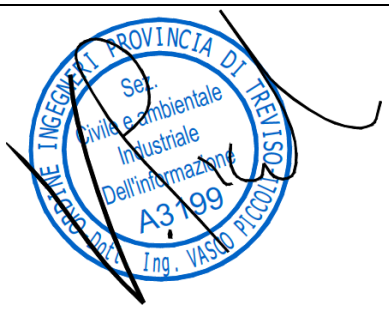
COMUNE DI POMARICO
PROVINCIA DI MATERA
REGIONE BASILICATA

PROGETTO DEFINITIVO DI UN IMPIANTO AGRI-FOTOVOLTAICO
DI POTENZA DI PICCO P=19'998,00 kWp
E POTENZA IN IMMISSIONE P=16'899,86 kW

Proponente

Solar Energy Dodici Srl
VIA SEBASTIAN ALTMANN n. 9 – 39100 BOLZANO (BZ)
PEC: solarenergydodici.srl@legalmail.it
n°REA: BZ-228479 – C.F.: 03058780218

Progettazione



Preparato	*Verificato*	*Approvato*
Andrea Guaiti	**Gianandrea Ing. Bertinazzo**	**Vasco Ing. Piccoli**

PROGETTAZIONE DEFINITIVA

Titolo elaborato

IMPIANTO AGRI-FOTOVOLTAICO
STIMA PRODUCIBILITA' ENERGETICA

Elaborato N. **A.19**	*Data emissione* 25/03/22			
	Nome file PVSyst REPORT			
N. Progetto **SOL015**	*Pagina* COVER	00	25/03/22	PRIMA EMISSIONE
		REV.	DATA	DESCRIZIONE

Version 7.2.11

PVsyst - Simulation report

Grid-Connected System

Project: SOL015_Pomarico

Variant: Layout rev.0 , fixed
Sheds, single array
System power: 12.57 MWp
Pomarico - Italy

Author
GSB Consulting Srl (Italy)

Project: SOL015_Pomarico

Variant: Layout rev.0 , fixed

GSB Consulting Srl (Italy)

Project summary

Geographical Site
Pomarico
Italy

Situation

Latitude	40.54 °N
Longitude	16.57 °E
Altitude	117 m
Time zone	UTC+1

Project settings

Albedo	0.20

Meteo data
Pomarico
Meteonorm 8.0, Sat=100% - Synthetic

System summary

Grid-Connected System

Sheds, single array

PV Field Orientation
Fixed plane
Tilt/Azimuth 20 / 0 °

Near Shadings
Linear shadings

User's needs
Unlimited load (grid)

System information

PV Array

Nb. of modules	19050 units
Pnom total	12.57 MWp

Inverters

Nb. of units	60 units
Pnom total	12.00 MWac
Pnom ratio	1.048

Results summary

Produced Energy	18 GWh/year	Specific production	1420 kWh/kWp/year	Perf. Ratio PR	85.12 %

Table of contents

General parameters

Grid-Connected System — **Sheds, single array**

PV Field Orientation

Orientation		Sheds configuration		Models used	
Fixed plane		Nb. of sheds	43 units	Transposition	Perez
Tilt/Azimuth	20 / 0 °	Single array		Diffuse	Perez, Meteonorm
		Sizes		Circumsolar	separate
		Sheds spacing	7.50 m		
		Collector width	4.79 m		
		Ground Cov. Ratio (GCR)	63.8 %		
		Top inactive band	0.02 m		
		Bottom inactive band	0.02 m		
		Shading limit angle			
		Limit profile angle	28.9 °		

Horizon		Near Shadings	User's needs
Average Height	4.6 °	Linear shadings	Unlimited load (grid)

PV Array Characteristics

PV module

Manufacturer	Risen Energy Co., Ltd
Model	RSM132-8-660BMDG
(Custom parameters definition)	
Unit Nom. Power	660 Wp
Number of PV modules	19050 units
Nominal (STC)	12.57 MWp
Modules	635 Strings x 30 In series
At operating cond. (50°C)	
Pmpp	11.51 MWp
U mpp	1039 V
I mpp	11074 A

Inverter

Manufacturer	Huawei Technologies
Model	SUN2000-215KTL-H3
(Custom parameters definition)	
Unit Nom. Power	200 kWac
Number of inverters	60 units
Total power	12000 kWac
Operating voltage	500-1500 V
Max. power (=>33°C)	215 kWac
Pnom ratio (DC:AC)	1.05

Total PV power

Nominal (STC)	12573 kWp
Total	19050 modules
Module area	59176 m²
Cell area	55447 m²

Total inverter power

Total power	12000 kWac
Number of inverters	60 units
Pnom ratio	1.05

Array losses

Array Soiling Losses
Loss Fraction 2.0 %

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. 1.0 mΩ
Loss Fraction 1.0 % at STC

LID - Light Induced Degradation
Loss Fraction 1.6 %

Module Quality Loss
Loss Fraction -0.5 %

Module mismatch losses
Loss Fraction 1.0 % at MPP

Strings Mismatch loss
Loss Fraction 0.1 %

IAM loss factor
Incidence effect (IAM): User defined profile

0°	20°	40°	60°	70°	75°	80°	85°	90°
1.000	1.000	1.000	1.000	0.992	0.978	0.946	0.850	0.000

PVsyst V7.2.11
VC0, Simulation date:
24/03/22 11:57
with v7.2.11

System losses

Auxiliaries loss
Proportionnal to Power 4.0 W/kW
0.0 kW from Power thresh.

AC wiring losses

Inv. output line up to MV transfo

Inverter voltage	800	Vac tri
Loss Fraction	1.04	% at STC
Inverter: SUN2000-215KTL-H3		
Wire section (60 Inv.)	Alu 60 x 3 x 240	mm²
Average wires length	246	m

MV line up to Injection

MV Voltage	36	kV
Wires	Copper 3 x 240	mm²
Length	13400	m
Loss Fraction	1.00	% at STC

AC losses in transformers

MV transfo

Grid voltage	36	kV
Operating losses at STC		
Nominal power at STC	12350	kVA
Iron loss (24/24 Connexion)	12.35	kW
Loss Fraction	0.10	% at STC
Coils equivalent resistance	3 x 0.52	mΩ
Loss Fraction	1.00	% at STC

Horizon definition

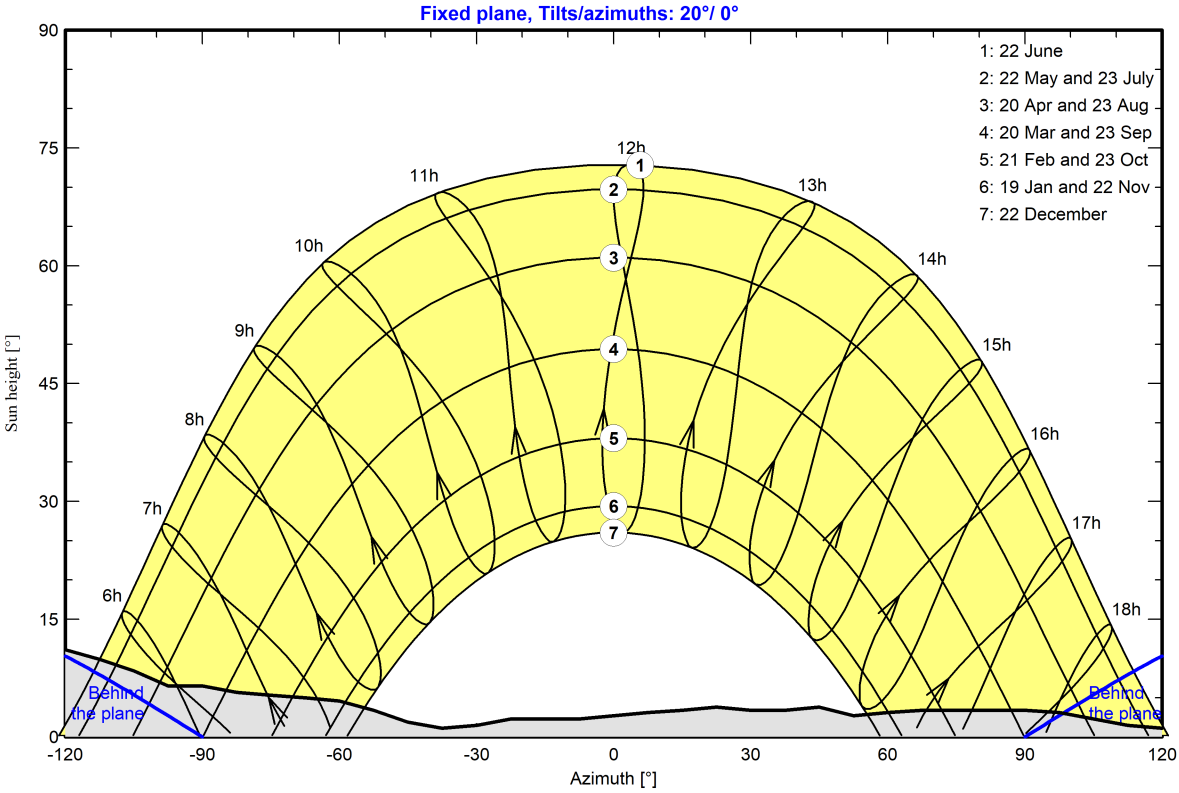
Horizon from PVGIS website API, Lat=40°30"56', Long=16°39"33', Alt=57m

Average Height	4.6 °	Albedo Factor	0.86
Diffuse Factor	0.99	Albedo Fraction	100 %

Horizon profile

Azimuth [°]	-180	-173	-165	-158	-150	-143	-135	-128	-120	-113	-105	-98
Height [°]	6.9	8.0	8.4	10.3	11.1	11.1	10.3	11.1	11.1	9.9	8.4	6.5
Azimuth [°]	-90	-83	-75	-68	-60	-53	-45	-38	-30	-23	-8	0
Height [°]	6.5	5.7	5.3	5.0	4.6	3.4	1.9	1.1	1.5	2.3	2.3	2.7
Azimuth [°]	8	15	23	30	38	45	53	60	68	90	98	105
Height [°]	3.1	3.4	3.8	3.4	3.4	3.8	2.7	3.1	3.4	3.4	3.1	2.3
Azimuth [°]	113	120	128	135	143	150	158	165	173	180		
Height [°]	1.5	1.1	0.4	0.8	0.8	2.3	2.3	2.7	4.2	6.9		

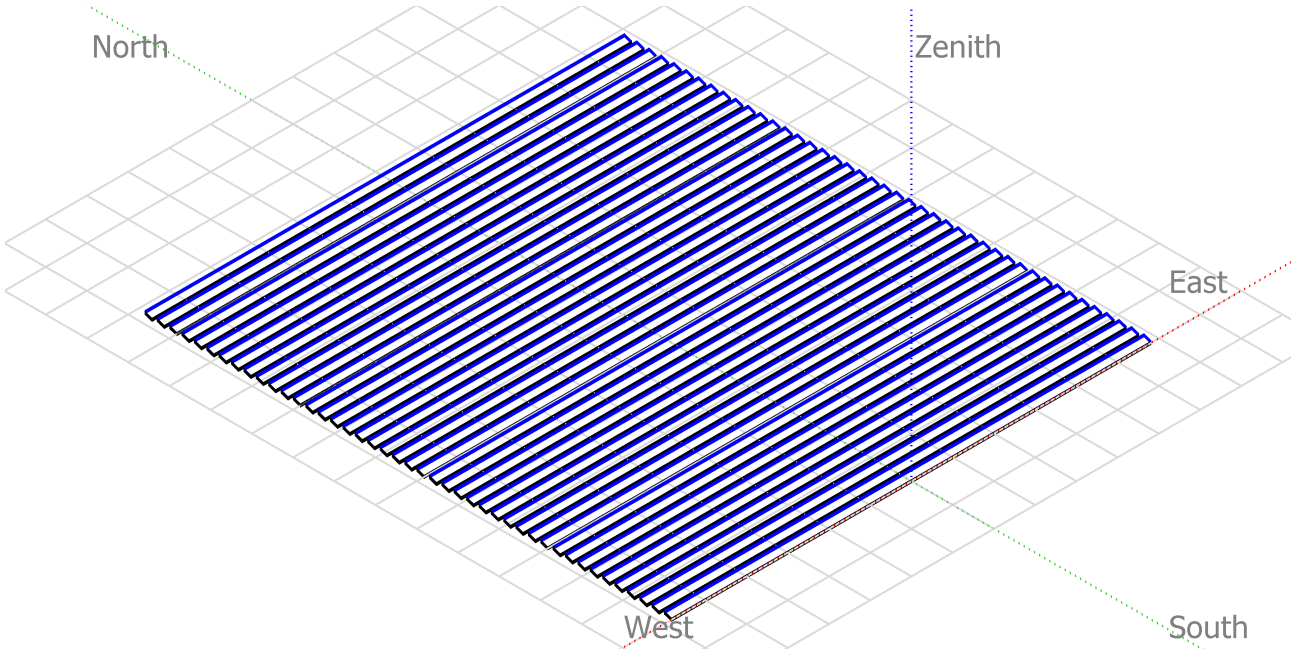
Sun Paths (Height / Azimuth diagram)



PVsyst V7.2.11
VC0, Simulation date:
24/03/22 11:57
with v7.2.11

Near shadings parameter

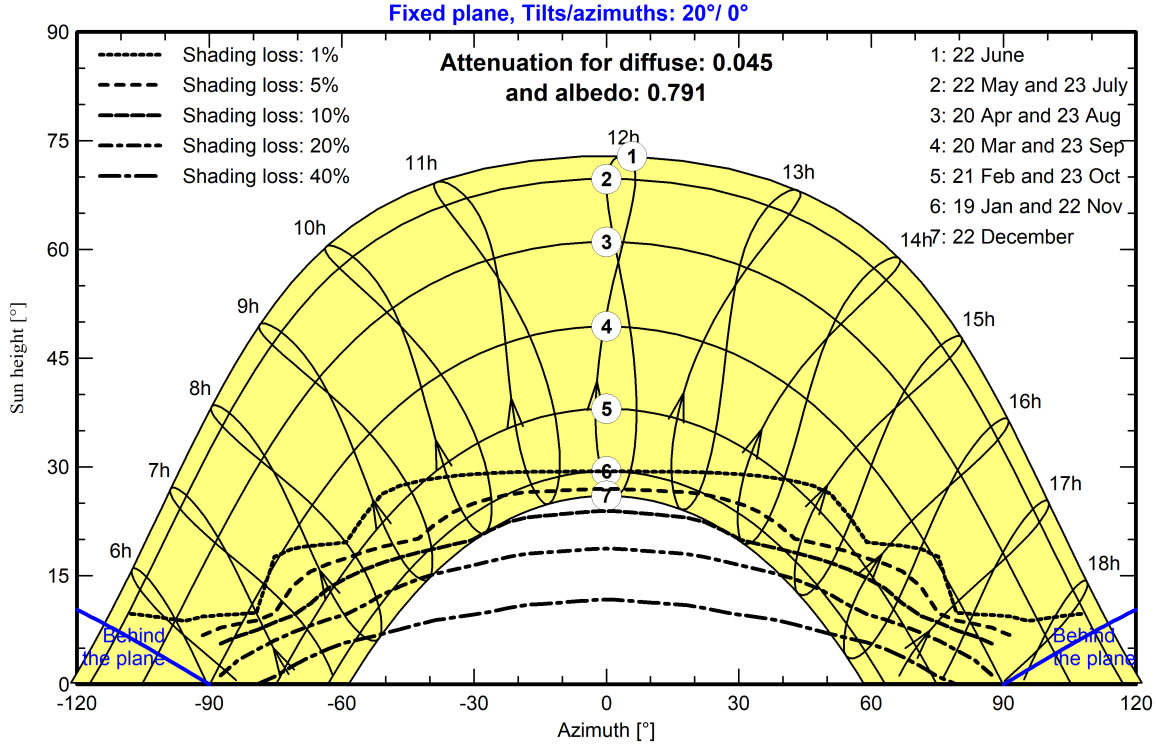
Perspective of the PV-field and surrounding shading scene



Iso-shadings diagram

Orientation #1

Fixed plane, Tilts/azimuths: 20°/ 0°



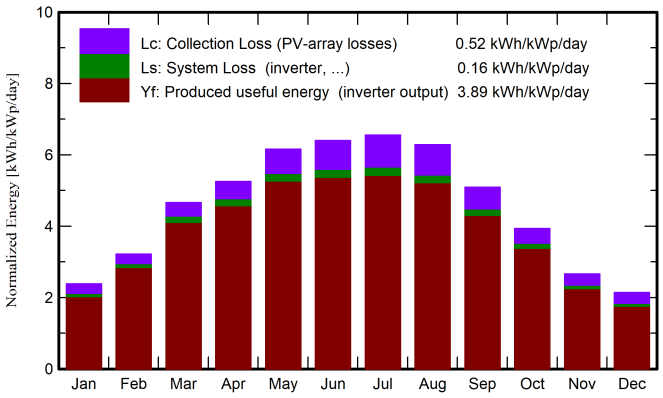
PVsyst V7.2.11
VC0, Simulation date:
24/03/22 11:57
with v7.2.11

Main results

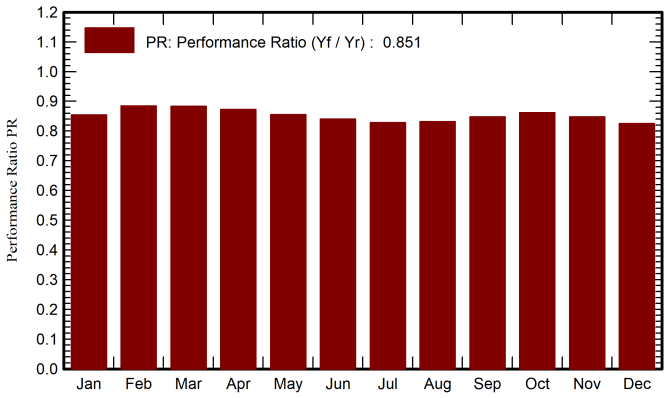
System Production

Produced Energy	18 GWh/year	Specific production	1420 kWh/kWp/year
		Performance Ratio PR	85.12 %

Normalized productions (per installed kWp)



Performance Ratio PR



Balances and main results

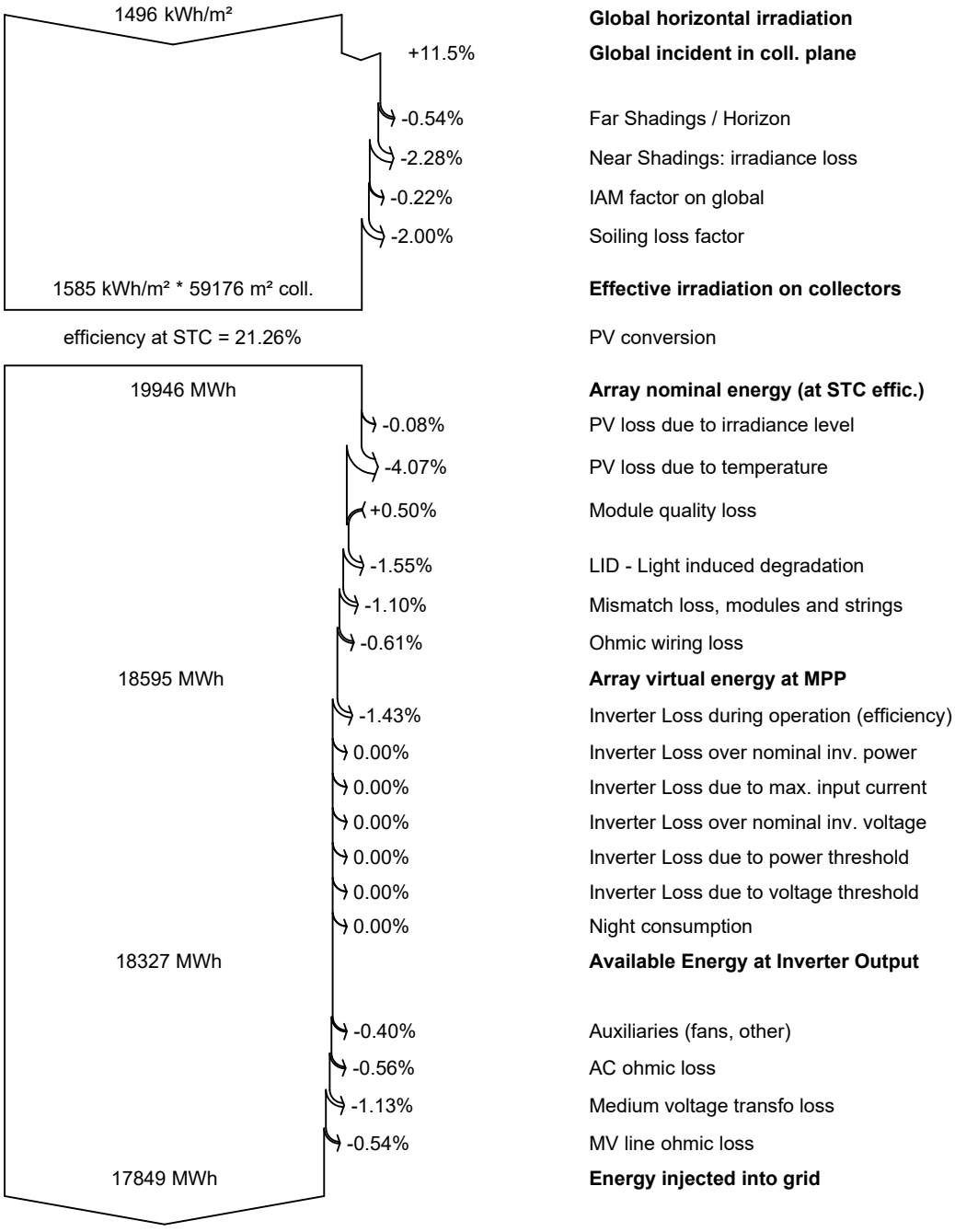
	GlobHor kWh/m²	DiffHor kWh/m²	T_Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray GWh	E_Grid GWh	PR ratio
January	53.5	28.80	8.75	73.8	66.9	0.825	0.792	0.854
February	71.0	40.53	9.56	90.1	84.6	1.041	1.001	0.884
March	122.0	54.10	12.17	144.6	138.7	1.672	1.605	0.883
April	146.1	71.67	15.09	157.6	151.0	1.800	1.729	0.872
May	187.7	86.19	19.77	191.0	183.1	2.139	2.054	0.855
June	193.8	87.76	24.56	191.9	184.0	2.112	2.027	0.840
July	203.0	80.96	27.86	203.2	195.3	2.207	2.117	0.829
August	183.7	74.65	27.63	194.8	187.5	2.122	2.036	0.831
September	133.9	60.70	22.60	152.6	146.3	1.695	1.627	0.848
October	97.3	45.60	18.65	122.0	116.2	1.375	1.321	0.861
November	58.3	28.18	14.10	79.9	73.3	0.888	0.851	0.848
December	46.1	24.63	10.26	66.4	58.3	0.719	0.689	0.825
Year	1496.4	683.79	17.63	1667.9	1585.2	18.595	17.849	0.851

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 V7.2.11
VC0, Simulation date:
24/03/22 11:57
with v7.2.11

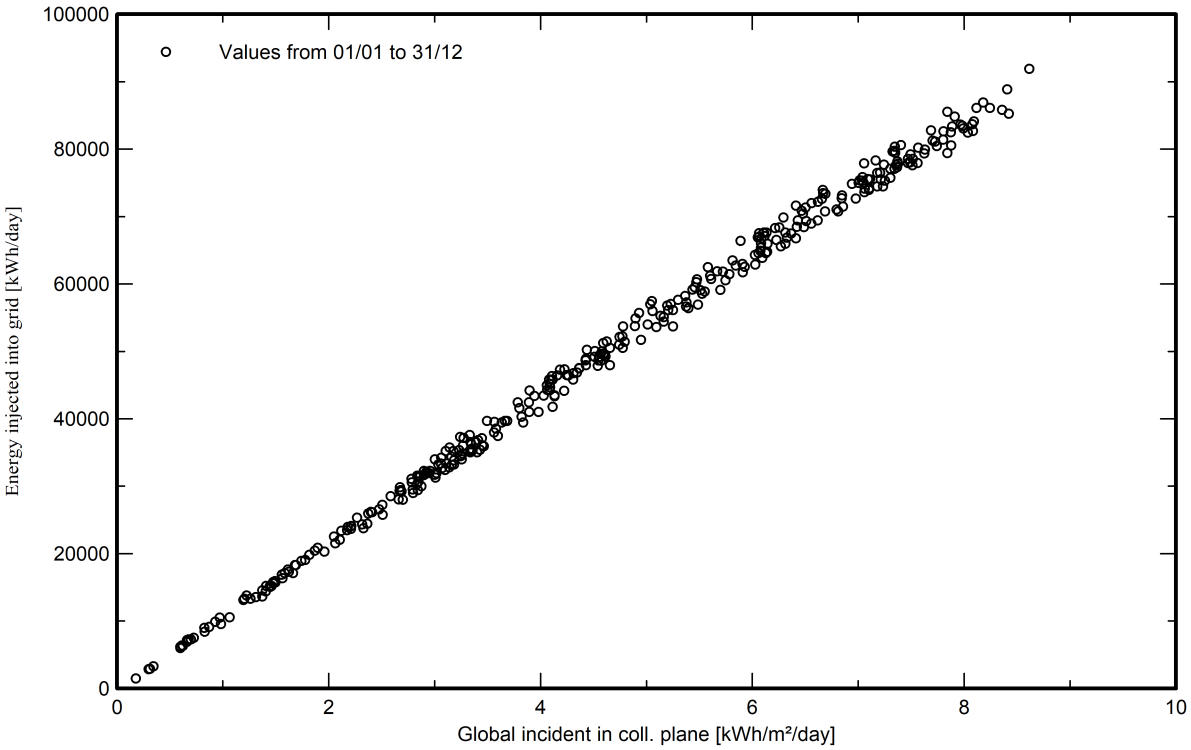
Loss diagram



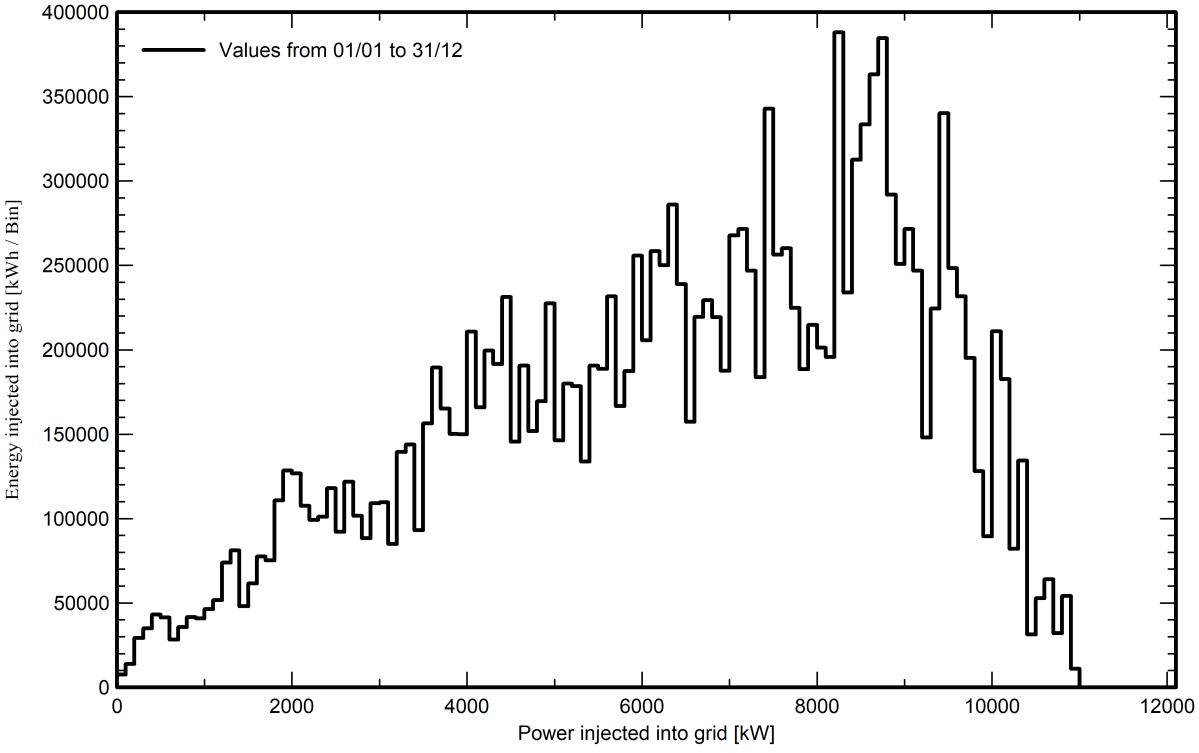
PVsyst V7.2.11
VC0, Simulation date:
24/03/22 11:57
with v7.2.11

Special graphs

Daily Input/Output diagram



System Output Power Distribution



Version 7.2.11

PVsyst - Simulation report

Grid-Connected System

Project: SOL015_Pomarico

Variant: Layout rev.0 , tracker

Trackers single array, with backtracking

System power: 7425 kWp

Pomarico - Italy

Author

GSB Consulting Srl (Italy)

Project: SOL015_Pomarico

Variant: Layout rev.0 , tracker

GSB Consulting Srl (Italy)

Project summary

Geographical Site
Pomarico
Italy

Situation

Latitude	40.54 °N
Longitude	16.57 °E
Altitude	117 m
Time zone	UTC+1

Project settings

Albedo	0.20

Meteo data
Pomarico
Meteonorm 8.0, Sat=100% - Synthetic

System summary

Grid-Connected System

Trackers single array, with backtracking

PV Field Orientation
Tracking plane, horizontal N-S axis
Axis azimuth 0 °

Near Shadings
Linear shadings

User's needs
Unlimited load (grid)

System information

PV Array

Nb. of modules	11250 units
Pnom total	7425 kWp

Inverters

Nb. of units	36 units
Pnom total	7200 kWac
Pnom ratio	1.031

Results summary

Produced Energy	13 GWh/year	Specific production	1705 kWh/kWp/year	Perf. Ratio PR	88.97 %

Table of contents

General parameters

Grid-Connected System — **Trackers single array, with backtracking**

PV Field Orientation

Orientation

Tracking plane, horizontal N-S axis	
Axis azimuth	0 °

Backtracking strategy

Nb. of trackers	56 units
Single array	

Sizes

Tracker Spacing	6.00 m
Collector width	2.38 m
Ground Cov. Ratio (GCR)	39.7 %
Phi min / max.	-/+ 55.0 °

Backtracking limit angle

Phi limits	+/- 66.4 °

Models used

Transposition	Perez
Diffuse	Perez, Meteonorm
Circumsolar	separate

Horizon

Average Height	4.6 °

Near Shadings

Linear shadings

User's needs

Unlimited load (grid)

Bifacial system

Model: 2D Calculation, unlimited trackers

Bifacial model geometry

Tracker Spacing	6.00 m
Tracker width	2.38 m
GCR	39.7 %
Axis height above ground	2.50 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 %

PV Array Characteristics

PV module

Manufacturer	Risen Energy Co., Ltd
Model	RSM132-8-660BMDG
(Custom parameters definition)	
Unit Nom. Power	660 Wp
Number of PV modules	11250 units
Nominal (STC)	7425 kWp
Modules	375 Strings x 30 In series
At operating cond. (50°C)	
Pmpp	6797 kWp
U mpp	1039 V
I mpp	6540 A

Inverter

Manufacturer	Huawei Technologies
Model	SUN2000-215KTL-H3
(Custom parameters definition)	
Unit Nom. Power	200 kWac
Number of inverters	36 units
Total power	7200 kWac
Operating voltage	500-1500 V
Max. power (=>33°C)	215 kWac
Pnom ratio (DC:AC)	1.03

Total PV power

Nominal (STC)	7425 kWp
Total	11250 modules
Module area	34946 m²
Cell area	32744 m²

Total inverter power

Total power	7200 kWac
Number of inverters	36 units
Pnom ratio	1.03

Array losses

Array Soiling Losses
Loss Fraction 2.0 %

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. 1.7 mΩ
Loss Fraction 1.0 % at STC

LID - Light Induced Degradation
Loss Fraction 1.6 %

Module Quality Loss
Loss Fraction -0.5 %

Module mismatch losses
Loss Fraction 1.0 % at MPP

Strings Mismatch loss
Loss Fraction 0.1 %

IAM loss factor
Incidence effect (IAM): User defined profile

0°	20°	40°	60°	70°	75°	80°	85°	90°
1.000	1.000	1.000	1.000	0.992	0.978	0.946	0.850	0.000

System losses

Auxiliaries loss
Proportionnal to Power 4.0 W/kW
0.0 kW from Power thresh.

AC wiring losses

Inv. output line up to MV transfo
Inverter voltage 800 Vac tri
Loss Fraction 1.02 % at STC

Inverter: SUN2000-215KTL-H3
Wire section (36 Inv.) Alu 36 x 3 x 240 mm²
Average wires length 246 m

MV line up to Injection
MV Voltage 36 kV
Wires Copper 3 x 240 mm²
Length 16000 m
Loss Fraction 0.71 % at STC

AC losses in transformers

MV transfo
Grid voltage 36 kV

Operating losses at STC
Nominal power at STC 7294 kVA
Iron loss (24/24 Connexion) 7.29 kW
Loss Fraction 0.10 % at STC
Coils equivalent resistance 3 x 0.88 mΩ
Loss Fraction 1.00 % at STC

PVsyst V7.2.11
VC1, Simulation date:
24/03/22 12:07
with v7.2.11

Horizon definition

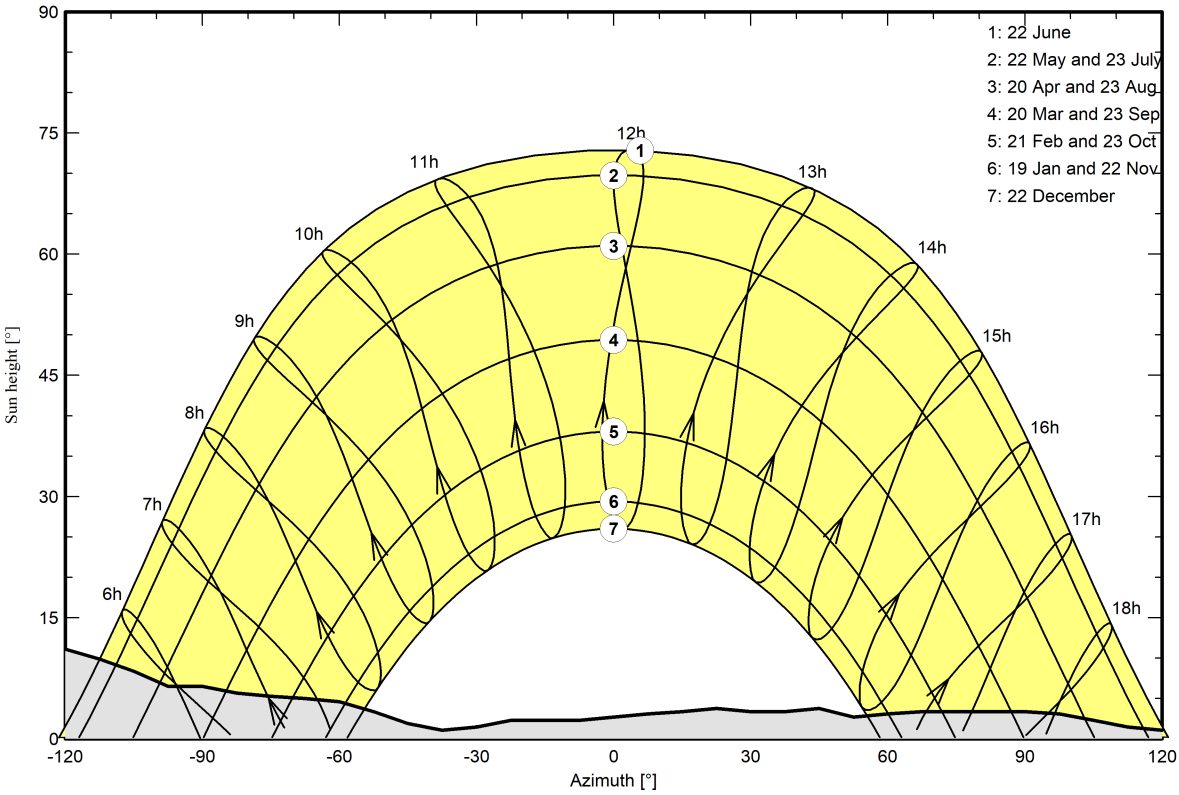
Horizon from PVGIS website API, Lat=40°30"56', Long=16°39"34', Alt=m

Average Height	4.6 °	Albedo Factor	0.87
Diffuse Factor	0.97	Albedo Fraction	100 %

Horizon profile

Azimuth [°]	-180	-173	-165	-158	-150	-143	-135	-128	-120	-113	-105	-98
Height [°]	6.9	8.0	8.4	10.3	11.1	11.1	10.3	11.1	11.1	9.9	8.4	6.5
Azimuth [°]	-90	-83	-75	-68	-60	-53	-45	-38	-30	-23	-8	0
Height [°]	6.5	5.7	5.3	5.0	4.6	3.4	1.9	1.1	1.5	2.3	2.3	2.7
Azimuth [°]	8	15	23	30	38	45	53	60	68	90	98	105
Height [°]	3.1	3.4	3.8	3.4	3.4	3.8	2.7	3.1	3.4	3.4	3.1	2.3
Azimuth [°]	113	120	128	135	143	150	158	165	173	180		
Height [°]	1.5	1.1	0.4	0.8	0.8	2.3	2.3	2.7	4.2	6.9		

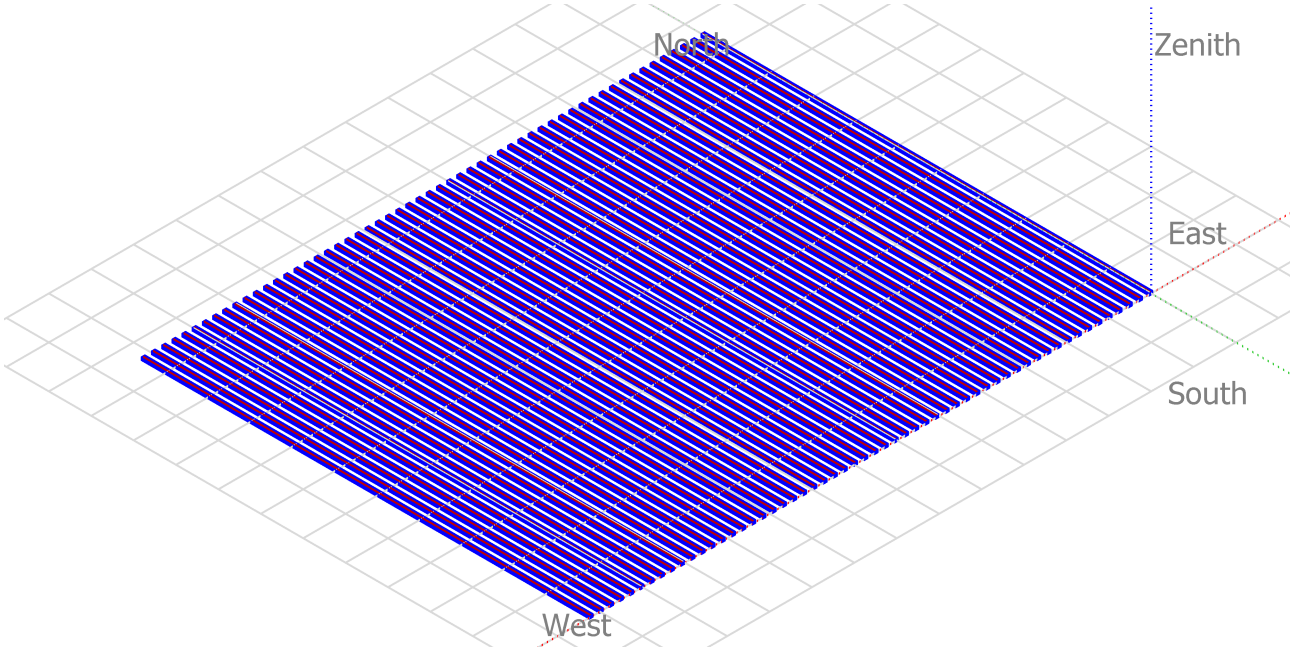
Sun Paths (Height / Azimuth diagram)



PVsyst V7.2.11
VC1, Simulation date:
24/03/22 12:07
with v7.2.11

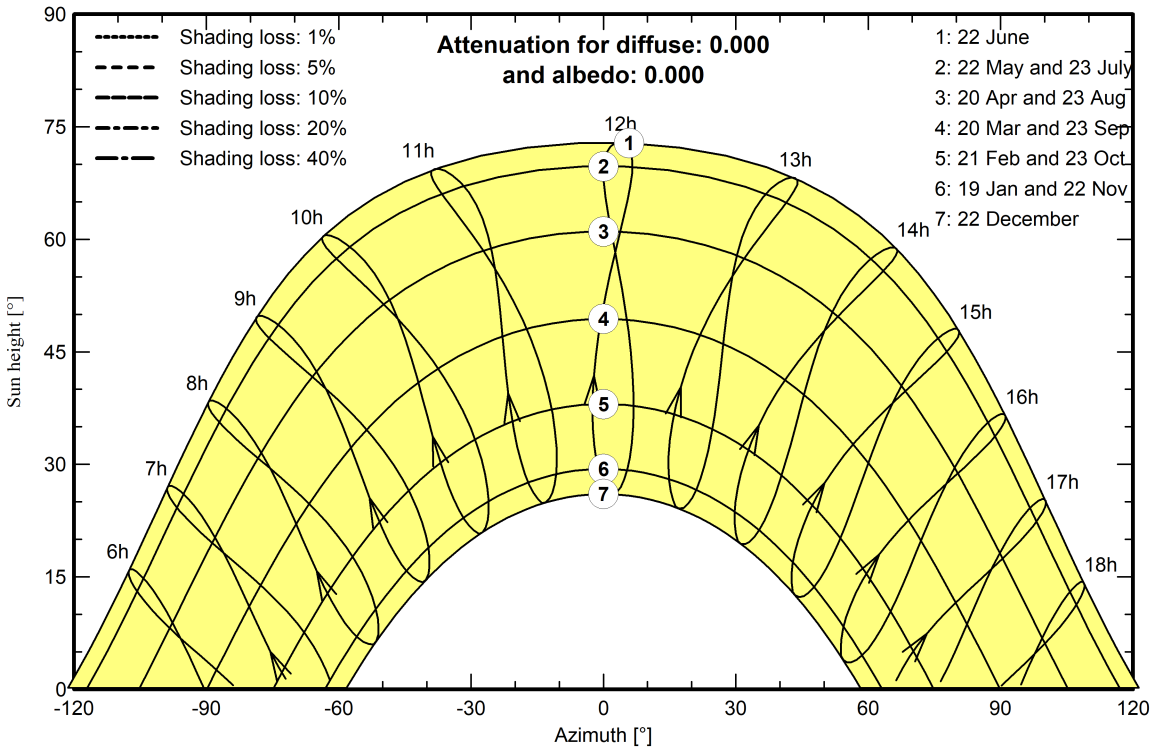
Near shadings parameter

Perspective of the PV-field and surrounding shading scene



Iso-shadings diagram

Orientation #1



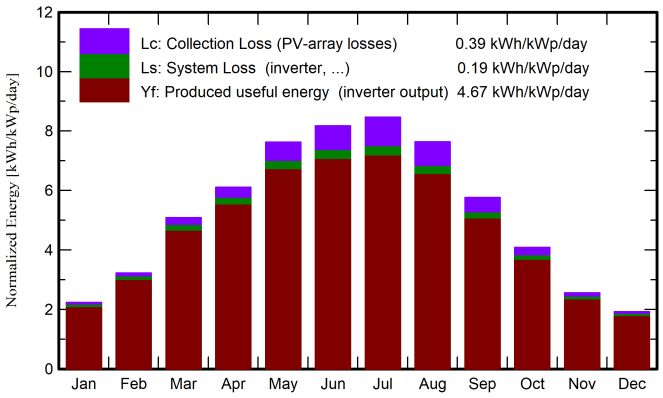
PVsyst V7.2.11
VC1, Simulation date:
24/03/22 12:07
with v7.2.11

Main results

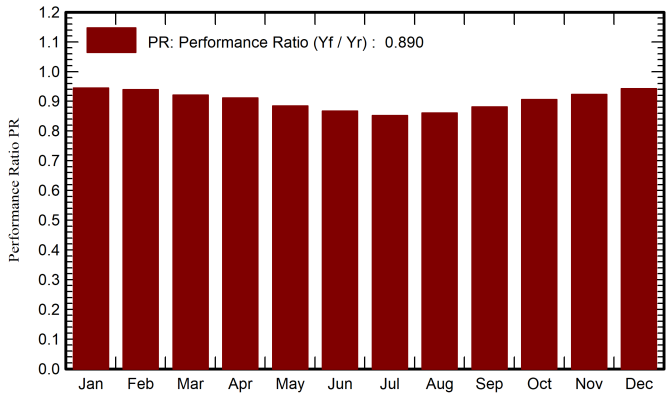
System Production

Produced Energy	13 GWh/year	Specific production	1705 kWh/kWp/year
		Performance Ratio PR	88.97 %

Normalized productions (per installed kWp)



Performance Ratio PR



Balances and main results

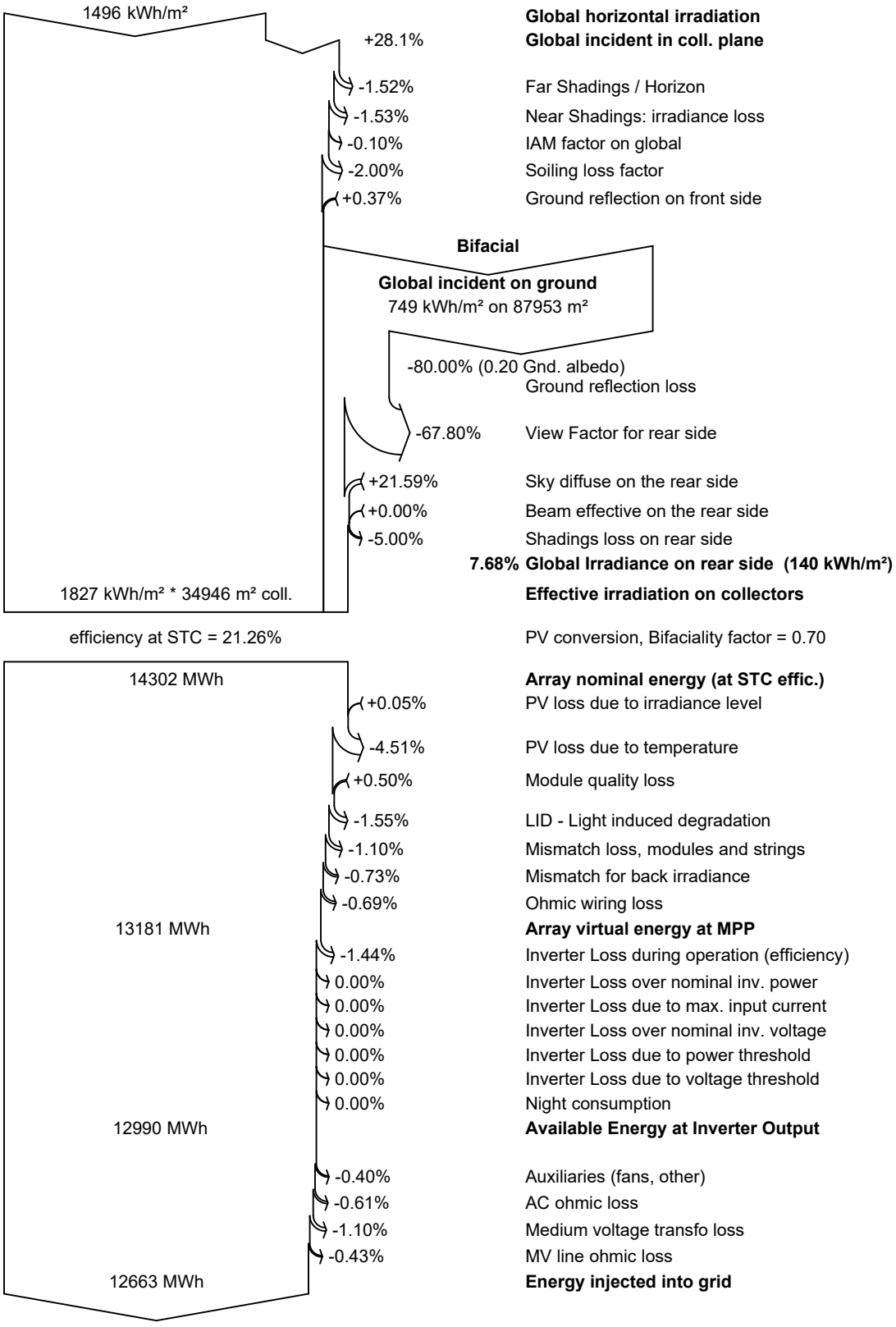
	GlobHor kWh/m²	DiffHor kWh/m²	T_Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray GWh	E_Grid GWh	PR ratio
January	53.5	28.80	8.75	69.1	65.7	0.504	0.485	0.944
February	71.0	40.53	9.56	90.1	85.2	0.653	0.629	0.940
March	122.0	54.10	12.17	157.6	150.3	1.120	1.077	0.921
April	146.1	71.67	15.09	183.2	174.9	1.289	1.239	0.911
May	187.7	86.19	19.77	236.5	225.1	1.617	1.553	0.884
June	193.8	87.76	24.56	245.2	233.4	1.646	1.580	0.868
July	203.0	80.96	27.86	262.3	250.2	1.730	1.659	0.852
August	183.7	74.65	27.63	236.9	227.0	1.578	1.514	0.861
September	133.9	60.70	22.60	173.1	164.8	1.178	1.132	0.881
October	97.3	45.60	18.65	126.7	120.7	0.885	0.852	0.906
November	58.3	28.18	14.10	76.8	72.9	0.548	0.527	0.923
December	46.1	24.63	10.26	59.4	56.4	0.433	0.416	0.942
Year	1496.4	683.79	17.63	1917.0	1826.6	13.181	12.663	0.890

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 V7.2.11
VC1, Simulation date:
24/03/22 12:07
with v7.2.11

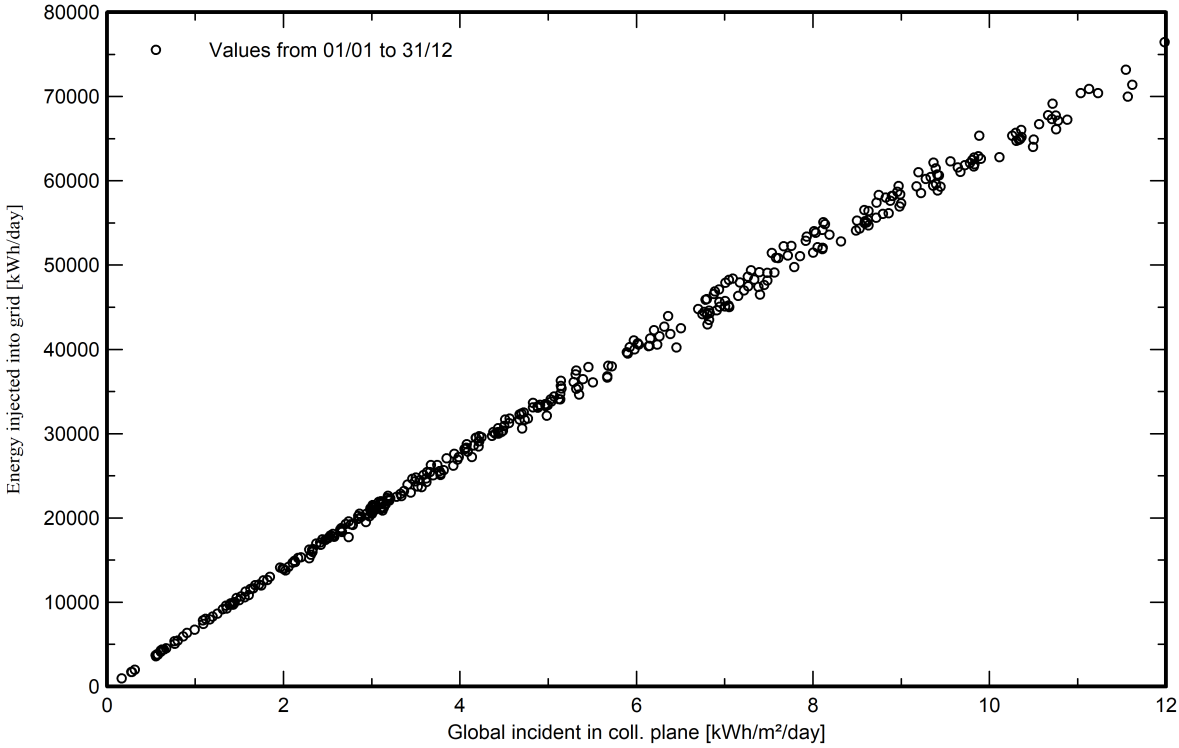
Loss diagram



PVsyst V7.2.11
VC1, Simulation date:
24/03/22 12:07
with v7.2.11

Special graphs

Daily Input/Output diagram



System Output Power Distribution