Comune di Orta Nova, Ordona
Provincia di Foggia, Regione Puglia

ARNG SOLAR I S.R.L.

Viale Giorgio Ribotta, 21 Eurosky Tower - Interno 0B3
ROMA (RM), 00144
PEC: arngsolar@pec.it

Impianto Agrivoltaico "ORTA NOVA 36.5"

PD01_21 – SIMULAZIONE ENERGETICA (PVSYST)

PROGETTISTI

RESPONSABILE TECNICO NRG+

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MAGGIO 2024

Version 7.2.8

PVsyst - Simulation report

Grid-Connected System

Project: IT21ON - Orta Nova

Variant: Orta Nova_Tracker_2P(30-60)_600Wp_Pitch=10.1

Tracking system with backtracking

System power: 47.88 MWp

Orta Nova - Italy

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Project summary

Geographical Site
Orta Nova
Italy

Situation

Latitude	41.27 °N
Longitude	15.64 °E
Altitude	160 m
Time zone	UTC+1

Project settings
Albedo 0.20

Meteo data
Orta Nova
Meteonorm 8.0 (1986-2005), Sat=38% - Sintético

System summary

Grid-Connected System
Simulation for year no 1

Tracking system with backtracking

Near Shadings
Linear shadings

PV Field Orientation

Orientation	
Tracking plane, tilted axis	
Avg axis tilt	-1.1 °
Avg axis azim.	0.0 °

Tracking algorithm
Astronomic calculation
Backtracking activated

System information

PV Array		Inverters	
Nb. of modules	79800 units	Nb. of units	235 units
Pnom total	47.88 MWp	Pnom total	47.94 MWac
		Grid power limit	36.50 MWac
		Grid lim. Pnom ratio	1.312

User's needs
Unlimited load (grid)

Results summary

Produced Energy	79596 MWh/year	Specific production	1662 kWh/kWp/year	Perf. Ratio PR	84.59 %

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General parameters

Grid-Connected System

Tracking system with backtracking

PV Field Orientation

Orientation

Tracking plane, tilted axis	
Avg axis tilt	-1.1 °
Avg axis azim.	0.0 °

Tracking algorithm

Astronomic calculation	
Backtracking activated	

Backtracking strategy

Nb. of trackers	759 units

Sizes

Tracker Spacing	10.1 m
Collector width	4.48 m
Ground Cov. Ratio (GCR)	44.4 %
Phi min / max.	-/+ 60.0 °

Backtracking limit angle

Phi limits	+/- 63.5 °

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	10.10 m
Tracker width	4.48 m
GCR	44.4 %
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	36.50 MWac
Pnom ratio	1.312

PV Array Characteristics

PV module

Manufacturer	Trina Solar
Model	TSM-600DEG20C.20
(Custom parameters definition)	
Unit Nom. Power	600 Wp
Number of PV modules	79800 units
Nominal (STC)	47.88 MWp
Modules	2660 Strings x 30 In series
At operating cond. (50°C)	
Pmpp	43.83 MWp
U mpp	938 V
I mpp	46739 A

Inverter

Manufacturer	Huawei Technologies
Model	SUN2000-215KTL-H0
(Custom parameters definition)	
Unit Nom. Power	204 kWac
Number of inverters	235 units
Total power	47940 kWac
Operating voltage	500-1500 V
Max. power (=>33°C)	215 kWac
Pnom ratio (DC:AC)	1.00

Total PV power

Nominal (STC)	47880 kWp
Total	79800 modules
Module area	225843 m²
Cell area	211151 m²

Total inverter power

Total power	47940 kWac
Nb. of inverters	235 units
Pnom ratio	1.00

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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. 0.33 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 0.7 %

Module Quality Loss
Loss Fraction -0.8 %

Module mismatch losses
Loss Fraction 2.0 % 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

System losses

Unavailability of the system
Time fraction 1.0 %
3.7 days,
3 periods

AC wiring losses

Inv. output line up to MV transfo
Inverter voltage 800 Vac tri
Loss Fraction 1.31 % at STC
Inverter: SUN2000-215KTL-H0
Wire section (235 Inv.) Alu 235 x 3 x 150 mm²
Average wires length 200 m

MV line up to Injection
MV Voltage 36 kV
Wires Alu 3 x 1000 mm²
Length 6000 m
Loss Fraction 0.69 % at STC

AC losses in transformers

MV transfo
Grid voltage 36 kV
Operating losses at STC
Nominal power at STC 47026 kVA
Iron loss (24/24 Connexion) 47.03 kW
Loss Fraction 0.10 % at STC
Coils equivalent resistance 3 x 0.14 mΩ
Loss Fraction 1.00 % at STC

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Horizon definition

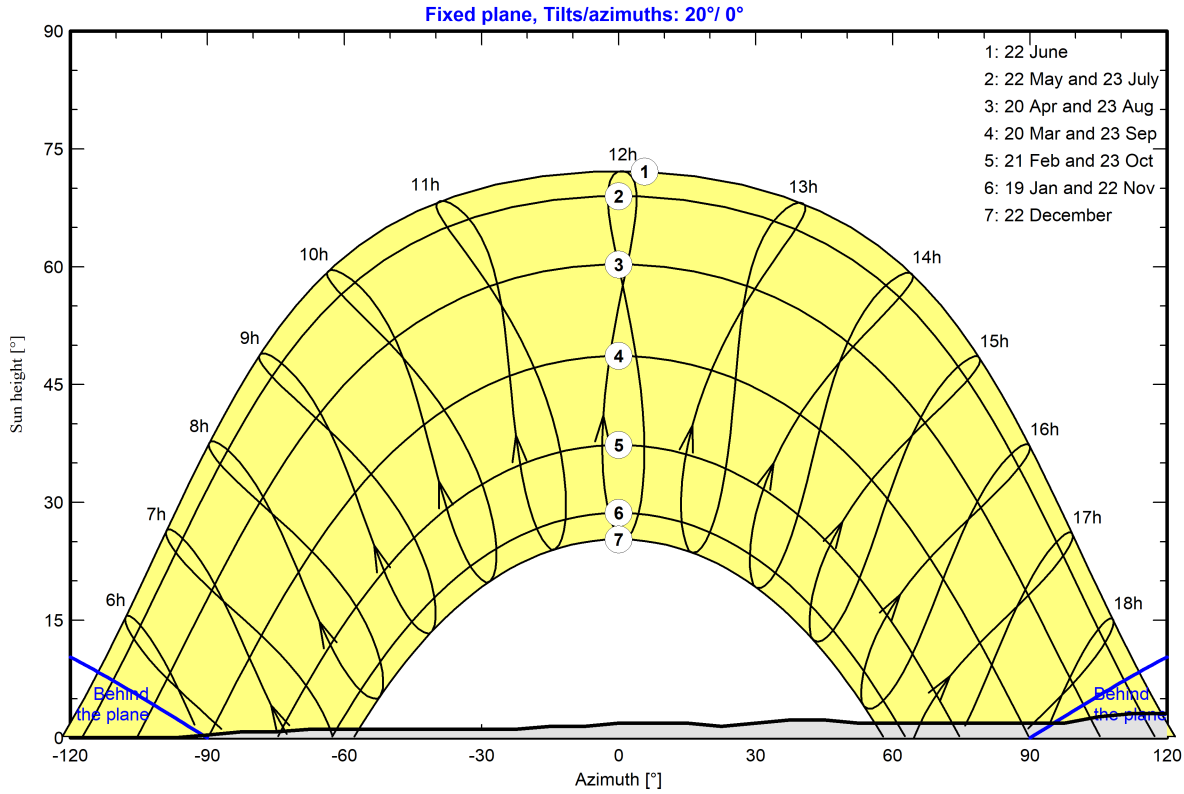
Horizon from PVGIS website API, Lat=41°16"12', Long=15°38"24', Alt=73m

Average Height	1.6 °	Albedo Factor	0.88
Diffuse Factor	0.96	Albedo Fraction	100 %

Horizon profile

Azimuth [°]	-180	-173	-165	-158	-135	-128	-98	-90	-83	-75
Height [°]	1.9	1.9	1.1	0.8	0.8	0.0	0.0	0.4	0.8	0.8
Azimuth [°]	-68	-23	-15	-8	0	15	23	30	38	45
Height [°]	1.1	1.1	1.5	1.5	1.9	1.9	1.5	1.9	2.3	2.3
Azimuth [°]	53	98	105	113	143	150	165	173	180	
Height [°]	1.9	1.9	2.7	3.1	3.1	2.3	2.3	1.9	1.9	

Sun Paths (Height / Azimuth diagram)



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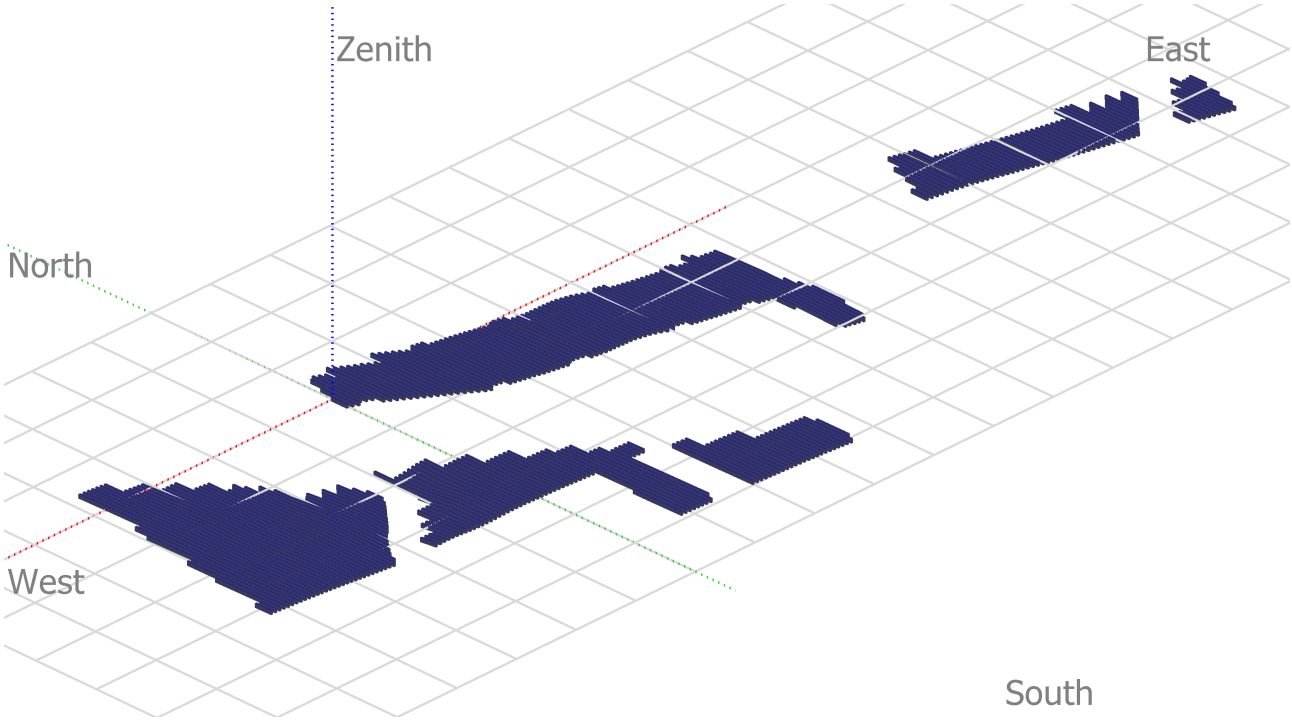
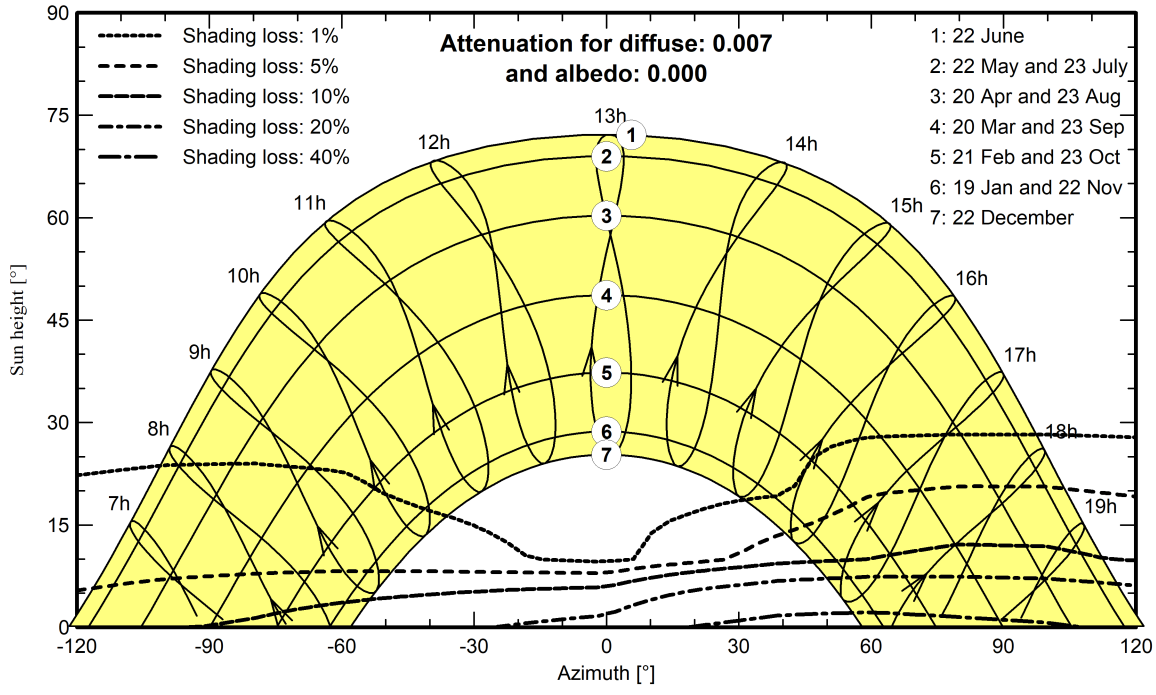
Near shadings parameter

Perspective of the PV-field and surrounding shading scene



Iso-shadings diagram

IT21ON - Orta Nova - Legal Time



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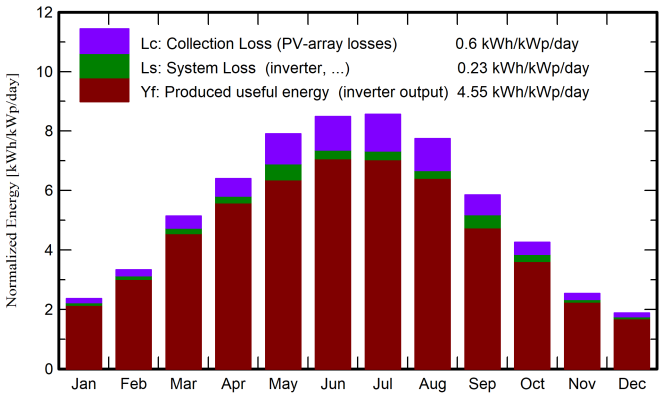
Main results

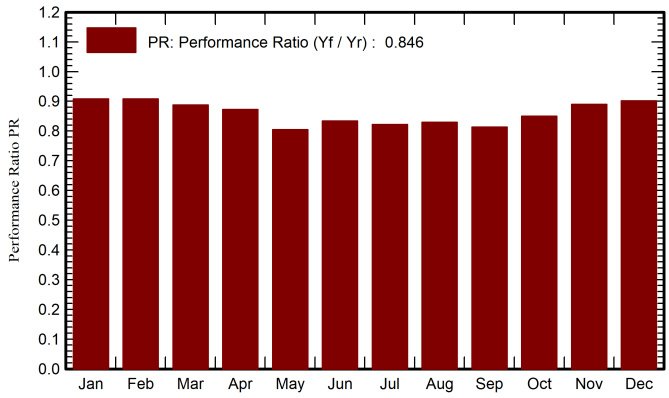
System Production

Produced Energy	79596 MWh/year	Specific production	1662 kWh/kWp/year
		Performance Ratio PR	84.59 %

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	56.8	26.31	7.53	73.3	68.3	3314	3190	0.909
February	73.8	35.78	8.06	93.2	87.1	4204	4053	0.908
March	124.2	52.47	11.29	159.3	149.8	7033	6768	0.887
April	153.0	66.10	14.41	192.1	181.5	8352	8029	0.873
May	191.9	77.54	19.83	245.3	231.7	10257	9451	0.805
June	201.3	86.23	24.55	254.8	241.2	10580	10171	0.834
July	208.2	80.01	27.56	265.6	251.6	10882	10456	0.822
August	186.7	73.01	27.14	240.1	227.0	9921	9532	0.829
September	136.7	56.77	21.85	175.5	165.3	7456	6833	0.813
October	103.2	43.99	17.91	131.9	123.8	5731	5370	0.850
November	59.4	30.39	12.69	75.9	70.6	3360	3233	0.889
December	47.1	25.95	8.79	58.2	53.7	2610	2509	0.901
Year	1542.2	654.54	16.86	1965.3	1851.8	83698	79596	0.846

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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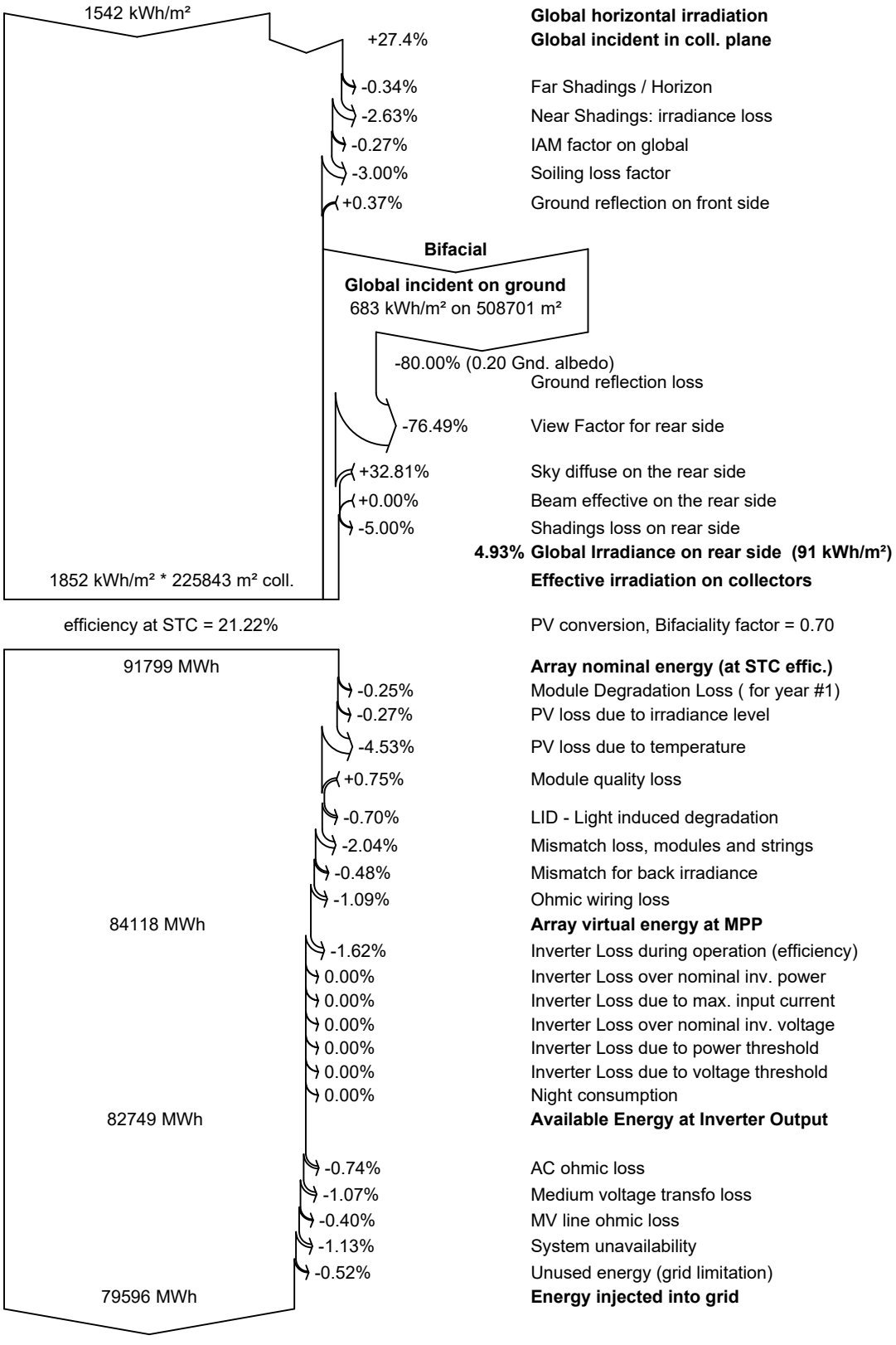
Loss diagram



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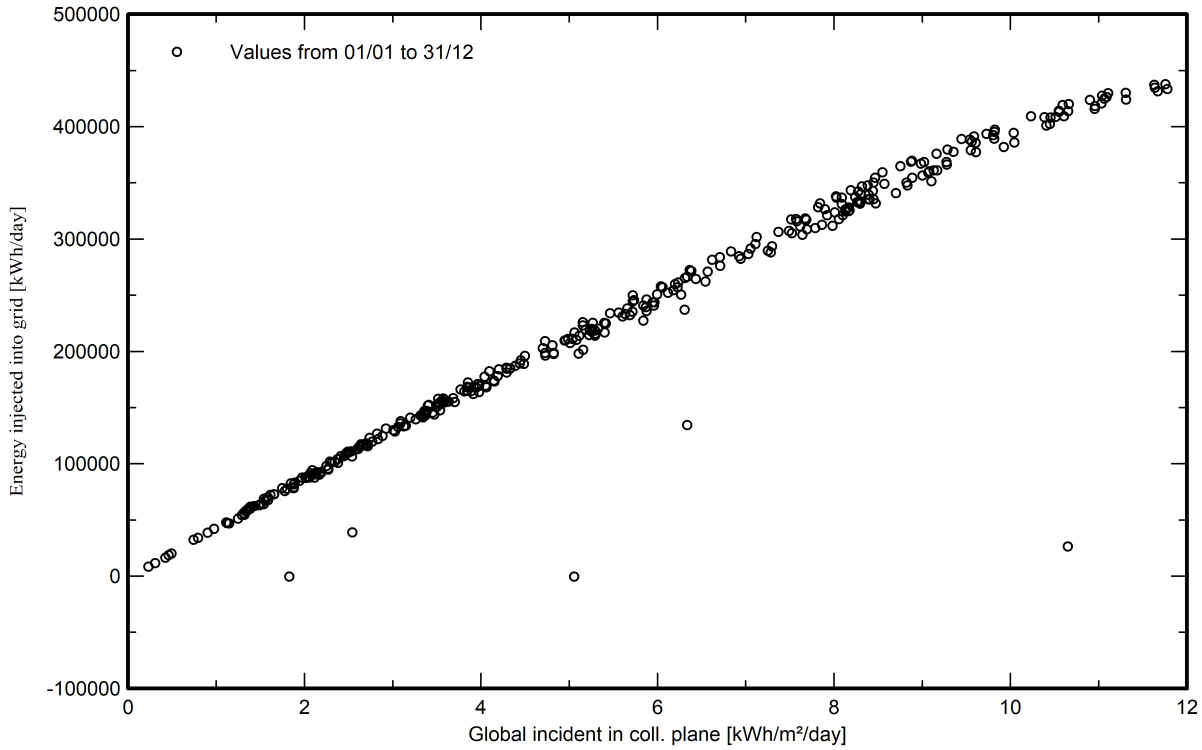
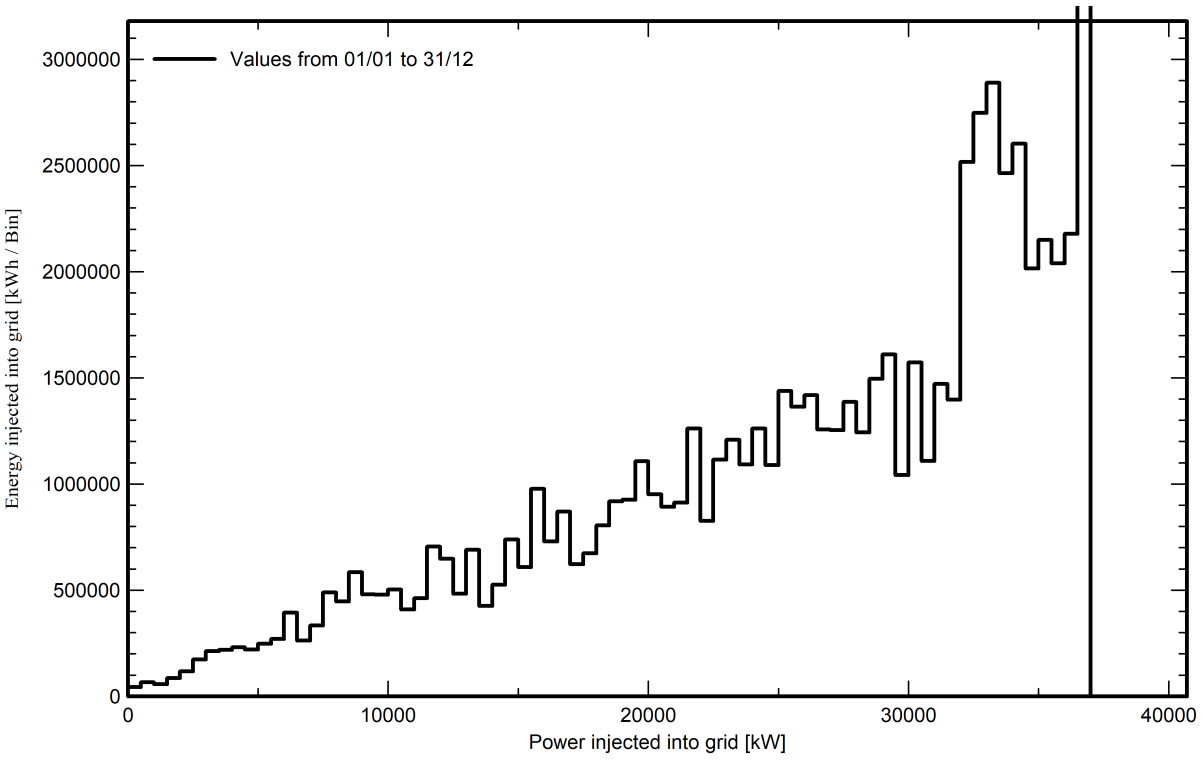
Special graphs

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

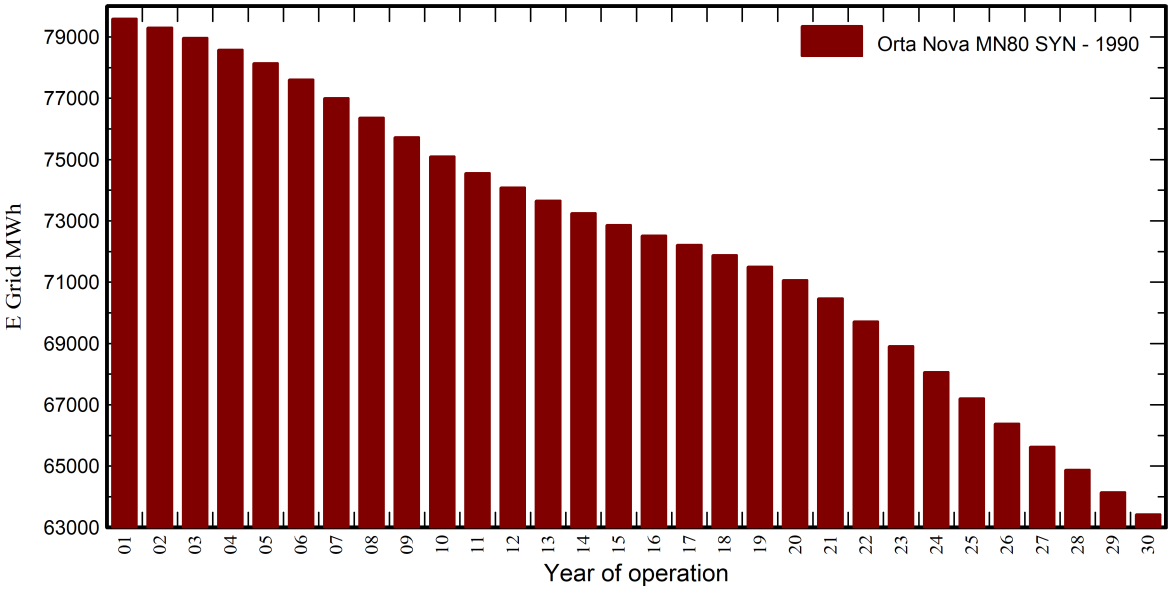
Imp RMS dispersion 0.4 %/year
Vmp RMS dispersion 0.4 %/year

Meteo used in the simulation

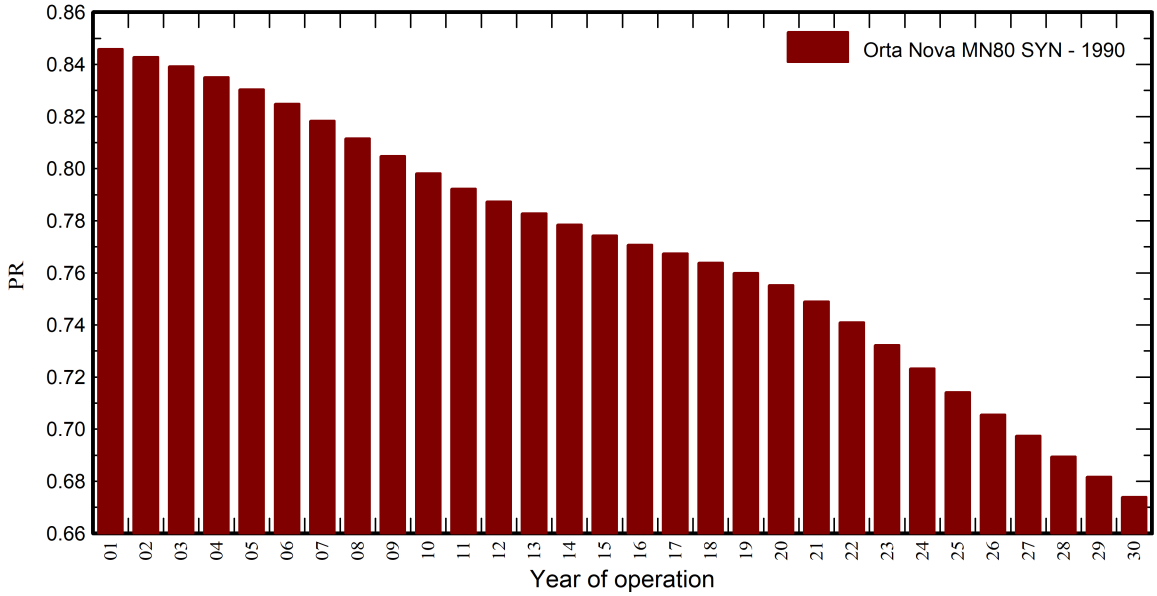
#1 Orta Nova MN80 SYN

Years 1990 (reference year)
Years simulated 1-30

Energy injected into grid



Performance Ratio



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Years simulated 1-30

Orta Nova MN80 SYN

Year	E Grid	PR	PR loss
	MWh		%
1	79596	0.846	0%
2	79307	0.843	-0.4%
3	78969	0.839	-0.8%
4	78580	0.835	-1.3%
5	78140	0.83	-1.8%
6	77612	0.825	-2.5%
7	77004	0.818	-3.3%
8	76371	0.812	-4.1%
9	75730	0.805	-4.9%
10	75101	0.798	-5.6%
11	74553	0.792	-6.3%
12	74090	0.787	-6.9%
13	73659	0.783	-7.5%
14	73253	0.778	-8%
15	72867	0.774	-8.5%
16	72524	0.771	-8.9%
17	72211	0.767	-9.3%
18	71878	0.764	-9.7%
19	71504	0.76	-10.2%
20	71071	0.755	-10.7%
21	70476	0.749	-11.5%
22	69721	0.741	-12.4%
23	68910	0.732	-13.4%
24	68065	0.723	-14.5%
25	67205	0.714	-15.6%
26	66389	0.706	-16.6%
27	65628	0.697	-17.5%
28	64880	0.69	-18.5%
29	64146	0.682	-19.4%
30	63425	0.674	-20.3%