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Scala	-----		Foglio	A4	
Ogg.	Calcolo Produzione Fotovoltaica			COD.	T13
Opera	PROGETTO PER UN IMPIANTO AGRIVOLTAICO AVANZATO UBICATO NEL COMUNE DI ARIANO NEL POLESINE E RELATIVE OPERE DI CONNESSIONE NEI COMUNI DI ARIANO NEL POLESINE (RO), CORBOLA (RO), MESOLA (FE), CODIGORO (FE)				
Rel. 0.0	Data 02/02/2026	Progettista Ing. Leopoldo Franceschini		Data	Progettista
Rel.					
Rel.					

PVsyst - Simulation report

Grid-Connected System

Project: REN Project-Ariano Polesine

Variant: Layout

Trackers single array, with backtracking

System power: 17.92 MWp

Mezzavilla - Italy

Author

GSB Consulting Srl (Italy)





Project: REN Project-Ariano Polesine

Variant: Layout

PVsyst V8.0.20

VC0, Simulation date:
17/03/26 09:47
with V8.0.20

GSB Consulting Srl (Italy)

Project summary

Geographical Site

Mezzavilla

Italy

Situation

Latitude 44.98 °(N)

Longitude 12.12 °(E)

Altitude 11 m

Time zone UTC+1

Project settings

Albedo 0.20

Weather data

Mezzavilla

PVGIS api TMY

System summary

Grid-Connected System

Orientation #1

Tracking plane, horizontal N-S axis

Axis azimuth 0 °

Phi min / max. -/+ 55 °

Diffuse shading all trackers

Tracking algorithm

Astronomic calculation

Backtracking activated

Trackers single array, with backtracking

Near Shadings

Linear shadings : Fast (table)

User's needs

Unlimited load (grid)

System information

PV Array

Nb. of modules 26946 units

Pnom total 17.92 MWp

Inverters

Nb. of units 6 units

Total power 17598 kWac

Pnom ratio 1.02

Results summary

Produced Energy	31332 MWh/year	Specific production	1749 kWh/kWp/year	Perf. Ratio PR	88.56 %
				Bifacial perf. ratio	84.05 %

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Predef. graphs	9
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General parameters

Grid-Connected System

Orientation #1

Tracking plane, horizontal N-S axis

Axis azimuth 0 °
 Phi min / max. -/+ 55 °
 Diffuse shading all trackers

Tracking algorithm

Astronomic calculation
 Backtracking activated

Trackers single array, with backtracking

Field properties

Nb. of trackers 200 units
 Tracking plane, horizontal N-S axis

Sizes

Tracker Spacing 6.00 m
 Sensitive width 2.38 m
 GCR Shading 39.7 %

Backtracking limit angle

Phi limits +/- 66.6 °

Backtracking parameters

Backtracking pitch 6.00 m
 Backtracking width 2.38 m
 Left inactive band 0.00 m
 Right inactive band 0.00 m
 GCR Backtracking 39.7 %
 Parameters choice Automatic

Models used

Transposition Perez
 Diffuse Imported
 Circumsolar separate

Horizon

Free Horizon

Near Shadings

Linear shadings : Fast (table)

User's needs

Unlimited load (grid)

Bifacial system definition

Orientation #1

Bifacial system

Model Unlimited Trackers 2D model

Bifacial model geometry

Tracker Spacing 6.00 m
 Tracker width 2.38 m
 Axis height above ground 3.00 m
 Nb. of sheds 200 units

Bifacial model definitions

Ground albedo 0.20
 Bifaciality factor 72 %
 Rear shading factor 5.0 %
 Rear mismatch loss 10.0 %
 Shed transparent fraction 0.0 %

PV Array Characteristics

PV module

Manufacturer Trina Solar
 Model TSM-DEG21C-20-665Wp Vertex
 (Original PVsyst database)
 Unit Nom. Power 665 Wp
 Number of PV modules 26946 units
 Nominal (STC) 17.92 MWp
 Modules 998 string x 27 In series

At operating cond. (50°C)

Pmpp 16.42 MWp
 U mpp 938 V
 I mpp 17505 A

Inverter

Manufacturer SMA
 Model Sunny Central 2930 UP
 (Original PVsyst database)
 Unit Nom. Power 2933 kWac
 Number of inverters 6 units
 Total power 17598 kWac
 Operating voltage 962-1325 V
 Pnom ratio (DC:AC) 1.02



PV Array Characteristics

Total PV power

Nominal (STC)	17919 kWp
Total	26946 modules
Module area	83704 m ²
Cell area	78429 m ²

Total inverter power

Total power	17598 kWac
Number of inverters	6 units
Pnom ratio	1.02

Array losses

Array Soiling Losses

Loss Fraction	2.0 %
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Thermal Loss factor

Module temperature according to irradiance	
Uc (const)	29.0 W/m ² K
Uv (wind)	0.0 W/m ² K/m/s

DC wiring losses

Global array res.	0.59 mΩ
Loss Fraction	1.00 % at STC

LID - Light Induced Degradation

Loss Fraction	1.00 %
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Module Quality Loss

Loss Fraction	-0.38 %
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Module mismatch losses

Loss Fraction	2.00 % at MPP
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Strings Mismatch loss

Loss Fraction	0.15 %
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IAM loss factor

Incidence effect (IAM): Fresnel, AR coating, n(glass)=1.526, n(AR)=1.290

0°	30°	50°	60°	70°	75°	80°	85°	90°
1.000	0.999	0.987	0.963	0.892	0.814	0.679	0.438	0.000

System losses

Auxiliary losses

Proportional to Power	3.0 W/kW
0.0 kW from Power thresh.	

AC wiring losses

Inv. output line up to MV transfo

Inverter voltage	660 Vac tri
Loss Fraction	0.06 % at STC

Inverter: Sunny Central 2930 UP

Wire section (6 Inv.)	Copper 6 x 3 x 2000 mm ²
Average wires length	10 m

MV line up to Injection

MV Voltage	20 kV
Average each transformer	
Wires	Alu 3 x 150 mm ²
Length	700 m
Loss Fraction	0.11 % at STC

AC losses in transformers



AC losses in transformers

MV transfo

Medium voltage 20 kV

One transfo parameters

Nominal power at STC	2.94 MVA
Iron Loss (24/24 Connexion)	2.93 kVA
Iron loss fraction	0.10 % at STC
Copper loss	29.38 kVA
Copper loss fraction	1.00 % at STC
Coils equivalent resistance	3 x 1.49 mΩ

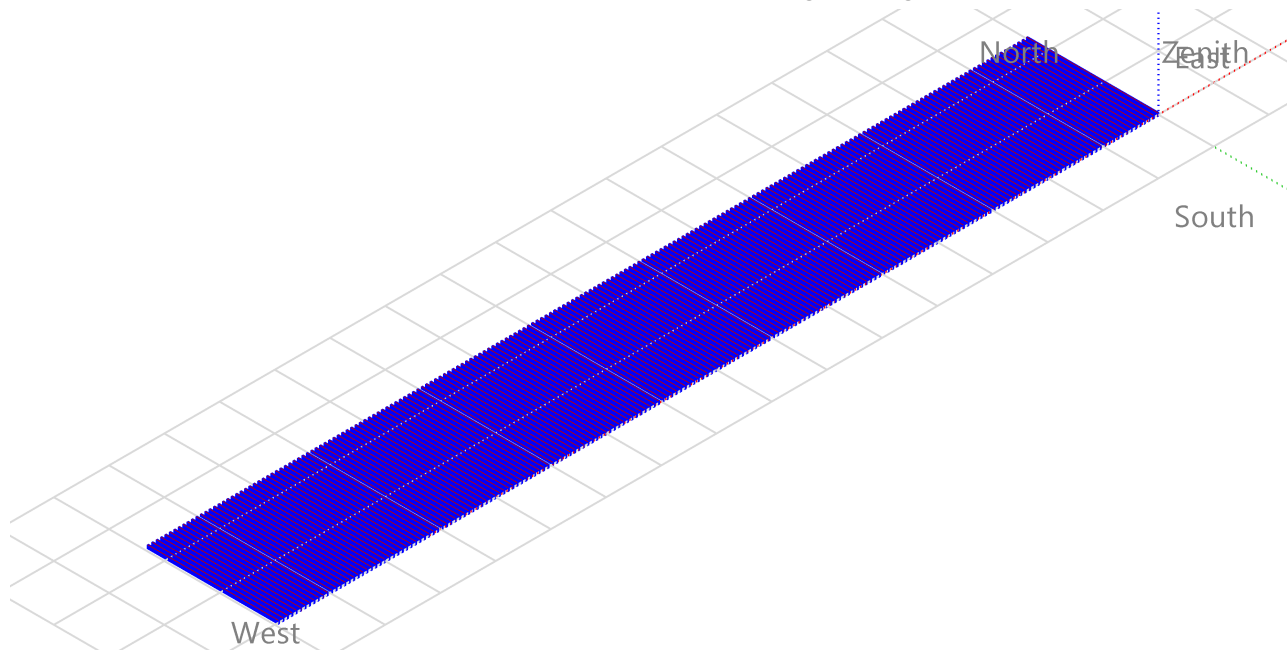
Operating losses at STC (full system)

Nb. identical MV transfos	6
Nominal power at STC	17.61 MVA
Iron loss (24/24 Connexion)	17.60 kVA
Copper loss	176.27 kVA



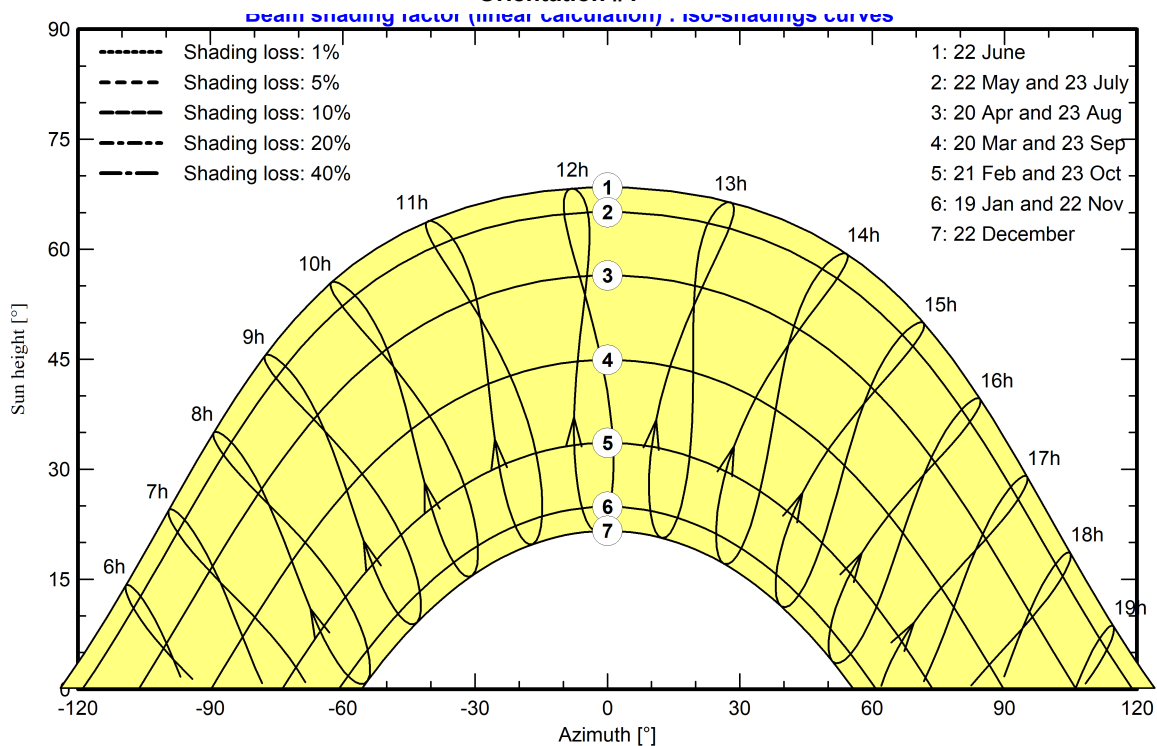
Near shadings parameter

Perspective of the PV-field and surrounding shading scene



Iso-shadings diagram

Orientation #1 -





Project: REN Project-Ariano Polesine

Variant: Layout

PVsyst V8.0.20

VC0, Simulation date:
17/03/26 09:47
with V8.0.20

GSB Consulting Srl (Italy)

Main results

System Production

Produced Energy 31332 MWh/year

Specific production

1749 kWh/kWp/year

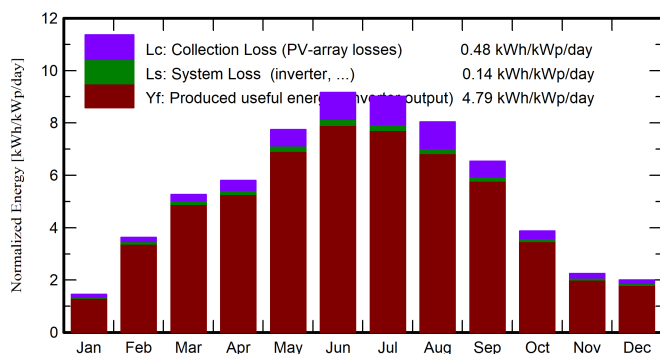
Perf. Ratio PR

88.56 %

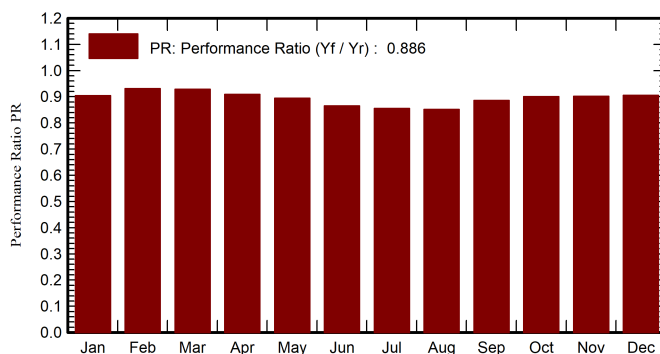
Bifacial perf. ratio

84.05 %

Normalized productions (per installed kWp)



Performance Ratio PR



Balances and main results

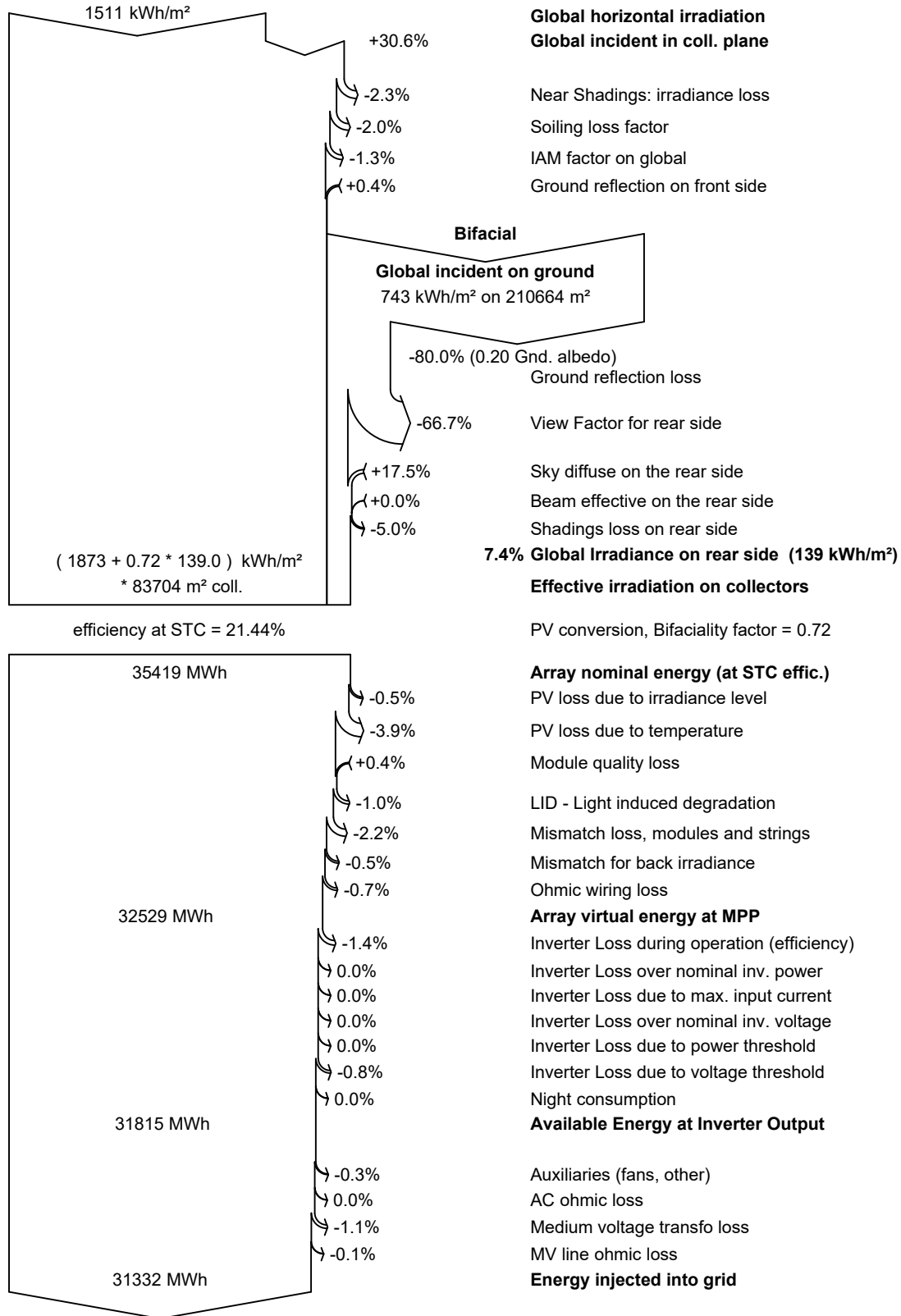
	GlobHor kWh/m ²	DiffHor kWh/m ²	T_Amb °C	GlobInc kWh/m ²	GlobEff kWh/m ²	EArray MWh	E_Grid MWh	PR ratio
January	36.3	23.07	5.64	45.1	41.1	762	732	0.904
February	74.5	29.20	6.32	101.8	95.5	1751	1698	0.931
March	123.0	48.46	7.79	163.4	154.6	2801	2720	0.929
April	139.0	63.54	13.64	174.1	165.2	2921	2836	0.909
May	190.6	76.76	17.65	240.3	229.1	3965	3851	0.894
June	212.8	73.28	23.13	274.8	262.9	4383	4259	0.865
July	215.2	75.71	25.42	279.7	267.5	4410	4287	0.855
August	187.4	61.96	26.41	249.4	238.6	3912	3803	0.851
September	145.5	51.03	21.73	196.3	186.8	3203	3114	0.885
October	90.6	41.01	17.39	120.0	112.8	1994	1936	0.901
November	51.3	26.79	11.97	67.3	62.0	1125	1088	0.901
December	44.9	18.60	5.87	62.2	56.7	1045	1009	0.905
Year	1511.3	589.41	15.29	1974.5	1872.7	32272	31332	0.886

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		



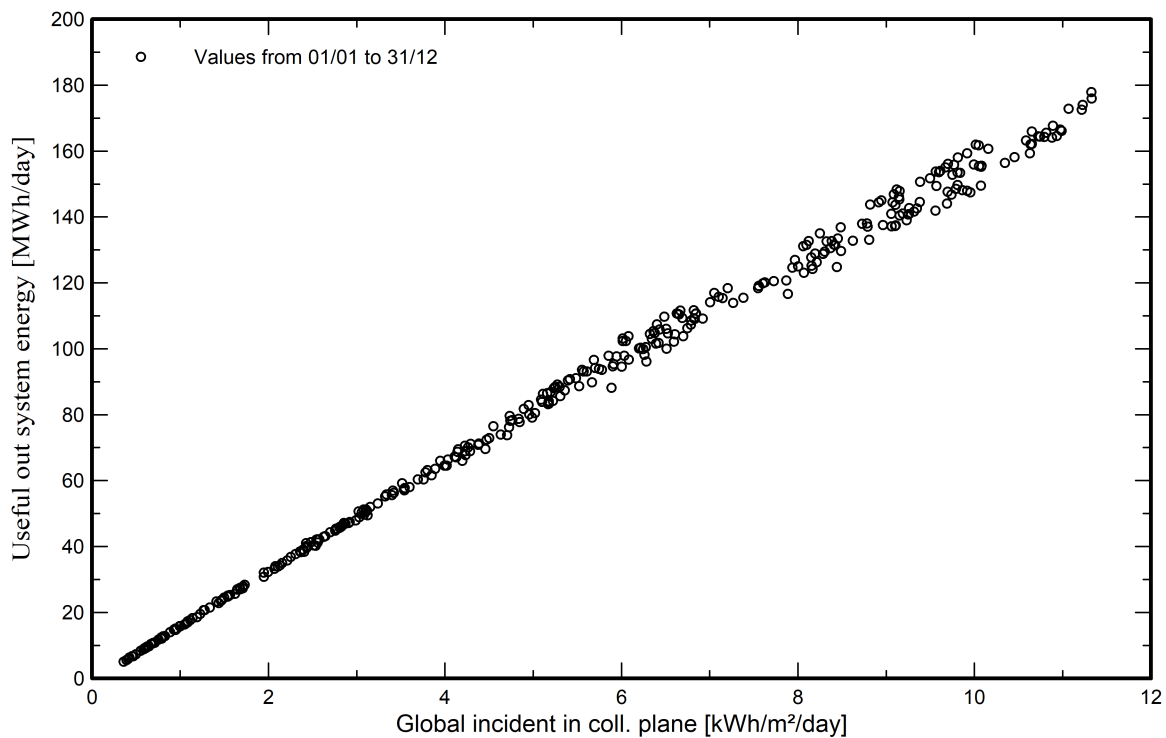
Loss diagram



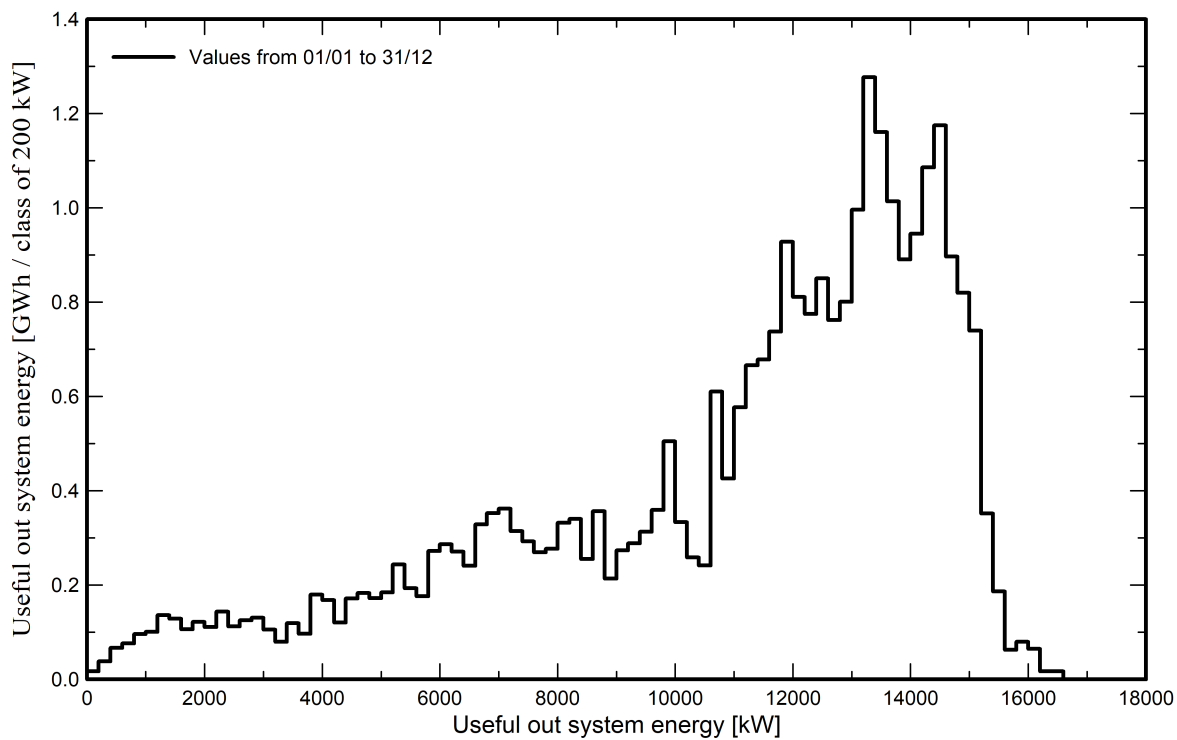


Predef. graphs

Daily Input/Output diagram



System Output Power Distribution





P50 - P90 evaluation

Weather data

Source	PVGIS api TMY
Kind	TMY, multi-year
Year-to-year variability(Variance)	3.8 %
Specified Deviation	
Climate change	0.0 %

Global variability (weather data + system)

Variability (Quadratic sum)	4.2 %
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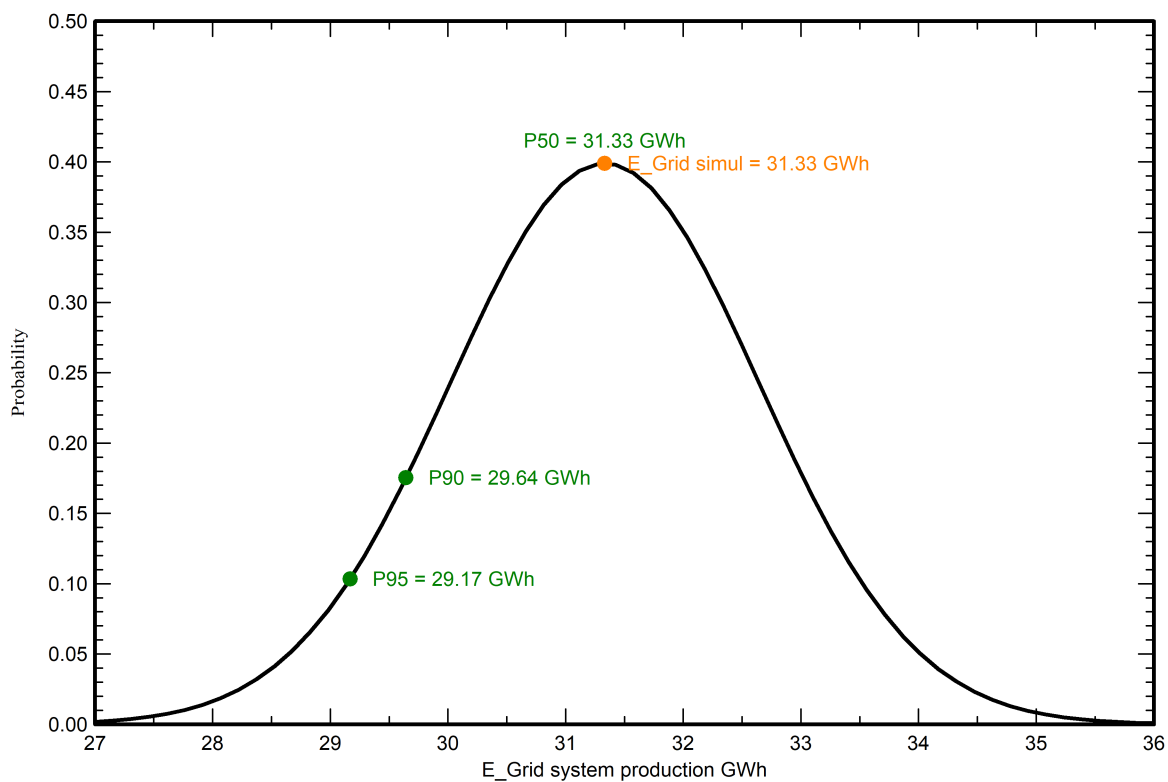
Simulation and parameters uncertainties

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	1.32 GWh
P50	31.33 GWh
P90	29.64 GWh
P95	29.17 GWh

Probability distribution



PVsyst - Simulation report

Grid-Connected System

Project: REN Project-Ariano Polesine

Variant: Impianto 1

Trackers single array, with backtracking

System power: 6177 kWp

Mezzavilla - Italy

Author

GSB Consulting Srl (Italy)





Project: REN Project-Ariano Polesine

Variant: Impianto 1

PVsyst V8.0.20

VC1, Simulation date:
17/03/26 09:35
with V8.0.20

GSB Consulting Srl (Italy)

Project summary

Geographical Site

Mezzavilla

Italy

Situation

Latitude 44.98 °(N)
Longitude 12.12 °(E)
Altitude 11 m
Time zone UTC+1

Project settings

Albedo 0.20

Weather data

Mezzavilla

PVGIS api TMY

System summary

Grid-Connected System

Orientation #1

Tracking plane, horizontal N-S axis

Axis azimuth 0 °
Phi min / max. +/- 55 °
Diffuse shading all trackers

Tracking algorithm

Astronomic calculation
Backtracking activated

System information

PV Array

Nb. of modules 9288 units
Pnom total 6177 kWp

Trackers single array, with backtracking

Near Shadings

Linear shadings : Fast (table)

User's needs

Unlimited load (grid)

Inverters

Nb. of units 2 units
Total power 5866 kWac
Pnom ratio 1.05

Results summary

Produced Energy	10744 MWh/year	Specific production	1740 kWh/kWp/year	Perf. Ratio PR	88.10 %
				Bifacial perf. ratio	83.63 %

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P50 - P90 evaluation	10



General parameters

Grid-Connected System

Orientation #1

Tracking plane, horizontal N-S axis

Axis azimuth	0 °
Phi min / max.	-/+ 55 °
Diffuse shading	all trackers

Tracking algorithm

Astronomic calculation
Backtracking activated

Trackers single array, with backtracking

Field properties

Nb. of trackers	344 units
Tracking plane, horizontal N-S axis	

Sizes

Tracker Spacing	6.00 m
Sensitive width	2.38 m
GCR Shading	39.7 %

Backtracking limit angle

Phi limits	+/- 66.6 °
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Backtracking parameters

Backtracking pitch	6.00 m
Backtracking width	2.38 m
Left inactive band	0.00 m
Right inactive band	0.00 m
GCR Backtracking	39.7 %
Parameters choice	Automatic

Models used

Transposition	Perez
Diffuse	Imported
Circumsolar	separate

Horizon

Free Horizon

Near Shadings

Linear shadings : Fast (table)

User's needs

Unlimited load (grid)

Bifacial system definition

Orientation #1

Bifacial system

Model Unlimited Trackers 2D model

Bifacial model geometry

Tracker Spacing	6.00 m
Tracker width	2.38 m
Axis height above ground	3.00 m
Nb. of sheds	344 units

Bifacial model definitions

Ground albedo	0.20
Bifaciality factor	72 %
Rear shading factor	5.0 %
Rear mismatch loss	10.0 %
Shed transparent fraction	0.0 %

PV Array Characteristics

PV module

Manufacturer	Trina Solar
Model	TSM-DEG21C-20-665Wp Vertex
(Original PVsyst database)	
Unit Nom. Power	665 Wp
Number of PV modules	9288 units
Nominal (STC)	6177 kWp
Modules	344 string x 27 In series

At operating cond. (50°C)

Pmpp	5660 kWp
U mpp	938 V
I mpp	6034 A

Inverter

Manufacturer	SMA
Model	Sunny Central 2930 UP
(Original PVsyst database)	
Unit Nom. Power	2933 kWac
Number of inverters	2 units
Total power	5866 kWac
Operating voltage	962-1325 V
Pnom ratio (DC:AC)	1.05



PV Array Characteristics

Total PV power

Nominal (STC)	6177 kWp
Total	9288 modules
Module area	28852 m ²
Cell area	27034 m ²

Total inverter power

Total power	5866 kWac
Number of inverters	2 units
Pnom ratio	1.05

Array losses

Array Soiling Losses

Loss Fraction	2.0 %
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Thermal Loss factor

Module temperature according to irradiance	
Uc (const)	29.0 W/m ² K
Uv (wind)	0.0 W/m ² K/m/s

DC wiring losses

Global array res.	1.7 mΩ
Loss Fraction	1.00 % at STC

LID - Light Induced Degradation

Loss Fraction	1.00 %
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Module Quality Loss

Loss Fraction	-0.38 %
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Module mismatch losses

Loss Fraction	2.00 % at MPP
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Strings Mismatch loss

Loss Fraction	0.15 %
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IAM loss factor

Incidence effect (IAM): Fresnel, AR coating, n(glass)=1.526, n(AR)=1.290

0°	30°	50°	60°	70°	75°	80°	85°	90°
1.000	0.999	0.987	0.963	0.892	0.814	0.679	0.438	0.000

System losses

Auxiliary losses

Proportional to Power	3.0 W/kW
0.0 kW from Power thresh.	

AC wiring losses

Inv. output line up to MV transfo

Inverter voltage	660 Vac tri
Loss Fraction	1.00 % at STC

Inverter: Sunny Central 2930 UP

Wire section (2 Inv.)	Copper 2 x 3 x 2500 mm ²
Average wires length	191 m

MV line up to Injection

MV Voltage	20 kV
Average each transformer	
Wires	Alu 3 x 120 mm ²
Length	900 m
Loss Fraction	0.18 % at STC

AC losses in transformers



AC losses in transformers

MV transfo

Medium voltage 20 kV

One transfo parameters

Nominal power at STC	3.03 MVA
Iron Loss (24/24 Connexion)	2.93 kVA
Iron loss fraction	0.10 % at STC
Copper loss	31.40 kVA
Copper loss fraction	1.03 % at STC
Coils equivalent resistance	3 x 1.49 mΩ

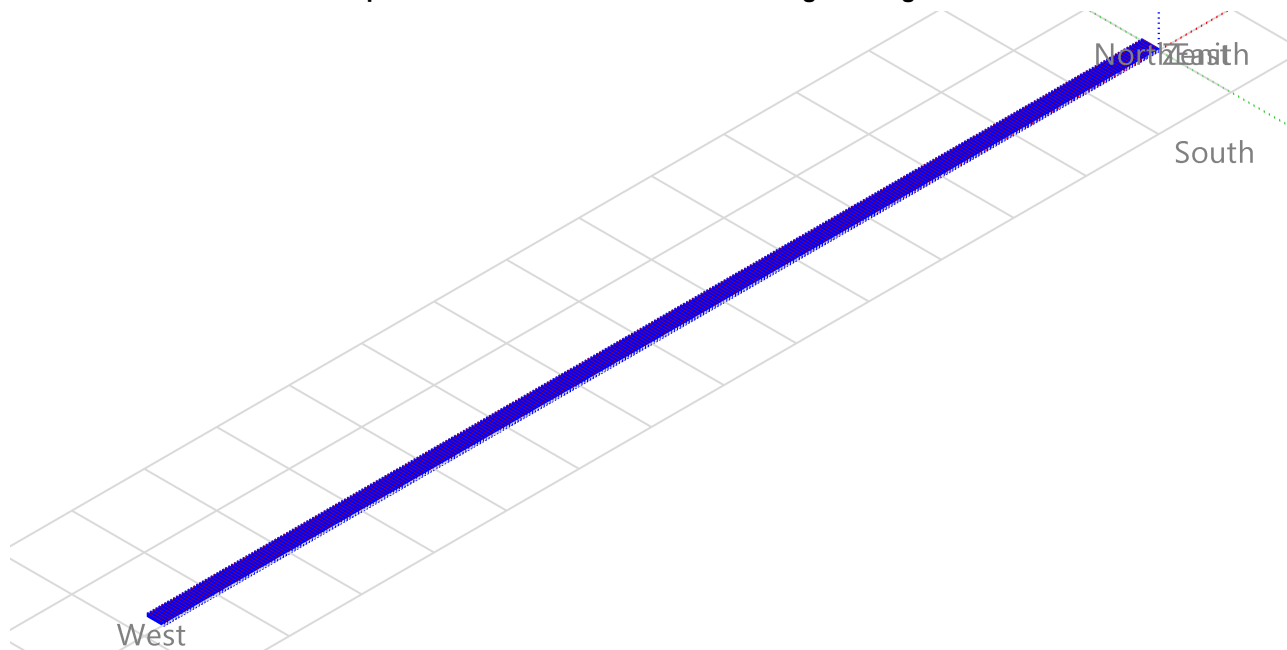
Operating losses at STC (full system)

Nb. identical MV transfos	2
Nominal power at STC	6.07 MVA
Iron loss (24/24 Connexion)	5.87 kVA
Copper loss	62.80 kVA



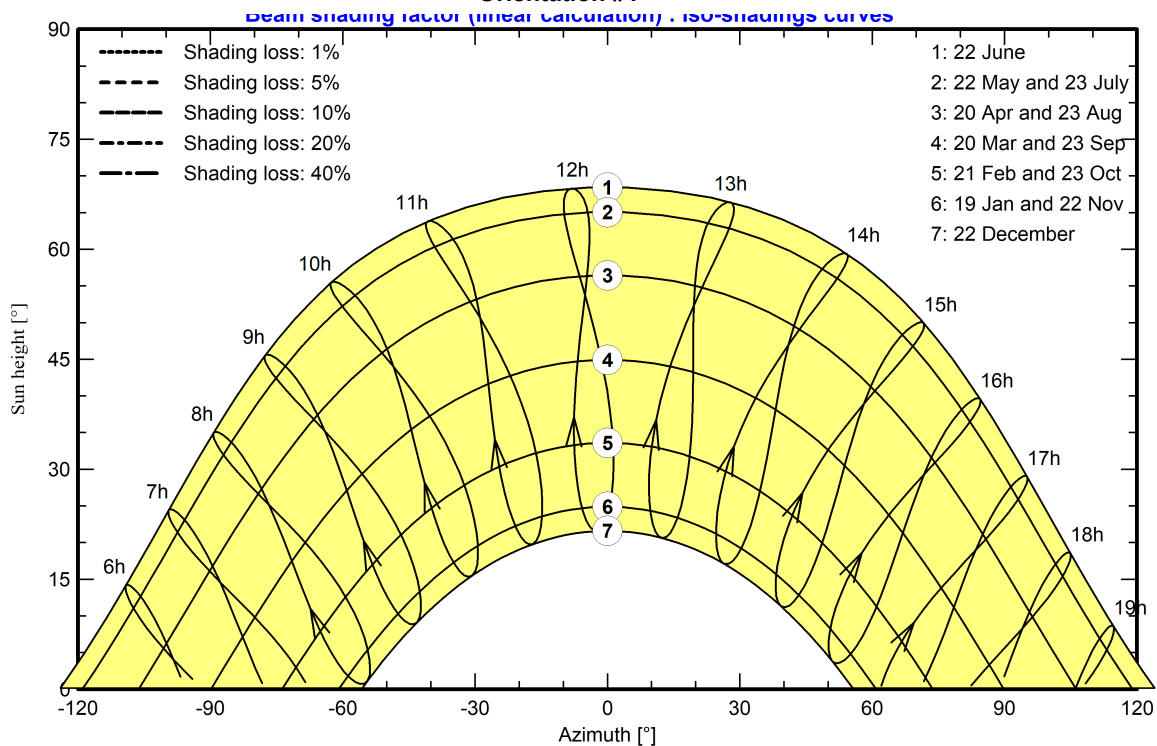
Near shadings parameter

Perspective of the PV-field and surrounding shading scene



Iso-shadings diagram

Orientation #1 -





Project: REN Project-Ariano Polesine

Variant: Impianto 1

PVsyst V8.0.20

VC1, Simulation date:
17/03/26 09:35
with V8.0.20

GSB Consulting Srl (Italy)

Main results

System Production

Produced Energy 10744 MWh/year

Specific production

1740 kWh/kWp/year

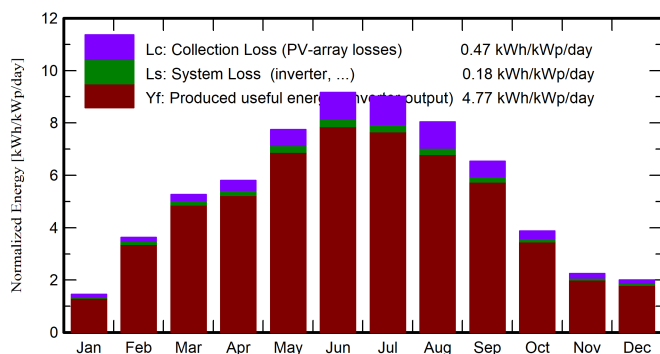
Perf. Ratio PR

88.10 %

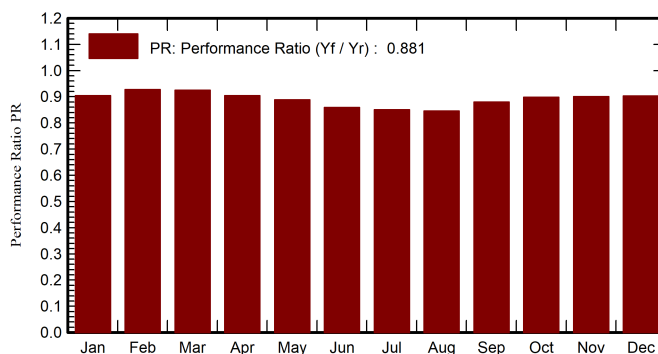
Bifacial perf. ratio

83.63 %

Normalized productions (per installed kWp)



Performance Ratio PR



Balances and main results

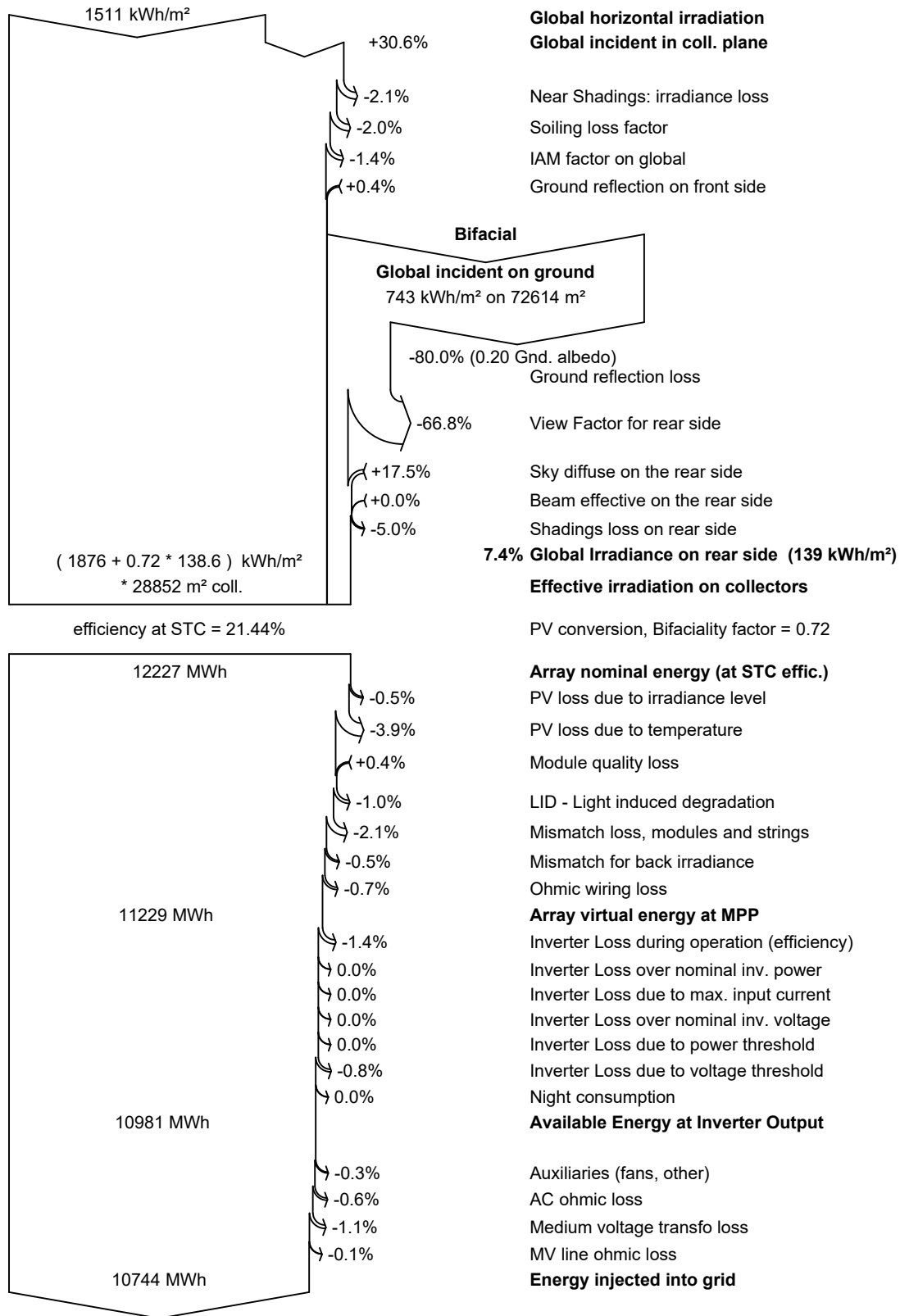
	GlobHor kWh/m ²	DiffHor kWh/m ²	T_Amb °C	GlobInc kWh/m ²	GlobEff kWh/m ²	EArray MWh	E_Grid MWh	PR ratio	PRBifi ratio
January	36.3	23.07	5.64	45.1	41.2	263	252	0.904	0.853
February	74.5	29.20	6.32	101.8	95.6	604	583	0.927	0.884
March	123.0	48.46	7.79	163.4	154.9	967	933	0.925	0.879
April	139.0	63.54	13.64	174.1	165.5	1009	973	0.904	0.855
May	190.6	76.76	17.65	240.3	229.5	1368	1319	0.889	0.841
June	212.8	73.28	23.13	274.8	263.4	1513	1458	0.859	0.815
July	215.2	75.71	25.42	279.7	267.9	1523	1469	0.850	0.807
August	187.4	61.96	26.41	249.4	239.0	1350	1303	0.846	0.805
September	145.5	51.03	21.73	196.3	187.1	1105	1067	0.880	0.838
October	90.6	41.01	17.39	120.0	113.0	689	665	0.898	0.853
November	51.3	26.79	11.97	67.3	62.1	388	374	0.900	0.854
December	44.9	18.60	5.87	62.2	56.8	361	347	0.904	0.862
Year	1511.3	589.41	15.29	1974.5	1876.0	11140	10744	0.881	0.836

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	PRBifi	Bifacial Performance Ratio
GlobEff	Effective Global, corr. for IAM and shadings		



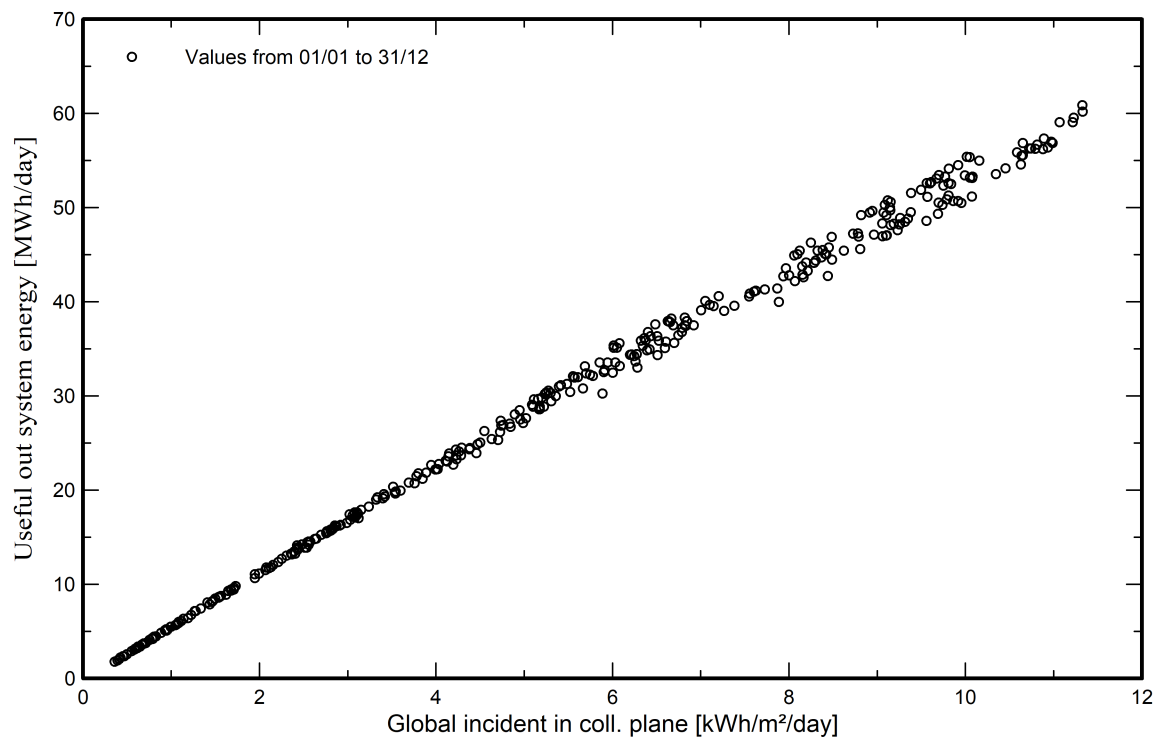
Loss diagram



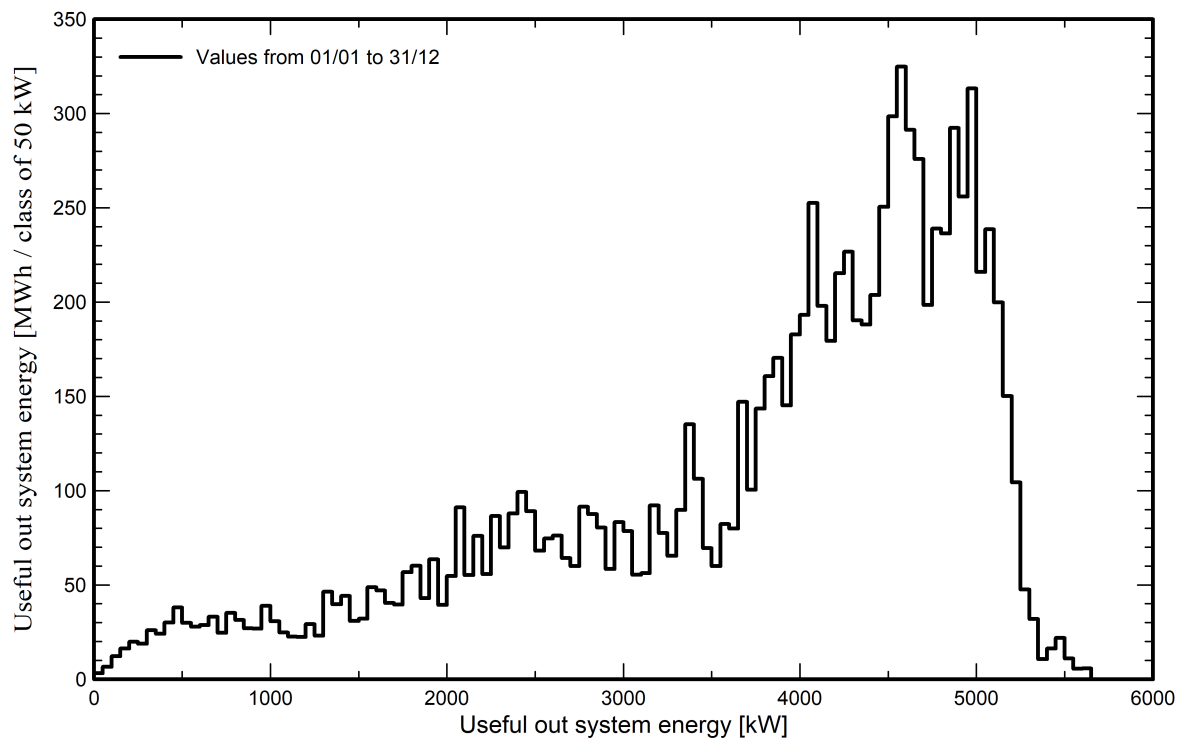


Predef. graphs

Daily Input/Output diagram



System Output Power Distribution





P50 - P90 evaluation

Weather data

Source	PVGIS api TMY
Kind	TMY, multi-year
Year-to-year variability(Variance)	3.8 %
Specified Deviation	
Climate change	0.0 %

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 %

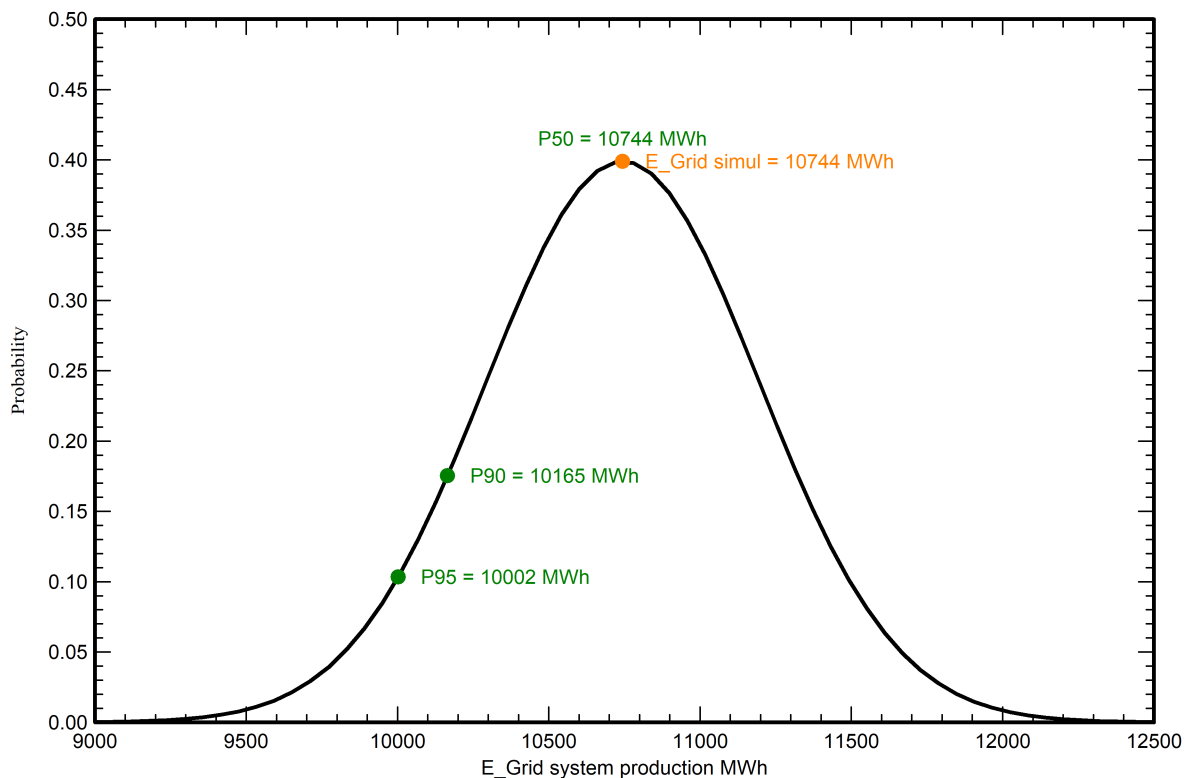
Global variability (weather data + system)

Variability (Quadratic sum)	4.2 %
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Annual production probability

Variability	452 MWh
P50	10744 MWh
P90	10165 MWh
P95	10002 MWh

Probability distribution



PVsyst - Simulation report

Grid-Connected System

Project: REN Project-Ariano Polesine

Variant: Impianto 2

Trackers single array, with backtracking

System power: 6194 kWp

Mezzavilla - Italy

Author

GSB Consulting Srl (Italy)





Project: REN Project-Ariano Polesine

Variant: Impianto 2

PVsyst V8.0.20

VC2, Simulation date:
13/03/26 10:39
with V8.0.20

GSB Consulting Srl (Italy)

Project summary

Geographical Site

Mezzavilla

Italy

Situation

Latitude 44.98 °(N)

Longitude 12.12 °(E)

Altitude 11 m

Time zone UTC+1

Project settings

Albedo 0.20

Weather data

Mezzavilla

PVGIS api TMY

System summary

Grid-Connected System

Orientation #1

Tracking plane, horizontal N-S axis

Axis azimuth 0 °

Phi min / max. -/+ 55 °

Diffuse shading all trackers

Tracking algorithm

Astronomic calculation

Backtracking activated

Trackers single array, with backtracking

Near Shadings

Linear shadings : Fast (table)

User's needs

Unlimited load (grid)

System information

PV Array

Nb. of modules

9315 units

Pnom total

6194 kWp

Inverters

Nb. of units

2 units

Total power

5866 kWac

Pnom ratio

1.06

Results summary

Produced Energy	10782 MWh/year	Specific production	1741 kWh/kWp/year	Perf. Ratio PR	88.15 %
				Bifacial perf. ratio	83.67 %

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Predef. graphs	9
P50 - P90 evaluation	10



General parameters

Grid-Connected System

Orientation #1

Tracking plane, horizontal N-S axis

Axis azimuth	0 °
Phi min / max.	-/+ 55 °
Diffuse shading	all trackers

Tracking algorithm

Astronomic calculation
Backtracking activated

Trackers single array, with backtracking

Field properties

Nb. of trackers	345 units
Tracking plane, horizontal N-S axis	

Sizes

Tracker Spacing	6.00 m
Sensitive width	2.38 m
GCR Shading	39.7 %

Backtracking limit angle

Phi limits	+/- 66.6 °
------------	------------

Backtracking parameters

Backtracking pitch	6.00 m
Backtracking width	2.38 m
Left inactive band	0.00 m
Right inactive band	0.00 m
GCR Backtracking	39.7 %
Parameters choice	Automatic

Models used

Transposition	Perez
Diffuse	Imported
Circumsolar	separate

Horizon

Free Horizon

Near Shadings

Linear shadings : Fast (table)

User's needs

Unlimited load (grid)

Bifacial system definition

Orientation #1

Bifacial system

Model Unlimited Trackers 2D model

Bifacial model geometry

Tracker Spacing	6.00 m
Tracker width	2.38 m
Axis height above ground	3.00 m
Nb. of sheds	345 units

Bifacial model definitions

Ground albedo	0.20
Bifaciality factor	72 %
Rear shading factor	5.0 %
Rear mismatch loss	10.0 %
Shed transparent fraction	0.0 %

PV Array Characteristics

PV module

Manufacturer	Trina Solar
Model	TSM-DEG21C-20-665Wp Vertex
(Original PVsyst database)	
Unit Nom. Power	665 Wp
Number of PV modules	9315 units
Nominal (STC)	6194 kWp
Modules	345 string x 27 In series
At operating cond. (50°C)	
Pmpp	5676 kWp
U mpp	938 V
I mpp	6051 A

Inverter

Manufacturer	SMA
Model	Sunny Central 2930 UP
(Original PVsyst database)	
Unit Nom. Power	2933 kWac
Number of inverters	2 units
Total power	5866 kWac
Operating voltage	962-1325 V
Pnom ratio (DC:AC)	1.06



PV Array Characteristics

Total PV power

Nominal (STC)	6194 kWp
Total	9315 modules
Module area	28936 m ²
Cell area	27112 m ²

Total inverter power

Total power	5866 kWac
Number of inverters	2 units
Pnom ratio	1.06

Array losses

Array Soiling Losses

Loss Fraction	2.0 %
---------------	-------

Thermal Loss factor

Module temperature according to irradiance	
Uc (const)	29.0 W/m ² K
Uv (wind)	0.0 W/m ² K/m/s

DC wiring losses

Global array res.	1.7 mΩ
Loss Fraction	1.00 % at STC

LID - Light Induced Degradation

Loss Fraction	1.00 %
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Module Quality Loss

Loss Fraction	-0.38 %
---------------	---------

Module mismatch losses

Loss Fraction	2.00 % at MPP
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Strings Mismatch loss

Loss Fraction	0.15 %
---------------	--------

IAM loss factor

Incidence effect (IAM): Fresnel, AR coating, n(glass)=1.526, n(AR)=1.290

0°	30°	50°	60°	70°	75°	80°	85°	90°
1.000	0.999	0.987	0.963	0.892	0.814	0.679	0.438	0.000

System losses

Auxiliary losses

Proportional to Power	3.0 W/kW
0.0 kW from Power thresh.	

AC wiring losses

Inv. output line up to MV transfo

Inverter voltage	660 Vac tri
Loss Fraction	1.00 % at STC

Inverter: Sunny Central 2930 UP

Wire section (2 Inv.)	Copper 2 x 3 x 2500 mm ²
Average wires length	191 m

MV line up to Injection

MV Voltage	20 kV
Average each transformer	
Wires	Alu 3 x 120 mm ²
Length	500 m
Loss Fraction	0.10 % at STC

AC losses in transformers



AC losses in transformers

MV transfo

Medium voltage 20 kV

One transfo parameters

Nominal power at STC	3.04 MVA
Iron Loss (24/24 Connexion)	2.93 kVA
Iron loss fraction	0.10 % at STC
Copper loss	31.58 kVA
Copper loss fraction	1.04 % at STC
Coils equivalent resistance	3 x 1.49 mΩ

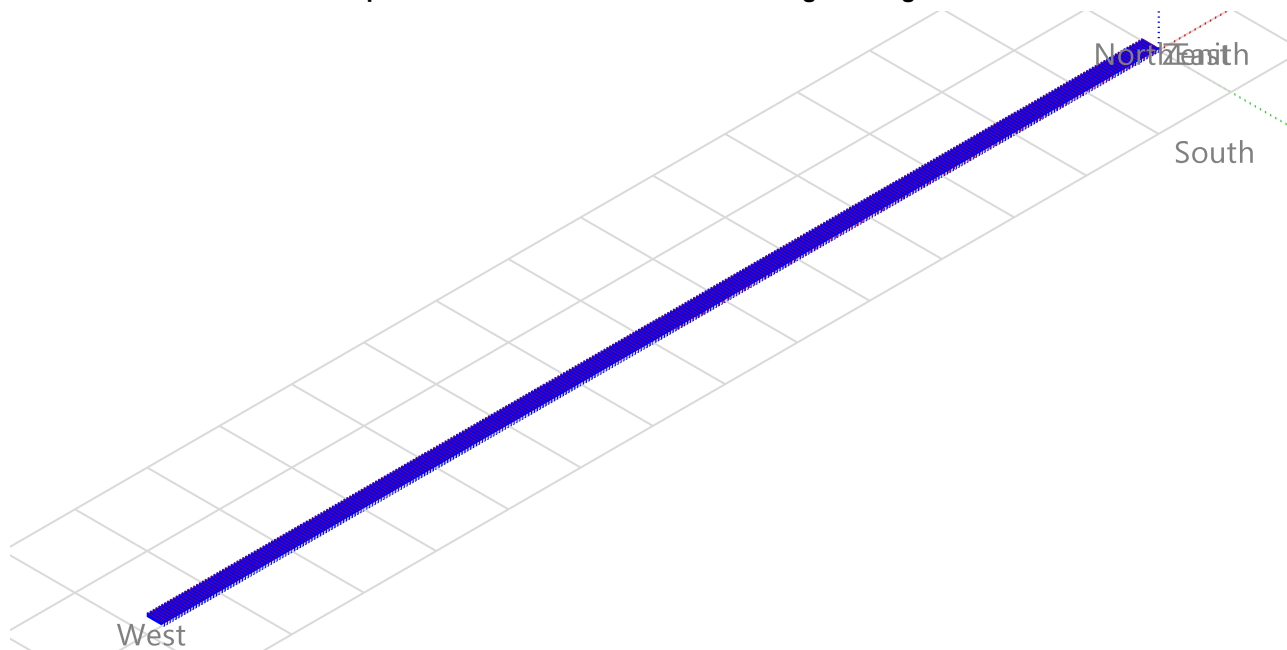
Operating losses at STC (full system)

Nb. identical MV transfos	2
Nominal power at STC	6.09 MVA
Iron loss (24/24 Connexion)	5.87 kVA
Copper loss	63.17 kVA



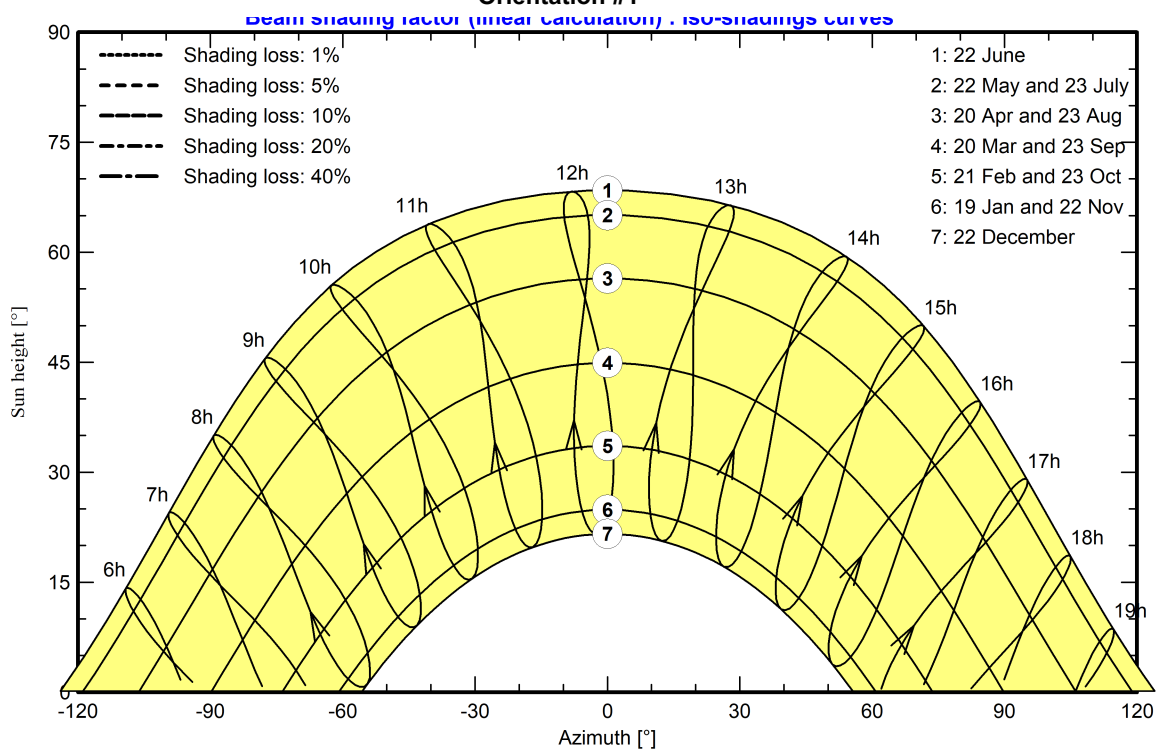
Near shadings parameter

Perspective of the PV-field and surrounding shading scene



Iso-shadings diagram

Orientation #1 -





Project: REN Project-Ariano Polesine

Variant: Impianto 2

PVsyst V8.0.20

VC2, Simulation date:
13/03/26 10:39
with V8.0.20

GSB Consulting Srl (Italy)

Main results

System Production

Produced Energy 10782 MWh/year

Specific production

1741 kWh/kWp/year

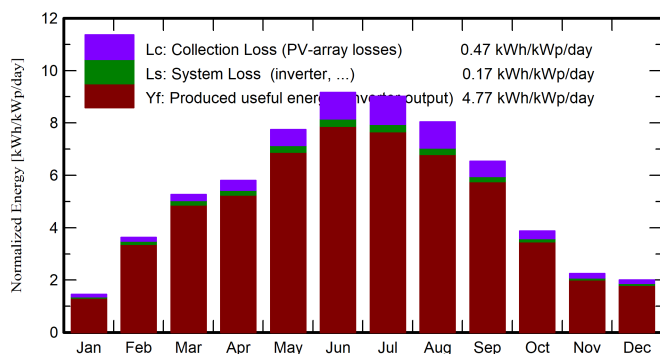
Perf. Ratio PR

88.15 %

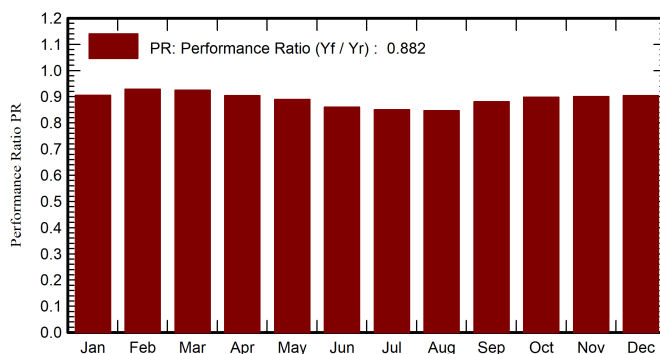
Bifacial perf. ratio

83.67 %

Normalized productions (per installed kWp)



Performance Ratio PR



Balances and main results

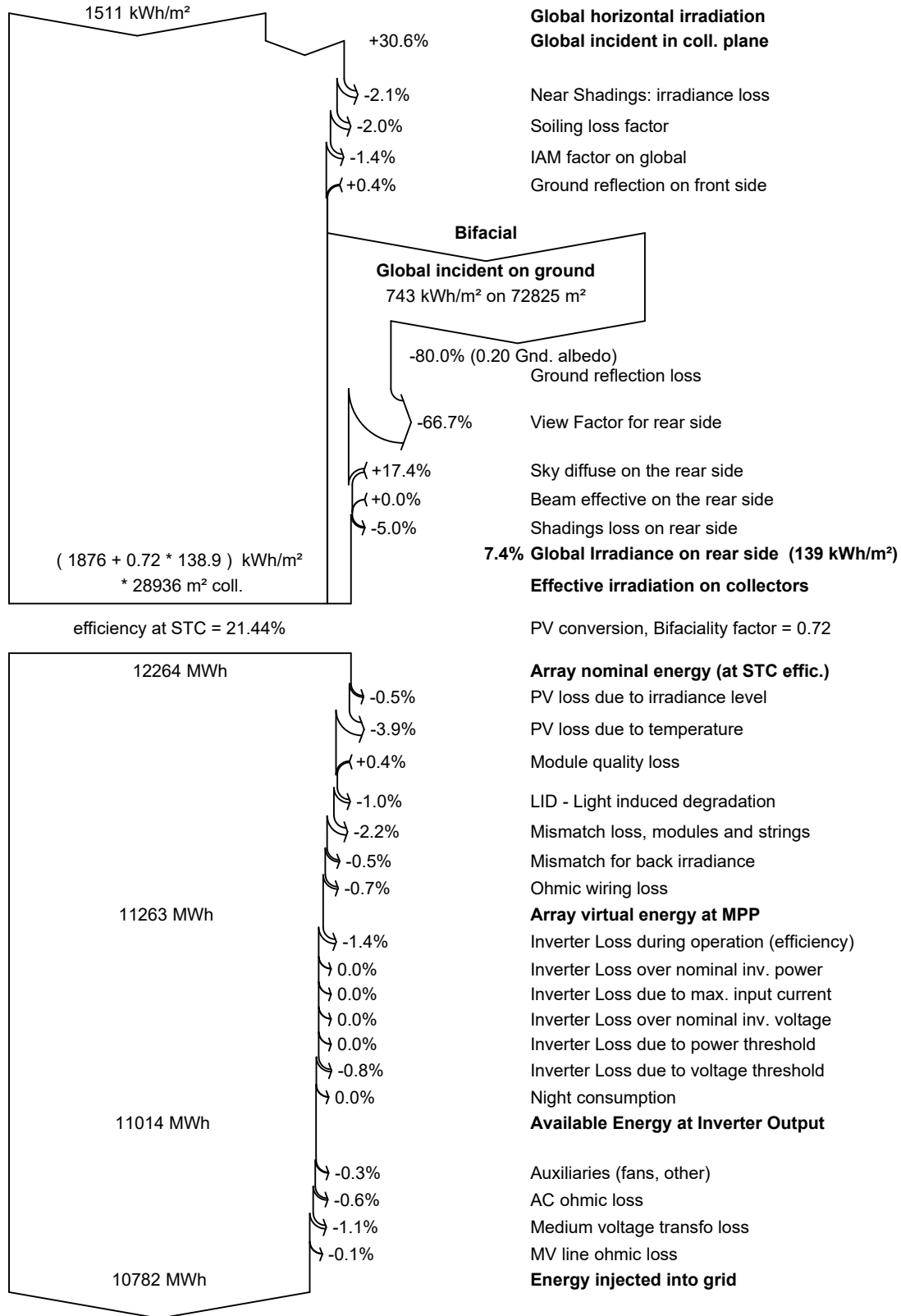
	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_Grid	PR	PRBifi
	kWh/m ²	kWh/m ²	°C	kWh/m ²	kWh/m ²	MWh	MWh	ratio	ratio
January	36.3	23.07	5.64	45.1	41.2	264	253	0.905	0.854
February	74.5	29.20	6.32	101.8	95.6	606	585	0.928	0.884
March	123.0	48.46	7.79	163.4	154.9	970	936	0.925	0.879
April	139.0	63.54	13.64	174.1	165.5	1011	976	0.905	0.855
May	190.6	76.76	17.65	240.3	229.5	1373	1324	0.889	0.841
June	212.8	73.28	23.13	274.8	263.4	1517	1464	0.860	0.816
July	215.2	75.71	25.42	279.7	267.9	1527	1474	0.851	0.807
August	187.4	61.96	26.41	249.4	239.0	1354	1308	0.846	0.805
September	145.5	51.03	21.73	196.3	187.1	1109	1071	0.881	0.838
October	90.6	41.01	17.39	120.0	113.0	691	668	0.898	0.853
November	51.3	26.79	11.97	67.3	62.1	390	376	0.901	0.854
December	44.9	18.60	5.87	62.2	56.8	362	348	0.904	0.862
Year	1511.3	589.41	15.29	1974.5	1876.0	11174	10782	0.882	0.837

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	PRBifi	Bifacial Performance Ratio
GlobEff	Effective Global, corr. for IAM and shadings		



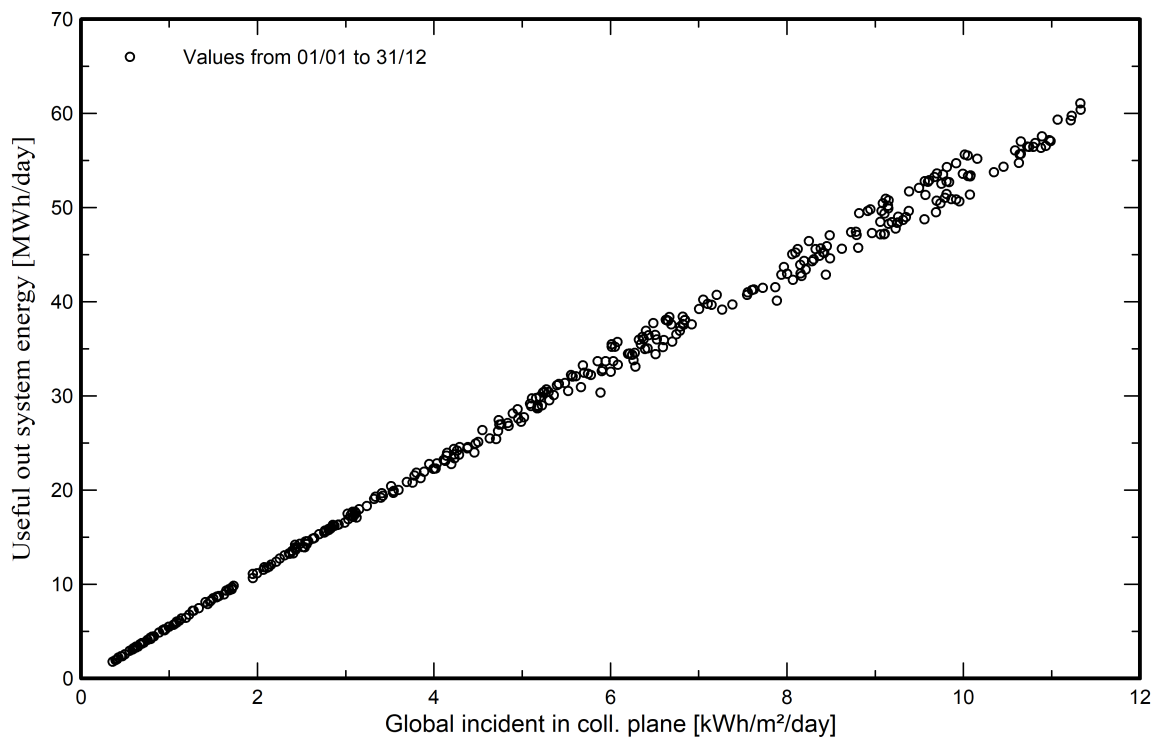
Loss diagram



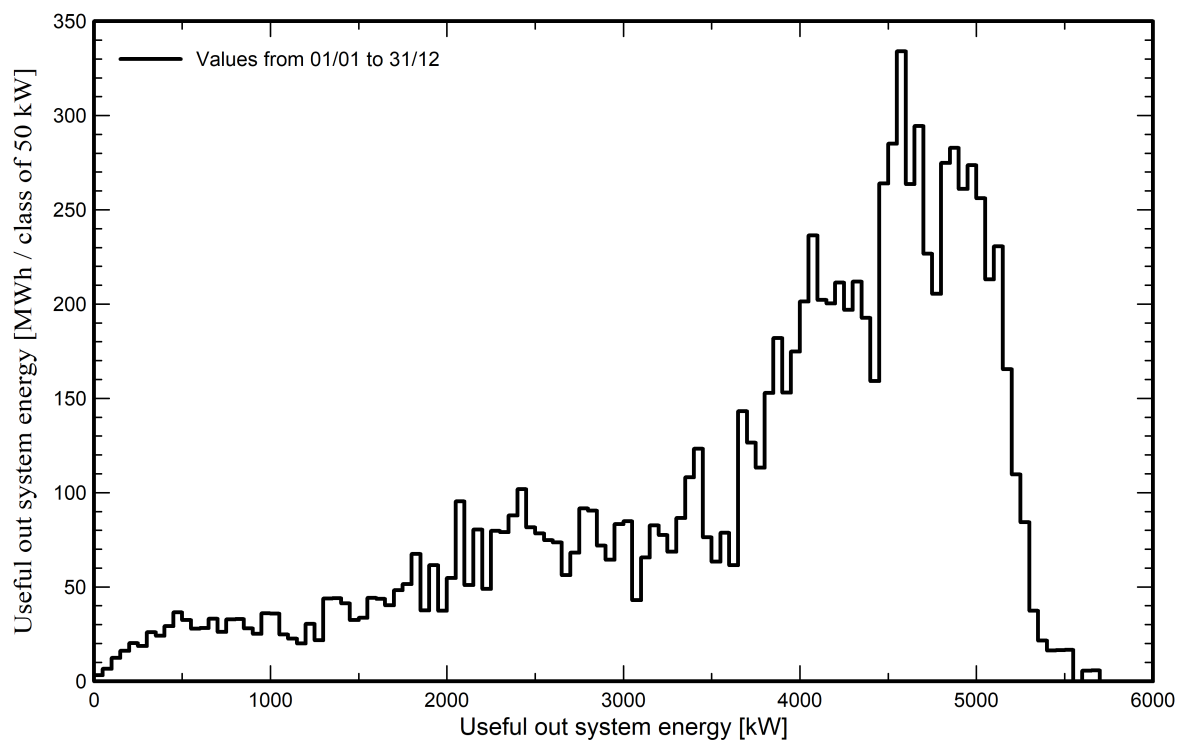


Predef. graphs

Daily Input/Output diagram



System Output Power Distribution





P50 - P90 evaluation

Weather data

Source	PVGIS api TMY
Kind	TMY, multi-year
Year-to-year variability(Variance)	3.8 %
Specified Deviation	
Climate change	0.0 %

Global variability (weather data + system)

Variability (Quadratic sum)	4.2 %
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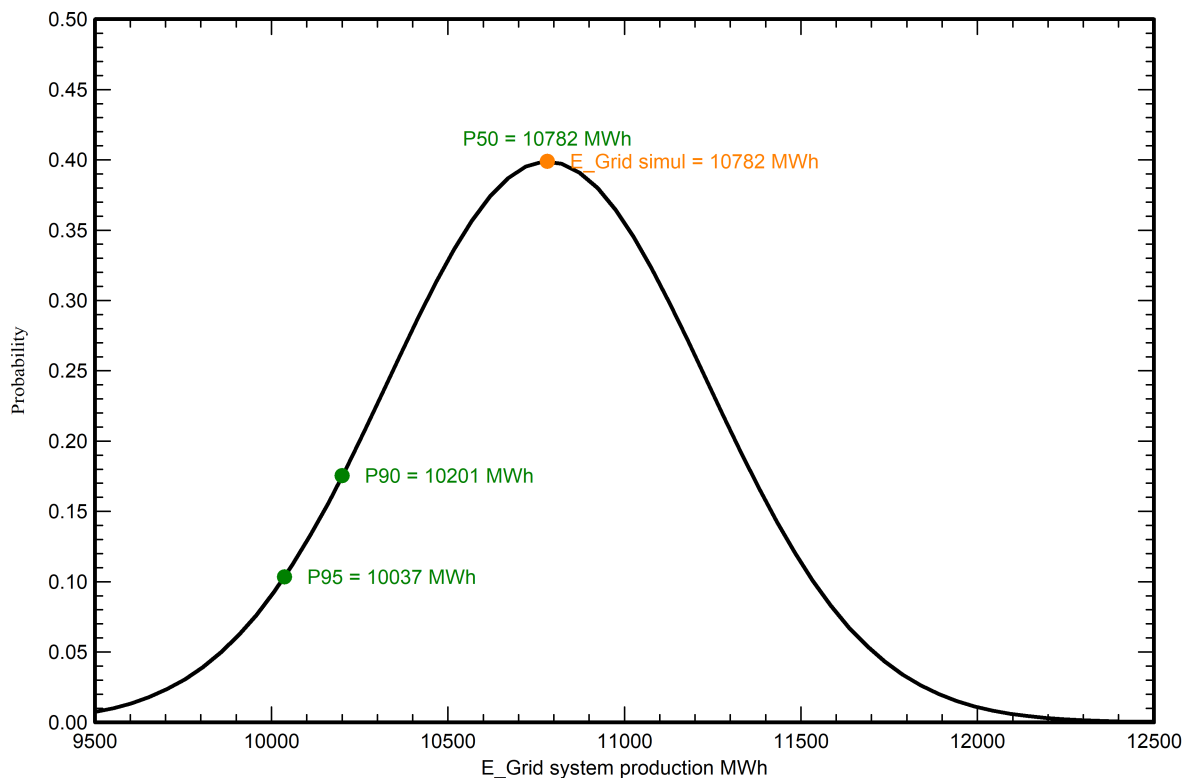
Simulation and parameters uncertainties

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	453 MWh
P50	10782 MWh
P90	10201 MWh
P95	10037 MWh

Probability distribution



PVsyst - Simulation report

Grid-Connected System

Project: REN Project-Ariano Polesine

Variant: Impianto 3

Trackers single array, with backtracking

System power: 5548 kWp

Mezzavilla - Italy

Author

GSB Consulting Srl (Italy)





Project: REN Project-Ariano Polesine

Variant: Impianto 3

PVsyst V8.0.20

VC3, Simulation date:
13/03/26 10:47
with V8.0.20

GSB Consulting Srl (Italy)

Project summary

Geographical Site

Mezzavilla

Italy

Situation

Latitude 44.98 °(N)

Longitude 12.12 °(E)

Altitude 11 m

Time zone UTC+1

Project settings

Albedo 0.20

Weather data

Mezzavilla

PVGIS api TMY

System summary

Grid-Connected System

Orientation #1

Tracking plane, horizontal N-S axis

Axis azimuth 0 °

Phi min / max. -/+ 55 °

Diffuse shading all trackers

Tracking algorithm

Astronomic calculation

Backtracking activated

Trackers single array, with backtracking

Near Shadings

Linear shadings : Fast (table)

User's needs

Unlimited load (grid)

System information

PV Array

Nb. of modules 8343 units

Pnom total 5548 kWp

Inverters

Nb. of units 2 units

Total power 5866 kWac

Pnom ratio 0.95

Results summary

Produced Energy	9660.6 MWh/year	Specific production	1741 kWh/kWp/year	Perf. Ratio PR	88.19 %
				Bifacial perf. ratio	83.71 %

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General parameters

Grid-Connected System

Orientation #1

Tracking plane, horizontal N-S axis

Axis azimuth	0 °
Phi min / max.	-/+ 55 °
Diffuse shading	all trackers

Tracking algorithm

Astronomic calculation
Backtracking activated

Trackers single array, with backtracking

Field properties

Nb. of trackers	309 units
Tracking plane, horizontal N-S axis	

Sizes

Tracker Spacing	6.00 m
Sensitive width	2.38 m
GCR Shading	39.7 %

Backtracking limit angle

Phi limits	+/- 66.6 °
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Backtracking parameters

Backtracking pitch	6.00 m
Backtracking width	2.38 m
Left inactive band	0.00 m
Right inactive band	0.00 m
GCR Backtracking	39.7 %
Parameters choice	Automatic

Models used

Transposition	Perez
Diffuse	Imported
Circumsolar	separate

Horizon

Free Horizon

Near Shadings

Linear shadings : Fast (table)

User's needs

Unlimited load (grid)

Bifacial system definition

Orientation #1

Bifacial system

Model	Unlimited Trackers 2D model
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Bifacial model geometry

Tracker Spacing	6.00 m
Tracker width	2.38 m
Axis height above ground	3.00 m
Nb. of sheds	309 units

Bifacial model definitions

Ground albedo	0.20
Bifaciality factor	72 %
Rear shading factor	5.0 %
Rear mismatch loss	10.0 %
Shed transparent fraction	0.0 %

PV Array Characteristics

PV module

Manufacturer	Trina Solar
Model	TSM-DEG21C-20-665Wp Vertex
(Original PVsyst database)	
Unit Nom. Power	665 Wp
Number of PV modules	8343 units
Nominal (STC)	5548 kWp
Modules	309 string x 27 In series
At operating cond. (50°C)	
Pmpp	5084 kWp
U mpp	938 V
I mpp	5420 A

Inverter

Manufacturer	SMA
Model	Sunny Central 2930 UP
(Original PVsyst database)	
Unit Nom. Power	2933 kWac
Number of inverters	2 units
Total power	5866 kWac
Operating voltage	962-1325 V
Pnom ratio (DC:AC)	0.95



PV Array Characteristics

Total PV power

Nominal (STC)	5548 kWp
Total	8343 modules
Module area	25916 m ²
Cell area	24283 m ²

Total inverter power

Total power	5866 kWac
Number of inverters	2 units
Pnom ratio	0.95

Array losses

Array Soiling Losses

Loss Fraction	2.0 %
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Thermal Loss factor

Module temperature according to irradiance	
Uc (const)	29.0 W/m ² K
Uv (wind)	0.0 W/m ² K/m/s

DC wiring losses

Global array res.	1.9 mΩ
Loss Fraction	1.00 % at STC

LID - Light Induced Degradation

Loss Fraction	1.00 %
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Module Quality Loss

Loss Fraction	-0.38 %
---------------	---------

Module mismatch losses

Loss Fraction	2.00 % at MPP
---------------	---------------

Strings Mismatch loss

Loss Fraction	0.15 %
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IAM loss factor

Incidence effect (IAM): Fresnel, AR coating, n(glass)=1.526, n(AR)=1.290

0°	30°	50°	60°	70°	75°	80°	85°	90°
1.000	0.999	0.987	0.963	0.892	0.814	0.679	0.438	0.000

System losses

Auxiliary losses

Proportional to Power	3.0 W/kW
0.0 kW from Power thresh.	

AC wiring losses

Inv. output line up to MV transfo

Inverter voltage	660 Vac tri
Loss Fraction	1.00 % at STC

Inverter: Sunny Central 2930 UP

Wire section (2 Inv.)	Copper 2 x 3 x 2500 mm ²
Average wires length	212 m

MV line up to Injection

MV Voltage	20 kV
Average each transformer	
Wires	Alu 3 x 120 mm ²
Length	600 m
Loss Fraction	0.11 % at STC

AC losses in transformers



AC losses in transformers

MV transfo

Medium voltage 20 kV

One transfo parameters

Nominal power at STC	2.73 MVA
Iron Loss (24/24 Connexion)	2.93 kVA
Iron loss fraction	0.11 % at STC
Copper loss	25.37 kVA
Copper loss fraction	0.93 % at STC
Coils equivalent resistance	3 x 1.49 mΩ

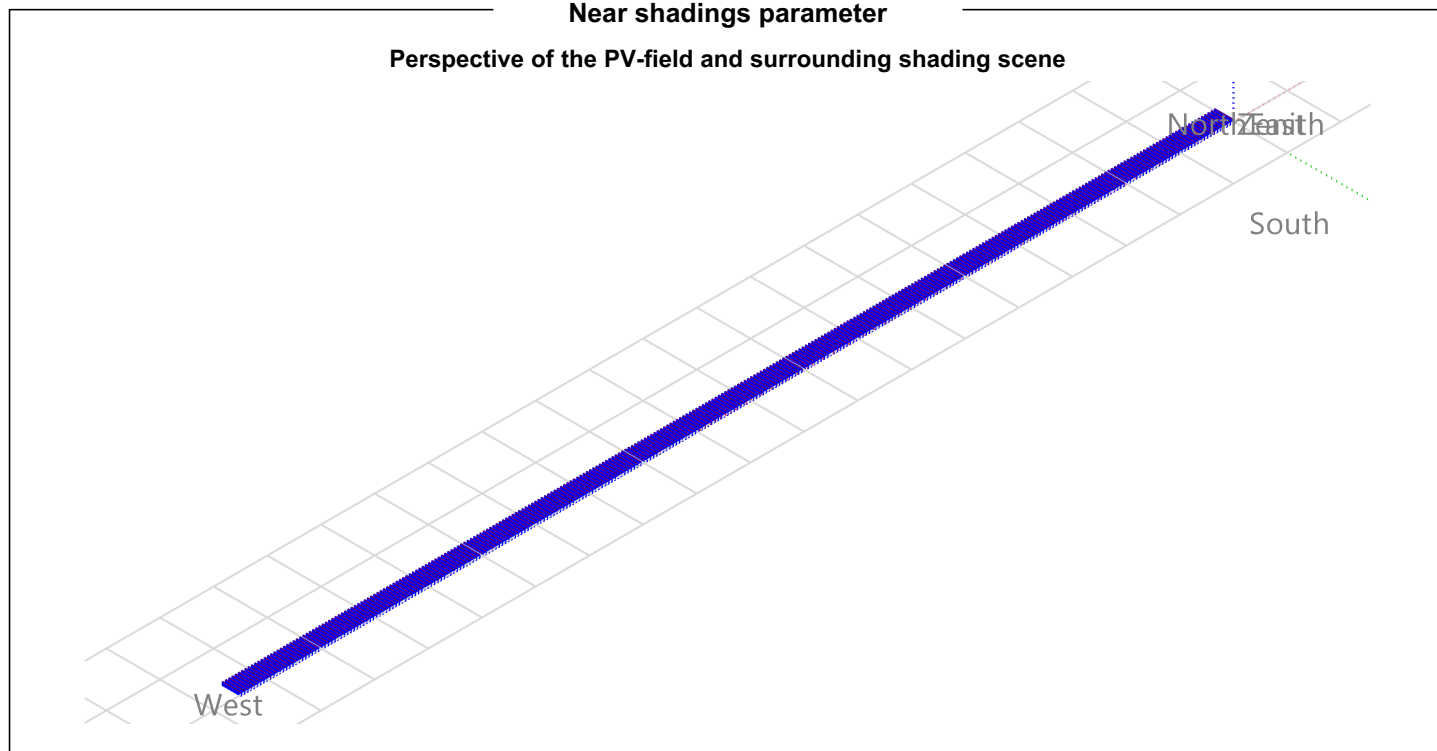
Operating losses at STC (full system)

Nb. identical MV transfos	2
Nominal power at STC	5.46 MVA
Iron loss (24/24 Connexion)	5.87 kVA
Copper loss	50.74 kVA



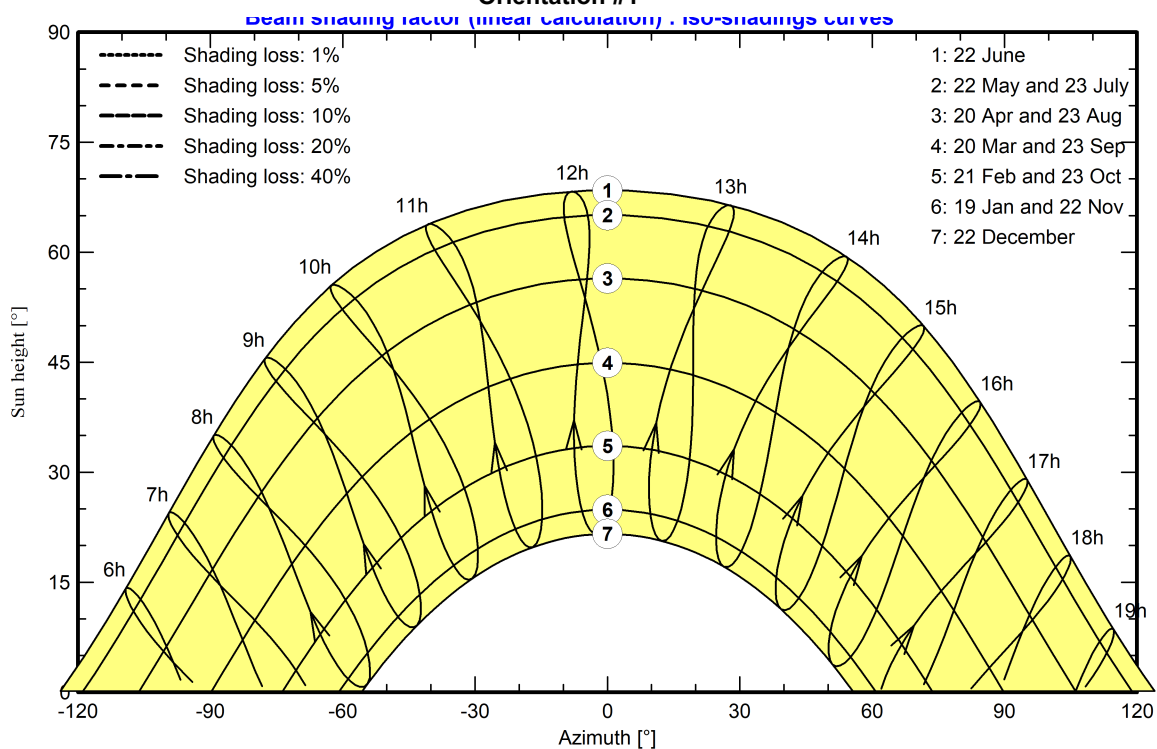
Near shadings parameter

Perspective of the PV-field and surrounding shading scene



Iso-shadings diagram

Orientation #1 -





Project: REN Project-Ariano Polesine

Variant: Impianto 3

PVsyst V8.0.20

VC3, Simulation date:
13/03/26 10:47
with V8.0.20

GSB Consulting Srl (Italy)

Main results

System Production

Produced Energy 9660.6 MWh/year

Specific production

1741 kWh/kWp/year

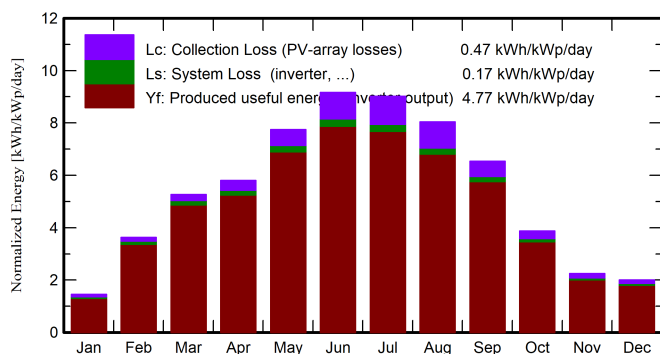
Perf. Ratio PR

88.19 %

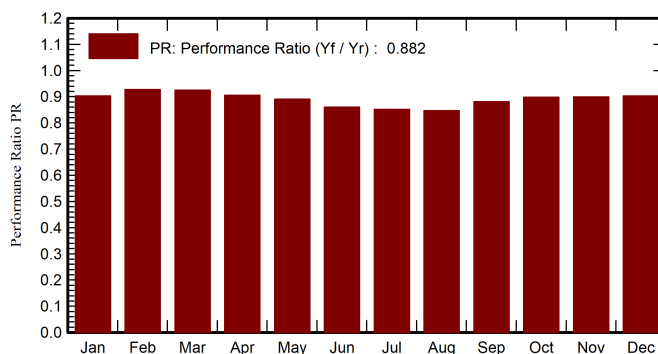
Bifacial perf. ratio

83.71 %

Normalized productions (per installed kWp)



Performance Ratio PR



Balances and main results

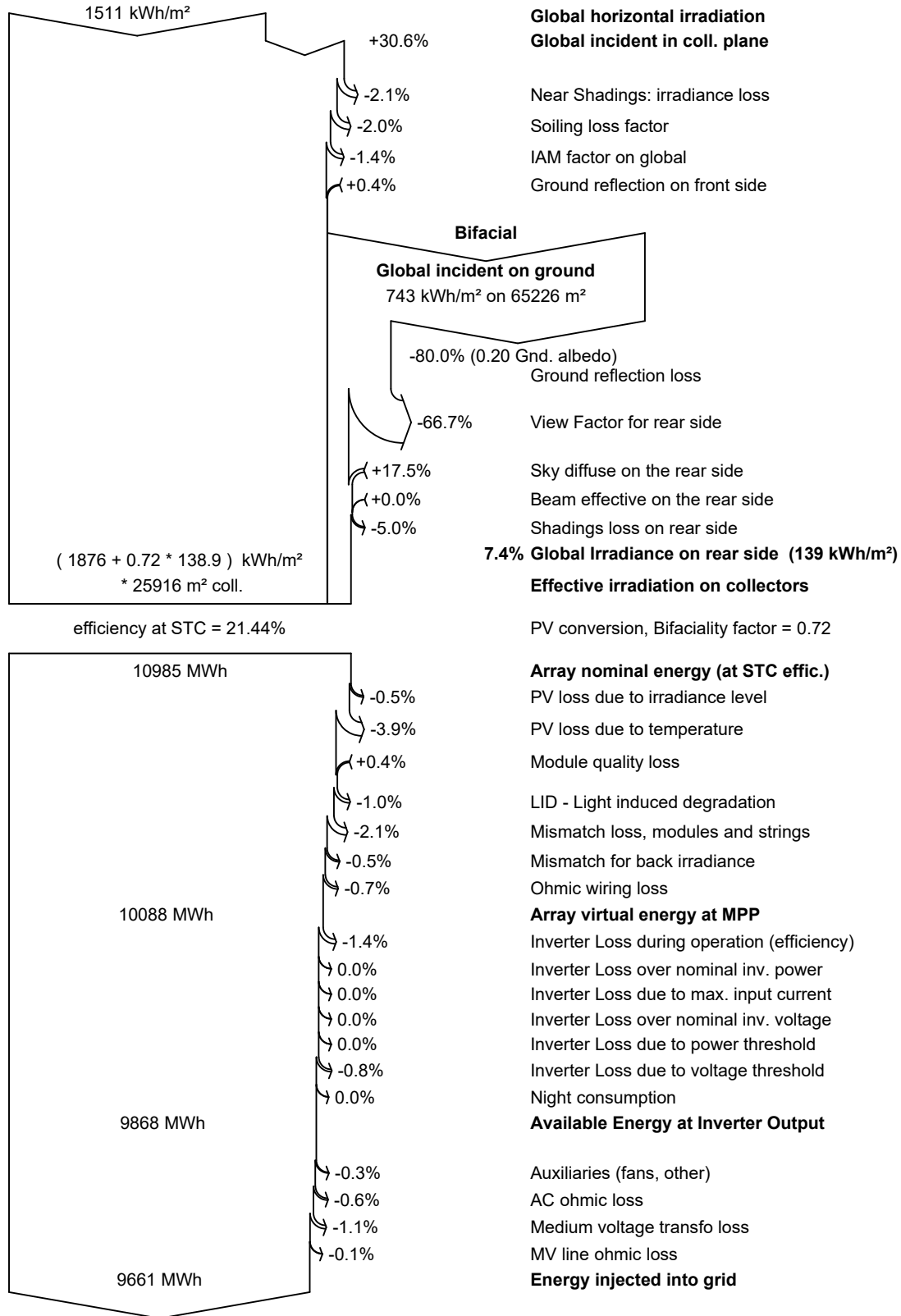
	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_Grid	PR	PRBifi
	kWh/m²	kWh/m²	°C	kWh/m²	kWh/m²	MWh	MWh	ratio	ratio
January	36.3	23.07	5.64	45.1	41.2	237	226	0.903	0.852
February	74.5	29.20	6.32	101.8	95.6	543	524	0.928	0.884
March	123.0	48.46	7.79	163.4	154.9	869	839	0.925	0.879
April	139.0	63.54	13.64	174.1	165.5	906	874	0.905	0.856
May	190.6	76.76	17.65	240.3	229.5	1229	1187	0.890	0.842
June	212.8	73.28	23.13	274.8	263.4	1359	1312	0.860	0.816
July	215.2	75.71	25.42	279.7	267.9	1367	1321	0.851	0.808
August	187.4	61.96	26.41	249.4	239.0	1213	1172	0.847	0.806
September	145.5	51.03	21.73	196.3	187.1	993	960	0.881	0.839
October	90.6	41.01	17.39	120.0	113.0	619	598	0.898	0.853
November	51.3	26.79	11.97	67.3	62.1	349	336	0.900	0.853
December	44.9	18.60	5.87	62.2	56.8	324	312	0.903	0.861
Year	1511.3	589.41	15.29	1974.5	1876.0	10008	9661	0.882	0.837

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	PRBifi	Bifacial Performance Ratio
GlobEff	Effective Global, corr. for IAM and shadings		



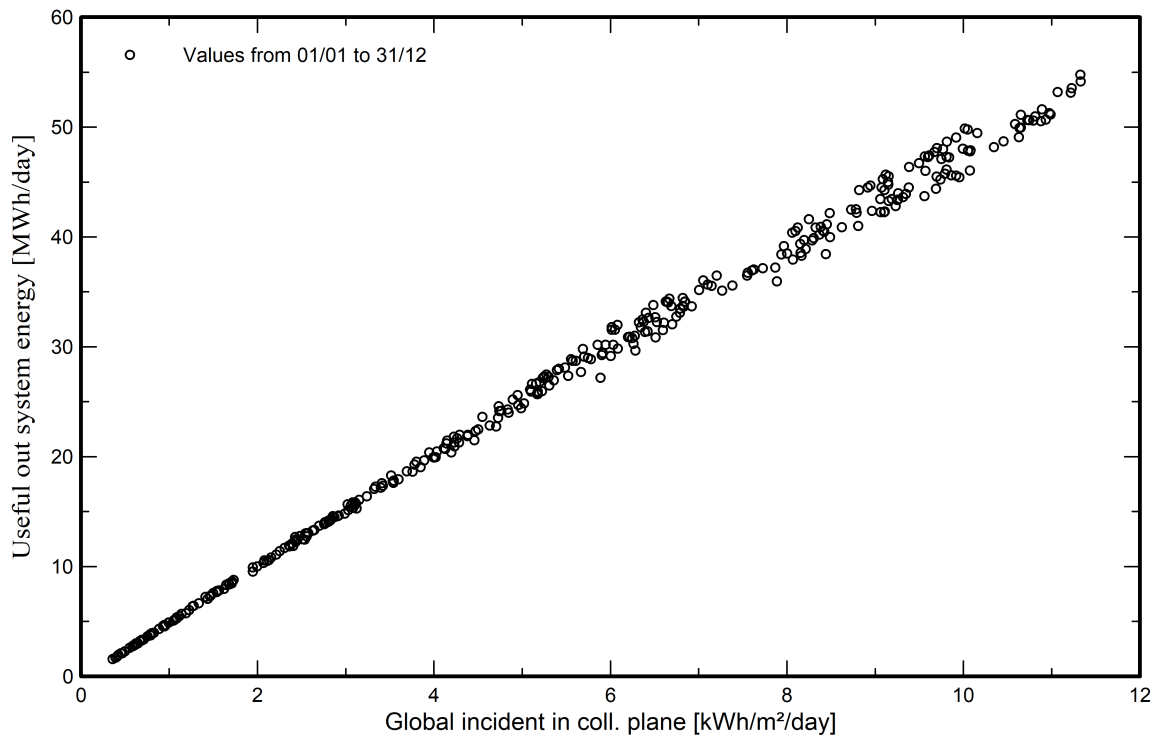
Loss diagram



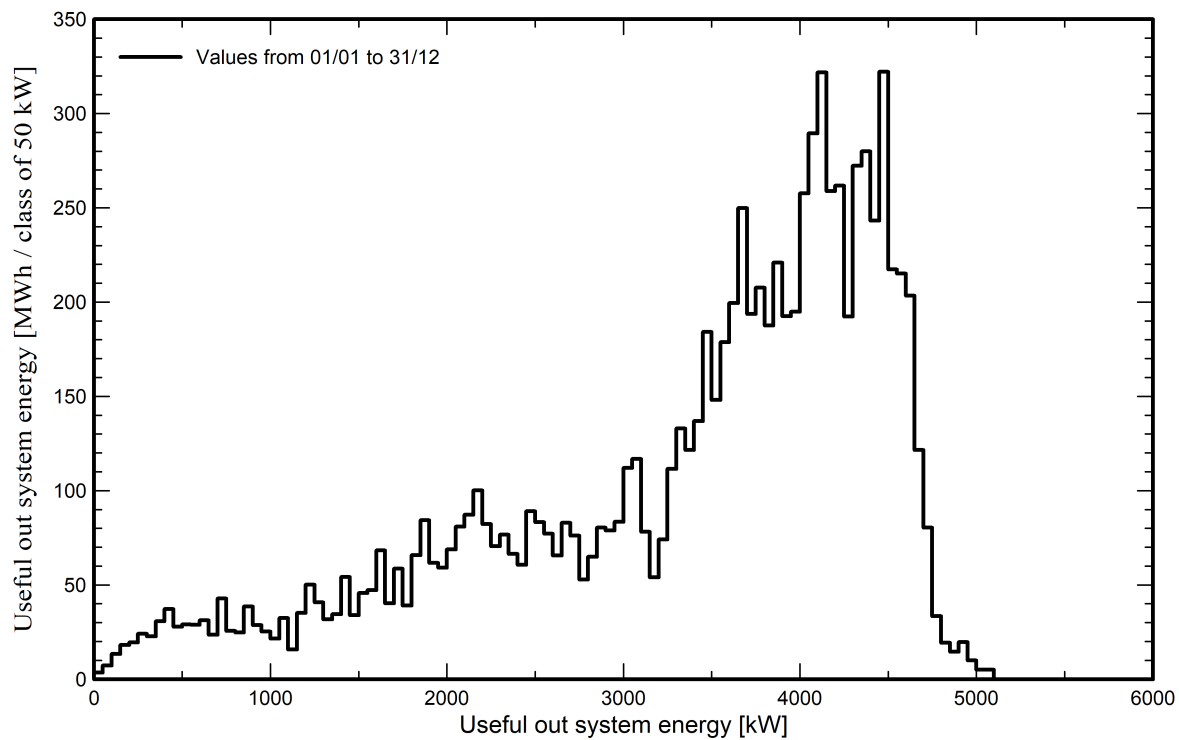


Predef. graphs

Daily Input/Output diagram



System Output Power Distribution





P50 - P90 evaluation

Weather data

Source	PVGIS api TMY
Kind	TMY, multi-year
Year-to-year variability(Variance)	3.8 %
Specified Deviation	
Climate change	0.0 %

Global variability (weather data + system)

Variability (Quadratic sum)	4.2 %
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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	406 MWh
P50	9661 MWh
P90	9140 MWh
P95	8993 MWh

Probability distribution

