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~~FEBBRAIO 2022~~MAGGIO 2023

Version 7.3.1

PVsyst - Simulation report

Grid-Connected System

Project: IT21R2 - Rotello 52

Variant: Rotello52_Fixed.2P(15-30-60)_660Wp_Pitch=7.5

Ground system (tables) on a hill

System power: 52.43 MWp

Author

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Project summary

Geographical Site
Rotello Prodiel
Italy

Situation

Latitude	41.77 °N
Longitude	15.06 °E
Altitude	171 m
Time zone	UTC+1

Project settings

Albedo	0.20

Meteo data
Rotello 55
Meteonorm 8.0 (1991-2012), Sat=90% - Sintético

System summary

Grid-Connected System
Simulation for year no 1

Ground system (tables) on a hill

PV Field Orientation
Fixed plane
Tilt/Azimuth 25.5 / -8 °

Near Shadings
Linear shadings

User's needs
Unlimited load (grid)

System information

PV Array

Nb. of modules	79440 units
Pnom total	52.43 MWp

Inverters

Nb. of units	260 units
Pnom total	52.00 MWac
Grid power limit	42.92 MWac
Grid lim. Pnom ratio	1.222

Results summary

Produced Energy	70334 MWh/year	Specific production	1341 kWh/kWp/year	Perf. Ratio PR	80.45 %

Table of contents

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General parameters

Grid-Connected System

Ground system (tables) on a hill

PV Field Orientation

Orientation	
Fixed plane	
Tilt/Azimuth	25.5 / -8 °

Sheds configuration	
Nb. of sheds	851 units
Identical arrays	
Sizes	
Sheds spacing	7.50 m
Collector width	4.79 m
Ground Cov. Ratio (GCR)	63.8 %
Shading limit angle	
Limit profile angle	32.9 °

Models used	
Transposition	Perez
Diffuse	Perez, Meteonorm
Circumsolar	separate

Horizon
Average Height 1.0 °

Near Shadings
Linear shadings

User's needs
Unlimited load (grid)

Grid power limitation

Active Power	42.92 MWac
Pnom ratio	1.222

PV Array Characteristics

PV module

Manufacturer	Trina Solar
Model	TSM-660DEG21C.20
(Custom parameters definition)	
Unit Nom. Power	660 Wp
Number of PV modules	79440 units
Nominal (STC)	52.43 MWp

Inverter

Manufacturer	Huawei Technologies
Model	SUN2000-215KTL-H3
(Custom parameters definition)	
Unit Nom. Power	200 kWac
Number of inverters	260 units
Total power	52000 kWac

Array #1 - Area Nord

Number of PV modules	9840 units	Number of inverters	28 units
Nominal (STC)	6494 kWp	Total power	5600 kWac
Modules	328 Strings x 30 In series		
At operating cond. (50°C)		Operating voltage	500-1500 V
Pmpp	5958 kWp	Max. power (=>33°C)	215 kWac
U mpp	1031 V	Pnom ratio (DC:AC)	1.16
I mpp	5781 A	Power sharing within this inverter	

Array #2 - Area sud

Number of PV modules	69600 units	Number of inverters	232 units
Nominal (STC)	45.94 MWp	Total power	46400 kWac
Modules	2320 Strings x 30 In series		
At operating cond. (50°C)		Operating voltage	500-1500 V
Pmpp	42.14 MWp	Max. power (=>33°C)	215 kWac
U mpp	1031 V	Pnom ratio (DC:AC)	0.99
I mpp	40890 A	Power sharing within this inverter	

Total PV power

Nominal (STC)	52430 kWp
Total	79440 modules
Module area	246769 m²
Cell area	231218 m²

Total inverter power

Total power	52000 kWac
Number of inverters	260 units
Pnom ratio	1.01

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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

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

LID - Light Induced Degradation
Loss Fraction 1.5 %

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

DC wiring losses

Global wiring resistance 0.36 mΩ
Loss Fraction 1.5 % at STC

Array #1 - Area Nord
Global array res. 2.9 mΩ
Loss Fraction 1.5 % at STC

Array #2 - Area sud
Global array res. 0.41 mΩ
Loss Fraction 1.5 % at STC

AC wiring losses

Inv. output line up to MV transfo
Inverter voltage 800 Vac tri
Loss Fraction 1.30 % at STC
Inverter: SUN2000-215KTL-H3
Wire section (260 Inv.) Alu 260 x 3 x 150 mm²
Average wires length 200 m

MV line up to Injection
MV Voltage 30 kV
Average loss Fraction 0.60 % at STC

Array #1 - Area Nord
Wires Alu 3 x 500 mm²
Length 3850 m

Array #2 - Area sud
Wires Alu 3 x 500 mm²
Length 2850 m

AC losses in transformers

MV transfo		
Grid voltage	30	kV
One transfo in each sub-array		
Array #1 - Area Nord		
Transformer parameters		
Nominal power at STC	6.38	MVA
Iron Loss (24/24 Connexion)	5.60	kVA
Iron loss fraction	0.09	% at STC
Copper loss	72.59	kVA
Copper loss fraction	1.14	% at STC
Coils equivalent resistance	3 x 1.14	mΩ
Array #2 - Area sud		
Transformer parameters		
Nominal power at STC	45.13	MVA
Iron Loss (24/24 Connexion)	46.40	kVA
Iron loss fraction	0.10	% at STC
Copper loss	439.02	kVA
Copper loss fraction	0.97	% at STC
Coils equivalent resistance	3 x 0.14	mΩ

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Horizon definition

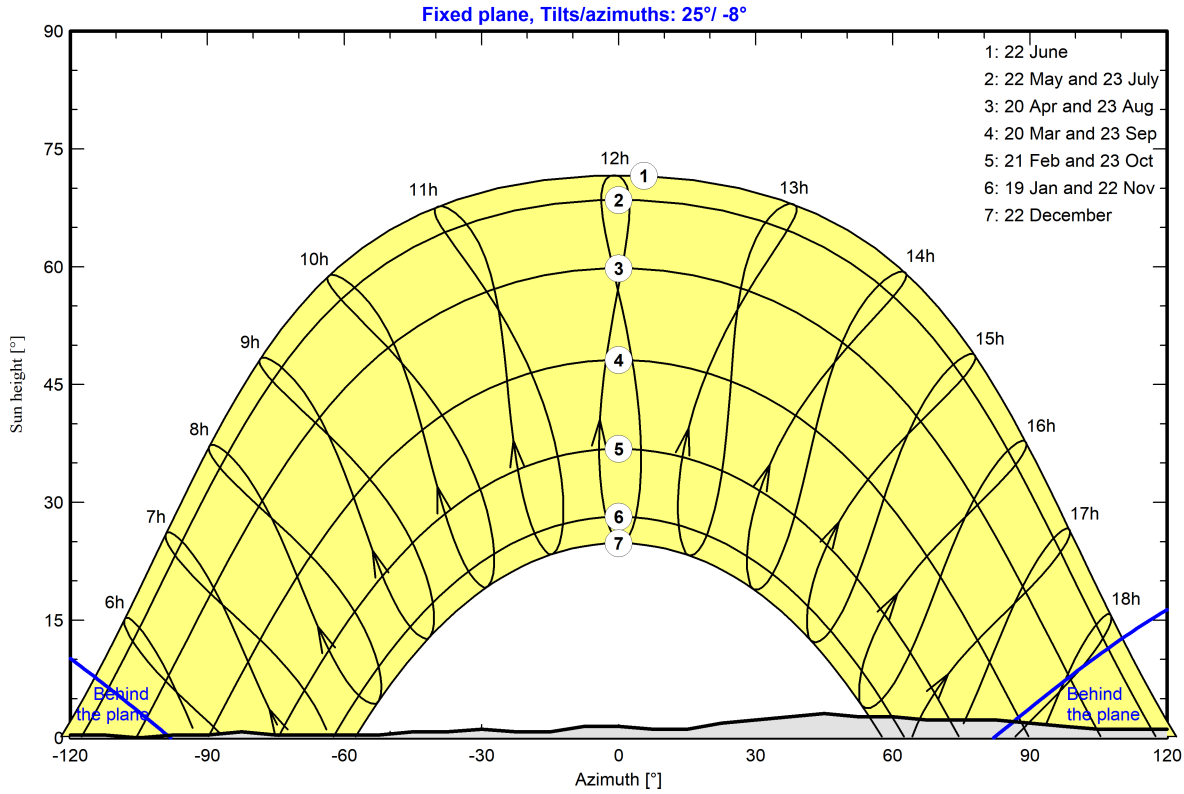
Horizon from PVGIS website API, Lat=41°46'22', Long=15°3'43', Alt=171m

Average Height	1.0 °	Albedo Factor	0.93
Diffuse Factor	0.99	Albedo Fraction	100 %

Horizon profile

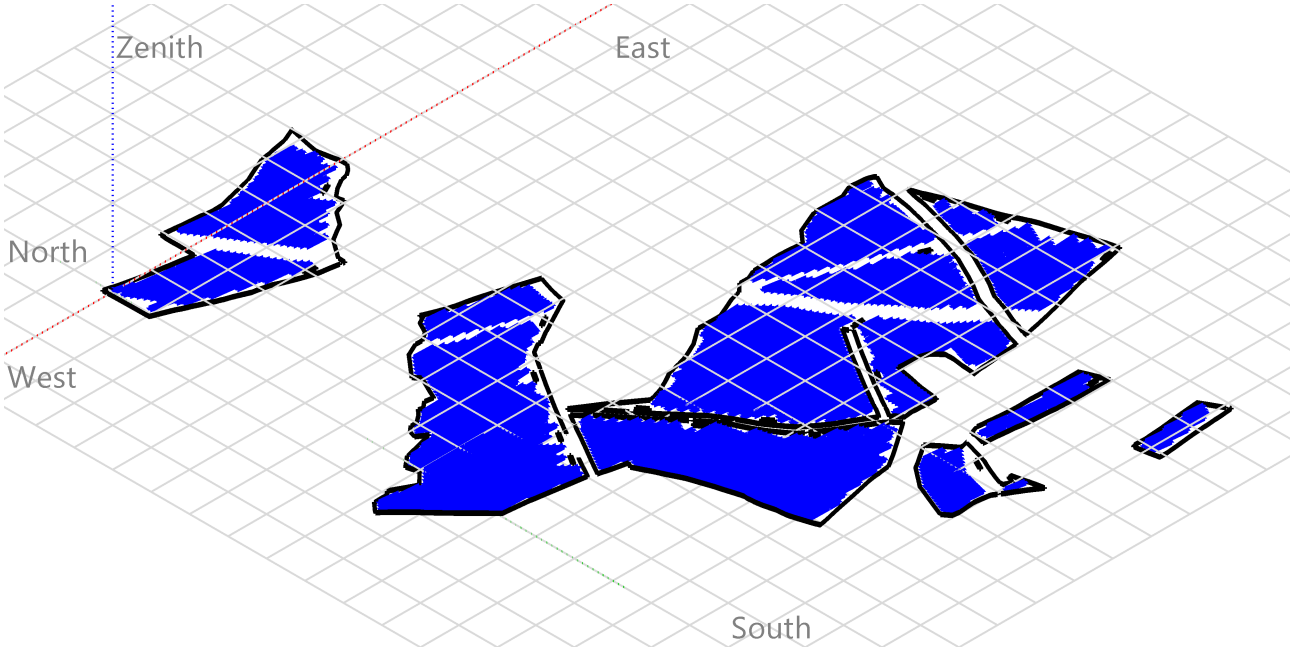
Azimuth [°]	-180	-158	-150	-113	-105	-98	-90	-83	-75	-53	-45	-38	-30
Height [°]	0.0	0.0	0.4	0.4	0.0	0.4	0.4	0.8	0.4	0.4	0.8	0.8	1.1
Azimuth [°]	-23	-15	-8	0	8	15	23	30	38	45	53	60	68
Height [°]	0.8	0.8	1.5	1.5	1.1	1.1	1.9	2.3	2.7	3.1	2.7	2.7	2.3
Azimuth [°]	83	90	98	105	120	128	143	150	165	173	180		
Height [°]	2.3	1.9	1.5	1.1	1.1	0.8	0.8	0.4	0.4	0.0	0.0		

Sun Paths (Height / Azimuth diagram)



Near shadings parameter

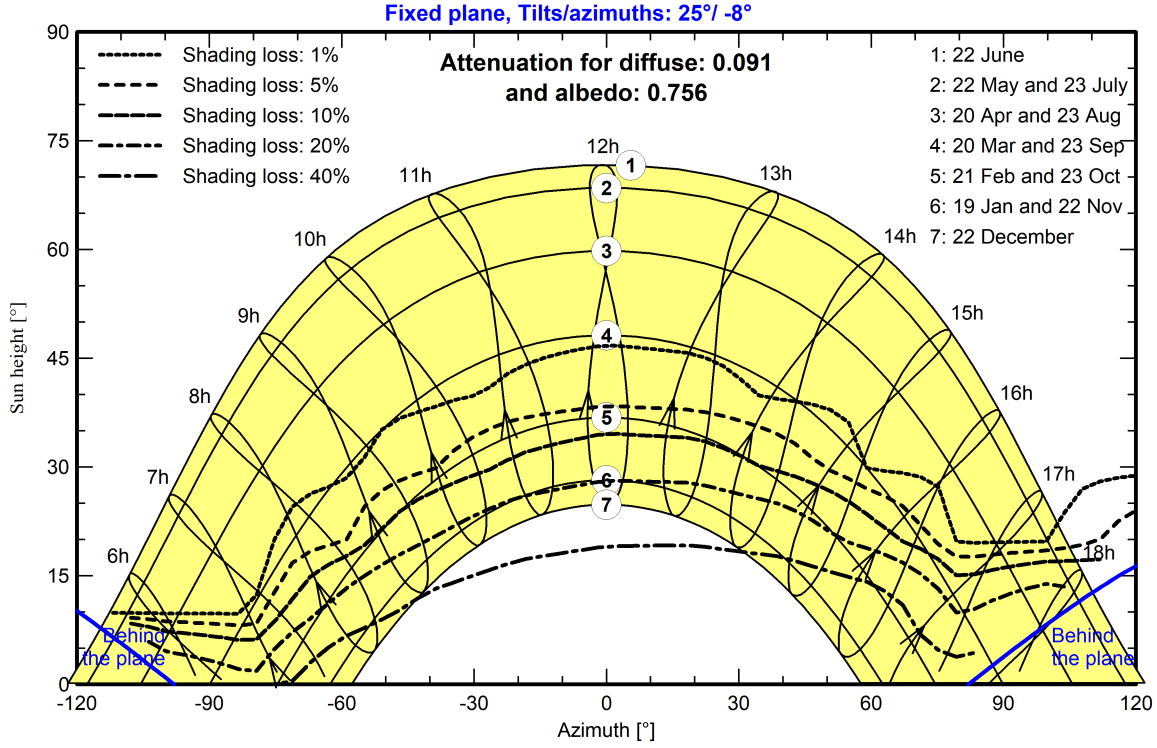
Perspective of the PV-field and surrounding shading scene



Iso-shadings diagram

Orientation #1

Fixed plane, Tilts/azimuths: 25°/ -8°



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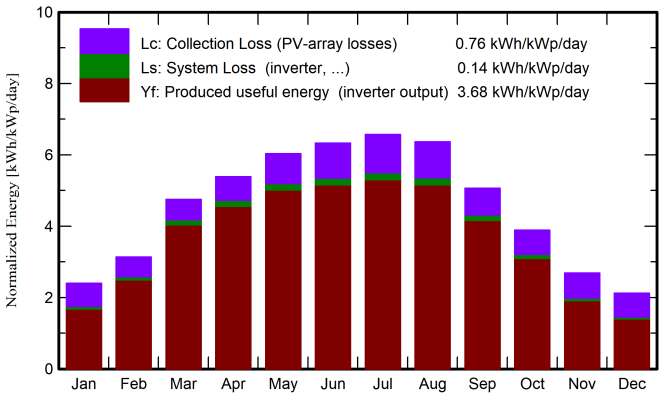
Main results

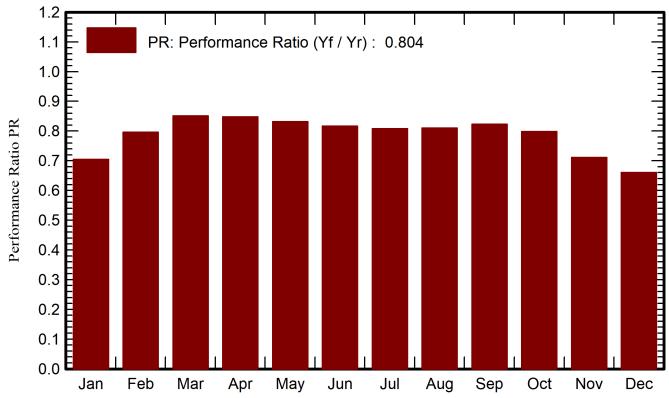
System Production

Produced Energy	70334 MWh/year	Specific production	1341 kWh/kWp/year
		Performance Ratio PR	80.45 %

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	50.0	26.87	7.68	74.3	55.1	2849	2741	0.704
February	66.0	35.40	8.28	87.8	74.2	3800	3665	0.796
March	121.0	55.73	11.22	147.3	135.7	6808	6569	0.850
April	146.0	69.80	14.12	161.5	150.7	7439	7176	0.847
May	185.0	85.58	19.53	187.1	174.5	8455	8158	0.832
June	194.8	81.81	24.41	189.8	177.3	8421	8121	0.816
July	204.7	81.48	27.35	203.6	190.8	8952	8630	0.808
August	183.6	72.00	27.05	197.4	185.5	8706	8389	0.810
September	129.4	57.16	21.52	151.8	140.9	6797	6554	0.823
October	92.7	41.93	17.56	120.5	106.4	5233	5044	0.799
November	55.2	28.84	12.44	80.7	61.6	3124	3009	0.711
December	42.5	23.58	8.83	65.7	45.9	2371	2277	0.661
Year	1470.9	660.18	16.72	1667.5	1498.6	72954	70334	0.804

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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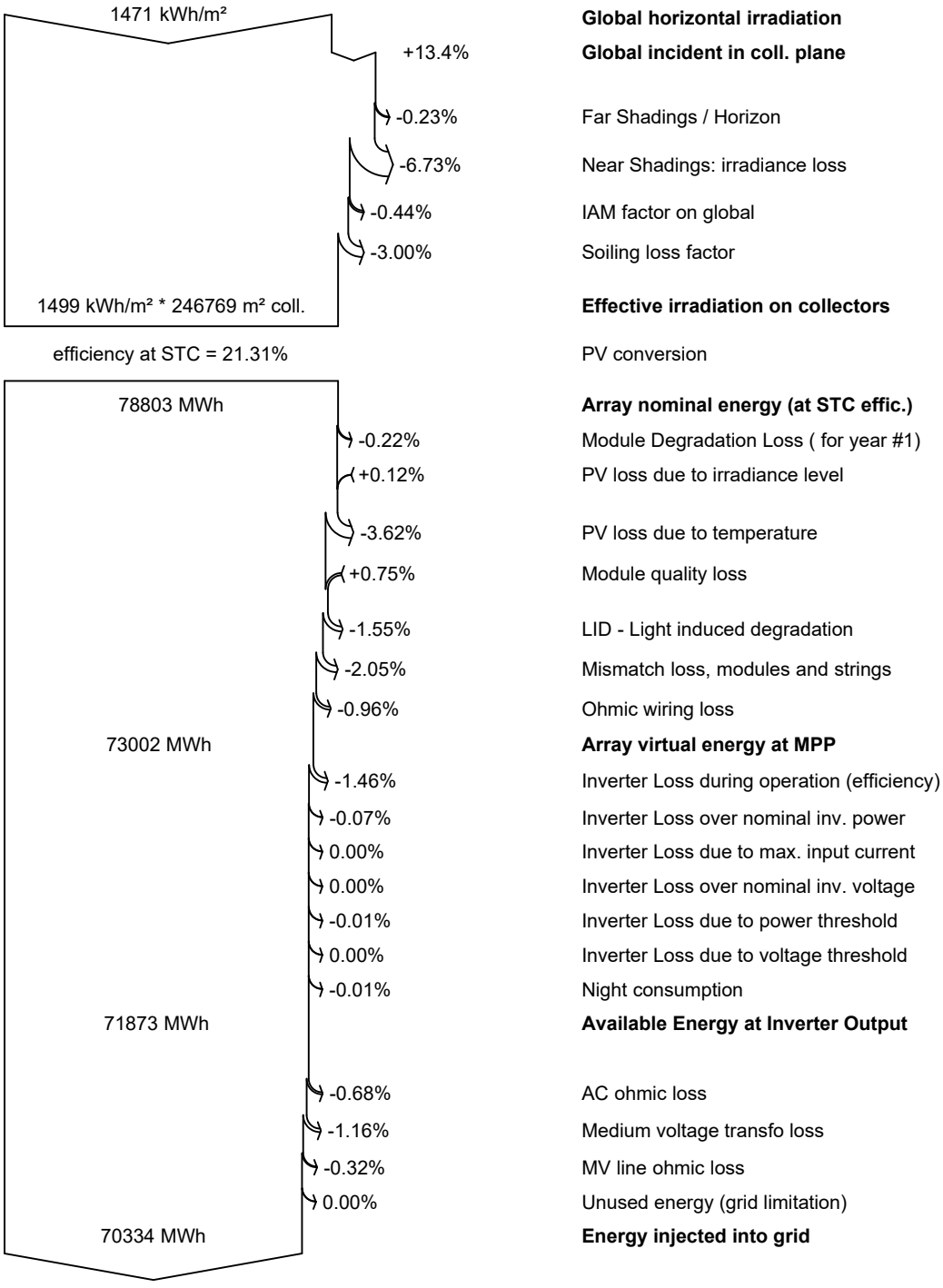
Loss diagram



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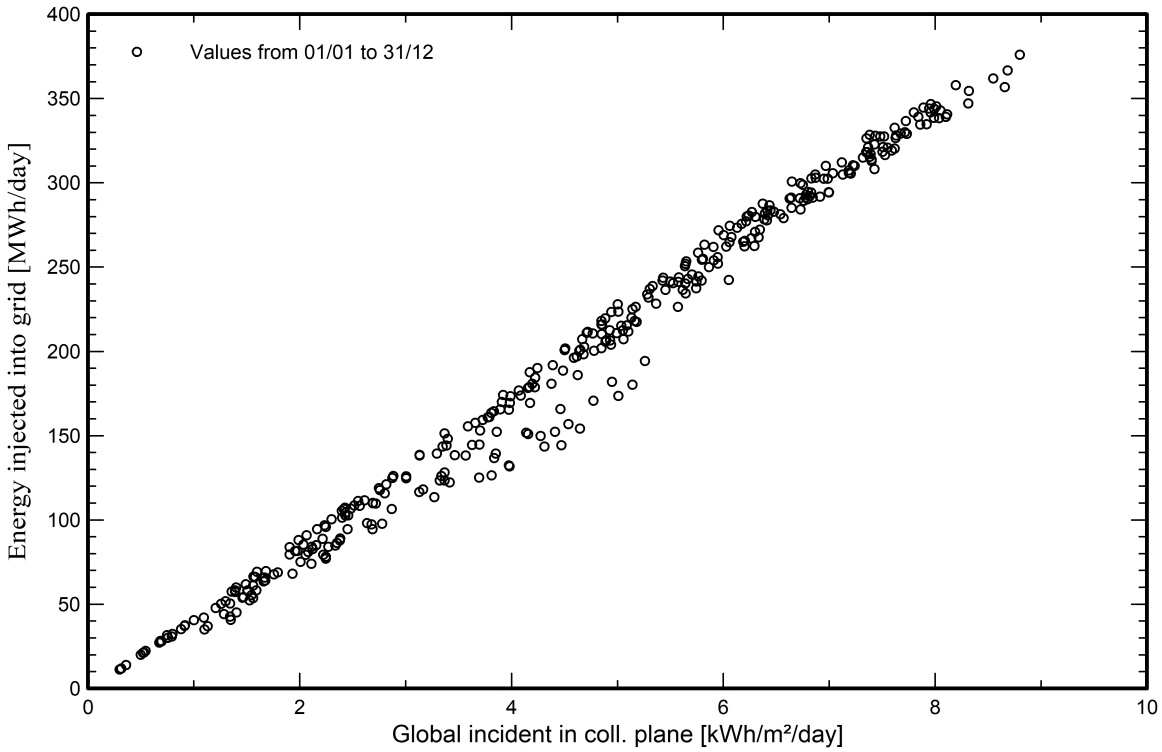
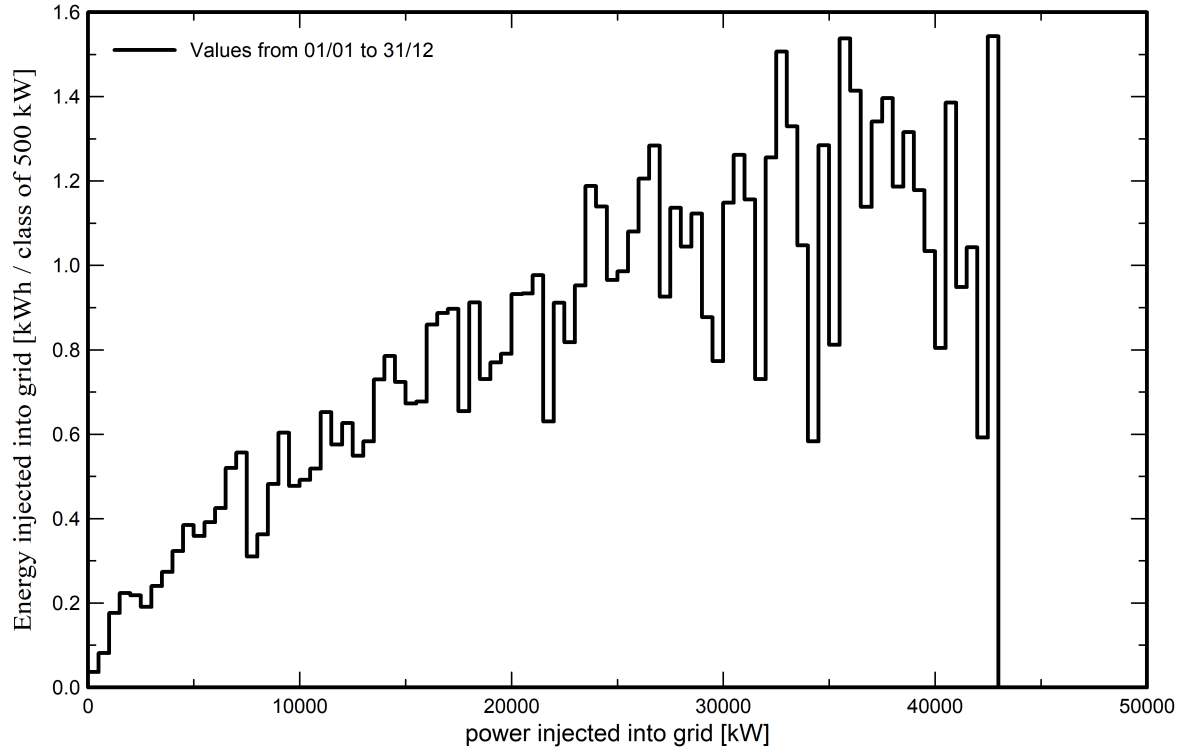
Predef. graphs

Diagramma giornaliero entrata/uscita



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

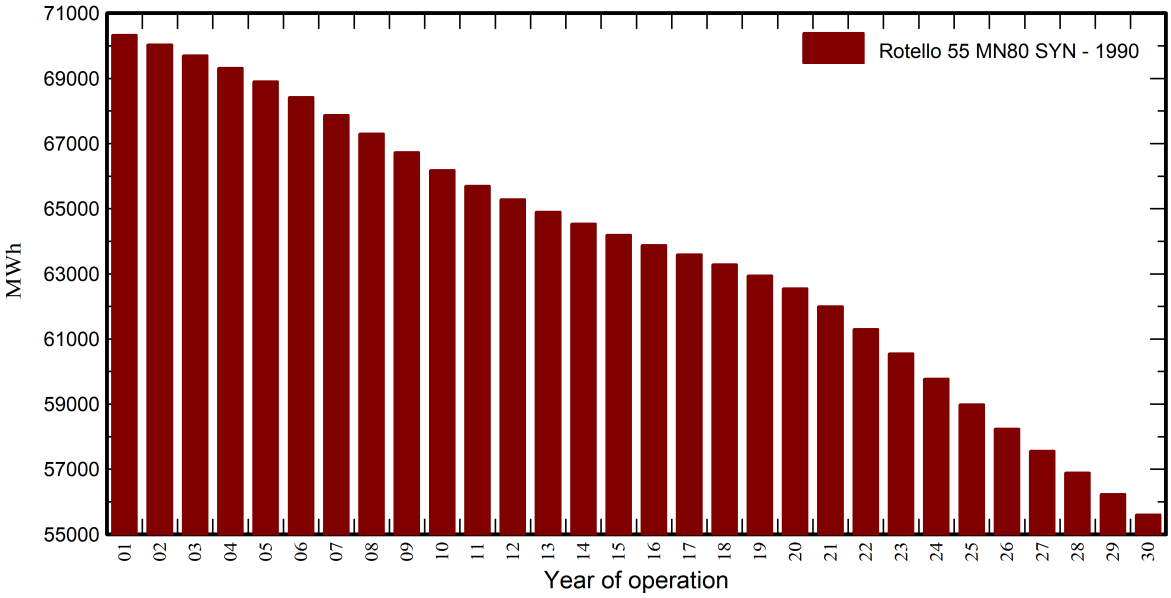
Imp RMS dispersion 0.4 %/year
Vmp RMS dispersion 0.4 %/year

Meteo used in the simulation

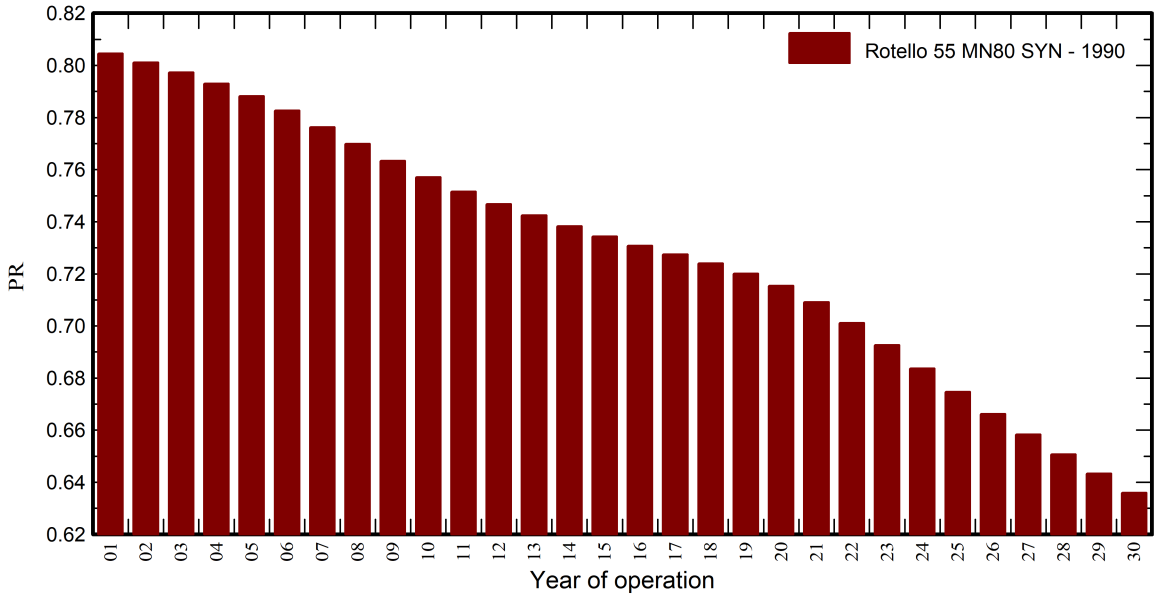
#1 Rotello 55 MN80 SYN

Years 1990 (reference year)
Years simulated 1-30

System output energy



Performance Ratio



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Meteo used in the simulation

#1 Rotello 55 MN80 SYN

Years 1990 (reference year)
Years simulated 1-30

Rotello 55 MN80 SYN

Year	System output	PR	PR loss
	MWh		%
1	70334	0.804	0%
2	70038	0.801	-0.4%
3	69702	0.797	-0.9%
4	69325	0.793	-1.4%
5	68908	0.788	-2%
6	68421	0.783	-2.7%
7	67871	0.776	-3.5%
8	67304	0.77	-4.3%
9	66737	0.763	-5.1%
10	66184	0.757	-5.9%
11	65700	0.751	-6.6%
12	65289	0.747	-7.2%
13	64905	0.742	-7.7%
14	64542	0.738	-8.2%
15	64195	0.734	-8.7%
16	63885	0.731	-9.2%
17	63599	0.727	-9.6%
18	63293	0.724	-10%
19	62948	0.72	-10.5%
20	62548	0.715	-11.1%
21	61997	0.709	-11.9%
22	61300	0.701	-12.8%
23	60553	0.693	-13.9%
24	59776	0.684	-15%
25	58988	0.675	-16.1%
26	58247	0.666	-17.2%
27	57561	0.658	-18.2%
28	56893	0.651	-19.1%
29	56240	0.643	-20%
30	55604	0.636	-20.9%