

# PVsyst - Simulation report

## Grid-Connected System

Project: GIRANCOURT\_maison\_des\_services

Variant: Nouvelle variante de simulation

Tables on a building

System power: 141 kWp

Girancourt - France



# Project: GIRANCOURT\_maison\_des\_services

Variant: Nouvelle variante de simulation

## PVsyst V7.3.4

VC0, Simulation date:  
08/09/23 17:07  
with v7.3.4

SEM TERR'ENR (France)

### Project summary

#### Geographical Site

**Girancourt**

France

#### Situation

Latitude 48.16 °N

Longitude 6.30 °E

Altitude 349 m

Time zone UTC+1

#### Project settings

Albedo 0.20

#### Meteo data

Girancourt

Meteonorm 8.1 (1991-2010), Sat=100 % - Synthétique

### System summary

#### Grid-Connected System

#### PV Field Orientation

Fixed planes 6 orientations

Tilts/azimuths 13 / 55 °

13 / -20 °

10 / -20 °

10 / 5 °

10 / 38 °

10 / 20 °

#### Tables on a building

#### Near Shadings

Linear shadings

#### User's needs

Unlimited load (grid)

#### System information

##### PV Array

Nb. of modules

343 units

Pnom total

141 kWp

##### Inverters

Nb. of units

6.6 units

Pnom total

126 kWac

Pnom ratio

1.121

### Results summary

Produced Energy 156461 kWh/year Specific production 1113 kWh/kWp/year Perf. Ratio PR 87.52 %

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## General parameters

## Grid-Connected System

## Tables on a building

## PV Field Orientation

## Orientation

Fixed planes 6 orientations  
Tilts/azimuths 13 / 55 °  
13 / -20 °  
10 / -20 °  
10 / 5 °  
10 / 38 °  
10 / 20 °

## Sheds configuration

## Models used

Transposition Perez  
Diffuse Perez, Meteonorm  
Circumsolar separate

## Horizon

Average Height 2.2 °

## Near Shadings

Linear shadings

## User's needs

Unlimited load (grid)

## PV Array Characteristics

## Array #1 - Champ PV

Orientation #1  
Tilt/Azimuth 13/55 °

## PV module

Manufacturer Longi Solar  
Model LR5-54HPH-410M

(Original PVsyst database)

Unit Nom. Power 410 Wp  
Number of PV modules 130 units  
Nominal (STC) 53.3 kWp  
Modules 5 Strings x 26 In series

## At operating cond. (50°C)

Pmpp 48.8 kWp  
U mpp 734 V  
I mpp 66 A

## Inverter

Manufacturer Huawei Technologies  
Model SUN2000-60KTL-M0-480Vac

(Original PVsyst database)

Unit Nom. Power 60.0 kWac  
Number of inverters 5 \* MPPT 17% 0.8 unit  
Total power 50.0 kWac  
Operating voltage 200-1000 V  
Max. power (=>50°C) 66.0 kWac  
Pnom ratio (DC:AC) 1.07  
No power sharing between MPPTs

## Array #2 - Sous-champ #2

Orientation #2  
Tilt/Azimuth 13/-20 °

## PV module

Manufacturer Longi Solar  
Model LR5-54HIB-410M

(Original PVsyst database)

Unit Nom. Power 410 Wp  
Number of PV modules 24 units  
Nominal (STC) 9.84 kWp  
Modules 1 String x 24 In series

## At operating cond. (50°C)

Pmpp 9.01 kWp  
U mpp 680 V  
I mpp 13 A

## Inverter

Manufacturer Huawei Technologies  
Model SUN2000-8KTL-M2-400V

(Original PVsyst database)

Unit Nom. Power 8.00 kWac  
Number of inverters 1 unit  
Total power 8.0 kWac  
Operating voltage 160-950 V  
Max. power (=>60°C) 8.80 kWac  
Pnom ratio (DC:AC) 1.23  
Power sharing within this inverter

## Array #3 - Sous-champ #3

Orientation #4  
Tilt/Azimuth 10/5 °



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## PV Array Characteristics

## PV module

Manufacturer Longi Solar  
Model LR5-54HIB-410M

(Original PVsyst database)

Unit Nom. Power 410 Wp  
Number of PV modules 24 units  
Nominal (STC) 9.84 kWp  
Modules 1 String x 24 In series

## At operating cond. (50°C)

Pmpp 9.01 kWp  
U mpp 680 V  
I mpp 13 A

## Array #4 - Sous-champ #4

Orientation #6  
Tilt/Azimuth 10/20 °

## PV module

Manufacturer Longi Solar  
Model LR5-54HIB-410M

(Original PVsyst database)

Unit Nom. Power 410 Wp  
Number of PV modules 8 units  
Nominal (STC) 3280 Wp  
Modules 1 String x 8 In series

## At operating cond. (50°C)

Pmpp 3002 Wp  
U mpp 227 V  
I mpp 13 A

## Array #5 - Sous-champ #5

Orientation #5  
Tilt/Azimuth 10/38 °

## PV module

Manufacturer Longi Solar  
Model LR5-54HIB-410M

(Original PVsyst database)

Unit Nom. Power 410 Wp  
Number of PV modules 10 units  
Nominal (STC) 4100 Wp  
Modules 1 String x 10 In series

## At operating cond. (50°C)

Pmpp 3753 Wp  
U mpp 283 V  
I mpp 13 A

## Array #6 - Sous-champ #6

Orientation #3  
Tilt/Azimuth 10/-20 °

## Inverter

Manufacturer Huawei Technologies  
Model SUN2000-8KTL-M1 220Vac

(Original PVsyst database)

Unit Nom. Power 8.00 kWac  
Number of inverters 1 unit  
Total power 8.0 kWac  
Operating voltage 140-980 V

Max. power (=>45°C) 8.80 kWac  
Pnom ratio (DC:AC) 1.23

Power sharing within this inverter

## Inverter

Manufacturer SMA  
Model Sunny Boy 3000 U-240

(Original PVsyst database)

Unit Nom. Power 3.00 kWac  
Number of inverters 1 unit  
Total power 3.0 kWac  
Operating voltage 200-400 V

Pnom ratio (DC:AC) 1.09

## Inverter

Manufacturer Huawei Technologies  
Model SUN2000-4KTL-M1-400V

(Original PVsyst database)

Unit Nom. Power 4.00 kWac  
Number of inverters 1 unit  
Total power 4.0 kWac  
Operating voltage 140-980 V

Max. power (=>50°C) 4.40 kWac  
Pnom ratio (DC:AC) 1.02

Power sharing within this inverter



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## PV Array Characteristics

## PV module

Manufacturer Longi Solar  
Model LR5-54HIB-410M  
(Original PVsyst database)

Unit Nom. Power 410 Wp  
Number of PV modules 147 units  
Nominal (STC) 60.3 kWp  
Modules 7 Strings x 21 In series

## At operating cond. (50°C)

Pmpp 55.2 kWp  
U mpp 595 V  
I mpp 93 A

## Total PV power

Nominal (STC) 141 kWp  
Total 343 modules  
Module area 670 m<sup>2</sup>  
Cell area 617 m<sup>2</sup>

## Inverter

Manufacturer Huawei Technologies  
Model SUN2000-30KTL-M3-380V  
(Original PVsyst database)

Unit Nom. Power 30.0 kWac  
Number of inverters 7 \* MPPT 25% 1.8 units  
Total power 52.5 kWac  
Operating voltage 200-1000 V  
Max. power (=>55°C) 33.0 kWac  
Pnom ratio (DC:AC) 1.15  
No power sharing between MPPTs

## Total inverter power

Total power 126 kWac  
Nb. of inverters 7 units  
0.4 unused  
Pnom ratio 1.12

## Array losses

## Thermal Loss factor

Module temperature according to irradiance  
Uc (const) 20.0 W/m<sup>2</sup>K  
Uv (wind) 0.0 W/m<sup>2</sup>K/m/s

## LID - Light Induced Degradation

Loss Fraction 0.8 %

## Module mismatch losses

Loss Fraction 2.0 % at MPP

## Module Quality Loss

## Array #1 - Champ PV

Loss Fraction 3.0 %

## Array #2 - Sous-champ #2

Loss Fraction 3.0 %

## Array #3 - Sous-champ #3

Loss Fraction 3.0 %

## Array #4 - Sous-champ #4

Loss Fraction 3.0 %

## Array #5 - Sous-champ #5

Loss Fraction 3.0 %

## Array #6 - Sous-champ #6

Loss Fraction 3.0 %

## Strings Mismatch loss

Loss Fraction 0.1 %

## IAM loss factor

Incidence effect (IAM): User defined profile

0°	25°	45°	60°	65°	70°	75°	80°	90°
1.000	1.000	0.995	0.962	0.936	0.903	0.851	0.754	0.000



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**DC wiring losses**

Global wiring resistance 10 mΩ  
Loss Fraction 1.5 % at STC

**Array #1 - Champ PV**

Global array res. 183 mΩ  
Loss Fraction 1.5 % at STC

**Array #3 - Sous-champ #3**

Global array res. 849 mΩ  
Loss Fraction 1.5 % at STC

**Array #5 - Sous-champ #5**

Global array res. 354 mΩ  
Loss Fraction 1.5 % at STC

**Array #2 - Sous-champ #2**

Global array res. 849 mΩ  
Loss Fraction 1.5 % at STC

**Array #4 - Sous-champ #4**

Global array res. 283 mΩ  
Loss Fraction 1.5 % at STC

**Array #6 - Sous-champ #6**

Global array res. 106 mΩ  
Loss Fraction 1.5 % at STC



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## Horizon definition

Horizon from PVGIS website API, Lat=48°9'41', Long=6°18'16', Alt=349m

Average Height	2.2 °	Albedo Factor	0.88
Diffuse Factor	0.99	Albedo Fraction	100 %

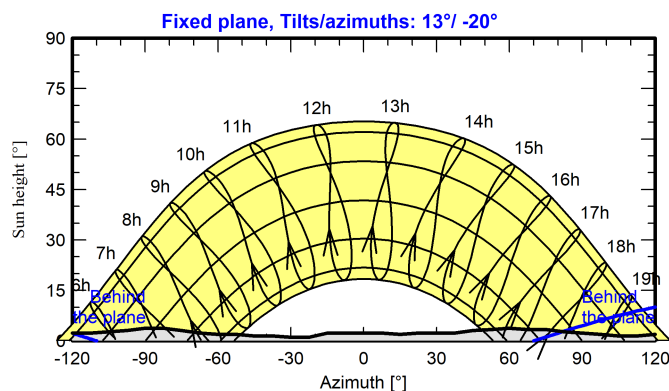
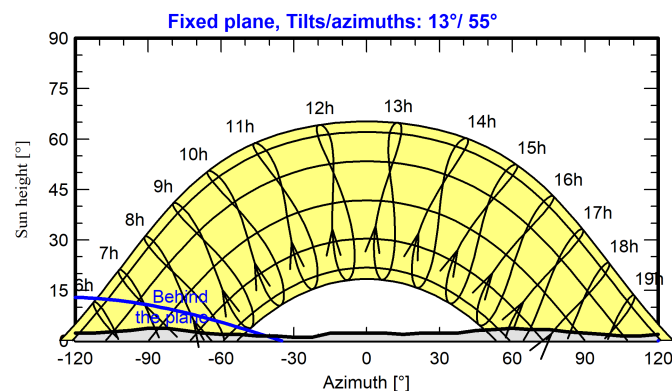
## Horizon profile

Azimuth [°]	-180	-173	-165	-158	-150	-143	-128	-120	-113	-105	-98	-90	-83	-75
Height [°]	1.1	1.5	1.9	2.3	2.3	2.7	2.7	2.3	2.3	2.7	3.1	3.8	3.8	3.1
Azimuth [°]	-68	-60	-53	-45	-38	-30	-23	-15	8	15	23	38	45	53
Height [°]	2.3	1.9	1.9	1.5	1.5	1.1	1.1	2.3	2.3	1.9	2.3	2.3	3.1	3.4
Azimuth [°]	60	68	75	83	90	98	105	113	120	128	135	143	150	180
Height [°]	3.8	3.4	3.4	2.7	2.3	1.9	1.5	1.5	1.9	1.9	1.5	1.5	1.1	1.1

## Sun Paths (Height / Azimuth diagram)

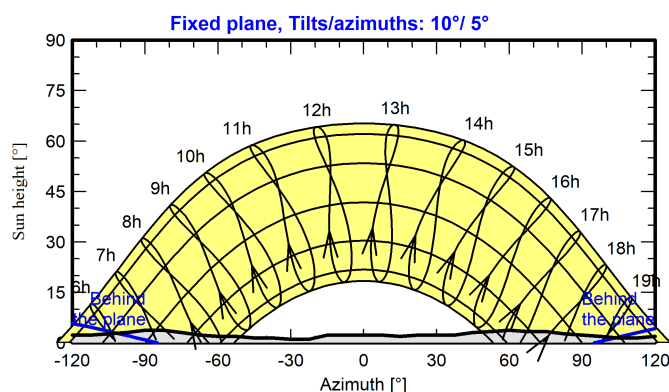
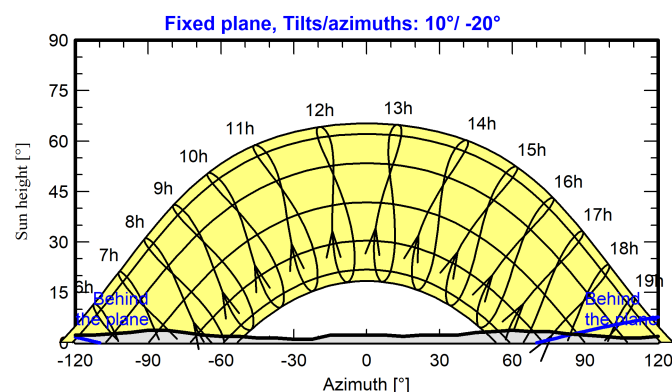
Orientation #1

Orientation #2



Orientation #3

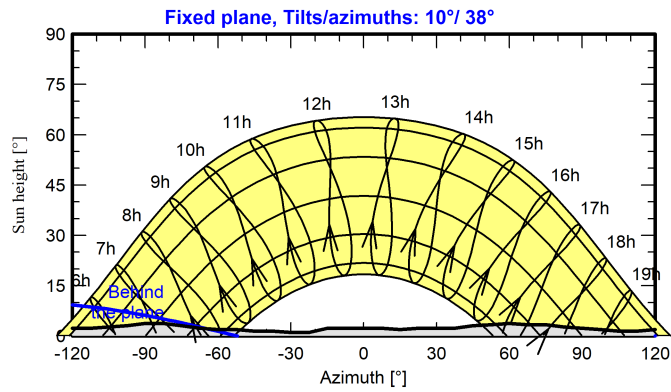
Orientation #4



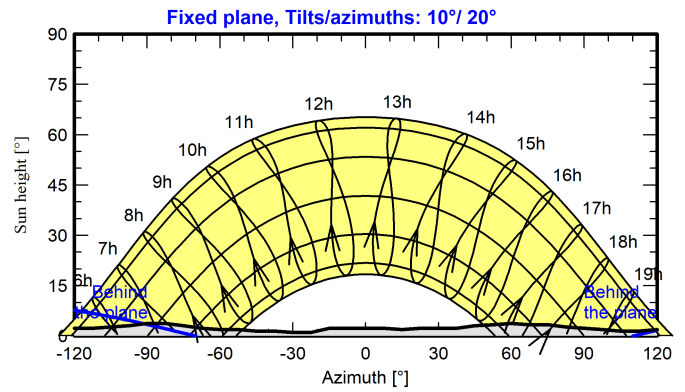


### Horizon definition

**Sun Paths (Height / Azimuth diagram)**  
**Orientation #5**



**Orientation #6**

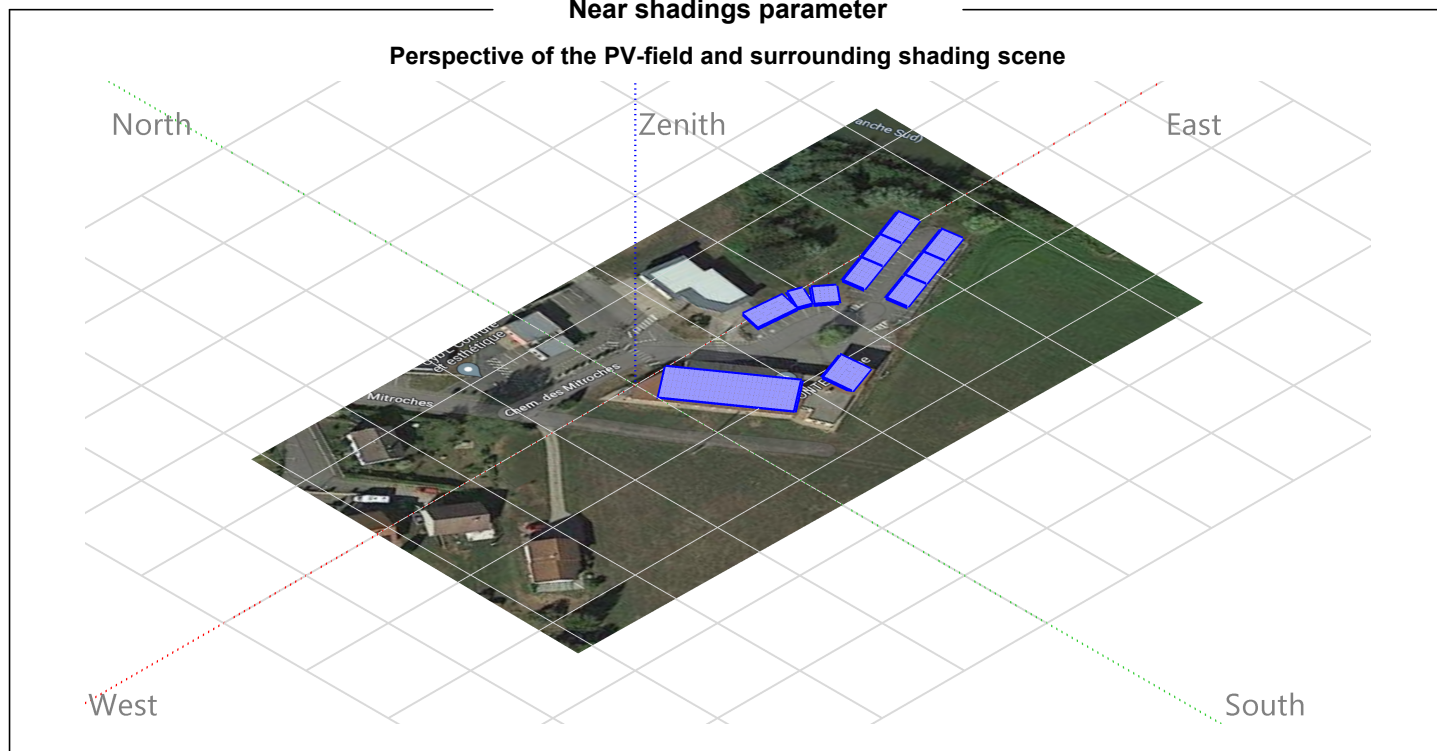






### Near shadings parameter

#### Perspective of the PV-field and surrounding shading scene

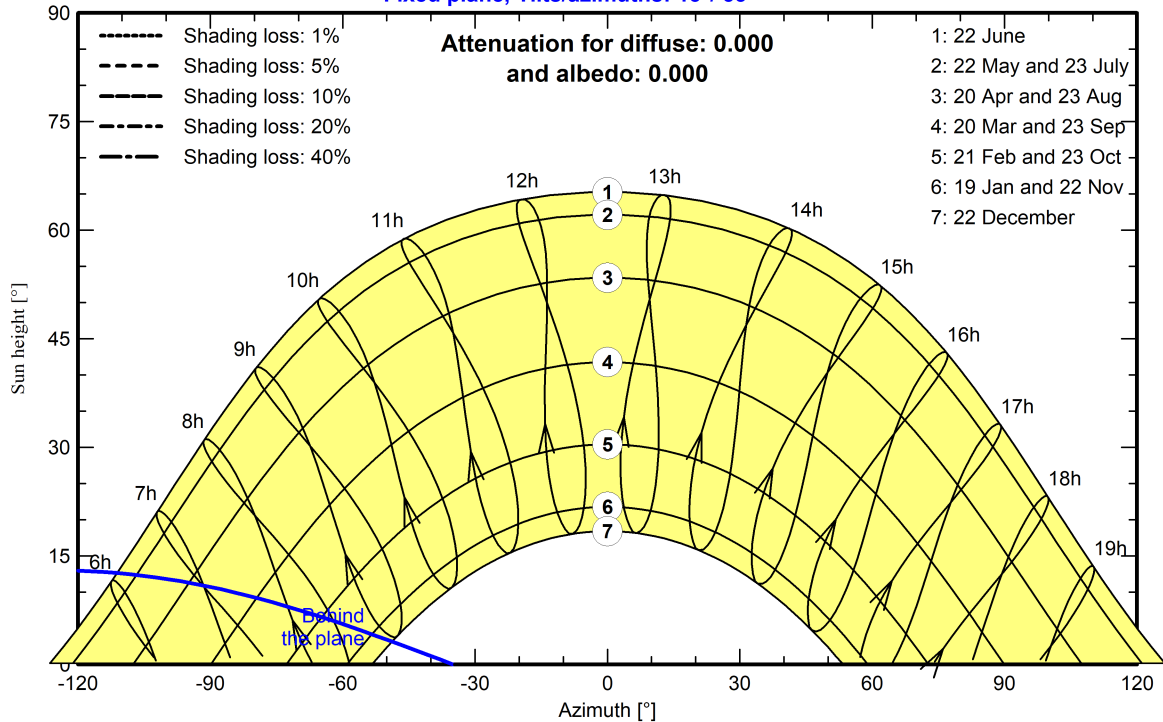




Iso-shadings diagram

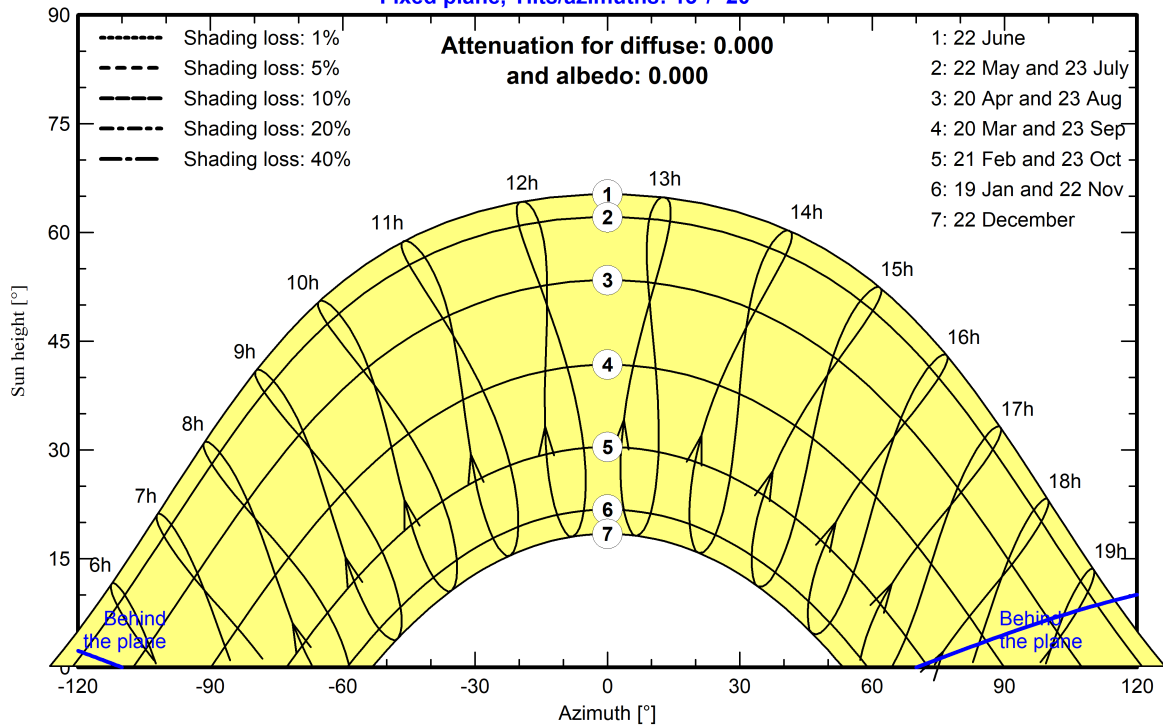
Orientation #1

Fixed plane, Tilts/azimuths: 13°/ 55°



Orientation #2

Fixed plane, Tilts/azimuths: 13°/ -20°



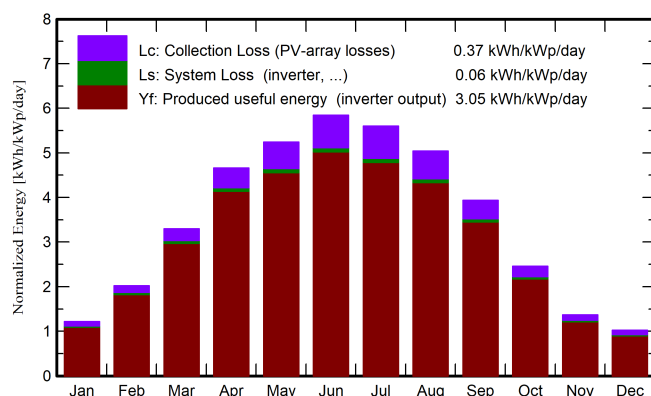


## Main results

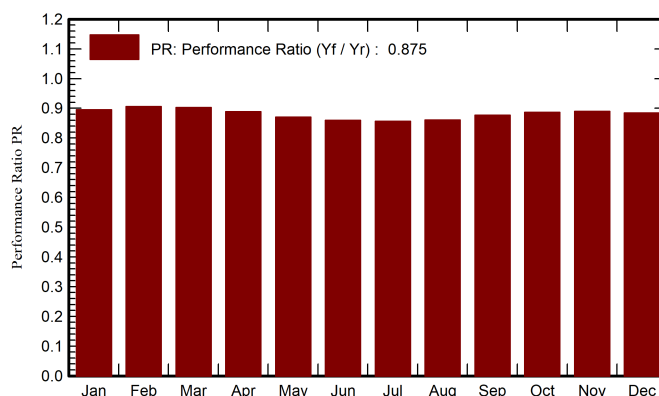
## System Production

Produced Energy (P50)	156461 kWh/year	Specific production (P50)	1113 kWh/kWp/year	Perf. Ratio PR	87.52 %
Produced Energy (P90)	146567 kWh/year	Specific production (P90)	1042 kWh/kWp/year		
Produced Energy (P75)	151259 kWh/year	Specific production (P75)	1076 kWh/kWp/year		

## Normalized productions (per installed kWp)



## Performance Ratio PR



## Balances and main results

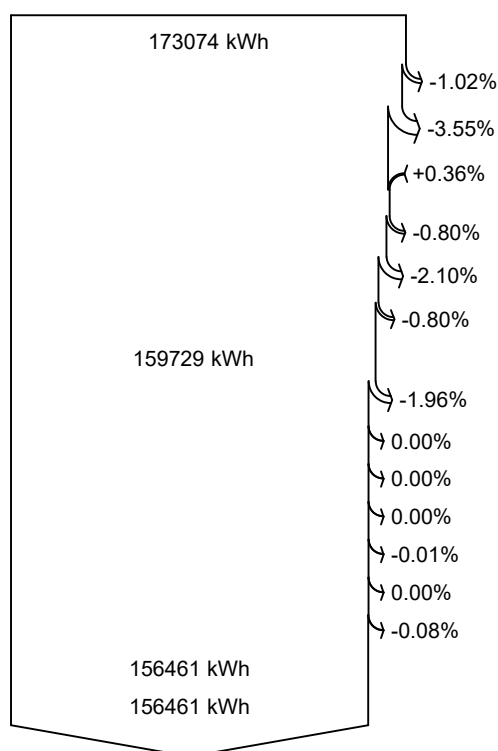
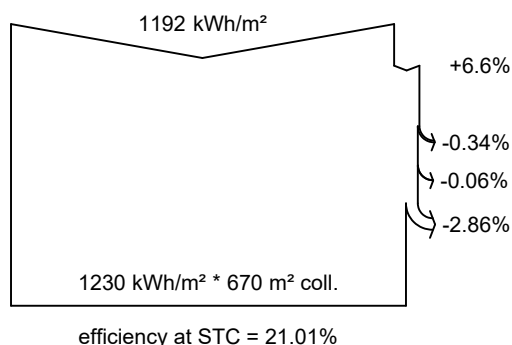
	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_Grid	PR
	kWh/m <sup>2</sup>	kWh/m <sup>2</sup>	°C	kWh/m <sup>2</sup>	kWh/m <sup>2</sup>	kWh	kWh	ratio
January	30.5	17.34	1.84	37.8	35.5	4905	4762	0.896
February	48.1	23.01	2.76	56.5	54.1	7381	7204	0.906
March	92.9	48.13	6.29	102.2	98.8	13238	12968	0.903
April	131.8	61.58	9.98	139.9	135.9	17827	17488	0.889
May	159.2	69.96	14.13	162.6	158.1	20286	19895	0.870
June	174.1	77.54	17.87	175.5	170.8	21604	21200	0.859
July	171.4	81.00	19.51	173.6	168.9	21295	20892	0.856
August	150.2	73.70	18.94	156.3	151.9	19282	18921	0.861
September	108.7	51.06	14.54	118.2	114.6	14869	14581	0.877
October	66.1	32.96	10.84	76.1	73.0	9706	9490	0.886
November	34.5	22.30	5.76	41.0	38.7	5277	5129	0.890
December	24.5	12.57	2.81	31.6	29.5	4060	3931	0.884
Year	1192.2	571.16	10.48	1271.2	1229.9	159729	156461	0.875

## 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

Far Shadings / Horizon

Near Shadings: irradiance loss

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

Module quality loss

LID - Light induced degradation

Mismatch loss, modules and strings

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

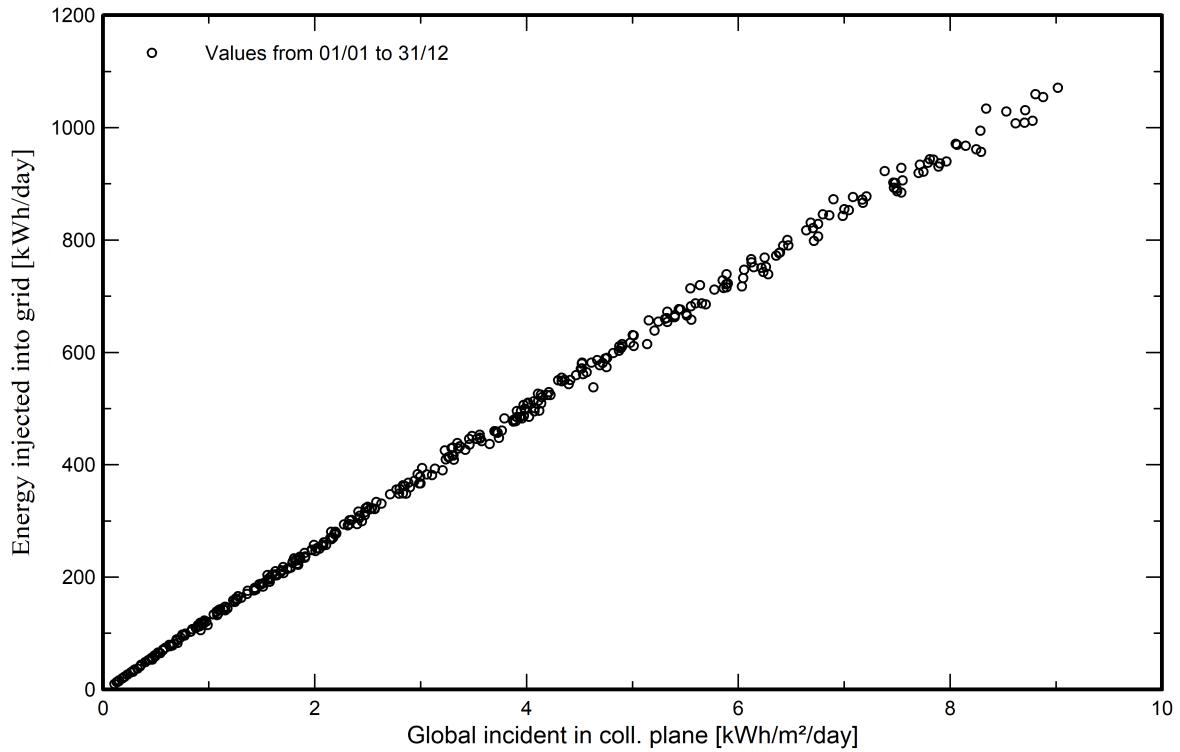
#### Available Energy at Inverter Output

#### Energy injected into grid

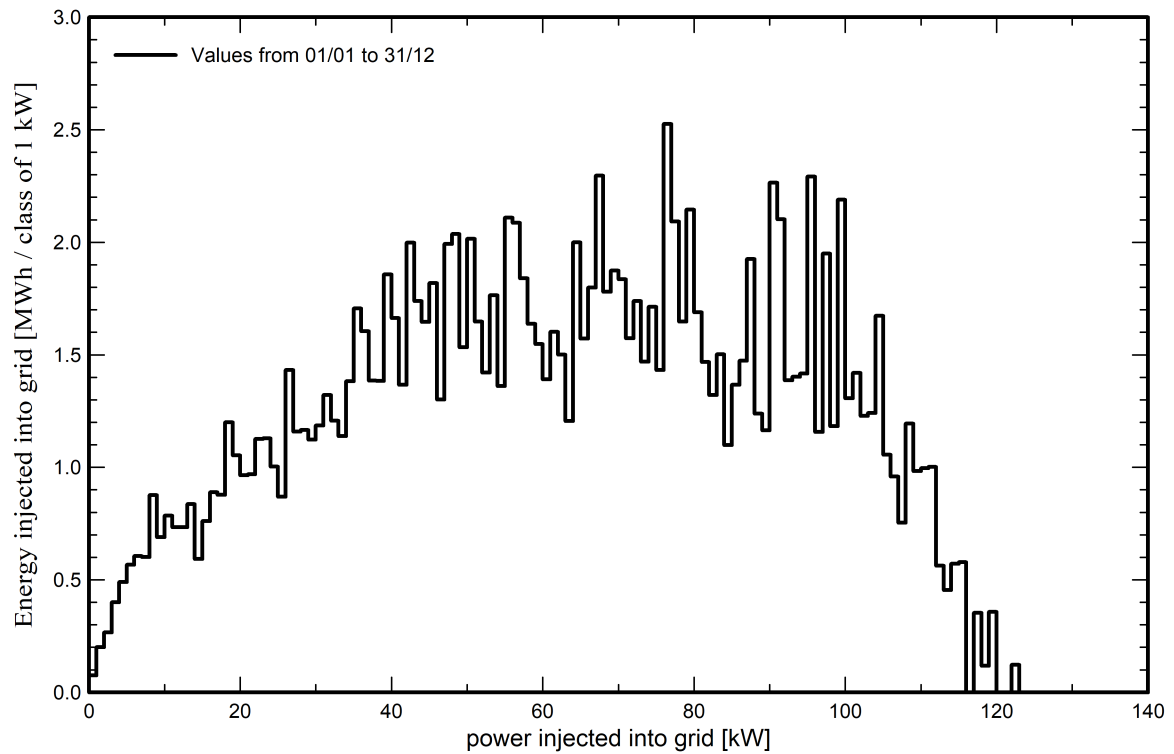


Predef. graphs

Diagramme d'entrée/sortie journalier



Distribution de la puissance de sortie système





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**P50 - P90 evaluation**

**Meteo data**

Source Meteonorm 8.1 (1991-2010), Sat=100 %  
Kind Monthly averages  
Synthétique - Multi-year average  
Year-to-year variability(Variance) 4.6 %

**Specified Deviation**

Climate change 0.0 %

**Global variability (meteo + system)**

Variability (Quadratic sum) 4.9 %

**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 7.72 MWh  
P50 156.46 MWh  
P90 146.57 MWh  
P75 151.26 MWh

**Probability distribution**

