

PVsyst - Simulation report

Grid-Connected System

Project: LBH - Highgrove Pool and Leisure Centre

Variant: New simulation variant

Rows as domes east-west

System power: 147 kWp

Hillingdon - United Kingdom

Author

Ameresco (USA)



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PVsyst V7.4.0

VC0, Simulation date:
29/07/23 17:37
with v7.4.0

Ameresco (USA)

Project summary

Geographical Site

Hillingdon
United Kingdom

Situation

Latitude 51.53 °N
Longitude -0.45 °W
Altitude 43 m
Time zone UTC

Project settings

Albedo 0.20

Meteo data

Hillingdon
Meteonorm 8.1 (1991-2006), Sat=35% - Synthetic

System summary

Grid-Connected System

PV Field Orientation

Fixed planes 2 orientations
Tilts/azimuths 10 / -90 °
10 / 90 °

Rows as domes east-west

Near Shadings

According to strings
Electrical effect 100 %

User's needs

Unlimited load (grid)

System information

PV Array

Nb. of modules 358 units
Pnom total 147 kWp

Inverters

Nb. of units 2 units
Pnom total 120 kWac
Pnom ratio 1.223

Results summary

Produced Energy 122178 kWh/year Specific production 832 kWh/kWp/year Perf. Ratio PR 82.37 %

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General parameters

Grid-Connected System

Rows as domes east-west

PV Field Orientation

Orientation

Fixed planes 2 orientations
Tilts/azimuths 10 / -90 °
10 / 90 °

Sheds configuration

Nb. of sheds 42 units
Several orientations

Models used

Transposition Perez
Diffuse Perez, Meteonorm
Circumsolar separate

Horizon

Free Horizon

Near Shadings

According to strings
Electrical effect 100 %

User's needs

Unlimited load (grid)

PV Array Characteristics

PV module

Manufacturer Hanwha Q Cells
Model Q.Peak-Duo-ML-G10-410
(Custom parameters definition)
Unit Nom. Power 410 Wp
Number of PV modules 233 units
Nominal (STC) 95.5 kWp

Inverter

Manufacturer Ginlong Technologies
Model Solis-80K-5G
(Custom parameters definition)
Unit Nom. Power 80.0 kWac
Number of inverters 1 unit
Total power 80.0 kWac

Array #1 - PV Array

Orientation #1
Tilt/Azimuth 10/-90 °
Number of PV modules 162 units
Nominal (STC) 66.4 kWp
Modules 9 Strings x 18 In series

Number of inverters 5 * MPPT 11% 0.6 unit
Total power 44.4 kWac

At operating cond. (50°C)

Pmpp 60.6 kWp
U mpp 626 V
I mpp 97 A

Operating voltage 180-800 V
Pnom ratio (DC:AC) 1.49
No power sharing between MPPTs

Array #2 - Sub-array #2

Orientation #1
Tilt/Azimuth 10/-90 °
Number of PV modules 17 units
Nominal (STC) 6.97 kWp
Modules 1 String x 17 In series

Number of inverters 1 * MPPT 11% 0.1 unit
Total power 8.9 kWac

At operating cond. (50°C)

Pmpp 6.36 kWp
U mpp 591 V
I mpp 11 A

Operating voltage 180-800 V
Pnom ratio (DC:AC) 0.78

Array #3 - Sub-array #3

Orientation #2
Tilt/Azimuth 10/90 °
Number of PV modules 54 units
Nominal (STC) 22.14 kWp
Modules 3 Strings x 18 In series

Number of inverters 3 * MPPT 11% 0.3 unit
Total power 26.7 kWac

At operating cond. (50°C)

Pmpp 20.20 kWp
U mpp 626 V
I mpp 32 A

Operating voltage 180-800 V
Pnom ratio (DC:AC) 0.83



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PV Array Characteristics

PV module

Manufacturer	Hanwha Q Cells
Model	Q.Peak-Duo-ML-G10-410
(Custom parameters definition)	
Unit Nom. Power	410 Wp
Number of PV modules	125 units
Nominal (STC)	51.3 kWp

Inverter

Manufacturer	Ginlong Technologies
Model	Solis-40K-5G
(Custom parameters definition)	
Unit Nom. Power	40.0 kWac
Number of inverters	1 unit
Total power	40.0 kWac

Array #4 - Sub-array #4

Orientation	#2
Tilt/Azimuth	10/90 °
Number of PV modules	108 units
Nominal (STC)	44.3 kWp
Modules	6 Strings x 18 In series

At operating cond. (50°C)

Pmpp	40.4 kWp
U mpp	626 V
I mpp	65 A

Number of inverters	3 * MPPT 25% 0.8 unit
Total power	30.0 kWac

Operating voltage	200-800 V
Pnom ratio (DC:AC)	1.48
No power sharing between MPPTs	

Array #5 - Sub-array #5

Orientation	#2
Tilt/Azimuth	10/90 °
Number of PV modules	17 units
Nominal (STC)	6.97 kWp
Modules	1 String x 17 In series

At operating cond. (50°C)

Pmpp	6.36 kWp
U mpp	591 V
I mpp	11 A

Number of inverters	1 * MPPT 25% 0.3 unit
Total power	10.0 kWac

Operating voltage	200-800 V
Pnom ratio (DC:AC)	0.70

Total PV power

Nominal (STC)	147 kWp
Total	358 modules
Module area	703 m²

Total inverter power

Total power	120 kWac
Number of inverters	2 units
Pnom ratio	1.22
No power sharing	

Array losses

Array Soiling Losses

Loss Fraction	2.0 %
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Thermal Loss factor

Module temperature according to irradiance	
Uc (const)	27.0 W/m²K
Uv (wind)	0.0 W/m²K/m/s

LID - Light Induced Degradation

Loss Fraction	2.5 %
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Module Quality Loss

Loss Fraction	-0.8 %
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Module mismatch losses

Array #1 - PV Array

Loss Fraction	2.0 % at MPP
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Array #2 - Sub-array #2

Loss Fraction	2.0 % at MPP
---------------	--------------

Array #3 - Sub-array #3

Loss Fraction	2.0 % at MPP
---------------	--------------

Array #4 - Sub-array #4

Loss Fraction	2.0 % at MPP
---------------	--------------

Array #5 - Sub-array #5

Loss Fraction	2.0 % at MPP
---------------	--------------



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Array losses

IAM loss factor

Incidence effect (IAM): Fresnel, AR coating, $n(\text{glass})=1.526$, $n(\text{AR})=1.290$

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

DC wiring losses

Global wiring resistance 10 mΩ
Loss Fraction 1.5 % at STC

Array #1 - PV Array

Global array res. 107 mΩ
Loss Fraction 1.5 % at STC

Array #3 - Sub-array #3

Global array res. 320 mΩ
Loss Fraction 1.5 % at STC

Array #5 - Sub-array #5

Global array res. 905 mΩ
Loss Fraction 1.5 % at STC

Array #2 - Sub-array #2

Global array res. 905 mΩ
Loss Fraction 1.5 % at STC

Array #4 - Sub-array #4

Global array res. 160 mΩ
Loss Fraction 1.5 % at STC

AC wiring losses

Inv. output line up to injection point

Inverter voltage 400 Vac tri
Loss Fraction 0.27 % at STC

Inverter: Solis-80K-5G

Wire section (1 Inv.) Copper 1 x 3 x 70 mm²
Wires length 30 m

Inverter: Solis-40K-5G

Wire section (1 Inv.) Copper 1 x 3 x 6 mm²
Wires length 0 m

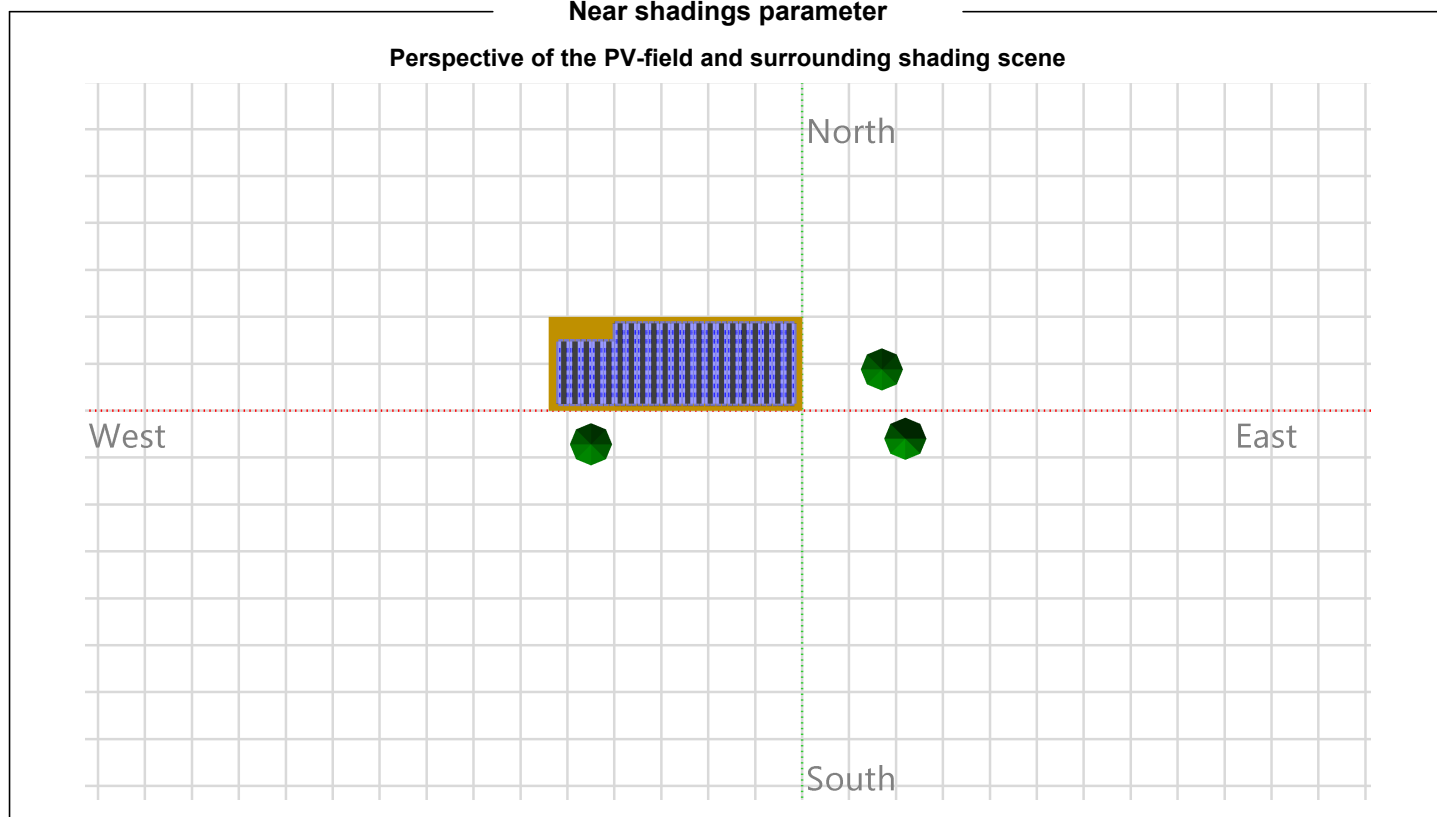
Inverters: Solis-80K-5G, Solis-40K-5G

Wire section (1 Inv.) Copper 1 x 3 x 25 mm²
Wires length 0 m



Near shadings parameter

Perspective of the PV-field and surrounding shading scene





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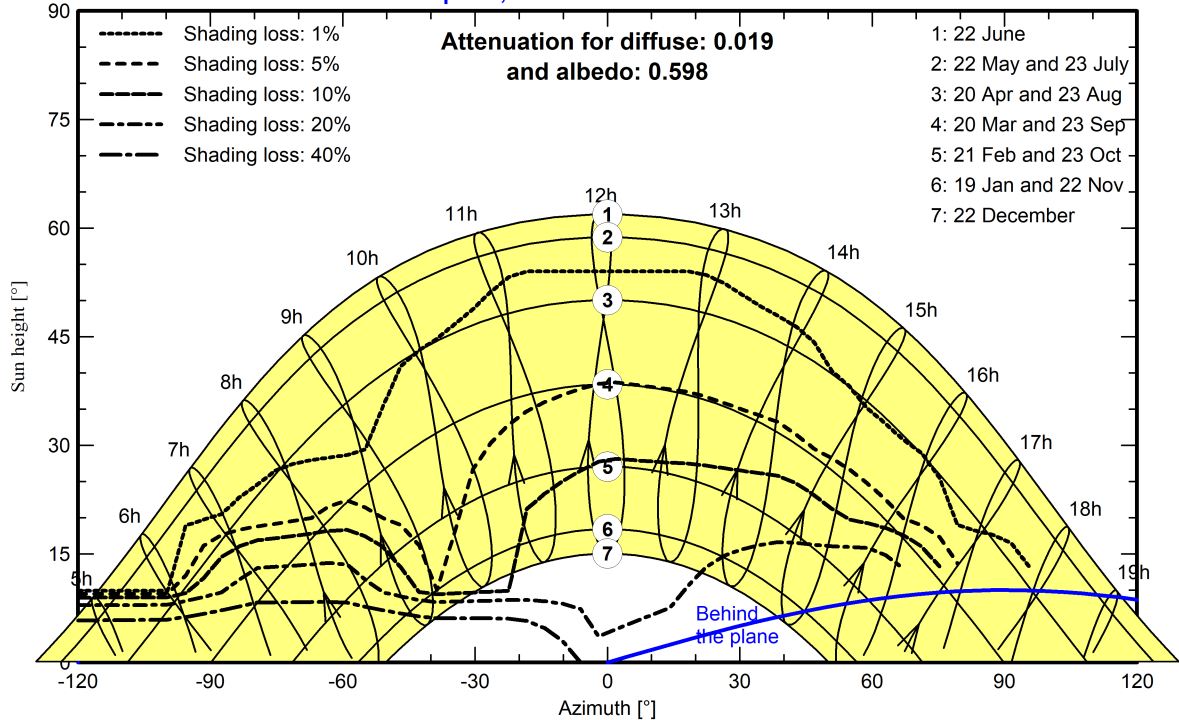
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Iso-shadings diagram

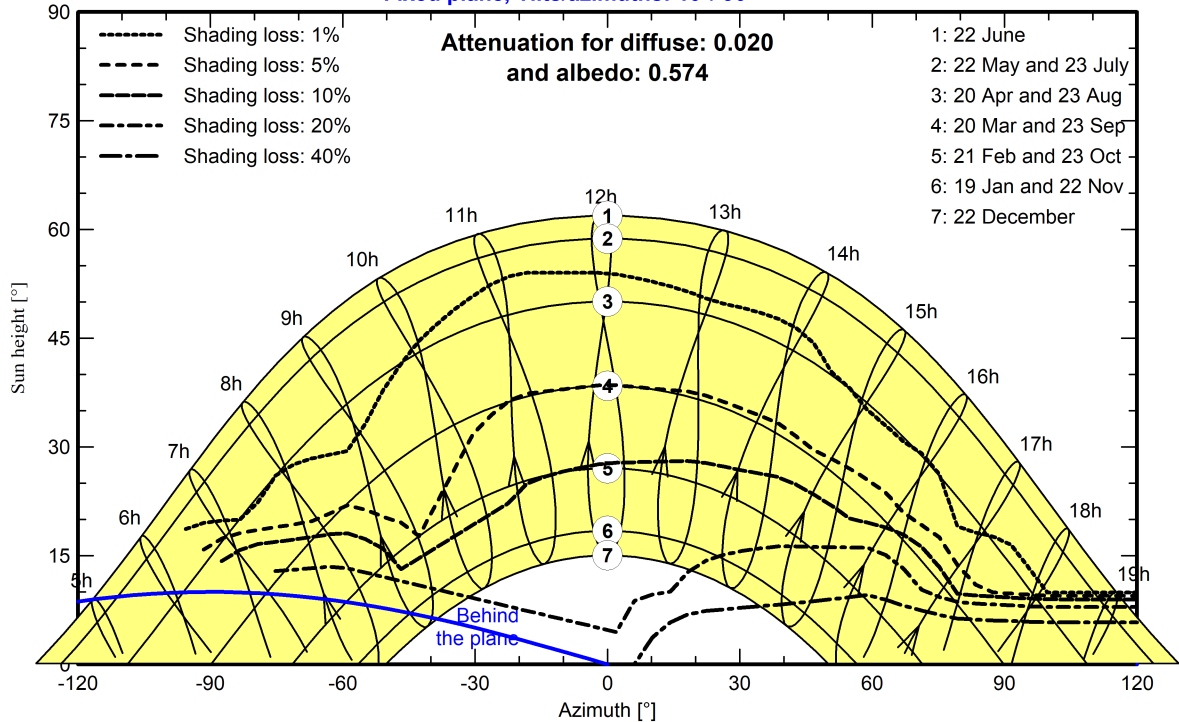
Orientation #1

Fixed plane, Tilts/azimuths: 10°/-90°



Orientation #2

Fixed plane, Tilts/azimuths: 10°/90°





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Main results

System Production

Produced Energy

122178 kWh/year

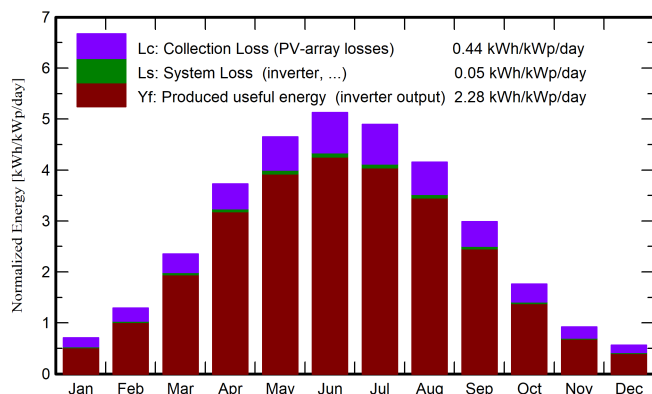
Specific production

832 kWh/kWp/year

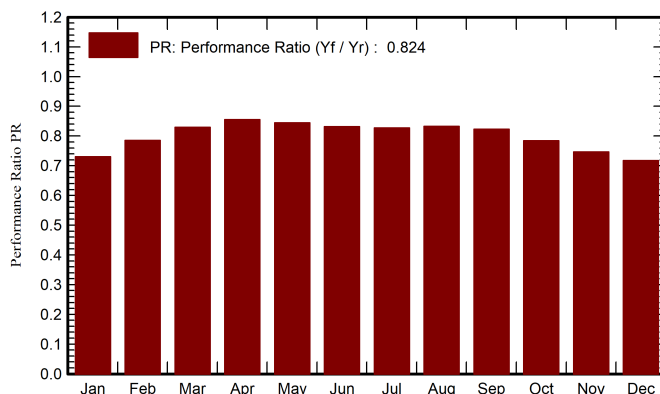
Perf. Ratio PR

82.37 %

Normalized productions (per installed kWp)



Performance Ratio PR



Balances and main results

	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_Grid	PR
	kWh/m ²	kWh/m ²	°C	kWh/m ²	kWh/m ²	kWh	kWh	ratio
January	22.1	14.33	5.33	21.9	17.7	2438	2350	0.730
February	36.4	21.70	5.42	36.1	30.7	4276	4166	0.785
March	73.5	41.09	7.34	73.0	65.5	9076	8887	0.830
April	112.7	62.73	9.89	111.7	104.2	14290	14022	0.855
May	145.3	77.31	13.27	144.2	135.6	18211	17873	0.845
June	154.8	84.88	16.49	153.8	144.7	19112	18759	0.831
July	152.8	79.66	18.84	151.7	142.6	18757	18408	0.827
August	129.6	72.02	18.10	128.7	120.3	16032	15735	0.833
September	90.2	47.41	15.20	89.6	82.1	11039	10821	0.823
October	55.1	32.30	12.05	54.7	47.4	6437	6296	0.784
November	27.8	18.19	8.01	27.6	22.7	3114	3020	0.746
December	17.7	11.85	5.96	17.5	14.0	1922	1841	0.717
Year	1018.1	563.46	11.36	1010.5	927.5	124705	122178	0.824

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

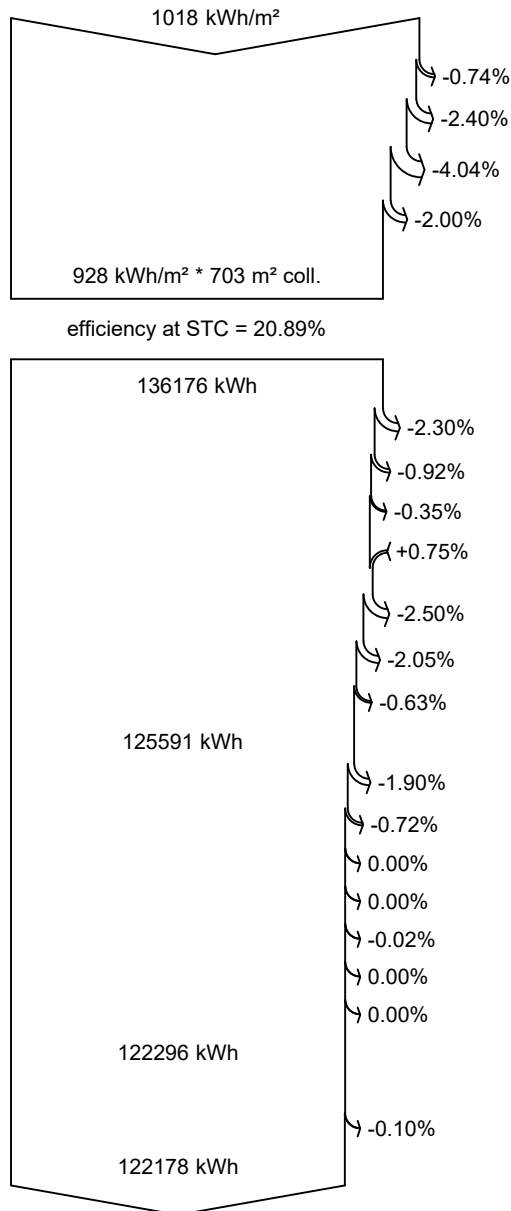
EArray Effective energy at the output of the array

E_Grid Energy injected into grid

PR Performance Ratio



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 eff.)

PV loss due to irradiance level

PV loss due to temperature

Shadings: Electrical Loss acc. to strings

Module quality loss

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

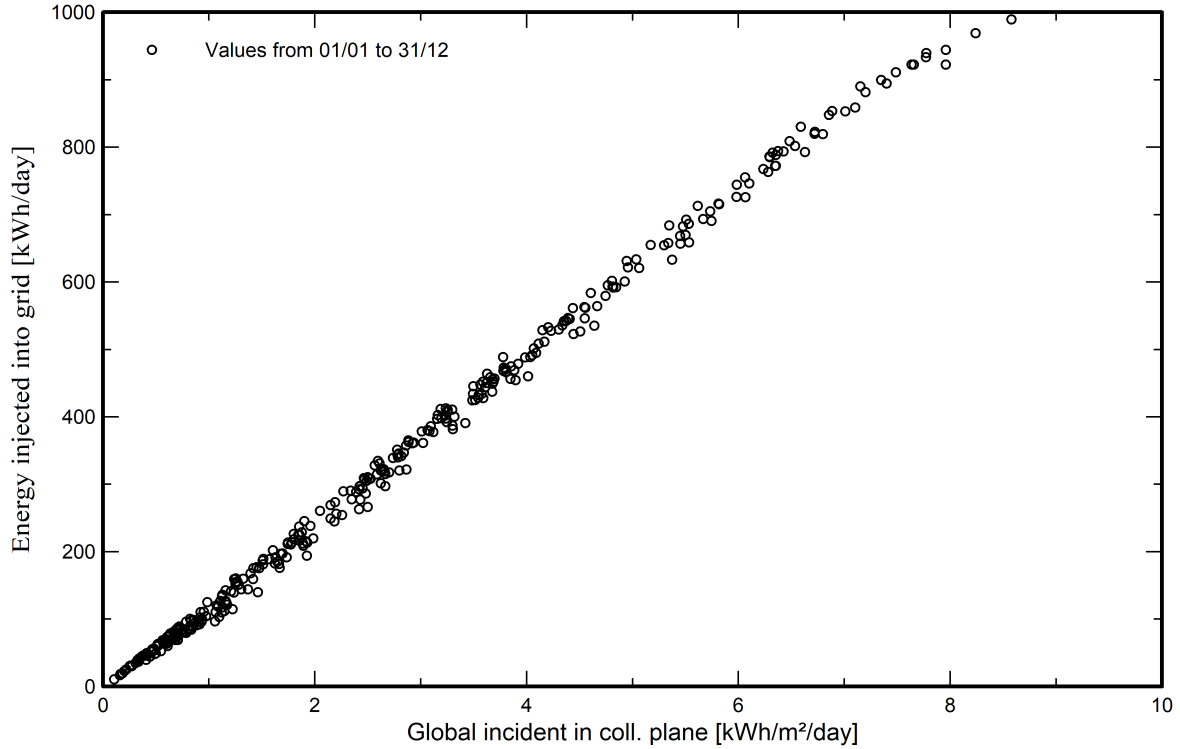
AC ohmic loss

Energy injected into grid



Predef. graphs

Daily Input/Output diagram



System Output Power Distribution

