

# 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



# Project: IT21ON - Orta Nova

Variant: Orta Nova\_Tracker\_2P(30-60)\_600Wp\_Pitch=10.1

## PVsyst V7.2.8

VCO, Simulation date:  
22/09/22 14:40  
with v7.2.8

### Project summary

<b>Geographical Site</b> Orta Nova Italy	<b>Situation</b> Latitude 41.27 °N Longitude 15.64 °E Altitude 160 m Time zone UTC+1	<b>Project settings</b> Albedo 0.20
<b>Meteo data</b> Orta Nova Meteonorm 8.0 (1986-2005), Sat=38% - Sintético		

### System summary

<b>Grid-Connected System</b> Simulation for year no 1	<b>Tracking system with backtracking</b>	
<b>PV Field Orientation</b> Orientation Tracking plane, tilted axis Avg axis tilt -1.1 ° Avg axis azim. 0.0 °	<b>Tracking algorithm</b> Astronomic calculation Backtracking activated	<b>Near Shadings</b> Linear shadings
<b>System information</b> <b>PV Array</b> Nb. of modules 79800 units Pnom total 47.88 MWp	<b>Inverters</b> Nb. of units 235 units Pnom total 47.94 MWac Grid power limit 36.50 MWac Grid lim. Pnom ratio 1.312	
<b>User's needs</b> Unlimited load (grid)		

### Results summary

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

### Table of contents

Project and results summary	2
General parameters, PV Array Characteristics, System losses	3
Horizon definition	5
Near shading definition - Iso-shadings diagram	6
Main results	7
Loss diagram	8
Special graphs	9
Aging Tool	10

**PVsyst V7.2.8**

VCO, Simulation date:  
22/09/22 14:40  
with v7.2.8

**General parameters**

<b>Grid-Connected System</b>		<b>Tracking system with backtracking</b>	
<b>PV Field Orientation</b>		<b>Tracking algorithm</b>	
Orientation		Astronomic calculation	
Tracking plane, tilted axis		Backtracking activated	
Avg axis tilt	-1.1 °		
Avg axis azim.	0.0 °		
<b>Models used</b>		<b>Backtracking strategy</b>	
Transposition	Perez	Nb. of trackers	759 units
Diffuse	Perez, Meteonorm	<b>Sizes</b>	
Circumsolar	separate	Tracker Spacing	10.1 m
		Collector width	4.48 m
		Ground Cov. Ratio (GCR)	44.4 %
		Phi min / max.	-/+ 60.0 °
		<b>Backtracking limit angle</b>	
		Phi limits	+/- 63.5 °
<b>Horizon</b>		<b>Near Shadings</b>	
Average Height	1.6 °	Linear shadings	
<b>Bifacial system</b>		<b>User's needs</b>	
Model	2D Calculation unlimited trackers	Unlimited load (grid)	
<b>Bifacial model geometry</b>		<b>Bifacial model definitions</b>	
Tracker Spacing	10.10 m	Ground albedo	0.20
Tracker width	4.48 m	Bifaciality factor	70 %
GCR	44.4 %	Rear shading factor	5.0 %
Axis height above ground	2.10 m	Rear mismatch loss	10.0 %
		Shed transparent fraction	0.0 %
<b>Grid power limitation</b>			
Active Power	36.50 MWac		
Pnom ratio	1.312		

**PV Array Characteristics**

<b>PV module</b>		<b>Inverter</b>	
Manufacturer	Trina Solar	Manufacturer	Huawei Technologies
Model	TSM-600DEG20C.20	Model	SUN2000-215KTL-H0
(Custom parameters definition)		(Custom parameters definition)	
Unit Nom. Power	600 Wp	Unit Nom. Power	204 kWac
Number of PV modules	79800 units	Number of inverters	235 units
Nominal (STC)	47.88 MWp	Total power	47940 kWac
Modules	2660 Strings x 30 In series	Operating voltage	500-1500 V
<b>At operating cond. (50°C)</b>		Max. power (=>33°C)	215 kWac
Pmpp	43.83 MWp	Pnom ratio (DC:AC)	1.00
U mpp	938 V		
I mpp	46739 A		
<b>Total PV power</b>		<b>Total inverter power</b>	
Nominal (STC)	47880 kWp	Total power	47940 kWac
Total	79800 modules	Nb. of inverters	235 units
Module area	225843 m <sup>2</sup>	Pnom ratio	1.00
Cell area	211151 m <sup>2</sup>		



**PVsyst V7.2.8**

VCO, Simulation date:  
22/09/22 14:40  
with v7.2.8

**Array losses**

<b>Array Soiling Losses</b>		<b>Thermal Loss factor</b>		<b>DC wiring losses</b>				
Loss Fraction	3.0 %	Module temperature according to irradiance		Global array res.	0.33 mΩ			
		Uc (const)	29.0 W/m²K	Loss Fraction	1.5 % at STC			
		Uv (wind)	0.0 W/m²K/m/s					
<b>Serie Diode Loss</b>		<b>LID - Light Induced Degradation</b>		<b>Module Quality Loss</b>				
Voltage drop	0.7 V	Loss Fraction	0.7 %	Loss Fraction	-0.8 %			
Loss Fraction	0.1 % at STC							
<b>Module mismatch losses</b>		<b>Strings Mismatch loss</b>		<b>Module average degradation</b>				
Loss Fraction	2.0 % at MPP	Loss Fraction	0.1 %	Year no	1			
				Loss factor	0.45 %/year			
				<b>Mismatch due to degradation</b>				
				Imp RMS dispersion	0.4 %/year			
				Vmp RMS dispersion	0.4 %/year			
<b>IAM loss factor</b>								
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**

<b>Unavailability of the system</b>	
Time fraction	1.0 %
	3.7 days,
	3 periods

**AC wiring losses**

<b>Inv. output line up to MV transfo</b>	
Inverter voltage	800 Vac tri
Loss Fraction	1.31 % at STC
<b>Inverter: SUN2000-215KTL-H0</b>	
Wire section (235 Inv.)	Alu 235 x 3 x 150 mm²
Average wires length	200 m
<b>MV line up to Injection</b>	
MV Voltage	36 kV
Wires	Alu 3 x 1000 mm²
Length	6000 m
Loss Fraction	0.69 % at STC

**AC losses in transformers**

<b>MV transfo</b>	
Grid voltage	36 kV
<b>Operating losses at STC</b>	
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



PVsyst V7.2.8

VCO, Simulation date:  
22/09/22 14:40  
with v7.2.8

Horizon definition

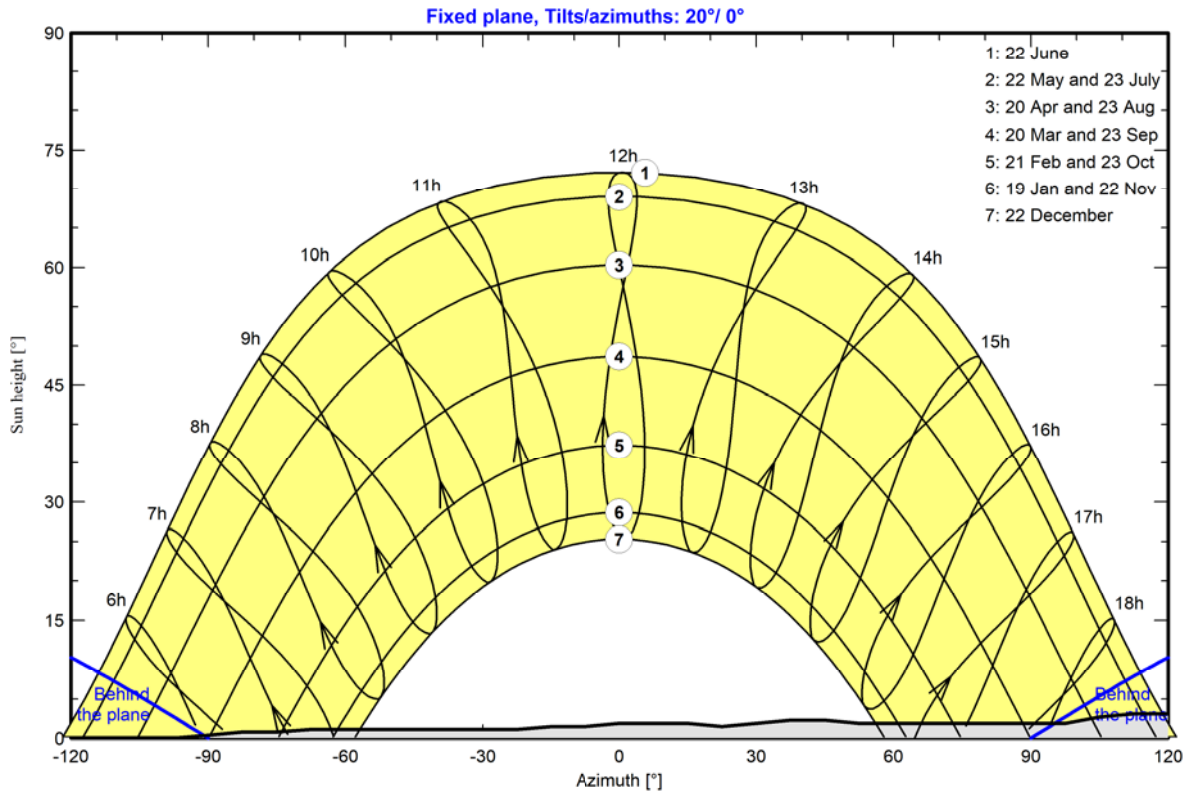
Horizon from PVGIS website API, Lat=41°16'12', Long=15°38'24', Alt=73m

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)

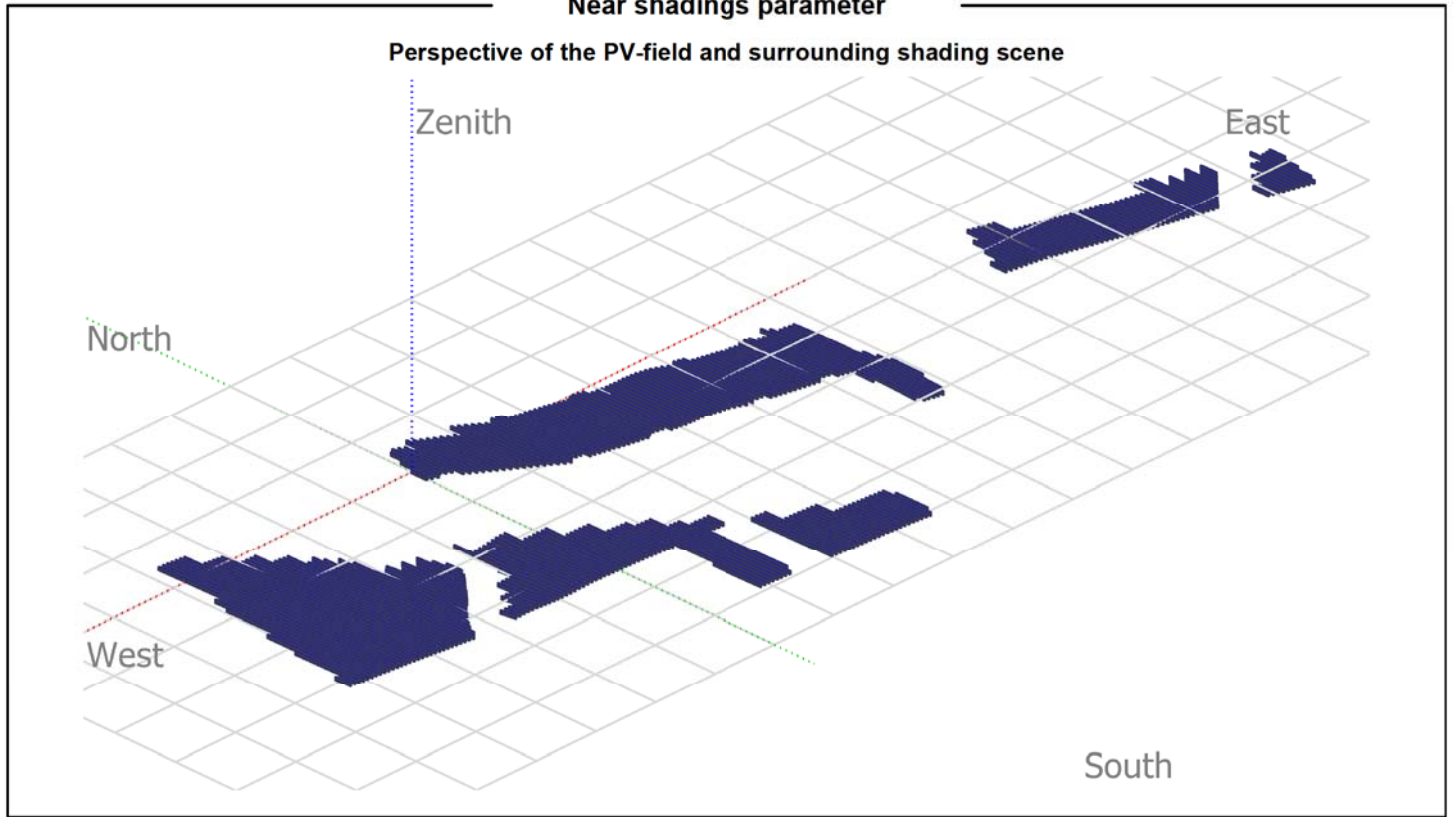




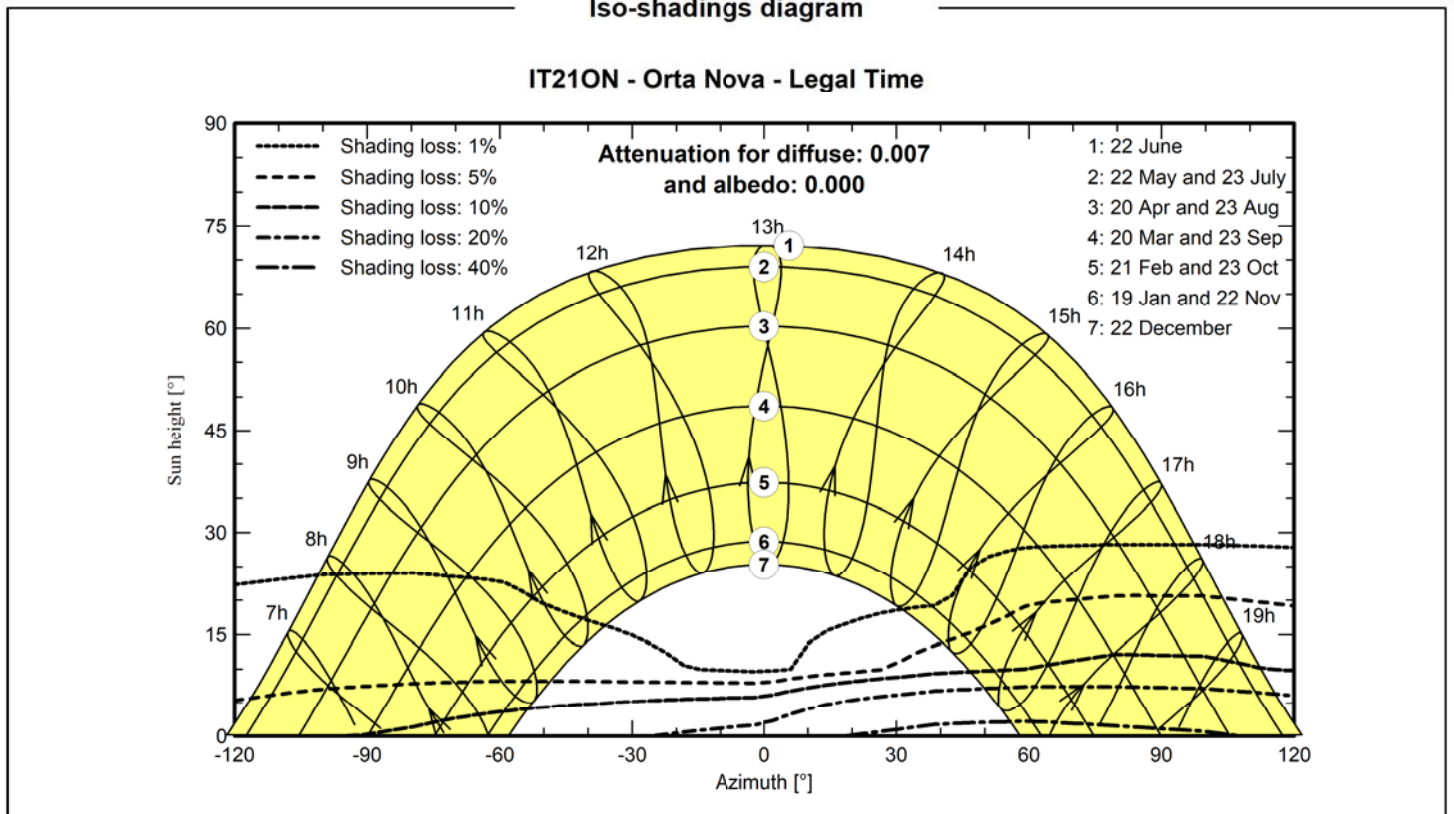
PVsyst V7.2.8

VCO, Simulation date:  
22/09/22 14:40  
with v7.2.8

Near shadings parameter



Iso-shadings diagram





**PVsyst V7.2.8**

VCO, Simulation date:  
22/09/22 14:40  
with v7.2.8

**Main results**

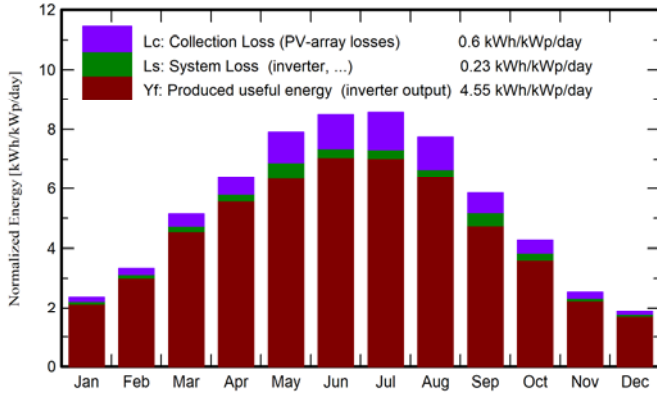
**System Production**

Produced Energy 79596 MWh/year

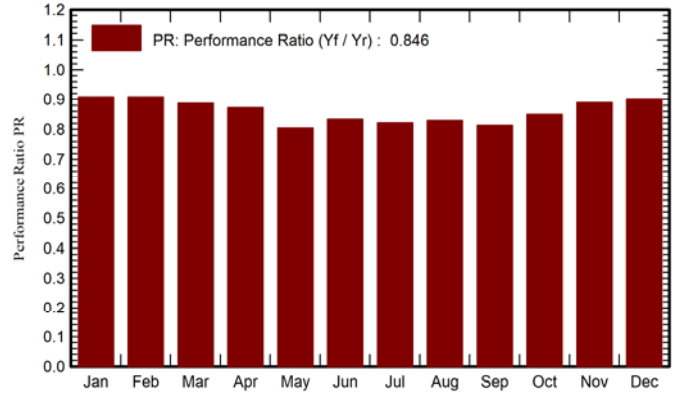
Specific production  
Performance Ratio PR

1662 kWh/kWp/year  
84.59 %

**Normalized productions (per installed kWp)**



**Performance Ratio PR**



**Balances and main results**

	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_Grid	PR
	kWh/m <sup>2</sup>	kWh/m <sup>2</sup>	°C	kWh/m <sup>2</sup>	kWh/m <sup>2</sup>	MWh	MWh	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**

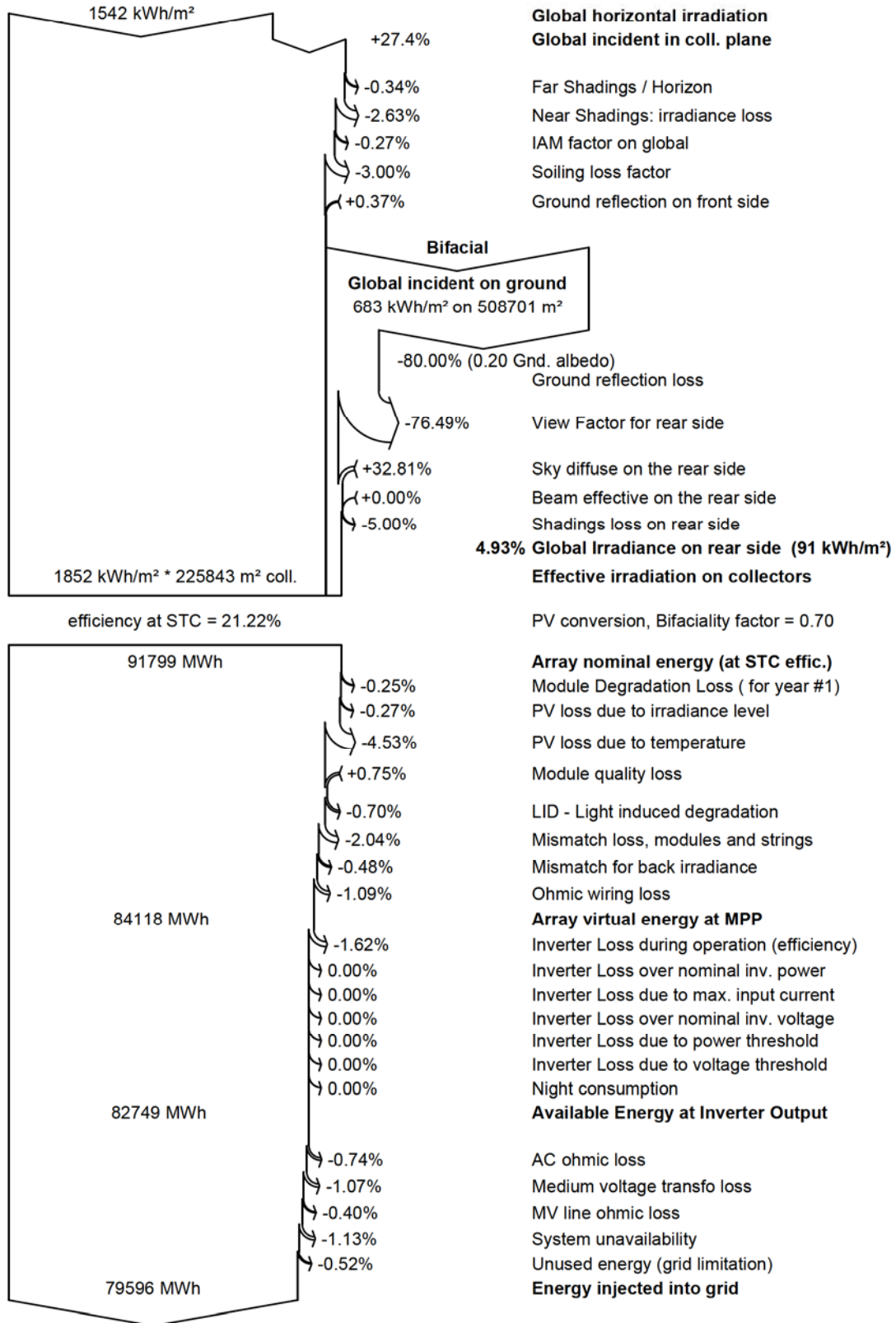
- GlobHor Global horizontal irradiation
- DiffHor Horizontal diffuse irradiation
- T\_Amb Ambient Temperature
- GlobInc Global incident in coll. plane
- GlobEff Effective Global, corr. for IAM and shadings
- EArray Effective energy at the output of the array
- E\_Grid Energy injected into grid
- PR Performance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



PVsyst V7.2.8

VCO, Simulation date:  
22/09/22 14:40  
with v7.2.8

Loss diagram





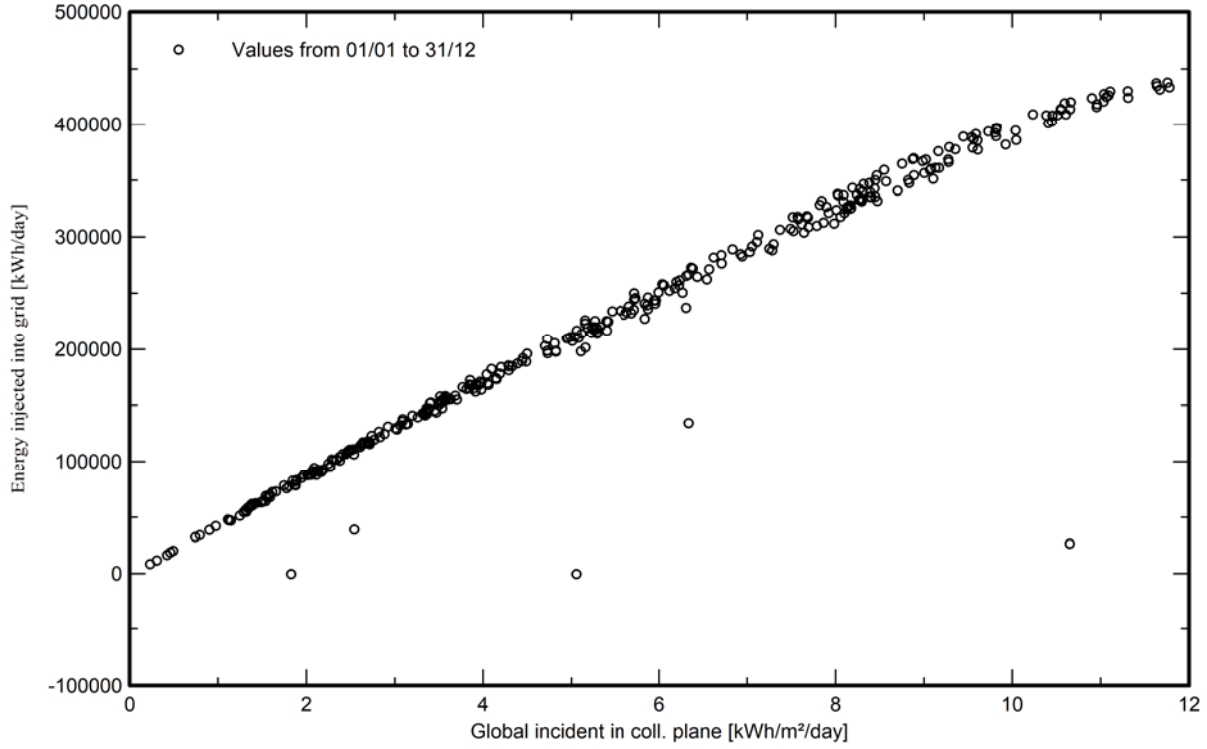


PVsyst V7.2.8

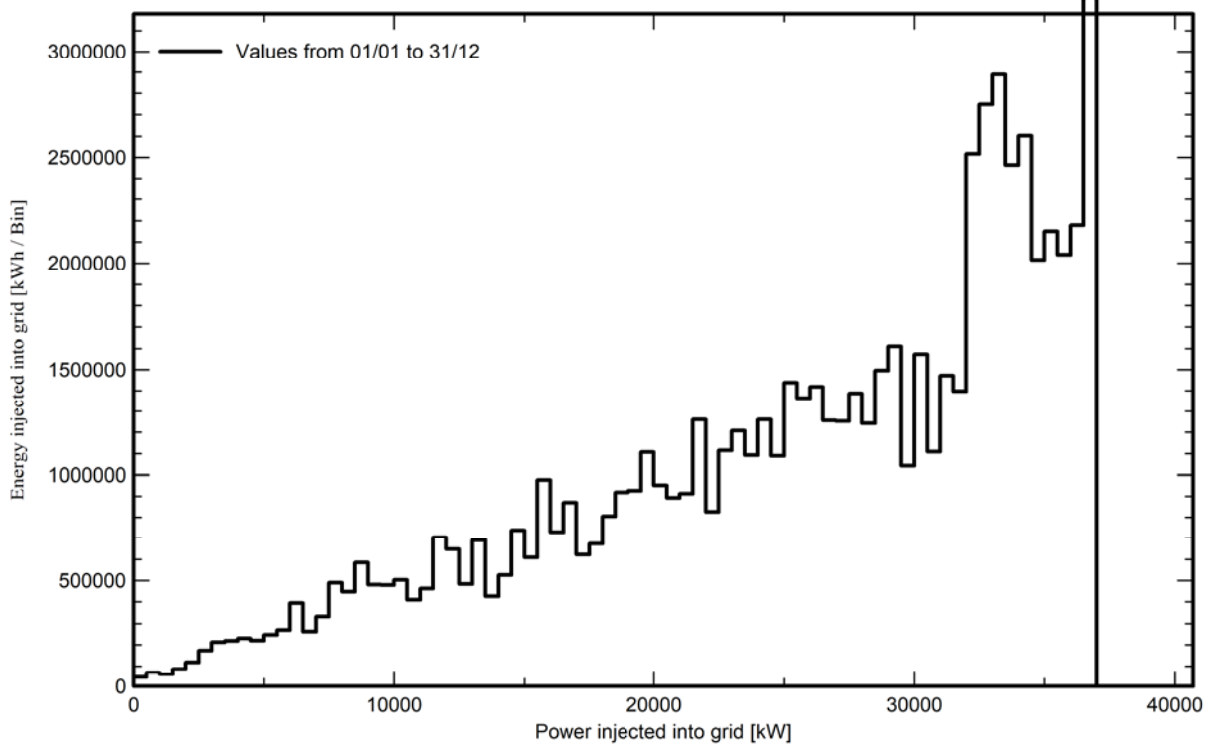
VCO, Simulation date:  
22/09/22 14:40  
with v7.2.8

Special graphs

Diagrama entrada/salida diaria



Distribución de potencia de salida del sistema





PVsyst V7.2.8

VCO, Simulation date:  
22/09/22 14:40  
with v7.2.8

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

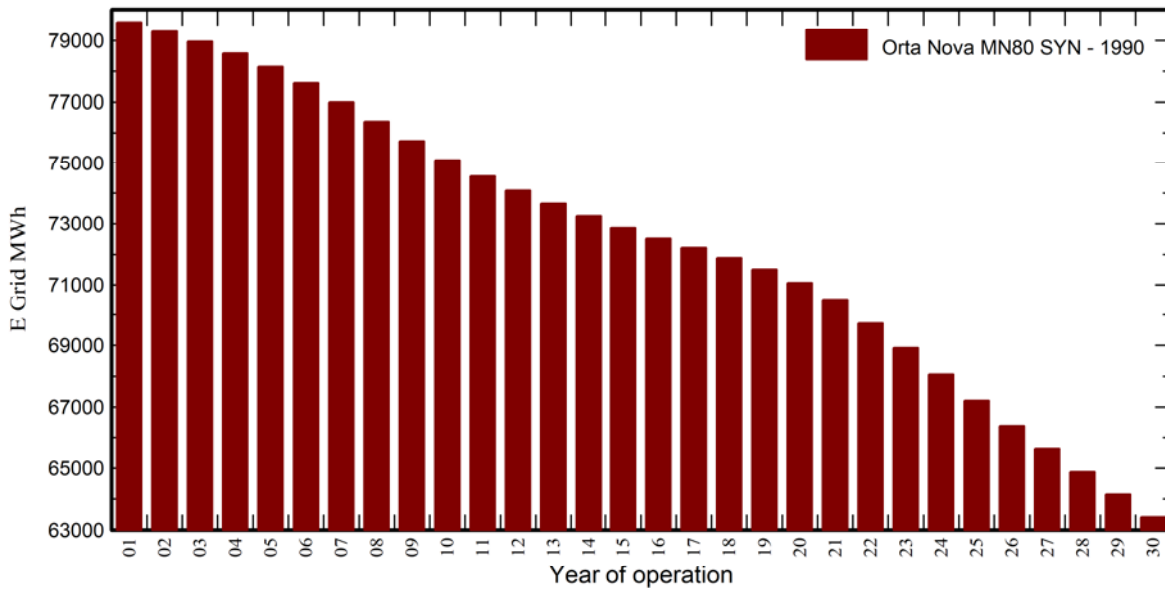
Meteo used in the simulation

#1 Orta Nova MN80 SYN

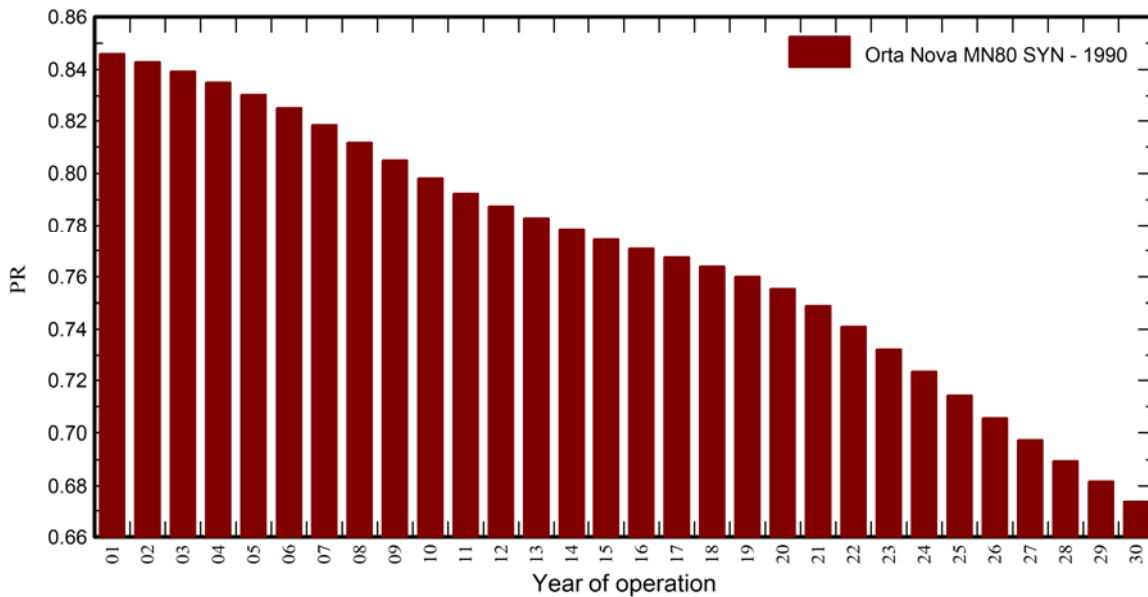
Years 1990 (reference year)

Years simulated 1-30

Energy injected into grid



Performance Ratio





**PVsyst V7.2.8**

VCO, Simulation date:  
22/09/22 14:40  
with v7.2.8

**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

**Orta Nova MN80 SYN**

Year	E Grid MWh	PR	PR loss %
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%