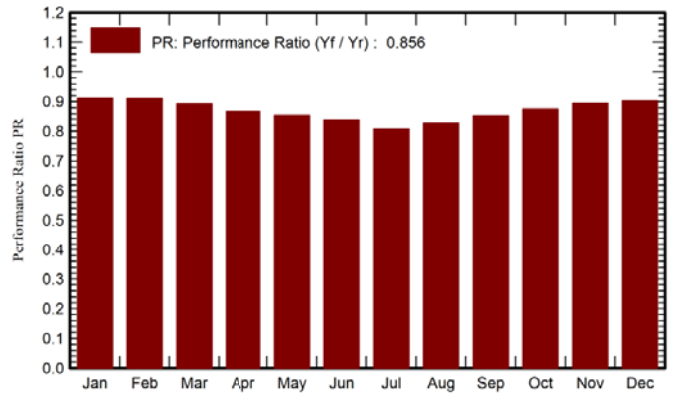
System Production

Produced Energy **64098 MWh/year** Specific production **1607 kWh/kWp/year**
 Performance Ratio PR **85.59 %**

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	23.05	7.48	67.4	62.9	2551	2449	0.912
February	66.5	32.19	7.99	85.8	79.9	3233	3113	0.910
March	120.5	51.22	10.90	154.2	144.8	5704	5493	0.893
April	145.4	62.04	13.78	181.9	171.7	6528	6282	0.866
May	183.5	87.82	18.75	226.9	213.8	8031	7734	0.855
June	192.3	86.99	23.53	237.6	224.4	8248	7942	0.838
July	207.2	75.96	26.51	263.0	248.6	8818	8481	0.809
August	185.9	69.29	26.20	238.8	225.9	8208	7890	0.828
September	131.0	55.10	20.96	166.8	156.6	5900	5678	0.853
October	96.6	42.34	17.21	124.8	116.7	4526	4358	0.876
November	57.5	26.14	12.43	75.5	70.3	2805	2696	0.895
December	43.9	25.29	8.76	54.9	50.5	2066	1981	0.904
Year	1481.7	637.43	16.26	1877.7	1766.2	66619	64098	0.856

Legends

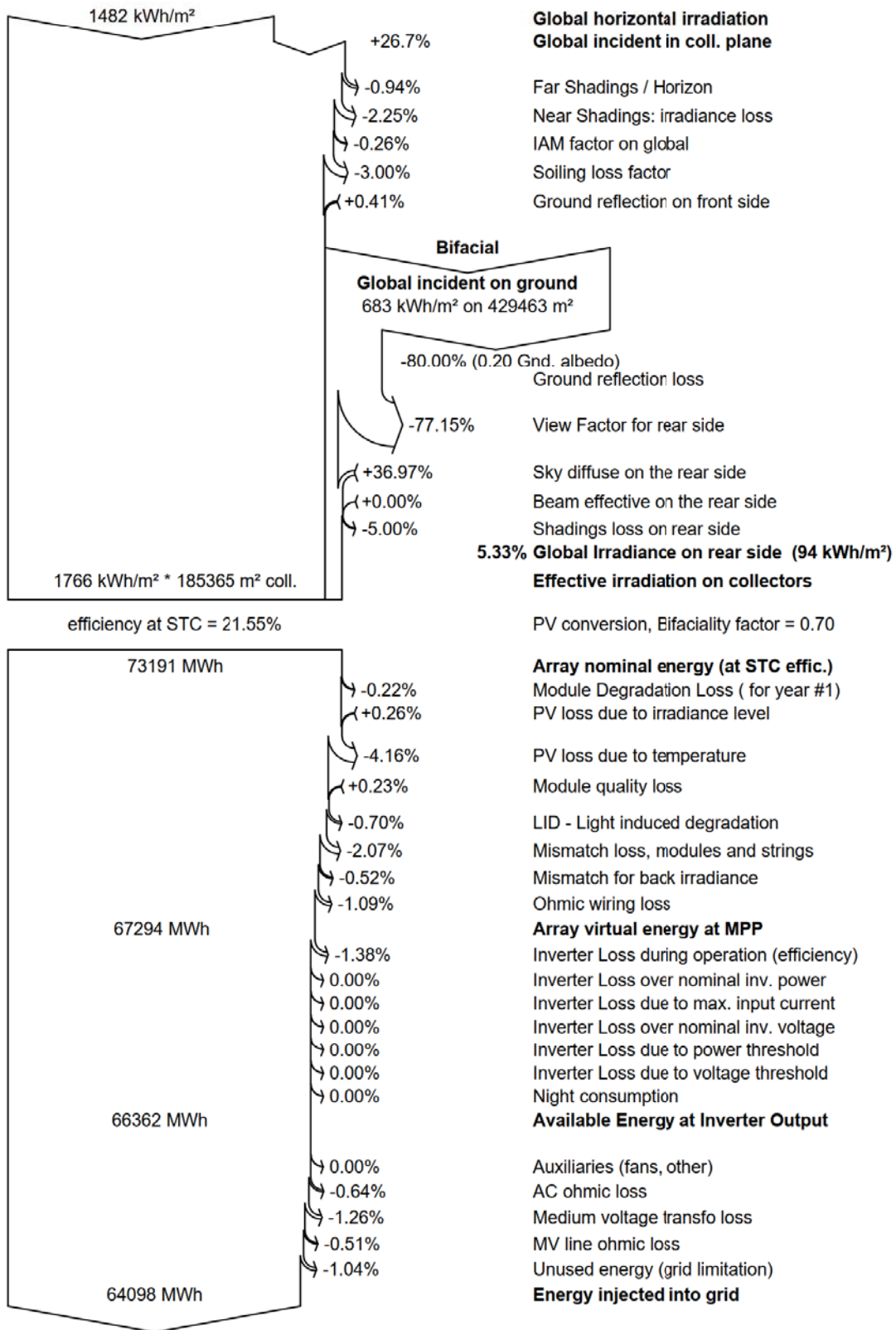
- | | | | |
|---------|--|--------|---|
| GlobHor | Global horizontal irradiation | EArray | Effective energy at the output of the array |
| DiffHor | Horizontal diffuse irradiation | E_Grid | Energy injected into grid |
| T_Amb | Ambient Temperature | PR | Performance Ratio |
| GlobInc | Global incident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



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Loss diagram



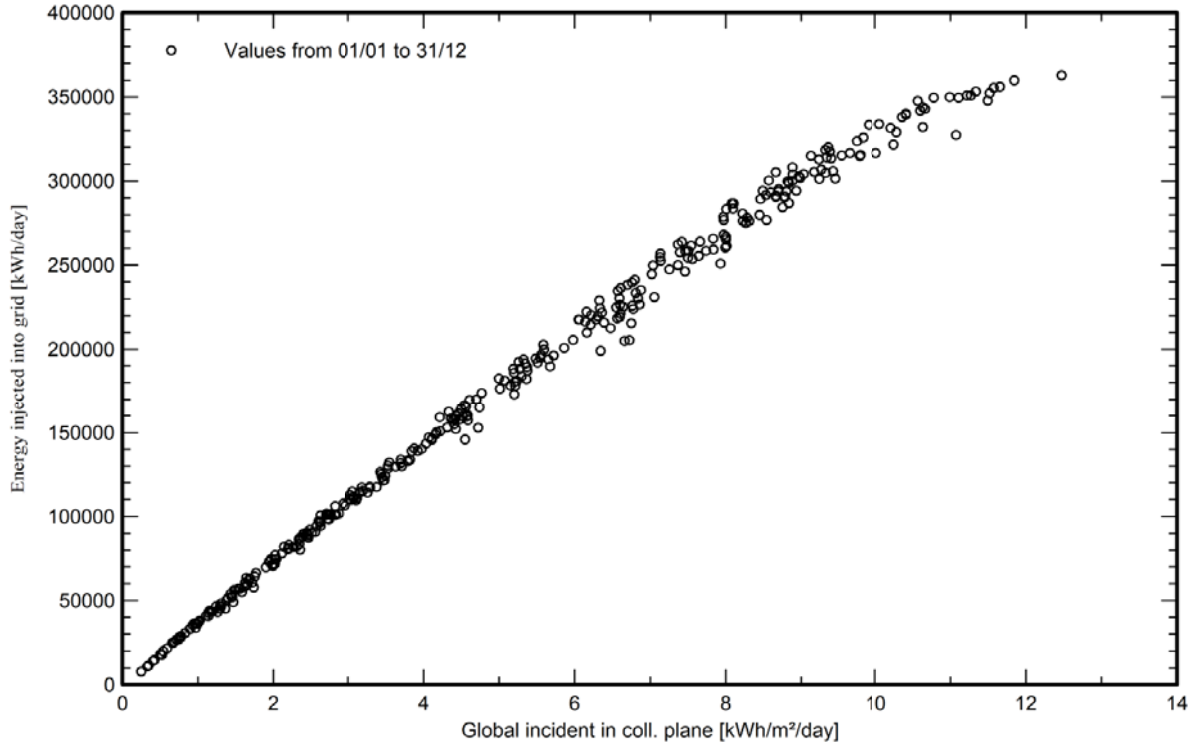


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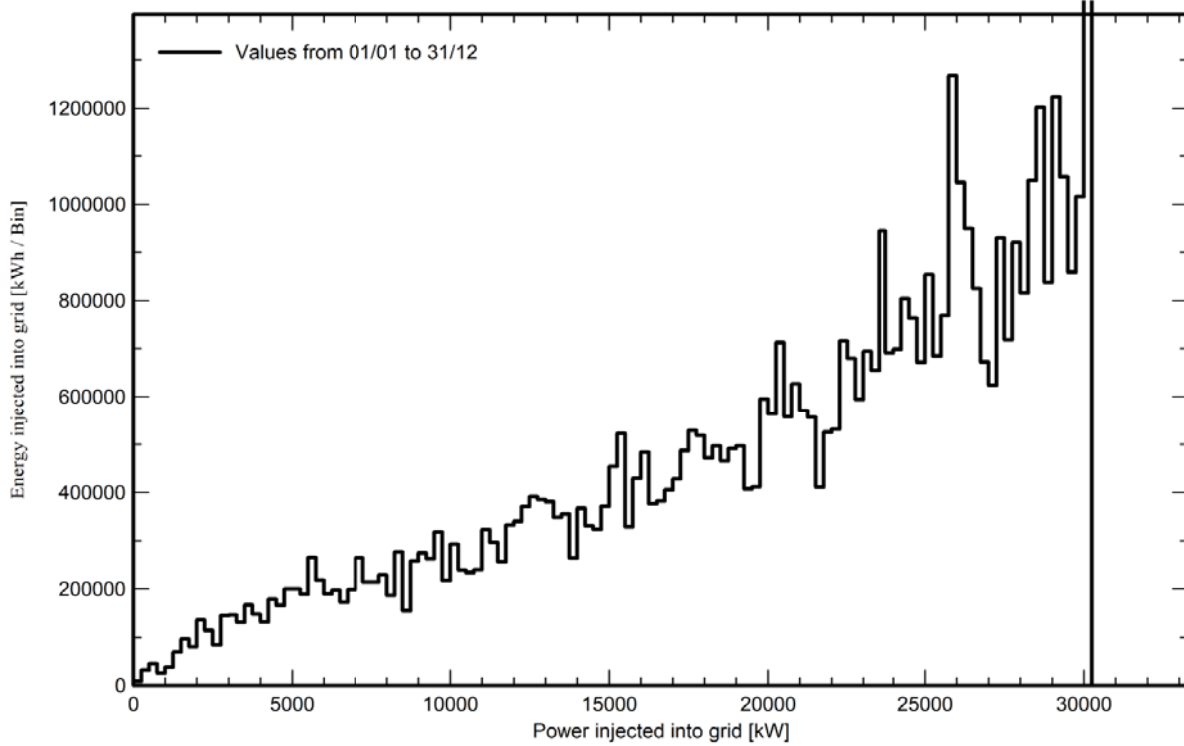
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Special graphs

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 0.45 %/year

Mismatch due to degradation

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

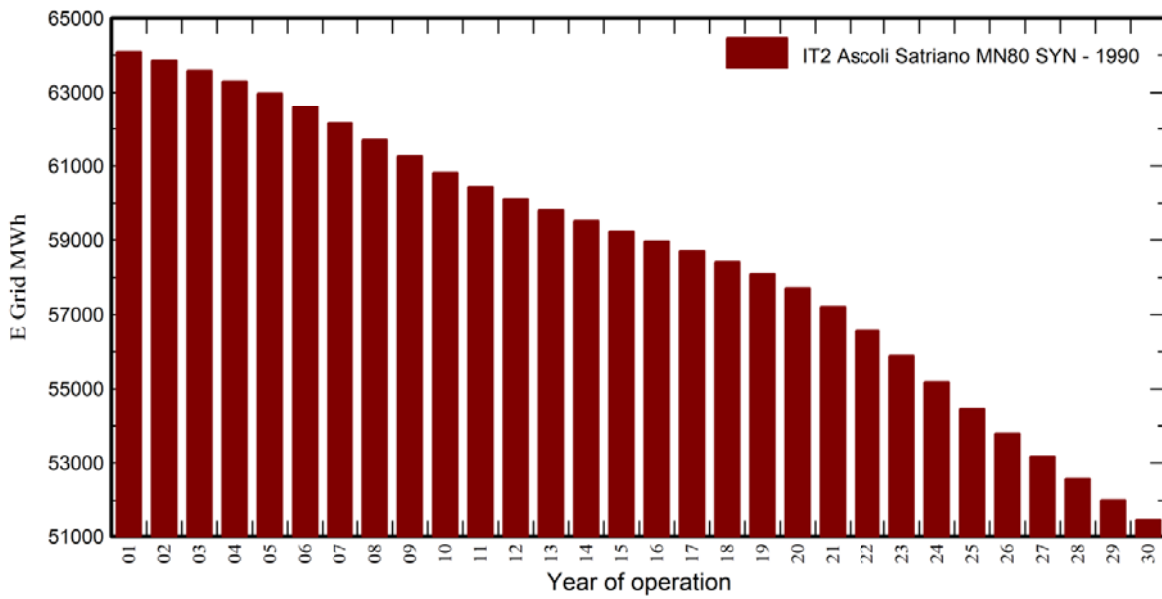
Meteo used in the simulation

#1 IT2 Ascoli Satriano MN80 SYN

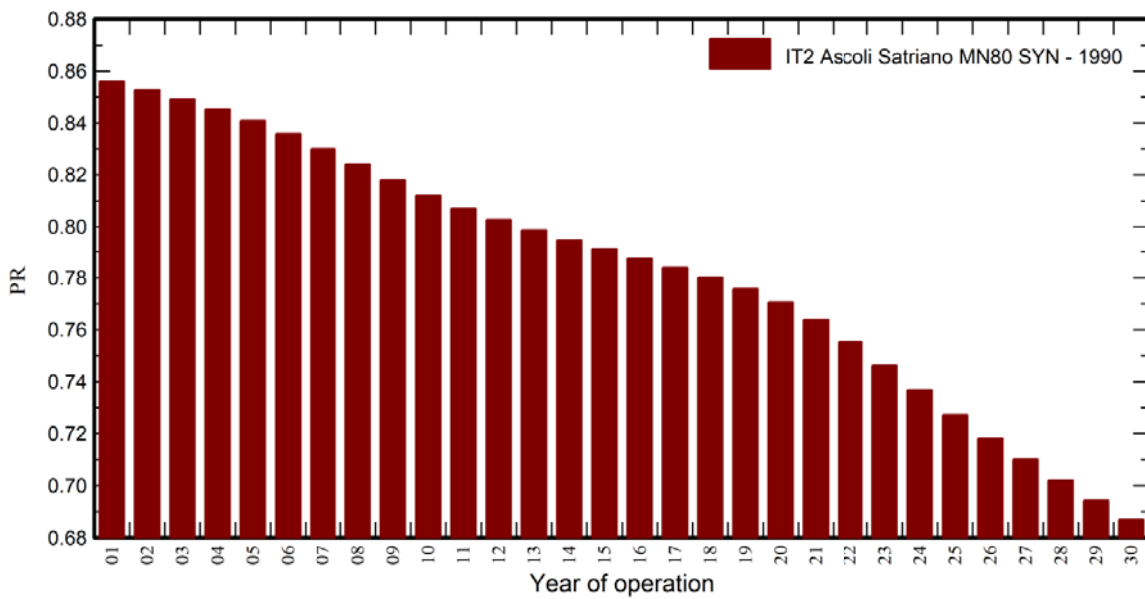
Years 1990 (reference year)

Years simulated 1-30

Energy injected into grid



Performance Ratio



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Aging Tool**Aging Parameters**

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Meteo used in the simulation**#1 IT2 Ascoli Satriano MN80 SYN**

Years 1990 (reference year)

Years simulated 1-30

IT2 Ascoli Satriano MN80 SYN

Year	E Grid MWh	PR	PR loss %
1	64098	0.856	0%
2	63861	0.853	-0.4%
3	63595	0.849	-0.8%
4	63297	0.845	-1.2%
5	62970	0.841	-1.8%
6	62588	0.836	-2.4%
7	62155	0.83	-3%
8	61709	0.824	-3.7%
9	61259	0.818	-4.4%
10	60817	0.812	-5.1%
11	60434	0.807	-5.7%
12	60114	0.803	-6.2%
13	59812	0.799	-6.7%
14	59522	0.795	-7.1%
15	59239	0.791	-7.6%
16	58971	0.787	-8%
17	58708	0.784	-8.4%
18	58420	0.78	-8.9%
19	58094	0.776	-9.4%
20	57716	0.771	-10%
21	57205	0.764	-10.8%
22	56568	0.755	-11.7%
23	55885	0.746	-12.8%
24	55178	0.737	-13.9%
25	54462	0.727	-15%
26	53792	0.718	-16.1%
27	53178	0.71	-17%
28	52582	0.702	-18%
29	52006	0.694	-18.9%
30	51448	0.687	-19.7%



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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 2.24 GWh
P50 64.10 GWh
P90 61.22 GWh
P95 60.41 GWh

Probability distribution

