

# PVsyst - Simulation report

## Grid-Connected System

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Project: District hospital Etah

Variant: New simulation variant

Unlimited sheds

System power: 427 kWp

Chamārpur - India

**Author**

Jakson Limited (India)

**PVsyst V8.0.2**

VC0, Simulation date:  
17/12/24 09:43  
with V8.0.2

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**Project summary****Geographical Site**

**Chamārpur**

India

**Situation**

Latitude 27.56 °N

Longitude 78.66 °E

Altitude 164 m

Time zone UTC+5.5

**Project settings**

Albedo 0.20

**Weather data**

Chamārpur

Meteonorm 8.2 (1996-2015), Sat=100% - Synthetic

**System summary****Grid-Connected System****Orientation #1****Sheds**

Tilt 10 °

Azimuth 33 °

**Unlimited sheds****Orientation #2****Sheds**

Tilt 10 °

Azimuth -33 °

**Orientation #3****Sheds**

Tilt 10 °

Azimuth 31 °

**Near Shadings**

Mutual shadings of sheds

**User's needs**

Unlimited load (grid)

**System information****PV Array**

Nb. of modules 737 units

Pnom total 427 kWp

**Inverters**

Nb. of units 6 units

Pnom total 365 kWac

Pnom ratio 1.171

**Results summary**

Produced Energy 663205 kWh/year Specific production 1552 kWh/kWp/year Perf. Ratio PR 93.88 %

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**General parameters****Grid-Connected System****Orientation #1****Sheds**

Tilt	10 °
Azimuth	33 °

**Orientation #2****Sheds**

Tilt	10 °
Azimuth	-33 °

**Orientation #3****Sheds**

Tilt	10 °
Azimuth	31 °

**Models used**

Transposition	Perez
Diffuse	Perez, Meteonorm
Circumsolar	separate

**Bifacial system definition****Orientation #1****Bifacial system**

Model	Unlimited Sheds 2D Model
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**Bifacial model geometry**

Sheds spacing	6.60 m
Sheds width	3.04 m
Limit profile angle	8.2 °
GCR	46.1 %
Height above ground	1.00 m
Nb. of sheds	6 units

**Bifacial model definitions**

Ground albedo	0.30
Bifaciality factor	80 %
Rear shading factor	5.0 %
Rear mismatch loss	10.0 %
Shed transparent fraction	0.0 %

**Unlimited sheds****Sheds configuration**

Nb. of sheds	6 units
Unlimited sheds	
<b>Shading limit angle</b>	
Limit profile angle	8.2 °

**Sheds configuration**

Nb. of sheds	10 units
Unlimited sheds	
<b>Shading limit angle</b>	
Limit profile angle	8.5 °

**Sheds configuration**

Nb. of sheds	5 units
Unlimited sheds	
<b>Shading limit angle</b>	
Limit profile angle	8.5 °

**Horizon**

Free Horizon

**Sizes**

Sheds spacing	6.60 m
Collector width	3.00 m
Average GCR	45.5 %
Top inactive band	0.02 m
Bottom inactive band	0.02 m

**Sizes**

Sheds spacing	6.50 m
Collector width	3.00 m
Average GCR	46.2 %
Top inactive band	0.02 m
Bottom inactive band	0.02 m

**Sizes**

Sheds spacing	6.50 m
Collector width	3.00 m
Average GCR	46.2 %
Top inactive band	0.02 m
Bottom inactive band	0.02 m

**Near Shadings**

Mutual shadings of sheds

**Orientation #2****Bifacial system**

Model	Unlimited Sheds 2D Model
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**Bifacial model geometry**

Sheds spacing	6.50 m
Sheds width	3.04 m
Limit profile angle	8.5 °
GCR	46.8 %
Height above ground	1.50 m
Nb. of sheds	10 units

**Bifacial model definitions**

Ground albedo	0.30
Bifaciality factor	80 %
Rear shading factor	5.0 %
Rear mismatch loss	10.0 %
Shed transparent fraction	0.0 %



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## General parameters

## Bifacial system definition

## Orientation #3

## Bifacial system

Model Unlimited Sheds 2D Model

## Bifacial model geometry

Sheds spacing	6.50 m
Sheds width	3.04 m
Limit profile angle	8.5 °
GCR	46.8 %
Height above ground	1.50 m
Nb. of sheds	5 units

## Bifacial model definitions

Ground albedo	0.30
Bifaciality factor	80 %
Rear shading factor	5.0 %
Rear mismatch loss	10.0 %
Shed transparent fraction	0.0 %

## User's needs

Unlimited load (grid)

## PV Array Characteristics

## Array #1 - PV Array

Orientation	#1
Tilt/Azimuth	10/33 °

## PV module

Manufacturer Panasonic Life Solutions India Pvt. Ltd

Model AE14T580VHC16B5R

(Custom parameters definition)

Unit Nom. Power	580 Wp
Number of PV modules	90 units
Nominal (STC)	52.2 kWp
Modules	5 string x 18 In series

## At operating cond. (50°C)

Pmpp	48.4 kWp
U mpp	739 V
I mpp	65 A

## Array #2 - Sub-array #2

Orientation	#2
Tilt/Azimuth	10/-33 °

## PV module

Manufacturer Panasonic Life Solutions India Pvt. Ltd

Model AE14T580VHC16B5R

(Custom parameters definition)

Unit Nom. Power	580 Wp
Number of PV modules	255 units
Nominal (STC)	148 kWp
Modules	17 string x 15 In series

## At operating cond. (50°C)

Pmpp	137 kWp
U mpp	616 V
I mpp	223 A

## Inverter

Manufacturer

Growatt New Energy

Model

MID 40KTL3-X

(Original PVsyst database)

Unit Nom. Power	40.0 kWac
Number of inverters	1 unit
Total power	40.0 kWac
Operating voltage	200-1000 V
Pnom ratio (DC:AC)	1.31
Power sharing within this inverter	

## Inverter

Manufacturer

Growatt New Energy

Model

MAX 125KTL3-X LV

(Original PVsyst database)

Unit Nom. Power	125 kWac
Number of inverters	1 unit
Total power	125 kWac
Operating voltage	180-1000 V
Pnom ratio (DC:AC)	1.18
Power sharing within this inverter	



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## PV Array Characteristics

## Array #3 - Sub-array #3

Orientation #3  
Tilt/Azimuth 10/31 °

## PV module

Manufacturer Panasonic Life Solutions India Pvt. Ltd  
Model AE14T580VHC16B5R  
(Custom parameters definition)

Unit Nom. Power 580 Wp  
Number of PV modules 120 units  
Nominal (STC) 69.6 kWp  
Modules 8 string x 15 In series

## At operating cond. (50°C)

Pmpp 64.5 kWp  
U mpp 616 V  
I mpp 105 A

## Array #4 - Sub-array #4

Orientation #3  
Tilt/Azimuth 10/31 °

## PV module

Manufacturer Panasonic Life Solutions India Pvt. Ltd  
Model AE14T580VHC16B5R  
(Custom parameters definition)

Unit Nom. Power 580 Wp  
Number of PV modules 119 units  
Nominal (STC) 69.0 kWp  
Modules 7 string x 17 In series

## At operating cond. (50°C)

Pmpp 64.0 kWp  
U mpp 698 V  
I mpp 92 A

## Array #5 - Sub-array #5

Orientation #3  
Tilt/Azimuth 10/31 °

## PV module

Manufacturer Panasonic Life Solutions India Pvt. Ltd  
Model AE14T580VHC16B5R  
(Custom parameters definition)

Unit Nom. Power 580 Wp  
Number of PV modules 153 units  
Nominal (STC) 88.7 kWp  
Modules 9 string x 17 In series

## At operating cond. (50°C)

Pmpp 82.3 kWp  
U mpp 698 V  
I mpp 118 A

## Total PV power

Nominal (STC) 427 kWp  
Total 737 modules  
Module area 1902 m²

## Inverter

Manufacturer Growatt New Energy  
Model MID 30KTL3-X  
(Original PVsyst database)

Unit Nom. Power 30.0 kWac  
Number of inverters 2 units  
Total power 60.0 kWac  
Operating voltage 200-1000 V  
Pnom ratio (DC:AC) 1.16  
Power sharing within this inverter

## Inverter

Manufacturer Growatt New Energy  
Model MAX 60KTL3 LV  
(Original PVsyst database)

Unit Nom. Power 60.0 kWac  
Number of inverters 1 unit  
Total power 60.0 kWac  
Operating voltage 200-1000 V  
Pnom ratio (DC:AC) 1.15  
Power sharing within this inverter

## Inverter

Manufacturer Growatt New Energy  
Model MAX 80KTL3 LV  
(Original PVsyst database)

Unit Nom. Power 80.0 kWac  
Number of inverters 1 unit  
Total power 80.0 kWac  
Operating voltage 200-1000 V  
Pnom ratio (DC:AC) 1.11  
Power sharing within this inverter

## Total inverter power

Total power 365 kWac  
Number of inverters 6 units  
Pnom ratio 1.17

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**Array losses****Array Soiling Losses**

Loss Fraction 2.0 %

**Thermal Loss factor**

Module temperature according to irradiance  
Uc (const) 29.0 W/m<sup>2</sup>K  
Uv (wind) 0.0 W/m<sup>2</sup>K/m/s

**Serie Diode Loss**

Voltage drop 0.7 V  
Loss Fraction 0.1 % at STC

**LID - Light Induced Degradation**

Loss Fraction 0.3 %

**Module Quality Loss**

Loss Fraction 0.0 %

**Module mismatch losses****Array #1 - PV Array**

Loss Fraction 1.0 % at MPP

**Array #2 - Sub-array #2**

Loss Fraction 1.0 % at MPP

**Array #3 - Sub-array #3**

Loss Fraction 1.0 % at MPP

**Array #4 - Sub-array #4**

Loss Fraction 1.0 % at MPP

**Array #5 - Sub-array #5**

Loss Fraction 1.0 % at MPP

**IAM loss factor**

Incidence effect (IAM): User defined profile

0°	30°	50°	60°	70°	75°	80°	85°	90°
1.000	1.000	0.998	0.992	0.963	0.917	0.812	0.567	0.000

**DC wiring losses**

Global wiring resistance 10 mΩ  
Loss Fraction 1.5 % at STC

**Array #1 - PV Array**

Global array res. 184 mΩ  
Loss Fraction 1.5 % at STC

**Array #3 - Sub-array #3**

Global array res. 96 mΩ  
Loss Fraction 1.5 % at STC

**Array #5 - Sub-array #5**

Global array res. 96 mΩ  
Loss Fraction 1.5 % at STC

**Array #2 - Sub-array #2**

Global array res. 45 mΩ  
Loss Fraction 1.5 % at STC

**Array #4 - Sub-array #4**

Global array res. 124 mΩ  
Loss Fraction 1.5 % 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 0.06 % at STC

#### Inverter: MID 40KTL3-X

Wire section (1 Inv.) Alu 1 x 3 x 95 mm<sup>2</sup>  
Wires length 45 m

#### Inverter: MID 30KTL3-X

Wire section (2 Inv.) Alu 2 x 3 x 16 mm<sup>2</sup>  
Average wires length 0 m

#### Inverter: MAX 80KTL3 LV

Wire section (1 Inv.) Alu 1 x 3 x 70 mm<sup>2</sup>  
Wires length 0 m

#### Inverter: MAX 125KTL3-X LV

Wire section (1 Inv.) Alu 1 x 3 x 150 mm<sup>2</sup>  
Wires length 0 m

#### Inverter: MAX 60KTL3 LV

Wire section (1 Inv.) Alu 1 x 3 x 50 mm<sup>2</sup>  
Wires length 0 m



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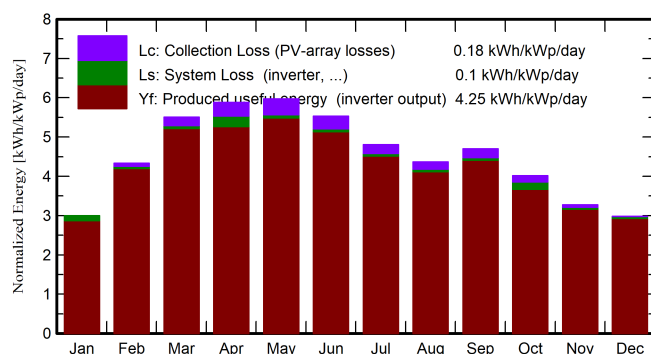
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## Main results

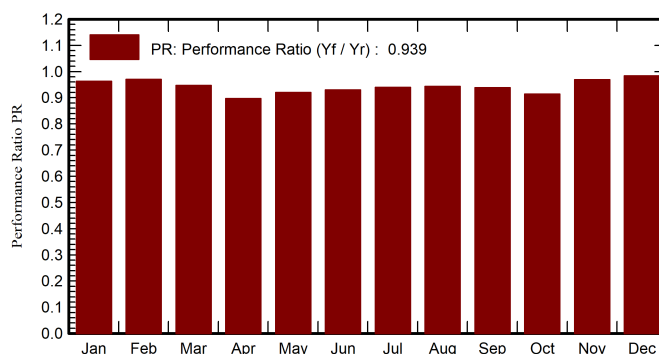
### System Production

Produced Energy (P50)	663205 kWh/year	Specific production (P50)	1552 kWh/kWp/year	Perf. Ratio PR	93.88 %
Produced Energy (P90)	647874 kWh/year	Specific production (P90)	1516 kWh/kWp/year		
Produced Energy (P75)	655145 kWh/year	Specific production (P75)	1533 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 <sup>2</sup>	kWh/m <sup>2</sup>	°C	kWh/m <sup>2</sup>	kWh/m <sup>2</sup>	kWh	kWh	ratio
January	84.6	52.5	13.61	92.6	89.4	39701	38072	0.962
February	111.2	54.2	18.07	121.3	117.5	51009	50279	0.970
March	161.3	72.2	24.32	170.7	165.6	70123	69142	0.947
April	172.6	85.2	30.05	176.3	171.1	71004	67594	0.897
May	185.4	100.2	33.92	185.0	179.4	73816	72764	0.920
June	168.1	104.2	33.21	165.8	160.6	66878	65937	0.930
July	150.5	99.1	31.12	149.1	144.2	60777	59901	0.940
August	135.0	90.5	29.98	135.5	131.0	55444	54632	0.943
September	136.1	76.2	28.99	141.1	136.7	57452	56619	0.939
October	117.7	71.7	26.58	124.5	120.6	51163	48662	0.914
November	90.6	59.0	20.41	98.3	95.0	41272	40694	0.969
December	83.3	50.4	15.14	92.5	89.4	39481	38908	0.984
Year	1596.4	915.3	25.48	1652.7	1600.4	678118	663205	0.939

### 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		





# Project: District hospital Etah

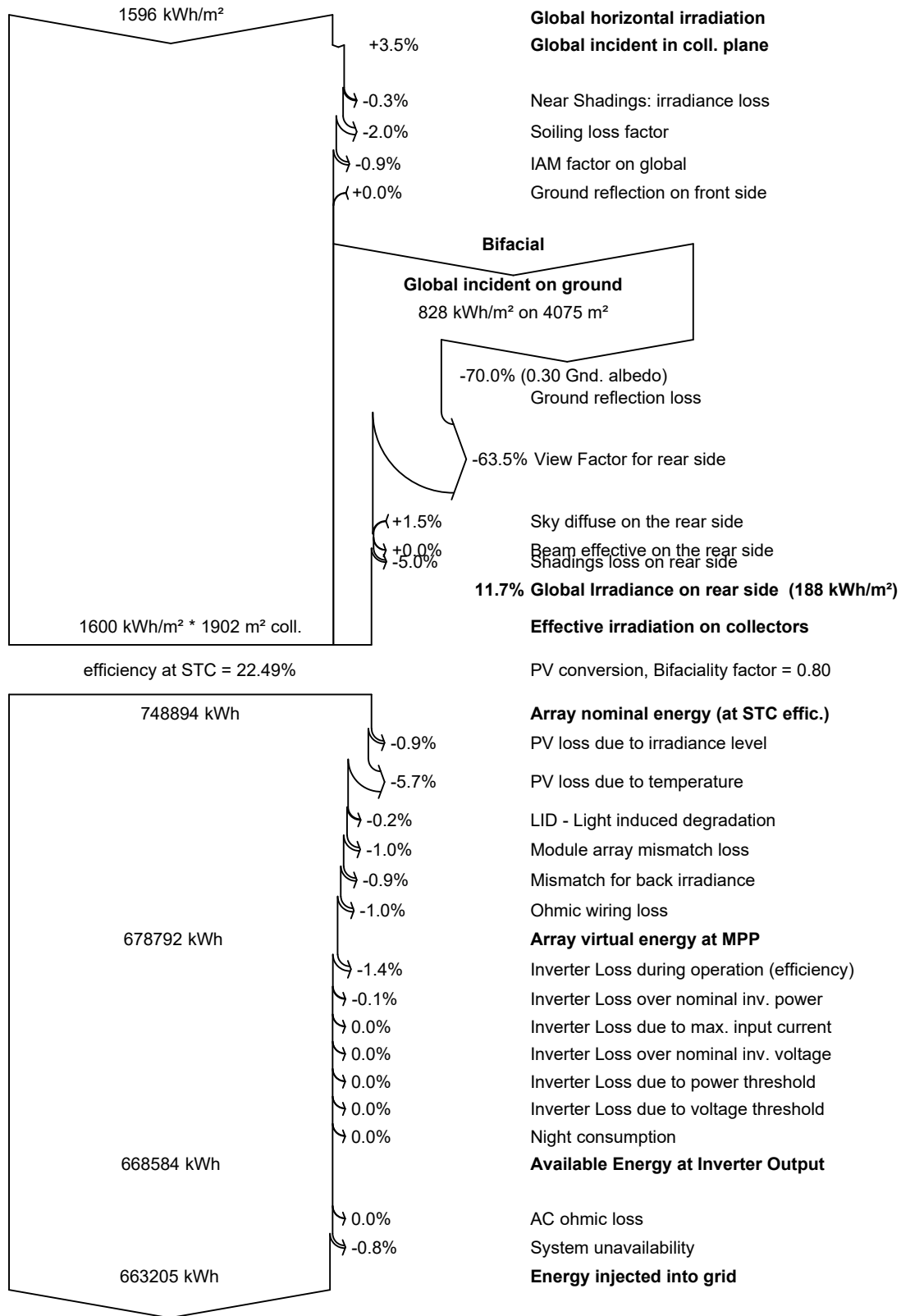
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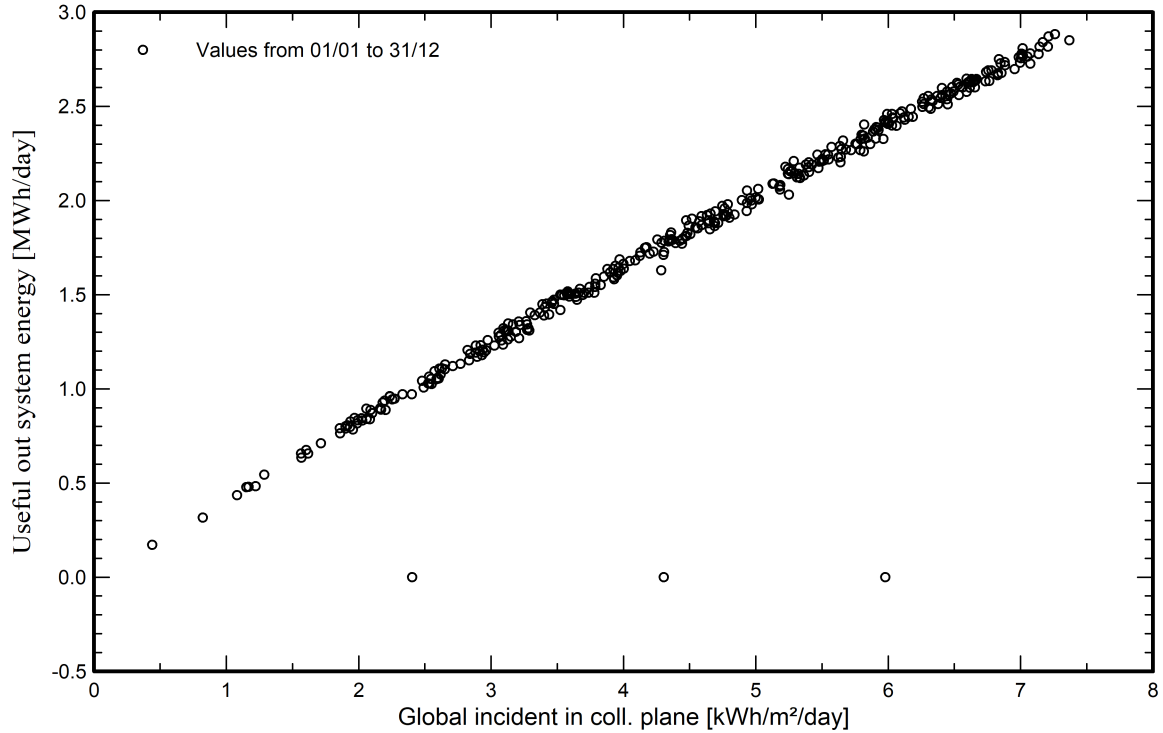
## Loss diagram



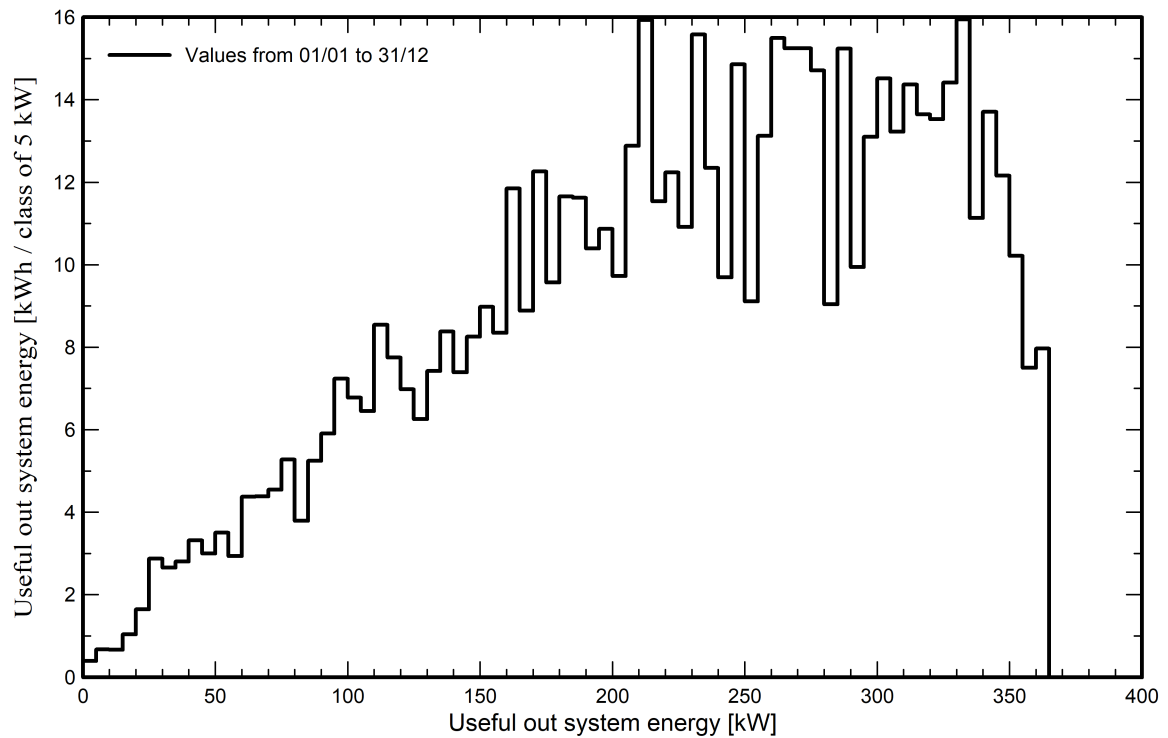


Predef. graphs

Daily Input/Output diagram



System Output Power Distribution





### P50 - P90 evaluation

#### Weather data

Source Meteonorm 8.2 (1996-2015), Sat=100%  
Kind Not defined  
Year-to-year variability(Variance) 0.0 %

#### Specified Deviation

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

Variability (Quadratic sum) 1.8 %

#### 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 12.0 MWh  
P50 663.2 MWh  
P90 647.9 MWh  
P75 655.1 MWh

### Probability distribution

