

PVsyst - Simulation report

Grid-Connected System

Project: WORLD BANK

Variant: New simulation variant

Building system

System power: 27.68 kWp

World Bank - Nigeria

**PVsyst V7.4.7**

VC0, Simulation date:
14/08/25 13:47
with V7.4.7

Project summary**Geographical Site**

World Bank

Nigeria

Situation

Latitude 9.04 °N

Longitude 7.52 °E

Altitude 0 m

Time zone UTC

Project settings

Albedo 0.20

Weather data

World Bank

Meteonorm 8.1 (2010-2021), Sat=100% - Synthetic

System summary**Grid-Connected System**

Simulation for year no 10

PV Field Orientation

Fixed plane

Tilt/Azimuth 10 / 180 °

Building system**Near Shadings**

Linear shadings : Fast (table)

User's needs

Daily household consumers

Seasonal modulation

Average 11.0 kWh/Day

System information**PV Array**

Nb. of modules 45 units

Pnom total 27.68 kWp

Inverters

Nb. of units 1.5 units

Pnom total 22.50 kWac

Pnom ratio 1.230

Battery pack

Storage strategy: Self-consumption

Nb. of units 10 units

Voltage 51 V

Capacity 3120 Ah

Results summary

Produced Energy 39728 kWh/year

Used Energy 4004 kWh/year

Specific production 1436 kWh/kWp/year

Perf. Ratio PR 72.25 %

Solar Fraction SF 100.00 %

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General parameters**Grid-Connected System****PV Field Orientation****Orientation**

Fixed plane

Tilt/Azimuth 10 / 180 °

Horizon

Free Horizon

Storage

Kind

Self-consumption

Charging strategy

When excess solar power is available

Building system**Sheds configuration****Near Shadings**

Linear shadings : Fast (table)

Discharging strategy

As soon as power is needed

Models used

Transposition Perez

Diffuse Perez, Meteonorm

Circumsolar separate

User's needs

Daily household consumers

Seasonal modulation

Average 11.0 kWh/Day

PV Array Characteristics**PV module**

Manufacturer

Jinkosolar

Model

JKM-615N-66HL4M-BDV

(Original PVsyst database)

Unit Nom. Power

615 Wp

Number of PV modules

45 units

Nominal (STC)

27.68 kWp

Modules

3 string x 15 In series

At operating cond. (50°C)

Pmpp

25.67 kWp

U mpp

568 V

I mpp

45 A

Total PV power

Nominal (STC)

28 kWp

Total

45 modules

Module area

121 m²**Inverter**

Manufacturer

VMC

Model

Sunvec 15KTLD3

(Original PVsyst database)

Unit Nom. Power

15.0 kWac

Number of inverters

3 * MPPT 50% 1.5 units

Total power

22.5 kWac

Operating voltage

160-950 V

Max. power (=>25°C)

16.5 kWac

Pnom ratio (DC:AC)

1.23

No power sharing between MPPTs

Total inverter power

Total power

22.5 kWac

Nb. of inverters

2 units

0.5 unused

Pnom ratio

1.23

Battery Storage**Battery**

Manufacturer

BYD

Model

Battery Box Premium LVS 12.0

Battery pack

Nb. of units

10 in parallel

Discharging min. SOC

40.0 %

Stored energy

95.8 kWh

Battery input charger

Model

Generic

Max. charg. power

23.0 kWdc

Max./Euro effic.

97.0/95.0 %

Battery to Grid inverter

Model

Generic

Max. disch. power

2.2 kWac

Max./Euro effic.

97.0/95.0 %

Battery Pack Characteristics

Voltage

51 V

Nominal Capacity

3120 Ah (C10)

Temperature

Fixed 20 °C



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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. 206 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

Module average degradation

Year no 10
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): Fresnel, AR coating, n(glass)=1.526, n(AR)=1.290

0°	30°	50°	60°	70°	75°	80°	85°	90°
1.000	0.999	0.987	0.962	0.892	0.816	0.681	0.440	0.000

Spectral correction

FirstSolar model

Precipitable water estimated from relative humidity

Coefficient Set	C0	C1	C2	C3	C4	C5
Monocrystalline Si	0.85914	-0.02088	-0.0058853	0.12029	0.026814	-0.001781

System losses

Unavailability of the system

Time fraction 2.0 %
7.3 days,
3 periods

AC wiring losses

Inv. output line up to injection point

Inverter voltage 380 Vac tri
Loss Fraction 0.47 % at STC

Inverter: Sunvec 15KTLD3

Wire section (2 Inv.) Copper 2 x 3 x 10 mm²
Average wires length 20 m

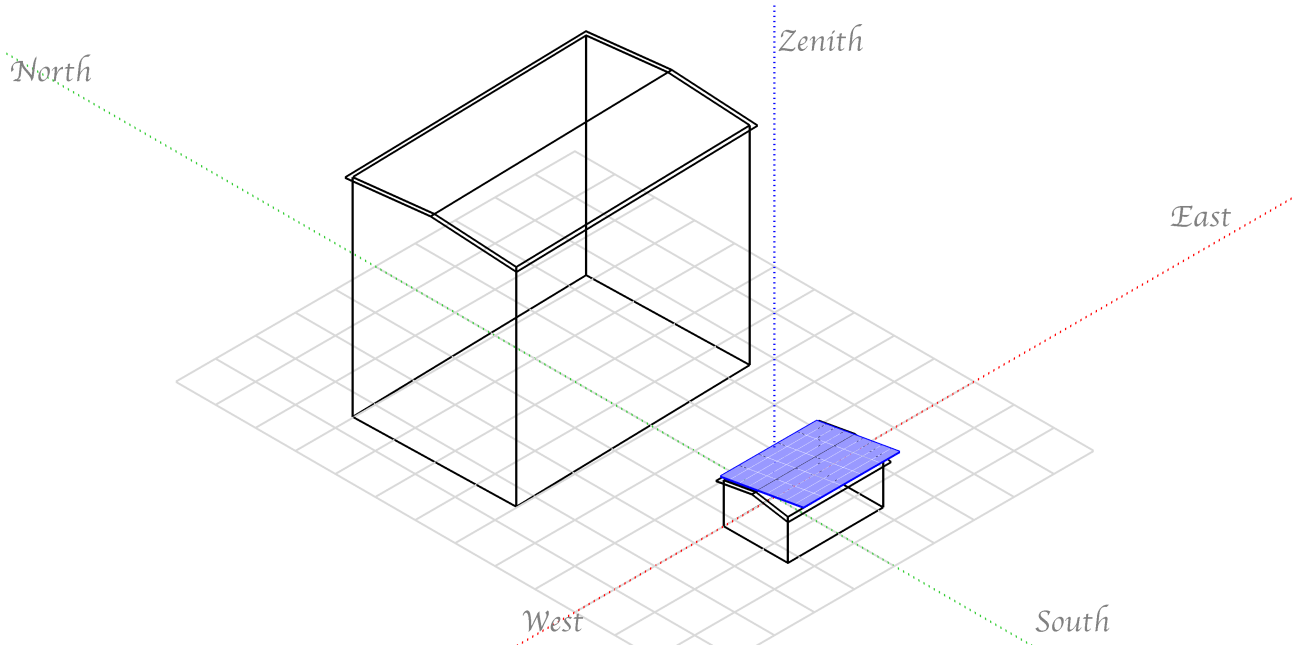


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Near shadings parameter

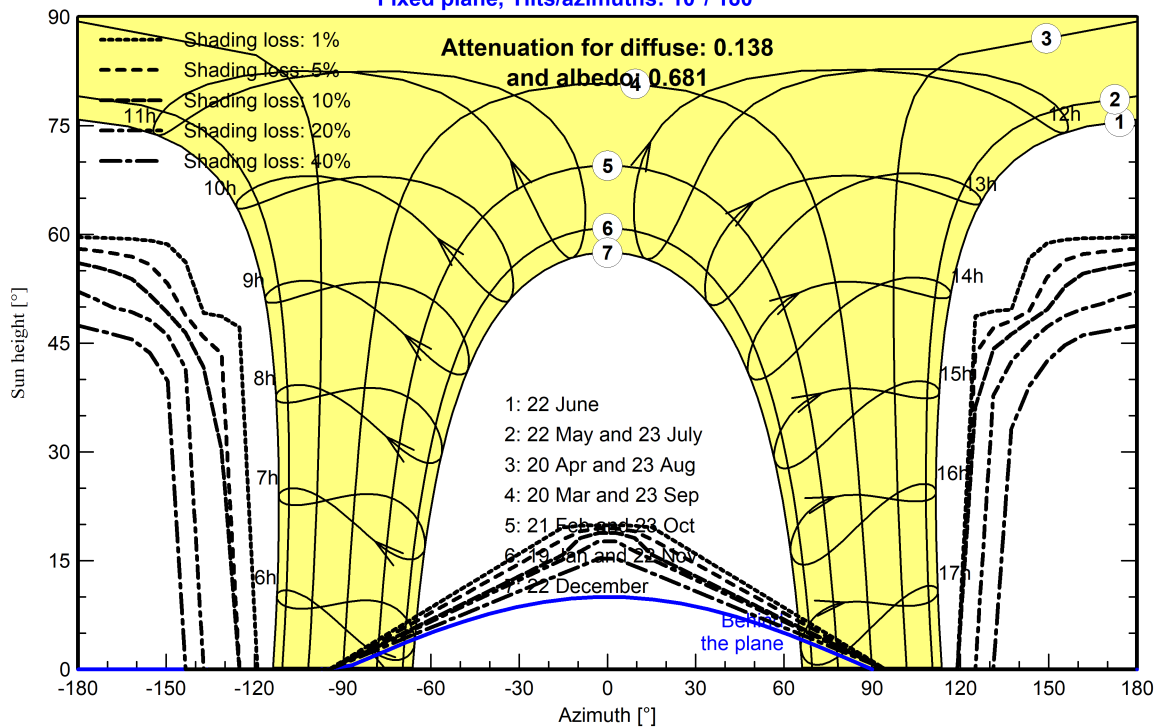
Perspective of the PV-field and surrounding shading scene



Iso-shadings diagram

Orientation #1

Fixed plane, Tilts/azimuths: 10°/ 180°





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Detailed User's needs

Daily household consumers, Seasonal modulation, average = 11.0 kWh/day

Summer (Jun-Aug)

	Nb.	Power	Use	Energy
		W	Hour/day	Wh/day
Lamps (LED or fluo)	10	10/lamp	5.0	500
TV / PC / Mobile	2	100/app	5.0	1000
Domestic appliances	1	500/app	4.0	2000
Fridge / Deep-freeze	2		24	1598
Dish- & Cloth-washers	1		2	2000
Ventilation	1	100 tot	24.0	2400
Air conditioning	1	1000 tot	3.0	3000
Stand-by consumers			24.0	144
Total daily energy				12642

Autumn (Sep-Nov)

	Nb.	Power	Use	Energy
		W	Hour/day	Wh/day
Lamps (LED or fluo)	10	10/lamp	5.0	500
TV / PC / Mobile	2	100/app	5.0	1000
Domestic appliances	1	500/app	5.0	2500
Fridge / Deep-freeze	2		24	1598
Dish- & Cloth-washers	1		2	2000
Ventilation	1	100 tot	24.0	2400
Stand-by consumers			24.0	144
Total daily energy				10142

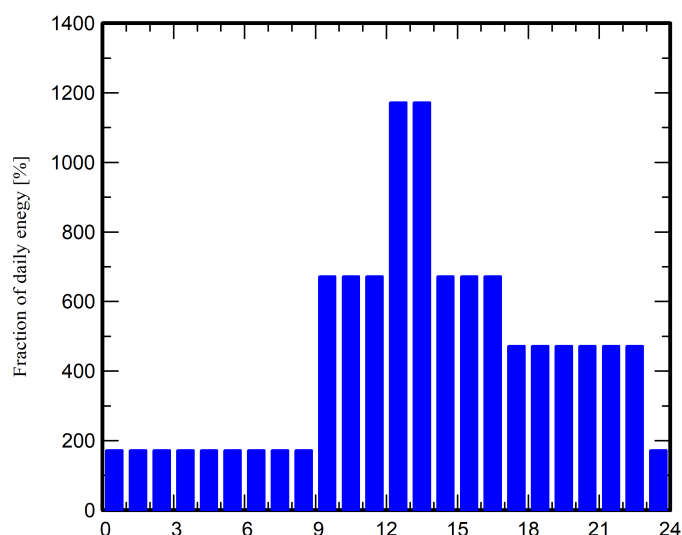
Winter (Dec-Feb)

	Nb.	Power	Use	Energy
		W	Hour/day	Wh/day
Lamps (LED or fluo)	10	10/lamp	6.0	600
TV / PC / Mobile	2	100/app	6.0	1200
Domestic appliances	1	500/app	6.0	3000
Fridge / Deep-freeze	2		24	1598
Dish- & Cloth-washers	1		2	2000
Ventilation	1	100 tot	24.0	2400
Stand-by consumers			24.0	144
Total daily energy				10942

Spring (Mar-May)

	Nb.	Power	Use	Energy
		W	Hour/day	Wh/day
Lamps (LED or fluo)	10	10/lamp	5.0	500
TV / PC / Mobile	2	100/app	5.0	1000
Domestic appliances	1	500/app	5.0	2500
Fridge / Deep-freeze	2		24	1598
Dish- & Cloth-washers	1		2	2000
Ventilation	1	100 tot	24.0	2400
Stand-by consumers			24.0	144
Total daily energy				10142

Hourly distribution





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Main results

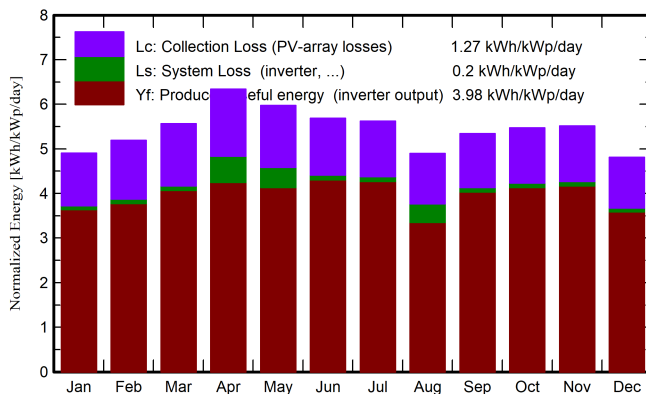
System Production

Produced Energy (P50)	39728 kWh/year	Specific production (P50)	1436 kWh/kWp/year	Perf. Ratio PR	72.25 %
Produced Energy (P90)	37020 kWh/year	Specific production (P90)	1338 kWh/kWp/year	Solar Fraction SF	100.00 %
Produced Energy (P95)	36259 kWh/year	Specific production (P95)	1310 kWh/kWp/year		

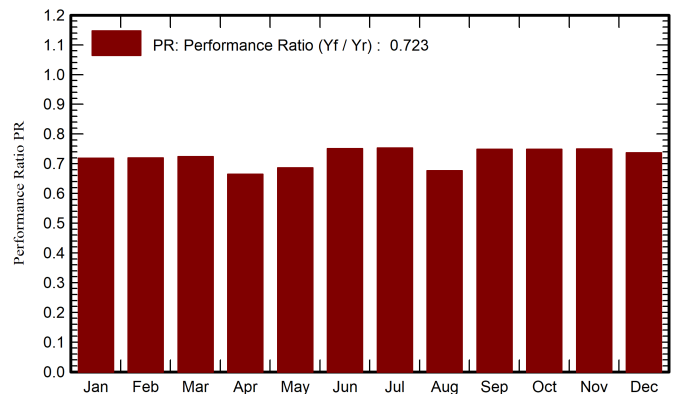
Battery aging (State of Wear)

Cycles SOW	99.6 %
Static SOW	90.0 %
Battery lifetime	10.0 years

Normalized productions (per installed kWp)



Performance Ratio PR



Balances and main results

	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_User	E_Solar	E_Grid	EFrGrid
	kWh/m ²	kWh/m ²	°C	kWh/m ²	kWh/m ²	kWh	kWh	kWh	kWh	kWh
January	168.0	78.6	27.99	152.0	136.9	3201	339.2	339.2	2686	0.000
February	154.3	95.8	30.36	145.4	130.3	3004	306.4	306.4	2587	0.000
March	177.9	104.8	32.04	172.6	156.5	3583	314.4	314.4	3144	0.000
April	190.3	97.8	31.09	190.3	174.9	4021	304.3	304.3	3195	0.000
May	180.6	94.5	29.45	185.1	169.7	3937	314.4	314.4	3204	0.000
June	164.2	83.6	26.74	170.6	156.2	3669	379.3	379.3	3167	0.000
July	168.7	86.4	26.28	174.4	159.5	3759	391.9	391.9	3242	0.000
August	150.8	91.4	25.36	151.9	136.7	3235	391.9	391.9	2452	0.000
September	163.3	81.6	25.58	160.2	145.8	3434	304.3	304.3	3014	0.000
October	179.3	83.9	26.83	169.6	154.4	3635	314.4	314.4	3201	0.000
November	183.8	57.7	27.86	165.4	151.7	3550	304.3	304.3	3130	0.000
December	167.1	72.3	27.92	149.2	134.5	3153	339.2	339.2	2703	0.000
Year	2048.4	1028.5	28.11	1986.7	1806.9	42180	4004.0	4004.0	35724	0.000

Legends

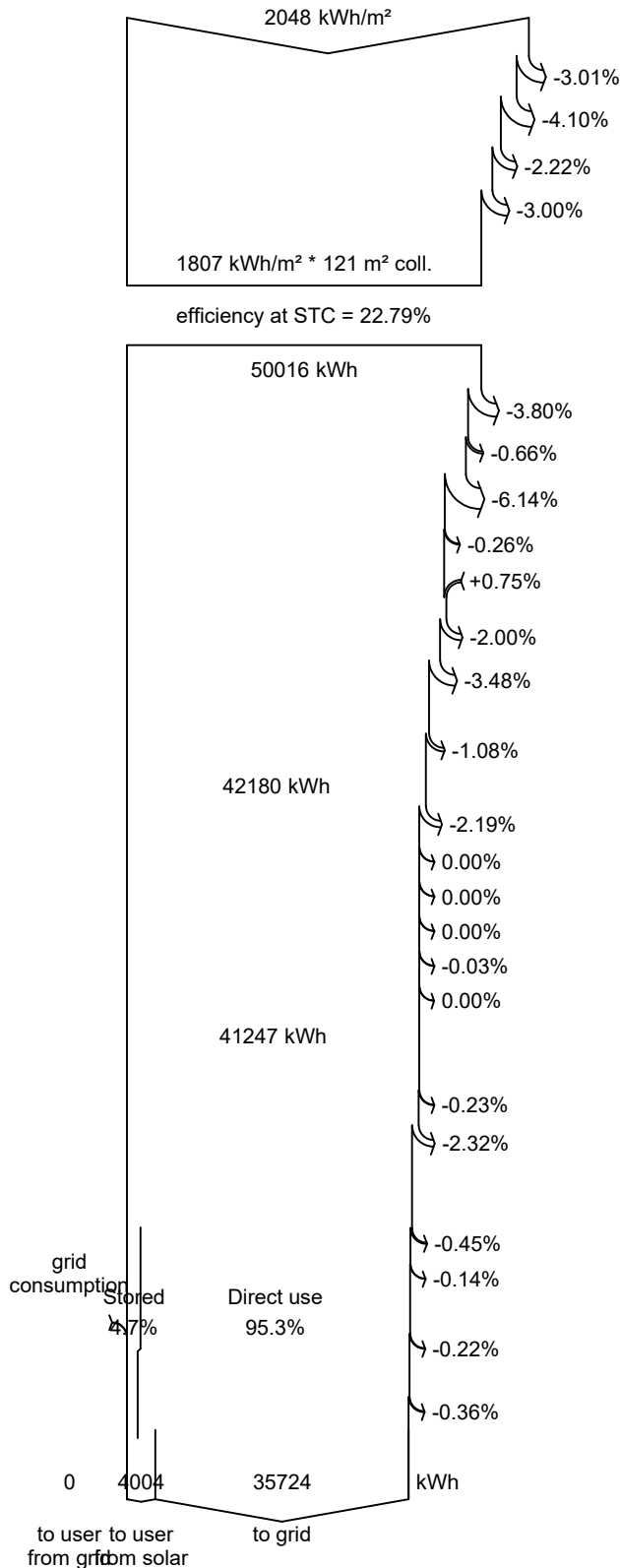
GlobHor	Global horizontal irradiation	EArray	Effective energy at the output of the array
DiffHor	Horizontal diffuse irradiation	E_User	Energy supplied to the user
T_Amb	Ambient Temperature	E_Solar	Energy from the sun
GlobInc	Global incident in coll. plane	E_Grid	Energy injected into grid
GlobEff	Effective Global, corr. for IAM and shadings	EFrGrid	Energy from the grid



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Loss diagram



Global horizontal irradiation

Global incident in coll. plane

Near Shadings: irradiance loss

IAM factor on global

Soiling loss factor

Effective irradiation on collectors

PV conversion

Array nominal energy (at STC effic.)

Module Degradation Loss (for year #10)

PV loss due to irradiance level

PV loss due to temperature

Spectral correction

Module quality loss

LID - Light induced degradation

Module array mismatch loss
(including 1.5% for degradation dispersion)

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

Available Energy at Inverter Output

AC ohmic loss

System unavailability

Battery IN, charger loss

Battery Stored Energy balance

Battery Storage

Battery global loss
(5.31% of the battery contribution)

Battery OUT, inverter loss

Dispatch: user and grid reinjection

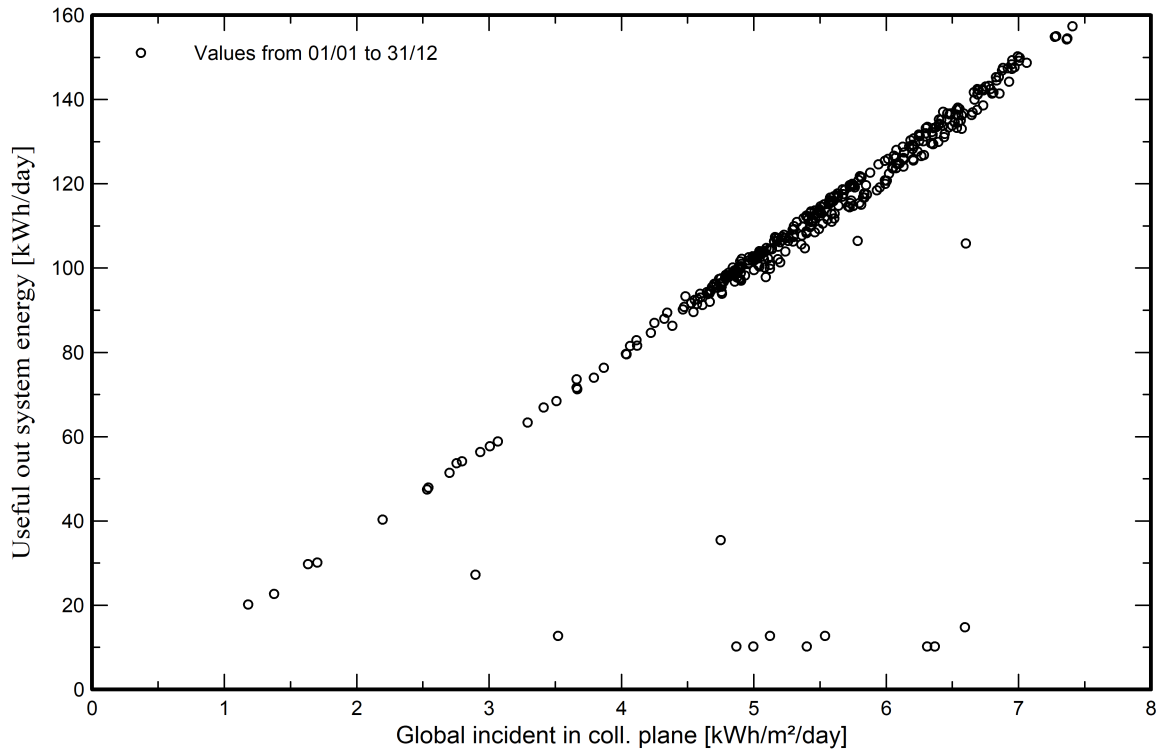


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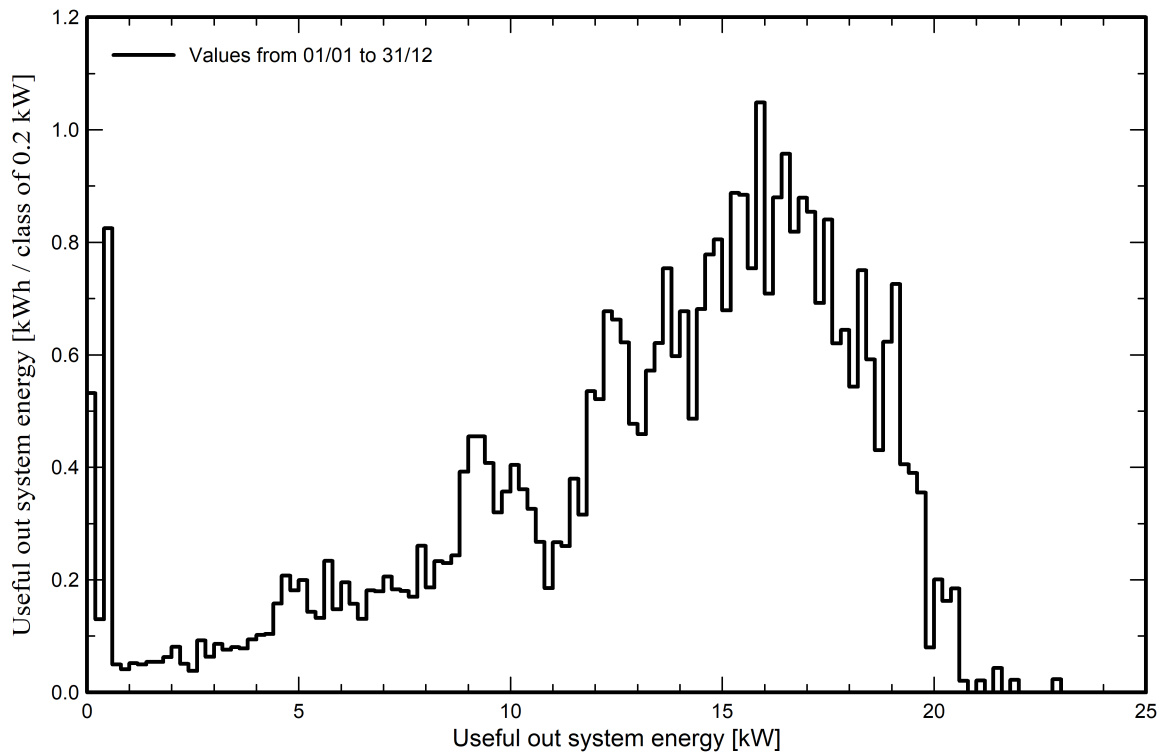
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Predef. graphs

Daily Input/Output diagram



System Output Power Distribution





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P50 - P90 evaluation

Weather data

Source Meteonorm 8.1 (2010-2021), Sat=100%
Kind Monthly averages
Synthetic - Multi-year average
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 2.11 MWh
P50 39.73 MWh
P90 37.02 MWh
P95 36.26 MWh

Probability distribution

