Version 7.4.8

PVsyst - Simulation report

Grid-Connected System

Project: Bhadla MiniGrid-2_Arjunpura

Variant: Bhadla MiniGrid-2_Arjunpura

Sheds, single array

System power: 9145 kWp

Mashala - India

Author

AVENGERS RAYS SOLAR PRIVATE LIMITED (India)

Project: Bhadla MiniGrid-2_Arjunpura

Variant: Bhadla MiniGrid-2_Arjunpura

AVENGERS RAYS SOLAR PRIVATE LIMITED (India)

Project summary

Geographical Site
Mashala
India

Situation

Latitude	27.29 °N
Longitude	71.88 °E
Altitude	221 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	15904 units
Pnom total	9145 kWp

Inverters

Nb. of units	2 units
Pnom total	7700 kWac
Grid power limit	7700 kWac
Grid lim. Pnom ratio	1.188

Results summary

Produced Energy	17632823 kWh/year	Specific production	1928 kWh/kWp/year	Perf. Ratio PR	86.35 %
Apparent energy	17632823 kVAh/year				

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General parameters

Grid-Connected System

Sheds, single array

PV Field Orientation

Orientation	
Fixed plane	
Tilt/Azimuth	22 / 0 °

Sheds configuration		
Nb. of sheds	68	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, Meteonorm
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	7700 kWac
Pnom ratio	1.188

Power factor	
Cos(phi) (lagging)	1.000

PV Array Characteristics

Array #1 - 2.52MW

PV module	
Manufacturer	Waaree Energies Ltd.
Model	BiN-08-575
(Custom parameters definition)	
Unit Nom. Power	575 Wp
Number of PV modules	6160 units
Nominal (STC)	3542 kWp
Modules	220 string x 28 In series
At operating cond. (50°C)	
Pmpp	3274 kWp
U mpp	1097 V
I mpp	2984 A

Inverter	
Manufacturer	Sungrow
Model	SG3300UD-20
(Custom parameters definition)	
Unit Nom. Power	3300 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)	1.07
Power sharing within this inverter	

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PV Array Characteristics

Array #2 - 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

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 PV power

Nominal (STC)	9145 kWp
Total	15904 modules
Module area	41084 m²

Total inverter power

Total power	7700 kWac
Max. power	9240 kWac
Number of inverters	2 units
Pnom ratio	1.19

Array losses

Array Soiling Losses
Loss Fraction 1.0 %

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 %

Module Quality Loss
Loss Fraction -0.5 %

Module mismatch losses
Loss Fraction 0.8 % at MPP

Strings Mismatch loss
Loss Fraction 0.2 %

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 2.8 mΩ
Loss Fraction 1.8 % at STC

Array #1 - 2.52MW
Global array res. 7.2 mΩ
Loss Fraction 1.8 % at STC

Array #2 - 4MW
Global array res. 4.6 mΩ
Loss Fraction 1.8 % at STC

System losses

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System losses

Unavailability of the system
Time fraction 1.0 %
3.7 days,
3 periods

Auxiliaries loss
Proportional to Power 16.0 W/kW
0.0 kW from Power thresh.
Night aux. cons. 16.00 kW

AC wiring losses

Inv. output line up to MV transfo
Inverter voltage 660 Vac tri
Loss Fraction 0.30 % at STC

Inverter: SG3300UD-20
Wire section (1 Inv.) Alu 1 x 3 x 2500 mm²
Wires length 30 m

Inverter: SG4400UD-20
Wire section (1 Inv.) Alu 1 x 3 x 4000 mm²
Wires length 30 m

MV line up to Injection
MV Voltage 33 kV
Average each inverter
Wires Alu 3 x 400 mm²
Length 10810 m
Loss Fraction 0.35 % at STC

AC losses in transformers

MV transfo
Grid voltage 33 kV
One transfo in each sub-array
Array #1 - 2.52MW
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 - 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

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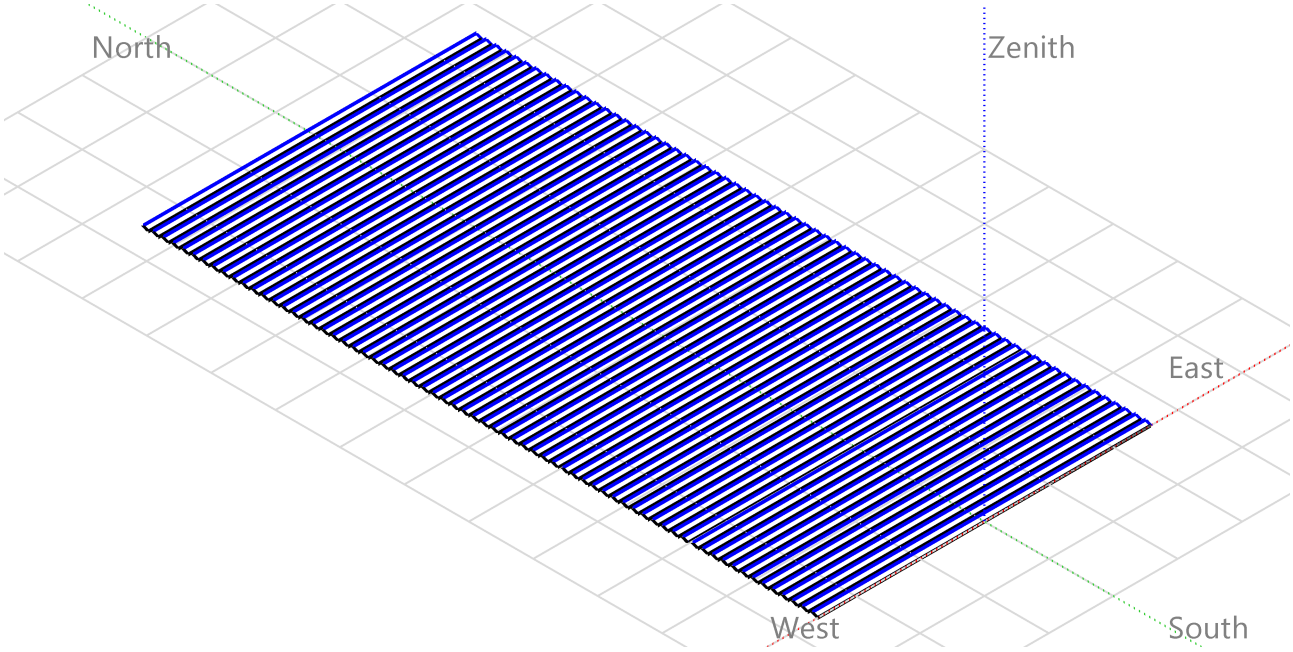
Near shadings parameter

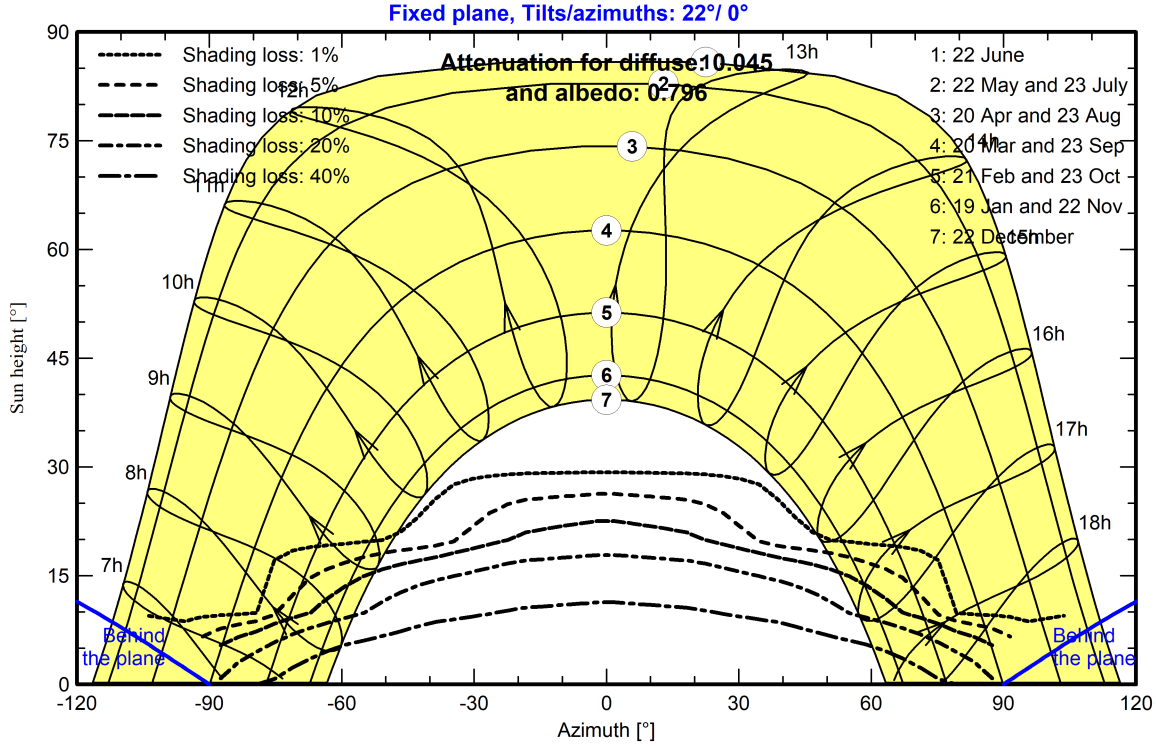
Perspective of the PV-field and surrounding shading scene



Iso-shadings diagram

Orientation #1

Fixed plane, Tilts/azimuths: 22° / 0°



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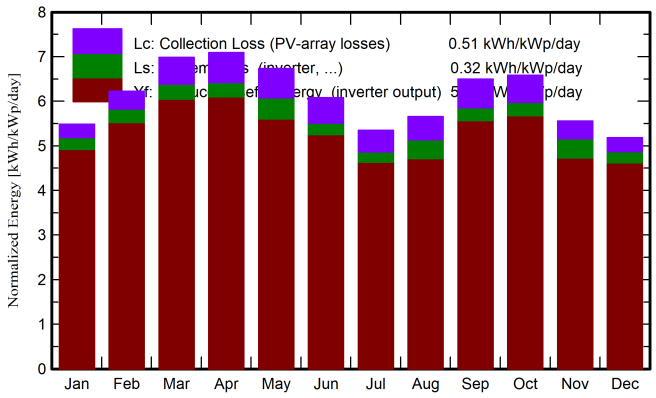
Main results

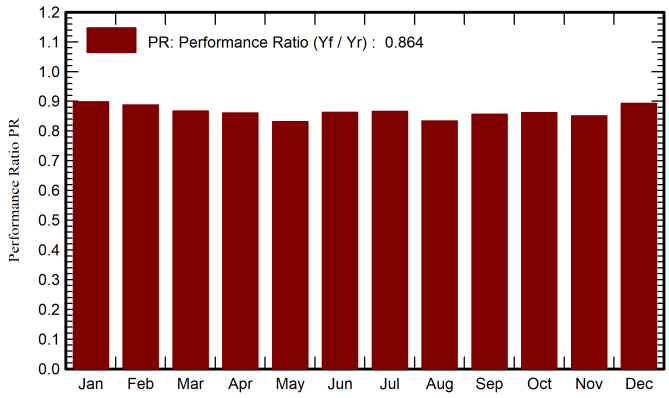
System Production

Produced Energy (P50)	17632823 kWh/year	Specific production (P50)	1928 kWh/kWp/year	Perf. Ratio PR	86.35 %
Produced Energy (P90)	16935925 kWh/year	Specific production (P90)	1852 kWh/kWp/year		
Produced Energy (P95)	16739845 kWh/year	Specific production (P95)	1831 kWh/kWp/year		
Apparent energy	17632823 kVAh/year				

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 kWh	E_Grid kWh	PR ratio
January	128.0	48.0	13.70	170.1	164.5	1471687	1397160	0.898
February	141.0	50.0	17.50	174.3	169.6	1492432	1415152	0.888
March	192.0	70.0	23.90	216.5	211.0	1811888	1715953	0.867
April	206.0	87.0	29.80	212.8	206.8	1762436	1674730	0.861
May	216.0	108.0	34.40	208.9	202.3	1725061	1589239	0.832
June	194.0	104.0	36.00	182.6	176.3	1512159	1441305	0.863
July	174.0	104.0	34.50	165.9	159.7	1380315	1314681	0.866
August	176.0	93.0	33.40	175.4	169.4	1457917	1337362	0.834
September	180.0	74.0	32.20	195.0	189.5	1607006	1528079	0.857
October	171.0	61.0	27.10	204.1	198.8	1695094	1609635	0.862
November	130.0	53.0	20.00	166.8	161.6	1416340	1297931	0.851
December	119.0	46.0	14.79	160.7	155.3	1382749	1311596	0.893
Year	2027.0	898.0	26.48	2233.0	2164.8	18715086	17632823	0.864

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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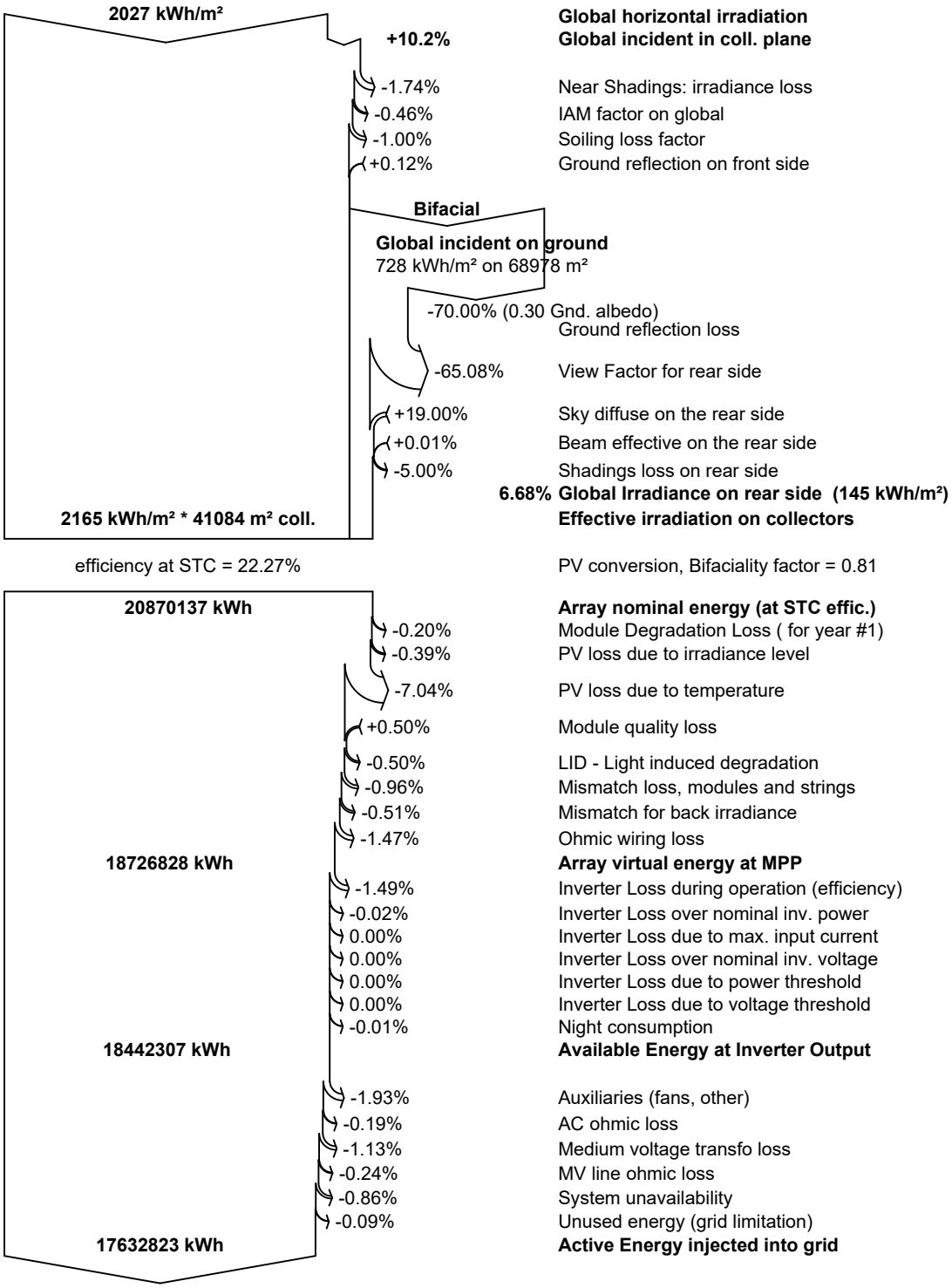
Loss diagram



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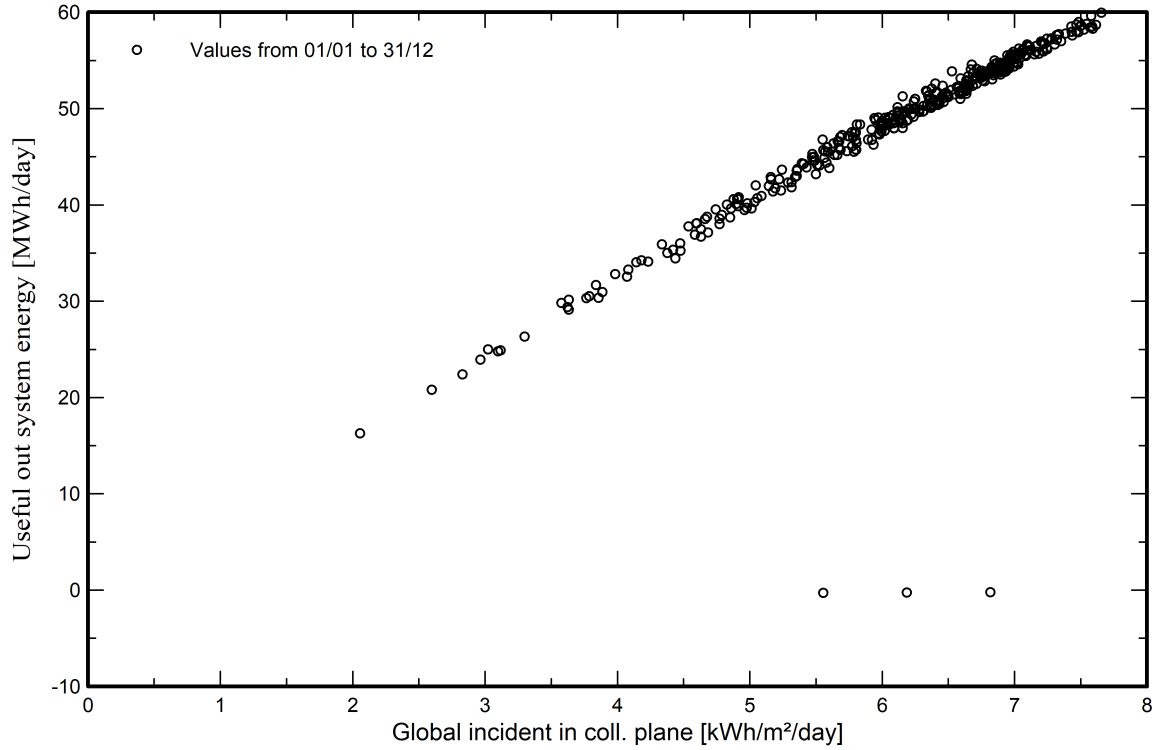
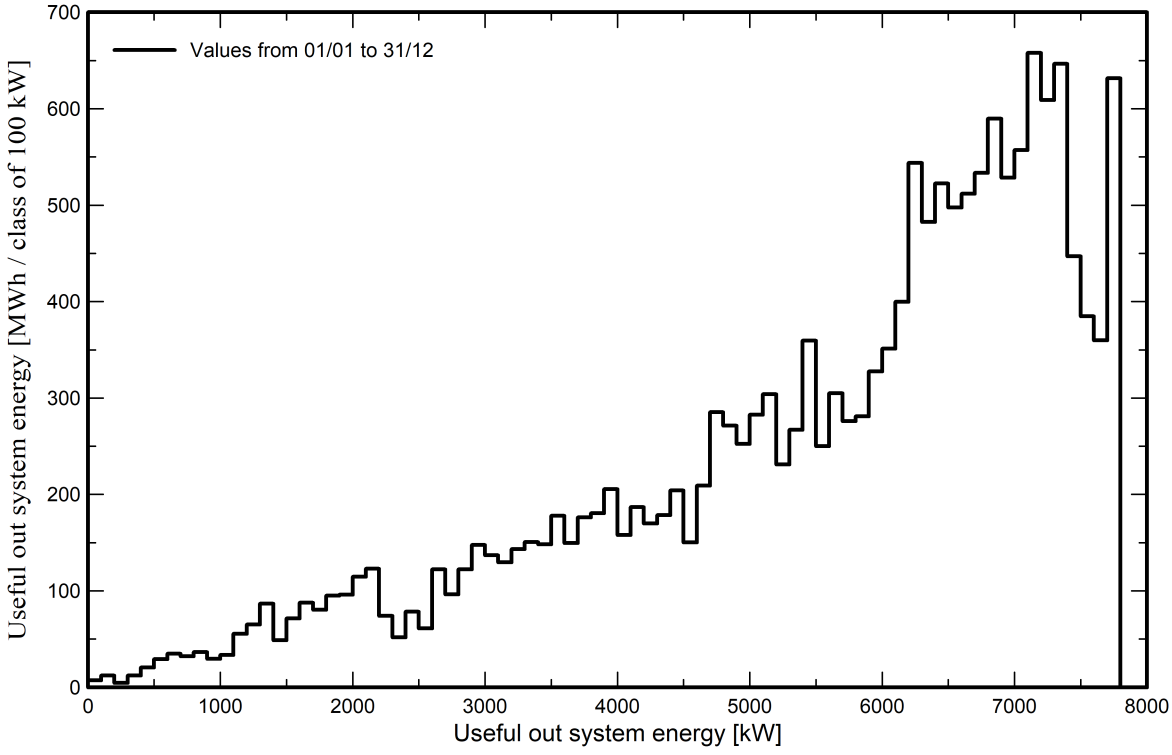
Predef. graphs

Daily Input/Output diagram



System Output Power Distribution



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P50 - P90 evaluation

Weather data

Source	SolarGIS Monthly aver. , period not spec.
Kind	TMY, multi-year
Year-to-year variability(Variance)	2.5 %

Specified Deviation

Climate change	0.0 %

Global variability (weather data + system)

Variability (Quadratic sum)	3.1 %

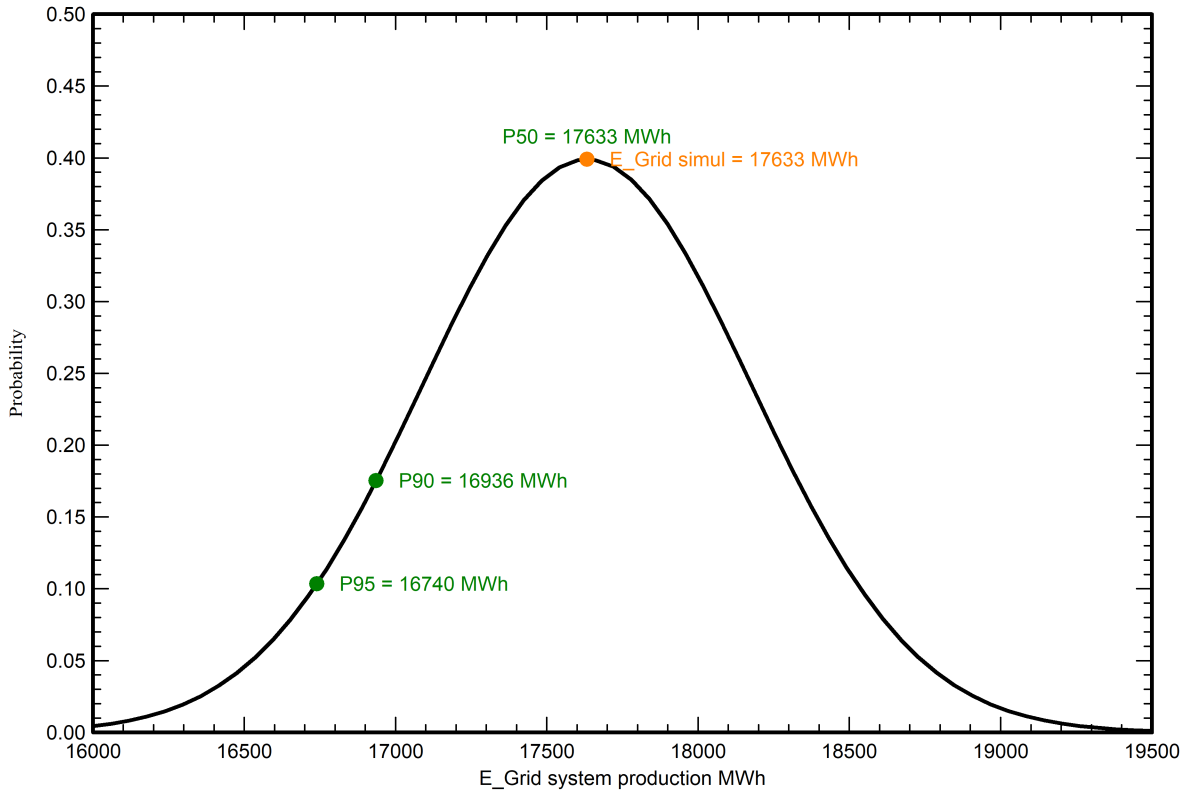
Simulation and parameters uncertainties

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	543 MWh
P50	17633 MWh
P90	16936 MWh
P95	16740 MWh

Probability distribution



Single-line diagram

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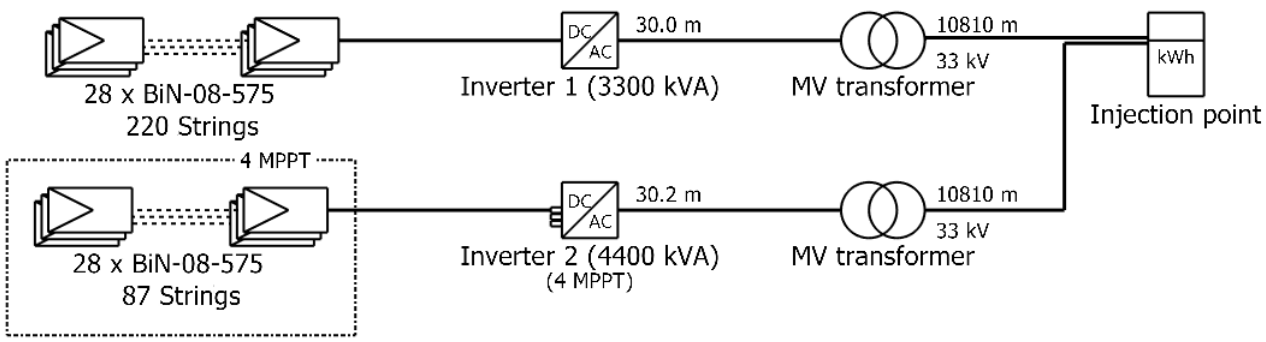

PV module	BiN-08-575
Inverter 1	SG3300UD-20
Inverter 2	SG4400UD-20
String	28 x BiN-08-575

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