

PVsyst - Simulation report

Grid-Connected System

Project: Bhadla MiniGrid-2_Dholiya

Variant: Bhadla MiniGrid-2_Dholiya

Sheds, single array

System power: 14.01 MWp

Chhayani - India

Author

AVENGERS RAYS SOLAR PRIVATE LIMITED (India)



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24/09/24 15:54
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Project summary

Geographical Site

Chhayani-li

India

Situation

Latitude 27.32 °N

Longitude 71.92 °E

Altitude 219 m

Time zone UTC+5.5

Project settings

Albedo 0.20

Weather data

Mashala

SolarGIS Monthly aver. , period not spec. - Synthetic

System summary

Grid-Connected System

Simulation for year no 1

Sheds, single array

PV Field Orientation

Fixed plane

Tilt/Azimuth 22 / 0 °

Near Shadings

Linear shadings : Fast (table)

User's needs

Unlimited load (grid)

System information

PV Array

Nb. of modules

24360 units

Pnom total

14.01 MWp

Inverters

Nb. of units

3 units

Pnom total

11.00 MWac

Grid power limit

11.00 MWac

Grid lim. Pnom ratio

1.273

Results summary

Produced Energy 26496059 kWh/year

Specific production 1892 kWh/kWp/year Perf. Ratio PR 84.70 %

Apparent energy 26496059 kVAh/year

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General parameters

Grid-Connected System

PV Field Orientation

Orientation

Fixed plane
Tilt/Azimuth 22 / 0 °

Sheds, single array

Sheds configuration

Nb. of sheds 280 units
Single array

Sizes

Sheds spacing 7.75 m
Collector width 4.58 m
Ground Cov. Ratio (GCR) 59.0 %
Top inactive band 0.02 m
Bottom inactive band 0.02 m

Shading limit angle

Limit profile angle 26.3 °

Models used

Transposition Perez
Diffuse Perez, Meteonom
Circumsolar separate

Horizon

Free Horizon

Near Shadings

Linear shadings : Fast (table)

User's needs

Unlimited load (grid)

Bifacial system

Model 2D Calculation
unlimited sheds

Bifacial model geometry

Sheds spacing 7.75 m
Sheds width 4.62 m
Limit profile angle 26.3 °
GCR 59.6 %
Height above ground 0.75 m

Bifacial model definitions

Ground albedo 0.30
Bifaciality factor 81 %
Rear shading factor 5.0 %
Rear mismatch loss 10.0 %
Shed transparent fraction 0.0 %

Grid injection point

Grid power limitation

Active power 11.00 MWac
Pnom ratio 1.273

Power factor

Cos(phi) (lagging) 1.000

PV Array Characteristics

PV module

Manufacturer Waaree Energies Ltd.
Model BiN-08-575

(Custom parameters definition)

Unit Nom. Power 575 Wp
Number of PV modules 14616 units
Nominal (STC) 8404 kWp

Array #1 - PV Array-1,3MW

Number of PV modules 7308 units
Nominal (STC) 4202 kWp
Modules 261 string x 28 In series

At operating cond. (50°C)

Pmpp 3884 kWp
U mpp 1097 V
I mpp 3540 A

Inverter

Manufacturer Sungrow
Model SG3300UD-20

(Custom parameters definition)

Unit Nom. Power 3300 kWac
Number of inverters 2 units
Total power 6600 kWac

Number of inverters 1 unit
Total power 3300 kWac

Operating voltage 938-1500 V
Max. power (=>23°C) 3960 kWac
Pnom ratio (DC:AC) 1.27
Power sharing within this inverter



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PV Array Characteristics

Array #2 - Sub-array #2-3MW

Number of PV modules	7308 units	Number of inverters	1 unit
Nominal (STC)	4202 kWp	Total power	3300 kWac
Modules	261 string x 28 In series		
At operating cond. (50°C)		Operating voltage	938-1500 V
Pmpp	3884 kWp	Max. power (=>23°C)	3960 kWac
U mpp	1097 V	Pnom ratio (DC:AC)	1.27
I mpp	3540 A	Power sharing within this inverter	

Array #3 - Sub-array #3_4MW

PV module

Manufacturer	Waaree Energies Ltd.
Model	BiN-08-575
(Custom parameters definition)	

Unit Nom. Power	575 Wp
Number of PV modules	9744 units
Nominal (STC)	5603 kWp
Modules	348 string x 28 In series

At operating cond. (50°C)

Pmpp	5179 kWp
U mpp	1097 V
I mpp	4720 A

Total PV power

Nominal (STC)	14007 kWp
Total	24360 modules
Module area	62928 m²

Inverter

Manufacturer	Sungrow
Model	SG4400UD-20
(Custom parameters definition)	

Unit Nom. Power	4400 kWac
Number of inverters	1 unit
Total power	4400 kWac
Operating voltage	938-1500 V
Max. power (=>23°C)	5280 kWac
Pnom ratio (DC:AC)	1.27
Power sharing within this inverter	

Total inverter power

Total power	11000 kWac
Max. power	13200 kWac
Number of inverters	3 units
Pnom ratio	1.27

Array losses

Array Soiling Losses

Loss Fraction	1.0 %
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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	0.5 %
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Module Quality Loss

Loss Fraction	-0.5 %
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Module mismatch losses

Loss Fraction	0.8 % at MPP
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Strings Mismatch loss

Loss Fraction	0.2 %
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Module average degradation

Year no	1
Loss factor	0.4 %/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°	30°	50°	60°	70°	75°	80°	85°	90°
1.000	1.000	0.999	0.993	0.979	0.946	0.855	0.615	0.000



DC wiring losses

Global wiring resistance 1.8 mΩ

Loss Fraction 1.8 % at STC

Array #1 - PV Array-1,3MW

Global array res. 6.1 mΩ

Loss Fraction 1.8 % at STC

Array #3 - Sub-array #3_4MW

Global array res. 4.6 mΩ

Loss Fraction 1.8 % at STC

Array #2 - Sub-array #2-3MW

Global array res. 6.1 mΩ

Loss Fraction 1.8 % at STC

System losses

Unavailability of the systemTime fraction 1.0 %
3.7 days,
3 periods**Auxiliaries loss**Proportional to Power 24.0 W/kW
0.0 kW from Power thresh.
Night aux. cons. 24.0 kW

AC wiring losses

Inv. output line up to MV transfo

Inverter voltage 660 Vac tri

Loss Fraction 0.09 % at STC

Inverter: SG3300UD-20Wire section (2 Inv.) Alu 2 x 3 x 3000 mm²

Average wires length 15 m

Inverter: SG4400UD-20Wire section (1 Inv.) Alu 1 x 3 x 4000 mm²

Wires length 0 m

MV line up to Injection

MV Voltage 33 kV

Average loss Fraction 0.71 % at STC

Array #1 - PV Array-1,3MWWires Alu 3 x 150 mm²

Length 8790 m

Array #3 - Sub-array #3_4MWWires Alu 3 x 150 mm²

Length 6590 m

Array #2 - Sub-array #2-3MWWires Alu 3 x 150 mm²

Length 8790 m



AC losses in transformers

MV transfo

Grid voltage 33 kV

One transfo in each sub-array

Array #1 - PV Array-1,3MW

Transformer from Datasheets

Nominal power 3300 kVA
Iron Loss (24/24 Connexion) 3.30 kVA
Iron loss fraction 0.10 % of PNom
Copper loss 33.00 kVA
Copper loss fraction 1.00 % at PNom
Coils equivalent resistance 3 x 1.32 mΩ

Array #2 - Sub-array #2-3MW

Transformer from Datasheets

Nominal power 3300 kVA
Iron Loss (24/24 Connexion) 3.30 kVA
Iron loss fraction 0.10 % of PNom
Copper loss 33.00 kVA
Copper loss fraction 1.00 % at PNom
Coils equivalent resistance 3 x 1.32 mΩ

Array #3 - Sub-array #3_4MW

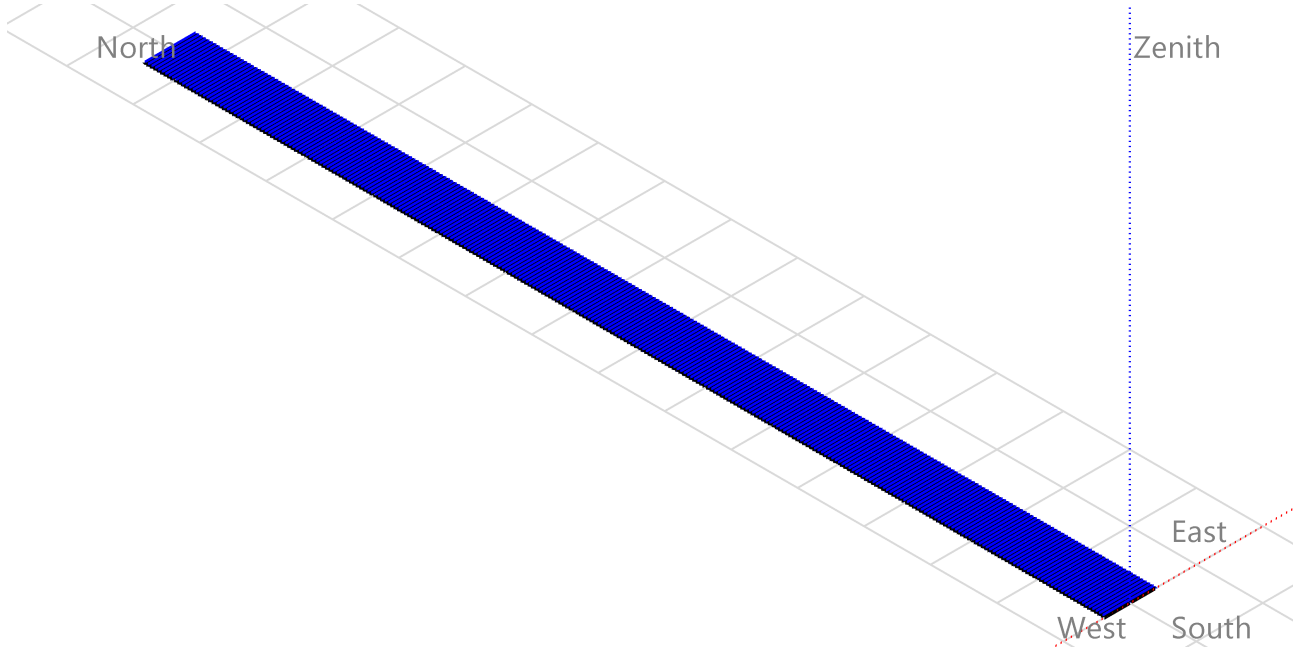
Transformer from Datasheets

Nominal power 4400 kVA
Iron Loss (24/24 Connexion) 4.40 kVA
Iron loss fraction 0.10 % of PNom
Copper loss 44.00 kVA
Copper loss fraction 1.00 % at PNom
Coils equivalent resistance 3 x 0.99 mΩ



Near shadings parameter

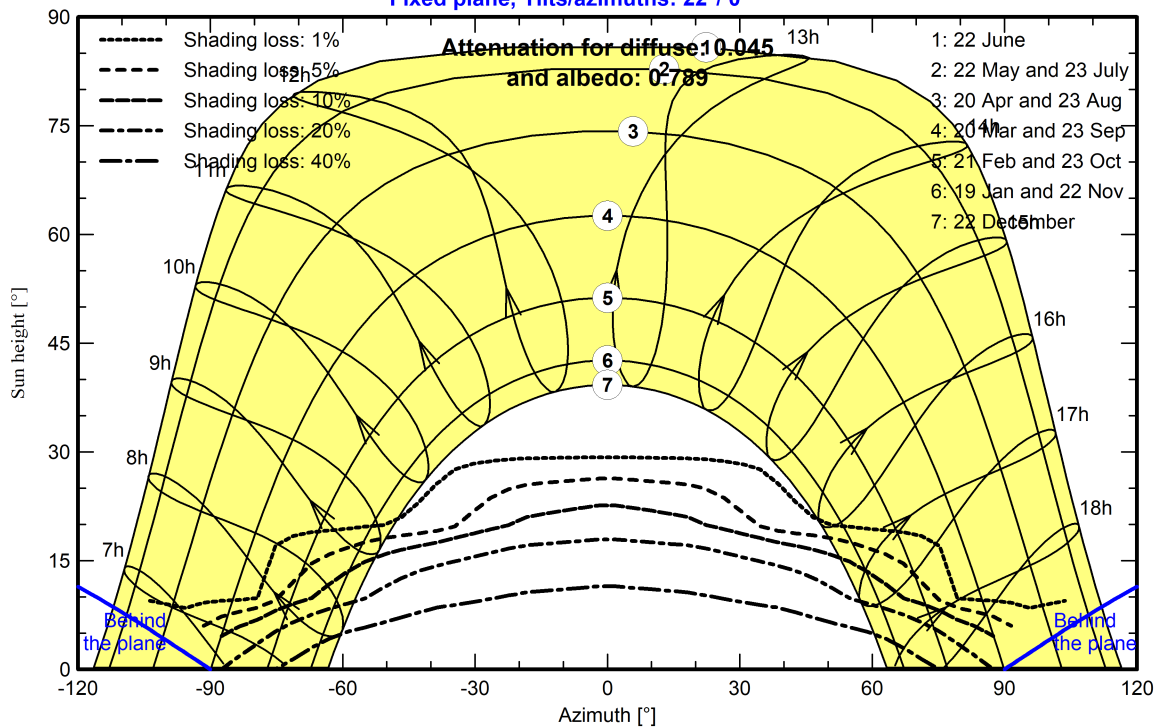
Perspective of the PV-field and surrounding shading scene



Iso-shadings diagram

Orientation #1

Fixed plane, Tilts/azimuths: 22°/ 0°



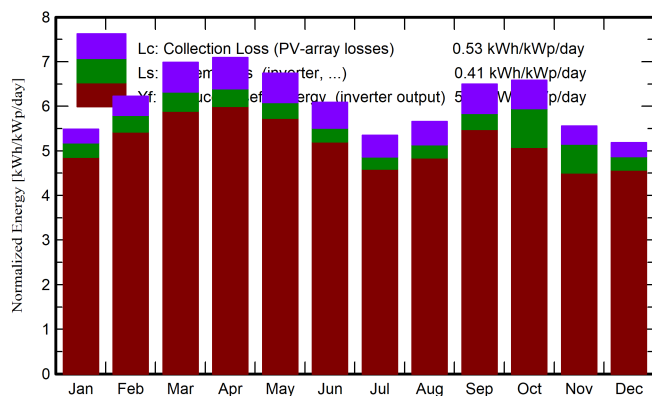


Main results

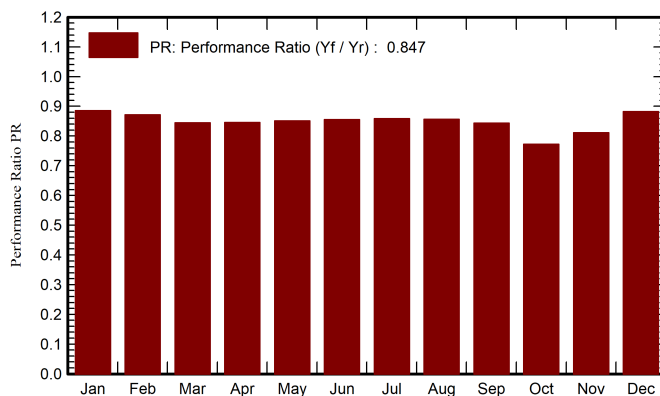
System Production

Produced Energy (P50) 26496059 kWh/year	Specific production (P50) 1892 kWh/kWp/year	Perf. Ratio PR	84.70 %
Produced Energy (P90) 25795634 kWh/year	Specific production (P90) 1842 kWh/kWp/year		
Produced Energy (P95) 25598562 kWh/year	Specific production (P95) 1828 kWh/kWp/year		
Apparent energy 26496059 kVAh/year			

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 kWh	E_Grid kWh	PR ratio
January	128.0	48.0	13.70	170.1	164.6	2250897	2111074	0.886
February	141.0	50.0	17.50	174.3	169.6	2274524	2128054	0.872
March	192.0	70.0	23.90	216.5	211.0	2746228	2561234	0.845
April	206.0	87.0	29.80	212.8	206.8	2689706	2521197	0.846
May	216.0	108.0	34.40	208.9	202.4	2642646	2491516	0.851
June	194.0	104.0	36.00	182.6	176.4	2316757	2186884	0.855
July	174.0	104.0	34.50	165.9	159.7	2114762	1995325	0.858
August	176.0	93.0	33.40	175.4	169.5	2233565	2105037	0.857
September	180.0	74.0	32.20	195.0	189.6	2455484	2305075	0.844
October	171.0	61.0	27.10	204.2	198.9	2586019	2209280	0.772
November	130.0	53.0	20.00	166.8	161.7	2167793	1894812	0.811
December	119.0	46.0	14.79	160.7	155.3	2117385	1986571	0.882
Year	2027.0	898.0	26.48	2233.4	2165.5	28595766	26496059	0.847

Legends

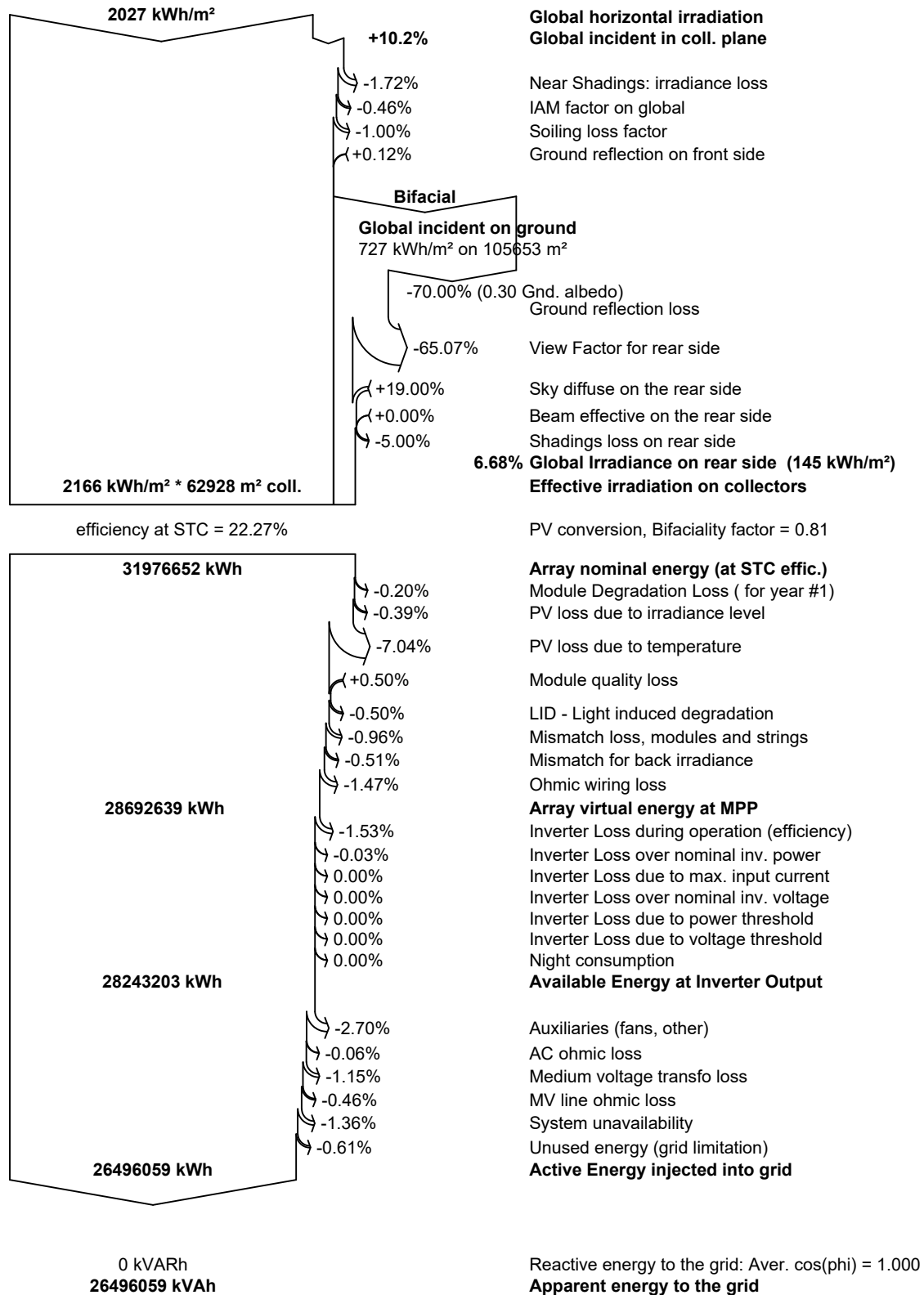
GlobHor	Global horizontal irradiation	EArray	Effective energy at the output of the array
DiffHor	Horizontal diffuse irradiation	E_Grid	Energy injected into grid
T_Amb	Ambient Temperature	PR	Performance Ratio
GlobInc	Global incident in coll. plane		
GlobEff	Effective Global, corr. for IAM and shadings		

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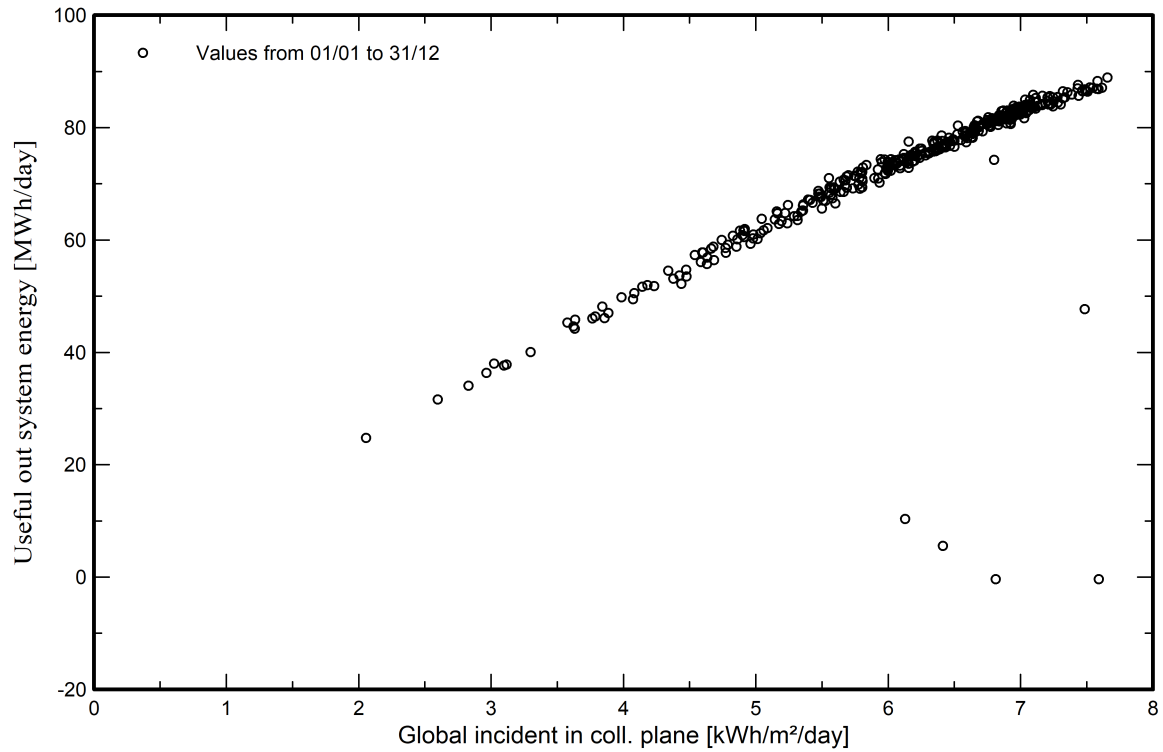
Loss diagram



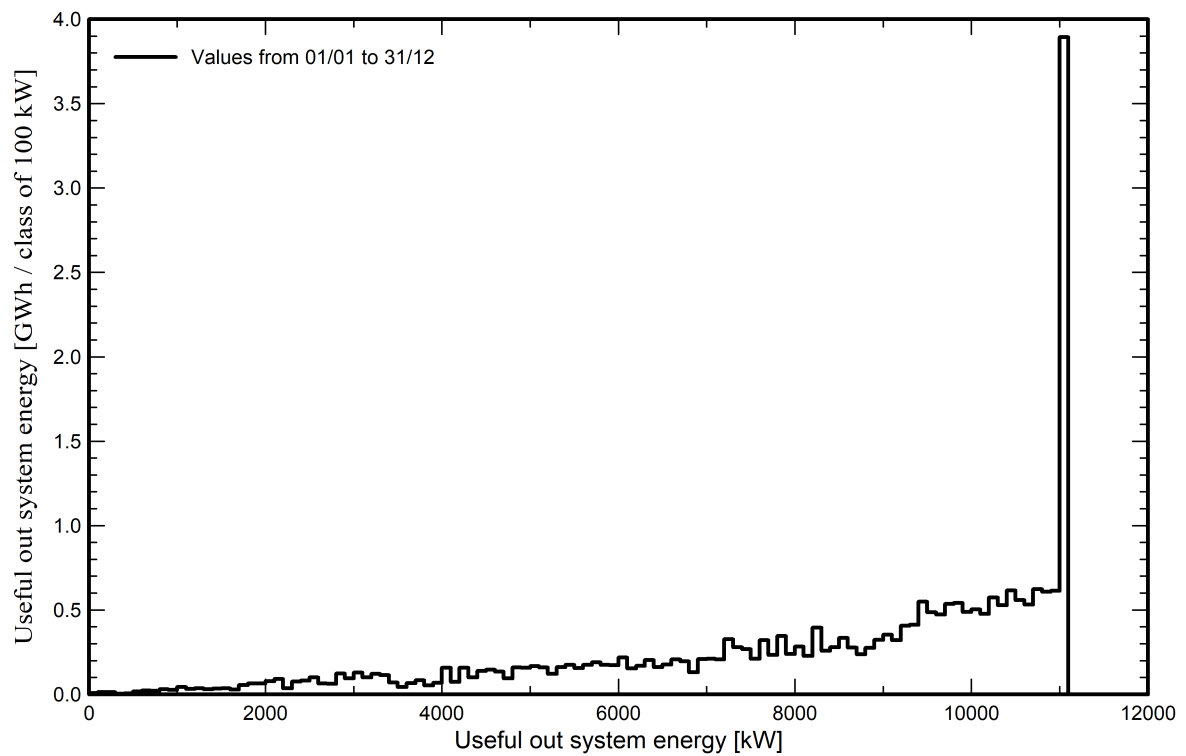


Predef. graphs

Daily Input/Output diagram



System Output Power Distribution





P50 - P90 evaluation

Weather data

Source SolarGIS Monthly aver. , period not spec.
Kind TMY, multi-year
Year-to-year variability(Variance) -1.0 %

Specified Deviation

Climate change 0.0 %

Global variability (weather data + system)

Variability (Quadratic sum) 2.1 %

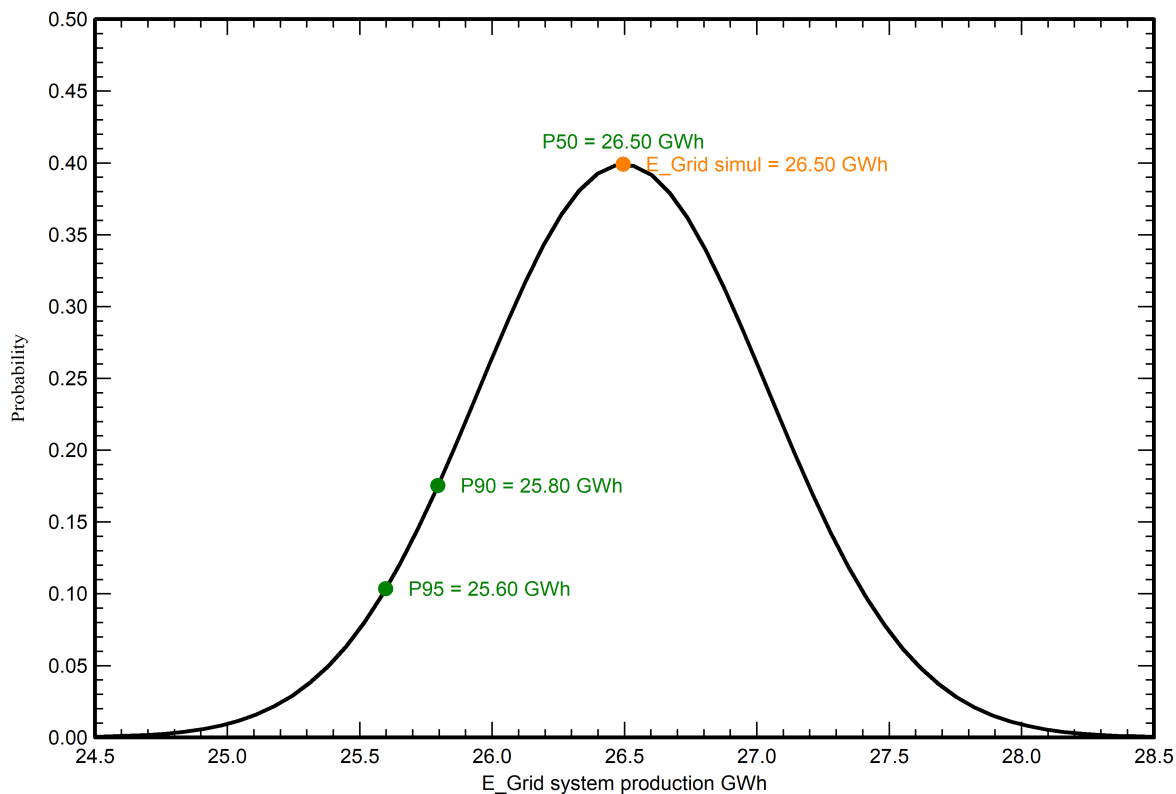
Simulation and parameters uncertainties

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	0.55 GWh
P50	26.50 GWh
P90	25.80 GWh
P95	25.60 GWh

Probability distribution

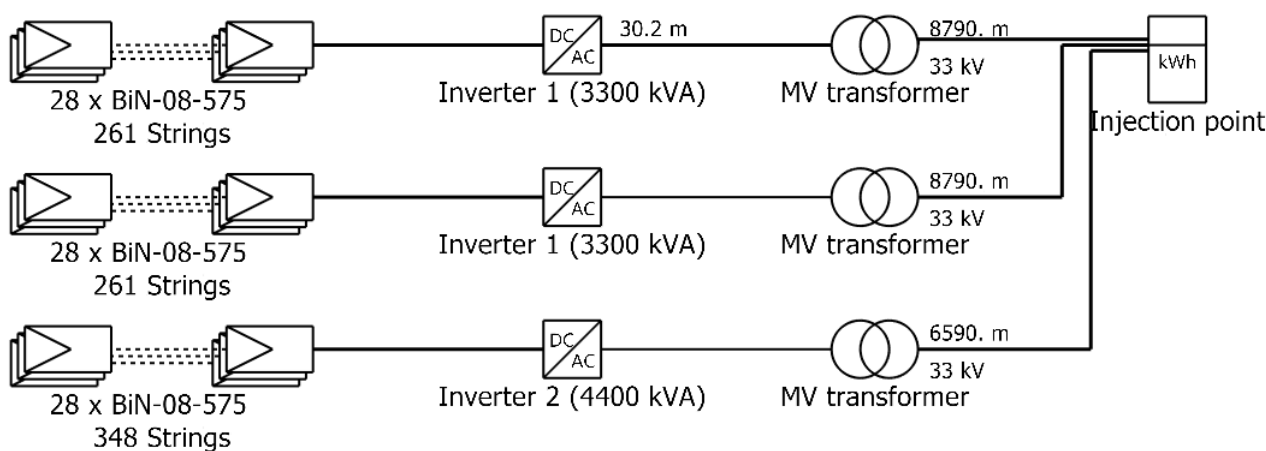




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Single-line diagram



PV module	BiN-08-575
Inverter 1	SG3300UD-20
Inverter 2	SG4400UD-20
String	28 x BiN-08-575

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