

# PVsyst - Simulation report

## Grid-Connected System

Project: SSEP\_DeH Halkani

Variant: SSEP Project\_KE\_120MWp\_JA Solar\_620W\_f

Tracking system with backtracking

System power: 120.0 MWp

DeH Halkani - Pakistan

**Author**

Renewable Resources Pvt Limited (Pakistan)



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## PVsyst V7.4.8

VDS, Simulation date:  
12/09/24 22:19  
with V7.4.8

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### Project summary

#### Geographical Site

Deh Halkani  
Pakistan

#### Situation

Latitude 25.03 °N  
Longitude 66.99 °E  
Altitude 60 m  
Time zone UTC+5

#### Project settings

Albedo 0.20

#### Weather data

Hazratnabad  
SolarGISv2.2.31 - TMY

### System summary

#### Grid-Connected System

#### PV Field Orientation

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

#### Tracking system with backtracking

#### Tracking algorithm

Astronomic calculation  
Backtracking activated

#### Near Shadings

Linear shadings : Fast (table)  
Diffuse shading Automatic

#### System information

##### PV Array

Nb. of modules 193564 units  
Pnom total 120.0 MWp

##### Inverters

Nb. of units 12 units  
Pnom total 105.6 MWac  
Pnom ratio 1.136

#### User's needs

Unlimited load (grid)

### Results summary

Produced Energy 237681230 kWh/year Specific production 1981 kWh/kWp/year Perf. Ratio PR 85.31 %

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### General parameters

#### Grid-Connected System

#### PV Field Orientation

##### Orientation

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

#### Models used

Transposition Hay  
Diffuse Imported  
Circumsolar separate

#### Horizon

Free Horizon

#### Bifacial system

Model 2D Calculation  
unlimited trackers

#### Bifacial model geometry

Tracker Spacing 6.30 m  
Tracker width 2.38 m  
GCR 37.8 %  
Axis height above ground 2.10 m

#### Tracking system with backtracking

##### Tracking algorithm

Astronomic calculation  
Backtracking activated

#### Near Shadings

Linear shadings : Fast (table)  
Diffuse shading Automatic

##### Backtracking array

Nb. of trackers 3019 units

##### Sizes

Tracker Spacing 6.30 m  
Collector width 2.38 m  
Ground Cov. Ratio (GCR) 37.8 %  
Phi min / max. -/+ 60.0 °

##### Backtracking strategy

Phi limits for BT -/+ 67.7 °  
Backtracking pitch 6.30 m  
Backtracking width 2.38 m

#### User's needs

Unlimited load (grid)

#### Bifacial model definitions

Ground albedo 0.20  
Bifaciality factor 81 %  
Rear shading factor 5.0 %  
Rear mismatch loss 10.0 %  
Shed transparent fraction 0.0 %

### PV Array Characteristics

#### PV module

Manufacturer JA Solar  
Model JAM66D45-620/LB  
(Custom parameters definition)

Unit Nom. Power 620 Wp  
Number of PV modules 193564 units  
Nominal (STC) 120.0 MWp  
Modules 6913 string x 28 In series

#### At operating cond. (50°C)

Pmpp 111.6 MWp  
U mpp 1045 V  
I mpp 106751 A

#### Total PV power

Nominal (STC) 120010 kWp  
Total 193564 modules  
Module area 522853 m²

#### Inverter

Manufacturer Generic  
Model Sungrow\_8800kW  
(Custom parameters definition)

Unit Nom. Power 8800 kWac  
Number of inverters 12 units  
Total power 105600 kWac  
Operating voltage 938-1500 V  
Max. power (=>23°C) 10560 kWac  
Pnom ratio (DC:AC) 1.14  
Power sharing within this inverter

#### Total inverter power

Total power 105600 kWac  
Max. power 126720 kWac  
Number of inverters 12 units  
Pnom ratio 1.14



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### Array losses

#### Array Soiling Losses

Loss Fraction 3.0 %

#### 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. 0.16 mΩ  
Loss Fraction 1.5 % at STC

#### Serie Diode Loss

Voltage drop 0.7 V  
Loss Fraction 0.1 % at STC

#### LID - Light Induced Degradation

Loss Fraction 2.0 %

#### Module Quality Loss

Loss Fraction -0.8 %

#### Module mismatch losses

Loss Fraction 2.0 % at MPP

#### Strings Mismatch loss

Loss Fraction 0.2 %

#### IAM loss factor

Incidence effect (IAM): User defined profile

0°	50°	60°	65°	70°	75°	80°	85°	90°
1.000	1.000	1.000	1.000	0.971	0.933	0.860	0.763	0.000

### System losses

#### Unavailability of the system

Time fraction 2.0 %  
7.3 days,  
5 periods

#### Auxiliaries loss

constant (fans) 250 kW  
0.0 kW from Power thresh.  
Night aux. cons. 200 kW

### AC wiring losses

#### Inv. output line up to MV transfo

Inverter voltage 33000 Vac tri  
Loss Fraction 0.00 % at STC

#### Inverter: Sungrow\_8800kW

Wire section (12 Inv.) Alu 12 x 3 x 95 mm²  
Average wires length 15 m

#### MV line up to HV Transfo

MV Voltage 33 kV  
Average each inverter  
Wires Alu 3 x 185 mm²  
Length 2000 m  
Loss Fraction 0.31 % at STC

#### HV line up to Injection

HV line voltage 220 kV  
Wires Alu 3 x 500 mm²  
Length 90 m  
Loss Fraction 0.00 % at STC

### AC losses in transformers

#### MV transfo

Medium voltage 33 kV

#### One transfo parameters

Nominal power at STC 9.88 MVA  
Iron Loss (24/24 Connexion) 9.88 kVA  
Iron loss fraction 0.10 % at STC  
Copper loss 98.78 kVA  
Copper loss fraction 1.00 % at STC  
Coils equivalent resistance 3 x 1102 mΩ

#### Operating losses at STC (full system)

Nb. identical MV transfos 12  
Nominal power at STC 118.5 MVA  
Iron loss (24/24 Connexion) 118.54 kVA  
Copper loss 1185.37 kVA



### AC losses in transformers

#### HV transfo

Grid voltage 220 kV

#### Transformer from Datasheets

Nominal power 120000 kVA

Iron Loss (24/24 Connexion) 250.00 kVA

Iron loss fraction 0.21 % of PNom

Copper loss 600.00 kVA

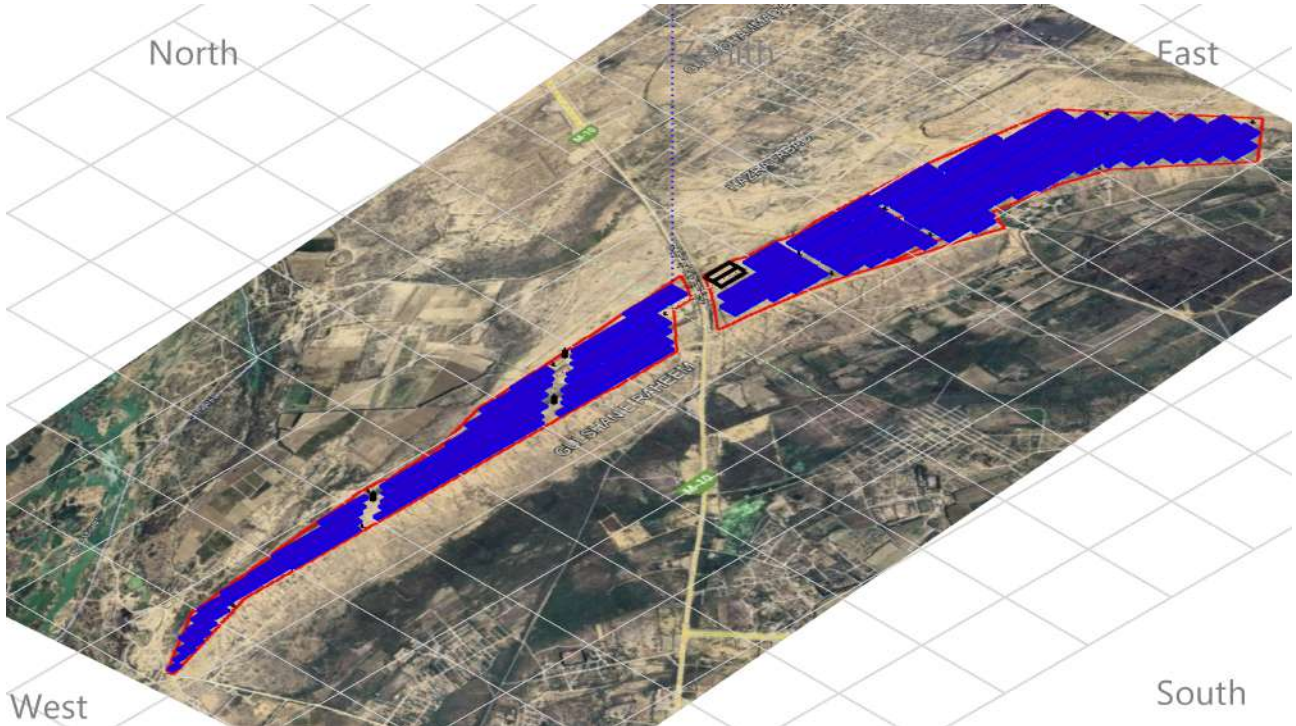
Copper loss fraction 0.50 % at PNom

Coils equivalent resistance 3 x 45.38 mΩ



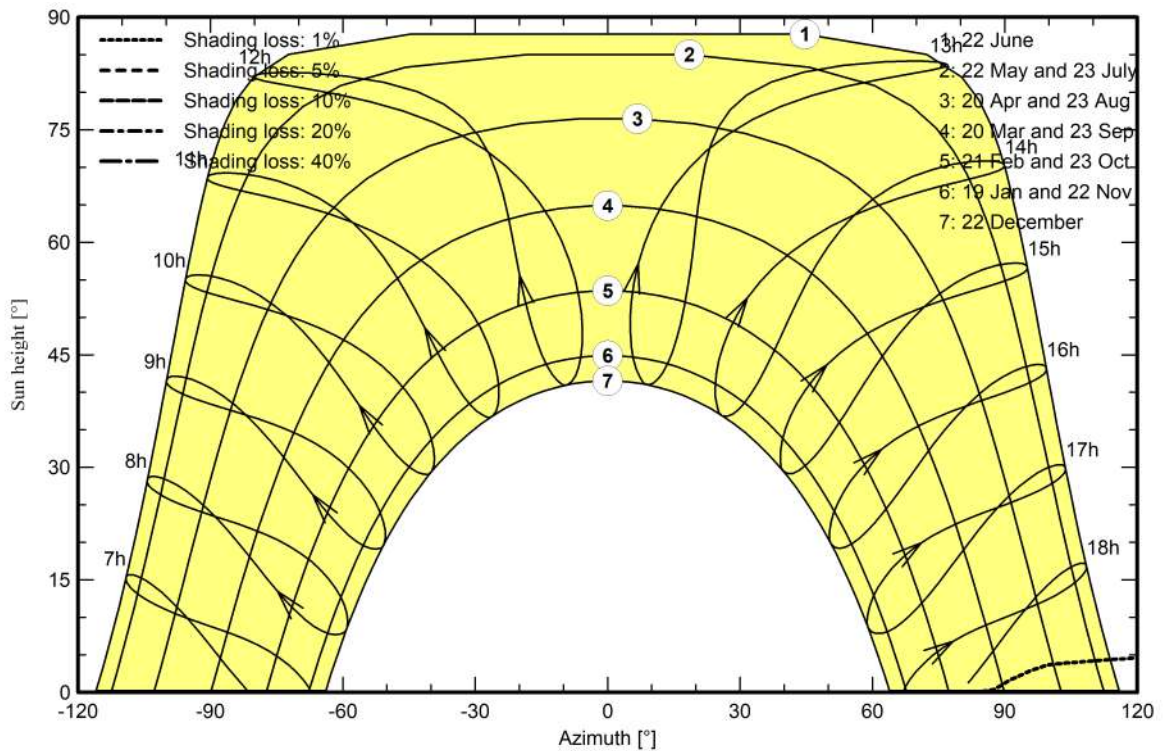
### Near shadings parameter

Perspective of the PV-field and surrounding shading scene



### Iso-shadings diagram

Orientation #1





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### Main results

#### System Production

Produced Energy 237681230 kWh/year

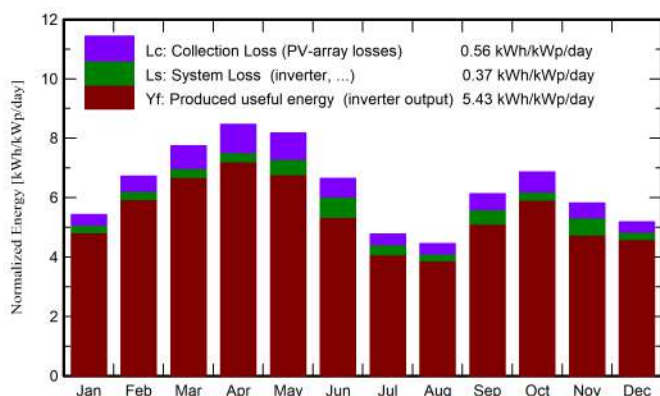
Specific production

1981 kWh/kWp/year

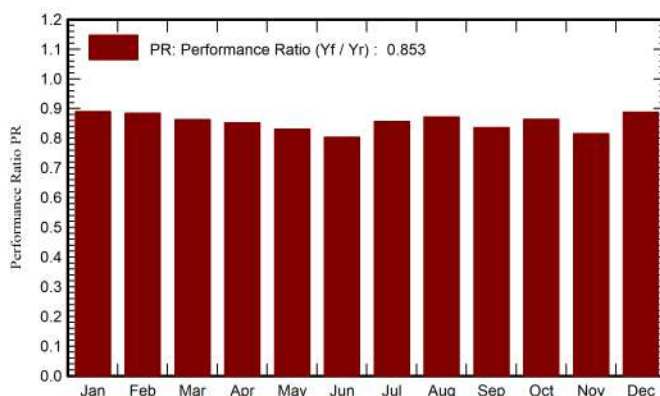
Perf. Ratio PR

85.31 %

#### Normalized productions (per installed kWp)



#### Performance Ratio PR



### Balances and main results

	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_Grid	PR
	kWh/m <sup>2</sup>	kWh/m <sup>2</sup>	°C	kWh/m <sup>2</sup>	kWh/m <sup>2</sup>	kWh	kWh	ratio
January	132.0	52.0	18.76	168.4	160.5	18905785	17978268	0.890
February	149.9	58.7	19.64	188.2	179.5	20911025	19969328	0.884
March	195.7	76.3	25.96	240.2	229.1	26008149	24883148	0.863
April	210.9	85.3	28.76	253.9	242.3	27115391	25971700	0.852
May	219.0	102.6	30.40	253.3	241.0	27177025	25259716	0.831
June	182.9	101.4	30.93	199.5	189.0	21708253	19246344	0.804
July	141.8	103.6	29.99	148.1	139.1	16474860	15215121	0.856
August	130.9	90.1	29.10	138.2	130.1	15329860	14445328	0.871
September	160.3	85.8	27.91	183.8	174.3	20154581	18430246	0.836
October	172.0	68.5	27.82	212.6	202.8	23082741	22057439	0.864
November	138.9	56.9	25.26	174.7	166.5	19209258	17101884	0.816
December	126.3	49.5	19.69	160.8	153.3	18024720	17122708	0.887
Year	1960.6	930.8	26.22	2321.6	2207.3	254101648	237681230	0.853

#### 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



## Project: SSEP\_DeH Halkani

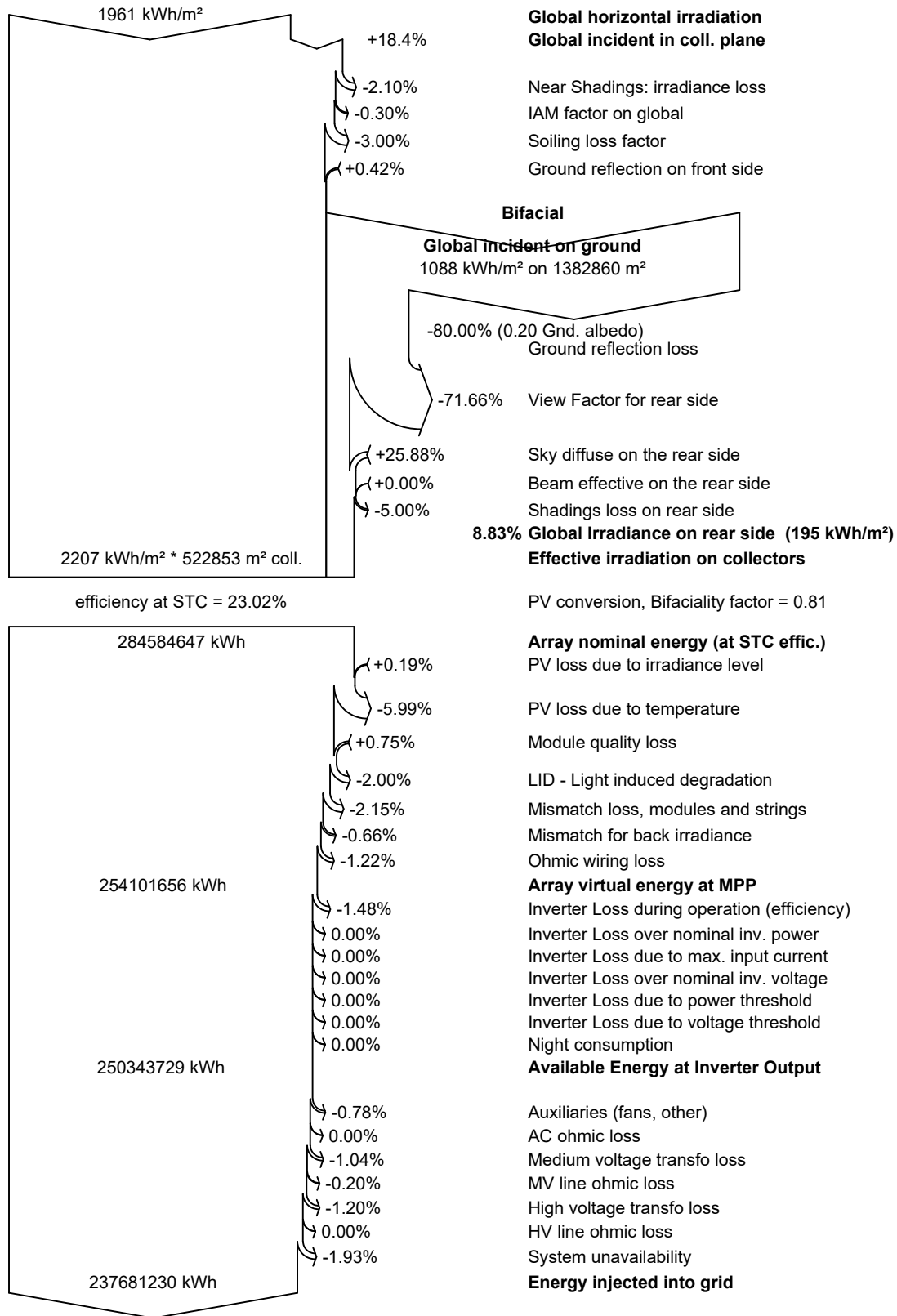
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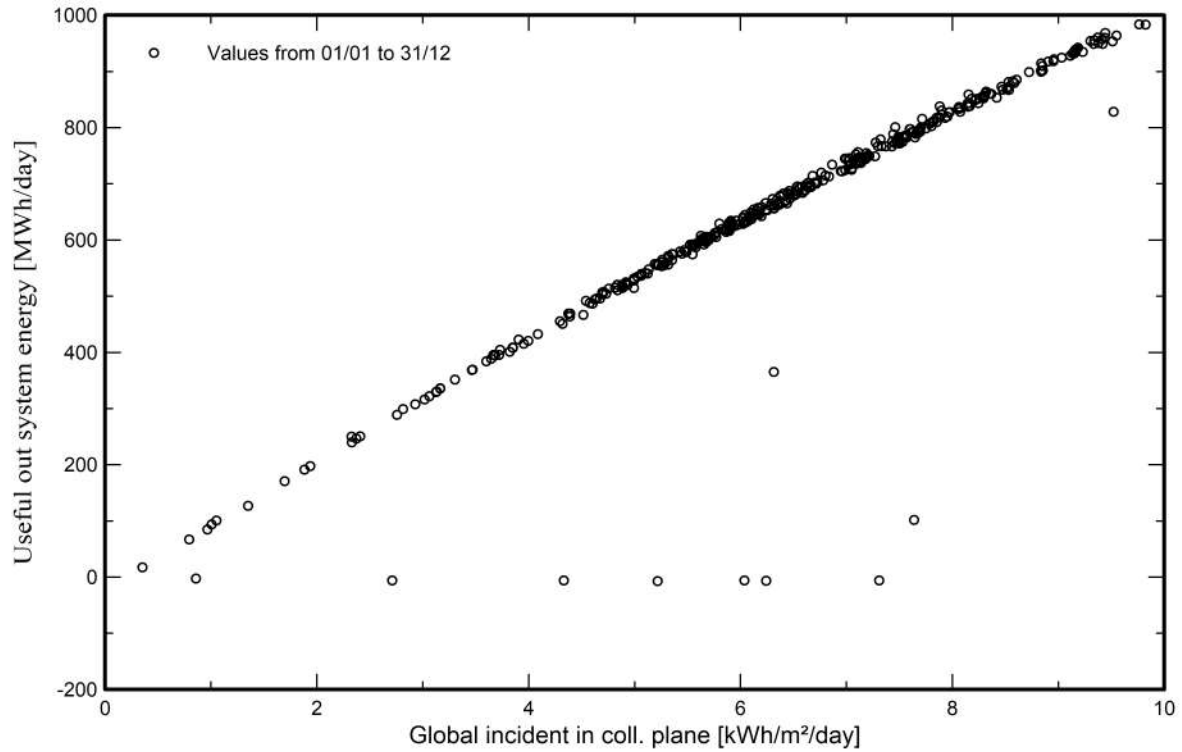
### Loss diagram



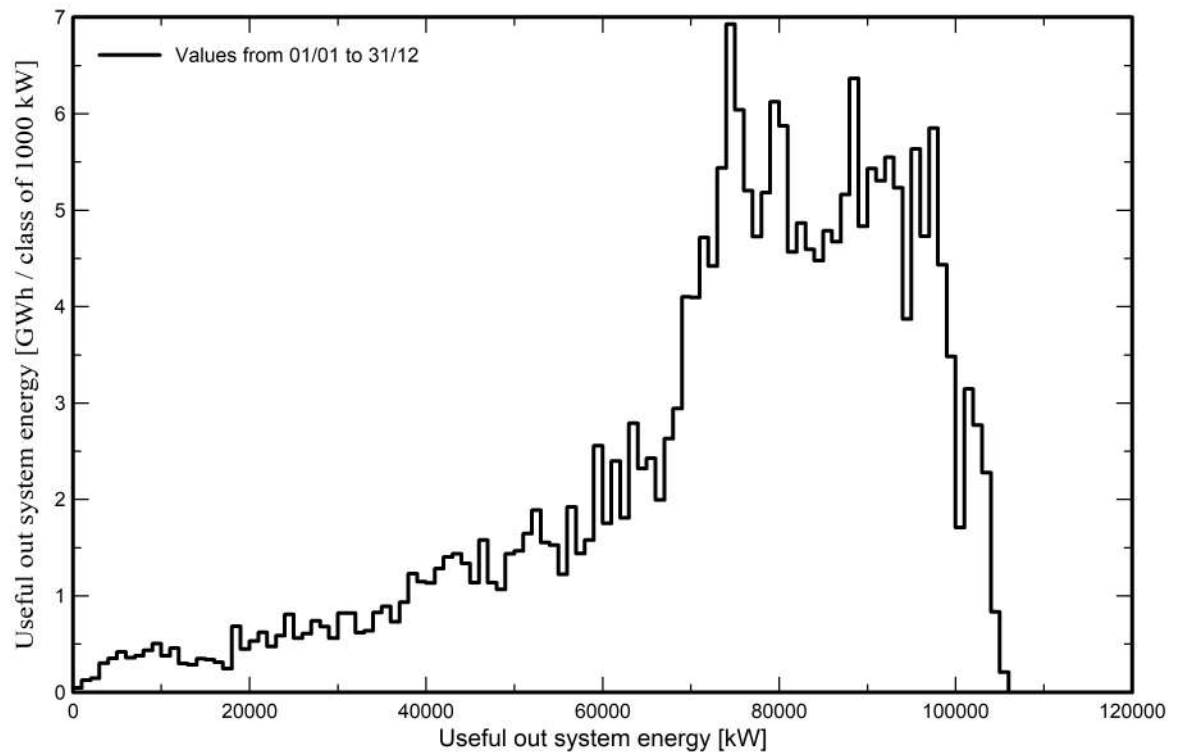


Predef. graphs

Daily Input/Output diagram



System Output Power Distribution





### P50 - P90 evaluation

#### Weather data

Source SolarGISv2.2.31  
Kind TMY, multi-year  
Year-to-year variability(Variance) 5.0 %

#### Specified Deviation

Climate change 0.0 %

#### Global variability (weather data + system)

Variability (Quadratic sum) 5.3 %

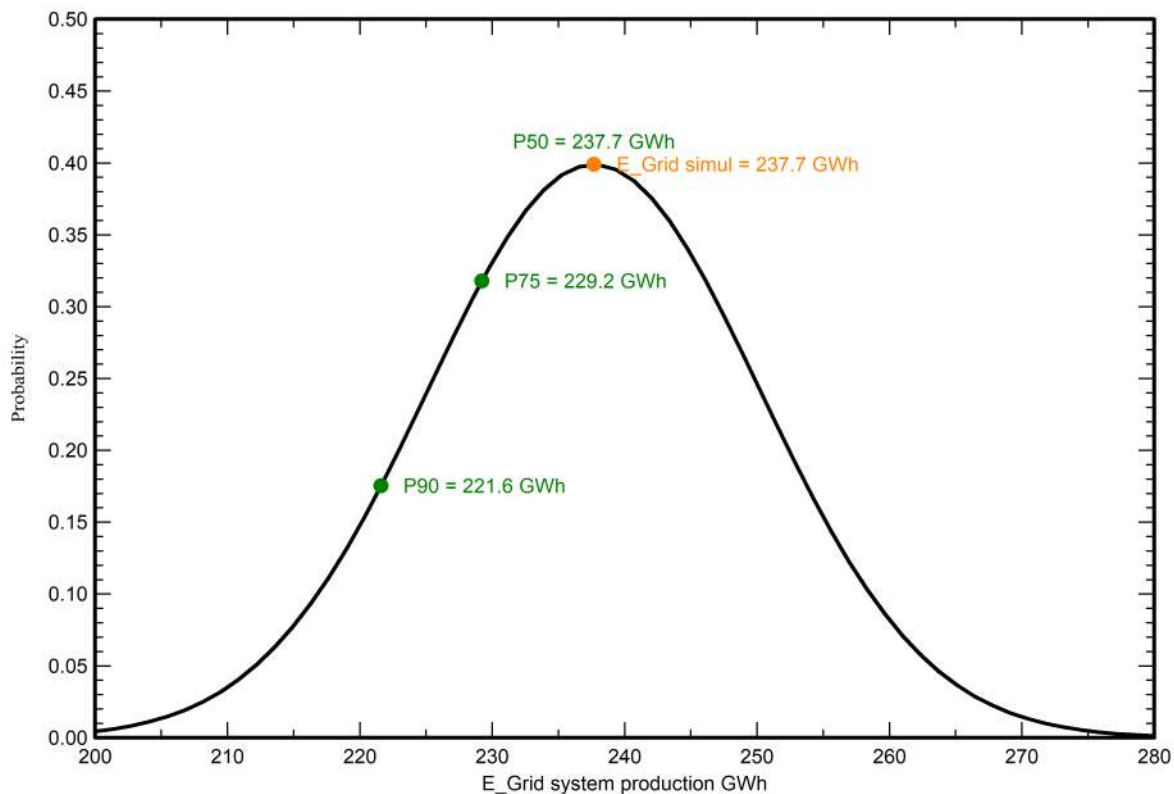
#### Simulation and parameters uncertainties

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	12.5 GWh
P50	237.7 GWh
P75	229.2 GWh
P90	221.6 GWh

### Probability distribution

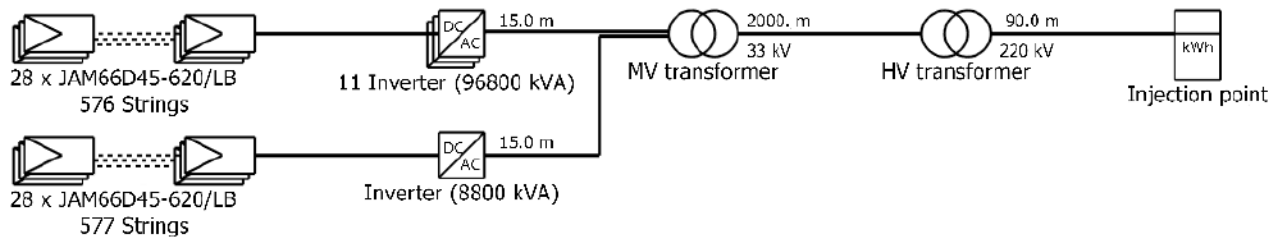




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# Single-line diagram



PV module	JAM66D45-620/LB
Inverter	Sungrow_8800kW
String	28 x JAM66D45-620/LB

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