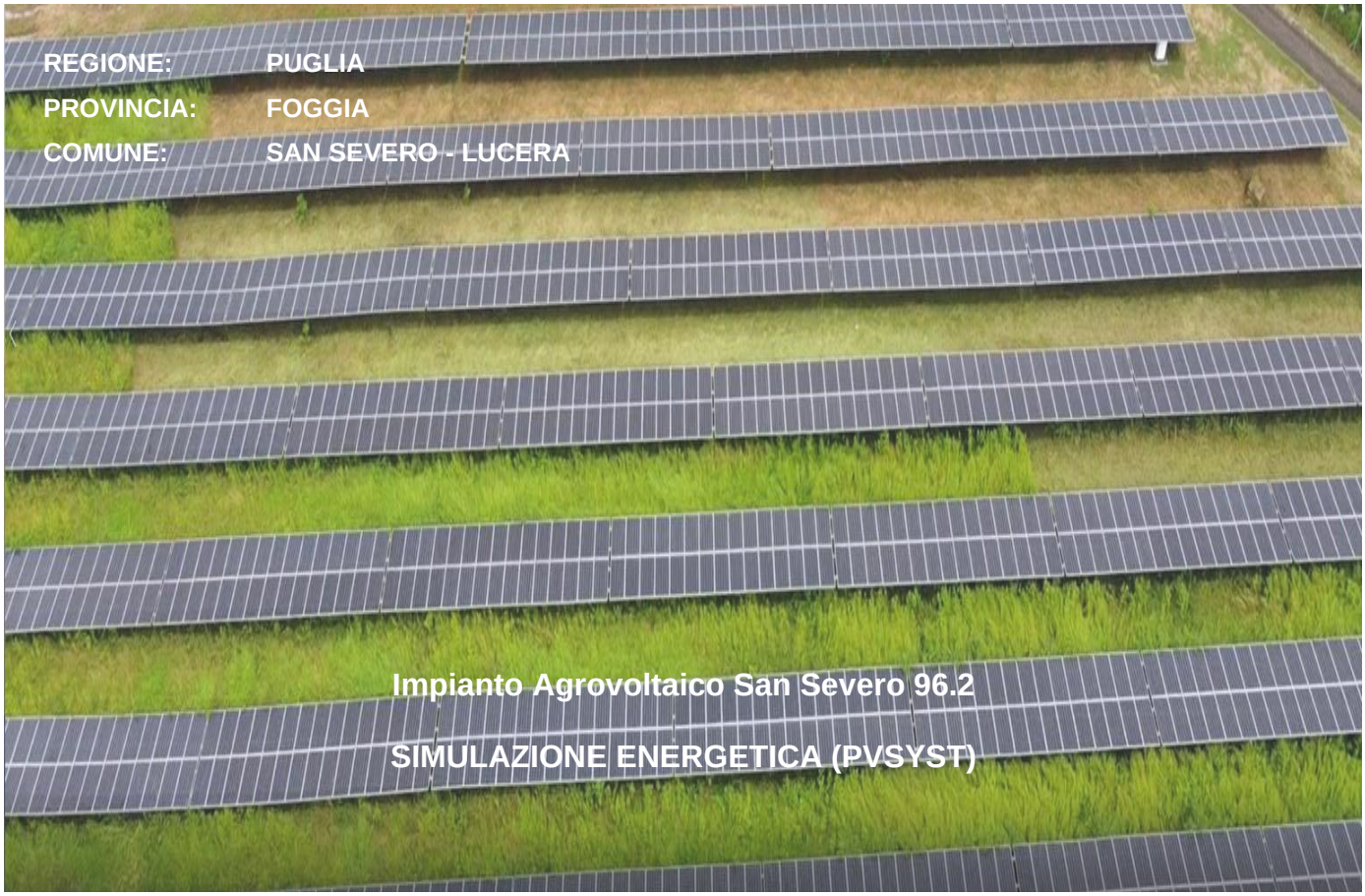

PROGETTISTI	IL PROPONENTE
Coordinamento tecnico di progetto	
Ingegner **Michele Di stefano** mdistefano@nrgplus.global Firmato digitalmente da: DI STEFANO MICHELE Data: 28/11/2022 15:37:30	**APOLLO SAN SEVERO S.R.L.** **Via della Stazione, 7** **39100 – Bolzano** **P.IVA: 03132340211** **apollosanseverosrl@legalmail.it**
RESPONSABILE TECNICO NRG+	
Ingegner **Maurizio De Donno** (per NRG Plus Italia S.r.l.) mdedonno@nrgplus.global MAURIZIO DE DONNO 28.11.2022 09:41:36 GMT+01:00	
NOVEMBRE 2022	

Version 7.2.8

PVsyst - Simulation report

Grid-Connected System

Project: IT21SS - San Severo 96.2

Tracking system with backtracking
System power: 91.85 MWp
San Severo - Italy

PVsyst V7.2.8
VC5, Simulation date:
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with v7.2.8

Project summary

Geographical Site
San Severo
Italy

Situation

Latitude	41.69 °N
Longitude	15.47 °E
Altitude	34 m
Time zone	UTC+1

Project settings
Albedo 0.20

Meteo data
San Severo
Meteonorm 8.0 (1986-2005), Sat=48% - Sintético

System summary

Grid-Connected System
Simulation for year no 1

Tracking system with backtracking

PV Field Orientation
Tracking plane, horizontal N-S axis
Avg axis azim. 0.0 °

Near Shadings
Linear shadings

User's needs
Unlimited load (grid)

System information

PV Array

Nb. of modules	153076 units
Pnom total	91.85 MWp

Inverters

Nb. of units	465 units
Pnom total	94.86 MWac
Grid power limit	88.00 MWac
Grid lim. Pnom ratio	1.044

Results summary

Produced Energy	146107 MWh/year	Specific production	1591 kWh/kWp/year	Perf. Ratio PR	84.41 %

Table of contents

General parameters

Grid-Connected System

Tracking system with backtracking

PV Field Orientation

Orientation	
Tracking plane, horizontal N-S axis	
Avg axis azim.	0.0 °

Backtracking strategy	
Nb. of trackers	2857 units
Sizes	
Tracker Spacing	8.50 m
Collector width	4.49 m
Ground Cov. Ratio (GCR)	52.9 %
Phi min / max.	-/+ 60.0 °
Backtracking limit angle	
Phi limits	+/- 58.0 °

Models used	
Transposition	Perez
Diffuse	Perez, Meteonorm
Circumsolar	separate

Horizon
Average Height 1.6 °

Near Shadings
Linear shadings

User's needs
Unlimited load (grid)

Bifacial system
Model 2D Calculation
unlimited trackers

Bifacial model geometry	
Tracker Spacing	8.50 m
Tracker width	4.49 m
GCR	52.9 %
Axis height above ground	2.10 m

Bifacial model definitions	
Ground albedo	0.20
Bifaciality factor	70 %
Rear shading factor	5.0 %
Rear mismatch loss	10.0 %
Shed transparent fraction	0.0 %

Grid power limitation

Active Power	88.00 MWac
Pnom ratio	1.044

PV Array Characteristics

PV module

Manufacturer	Trina Solar
Model	TSM-600DEG20C.20
(Custom parameters definition)	
Unit Nom. Power	600 Wp
Number of PV modules	153076 units
Nominal (STC)	91.85 MWp
Modules	5467 Strings x 28 In series
At operating cond. (50°C)	
Pmpp	84.08 MWp
U mpp	875 V
I mpp	96062 A

Inverter

Manufacturer	Huawei Technologies
Model	SUN2000-215KTL-H0
(Custom parameters definition)	
Unit Nom. Power	204 kWac
Number of inverters	465 units
Total power	94860 kWac
Operating voltage	500-1500 V
Max. power (=>33°C)	215 kWac
Pnom ratio (DC:AC)	0.97

Total PV power

Nominal (STC)	91846 kWp
Total	153076 modules
Module area	433223 m²
Cell area	405039 m²

Total inverter power

Total power	94860 kWac
Nb. of inverters	465 units
Pnom ratio	0.97

Array losses

Array Soiling Losses
Loss Fraction 3.0 %

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. 0.15 mΩ
Loss Fraction 1.5 % at STC

Serie Diode Loss
Voltage drop 0.7 V
Loss Fraction 0.1 % at STC

LID - Light Induced Degradation
Loss Fraction 0.2 %

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 0.40 % at STC
Inverter: SUN2000-215KTL-H0
Wire section (465 Inv.) Alu 465 x 3 x 120 mm²
Average wires length 50 m

MV line up to HV Transfo
MV Voltage 30 kV
Wires Alu 3 x 1500 mm²
Length 1465 m
Loss Fraction 0.31 % at STC

HV line up to Injection
HV line voltage 150 kV
Wires Alu 3 x 700 mm²
Length 21300 m
Loss Fraction 0.38 % at STC

AC losses in transformers

MV transfo
Medium voltage 30 kV
Operating losses at STC
Nominal power at STC 90224 kVA
Iron loss (24/24 Connexion) 90.22 kW
Loss Fraction 0.10 % at STC
Coils equivalent resistance 3 x 0.07 mΩ
Loss Fraction 1.00 % at STC

HV transfo
Grid voltage 150 kV
Transformer from Datasheets
Nominal power 100000 kVA
Iron loss 550.00 kVA
Loss Fraction 0.55 % of PNom
Copper loss 380.00 kVA
Loss Fraction 0.38 % of PNom

Operating losses at STC
Nominal power at STC 90224 kVA
Iron loss (24/24 Connexion) 550.00 kW
Loss Fraction 0.61 % at STC
Coils equivalent resistance 3 x 34.20 mΩ
Loss Fraction 0.34 % at STC

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13/09/22 15:18
with v7.2.8

Horizon definition

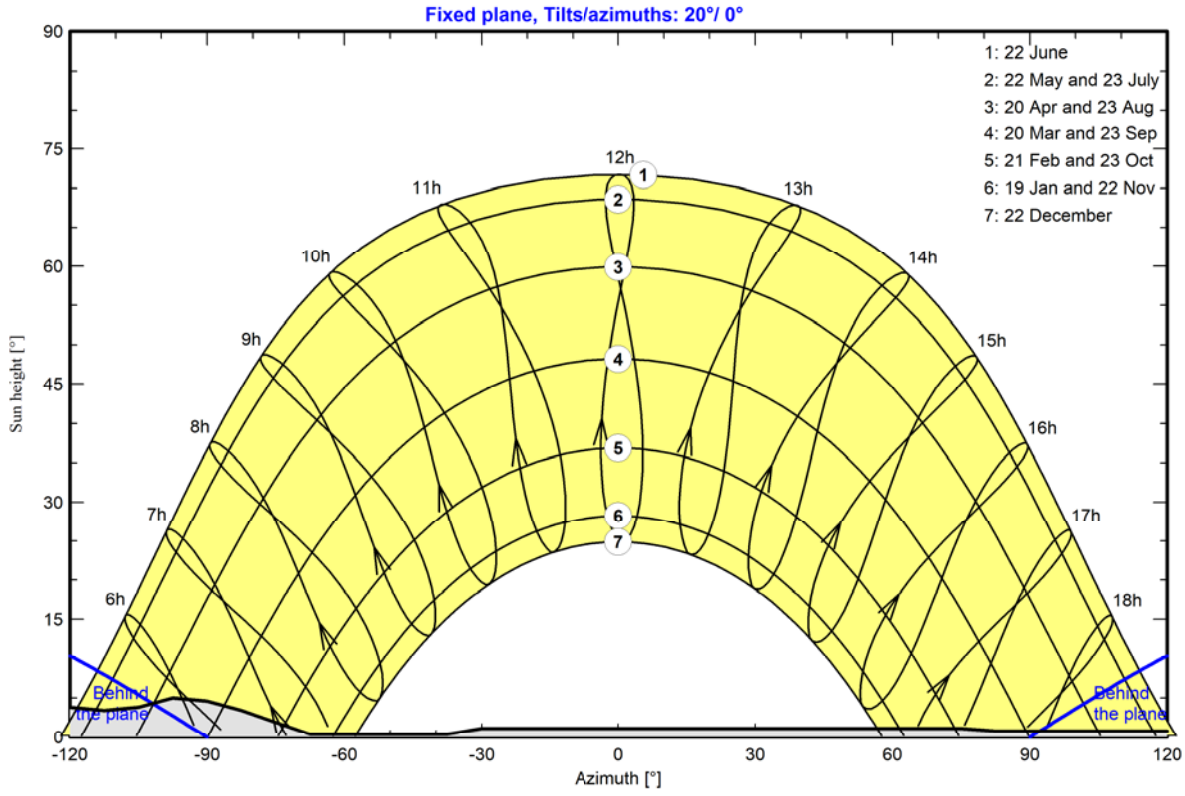
Horizon from PVGIS website API, Lat=41°41"36', Long=15°28"25', Alt=34m

Average Height	1.6 °	Albedo Factor	0.95
Diffuse Factor	1.00	Albedo Fraction	100 %

Horizon profile

Azimuth [°]	-180	-173	-165	-158	-150	-143	-135	-128	-120	-113	-105	-98
Height [°]	0.8	1.1	1.9	2.3	3.4	3.8	3.8	3.4	3.8	3.4	3.8	5.0
Azimuth [°]	-90	-83	-75	-68	-38	-30	75	83	165	173	180	
Height [°]	4.6	3.4	1.9	0.4	0.4	1.1	1.1	0.8	0.8	0.4	0.8	

Sun Paths (Height / Azimuth diagram)



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13/09/22 15:18
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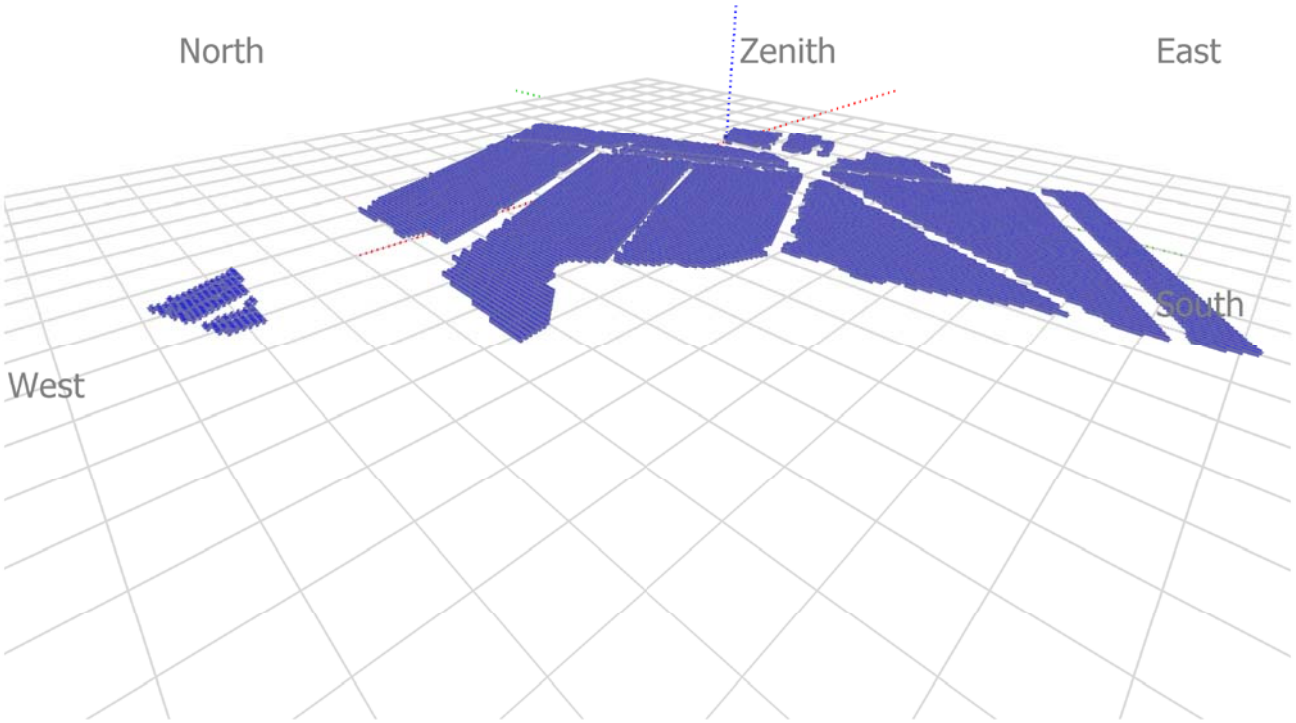
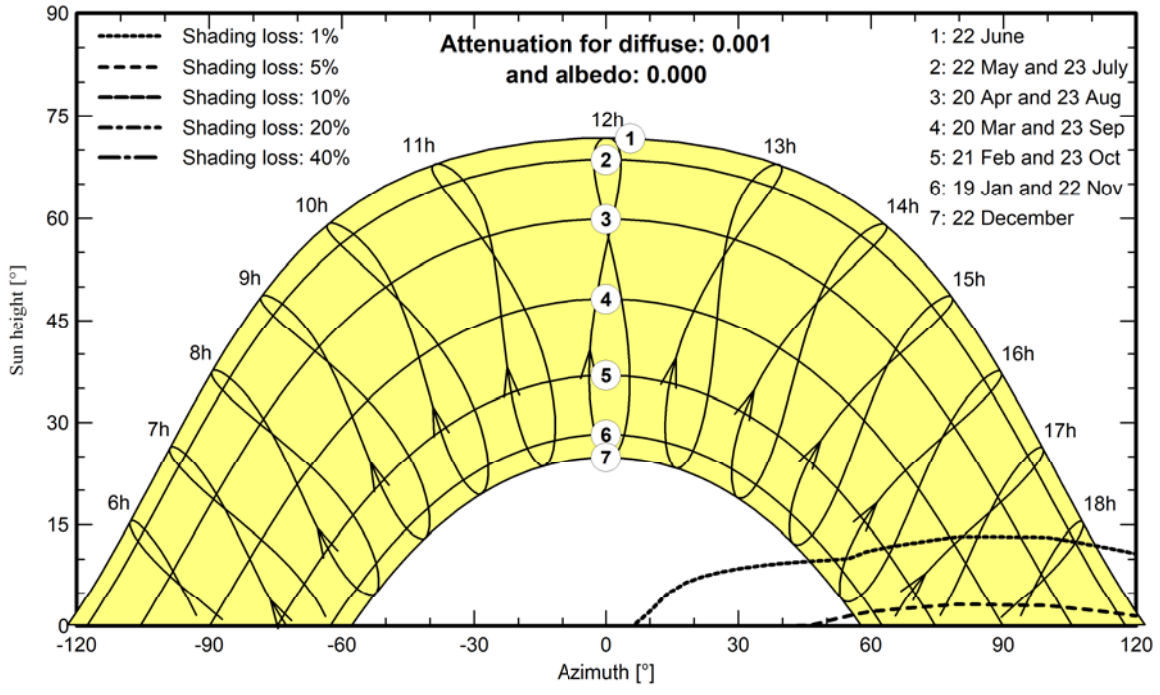
Near shadings parameter

Perspective of the PV-field and surrounding shading scene



Iso-shadings diagram

IT21SS - San Severo 96.2 - Legal Time



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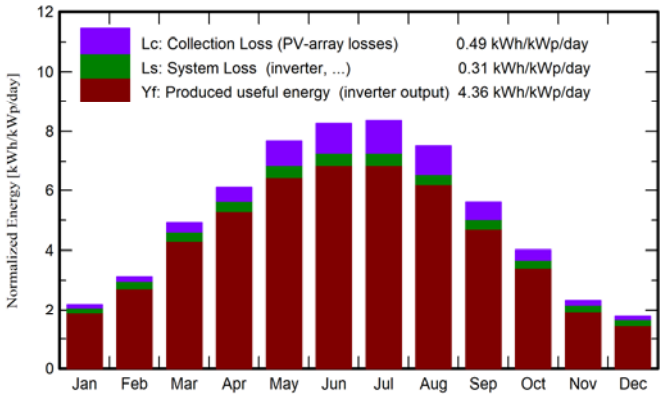
Main results

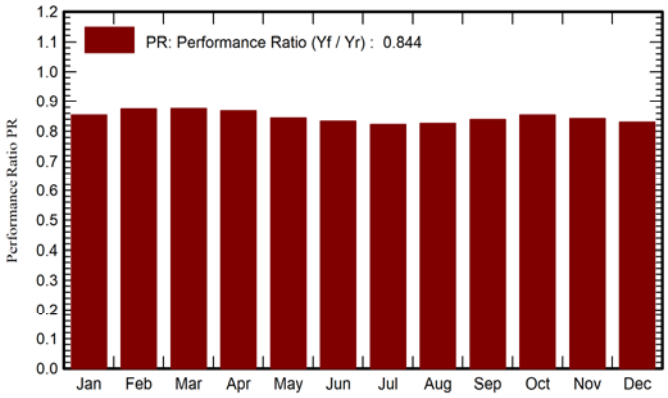
System Production

Produced Energy	146107 MWh/year	Specific production	1591 kWh/kWp/year
		Performance Ratio PR	84.41 %

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
January	54.3	26.23	7.80	67.7	63.4	5938	5309	0.854
February	71.0	37.08	8.31	87.3	81.9	7648	7013	0.875
March	123.0	55.74	11.41	152.4	144.0	13127	12254	0.875
April	150.6	74.83	14.44	183.1	172.7	15554	14605	0.869
May	190.6	76.57	19.81	238.1	225.8	19599	18467	0.844
June	199.4	84.18	24.64	247.8	234.7	20102	18975	0.834
July	206.8	80.28	27.48	259.2	246.0	20760	19595	0.823
August	184.9	74.00	27.18	233.0	221.1	18747	17667	0.826
September	134.0	54.59	21.81	168.2	158.9	13864	12972	0.840
October	99.0	47.21	17.90	124.2	117.0	10507	9737	0.854
November	57.1	32.09	12.76	69.6	65.1	6007	5389	0.843
December	44.8	26.24	8.99	54.1	50.4	4717	4123	0.830
Year	1515.5	669.05	16.93	1884.5	1781.0	156570	146107	0.844

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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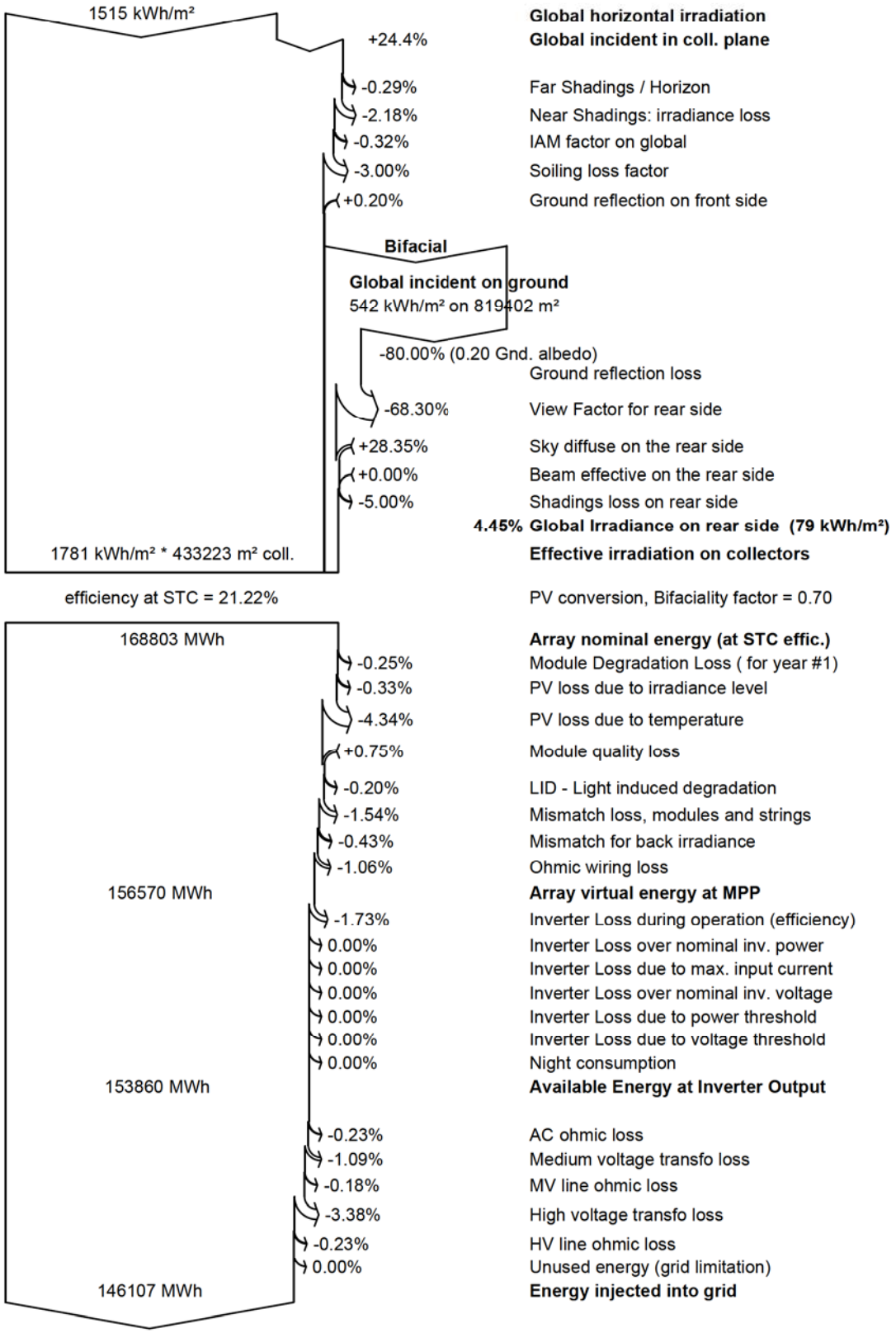
Loss diagram



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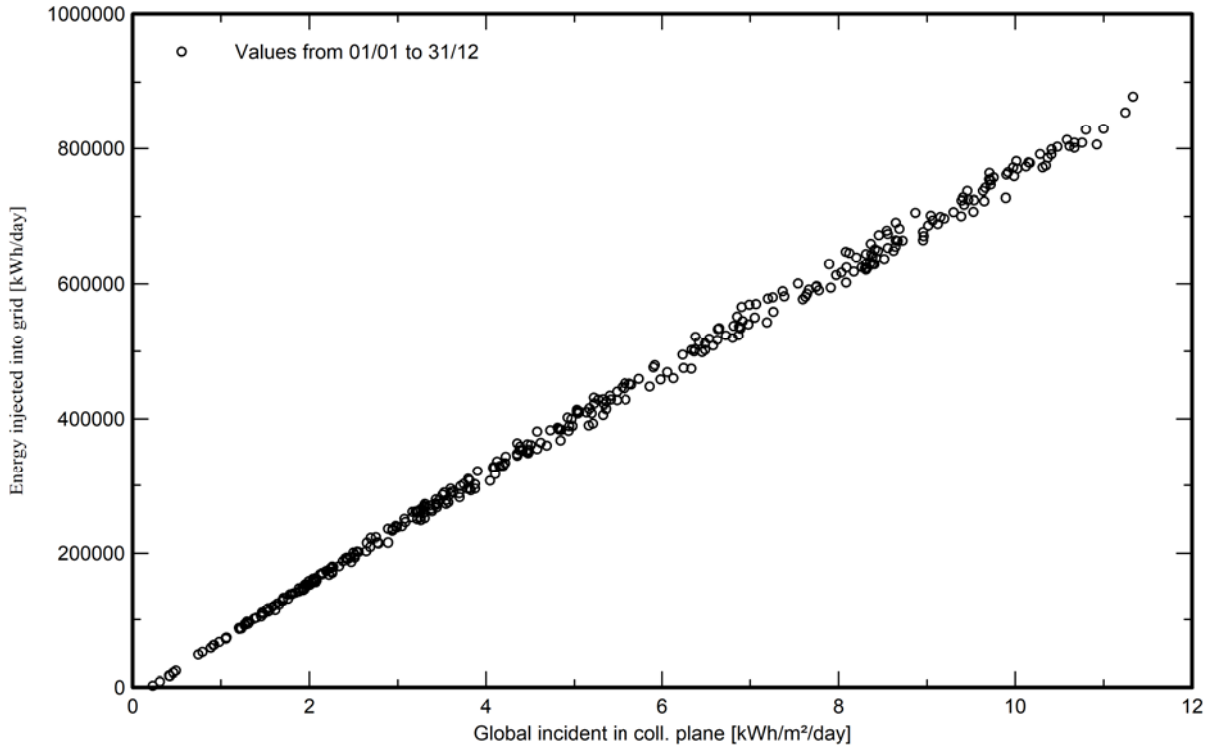
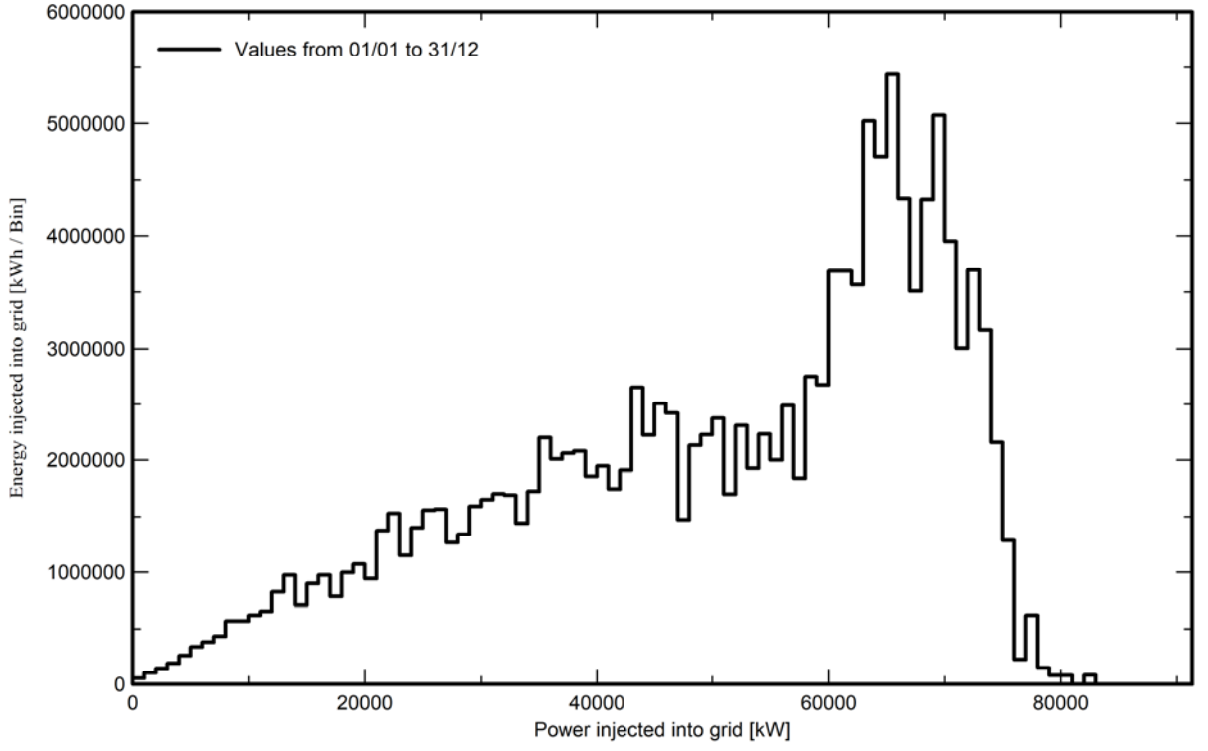
Special graphs

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

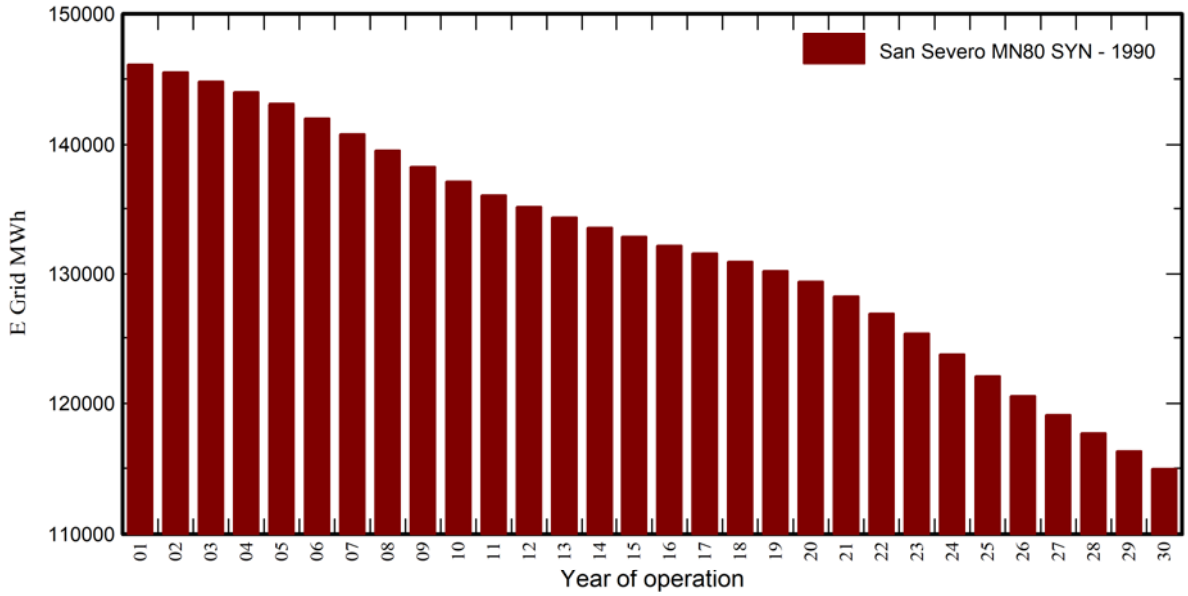
Meteo used in the simulation

#1 San Severo MN80 SYN

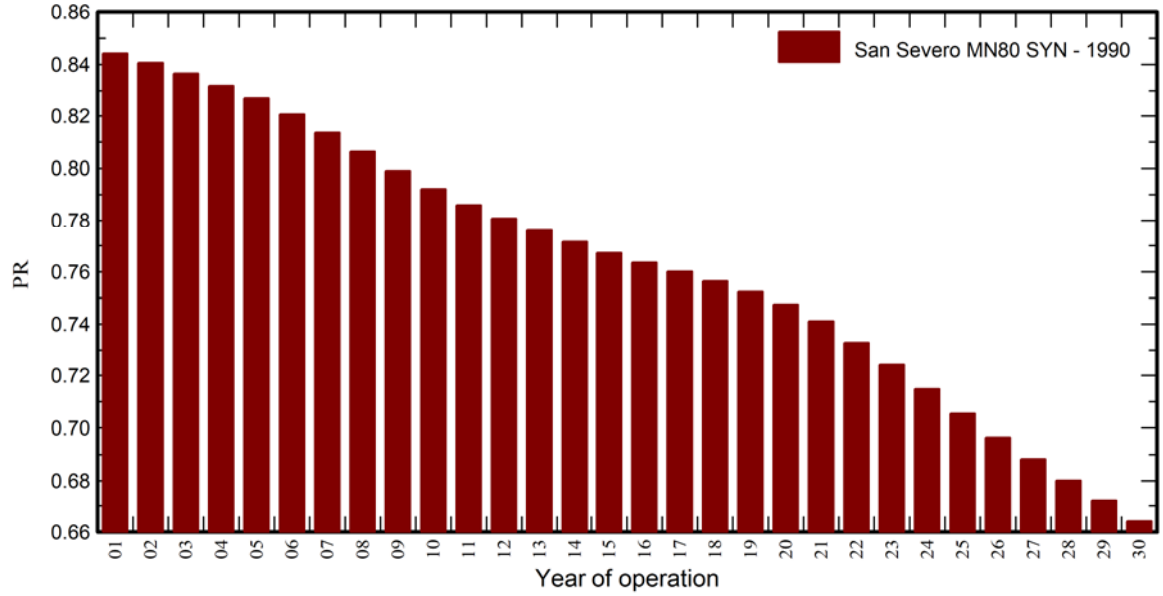
Years 1990 (reference year)

Years simulated 1-30

Energy injected into grid



Performance Ratio



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Meteo used in the simulation

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Years 1990 (reference year)

Years simulated 1-30

San Severo MN80 SYN

Year	E Grid	PR	PR loss
	MWh		%
1	146107	0.844	0%
2	145502	0.841	-0.4%
3	144793	0.837	-0.9%
4	143987	0.832	-1.5%
5	143087	0.827	-2.1%
6	142020	0.821	-2.8%
7	140806	0.814	-3.6%
8	139555	0.806	-4.5%
9	138302	0.799	-5.3%
10	137081	0.792	-6.2%
11	136022	0.786	-6.9%
12	135134	0.781	-7.5%
13	134309	0.776	-8.1%
14	133535	0.771	-8.6%
15	132799	0.767	-9.1%
16	132148	0.763	-9.6%
17	131554	0.76	-10%
18	130923	0.756	-10.4%
19	130216	0.752	-10.9%
20	129397	0.748	-11.4%
21	128273	0.741	-12.2%
22	126849	0.733	-13.2%
23	125320	0.724	-14.2%
24	123725	0.715	-15.3%
25	122101	0.705	-16.4%
26	120562	0.697	-17.5%
27	119125	0.688	-18.5%
28	117713	0.68	-19.4%
29	116326	0.672	-20.4%
30	114964	0.664	-21.3%