

PVsyst - Simulation report

Grid-Connected System

Project: HOPITAL SAINT GAUDENS OMBRIERE

Variant: 1119 modules de 440Wc 4 onduleur de 100 kVA

No 3D scene defined, no shadings

System power: 492 kWp

Saint-Gaudens - France

5.2. Complément d'étude de faisabilité sur Installation en ombrières

Auteur

Bet Ramat (France)



Project: HOPITAL SAINT GAUDENS OMBRIERE

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VC3, Simulation date:
13/06/23 11:55
with v7.3.4

Bet Ramat (France)

Project summary

Geographical Site

Saint-Gaudens

France

Situation

Latitude 43.11 °N

Longitude 0.71 °E

Altitude 408 m

Time zone UTC+1

Project settings

Albedo 0.20

Meteo data

Saint-Gaudens

Meteonorm 8.1 (1996-2015), Sat=100 % - Synthétique

System summary

Grid-Connected System

No 3D scene defined, no shadings

PV Field Orientation

Fixed planes 2 orientations

Tilts/azimuths 7 / -45 °

7 / 45 °

Near Shadings

No Shadings

User's needs

Ext. defined as file

MODELE PV SYST.csv

System information

PV Array

Nb. of modules

1119 units

Pnom total

492 kWp

Inverters

Nb. of units

4 units

Pnom total

400 kWac

Pnom ratio

1.231

Results summary

Produced Energy 651980 kWh/year

Specific production 1324 kWh/kWp/year

Perf. Ratio PR 88.23 %

Used Energy 3416094 kWh/year

Solar Fraction SF 19.01 %

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General parameters

Grid-Connected System

No 3D scene defined, no shadings

PV Field Orientation

Orientation

Fixed planes 2 orientations
Tilts/azimuths 7 / -45 °
7 / 45 °

Sheds configuration

No 3D scene defined

Models used

Transposition Perez
Diffuse Perez, Meteonorm
Circumsolar separate

Horizon

Free Horizon

Near Shadings

No Shadings

User's needs

Ext. defined as file
MODELE PV SYST.csv

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year	
343197	292778	311310	287452	267957	259714	283687	285600	250256	251787	277535	304822	3416094	kWh

PV Array Characteristics

PV module

Manufacturer Jinkosolar
Model JKM-440N-60HC
(Custom parameters definition)

Unit Nom. Power 440 Wp
Number of PV modules 1119 units
Nominal (STC) 492 kWp

Array #1 - Ond1 Ch1

Orientation #1
Tilt/Azimuth 7/-45 °
Number of PV modules 96 units
Nominal (STC) 42.2 kWp
Modules 4 Strings x 24 In series

At operating cond. (50°C)

Pmpp 39.1 kWp
U mpp 749 V
I mpp 52 A

Array #2 - Ond1 Ch2

Orientation #1
Tilt/Azimuth 7/-45 °
Number of PV modules 69 units
Nominal (STC) 30.4 kWp
Modules 3 Strings x 23 In series

At operating cond. (50°C)

Pmpp 28.09 kWp
U mpp 718 V
I mpp 39 A

Array #3 - Ond1 Ch3

Orientation #1
Tilt/Azimuth 7/-45 °
Number of PV modules 92 units
Nominal (STC) 40.5 kWp
Modules 4 Strings x 23 In series

Inverter

Manufacturer Huawei Technologies
Model SUN2000-100KTL-M2-400Vac
(Custom parameters definition)

Unit Nom. Power 100 kWac
Number of inverters 4 units
Total power 400 kWac

Number of inverters 4 * MPPT 9% 0.3 unit
Total power 34.4 kWac

Operating voltage 200-1000 V
Max. power (=>33°C) 110 kWac
Pnom ratio (DC:AC) 1.23

Number of inverters 3 * MPPT 8% 0.2 unit
Total power 24.7 kWac

Operating voltage 200-1000 V
Max. power (=>33°C) 110 kWac
Pnom ratio (DC:AC) 1.23

Number of inverters 2 * MPPT 16% 0.3 unit
Total power 33.0 kWac



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PV Array Characteristics

At operating cond. (50°C)

Pmpp	37.5 kWp
U mpp	718 V
I mpp	52 A

Operating voltage	200-1000 V
Max. power (=>33°C)	110 kWac
Pnom ratio (DC:AC)	1.23

Array #4 - Ond1 Ch4

Orientation	#1
Tilt/Azimuth	7/-45 °
Number of PV modules	22 units
Nominal (STC)	9.68 kWp
Modules	1 String x 22 In series

Number of inverters	1 * MPPT 8% 0.1 unit
Total power	7.9 kWac

At operating cond. (50°C)

Pmpp	8.96 kWp
U mpp	687 V
I mpp	13 A

Operating voltage	200-1000 V
Max. power (=>33°C)	110 kWac
Pnom ratio (DC:AC)	1.23

Array #5 - Ond2 Ch1

Orientation	#1
Tilt/Azimuth	7/-45 °
Number of PV modules	96 units
Nominal (STC)	42.2 kWp
Modules	4 Strings x 24 In series

Number of inverters	4 * MPPT 9% 0.3 unit
Total power	34.4 kWac

At operating cond. (50°C)

Pmpp	39.1 kWp
U mpp	749 V
I mpp	52 A

Operating voltage	200-1000 V
Max. power (=>33°C)	110 kWac
Pnom ratio (DC:AC)	1.23

Array #6 - Ond2 Ch2

Orientation	#1
Tilt/Azimuth	7/-45 °
Number of PV modules	69 units
Nominal (STC)	30.4 kWp
Modules	3 Strings x 23 In series

Number of inverters	3 * MPPT 8% 0.2 unit
Total power	24.7 kWac

At operating cond. (50°C)

Pmpp	28.09 kWp
U mpp	718 V
I mpp	39 A

Operating voltage	200-1000 V
Max. power (=>33°C)	110 kWac
Pnom ratio (DC:AC)	1.23

Array #7 - Ond2 Ch3

Orientation	#1
Tilt/Azimuth	7/-45 °
Number of PV modules	92 units
Nominal (STC)	40.5 kWp
Modules	4 Strings x 23 In series

Number of inverters	2 * MPPT 16% 0.3 unit
Total power	33.0 kWac

At operating cond. (50°C)

Pmpp	37.5 kWp
U mpp	718 V
I mpp	52 A

Operating voltage	200-1000 V
Max. power (=>33°C)	110 kWac
Pnom ratio (DC:AC)	1.23

Array #8 - Ond2 Ch4

Orientation	#1
Tilt/Azimuth	7/-45 °
Number of PV modules	22 units
Nominal (STC)	9.68 kWp
Modules	1 String x 22 In series

Number of inverters	1 * MPPT 8% 0.1 unit
Total power	7.9 kWac



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PV Array Characteristics

At operating cond. (50°C)

Pmpp 8.96 kWp
U mpp 687 V
I mpp 13 A

Operating voltage 200-1000 V
Max. power ($\Rightarrow 33^{\circ}\text{C}$) 110 kWac
Pnom ratio (DC:AC) 1.23

Array #9 - Ond3 Ch1

Orientation #1
Tilt/Azimuth 7/-45 °
Number of PV modules 22 units
Nominal (STC) 9.68 kWp
Modules 1 String x 22 In series

Number of inverters 1 * MPPT 15% 0.1 unit
Total power 14.5 kWac

At operating cond. (50°C)

Pmpp 8.96 kWp
U mpp 687 V
I mpp 13 A

Operating voltage 200-1000 V
Max. power ($\Rightarrow 33^{\circ}\text{C}$) 110 kWac
Pnom ratio (DC:AC) 0.67

Array #10 - Ond3 Ch2

Orientation #1
Tilt/Azimuth 7/-45 °
Number of PV modules 22 units
Nominal (STC) 9.68 kWp
Modules 1 String x 22 In series

Number of inverters 1 * MPPT 7% 0.1 unit
Total power 7.3 kWac

At operating cond. (50°C)

Pmpp 8.96 kWp
U mpp 687 V
I mpp 13 A

Operating voltage 200-1000 V
Max. power ($\Rightarrow 33^{\circ}\text{C}$) 110 kWac
Pnom ratio (DC:AC) 1.33

Array #11 - Ond3 Ch3

Orientation #2
Tilt/Azimuth 7/45 °
Number of PV modules 22 units
Nominal (STC) 9.68 kWp
Modules 1 String x 22 In series

Number of inverters 1 * MPPT 7% 0.1 unit
Total power 7.3 kWac

At operating cond. (50°C)

Pmpp 8.96 kWp
U mpp 687 V
I mpp 13 A

Operating voltage 200-1000 V
Max. power ($\Rightarrow 33^{\circ}\text{C}$) 110 kWac
Pnom ratio (DC:AC) 1.33

Array #12 - Ond3 Ch4

Orientation #2
Tilt/Azimuth 7/45 °
Number of PV modules 96 units
Nominal (STC) 42.2 kWp
Modules 4 Strings x 24 In series

Number of inverters 4 * MPPT 8% 0.3 unit
Total power 31.7 kWac

At operating cond. (50°C)

Pmpp 39.1 kWp
U mpp 749 V
I mpp 52 A

Operating voltage 200-1000 V
Max. power ($\Rightarrow 33^{\circ}\text{C}$) 110 kWac
Pnom ratio (DC:AC) 1.33

Array #13 - Ond3 Ch5

Orientation #2
Tilt/Azimuth 7/45 °
Number of PV modules 96 units
Nominal (STC) 42.2 kWp
Modules 4 Strings x 24 In series

Number of inverters 2 * MPPT 16% 0.3 unit
Total power 31.7 kWac



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PV Array Characteristics

At operating cond. (50°C)

Pmpp 39.1 kWp
U mpp 749 V
I mpp 52 A

Operating voltage 200-1000 V
Max. power ($\Rightarrow 33^{\circ}\text{C}$) 110 kWac
Pnom ratio (DC:AC) 1.33

Array #14 - Ond3 Ch6

Orientation #2
Tilt/Azimuth 7/45 °
Number of PV modules 23 units
Nominal (STC) 10.12 kWp
Modules 1 String x 23 In series

Number of inverters 1 * MPPT 8% 0.1 unit
Total power 7.6 kWac

At operating cond. (50°C)

Pmpp 9.36 kWp
U mpp 718 V
I mpp 13 A

Operating voltage 200-1000 V
Max. power ($\Rightarrow 33^{\circ}\text{C}$) 110 kWac
Pnom ratio (DC:AC) 1.33

Array #15 - Ond4 Ch1

Orientation #2
Tilt/Azimuth 7/45 °
Number of PV modules 184 units
Nominal (STC) 81.0 kWp
Modules 8 Strings x 23 In series

Number of inverters 8 * MPPT 8% 0.7 unit
Total power 65.7 kWac

At operating cond. (50°C)

Pmpp 74.9 kWp
U mpp 718 V
I mpp 104 A

Operating voltage 200-1000 V
Max. power ($\Rightarrow 33^{\circ}\text{C}$) 110 kWac
Pnom ratio (DC:AC) 1.23

Array #16 - Ond4 Ch2

Orientation #2
Tilt/Azimuth 7/45 °
Number of PV modules 96 units
Nominal (STC) 42.2 kWp
Modules 4 Strings x 24 In series

Number of inverters 2 * MPPT 17% 0.3 unit
Total power 34.3 kWac

At operating cond. (50°C)

Pmpp 39.1 kWp
U mpp 749 V
I mpp 52 A

Operating voltage 200-1000 V
Max. power ($\Rightarrow 33^{\circ}\text{C}$) 110 kWac
Pnom ratio (DC:AC) 1.23

Total PV power

Nominal (STC) 492 kWp
Total 1119 modules
Module area 2415 m²

Total inverter power

Total power 400 kWac
Nb. of inverters 4 units
0.0 unused
Pnom ratio 1.23
Power sharing defined

Array losses

Array Soiling Losses

Loss Fraction 2.0 %

Thermal Loss factor

Module temperature according to irradiance
Uc (const) 29.0 W/m²K
Uv (wind) 0.0 W/m²K/m/s

Module Quality Loss

Loss Fraction -0.8 %



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Array losses

Module mismatch losses

Array #1 - Ond1 Ch1

Loss Fraction 2.0 % at MPP

Array #2 - Ond1 Ch2

Loss Fraction 2.0 % at MPP

Array #3 - Ond1 Ch3

Loss Fraction 2.0 % at MPP

Array #4 - Ond1 Ch4

Loss Fraction 2.0 % at MPP

Array #5 - Ond2 Ch1

Loss Fraction 2.0 % at MPP

Array #6 - Ond2 Ch2

Loss Fraction 2.0 % at MPP

Array #7 - Ond2 Ch3

Loss Fraction 2.0 % at MPP

Array #8 - Ond2 Ch4

Loss Fraction 2.0 % at MPP

Array #9 - Ond3 Ch1

Loss Fraction 2.0 % at MPP

Array #10 - Ond3 Ch2

Loss Fraction 2.0 % at MPP

Array #11 - Ond3 Ch3

Loss Fraction 2.0 % at MPP

Array #12 - Ond3 Ch4

Loss Fraction 2.0 % at MPP

Array #13 - Ond3 Ch5

Loss Fraction 2.0 % at MPP

Array #14 - Ond3 Ch6

Loss Fraction 2.0 % at MPP

Array #15 - Ond4 Ch1

Loss Fraction 2.0 % at MPP

Array #16 - Ond4 Ch2

Loss Fraction 2.0 % at MPP

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

DC wiring losses

Global wiring resistance

10 mΩ

Loss Fraction

1.5 % at STC

Array #1 - Ond1 Ch1

Global array res. 234 mΩ

Loss Fraction 1.5 % at STC

Array #3 - Ond1 Ch3

Global array res. 224 mΩ

Loss Fraction 1.5 % at STC

Array #5 - Ond2 Ch1

Global array res. 234 mΩ

Loss Fraction 1.5 % at STC

Array #2 - Ond1 Ch2

Global array res. 299 mΩ

Loss Fraction 1.5 % at STC

Array #4 - Ond1 Ch4

Global array res. 859 mΩ

Loss Fraction 1.5 % at STC

Array #6 - Ond2 Ch2

Global array res. 299 mΩ

Loss Fraction 1.5 % at STC



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DC wiring losses

Array #7 - Ond2 Ch3

Global array res. 224 mΩ
Loss Fraction 1.5 % at STC

Array #9 - Ond3 Ch1

Global array res. 859 mΩ
Loss Fraction 1.5 % at STC

Array #11 - Ond3 Ch3

Global array res. 859 mΩ
Loss Fraction 1.5 % at STC

Array #13 - Ond3 Ch5

Global array res. 234 mΩ
Loss Fraction 1.5 % at STC

Array #15 - Ond4 Ch1

Global array res. 112 mΩ
Loss Fraction 1.5 % at STC

Array #8 - Ond2 Ch4

Global array res. 859 mΩ
Loss Fraction 1.5 % at STC

Array #10 - Ond3 Ch2

Global array res. 859 mΩ
Loss Fraction 1.5 % at STC

Array #12 - Ond3 Ch4

Global array res. 234 mΩ
Loss Fraction 1.5 % at STC

Array #14 - Ond3 Ch6

Global array res. 898 mΩ
Loss Fraction 1.5 % at STC

Array #16 - Ond4 Ch2

Global array res. 234 mΩ
Loss Fraction 1.5 % at STC

AC wiring losses

Inv. output line up to injection point

Inverter voltage 400 Vac tri
Loss Fraction 0.13 % at STC

Inverter: SUN2000-100KTL-M2-400Vac

Wire section (4 Inv.) Copper 4 x 3 x 70 mm²
Average wires length 6 m



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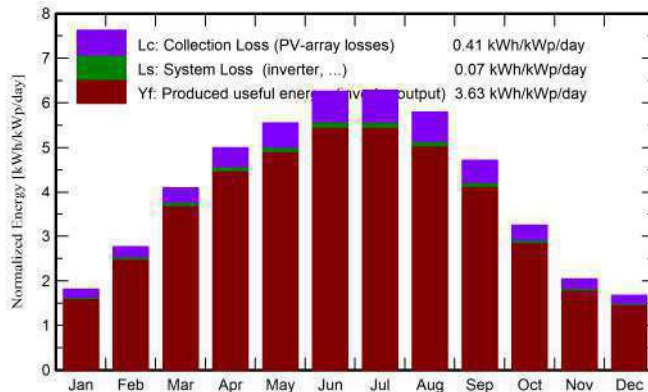
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Main results

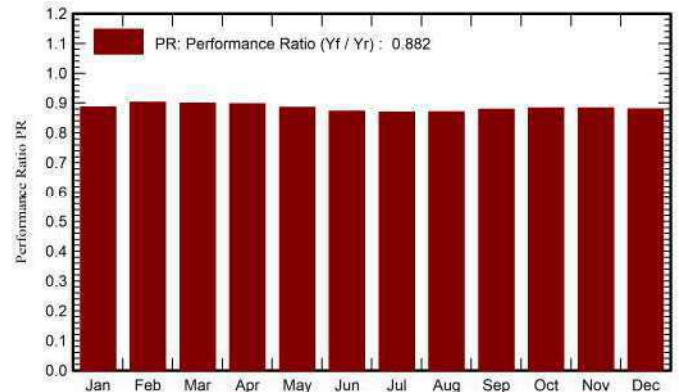
System Production

Produced Energy	651980 kWh/year	Specific production	1324 kWh/kWp/year
Used Energy	3416094 kWh/year	Perf. Ratio PR	88.23 %
		Solar Fraction SF	19.01 %

Normalized productions (per installed kWp)



Performance Ratio PR



Balances and main results

	GlobHor kWh/m ²	DiffHor kWh/m ²	T_Amb °C	GlobInc kWh/m ²	GlobEff kWh/m ²	EArray kWh	E_User kWh	E_Solar kWh	E_Grid kWh	EFrGrid kWh
January	49.4	19.83	4.67	56.3	51.5	25044	343197	24561	-7	318637
February	70.6	29.68	5.26	77.5	72.4	35114	292778	34430	-6	258348
March	119.8	46.66	8.59	127.2	120.3	57521	311310	56354	-5	254956
April	145.6	69.02	10.86	150.0	142.5	67656	287452	66210	68	221242
May	170.5	82.51	14.29	172.1	163.7	76612	267957	74478	562	193479
June	187.1	73.17	18.31	187.8	179.1	82386	259714	79519	1174	180195
July	193.2	85.24	20.37	194.8	185.8	85087	283687	83097	276	200589
August	175.5	69.92	20.27	179.8	171.4	78642	285600	76831	220	208768
September	134.8	54.26	16.73	141.5	134.1	62502	250256	61063	201	189193
October	92.6	34.68	13.43	100.7	94.5	44669	251787	43800	-6	207987
November	55.0	25.06	7.80	61.3	56.6	27204	277535	26683	-6	250851
December	45.6	23.19	5.26	51.9	47.2	22914	304822	22490	-7	282332
Year	1439.8	613.21	12.20	1500.8	1419.0	665350	3416094	649517	2463	2766578

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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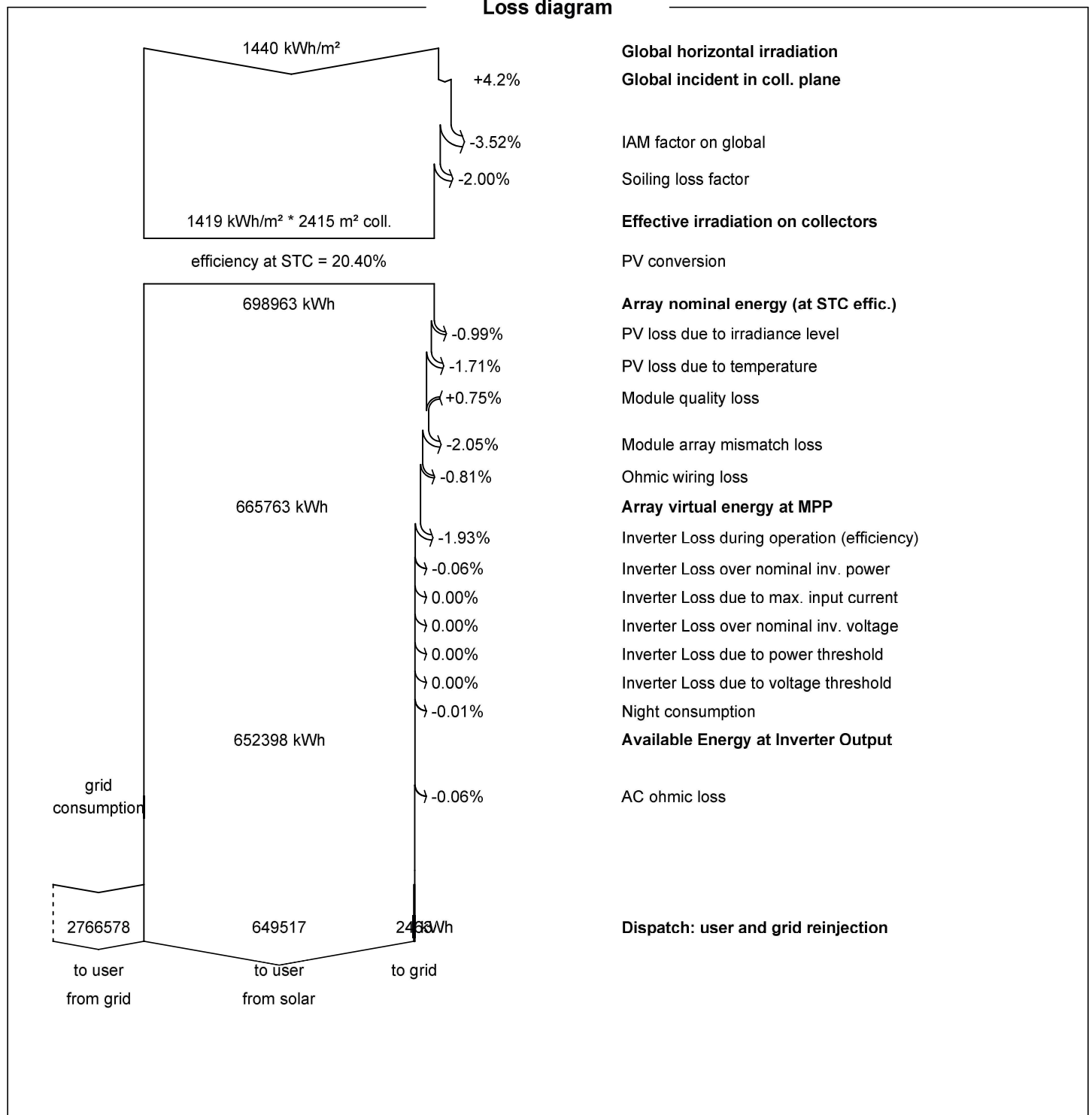
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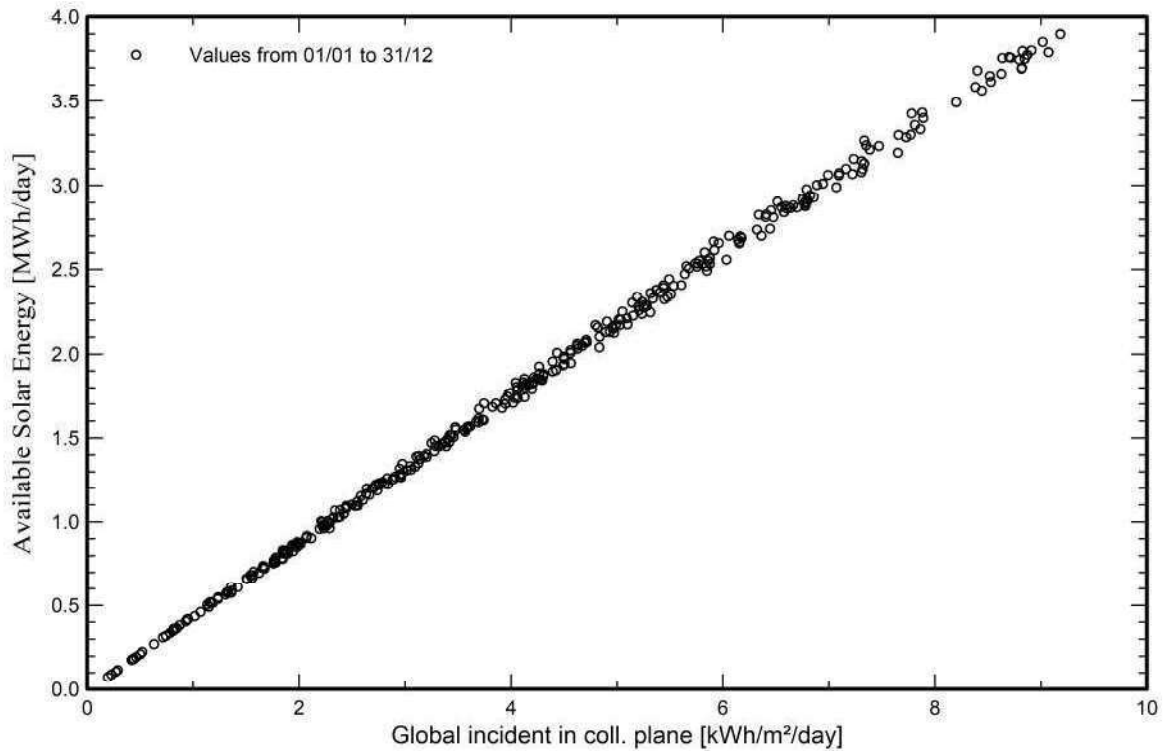
Loss diagram



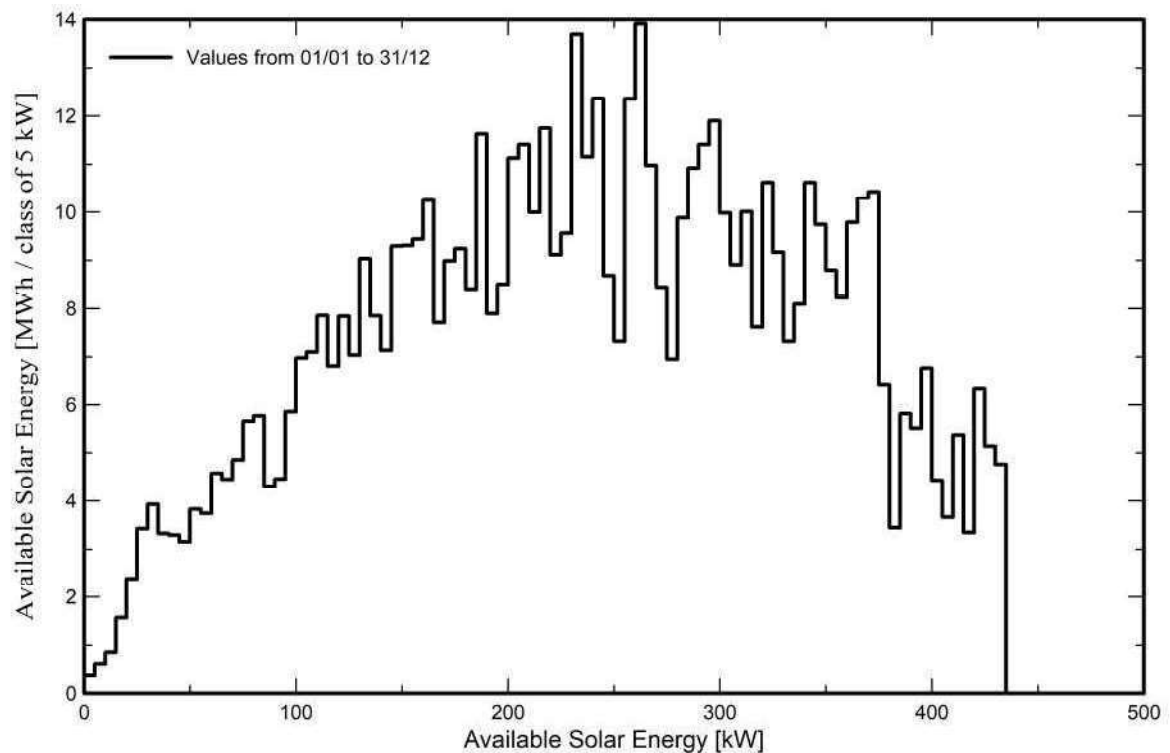


Predef. graphs

Diagramme d'entrée/sortie journalier



Distribution de la puissance de sortie système





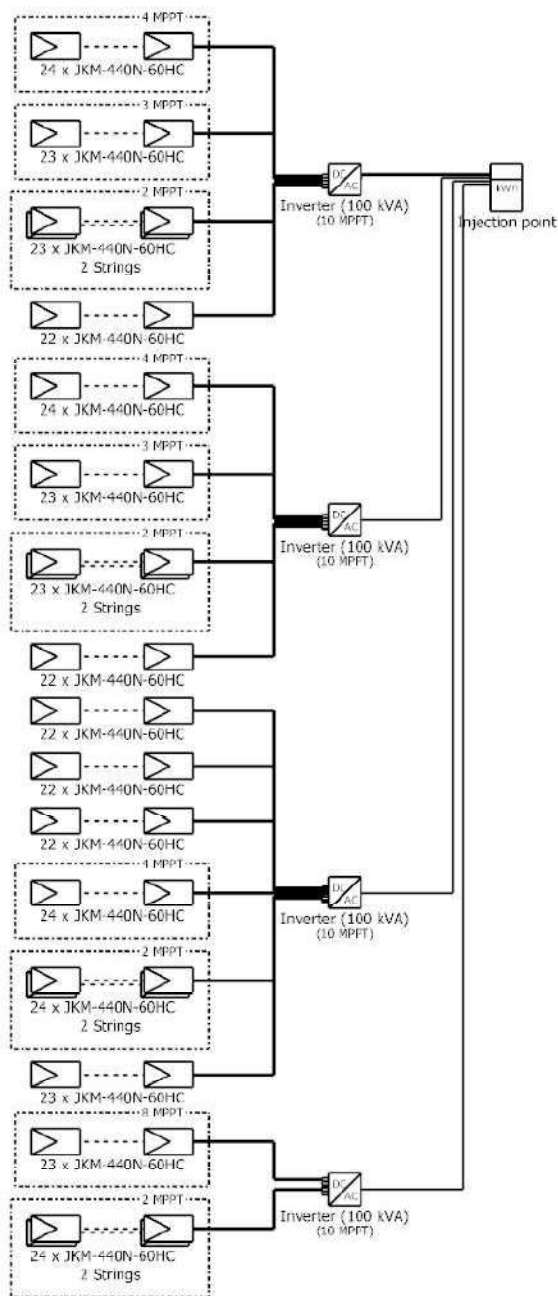
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Single-line diagram



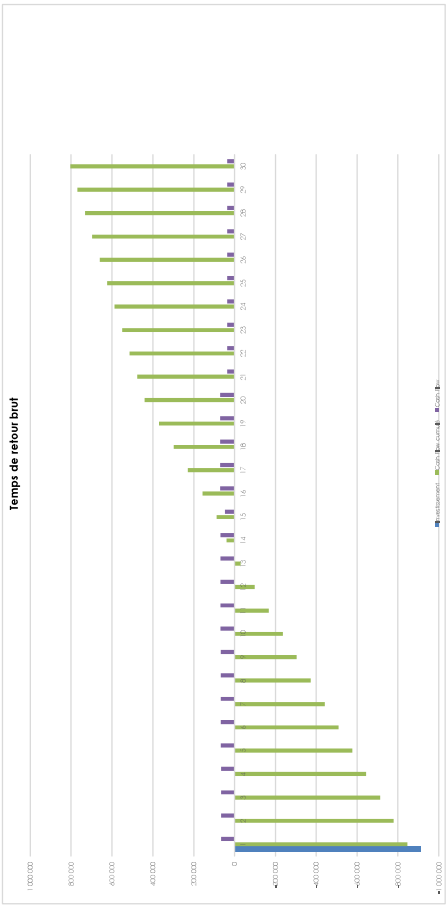
PV module	JKM-440N-60HC
Inverter	SUN2000-100KTL-M2-400Vac
String 1	24 x JKM-440N-60HC
String 2	23 x JKM-440N-60HC
String 3	22 x JKM-440N-60HC

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eur de 100 kVA

13/06/23

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