

# PVsyst - Simulation report

## Grid-Connected System

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Project: District Hospital Gonda

Variant: New simulation variant

Unlimited sheds

System power: 704 kWp

Uparihat - India

**Author**

Jakson Limited (India)



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## PVsyst V8.0.2

VC0, Simulation date:  
16/12/24 16:36  
with V8.0.2

Jakson Limited (India)

### Project summary

#### Geographical Site

##### Uparihat

India

#### Situation

Latitude 27.14 °N

Longitude 81.97 °E

Altitude 107 m

Time zone UTC+5.5

#### Project settings

Albedo 0.20

#### Weather data

Uparihat

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

### System summary

#### Grid-Connected System

##### Orientation #1

##### Sheds

Tilt 10 °

Azimuth 29 °

#### Unlimited sheds

##### Near Shadings

Mutual shadings of sheds

#### User's needs

Unlimited load (grid)

#### System information

##### PV Array

Nb. of modules 1214 units

Pnom total 704 kWp

##### Inverters

Nb. of units 13 units

Pnom total 615 kWac

Pnom ratio 1.145

### Results summary

Produced Energy 938440 kWh/year Specific production 1333 kWh/kWp/year Perf. Ratio PR 84.93 %

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### General parameters

#### Grid-Connected System

##### Orientation #1

###### Sheds

Tilt	10 °
Azimuth	29 °

#### Unlimited sheds

##### Sheds configuration

Nb. of sheds	10 units
Unlimited sheds	
Shading limit angle	
Limit profile angle	8 °

##### Sizes

Sheds spacing	6.70 m
Collector width	3.00 m
Average GCR	44.8 %
Top inactive band	0.02 m
Bottom inactive band	0.02 m

##### Models used

Transposition	Perez
Diffuse	Perez, Meteonorm
Circumsolar	separate

##### Horizon

Free Horizon

##### Near Shadings

Mutual shadings of sheds

##### User's needs

Unlimited load (grid)

### PV Array Characteristics

#### Array #1 - PV Array

##### PV module

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

Unit Nom. Power	580 Wp
Number of PV modules	22 units
Nominal (STC)	12.76 kWp
Modules	2 string x 11 In series

##### At operating cond. (50°C)

Pmpp	11.83 kWp
U mpp	452 V
I mpp	26 A

##### Inverter

Manufacturer	Growatt New Energy
Model	MOD 10KTL3-X
(Original PVsyst database)	

Unit Nom. Power	10.00 kWac
Number of inverters	1 unit
Total power	10.0 kWac
Operating voltage	140-1000 V
Pnom ratio (DC:AC)	1.28
Power sharing within this inverter	

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

##### PV module

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

Unit Nom. Power	580 Wp
Number of PV modules	30 units
Nominal (STC)	17.40 kWp
Modules	2 string x 15 In series

##### At operating cond. (50°C)

Pmpp	16.13 kWp
U mpp	616 V
I mpp	26 A

##### Inverter

Manufacturer	Growatt New Energy
Model	MID 15KTL3-X
(Original PVsyst database)	

Unit Nom. Power	15.0 kWac
Number of inverters	1 unit
Total power	15.0 kWac
Operating voltage	160-1000 V
Pnom ratio (DC:AC)	1.16
Power sharing within this inverter	



## PV Array Characteristics

## Array #3 - Sub-array #3

## PV module

ManufacturePanasonic Life Solutions India Pvt. Ltd

ModelAE14T580VHC16B5R

(Custom parameters definition)

Unit Nom. Power 580 Wp  
Number of PV modules 84 units  
Nominal (STC) 48.7 kWp  
Modules 6 string x 14 In series

## At operating cond. (50°C)

Pmpp 45.2 kWp  
U mpp 575 V  
I mpp 79 A

## Array #4 - Sub-array #4

## PV module

ManufacturePanasonic Life Solutions India Pvt. Ltd

ModelAE14T580VHC16B5R

(Custom parameters definition)

Unit Nom. Power 580 Wp  
Number of PV modules 100 units  
Nominal (STC) 58.0 kWp  
Modules 10 string x 10 In series

## At operating cond. (50°C)

Pmpp 53.8 kWp  
U mpp 411 V  
I mpp 131 A

## Array #5 - Sub-array #5

## PV module

ManufacturePanasonic Life Solutions India Pvt. Ltd

ModelAE14T580VHC16B5R

(Custom parameters definition)

Unit Nom. Power 580 Wp  
Number of PV modules 112 units  
Nominal (STC) 65.0 kWp  
Modules 7 string x 16 In series

## At operating cond. (50°C)

Pmpp 60.2 kWp  
U mpp 657 V  
I mpp 92 A

## Array #6 - Sub-array #6

## PV module

ManufacturePanasonic Life Solutions India Pvt. Ltd

ModelAE14T580VHC16B5R

(Custom parameters definition)

Unit Nom. Power 580 Wp  
Number of PV modules 112 units  
Nominal (STC) 65.0 kWp  
Modules 7 string x 16 In series

## At operating cond. (50°C)

Pmpp 60.2 kWp  
U mpp 657 V  
I mpp 92 A

## Inverter

Manufacturer

Growatt New Energy

Model

MAC 20KTL3-XL

(Original PVsyst database)

Unit Nom. Power 20.0 kWac  
Number of inverters 2 units  
Total power 40.0 kWac  
Operating voltage 200-650 V  
Pnom ratio (DC:AC) 1.22  
Power sharing within this inverter

## 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) 0.97  
Power sharing within this inverter

## Inverter

Manufacturer

Growatt New Energy

Model

MAC 50KTL3-X LV

(Custom parameters definition)

Unit Nom. Power 50.0 kWac  
Number of inverters 1 unit  
Total power 50.0 kWac  
Operating voltage 200-1000 V  
Pnom ratio (DC:AC) 1.30  
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) 1.08  
Power sharing within this inverter



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## PV Array Characteristics

## Array #7 - Sub-array #7

## PV module

ManufacturePanasonic Life Solutions India Pvt. Ltd

ModelAE14T580VHC16B5R

(Custom parameters definition)

Unit Nom. Power580 Wp  
Number of PV modules476 units  
Nominal (STC)276 kWp  
Modules28 string x 17 In series

## At operating cond. (50°C)

Pmpp256 kWp  
U mpp698 V  
I mpp367 A

## Array #8 - Sub-array #8

## PV module

ManufacturePanasonic Life Solutions India Pvt. Ltd

ModelAE14T580VHC16B5R

(Custom parameters definition)

Unit Nom. Power580 Wp  
Number of PV modules208 units  
Nominal (STC)121 kWp  
Modules13 string x 16 In series

## At operating cond. (50°C)

Pmpp112 kWp  
U mpp657 V  
I mpp170 A

## Array #9 - Sub-array #9

## PV module

ManufacturePanasonic Life Solutions India Pvt. Ltd

ModelAE14T580VHC16B5R

(Custom parameters definition)

Unit Nom. Power580 Wp  
Number of PV modules70 units  
Nominal (STC)40.6 kWp  
Modules5 string x 14 In series

## At operating cond. (50°C)

Pmpp37.6 kWp  
U mpp575 V  
I mpp65 A

## Total PV power

Nominal (STC)704 kWp  
Total1214 modules  
Module area3133 m²

## Inverter

Manufacturer

Growatt New Energy

Model

MAX 80KTL3 LV

(Original PVsyst database)

Unit Nom. Power80.0 kWac  
Number of inverters3 units  
Total power240 kWac  
Operating voltage200-1000 V  
Pnom ratio (DC:AC)1.15  
Power sharing within this inverter

## Inverter

Manufacturer

Growatt New Energy

Model

MAX 100KTL3-X LV

(Original PVsyst database)

Unit Nom. Power100 kWac  
Number of inverters1 unit  
Total power100 kWac  
Operating voltage180-1000 V  
Pnom ratio (DC:AC)1.21  
Power sharing within this inverter

## Inverter

Manufacturer

Growatt New Energy

Model

MID 40KTL3-X

(Original PVsyst database)

Unit Nom. Power40.0 kWac  
Number of inverters1 unit  
Total power40.0 kWac  
Operating voltage200-1000 V  
Pnom ratio (DC:AC)1.02  
Power sharing within this inverter

## Total inverter power

Total power615 kWac  
Number of inverters13 units  
Pnom ratio1.14



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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 2.0 %

## 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

## Array #6 - Sub-array #6

Loss Fraction 1.0 % at MPP

## Array #7 - Sub-array #7

Loss Fraction 1.0 % at MPP

## Array #8 - Sub-array #8

Loss Fraction 1.0 % at MPP

## Array #9 - Sub-array #9

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 9.4 mΩ  
Loss Fraction 1.5 % at STC

## Array #1 - PV Array

Global array res. 281 mΩ  
Loss Fraction 1.5 % at STC

## Array #3 - Sub-array #3

Global array res. 119 mΩ  
Loss Fraction 1.5 % at STC

## Array #5 - Sub-array #5

Global array res. 117 mΩ  
Loss Fraction 1.5 % at STC

## Array #7 - Sub-array #7

Global array res. 31 mΩ  
Loss Fraction 1.5 % at STC

## Array #9 - Sub-array #9

Global array res. 143 mΩ  
Loss Fraction 1.5 % at STC

## Array #2 - Sub-array #2

Global array res. 383 mΩ  
Loss Fraction 1.5 % at STC

## Array #4 - Sub-array #4

Global array res. 51 mΩ  
Loss Fraction 1.5 % at STC

## Array #6 - Sub-array #6

Global array res. 117 mΩ  
Loss Fraction 1.5 % at STC

## Array #8 - Sub-array #8

Global array res. 63 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 0.00 % at STC

##### Inverters: MOD 10KTL3-X, MAX 60KTL3 LV

Wire section (2 Inv.) Alu 2 x 3 x 50 mm<sup>2</sup>  
Average wires length 18 m

##### Inverter: MAC 20KTL3-XL

Wire section (2 Inv.) Alu 2 x 3 x 25 mm<sup>2</sup>  
Average wires length 0 m

##### Inverter: MAC 50KTL3-X LV

Wire section (1 Inv.) Alu 1 x 3 x 35 mm<sup>2</sup>  
Wires length 0 m

##### Inverter: MAX 100KTL3-X LV

Wire section (1 Inv.) Alu 1 x 3 x 95 mm<sup>2</sup>  
Wires length 0 m

##### Inverter: MID 15KTL3-X

Wire section (1 Inv.) Alu 1 x 3 x 4 mm<sup>2</sup>  
Wires length 0 m

##### Inverter: MID 30KTL3-X

Wire section (2 Inv.) Alu 2 x 3 x 10 mm<sup>2</sup>  
Average wires length 0 m

##### Inverter: MAX 80KTL3 LV

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

##### Inverter: MID 40KTL3-X

Wire section (1 Inv.) Alu 1 x 3 x 16 mm<sup>2</sup>  
Wires length 0 m



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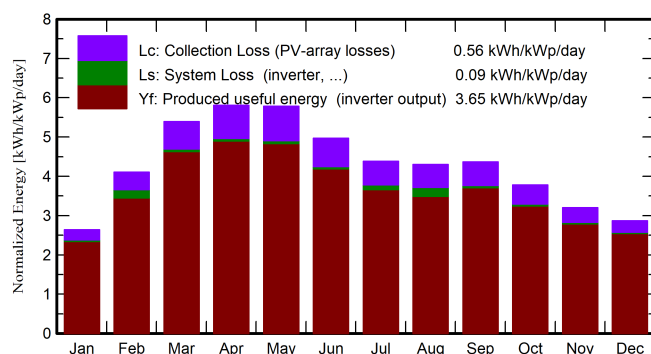
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## Main results

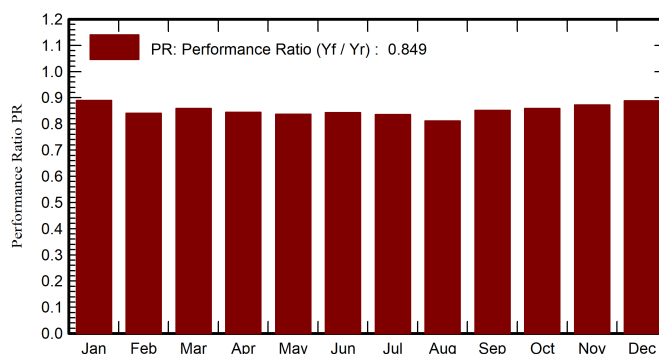
### System Production

Produced Energy (P50)	938440 kWh/year	Specific production (P50)	1333 kWh/kWp/year	Perf. Ratio PR	84.93 %
Produced Energy (P90)	916746 kWh/year	Specific production (P90)	1302 kWh/kWp/year		
Produced Energy (P75)	927035 kWh/year	Specific production (P75)	1317 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	75.7	52.38	14.34	81.8	78.9	52120	51293	0.890
February	105.9	59.55	18.82	115.0	111.3	72280	68069	0.841
March	157.5	74.02	24.53	167.1	162.0	102526	101091	0.859
April	170.5	88.79	29.74	174.3	169.0	105007	103573	0.844
May	180.3	97.51	32.20	179.3	173.8	107227	105674	0.837
June	150.8	98.63	31.71	149.2	144.3	89906	88546	0.843
July	137.5	90.07	29.95	135.9	131.4	82620	79937	0.835
August	132.9	90.04	29.52	133.4	128.9	81216	76207	0.811
September	126.4	70.05	28.56	131.0	126.7	79744	78548	0.851
October	111.1	73.10	26.34	117.2	113.3	71970	70896	0.859
November	88.4	56.90	20.80	96.1	92.8	59892	59002	0.872
December	81.2	55.06	15.99	88.9	85.8	56443	55604	0.888
Year	1518.3	906.11	25.23	1569.3	1518.3	960951	938440	0.849

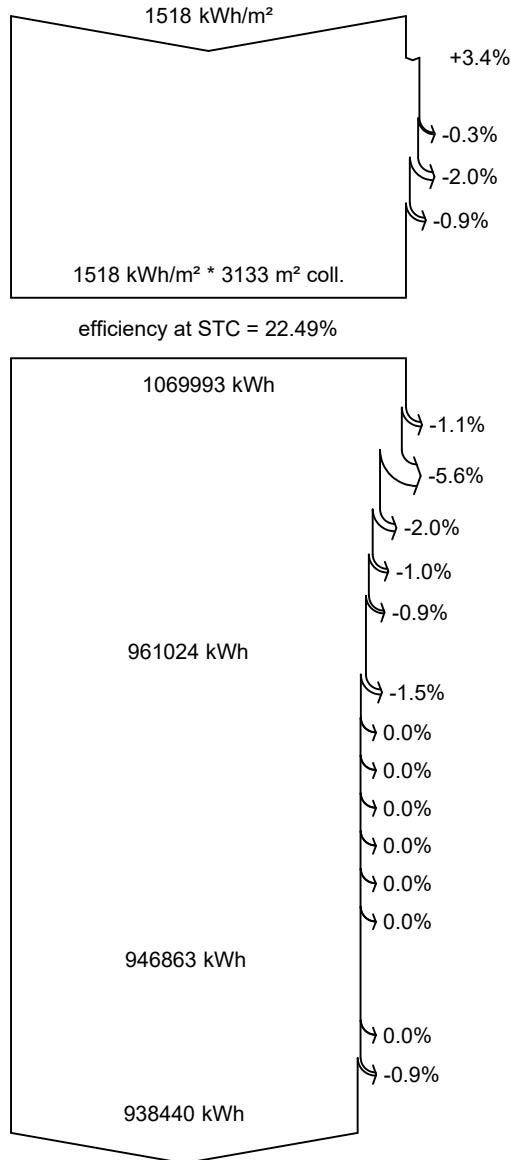
### Legends

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		





### Loss diagram



**Global horizontal irradiation**

**Global incident in coll. plane**

Near Shadings: irradiance loss

Soiling loss factor

IAM factor on global

**Effective irradiation on collectors**

PV conversion

**Array nominal energy (at STC effic.)**

PV loss due to irradiance level

PV loss due to temperature

LID - Light induced degradation

Module array mismatch loss

Ohmic wiring 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

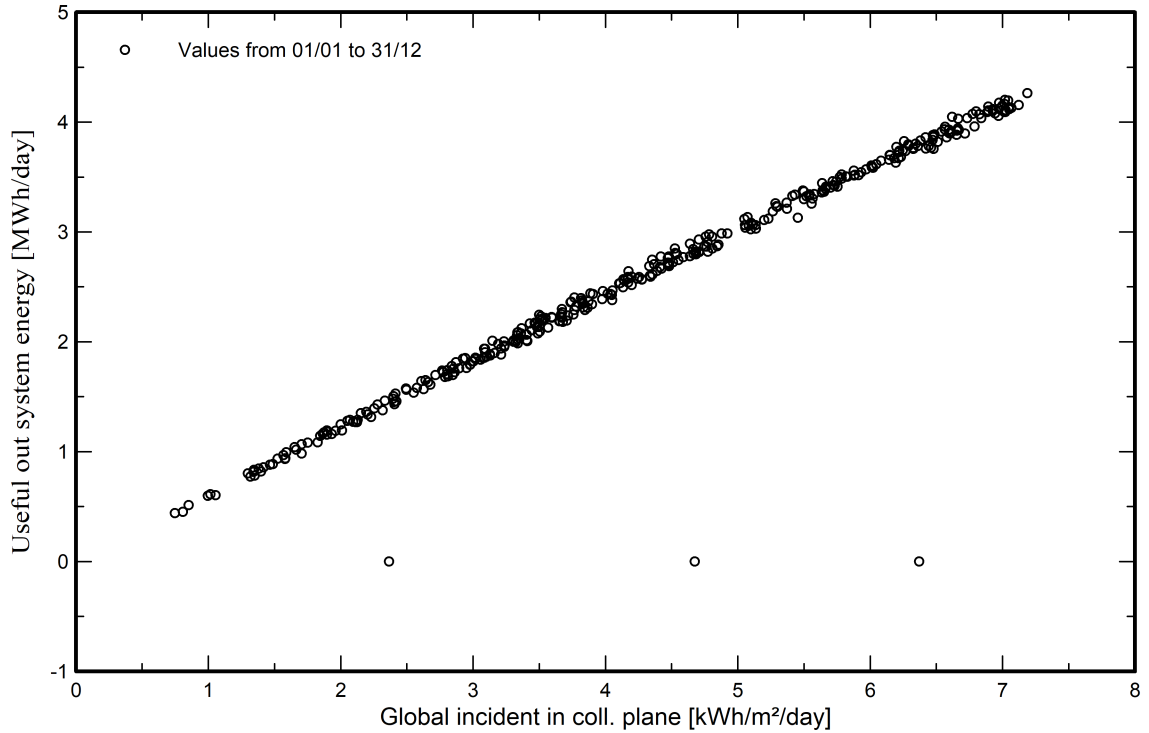
System unavailability

**Energy injected into grid**

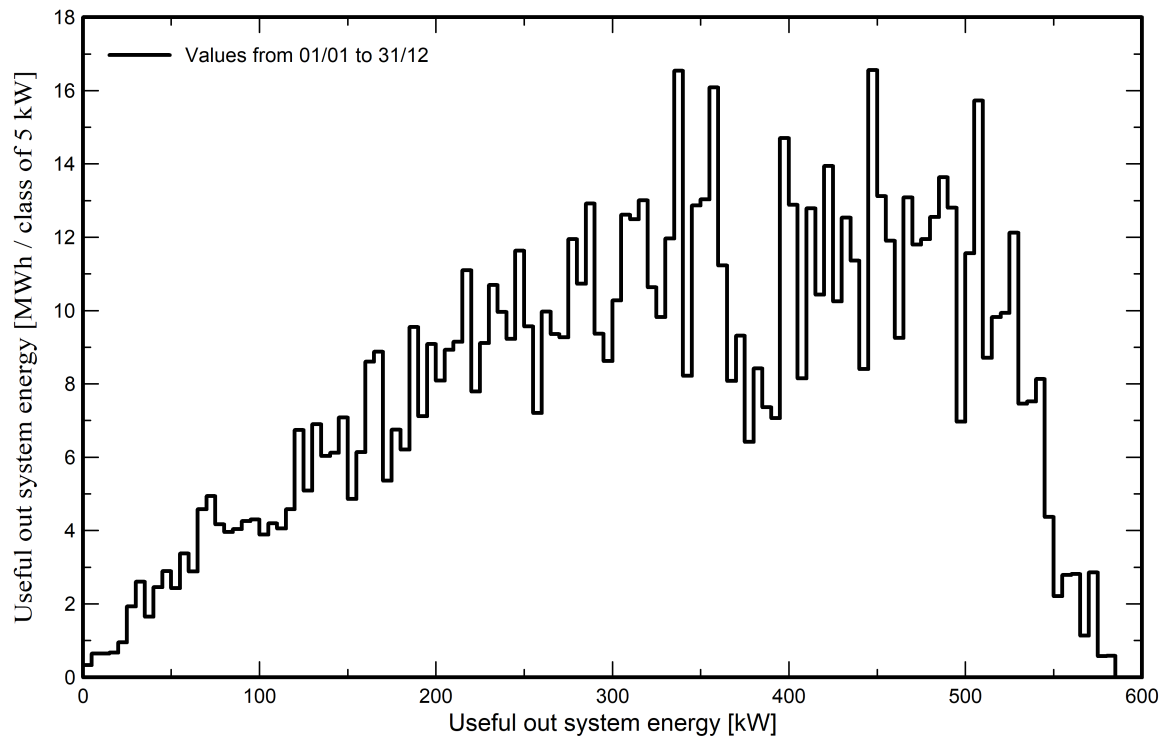


Predef. graphs

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 16.9 MWh  
P50 938.4 MWh  
P90 916.7 MWh  
P75 927.0 MWh

### Probability distribution

