

MARCHÉ GLOBAL DE CONCEPTION - REALISATION POUR L'EXTENSION DU CENTRE HOSPITALIER DU FRANCOIS ET LA CONSTRUCTION D'UN LOGIPOLE INTER-SITE SUR LE NOUVEAU SITE DU CENTRE HOSPITALIER DU SAINT-ESPRIT



ANNEXE 9: CALCUL PV CHSE

PRO

PVsyst - Simulation report

Grid-Connected System

Project: PV CHSE

Variant: CHSE 75 kWc

Sheds on a building

System power: 75.0 kWp

Fort de France/Aime Cesaire/Four à Chaux - France Martinique

Auteur

H3C-CARAÏBES (Martinique)



Project: PV CHSE

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PVsyst V7.4.0

VC0, Simulation date:
20/07/23 09:58
with v7.4.0

H3C-CARAÏBES (Martinique)

Project summary

Geographical Site

Fort de France/Aime Cesaire/Four à Chaux
France Martinique

Situation

Latitude 14.59 °N
Longitude -61.00 °W
Altitude 7 m
Time zone UTC-4

Project settings

Albedo 0.20

Meteo data

Fort de France/Aime Cesaire/Four à Chaux
MeteoNorm 8.0 station - Synthétique

System summary

Grid-Connected System

PV Field Orientation

Fixed plane
Tilt/Azimuth 15 / -28.9 °

Sheds on a building

Near Shadings

Linear shadings

User's needs

Unlimited load (grid)

System information

PV Array

Nb. of modules 183 units
Pnom total 75.0 kWp

Inverters

Nb. of units 4 units
Pnom total 71.0 kWac
Pnom ratio 1.057

Results summary

Produced Energy 120472 kWh/year Specific production 1606 kWh/kWp/year Perf. Ratio PR 80.12 %

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General parameters

Grid-Connected System

PV Field Orientation

Orientation

Fixed plane
Tilt/Azimuth 15 / -28.9 °

Horizon

Free Horizon

Sheds on a building

Sheds configuration

Nb. of sheds 32 units

Sizes

Sheds spacing 1.88 m
Collector width 1.13 m
Ground Cov. Ratio (GCR) 60.3 %
Top inactive band 0.02 m
Bottom inactive band 0.02 m

Shading limit angle

Limit profile angle 21.3 °

Near Shadings

Linear shadings

Models used

Transposition Perez
Diffuse Perez, Meteonorm
Circumsolar separate

User's needs

Unlimited load (grid)

PV Array Characteristics

Array #1 - Sous-champ #4

PV module

Manufacturer Jinkosolar
Model JKM-410M-54HL4

(Original PVsyst database)

Unit Nom. Power 410 Wp
Number of PV modules 18 units
Nominal (STC) 7.38 kWp
Modules 2 Strings x 9 In series

At operating cond. (50°C)

Pmpp 6.74 kWp
U mpp 253 V
I mpp 27 A

Array #2 - Sous-champ #4

PV module

Manufacturer Jinkosolar
Model JKM-410M-54HL4

(Original PVsyst database)

Unit Nom. Power 410 Wp
Number of PV modules 105 units
Nominal (STC) 43.1 kWp
Modules 5 Strings x 21 In series

At operating cond. (50°C)

Pmpp 39.3 kWp
U mpp 591 V
I mpp 67 A

Inverter

Manufacturer SMA
Model Sunny Boy 6000 US-12-208

(Original PVsyst database)

Unit Nom. Power 6.00 kWac
Number of inverters 1 unit
Total power 6.0 kWac
Operating voltage 250-480 V
Pnom ratio (DC:AC) 1.23

Inverter

Manufacturer SMA
Model Sunny Tripower 20000TL-30

(Original PVsyst database)

Unit Nom. Power 20.0 kWac
Number of inverters 4 * MPPT 50% 2 units
Total power 40.0 kWac
Operating voltage 320-800 V
Pnom ratio (DC:AC) 1.08
No power sharing between MPPTs



PV Array Characteristics

Array #3 - Sous-champ #3

PV module

| | |
|----------------------------|--------------------------|
| Manufacturer | Jinkosolar |
| Model | JKM-410M-54HL4 |
| (Original PVsyst database) | |
| Unit Nom. Power | 410 Wp |
| Number of PV modules | 60 units |
| Nominal (STC) | 24.60 kWp |
| Modules | 4 Strings x 15 In series |

At operating cond. (50°C)

| | |
|-------|-----------|
| Pmpp | 22.48 kWp |
| U mpp | 422 V |
| I mpp | 53 A |

Total PV power

| | |
|---------------|--------------------|
| Nominal (STC) | 75 kWp |
| Total | 183 modules |
| Module area | 357 m ² |

Inverter

| | |
|----------------------------|---------------------------|
| Manufacturer | SMA |
| Model | Sunny Tripower 25000TL-30 |
| (Original PVsyst database) | |

| | |
|--------------------------------|---------------------|
| Unit Nom. Power | 25.0 kWac |
| Number of inverters | 2 * MPPT 50% 1 unit |
| Total power | 25.0 kWac |
| Operating voltage | 390-800 V |
| Pnom ratio (DC:AC) | 0.98 |
| No power sharing between MPPTs | |

Total inverter power

| | |
|---------------------|---------|
| Total power | 71 kWac |
| Number of inverters | 4 units |
| Pnom ratio | 1.06 |

Array losses

Thermal Loss factor

| | |
|--|----------------------------|
| Module temperature according to irradiance | |
| Uc (const) | 20.0 W/m ² K |
| Uv (wind) | 0.0 W/m ² K/m/s |

Module Quality Loss

| | |
|---------------|--------|
| Loss Fraction | -0.8 % |
|---------------|--------|

Module mismatch losses

Array #1 - Sous-champ #4

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

Array #2 - Sous-champ #4

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

Array #3 - Sous-champ #3

| | |
|---------------|--------------|
| 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 - Sous-champ #4

| | |
|-------------------|--------------|
| Global array res. | 158 mΩ |
| Loss Fraction | 1.5 % at STC |

Array #3 - Sous-champ #3

| | |
|-------------------|--------------|
| Global array res. | 132 mΩ |
| Loss Fraction | 1.5 % at STC |

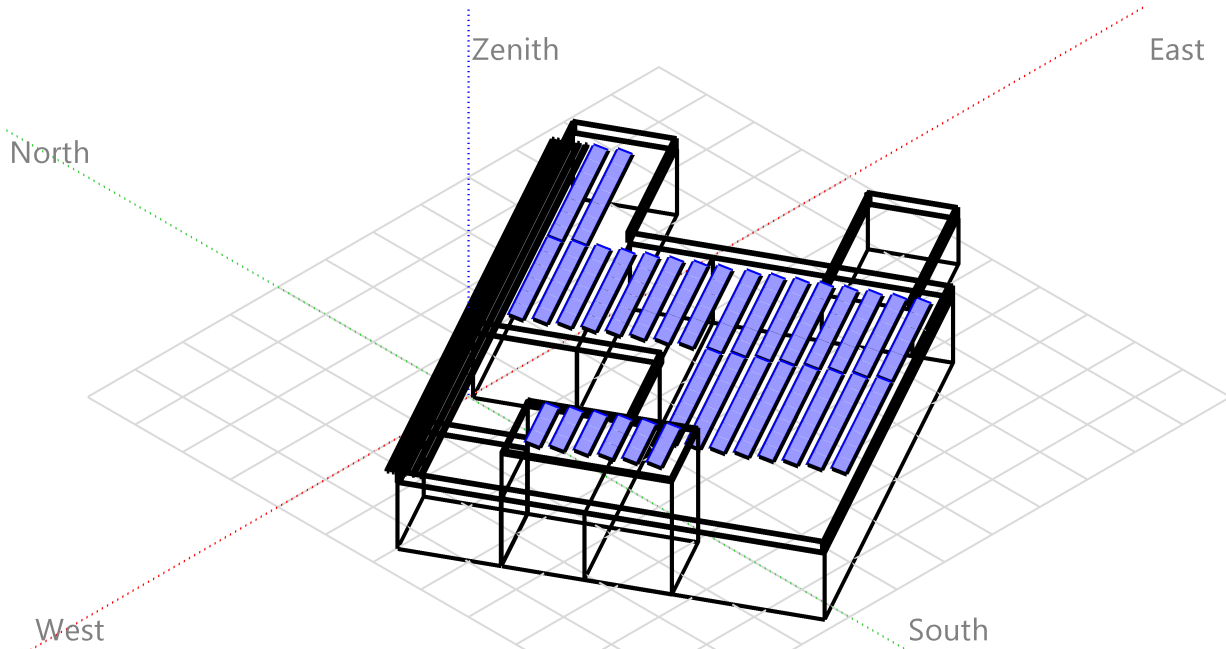
Array #2 - Sous-champ #4

| | |
|-------------------|--------------|
| Global array res. | 147 mΩ |
| Loss Fraction | 1.5 % at STC |



Near shadings parameter

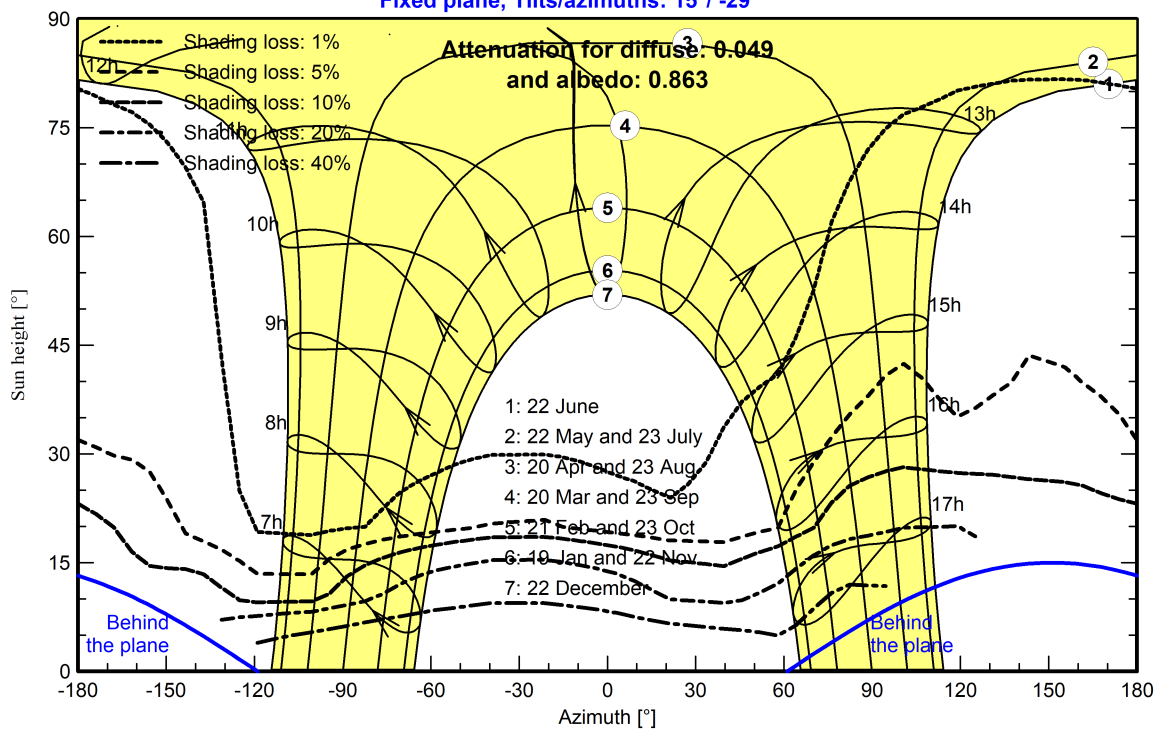
Perspective of the PV-field and surrounding shading scene



Iso-shadings diagram

Orientation #1

Fixed plane, Tilts/azimuths: 15°/-29°





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Main results

System Production

Produced Energy

120472 kWh/year

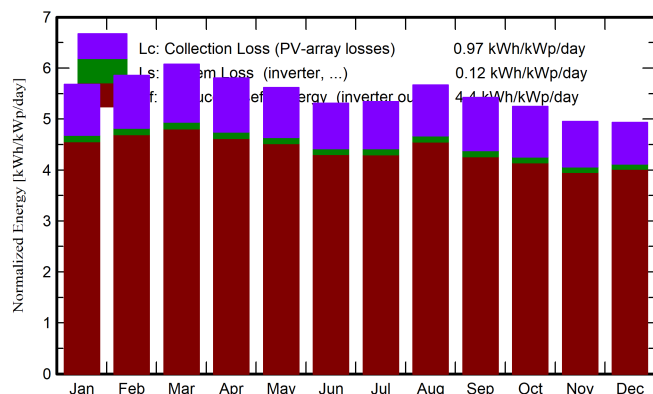
Specific production

1606 kWh/kWp/year

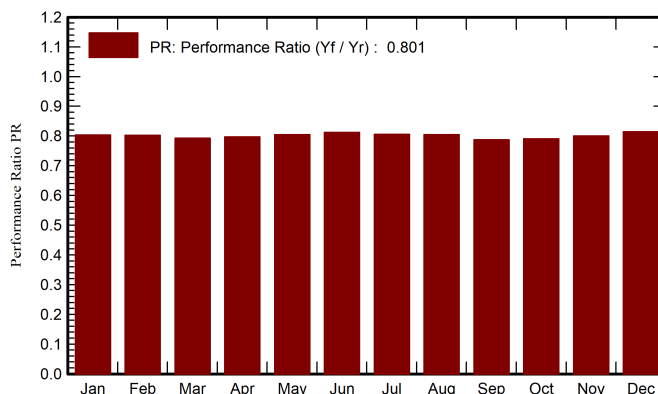
Perf. Ratio PR

80.12 %

Normalized productions (per installed kWp)



Performance Ratio PR



Balances and main results

| | GlobHor | DiffHor | T_Amb | GlobInc | GlobEff | EArray | E_Grid | PR |
|-----------|---------|---------|-------|---------|---------|--------|--------|-------|
| | kWh/m² | kWh/m² | °C | kWh/m² | kWh/m² | kWh | kWh | ratio |
| January | 155.1 | 62.90 | 26.00 | 176.0 | 168.7 | 10897 | 10616 | 0.804 |
| February | 151.4 | 59.70 | 25.10 | 164.0 | 157.4 | 10136 | 9875 | 0.803 |
| March | 182.9 | 70.40 | 25.60 | 188.3 | 181.0 | 11504 | 11200 | 0.793 |
| April | 176.1 | 74.50 | 26.10 | 174.1 | 166.8 | 10690 | 10407 | 0.797 |
| May | 182.7 | 80.90 | 27.10 | 174.2 | 166.5 | 10802 | 10523 | 0.805 |
| June | 170.1 | 89.40 | 27.20 | 159.4 | 151.5 | 9961 | 9708 | 0.812 |
| July | 175.1 | 89.90 | 27.60 | 165.6 | 157.4 | 10284 | 10020 | 0.806 |
| August | 181.3 | 91.10 | 27.70 | 175.6 | 167.6 | 10878 | 10598 | 0.804 |
| September | 159.8 | 76.80 | 27.00 | 162.6 | 155.1 | 9872 | 9610 | 0.788 |
| October | 153.2 | 68.40 | 27.00 | 162.6 | 155.3 | 9915 | 9653 | 0.791 |
| November | 135.5 | 61.80 | 26.10 | 148.5 | 141.9 | 9156 | 8914 | 0.800 |
| December | 133.8 | 56.90 | 25.10 | 153.0 | 145.9 | 9593 | 9348 | 0.814 |
| Year | 1957.0 | 882.70 | 26.48 | 2004.0 | 1915.2 | 123689 | 120472 | 0.801 |

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

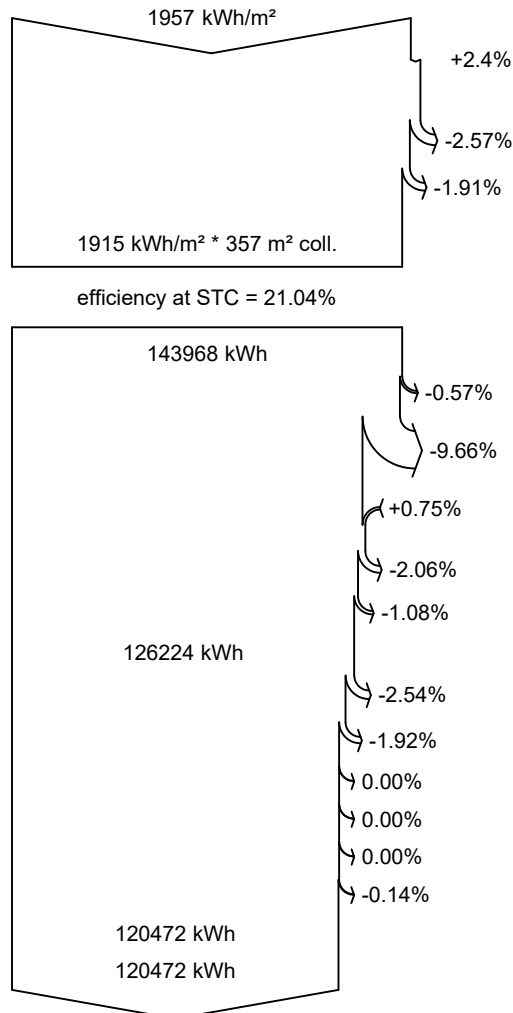
EArray Effective energy at the output of the array

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

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

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

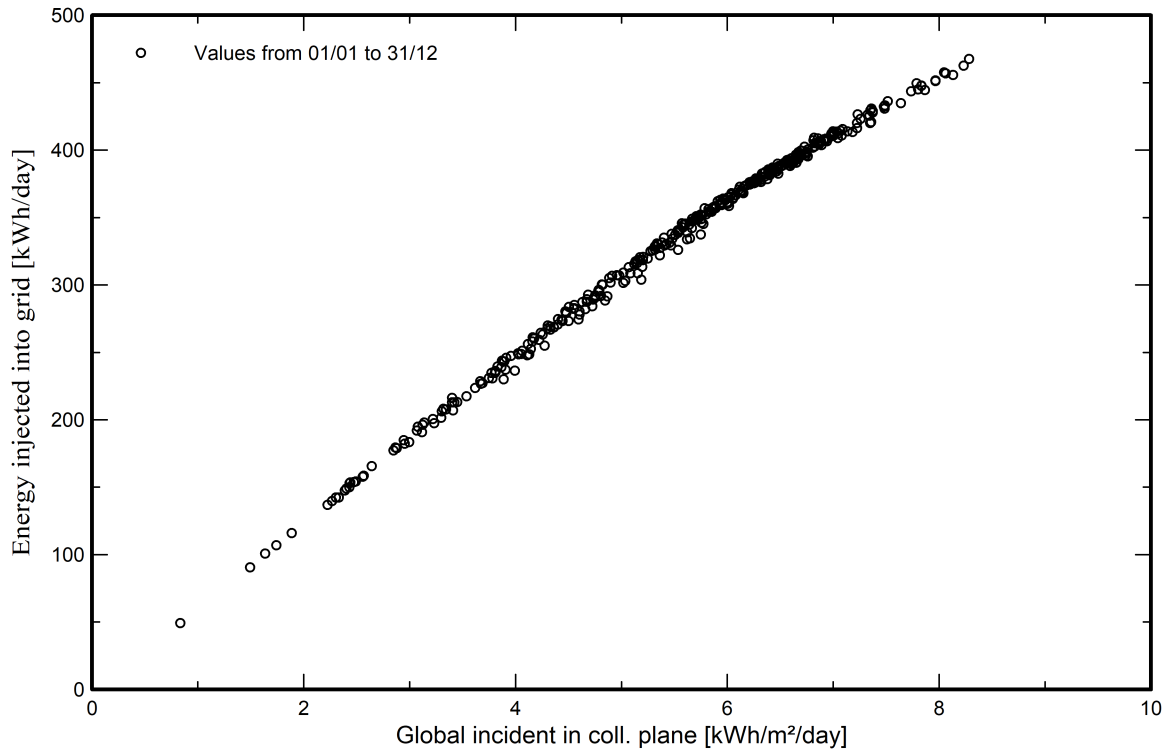
Available Energy at Inverter Output

Energy injected into grid



Predef. graphs

Diagramme d'entrée/sortie journalier



Distribution de la puissance de sortie système

