Comune di Cerignola, Ascoli Satriano
Provincia di Foggia, Regione Puglia

CERIGNOLA SOLAR PARK S.R.L.

Viale Francesco Restelli 3/7
20124 Milano (MI)
PEC: nrgsolar3@pec.it

Impianto Agrivoltaico "CERIGNOLA 30.3"

PD01_21 – SIMULAZIONE ENERGETICA (PVSYST)

PROGETTISTI

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SETTEMBRE 2023

Version 7.4.0

PVsyst - Simulation report

Grid-Connected System

Project: ITS2CG - Cerignola

Variant: P17_Cerignola_2P(15-30)_Tracker_600Wp_Pitch=8.15m_3D

Tracking system with backtracking

System power: 39.02 MWp

Cerignola_site_157661_411333 - Italia

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Project summary

Geographical Site
Cerignola_site_157661_411333
Italia

Situation

Latitude	41.13 °N
Longitude	15.77 °E
Altitude	255 m
Time zone	UTC+1

Project settings

Albedo	0.20

Meteo data
Solcast_site_157661_411333
Solcast https://solcast.com - 2022

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	-1.3 °
Avg axis azim.	0 °

Tracking algorithm
Irradiance optimization
Backtracking activated

Near Shadings

According to strings	
Electrical effect	100 %
Diffuse shading	Automatic

System information

PV Array

Nb. of modules	65040 units
Pnom total	39.02 MWp

Inverters

Nb. of units	119 units
Pnom total	39.27 MWac
Grid power limit	30.30 MWac
Grid lim. Pnom ratio	1.288

User's needs
Unlimited load (grid)

Results summary

Produced Energy	62273.01 MWh/year	Specific production	1596 kWh/kWp/year	Perf. Ratio PR	83.22 %

Table of contents

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General parameters

Grid-Connected System

Tracking system with backtracking

PV Field Orientation

Orientation

Tracking plane, tilted axis	
Avg axis tilt	-1.3 °
Avg axis azim.	0 °

Tracking algorithm

Irradiance optimization	
Backtracking activated	

Backtracking array

Nb. of trackers	1137 units

Sizes

Tracker Spacing	8.15 m
Collector width	4.48 m
Ground Cov. Ratio (GCR)	55.0 %
Phi min / max.	-/+ 38.0 °

Backtracking strategy

Phi limits for BT	-/+ 79.9 °
Backtracking pitch	8.15 m
Backtracking width	4.48 m

Models used

Transposition	Perez
Diffuse	Imported
Circumsolar	separate

Horizon

Average Height	0.6 °

Near Shadings

According to strings	
Electrical effect	100 %
Diffuse shading	Automatic

User's needs

Unlimited load (grid)

Bifacial system

Model: 2D Calculation unlimited trackers

Bifacial model geometry

Tracker Spacing	8.15 m
Tracker width	4.48 m
GCR	55.0 %
Axis height above ground	3.51 m

Bifacial model definitions

Ground albedo	0.20
Bifaciality factor	70 %
Rear shading factor	0.0 %
Rear mismatch loss	10.0 %
Shed transparent fraction	0.0 %

Grid power limitation

Active power	30.30 MWac
Pnom ratio	1.288

PV Array Characteristics

PV module

Manufacturer	Trina Solar
Model	TSM-600DEG20C.20
(Custom parameters definition)	
Unit Nom. Power	600 Wp
Number of PV modules	65040 units
Nominal (STC)	39.02 MWp
Modules	2168 Strings x 30 In series
At operating cond. (49°C)	
Pmpp	35.86 MWp
U mpp	941 V
I mpp	38091 A

Inverter

Manufacturer	Huawei Technologies
Model	SUN2000-330KTL-H1-Preliminary V0.1
(Custom parameters definition)	
Unit Nom. Power	330 kWac
Number of inverters	119 units
Total power	39270 kWac
Operating voltage	500-1500 V
Pnom ratio (DC:AC)	0.99
Power sharing within this inverter	

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PV Array Characteristics

Total PV power

Nominal (STC)	39024	kWp
Total	65040	modules
Module area	184071	m²
Cell area	172096	m²

Total inverter power

Total power	39270	kWac
Number of inverters	119	units
Pnom ratio	0.99	

Array losses

Array Soiling Losses
Loss Fraction 2.5 %

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. 0.40 mΩ
Loss Fraction 1.5 % at STC

LID - Light Induced Degradation
Loss Fraction 1.5 %

Module Quality Loss
Loss Fraction -0.8 %

Module mismatch losses
Loss Fraction 1.5 % at MPP

Strings Mismatch loss
Loss Fraction 0.1 %

Module average degradation
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

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 (119 Inv.) Alu 119 x 3 x 240 mm²
Average wires length 200 m

MV line up to Injection
MV Voltage 36 kV
Wires Alu 3 x 1200 mm²
Length 23209 m
Loss Fraction 1.80 % at STC

AC losses in transformers

MV transfo
Medium voltage 36 kV
Transformer parameters
Nominal power at STC 38.34 MVA
Iron Loss (24/24 Connexion) 42.56 kVA
Iron loss fraction 0.11 % at STC
Copper loss 338.16 kVA
Copper loss fraction 0.88 % at STC
Coils equivalent resistance 3 x 0.15 mΩ

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Horizon definition

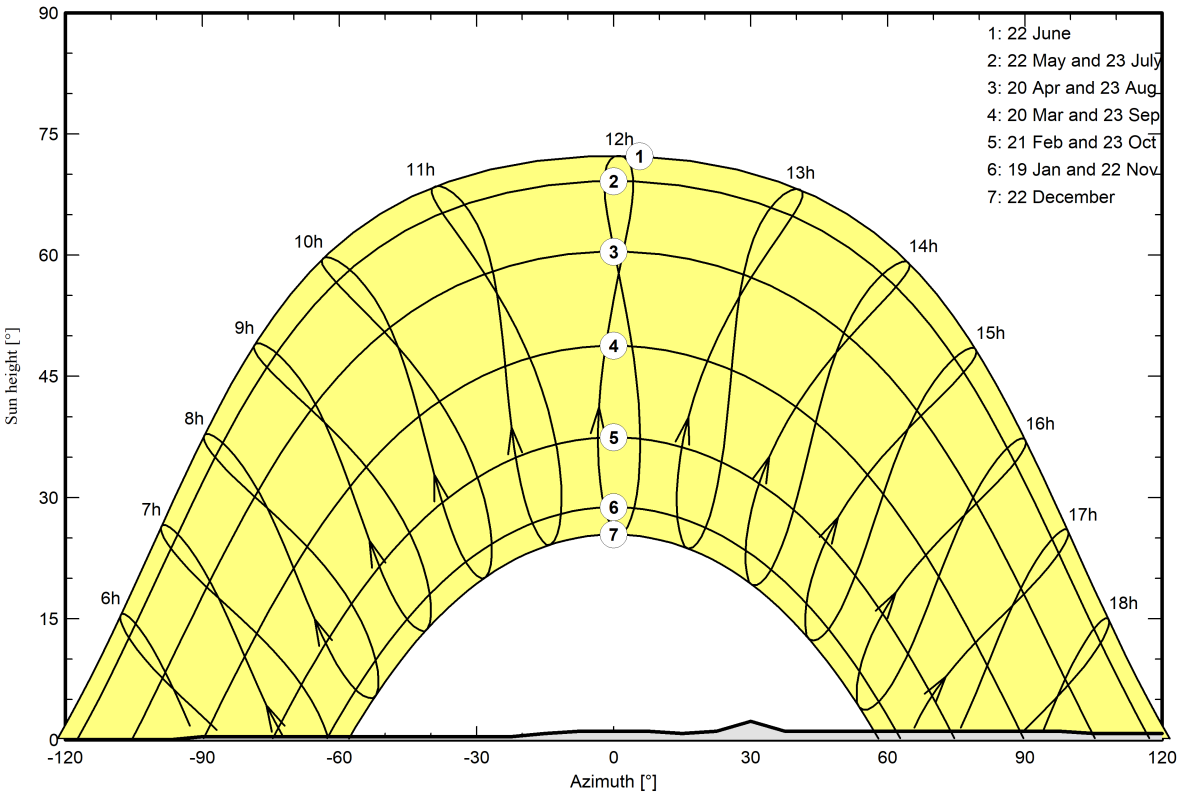
Horizon from PVGIS website API, Lat=41°7'59", Long=15°45'57", Alt=255m

Average Height	0.6 °	Albedo Factor	0.95
Diffuse Factor	1.00	Albedo Fraction	100 %

Horizon profile

Azimuth [°]	-180	-173	-98	-90	-23	-15	-8	8	15	23
Height [°]	0.4	0.0	0.0	0.4	0.4	0.8	1.1	1.1	0.8	1.1
Azimuth [°]	30	38	98	105	135	143	158	165	173	180
Height [°]	2.3	1.1	1.1	0.8	0.8	0.4	0.4	0.0	0.4	0.4

Sun Paths (Height / Azimuth diagram)



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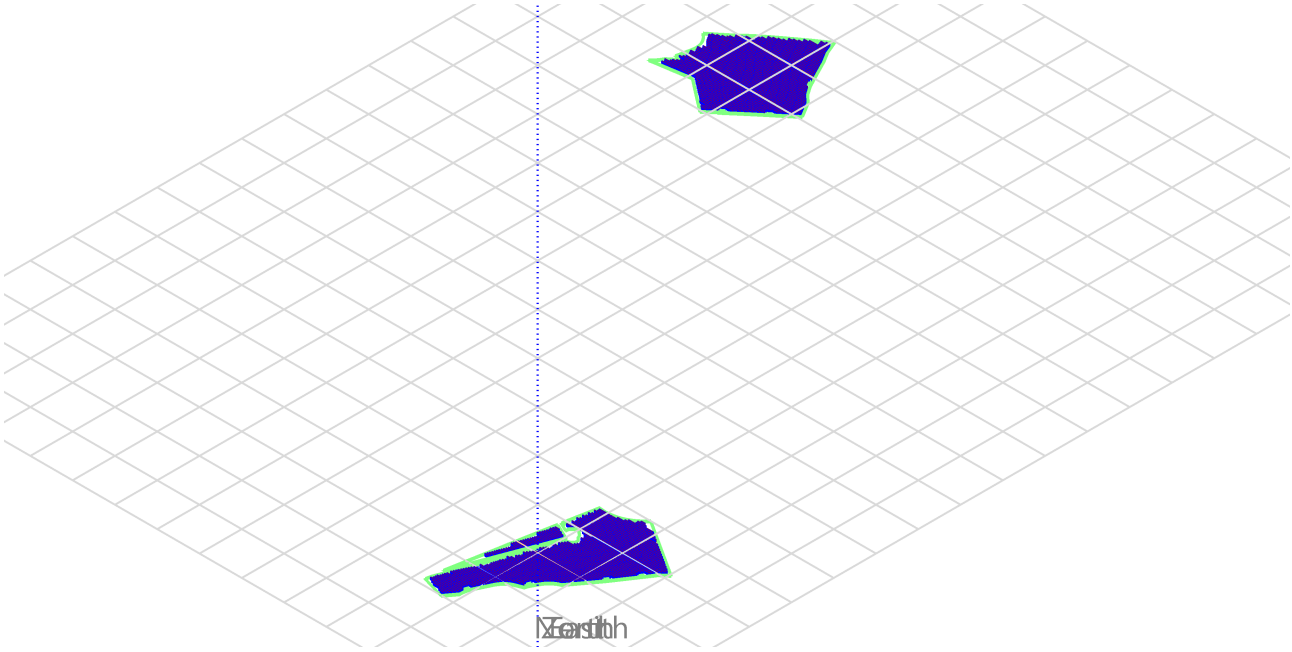
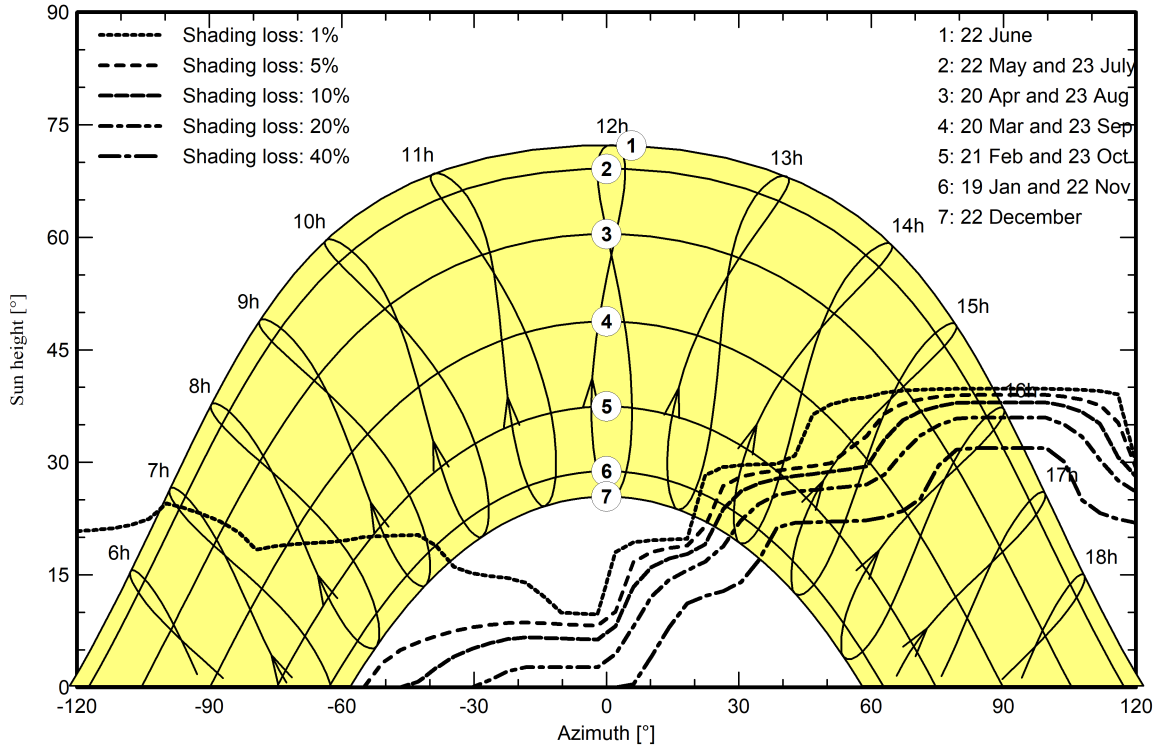
Near shadings parameter

Perspective of the PV-field and surrounding shading scene



Iso-shadings diagram

Orientation #1



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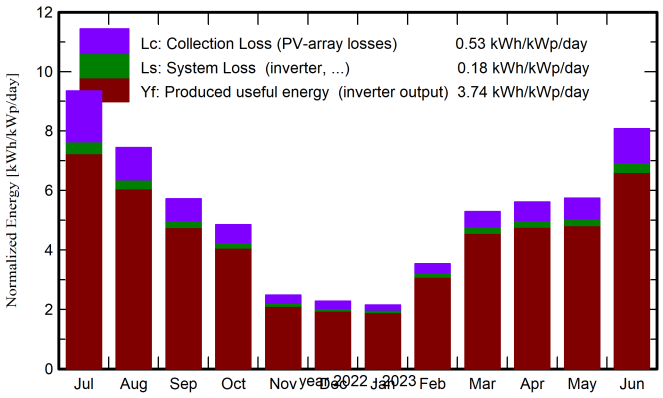
Main results

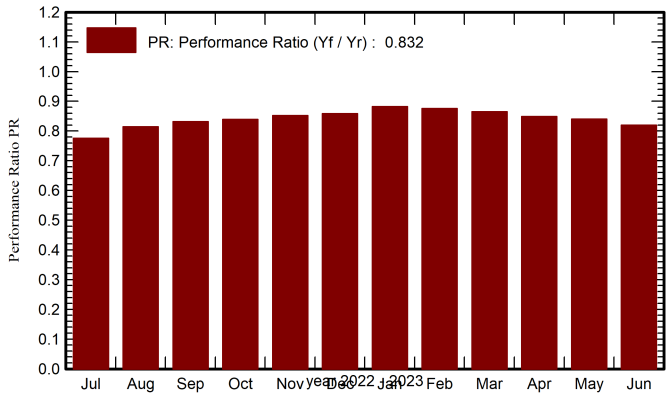
System Production

Produced Energy	62273.01 MWh/year	Specific production	1596 kWh/kWp/year
		Perf. Ratio PR	83.22 %

Normalized productions (per installed kWp)



Performance Ratio PR



Balances and main results

	GlobHor kWh/m²	DiffHor kWh/m²	T_Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray MWh	E_Grid MWh	PR ratio
July 22	7.5	1.36	26.43	9.3	9.0	298	283	0.776
Aug. 22	185.9	63.50	25.82	230.8	222.3	7698	7333	0.814
Sep. 22	138.3	46.07	21.60	171.6	165.0	5843	5572	0.832
Oct. 22	118.4	35.14	18.09	150.4	144.0	5154	4928	0.840
Nov. 22	61.2	25.04	12.79	74.4	70.9	2588	2473	0.852
Dec. 22	57.1	21.79	10.84	70.5	66.9	2470	2364	0.858
Jan. 23	55.3	26.30	8.07	66.6	63.4	2397	2293	0.882
Feb. 23	80.2	30.45	7.90	98.9	94.7	3535	3382	0.876
Mar. 23	131.6	43.71	11.59	163.9	157.6	5803	5534	0.865
Apr. 23	139.7	58.15	12.44	168.6	162.3	5858	5584	0.849
May 23	149.8	73.59	17.29	178.2	171.7	6131	5846	0.841
June 23	199.4	75.99	22.84	242.3	233.9	8141	7748	0.819
July 23	230.7	54.97	29.26	292.0	281.6	9397	8930	0.784
Period	1555.2	556.08	16.60	1917.6	1843.1	65313	62273	0.832

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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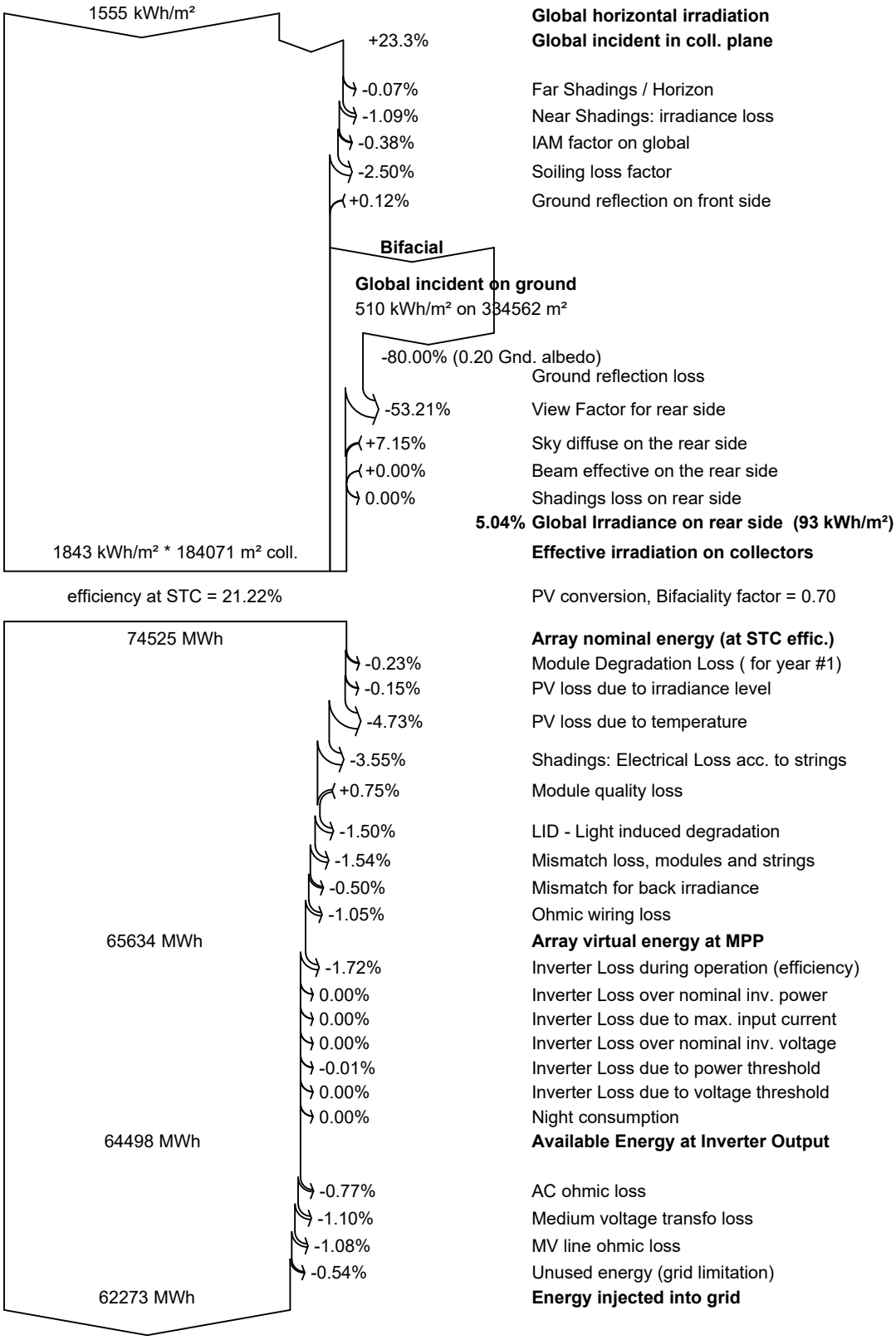
Loss diagram



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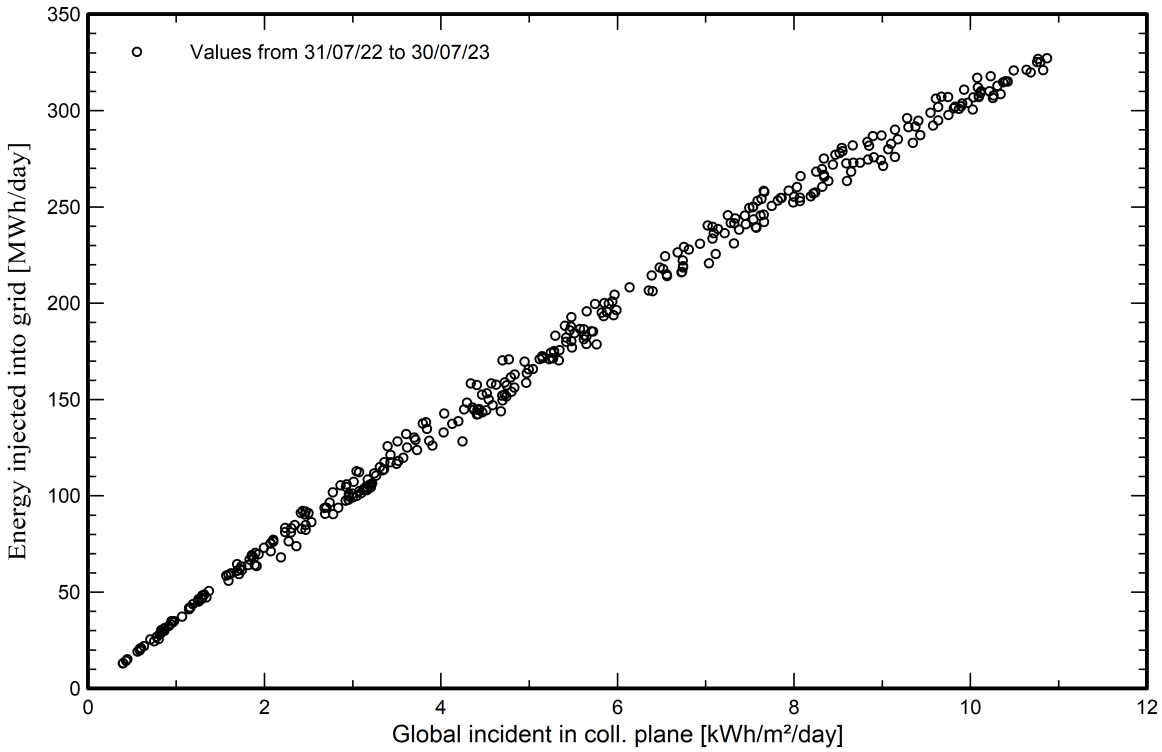
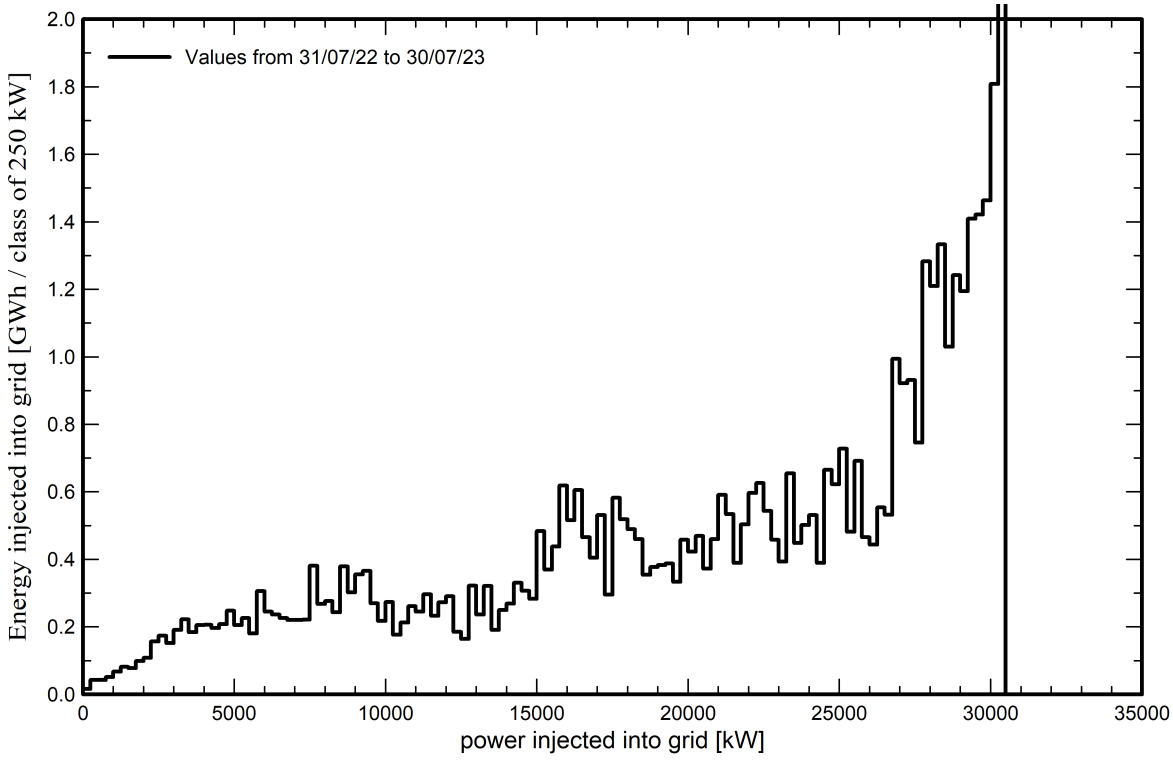
Predef. graphs

Diagrama entrada/salida diaria



Distribución de potencia de salida del sistema



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

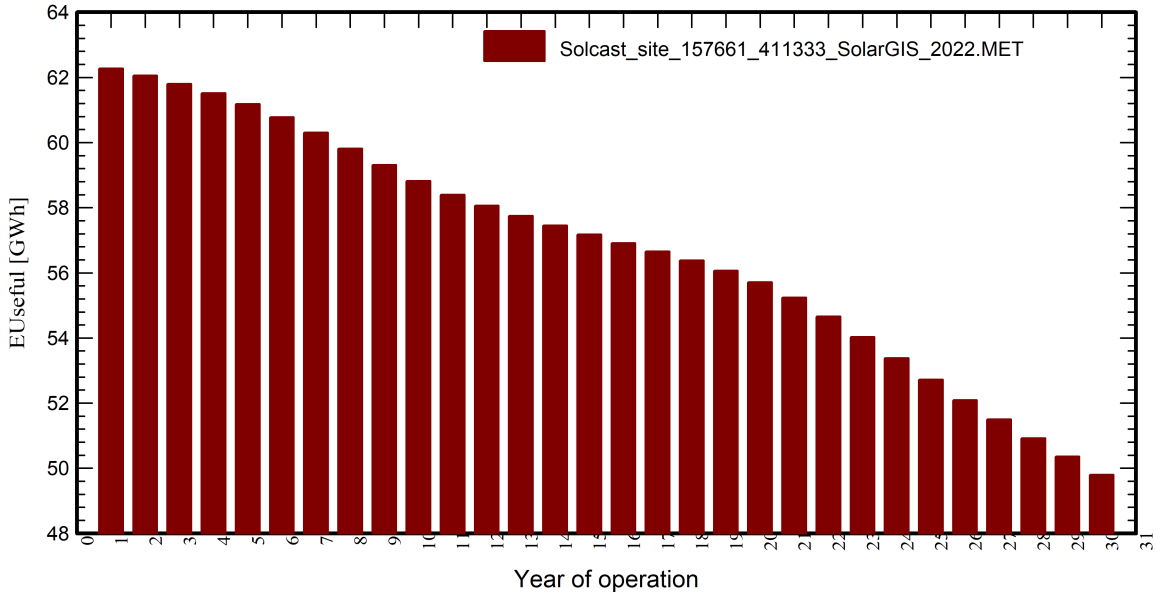
Vmp RMS dispersion 0.4 %/year

Meteo used in the simulation

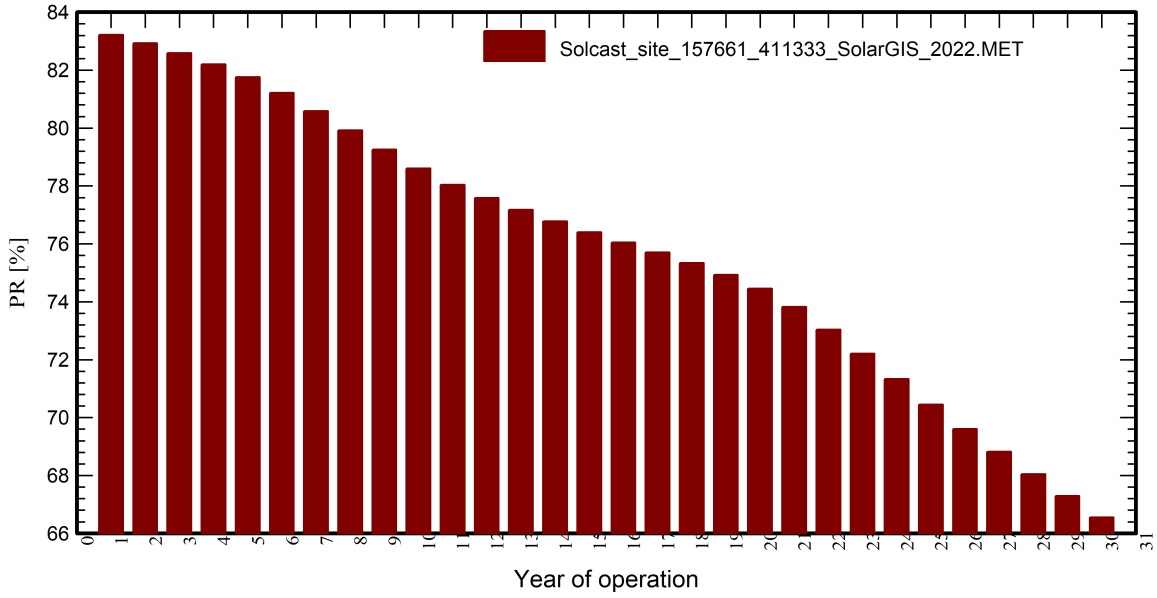
Solcast site 157661 411333 SolarGIS

Years 2022

Useful out system 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

Solcast site 157661 411333 SolarGIS

Years 2022

	EUseful	PR	PR loss
Year	GWh	%	%
1	62.27	83.22	-0.17
2	62.06	82.93	-0.52
3	61.80	82.59	-0.93
4	61.51	82.20	-1.40
5	61.18	81.75	-1.93
6	60.77	81.21	-2.58
7	60.30	80.58	-3.33
8	59.81	79.92	-4.12
9	59.31	79.25	-4.93
10	58.82	78.60	-5.71
11	58.40	78.04	-6.38
12	58.06	77.59	-6.93
13	57.75	77.17	-7.43
14	57.45	76.78	-7.90
15	57.17	76.40	-8.35
16	56.91	76.05	-8.77
17	56.65	75.71	-9.18
18	56.38	75.34	-9.62
19	56.07	74.92	-10.12
20	55.71	74.45	-10.69
21	55.24	73.82	-11.45
22	54.65	73.04	-12.39
23	54.03	72.20	-13.39
24	53.38	71.33	-14.43
25	52.72	70.45	-15.49
26	52.09	69.61	-16.50
27	51.50	68.82	-17.44
28	50.92	68.05	-18.37
29	50.35	67.29	-19.28
30	49.80	66.55	-20.17

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P50 - P90 evaluation

Meteo data

Source	Solcast https://solcast.com
Kind	Monthly averages
2022 - 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	2.18 GWh
P50	62.27 GWh
P90	59.48 GWh
P95	58.69 GWh

Probability distribution