

# PVsyst - Simulation report

## Grid-Connected System

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Project: Folkendange north

Variant: Folkendange North

Sheds, single array

System power: 9990 kWp

Folkendange - Luxembourg

**Author**

Tecnica y Proyectos SA (Spain)

**PVsyst V7.3.2**

VC2, Simulation date:  
29/03/23 17:34  
with v7.3.2

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

Luxembourg

**Situation**

Latitude 49.83 °N

Longitude 6.20 °E

Altitude 304 m

Time zone UTC+1

**Meteo data**

Folkendange

SolarGIS Monthly aver. , period not spec. - Synthetic

**Monthly albedo values**

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Albedo	0.17	0.17	0.15	0.16	0.19	0.19	0.18	0.17	0.16	0.15	0.13	0.16

**System summary****Grid-Connected System**

Simulation for year no 1

**Sheds, single array****PV Field Orientation**

Fixed plane

Tilt/Azimuth 20 / 0 °

**Near Shadings**

According to strings

Electrical effect 100 %

**User's needs**

Unlimited load (grid)

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

Nb. of modules

15252 units

Pnom total

9990 kWp

**Inverters**

Nb. of units

27 units

Pnom total

8886 kWac

Pnom ratio

1.124

**Results summary**

Produced Energy 10824637 kWh/year Specific production 1084 kWh/kWp/year Perf. Ratio PR 86.88 %

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

Fixed plane  
Tilt/Azimuth 20 / 0 °

**Horizon**

Average Height 3.7 °

**Bifacial system**

Model 2D Calculation  
unlimited sheds

**Bifacial model geometry**

Sheds spacing 8.50 m  
Sheds width 4.83 m  
Limit profile angle 22.4 °  
GCR 56.8 %  
Height above ground 1.00 m

**Sheds, single array****Sheds configuration**

Nb. of sheds 41 units  
Single array

**Sizes**

Sheds spacing 8.50 m  
Collector width 4.79 m  
Ground Cov. Ratio (GCR) 56.3 %  
Top inactive band 0.02 m  
Bottom inactive band 0.02 m

**Shading limit angle**

Limit profile angle 22.4 °

**Near Shadings**

According to strings  
Electrical effect 100 %

**Models used**

Transposition Perez  
Diffuse Perez, Meteonorm  
Circumsolar separate

**User's needs**

Unlimited load (grid)

**Monthly ground albedo values**

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year
0.17	0.17	0.15	0.16	0.19	0.19	0.18	0.17	0.16	0.15	0.13	0.16	0.16

**PV Array Characteristics****PV module**

Manufacturer CSI Solar  
Model CS7N-655MB-AG 1500V  
(Original PVsyst database)

Unit Nom. Power 655 Wp  
Number of PV modules 15252 units  
Nominal (STC) 9990 kWp

**Array #1 - Block type 1**

Number of PV modules 9114 units  
Nominal (STC) 5970 kWp  
Modules 294 Strings x 31 In series

**At operating cond. (50°C)**

Pmpp 5482 kWp  
U mpp 1057 V  
I mpp 5185 A

**Inverter**

Manufacturer Ingeteam  
Model Ingecon Sun 350 TL M (datasheet Ingeteam)  
(Custom parameters definition)

Unit Nom. Power 329 kWac  
Number of inverters 27 units  
Total power 8886 kWac

Number of inverters 16 units  
Total power 5266 kWac

Operating voltage 850-1300 V  
Max. power (=>30°C) 346 kWac  
Pnom ratio (DC:AC) 1.13  
Power sharing within this inverter

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**PV Array Characteristics****Array #2 - Block type 2**

Number of PV modules	6138 units	Number of inverters	11 units
Nominal (STC)	4020 kWp	Total power	3620 kWac
Modules	198 Strings x 31 In series		
<b>At operating cond. (50°C)</b>		Operating voltage	850-1300 V
Pmpp	3692 kWp	Max. power (=>30°C)	346 kWac
U mpp	1057 V	Pnom ratio (DC:AC)	1.11
I mpp	3492 A	Power sharing within this inverter	

**Total PV power**

Nominal (STC)	9990 kWp
Total	15252 modules
Module area	47378 m <sup>2</sup>

**Total inverter power**

Total power	8886 kWac
Max. power	9342 kWac
Number of inverters	27 units
Pnom ratio	1.12

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

Loss Fraction	2.0 %
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**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	1.5 %
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**Module Quality Loss**

Loss Fraction	-0.3 %
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**Module mismatch losses**

Loss Fraction	1.0 % at MPP
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**Strings Mismatch loss**

Loss Fraction	0.1 %
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**Module average degradation**

Year no	1
Loss factor	0.5 %/year

**Mismatch due to degradation**

Imp RMS dispersion	0.4 %/year
Vmp RMS dispersion	0.4 %/year

**IAM loss factor**

Incidence effect (IAM): User defined profile

10°	20°	30°	40°	50°	60°	70°	80°	90°
0.998	0.998	0.995	0.992	0.986	0.970	0.917	0.763	0.000

**DC wiring losses**

Global wiring resistance	0.40 mΩ
Loss Fraction	0.3 % at STC

**Array #1 - Block type 1**

Global array res.	0.67 mΩ
Loss Fraction	0.3 % at STC

**Array #2 - Block type 2**

Global array res.	1.00 mΩ
Loss Fraction	0.3 % at STC

**System losses****Unavailability of the system**

Time fraction	1.0 %
	3.7 days,
	3 periods

**Auxiliaries loss**

Proportionnal to Power	3.0 W/kW
0.0 kW from Power thresh.	

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**AC wiring losses****Inv. output line up to MV transfo**

Inverter voltage 800 Vac tri  
Loss Fraction 1.00 % at STC

**Inverter: Ingecon Sun 350 TL M (datasheet Ingeteam)**

Wire section (27 Inv.) Copper 27 x 3 x 120 mm<sup>2</sup>  
Average wires length 112 m

**MV line up to Injection**

MV Voltage 33 kV  
Average each inverter  
Wires Alu 3 x 16 mm<sup>2</sup>  
Length 1683 m  
Loss Fraction 1.00 % at STC

**AC losses in transformers****MV transfo**

Medium voltage 33 kV

**One transfo parameters**

Nominal power at STC 3.29 MVA  
Iron Loss (24/24 Connexion) 3.29 kVA  
Iron loss fraction 0.10 % at STC  
Copper loss 29.64 kVA  
Copper loss fraction 0.90 % at STC  
Coils equivalent resistance 3 x 1.76 mΩ

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

Nb. identical MV transfos 3  
Nominal power at STC 9.86 MVA  
Iron loss (24/24 Connexion) 9.86 kVA  
Copper loss 88.93 kVA



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### Horizon definition

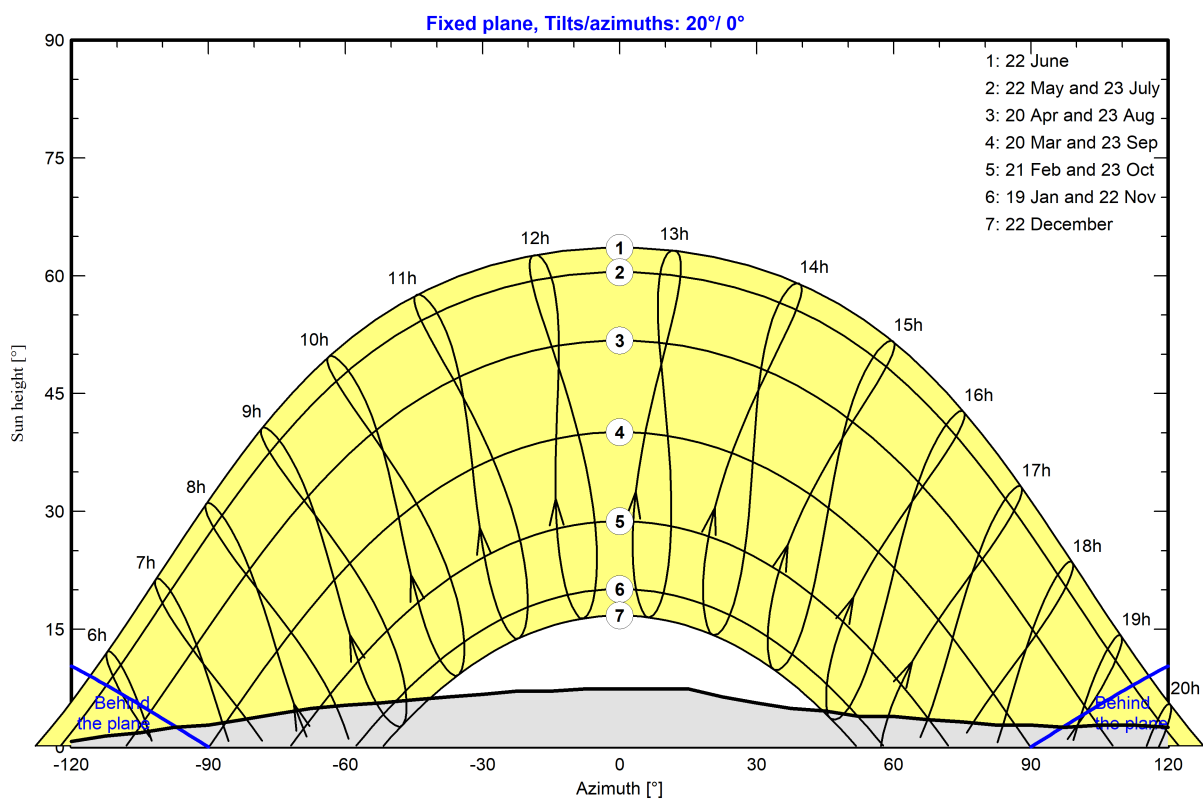
CSV horizon file, lat:49.83232190877928, lng:6.198660135269165, exported by sola

Average Height 3.7 °  
Diffuse Factor 0.97  
Albedo Factor 0.68  
Albedo Fraction 100 %

### Horizon profile

Azimuth [°]	-180	-173	-165	-158	-150	-143	-135	-128	-120	-113	-105	-98
Height [°]	1.8	1.4	1.1	0.7	0.7	1.1	0.7	0.4	0.7	1.4	1.8	2.5
Azimuth [°]	-90	-83	-75	-68	-60	-53	-45	-38	-30	-23	-15	-8
Height [°]	2.8	3.5	4.2	4.9	5.3	5.6	6.0	6.4	6.7	7.1	7.1	7.4
Azimuth [°]	15	23	30	38	45	53	60	68	75	83	90	98
Height [°]	7.4	6.4	5.6	4.9	4.6	3.9	3.9	3.5	3.2	2.8	2.8	2.5
Azimuth [°]	105	113	120	128	135	143	150	158	165	173		
Height [°]	2.8	2.8	2.5	2.5	2.8	2.8	3.2	2.8	2.5	2.1		

### Sun Paths (Height / Azimuth diagram)





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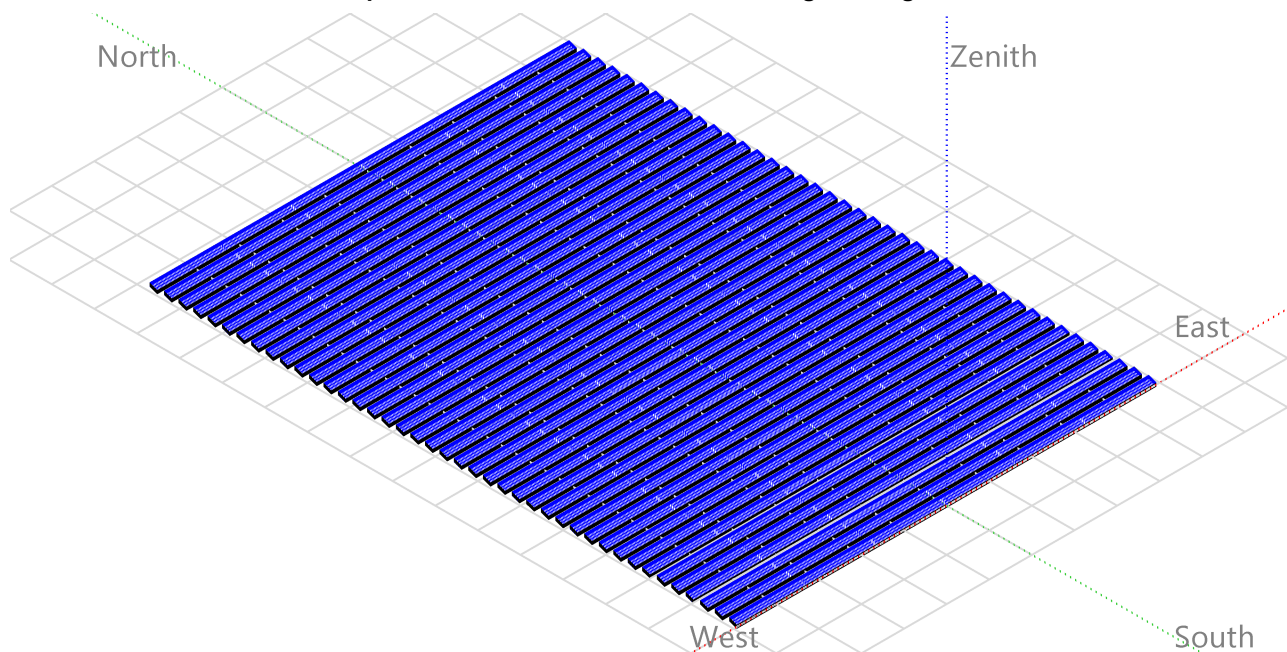
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### Near shadings parameter

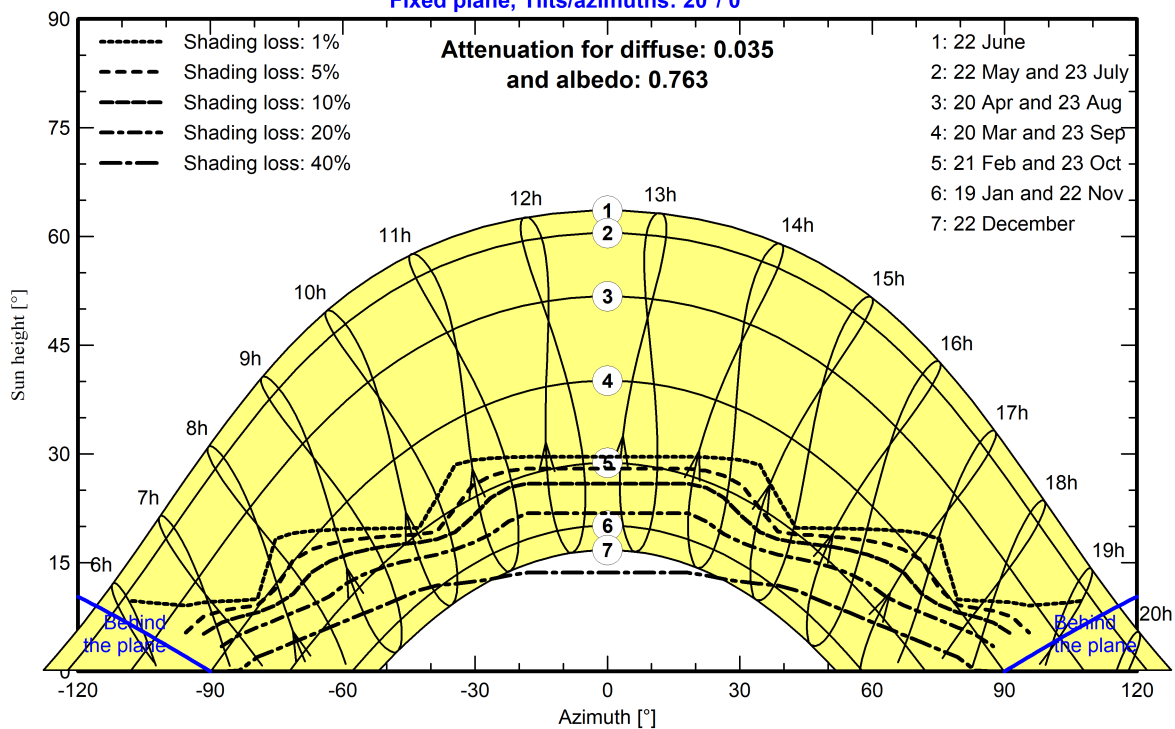
Perspective of the PV-field and surrounding shading scene



### Iso-shadings diagram

#### Orientation #1

Fixed plane, Tilts/azimuths: 20°/ 0°





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## Main results

### System Production

Produced Energy

10824637 kWh/year

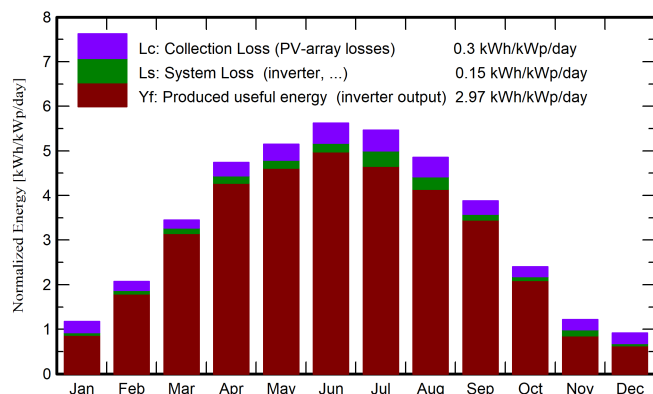
Specific production

1084 kWh/kWp/year

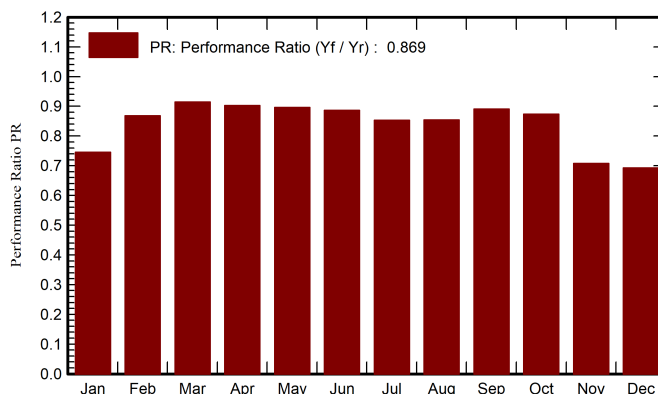
Performance Ratio PR

86.88 %

### 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	25.2	16.90	1.40	36.3	30.6	288175	270683	0.746
February	42.6	24.50	2.30	57.9	52.9	524927	502640	0.869
March	86.1	44.00	5.30	106.9	100.5	1014608	976827	0.915
April	126.6	61.90	9.00	142.2	134.1	1332570	1282799	0.903
May	153.3	76.90	12.70	159.7	150.3	1485542	1430715	0.897
June	166.7	82.00	16.10	168.7	159.0	1550848	1494041	0.886
July	165.4	82.10	18.00	169.4	159.6	1549839	1443834	0.853
August	139.1	69.40	17.50	150.4	141.7	1371056	1283575	0.854
September	98.4	49.60	13.70	116.4	109.7	1075326	1035748	0.891
October	57.4	33.10	9.70	74.4	69.0	677537	649577	0.874
November	27.0	18.60	5.30	36.5	31.8	297503	257668	0.707
December	19.1	13.10	2.30	28.4	22.6	212204	196528	0.693
Year	1106.9	572.10	9.48	1247.2	1161.7	11380134	10824637	0.869

### 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

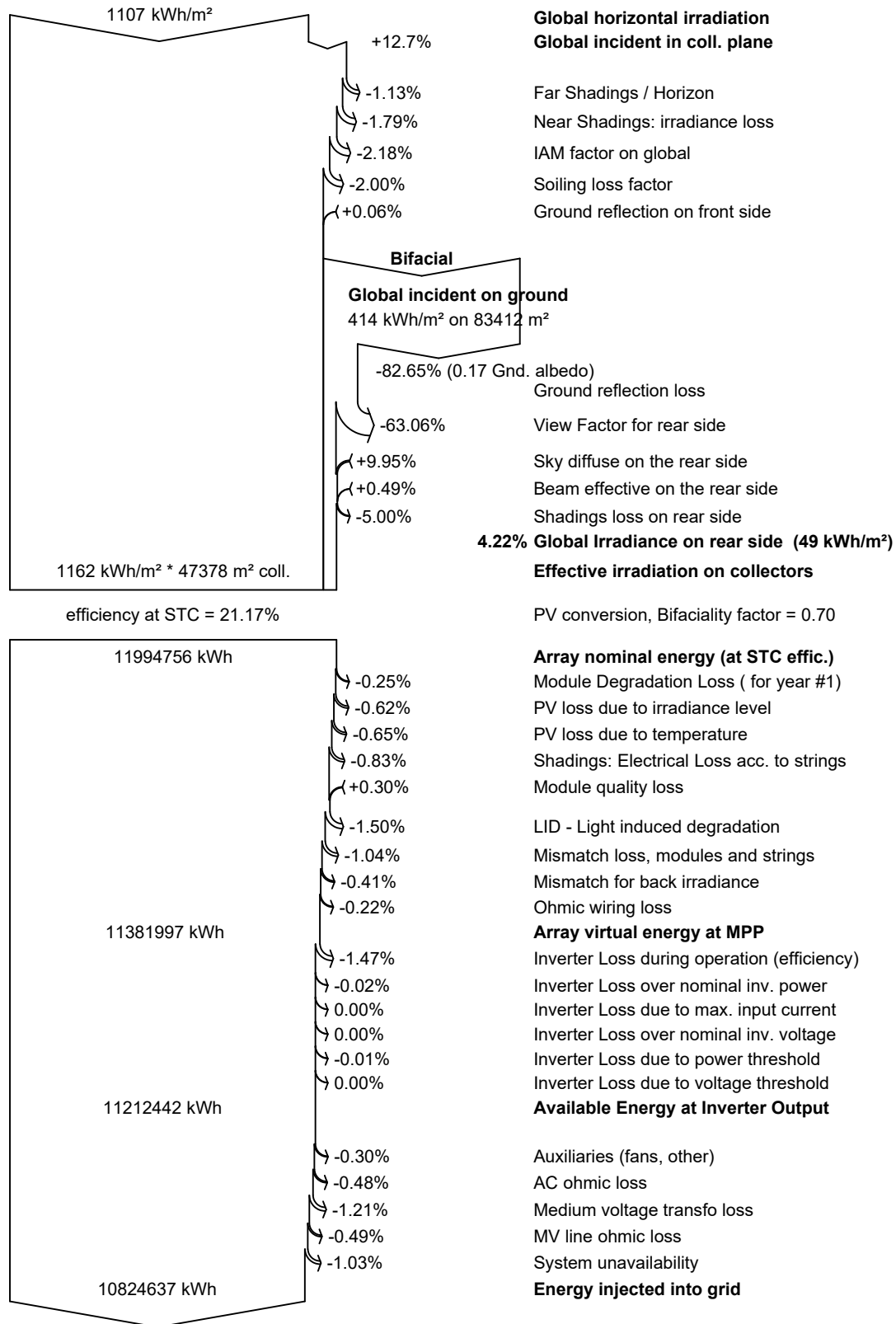
E\_Grid Energy injected into grid

PR Performance Ratio





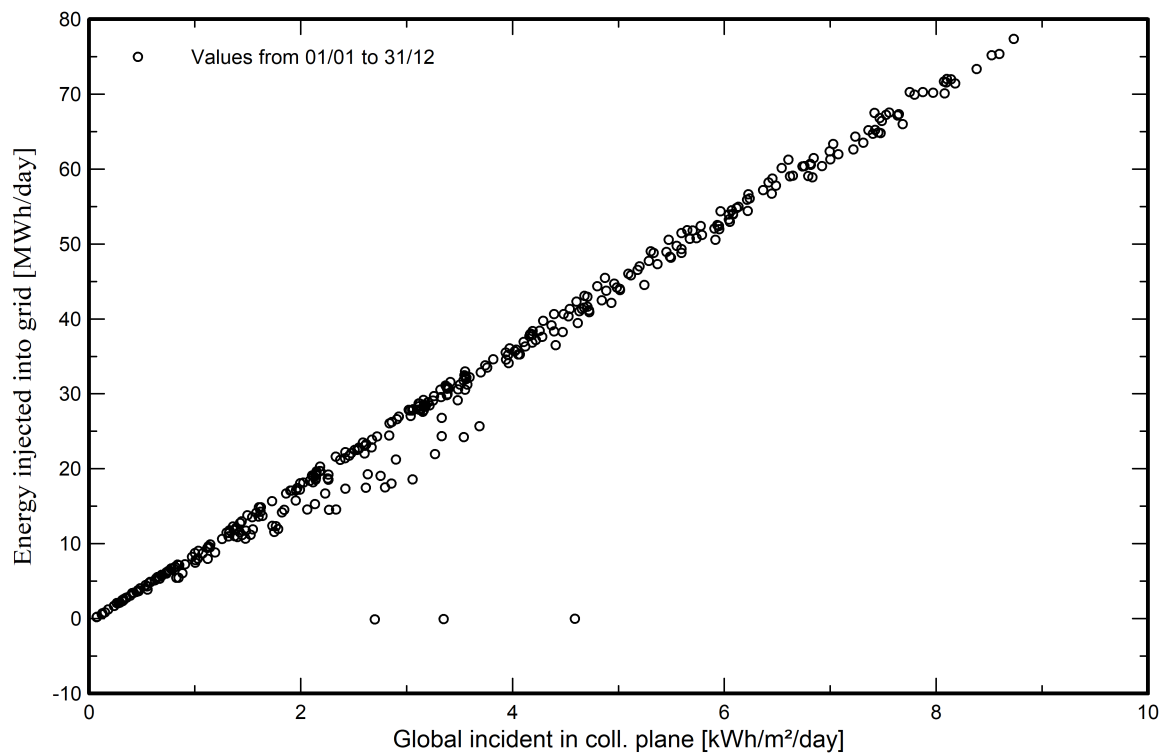
### Loss diagram





### Predef. graphs

#### Daily Input/Output diagram



#### System Output Power Distribution

