

COMUNE DI MONTECAGLIOSO
PROVINCIA DI MATERA
REGIONE BASILICATA

**PROGETTO DEFINITIVO DI UN IMPIANTO AGRI-FOTOVOLTAICO
 DI POTENZA DI PICCO P=10'949,40 kWp CON SISTEMA DI
 ACCUMULO PER UNA POTENZA NOMINALE P=6'300,00 kW**

Proponente

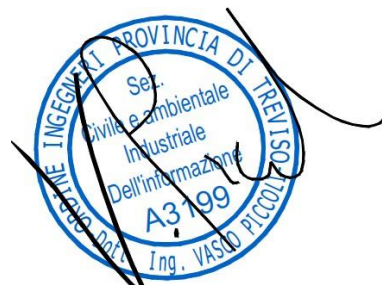
Solar Energy Diciotto Srl

VIA SEBASTIAN ALTMANN n. 9 – 39100 BOLZANO (BZ)

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n°REA: BZ-228497 – C.F.: 03058960216

Progettazione



Preparato

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Approvato

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PROGETTAZIONE DEFINITIVA

Titolo elaborato

**IMPIANTO AGRI-FOTOVOLTAICO
 STIMA PRODUCIBILITA' ENERGETICA**

Elaborato N.

A.14

Data emissione

25/03/22

Nome file

PVSystem REPORT

N. Progetto

SOLO14

Pagina

COVER

00

25/03/22

PRIMA EMISSIONE

REV.

DATA

DESCRIZIONE

PVsyst - Simulation report

Grid-Connected System

Project: SOL014_Montescaglioso

Variant: Layout rev.0 , fixed

Sheds, single array

System power: 5643 kWp

Montescaglioso - Italy



Project summary

Geographical Site Montescaglioso Italy	Situation Latitude 40.52 °N Longitude 16.66 °E Altitude 57 m Time zone UTC+1	Project settings Albedo 0.20
Meteo data Montescaglioso 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		Inverters
Nb. of modules 8550 units		Nb. of units 28 units
Pnom total 5643 kWp		Pnom total 5600 kWac
		Pnom ratio 1.008

Results summary

Produced Energy 8 GWh/year	Specific production 1429 kWh/kWp/year	Perf. Ratio PR 85.50 %
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General parameters, PV Array Characteristics, System losses	3
Horizon definition	5
Near shading definition - Iso-shadings diagram	6
Main results	7
Loss diagram	8
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General parameters

Grid-Connected System		Sheds, single array			
PV Field Orientation		Sheds configuration		Models used	
Orientation		Nb. of sheds		Transposition	
Fixed plane		20 units		Perez	
Tilt/Azimuth		Single array		Diffuse	
20 / 0 °				Perez, Meteonorm	
		Sizes		Circumsolar	
		Sheds spacing		separate	
		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		Linear shadings		Unlimited load (grid)	
4.6 °					

PV Array Characteristics

PV module		Inverter	
Manufacturer	Risen Energy Co., Ltd	Manufacturer	Huawei Technologies
Model	RSM132-8-660BMDG	Model	SUN2000-215KTL-H3
(Custom parameters definition)		(Custom parameters definition)	
Unit Nom. Power	660 Wp	Unit Nom. Power	200 kWac
Number of PV modules	8550 units	Number of inverters	28 units
Nominal (STC)	5643 kWp	Total power	5600 kWac
Modules	285 Strings x 30 In series	Operating voltage	500-1500 V
At operating cond. (50°C)		Max. power (=>33°C)	215 kWac
Pmpp	5166 kWp	Pnom ratio (DC:AC)	1.01
U mpp	1039 V		
I mpp	4970 A		
Total PV power		Total inverter power	
Nominal (STC)	5643 kWp	Total power	5600 kWac
Total	8550 modules	Number of inverters	28 units
Module area	26559 m ²	Pnom ratio	1.01
Cell area	24886 m ²		

Array losses

Array Soiling Losses		Thermal Loss factor		DC wiring losses				
Loss Fraction	2.0 %	Module temperature according to irradiance		Global array res.				
		Uc (const)		2.3 mΩ				
		29.0 W/m ² K		Loss Fraction				
		Uv (wind)		1.0 % at STC				
		0.0 W/m ² K/m/s						
LID - Light Induced Degradation		Module Quality Loss		Module mismatch losses				
Loss Fraction	1.6 %	Loss Fraction		Loss Fraction				
		-0.5 %		1.0 % at MPPT				
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

VCO, Simulation date:
22/03/22 14:24
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 1.00 % at STC

Inverter: SUN2000-215KTL-H3

Wire section (28 Inv.) Alu 28 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 0.45 % at STC

AC losses in transformers

MV transfo

Grid voltage 36 kV

Operating losses at STC

Nominal power at STC 5544 kVA
Iron loss (24/24 Connexion) 5.54 kW
Loss Fraction 0.10 % at STC
Coils equivalent resistance 3 x 1.15 mΩ
Loss Fraction 1.00 % at STC



PVsyst V7.2.11

VC0, Simulation date:
22/03/22 14:24
with v7.2.11

Horizon definition

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

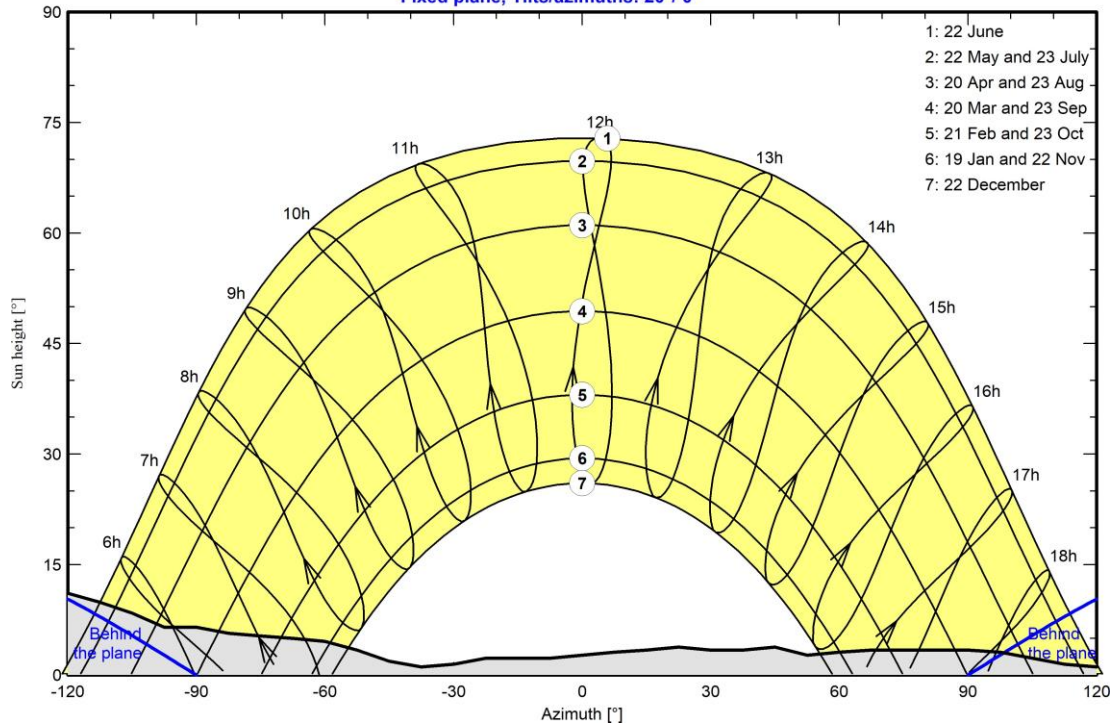
Average Height	4.6 °	Albedo Factor	0.86
Diffuse Factor	0.99	Albedo Fraction	100 %

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)

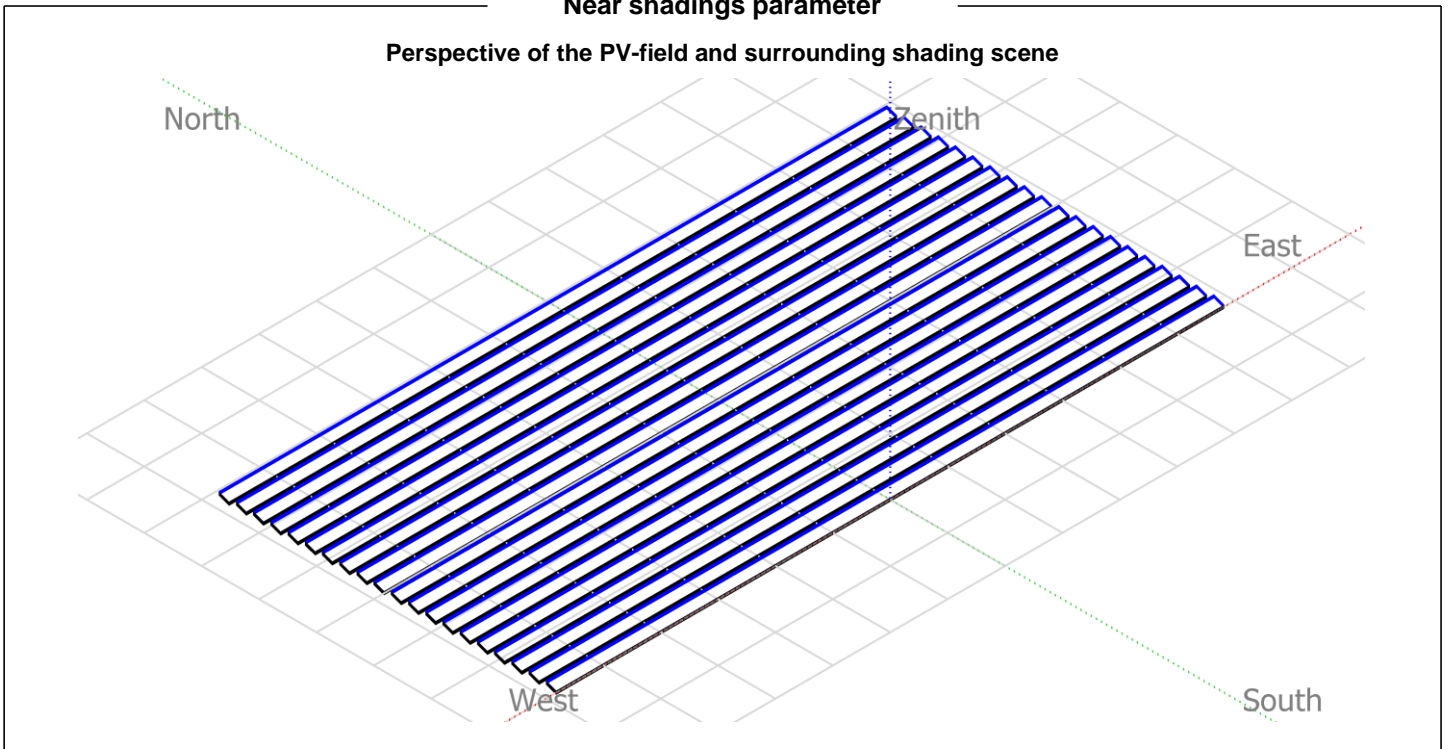
Fixed plane, Tilts/azimuths: 20°/ 0°





Near shadings parameter

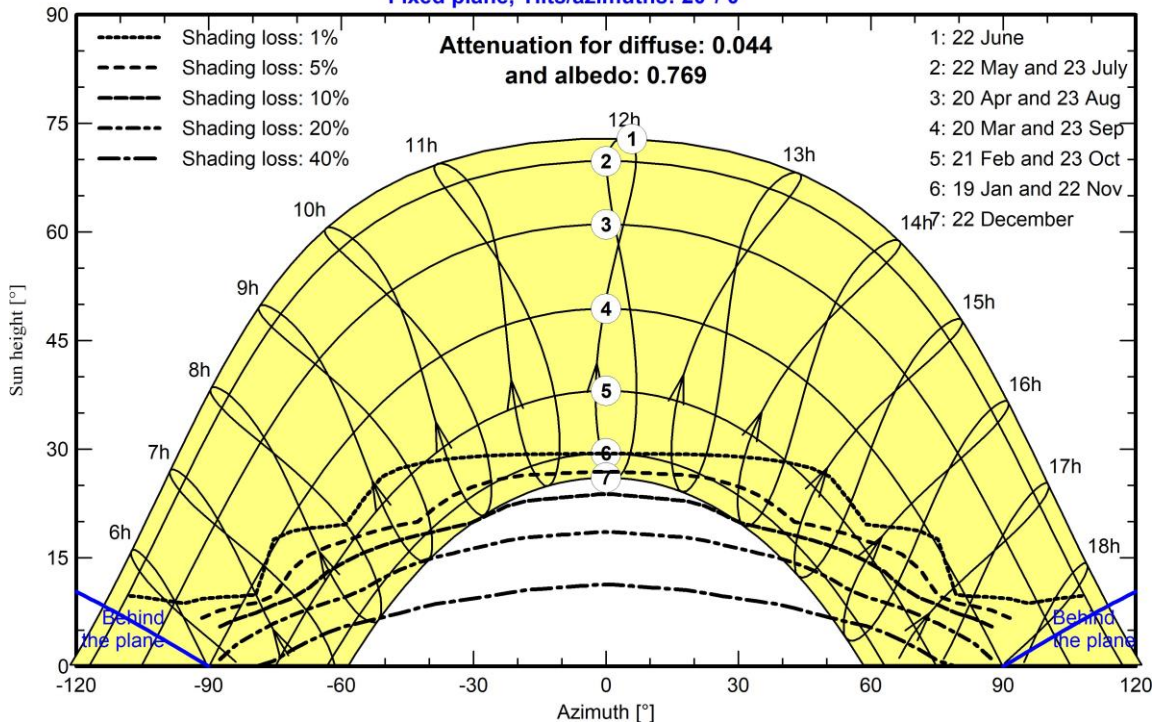
Perspective of the PV-field and surrounding shading scene



Iso-shadings diagram

Orientation #1

Fixed plane, Tilts/azimuths: 20°/ 0°





Main results

System Production

Produced Energy

8 GWh/year

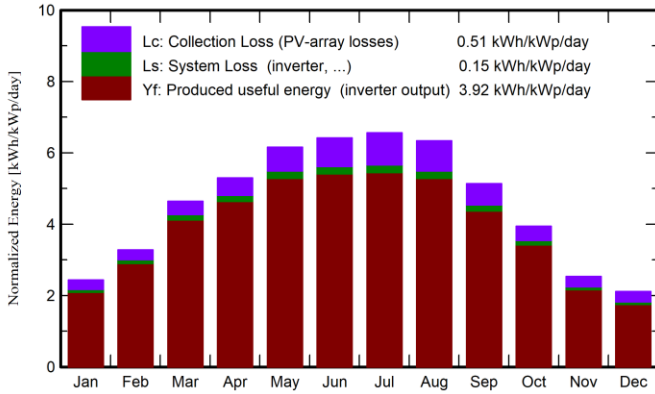
Specific production

1429 kWh/kWp/year

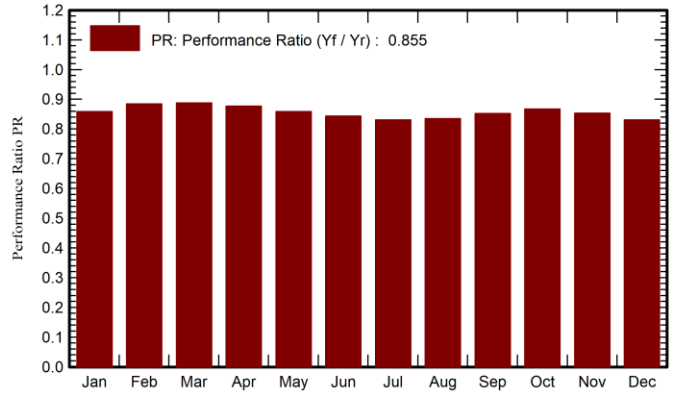
Performance Ratio PR

85.50 %

Normalized productions (per installed kWp)



Performance Ratio PR



Balances and main results

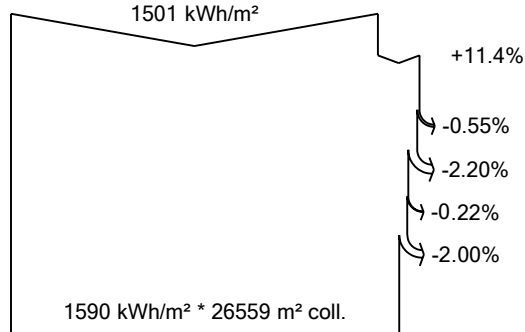
	GlobHor kWh/m ²	DiffHor kWh/m ²	T_Amb °C	GlobInc kWh/m ²	GlobEff kWh/m ²	EArray GWh	E_Grid GWh	PR ratio
January	54.3	28.05	9.07	75.6	68.7	0.381	0.366	0.858
February	71.2	34.97	9.74	91.7	86.7	0.475	0.458	0.885
March	121.9	56.72	12.18	144.0	138.0	0.748	0.721	0.888
April	146.8	72.16	14.99	158.9	152.2	0.815	0.786	0.876
May	188.1	80.48	19.54	191.0	183.2	0.961	0.925	0.859
June	194.2	90.65	24.28	192.5	184.5	0.951	0.916	0.844
July	203.0	78.54	27.75	203.5	195.7	0.991	0.954	0.831
August	183.9	73.56	27.50	196.4	189.2	0.961	0.925	0.835
September	134.6	58.62	22.49	154.1	147.7	0.769	0.741	0.852
October	98.1	48.91	18.62	122.4	116.5	0.621	0.599	0.867
November	58.1	35.50	14.12	76.1	69.7	0.381	0.366	0.853
December	46.9	27.49	10.39	65.5	57.8	0.320	0.307	0.831
Year	1501.1	685.65	17.60	1671.6	1589.9	8.373	8.065	0.855

Legends

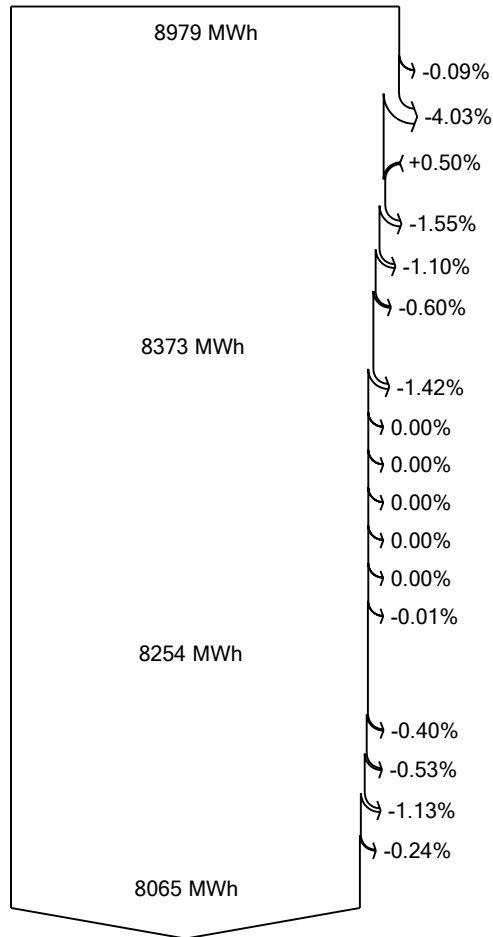
GlobHor	Global horizontal irradiation	EArray	Effective energy at the output of the array
DiffHor	Horizontal diffuse irradiation	E_Grid	Energy injected into grid
T_Amb	Ambient Temperature	PR	Performance Ratio
GlobInc	Global incident in coll. plane		
GlobEff	Effective Global, corr. for IAM and shadings		



Loss diagram



efficiency at STC = 21.26%



Global horizontal irradiation

Global incident in coll. plane

Far Shadings / Horizon

Near Shadings: irradiance loss

IAM factor on global

Soiling loss factor

Effective irradiation on collectors

PV conversion

Array nominal energy (at STC effic.)

PV loss due to irradiance level

PV loss due to temperature

Module quality loss

LID - Light induced degradation

Mismatch loss, modules and strings

Ohmic wiring loss

Array virtual energy at MPP

Inverter Loss during operation (efficiency)

Inverter Loss over nominal inv. power

Inverter Loss due to max. input current

Inverter Loss over nominal inv. voltage

Inverter Loss due to power threshold

Inverter Loss due to voltage threshold

Night consumption

Available Energy at Inverter Output

Auxiliaries (fans, other)

AC ohmic loss

Medium voltage transfo loss

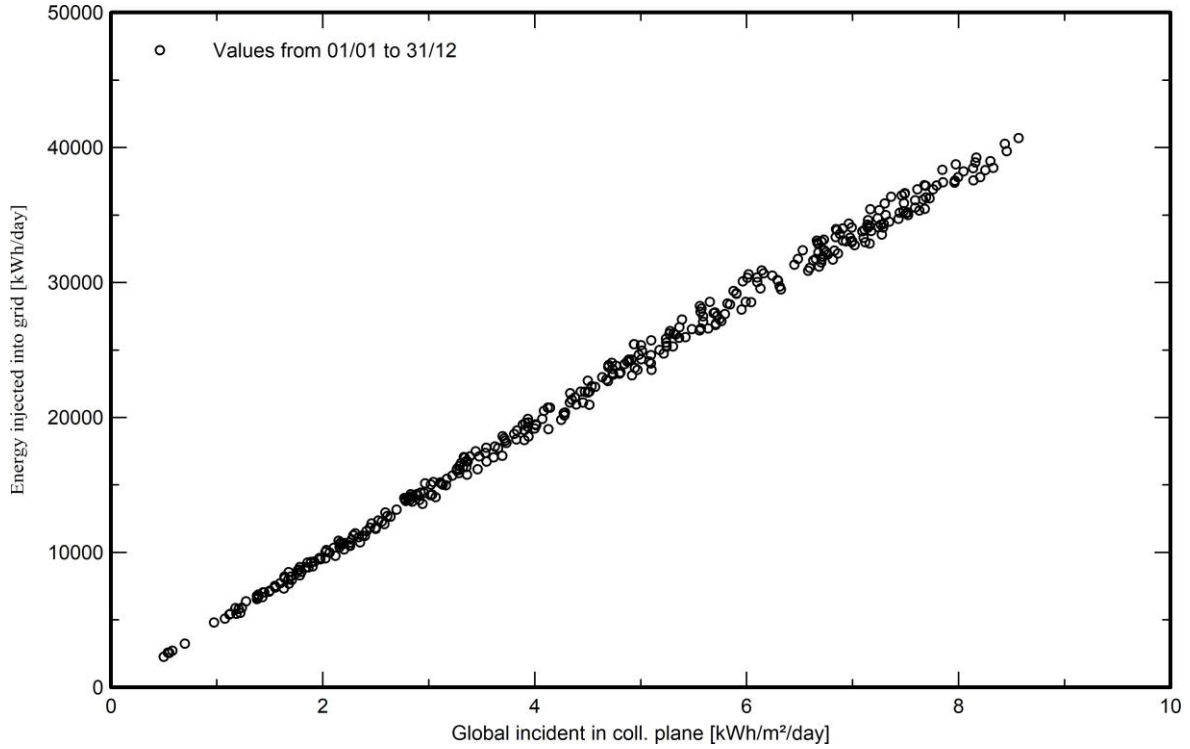
MV line ohmic loss

Energy injected into grid

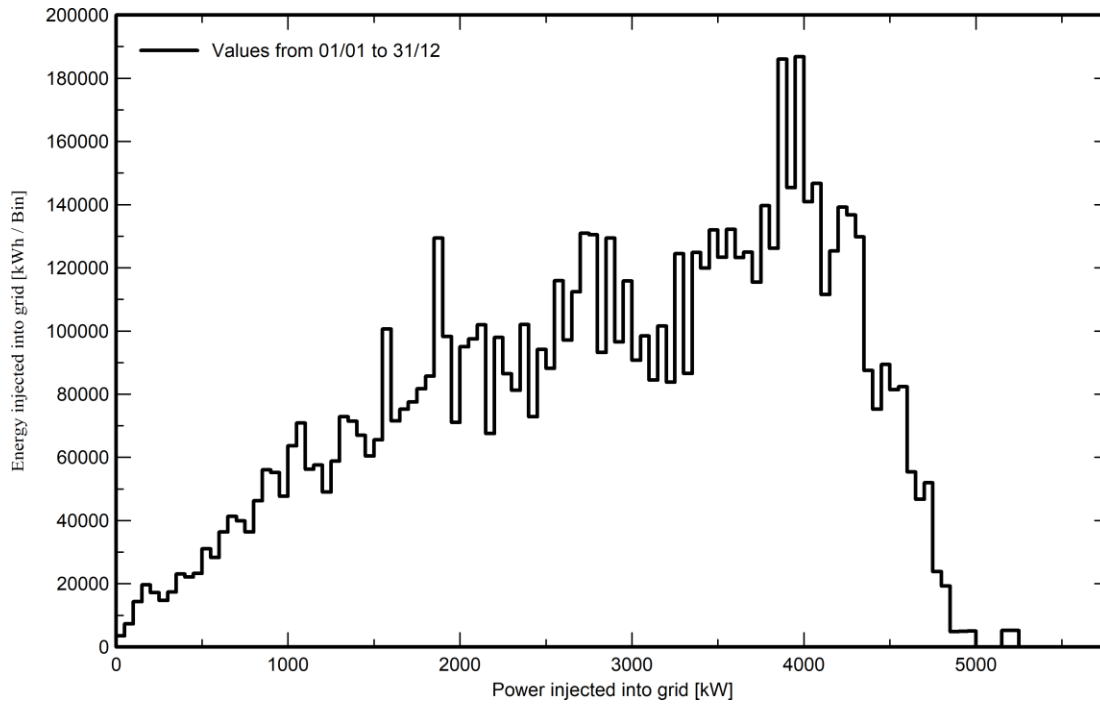


Special graphs

Daily Input/Output diagram



System Output Power Distribution



PVsyst - Simulation report

Grid-Connected System

Project: SOL014_Montescaglioso

Variant: Layout rev.0 , tracker

Trackers single array, with backtracking

System power: 5306 kWp

Montescaglioso - Italy



Project summary

Geographical Site Montescaglioso Italy	Situation Latitude 40.52 °N Longitude 16.66 °E Altitude 57 m Time zone UTC+1	Project settings Albedo 0.20
Meteo data Montescaglioso 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		Inverters	
Nb. of modules	8040 units	Nb. of units	26 units
Pnom total	5306 kWp	Pnom total	5200 kWac
		Pnom ratio	1.020

Results summary

Produced Energy	9 GWh/year	Specific production	1718 kWh/kWp/year	Perf. Ratio PR	89.19 %
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**PVsyst V7.2.11**

VC1, Simulation date:

22/03/22 14:26

with v7.2.11

General parameters**Grid-Connected System****PV Field Orientation****Orientation**

Tracking plane, horizontal N-S axis

Axis azimuth 0 °

Horizon

Average Height 4.6 °

Bifacial systemModel 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

Trackers single array, with backtracking**Backtracking strategy**

Nb. of trackers 40 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 °

Near Shadings

Linear shadings

Models used

Transposition Perez

Diffuse Perez, Meteonorm

Circumsolar separate

User's needs

Unlimited load (grid)

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 8040 units

Nominal (STC) 5306 kWp

Modules 268 Strings x 30 In series

At operating cond. (50°C)

Pmpp 4858 kWp

U mpp 1039 V

I mpp 4674 A

Total PV power

Nominal (STC) 5306 kWp

Total 8040 modules

Module area 24975 m²Cell area 23401 m²**Inverter**

Manufacturer Huawei Technologies

Model SUN2000-215KTL-H3

(Custom parameters definition)

Unit Nom. Power 200 kWac

Number of inverters 26 units

Total power 5200 kWac

Operating voltage 500-1500 V

Max. power (=>33°C) 215 kWac

Pnom ratio (DC:AC) 1.02

Total inverter power

Total power 5200 kWac

Number of inverters 26 units

Pnom ratio 1.02

**PVsyst V7.2.11**

VC1, Simulation date:

22/03/22 14:26

with v7.2.11

Array losses**Array Soiling Losses**

Loss Fraction 2.0 %

Thermal Loss factor

Module temperature according to irradiance

Uc (const) 29.0 W/m²KUv (wind) 0.0 W/m²K/m/s**DC wiring losses**

Global array res. 2.4 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 1.01 % at STC

Inverter: SUN2000-215KTL-H3Wire section (26 Inv.) Alu 26 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 0.42 % at STC

AC losses in transformers**MV transfo**

Grid voltage 36 kV

Operating losses at STC

Nominal power at STC 5213 kVA

Iron loss (24/24 Connexion) 5.21 kW

Loss Fraction 0.10 % at STC

Coils equivalent resistance 3 x 1.23 mΩ

Loss Fraction 1.00 % at STC



PVsyst V7.2.11

VC1, Simulation date:
22/03/22 14:26
with v7.2.11

Horizon definition

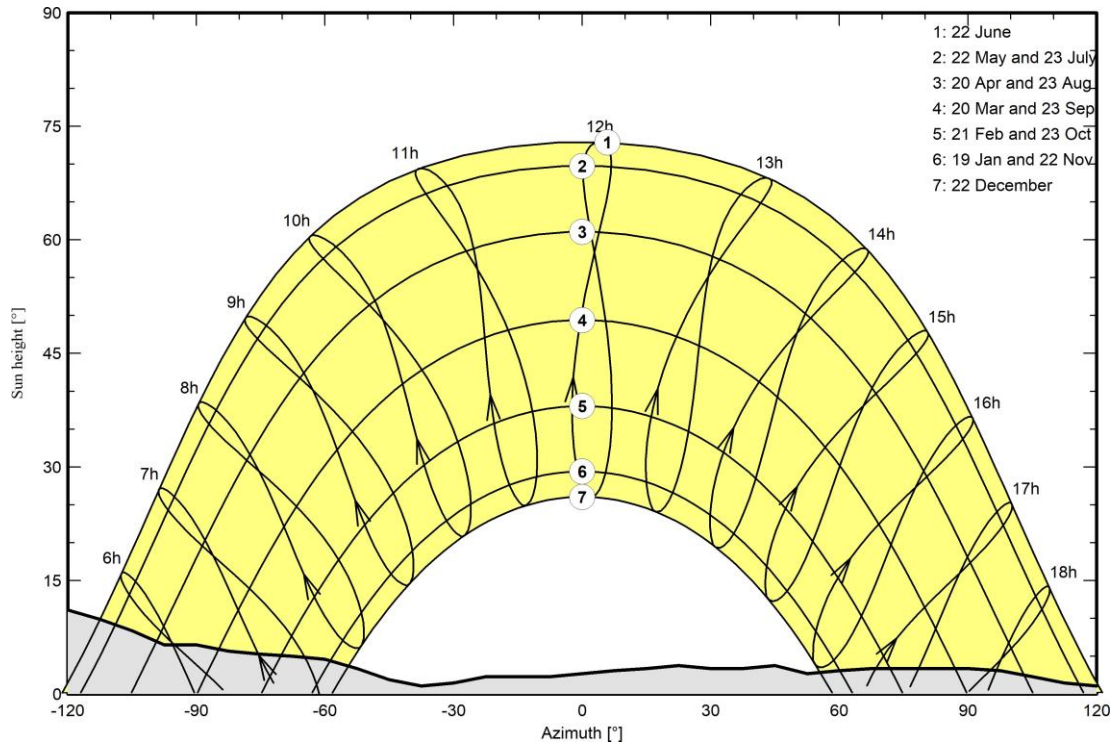
Horizon from PVGIS website API, Lat=40°30'56', Long=16°39'34', Alt=m

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		

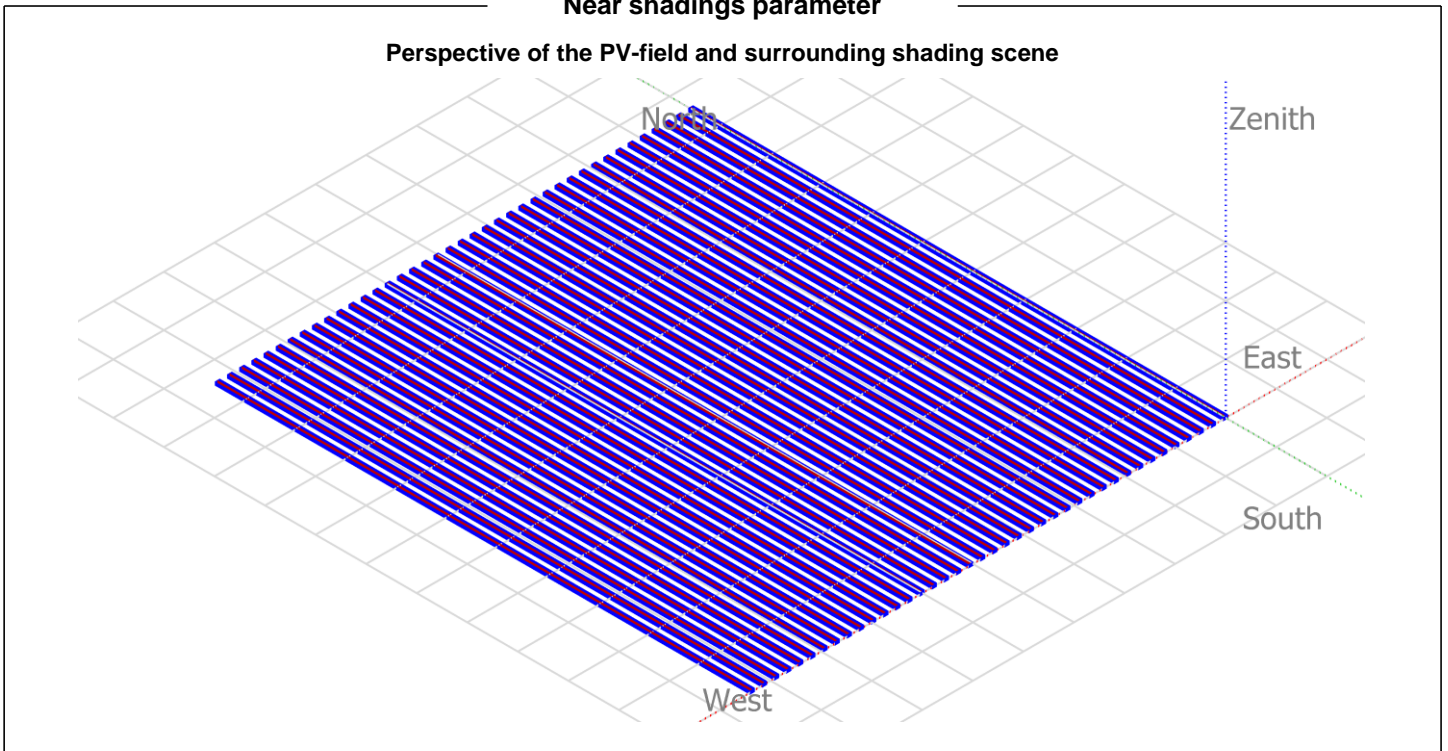
Sun Paths (Height / Azimuth diagram)





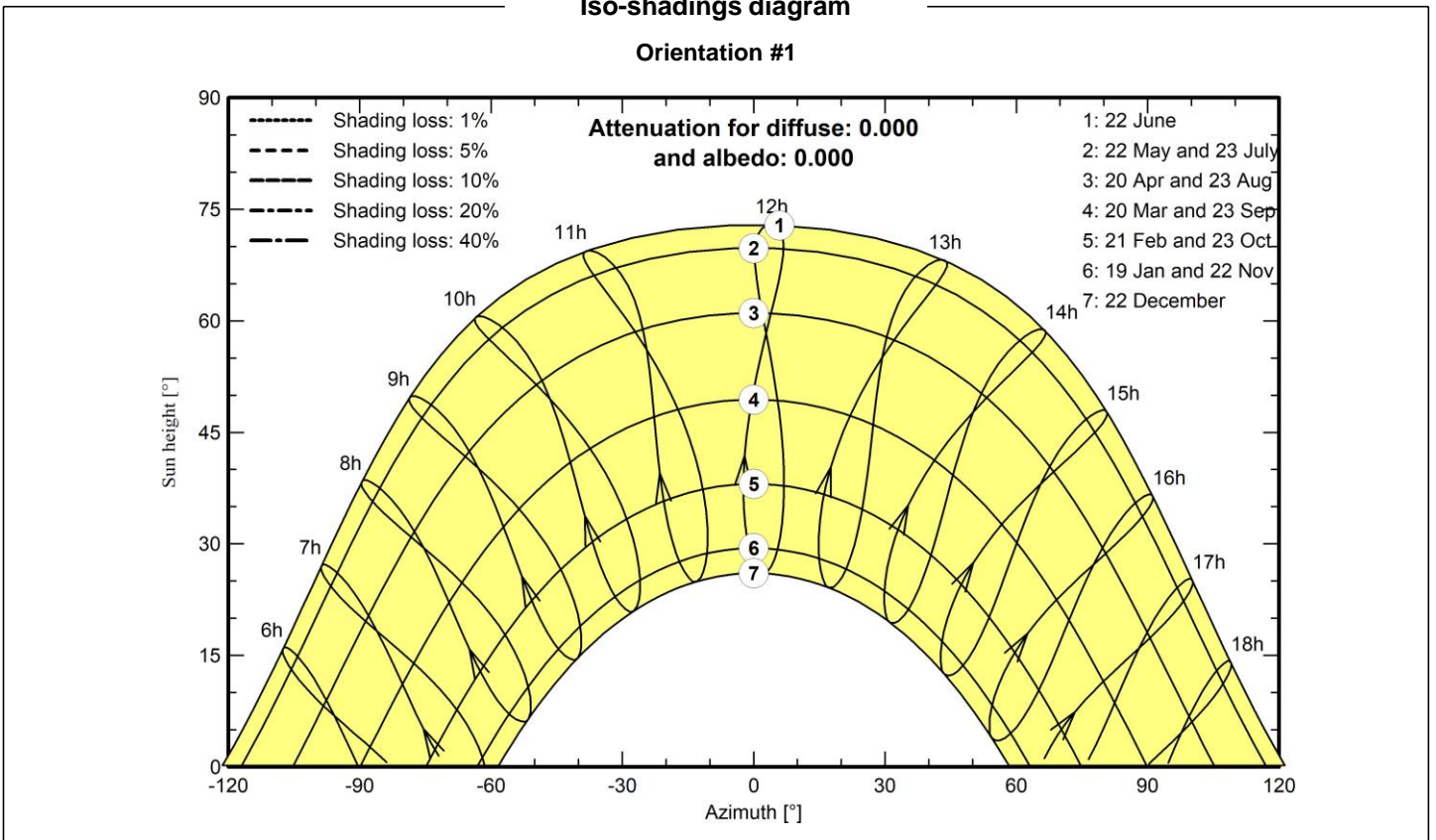
Near shadings parameter

Perspective of the PV-field and surrounding shading scene



Iso-shadings diagram

Orientation #1





Main results

System Production

Produced Energy

9 GWh/year

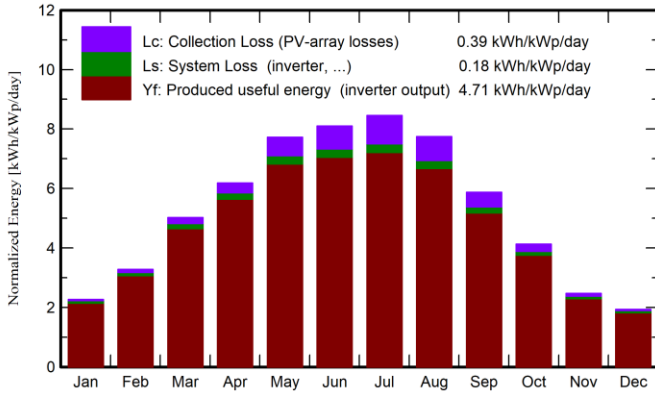
Specific production

1718 kWh/kWp/year

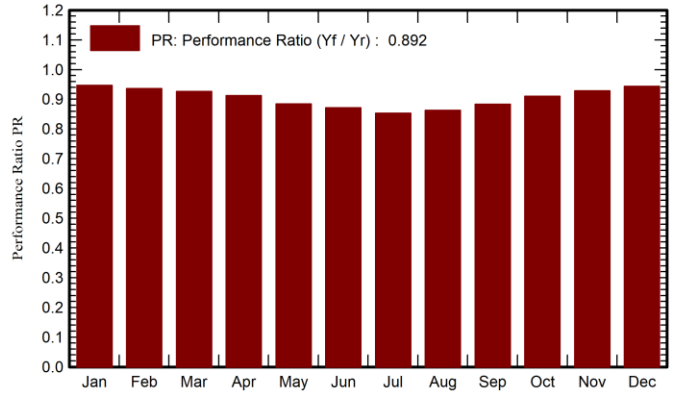
Performance Ratio PR

89.19 %

Normalized productions (per installed kWp)



Performance Ratio PR



Balances and main results

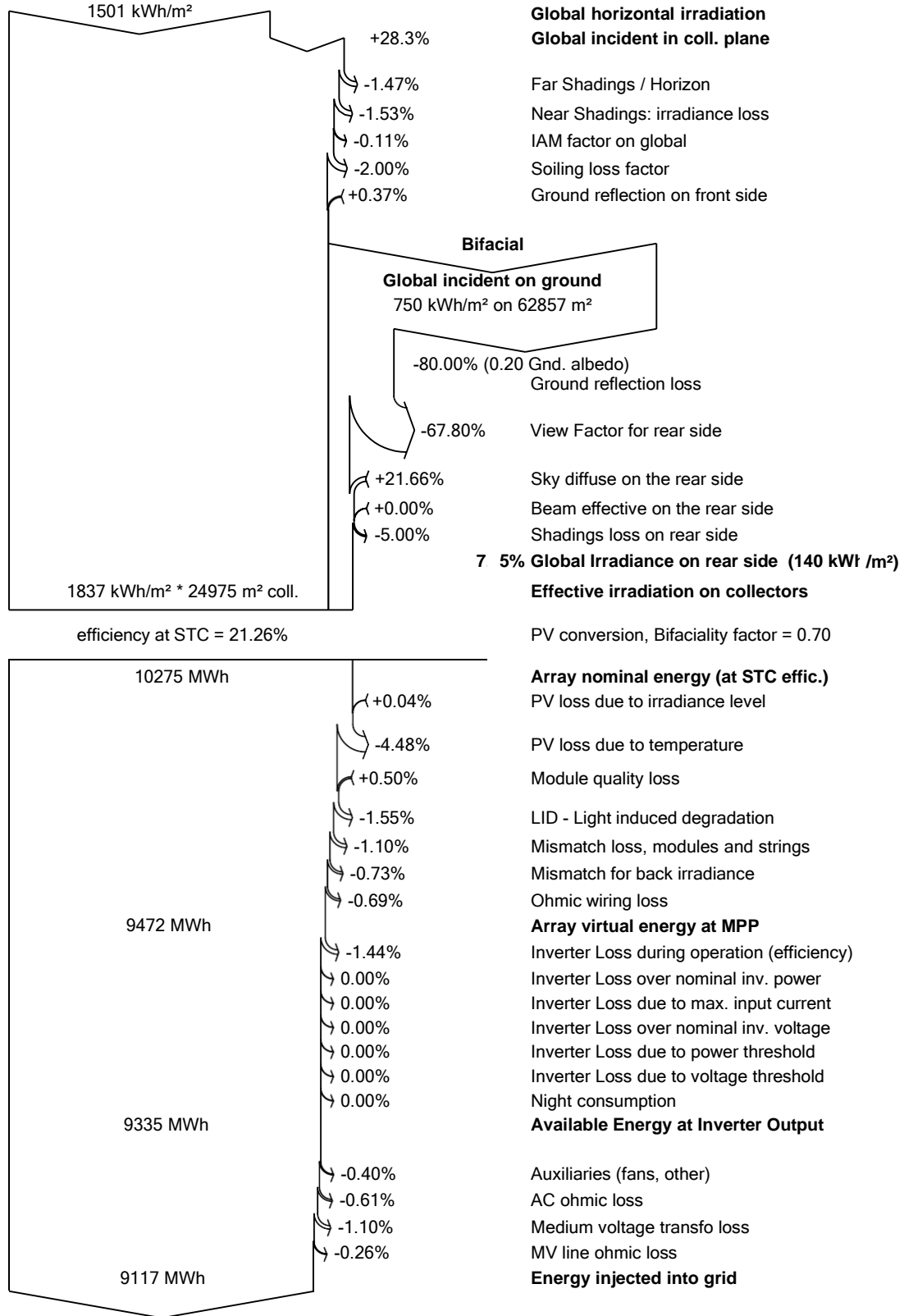
	GlobHor kWh/m ²	DiffHor kWh/m ²	T_Amb °C	GlobInc kWh/m ²	GlobEff kWh/m ²	EArray GWh	E_Grid GWh	PR ratio
January	54.3	28.05	9.07	70.4	67.0	0.368	0.354	0.947
February	71.2	34.97	9.74	91.8	87.2	0.473	0.456	0.936
March	121.9	56.72	12.18	155.8	148.6	0.794	0.766	0.926
April	146.8	72.16	14.99	185.6	177.1	0.933	0.899	0.913
May	188.1	80.48	19.54	239.6	228.1	1.169	1.124	0.884
June	194.2	90.65	24.28	242.9	231.3	1.168	1.123	0.871
July	203.0	78.54	27.75	262.1	250.1	1.235	1.187	0.853
August	183.9	73.56	27.50	240.3	230.5	1.144	1.100	0.862
September	134.6	58.62	22.49	176.0	167.8	0.857	0.826	0.884
October	98.1	48.91	18.62	128.0	121.9	0.641	0.618	0.910
November	58.1	35.50	14.12	74.2	70.1	0.379	0.366	0.929
December	46.9	27.49	10.39	59.9	56.8	0.312	0.300	0.943
Year	1501.1	685.65	17.60	1926.5	1836.5	9.472	9.117	0.892

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		



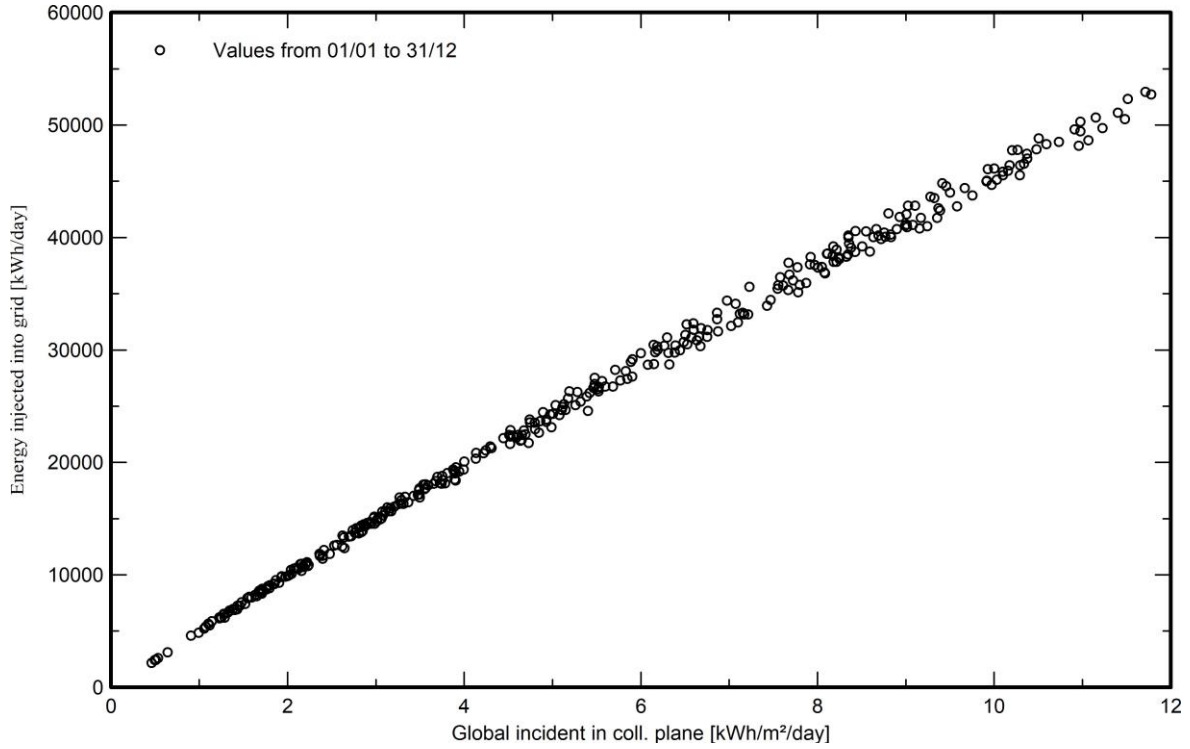
Loss diagram





Special graphs

Daily Input/Output diagram



System Output Power Distribution

