

PVsyst - Simulation report

Grid-Connected System

Project: New Project

Variant: Adani 320Wp_Solis_user defined soiling loss_994.88kWp_Near Shading with P90

Building system

System power: 995 kWp

Strides Pharma (KRSG), Bengaluru - India

Author

SunSource Energy (United States)



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with v7.2.21

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Project summary

Geographical Site

Strides Pharma (KRSG), Bengaluru
India

Situation

Latitude 12.73 °N
Longitude 77.67 °E
Altitude 938 m
Time zone UTC+5.5

Project settings

Albedo 0.20

Meteo data

Strides Pharma (KRSG), Bengaluru
SolarGIS Monthly aver. , period not spec. - Synthetic

System summary

Grid-Connected System

PV Field Orientation

Fixed planes 8 orientations
Tilts/azimuths 8 / 8 °
15 / 8 °
5 / -82 °
12 / -172 °
12 / 8 °
15 / -172 °
15 / -82 °

Building system

Near Shadings

According to strings
Electrical effect 100 %

User's needs

Unlimited load (grid)

System information

PV Array

Nb. of modules 3109 units
Pnom total 995 kWp

Inverters

Nb. of units 10 units
Pnom total 735 kWac
Pnom ratio 1.354

Results summary

Produced Energy 1446 MWh/year Specific production 1454 kWh/kWp/year Perf. Ratio PR 73.83 %

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General parameters

Grid-Connected System

PV Field Orientation

Orientation

Fixed planes 8 orientations
Tilts/azimuths 8 / 8 °
8 / -172 °
15 / 8 °
5 / -82 °
12 / -172 °
12 / 8 °
15 / -172 °
15 / -82 °

Horizon

Free Horizon

Building system

Sheds configuration

Near Shadings

According to strings
Electrical effect 100 %

Models used

Transposition Perez
Diffuse Perez, Meteonorm
Circumsolar separate

User's needs

Unlimited load (grid)

PV Array Characteristics

Array #1 - Sub-array #1

Orientation #2
Tilt/Azimuth 8/-172 °

PV module

Manufacturer MSPVL
Model ASP-7-320.PAN
(Custom parameters definition)

Unit Nom. Power 320 Wp
Number of PV modules 100 units
Nominal (STC) 32.0 kWp
Modules 5 Strings x 20 In series

At operating cond. (40°C)

Pmpp 29.97 kWp
U mpp 684 V
I mpp 44 A

PV module

Manufacturer MSPVL
Model ASP-7-320.PAN
(Custom parameters definition)

Unit Nom. Power 320 Wp
Number of PV modules 2000 units
Nominal (STC) 640 kWp

Array #2 - Sub-array #2

Mixed orient.
#1/2: 22/3 strings
Tilt/Azimuth 8/8 °
8/-172 °

Number of PV modules 500 units
Nominal (STC) 160 kWp
Modules 25 Strings x 20 In series

At operating cond. (40°C)

Pmpp 150 kWp
U mpp 684 V
I mpp 219 A

Inverter

Manufacturer Ginlong Technologies
Model Solis-25K-5G
(Custom parameters definition)

Unit Nom. Power 25.0 kWac
Number of inverters 1 unit
Total power 25.0 kWac
Operating voltage 180-1000 V
Max. power (=>40°C) 27.5 kWac
Pnom ratio (DC:AC) 1.28

Inverter

Manufacturer Ginlong Technologies
Model GCI-110K-5G
(Custom parameters definition)

Unit Nom. Power 110 kWac
Number of inverters 4 units
Total power 440 kWac

Operating voltage 180-1000 V
Max. power (=>40°C) 121 kWac
Pnom ratio (DC:AC) 1.45



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PV Array Characteristics

Array #3 - Sub-array #3

Mixed orient.

#1/2: 32/40 strings

Tilt/Azimuth

8/8 °

8/-172 °

Number of PV modules

1440 units

Nominal (STC)

461 kWp

Modules

72 Strings x 20 In series

At operating cond. (40°C)

Pmpp

432 kWp

U mpp

684 V

I mpp

631 A

Number of inverters

28 * MPPT 10% 2.8 units

Total power

308 kWac

Operating voltage

180-1000 V

Max. power (=>40°C)

121 kWac

Pnom ratio (DC:AC)

1.50

Array #4 - Sub-array #4

Orientation

#3

Tilt/Azimuth

15/8 °

Number of PV modules

60 units

Nominal (STC)

19.20 kWp

Modules

3 Strings x 20 In series

At operating cond. (40°C)

Pmpp

17.98 kWp

U mpp

684 V

I mpp

26 A

Number of inverters

2 * MPPT 10% 0.2 unit

Total power

22.0 kWac

Operating voltage

180-1000 V

Max. power (=>40°C)

121 kWac

Pnom ratio (DC:AC)

0.87

PV module

Manufacturer

MSPVL

Model

ASP-7-320.PAN

(Custom parameters definition)

Unit Nom. Power

320 Wp

Number of PV modules

80 units

Nominal (STC)

25.60 kWp

Inverter

Manufacturer

Ginlong Technologies

Model

Solis-3P20K-4G

(Custom parameters definition)

Unit Nom. Power

20.0 kWac

Number of inverters

1 unit

Total power

20.0 kWac

Array #5 - Sub-array #5

Orientation

#1

Tilt/Azimuth

8/8 °

Number of PV modules

40 units

Nominal (STC)

12.80 kWp

Modules

2 Strings x 20 In series

At operating cond. (40°C)

Pmpp

11.99 kWp

U mpp

684 V

I mpp

18 A

Number of inverters

1 * MPPT 50% 0.5 unit

Total power

10.0 kWac

Operating voltage

160-850 V

Max. power (=>40°C)

22.0 kWac

Pnom ratio (DC:AC)

1.28

Array #15 - Sub-array #16

Orientation

#3

Tilt/Azimuth

15/8 °

Number of PV modules

40 units

Nominal (STC)

12.80 kWp

Modules

2 Strings x 20 In series

At operating cond. (40°C)

Pmpp

11.99 kWp

U mpp

684 V

I mpp

18 A

Number of inverters

1 * MPPT 50% 0.5 unit

Total power

10.0 kWac

Operating voltage

160-850 V

Max. power (=>40°C)

22.0 kWac

Pnom ratio (DC:AC)

1.28



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PV Array Characteristics

PV module

Manufacturer	MSPVL
Model	ASP-7-320.PAN
(Custom parameters definition)	
Unit Nom. Power	320 Wp
Number of PV modules	609 units
Nominal (STC)	195 kWp

Inverter

Manufacturer	Ginlong Technologies
Model	Solis-80K-5G
(Custom parameters definition)	
Unit Nom. Power	80.0 kWac
Number of inverters	2 units
Total power	160 kWac

Array #6 - Sub-array #6

Orientation	#3
Tilt/Azimuth	15/8 °
Number of PV modules	108 units
Nominal (STC)	34.6 kWp
Modules	6 Strings x 18 In series

At operating cond. (40°C)

Pmpp	32.4 kWp
U mpp	615 V
I mpp	53 A

Number of inverters	3 * MPPT 13% 0.4 unit
Total power	30.0 kWac

Operating voltage	180-1000 V
Max. power (=>40°C)	88.0 kWac
Pnom ratio (DC:AC)	1.15

Array #7 - Sub-array #8

Orientation	#7
Tilt/Azimuth	15/-172 °
Number of PV modules	68 units
Nominal (STC)	21.76 kWp
Modules	4 Strings x 17 In series

At operating cond. (40°C)

Pmpp	20.38 kWp
U mpp	581 V
I mpp	35 A

Number of inverters	2 * MPPT 13% 0.3 unit
Total power	20.0 kWac

Operating voltage	180-1000 V
Max. power (=>40°C)	88.0 kWac
Pnom ratio (DC:AC)	1.09

Array #8 - Sub-array #9

Orientation	#3
Tilt/Azimuth	15/8 °
Number of PV modules	34 units
Nominal (STC)	10.88 kWp
Modules	2 Strings x 17 In series

At operating cond. (40°C)

Pmpp	10.19 kWp
U mpp	581 V
I mpp	18 A

Number of inverters	1 * MPPT 13% 0.1 unit
Total power	10.0 kWac

Operating voltage	180-1000 V
Max. power (=>40°C)	88.0 kWac
Pnom ratio (DC:AC)	1.09

Array #10 - Sub-array #11

Orientation	#3
Tilt/Azimuth	15/8 °
Number of PV modules	300 units
Nominal (STC)	96.0 kWp
Modules	15 Strings x 20 In series

At operating cond. (40°C)

Pmpp	89.9 kWp
U mpp	684 V
I mpp	131 A

Number of inverters	7 * MPPT 13% 0.9 unit
Total power	70.0 kWac

Operating voltage	180-1000 V
Max. power (=>40°C)	88.0 kWac
Pnom ratio (DC:AC)	1.37



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PV Array Characteristics

Array #11 - Sub-array #12

Orientation	#8		
Tilt/Azimuth	15/-82 °		
Number of PV modules	19 units	Number of inverters	1 * MPPT 13% 0.1 unit
Nominal (STC)	6.08 kWp	Total power	10.0 kWac
Modules	1 String x 19 In series		
At operating cond. (40°C)		Operating voltage	180-1000 V
Pmpp	5.69 kWp	Max. power (=>40°C)	88.0 kWac
U mpp	650 V	Pnom ratio (DC:AC)	0.61
I mpp	8.8 A		

Array #12 - Sub-array #13

Orientation	#8		
Tilt/Azimuth	15/-82 °		
Number of PV modules	80 units	Number of inverters	2 * MPPT 13% 0.3 unit
Nominal (STC)	25.60 kWp	Total power	20.0 kWac
Modules	4 Strings x 20 In series		
At operating cond. (40°C)		Operating voltage	180-1000 V
Pmpp	23.98 kWp	Max. power (=>40°C)	88.0 kWac
U mpp	684 V	Pnom ratio (DC:AC)	1.28
I mpp	35 A		

Array #9 - Sub-array #10

Orientation	#4		
Tilt/Azimuth	5/-82 °		
PV module		Inverter	
Manufacturer	MSPVL	Manufacturer	Ginlong Technologies
Model	ASP-7-320.PAN	Model	Solis-40K-5G
(Custom parameters definition)		(Custom parameters definition)	
Unit Nom. Power	320 Wp	Unit Nom. Power	40.0 kWac
Number of PV modules	140 units	Number of inverters	1 unit
Nominal (STC)	44.8 kWp	Total power	40.0 kWac
Modules	7 Strings x 20 In series	Operating voltage	180-1000 V
At operating cond. (40°C)		Max. power (=>40°C)	44.0 kWac
Pmpp	42.0 kWp	Pnom ratio (DC:AC)	1.12
U mpp	684 V		
I mpp	61 A		

PV module

Manufacturer	MSPVL
Model	ASP-7-320.PAN
(Custom parameters definition)	
Unit Nom. Power	320 Wp
Number of PV modules	180 units
Nominal (STC)	57.6 kWp

Inverter

Manufacturer	Ginlong Technologies
Model	Solis-50K-HV-5G
(Custom parameters definition)	
Unit Nom. Power	50.0 kWac
Number of inverters	1 unit
Total power	50.0 kWac

Array #13 - Sub-array #14

Orientation	#6		
Tilt/Azimuth	12/8 °		
Number of PV modules	100 units	Number of inverters	2 * MPPT 25% 0.5 unit
Nominal (STC)	32.0 kWp	Total power	25.0 kWac
Modules	5 Strings x 20 In series		
At operating cond. (40°C)		Operating voltage	180-1000 V
Pmpp	29.97 kWp	Max. power (=>40°C)	55.0 kWac
U mpp	684 V	Pnom ratio (DC:AC)	1.28
I mpp	44 A		



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PV Array Characteristics

Array #14 - Sub-array #15

Orientation	#5		
Tilt/Azimuth	12/-172 °		
Number of PV modules	80 units	Number of inverters	2 * MPPT 25% 0.5 unit
Nominal (STC)	25.60 kWp	Total power	25.0 kWac
Modules	4 Strings x 20 In series		
At operating cond. (40°C)		Operating voltage	180-1000 V
Pmpp	23.98 kWp	Max. power (=>40°C)	55.0 kWac
U mpp	684 V	Pnom ratio (DC:AC)	1.02
I mpp	35 A		
Total PV power		Total inverter power	
Nominal (STC)	995 kWp	Total power	735 kWac
Total	3109 modules	Number of inverters	10 units
Module area	6274 m²	Pnom ratio	1.35
Cell area	11282 m²		

Array losses

Array Soiling Losses

Average loss Fraction 3.1 %

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
2.5%	2.5%	4.0%	4.0%	4.0%	2.5%	2.5%	2.5%	2.5%	4.0%	4.0%	2.5%

Thermal Loss factor

Module temperature according to irradiance
Uc (const) 19.0 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 2.5 %

Module Quality Loss

Loss Fraction 0.0 %

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°	30°	50°	60°	70°	75°	80°	85°	90°
1.000	1.000	0.980	0.940	0.840	0.720	0.600	0.520	0.000

DC wiring losses

Global wiring resistance 10 mΩ
Loss Fraction 2.0 % at STC

Array #1 - Sub-array #1

Global array res. 335 mΩ
Loss Fraction 2.0 % at STC

Array #3 - Sub-array #3

Global array res. 23 mΩ
Loss Fraction 2.0 % at STC

Array #5 - Sub-array #5

Global array res. 837 mΩ
Loss Fraction 2.0 % at STC

Array #7 - Sub-array #8

Global array res. 356 mΩ
Loss Fraction 2.0 % at STC

Array #2 - Sub-array #2

Global array res. 67 mΩ
Loss Fraction 2.0 % at STC

Array #4 - Sub-array #4

Global array res. 558 mΩ
Loss Fraction 2.0 % at STC

Array #6 - Sub-array #6

Global array res. 251 mΩ
Loss Fraction 2.0 % at STC

Array #8 - Sub-array #9

Global array res. 712 mΩ
Loss Fraction 2.0 % at STC



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DC wiring losses

Array #9 - Sub-array #10

Global array res. 239 mΩ
Loss Fraction 2.0 % at STC

Array #11 - Sub-array #12

Global array res. 1591 mΩ
Loss Fraction 2.0 % at STC

Array #13 - Sub-array #14

Global array res. 335 mΩ
Loss Fraction 2.0 % at STC

Array #15 - Sub-array #16

Global array res. 837 mΩ
Loss Fraction 2.0 % at STC

Array #10 - Sub-array #11

Global array res. 112 mΩ
Loss Fraction 2.0 % at STC

Array #12 - Sub-array #13

Global array res. 419 mΩ
Loss Fraction 2.0 % at STC

Array #14 - Sub-array #15

Global array res. 419 mΩ
Loss Fraction 2.0 % at STC

System losses

Unavailability of the system

Time fraction 1.0 %
3.7 days,
3 periods

AC wiring losses

Inv. output line up to injection point

Inverter voltage 400 Vac tri
Loss Fraction 1.80 % at STC

Global System

Wire section Copper 3 x 1000 mm²
Wires length 157 m



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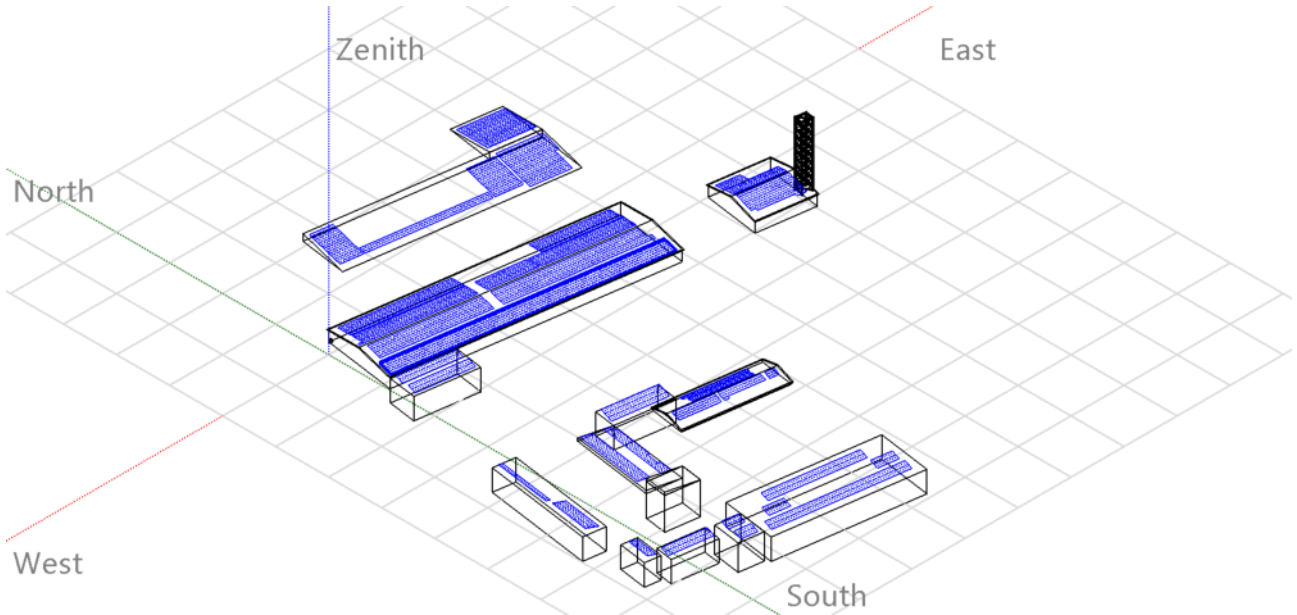
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Near shadings parameter

Perspective of the PV-field and surrounding shading scene





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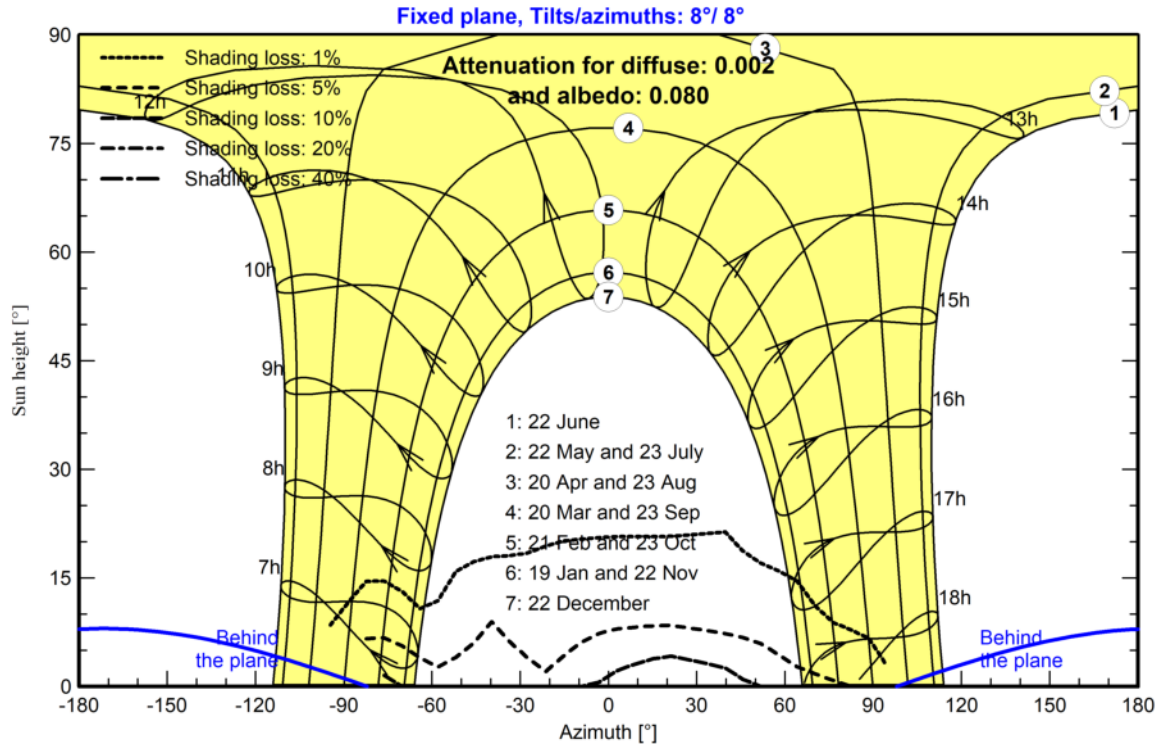
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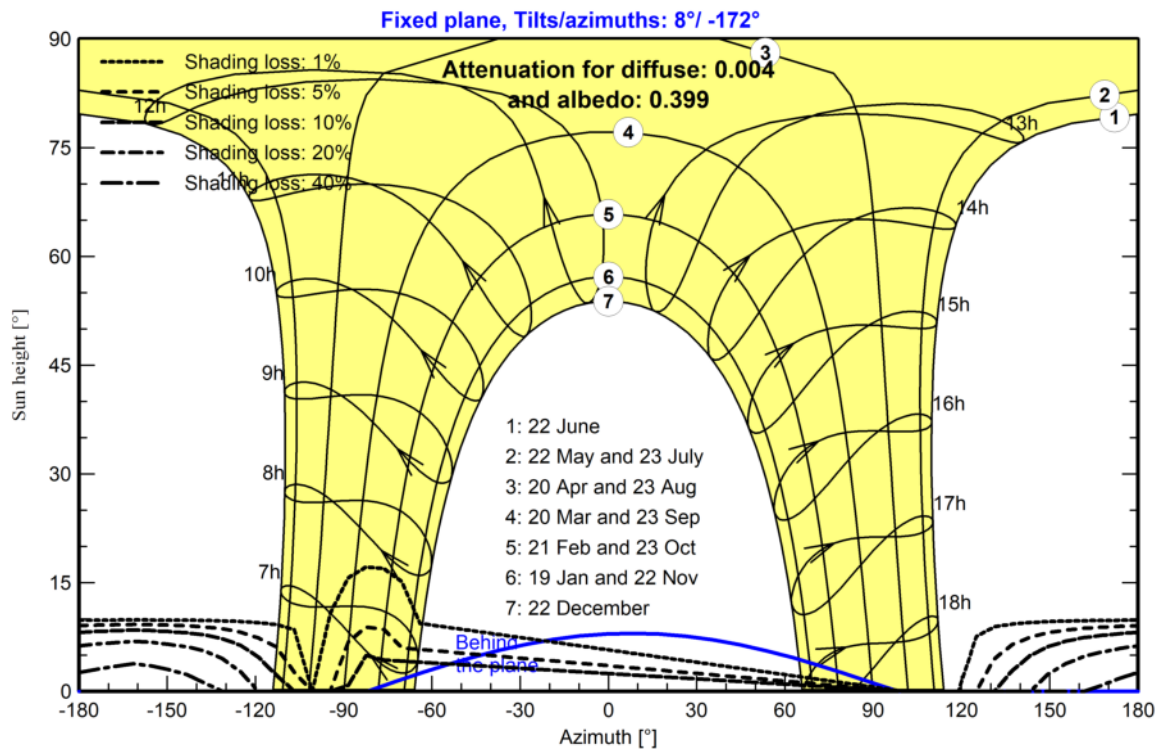
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Iso-shadings diagram

Orientation #1



Orientation #2





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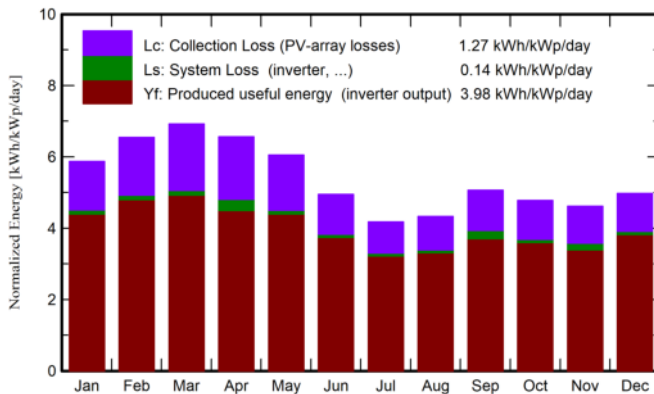
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Main results

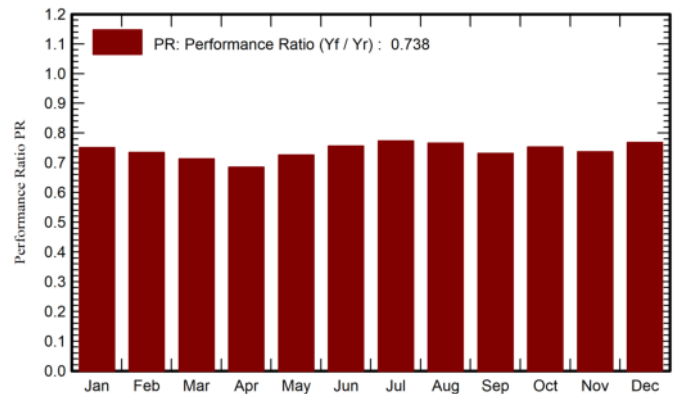
System Production

Produced Energy (P50)	1446 MWh/year	Specific production (P50)	1454 kWh/kWp/year	Performance Ratio PR	73.83 %
Produced Energy (P90)	1360 MWh/year	Specific production (P90)	1367 kWh/kWp/year		
Produced Energy (P75)	1401 MWh/year	Specific production (P75)	1408 kWh/kWp/year		

Normalized productions (per installed kWp)



Performance Ratio PR



Balances and main results

	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_Grid	PR
	kWh/m ²	kWh/m ²	°C	kWh/m ²	kWh/m ²	MWh	MWh	ratio
January	177.3	54.60	20.10	181.9	169.7	139.3	135.8	0.750
February	180.2	51.20	22.40	183.1	172.1	137.3	133.8	0.735
March	214.0	69.80	25.00	214.5	199.0	156.2	152.1	0.713
April	198.7	80.40	26.80	196.8	182.9	143.6	134.3	0.686
May	190.9	86.50	26.30	187.7	173.4	139.1	135.6	0.726
June	151.4	87.90	23.40	148.4	138.4	114.5	111.7	0.757
July	131.7	91.10	22.20	129.4	120.8	102.0	99.5	0.773
August	136.1	89.00	21.80	134.1	124.9	104.7	102.1	0.765
September	152.6	84.00	22.00	152.0	142.6	117.6	110.7	0.732
October	147.5	79.70	21.30	148.2	136.7	113.9	111.0	0.753
November	136.4	64.20	20.10	138.5	127.6	107.0	101.5	0.736
December	150.6	59.80	19.09	154.2	143.9	120.9	117.9	0.769
Year	1967.4	898.19	22.54	1968.8	1832.2	1496.1	1446.2	0.738

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		



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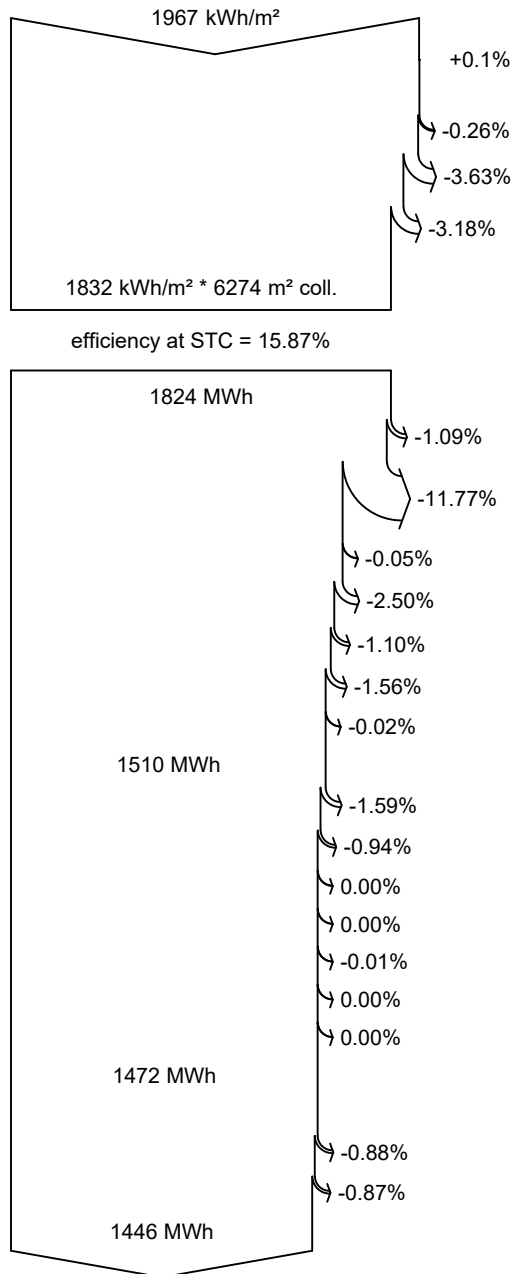
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Loss diagram



Global horizontal irradiation

Global incident in coll. plane

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

Shadings: Electrical Loss acc. to strings

LID - Light induced degradation

Mismatch loss, modules and strings

Ohmic wiring loss

Mixed orientation mismatch 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

AC ohmic loss

System unavailability

Energy injected into grid



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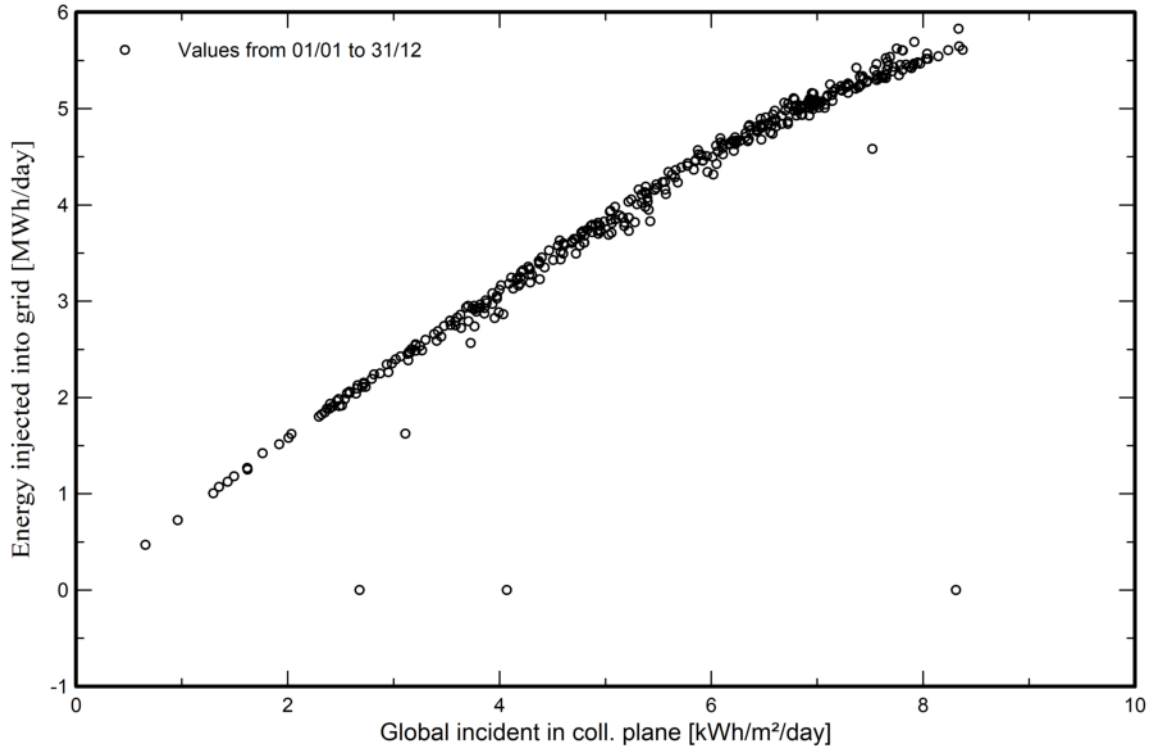
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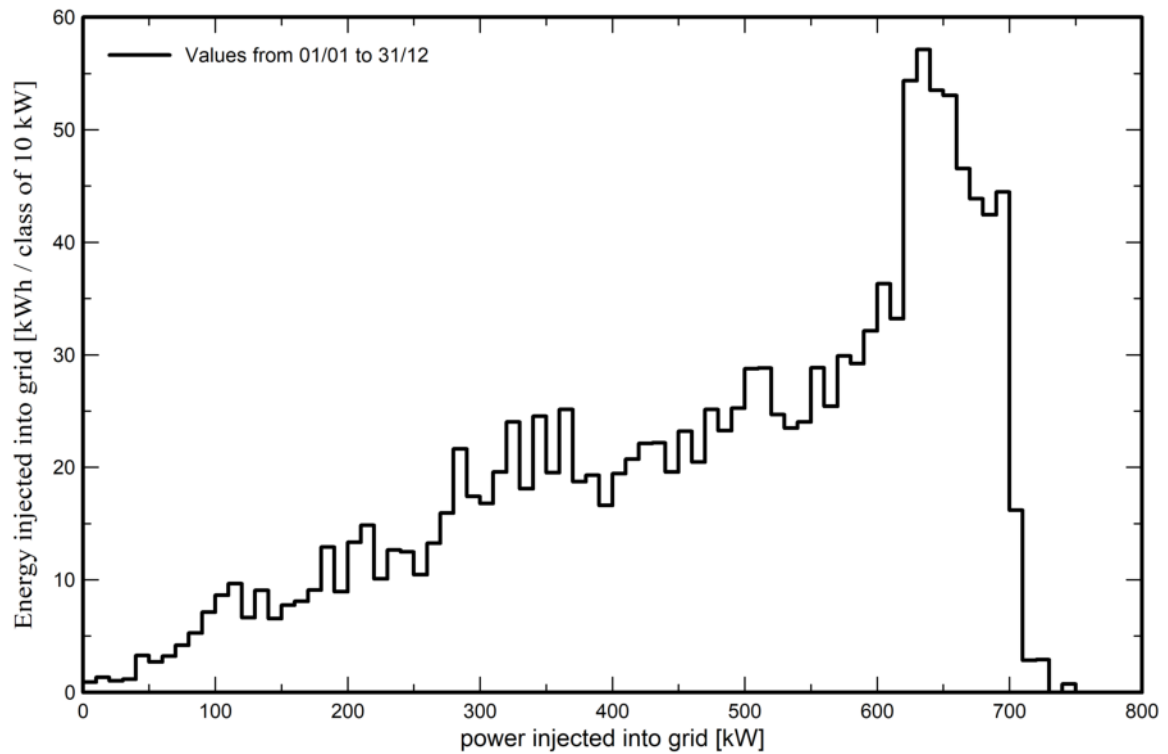
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Special graphs

Daily Input/Output diagram



System Output Power Distribution





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P50 - P90 evaluation

Meteo data

Source SolarGIS Monthly aver. , period not spec.
Kind Monthly averages
Synthetic - Multi-year average
Year-to-year variability(Variance) 4.3 %

Specified Deviation

Climate change 0.0 %

Global variability (meteo + system)

Variability (Quadratic sum) 4.7 %

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 67.4 MWh
P50 1446.2 MWh
P90 1359.7 MWh
P75 1400.7 MWh

Probability distribution

