

SIMULAZIONE PVSYST

IMPIANTO DI PRODUZIONE DA FONTE SOLARE “BONDENO GAVELLO” DA INSTALLARE NEL COMUNE DI BONDENO (FE)

| | | | | | |
|------------|-------------|--------------------|-----------|------------|------------|
| 00 | 11/2025 | Prima emissione | FC | RM | RC |
| REV | DATA | DESCRIZIONE | BY | CHK | APP |

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PVsyst - Simulation report

Grid-Connected System

Project: 1037 Bondeno Gavello

Variant: 11.2025

Tracking system with backtracking

System power: 115.6 MWp

Gavello - Italy



PVsyst V8.0.18

VC1, Simulation date:
19/11/25 08:45
with V8.0.18

GRID SHAPE SRL (Italy)

Project summary

| | | |
|--------------------------|----------------------|-------------------------|
| Geographical Site | Situation | Project settings |
| Gavello | Latitude 44.90 °(N) | Albedo 0.20 |
| Italy | Longitude 11.29 °(E) | |
| | Altitude -7 m | |
| | Time zone UTC+1 | |
| Weather data | | |
| Gavello | | |
| PVGIS api TMY | | |

System summary

| | | |
|-------------------------------------|--|-------------------------------------|
| Grid-Connected System | Tracking system with backtracking | |
| Orientation #1 | Orientation #2 | Orientation #3 |
| Tracking plane, horizontal N-S axis | Tracking plane, horizontal N-S axis | Tracking plane, horizontal N-S axis |
| Orientation #4 | Near Shadings | User's needs |
| Tracking plane, horizontal N-S axis | Linear shadings : Fast (table) | Unlimited load (grid) |
| System information | | |
| PV Array | Inverters | |
| Nb. of modules 175084 units | Nb. of units 334 units | |
| Pnom total 115.6 MWp | Total power 100200 kWac | |
| | Pnom ratio 1.15 | |

Results summary

| | | |
|---------------------------------|---------------------------------------|------------------------|
| Produced Energy 197.97 GWh/year | Specific production 1713 kWh/kWp/year | Perf. Ratio PR 87.82 % |
|---------------------------------|---------------------------------------|------------------------|

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General parameters

Grid-Connected System

Orientation #1

Tracking plane, horizontal N-S axis

Axis azimuth 10.1 °
Phi min / max. +/- 55 °
Diffuse shading all trackers

Tracking algorithm

Astronomic calculation
Backtracking activated

Orientation #2

Tracking plane, horizontal N-S axis

Axis azimuth 7.1 °
Phi min / max. +/- 55 °
Diffuse shading all trackers

Tracking algorithm

Astronomic calculation
Backtracking activated

Orientation #3

Tracking plane, horizontal N-S axis

Avg axis azim. 11.1 °
Phi min / max. +/- 55 °
Diffuse shading all trackers

Tracking algorithm

Astronomic calculation
Backtracking activated

Tracking system with backtracking

Field properties

Nb. of trackers 533 units
Tracking plane, horizontal N-S axis

Sizes

Tracker Spacing 6.00 m
Sensitive width 2.38 m
GCR Shading 39.7 %

Backtracking limit angle

Phi limits +/- 66.6 °

Backtracking parameters

Backtracking pitch 5.97 m
Backtracking width 2.38 m
Left inactive band 0.00 m
Right inactive band 0.00 m
GCR Backtracking 39.9 %
Parameters choice Automatic

Field properties

Nb. of trackers 1219 units
Tracking plane, horizontal N-S axis

Sizes

Tracker Spacing 6.00 m
Sensitive width 2.38 m
GCR Shading 39.7 %

Backtracking limit angle

Phi limits +/- 66.6 °

Backtracking parameters

Backtracking pitch 5.48 m
Backtracking width 2.38 m
Left inactive band 0.00 m
Right inactive band 0.00 m
GCR Backtracking 43.5 %
Parameters choice Automatic

Field properties

Nb. of trackers 1581 units
Tracking plane, horizontal N-S axis

Sizes

Tracker Spacing 6.00 m
Sensitive width 2.38 m
GCR Shading 39.7 %

Backtracking limit angle

Phi limits +/- 66.6 °

Backtracking parameters

Backtracking pitch 5.95 m
Backtracking width 2.38 m
Left inactive band 0.00 m
Right inactive band 0.00 m
GCR Backtracking 40.0 %
Parameters choice Automatic

Models used

Transposition Perez
Diffuse Imported
Circumsolar separate

Horizon

Free Horizon

Near Shadings

Linear shadings : Fast (table)



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General parameters

Orientation #4

Tracking plane, horizontal N-S axis

Axis azimuth 15.1 °
Phi min / max. +/- 55 °
Diffuse shading all trackers

Tracking algorithm

Astronomic calculation
Backtracking activated

Field properties

Nb. of trackers 493 units
Tracking plane, horizontal N-S axis

Sizes

Tracker Spacing 6.00 m
Sensitive width 2.38 m
GCR Shading 39.7 %

Backtracking limit angle

Phi limits +/- 66.6 °

Backtracking parameters

Backtracking pitch 5.95 m
Backtracking width 2.38 m
Left inactive band 0.00 m
Right inactive band 0.00 m
GCR Backtracking 40.0 %
Parameters choice Automatic

User's needs

Unlimited load (grid)

PV Array Characteristics

PV module

Manufacturer CSI Solar Co., Ltd.
Model CS6.2-66TB635 1500V
(Custom parameters definition)
CS6.2-66TB660_CSI_DRA_1500V_V7_40_A0.PAN
Unit Nom. Power 660 Wp

Inverter

Manufacturer Huawei Technologies
Model SUN2000-330KTL-H1
(Original PVsyst database)
Unit Nom. Power 300 kWac

Array #1 - AREA 1

Orientation 4
Tilt/Azimuth 0/105 °
Number of PV modules 24284 units
Nominal (STC) 16.03 MWp
Modules 934 string x 26 In series

Number of inverters 47 units
Total power 14100 kWac

At operating cond. (50°C)

Pmpp 14.93 MWp
U mpp 1009 V
I mpp 14803 A

Operating voltage 550-1500 V
Max. power (=>30°C) 330 kWac
Pnom ratio (DC:AC) 1.14
Power sharing within this inverter

Array #2 - AREA 2

Orientation 3
Tilt/Azimuth 0/101 °
Number of PV modules 72410 units
Nominal (STC) 47.79 MWp
Modules 2785 string x 26 In series

Number of inverters 136 units
Total power 40800 kWac

At operating cond. (50°C)

Pmpp 44.53 MWp
U mpp 1009 V
I mpp 44140 A

Operating voltage 550-1500 V
Max. power (=>30°C) 330 kWac
Pnom ratio (DC:AC) 1.17
Power sharing within this inverter

Array #3 - AREA 3

Orientation 1
Tilt/Azimuth 0/100 °
Number of PV modules 23088 units
Nominal (STC) 15.24 MWp
Modules 888 string x 26 In series

Number of inverters 44 units
Total power 13200 kWac



PV Array Characteristics

| | | | |
|----------------------------------|----------------------------|------------------------------------|-------------|
| At operating cond. (50°C) | | Operating voltage | 550-1500 V |
| Pmpp | 14.20 MWp | Max. power (=>30°C) | 330 kWac |
| U mpp | 1009 V | Pnom ratio (DC:AC) | 1.15 |
| I mpp | 14074 A | Power sharing within this inverter | |
| Array #4 - AREA 4 | | | |
| Orientation | 2 | | |
| Tilt/Azimuth | 0/97 ° | | |
| Number of PV modules | 12220 units | Number of inverters | 23 units |
| Nominal (STC) | 8065 kWp | Total power | 6900 kWac |
| Modules | 470 string x 26 In series | | |
| At operating cond. (50°C) | | Operating voltage | 550-1500 V |
| Pmpp | 7514 kWp | Max. power (=>30°C) | 330 kWac |
| U mpp | 1009 V | Pnom ratio (DC:AC) | 1.17 |
| I mpp | 7449 A | Power sharing within this inverter | |
| Array #5 - AREA 5 | | | |
| Orientation | 2 | | |
| Tilt/Azimuth | 0/97 ° | | |
| Number of PV modules | 39286 units | Number of inverters | 77 units |
| Nominal (STC) | 25.93 MWp | Total power | 23100 kWac |
| Modules | 1511 string x 26 In series | | |
| At operating cond. (50°C) | | Operating voltage | 550-1500 V |
| Pmpp | 24.16 MWp | Max. power (=>30°C) | 330 kWac |
| U mpp | 1009 V | Pnom ratio (DC:AC) | 1.12 |
| I mpp | 23948 A | Power sharing within this inverter | |
| Array #6 - AREA 6 | | | |
| Orientation | 2 | | |
| Tilt/Azimuth | 0/97 ° | | |
| Number of PV modules | 3796 units | Number of inverters | 7 units |
| Nominal (STC) | 2505 kWp | Total power | 2100 kWac |
| Modules | 146 string x 26 In series | | |
| At operating cond. (50°C) | | Operating voltage | 550-1500 V |
| Pmpp | 2334 kWp | Max. power (=>30°C) | 330 kWac |
| U mpp | 1009 V | Pnom ratio (DC:AC) | 1.19 |
| I mpp | 2314 A | Power sharing within this inverter | |
| Total PV power | | Total inverter power | |
| Nominal (STC) | 115555 kWp | Total power | 100200 kWac |
| Total | 175084 modules | Max. power | 110220 kWac |
| Module area | 472935 m ² | Number of inverters | 334 units |
| Cell area | 441653 m ² | Pnom ratio | 1.15 |

Array losses

| | | | | | |
|-----------------------------|---------|--|----------------------------|--|--------|
| Array Soiling Losses | | Thermal Loss factor | | LID - Light Induced Degradation | |
| Loss Fraction | 1.0 % | Module temperature according to irradiance | | Loss Fraction | 1.0 % |
| | | Uc (const) | 29.0 W/m ² K | | |
| | | Uv (wind) | 0.0 W/m ² K/m/s | | |
| Module Quality Loss | | Module mismatch losses | | Strings Mismatch loss | |
| Loss Fraction | -0.40 % | Loss Fraction | 2.00 % at MPP | Loss Fraction | 0.10 % |



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Array losses

IAM loss factor

Incidence effect (IAM): User defined profile

| 20° | 40° | 60° | 65° | 70° | 75° | 80° | 85° | 90° |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1.000 | 1.000 | 1.000 | 0.990 | 0.960 | 0.920 | 0.840 | 0.720 | 0.000 |

DC wiring losses

Global wiring resistance 0.15 mΩ
Loss Fraction 1.5 % at STC

Array #1 - AREA 1

Global array res. 1.1 mΩ
Loss Fraction 1.5 % at STC

Array #3 - AREA 3

Global array res. 1.2 mΩ
Loss Fraction 1.5 % at STC

Array #5 - AREA 5

Global array res. 0.69 mΩ
Loss Fraction 1.5 % at STC

Array #2 - AREA 2

Global array res. 0.37 mΩ
Loss Fraction 1.5 % at STC

Array #4 - AREA 4

Global array res. 2.2 mΩ
Loss Fraction 1.5 % at STC

Array #6 - AREA 6

Global array res. 7.1 mΩ
Loss Fraction 1.5 % at STC

AC wiring losses

Inv. output line up to injection point

Inverter voltage 800 Vac tri
Loss Fraction 0.19 % at STC

Inverter: SUN2000-330KTL-H1

Wire section (47 Inv.) Alu 47 x 3 x 300 mm²
Average wires length 248 m

Inverter: SUN2000-330KTL-H1

Wire section (77 Inv.) Alu 77 x 3 x 150 mm²
Average wires length 0 m

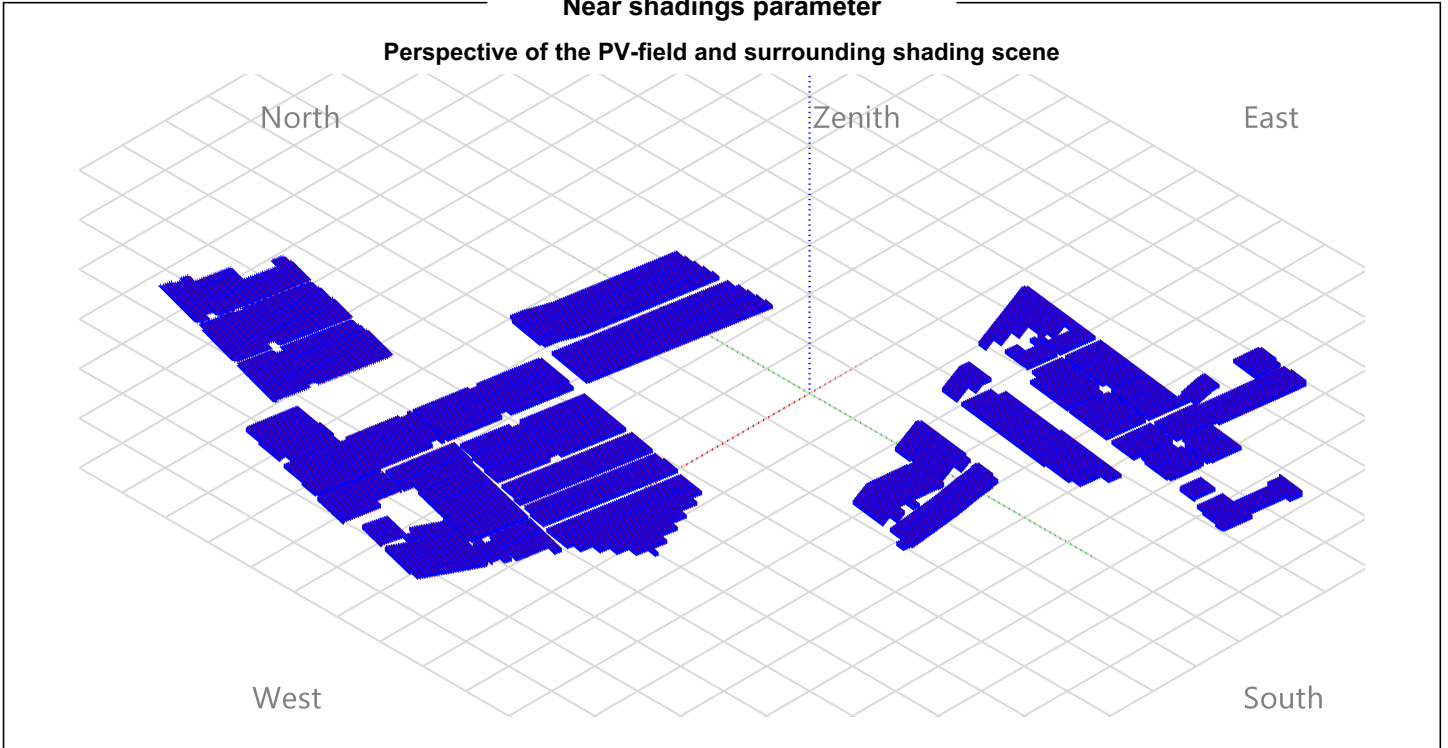
Inverter: SUN2000-330KTL-H1

Wire section (210 Inv.) Alu 210 x 3 x 185 mm²
Average wires length 0 m



Near shadings parameter

Perspective of the PV-field and surrounding shading scene



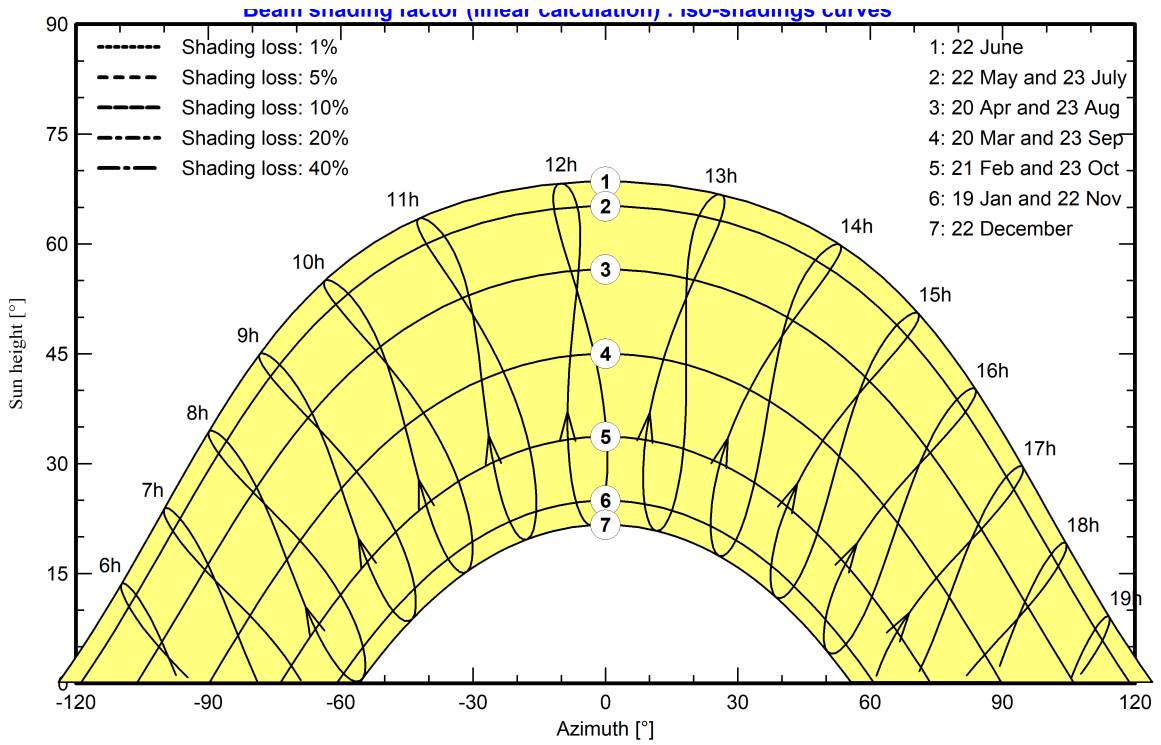


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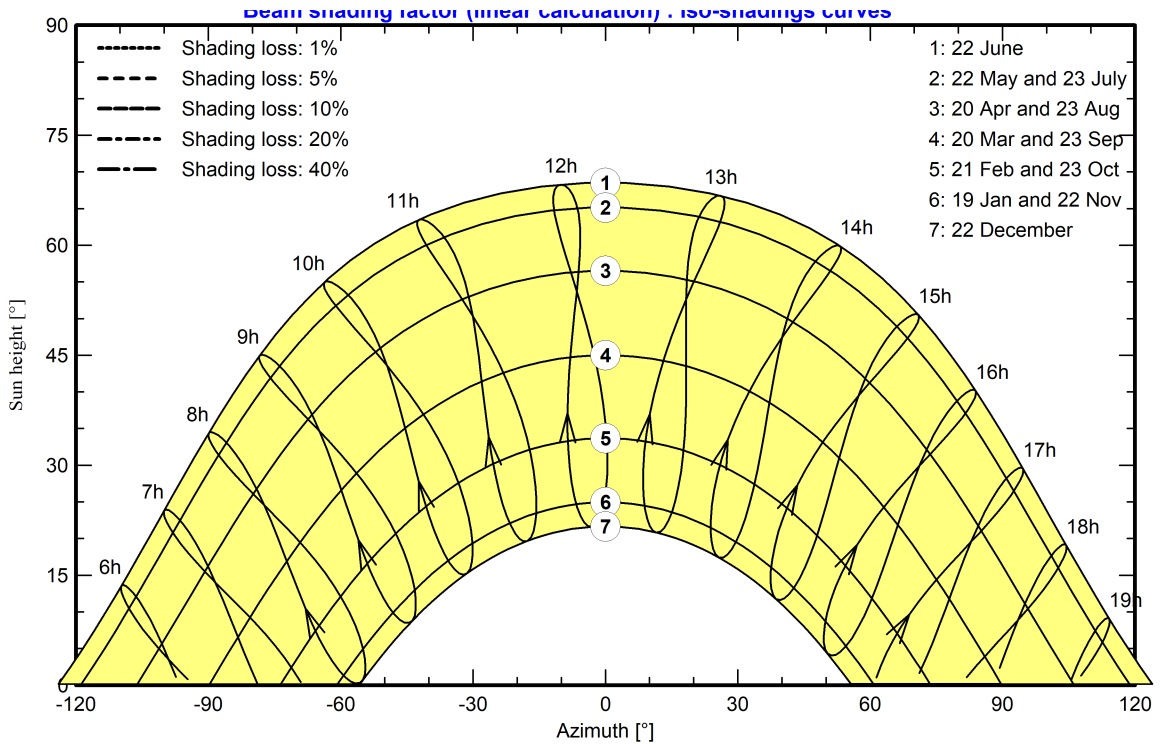
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Iso-shadings diagram

Orientation #1 -



Orientation #2 -



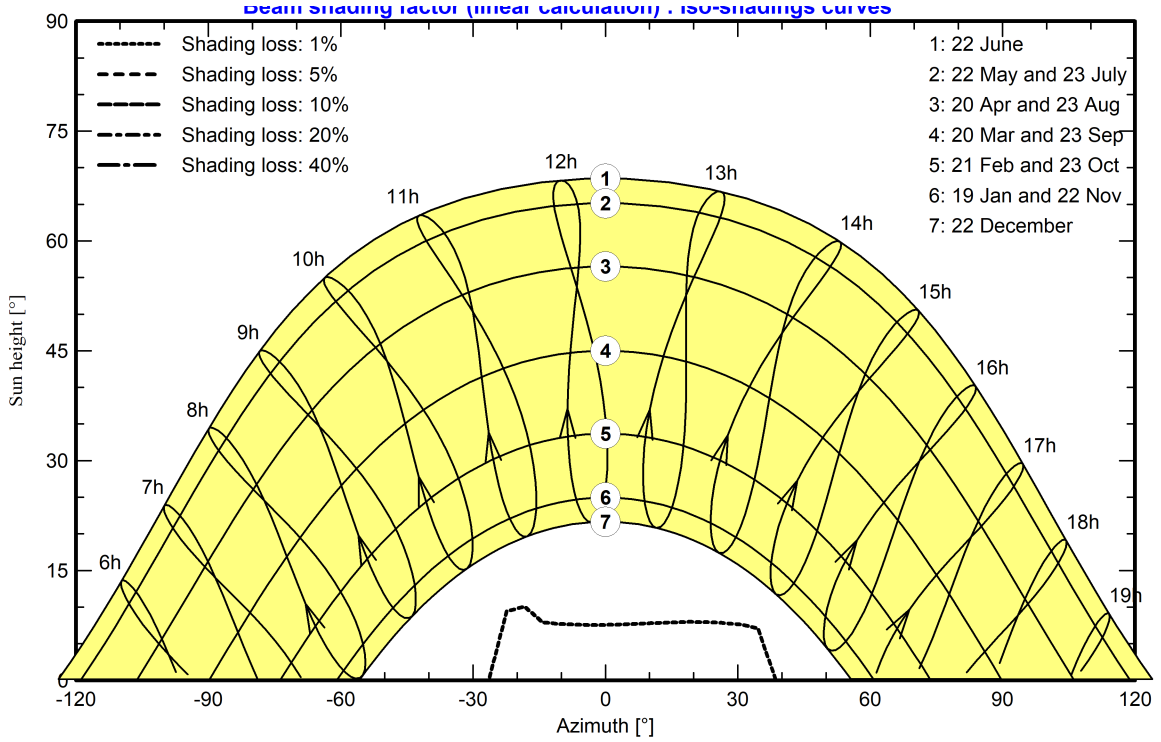


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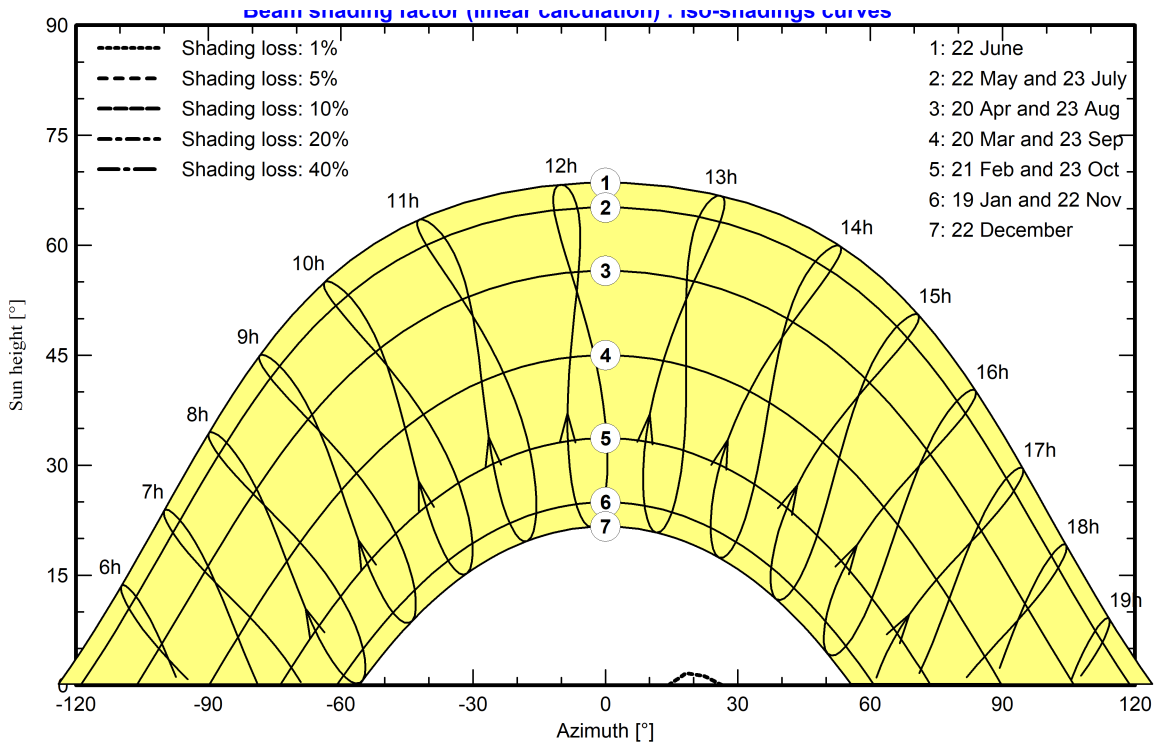
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Iso-shadings diagram

Orientation #3 -



Orientation #4 -





Main results

System Production

Produced Energy 197.97 GWh/year

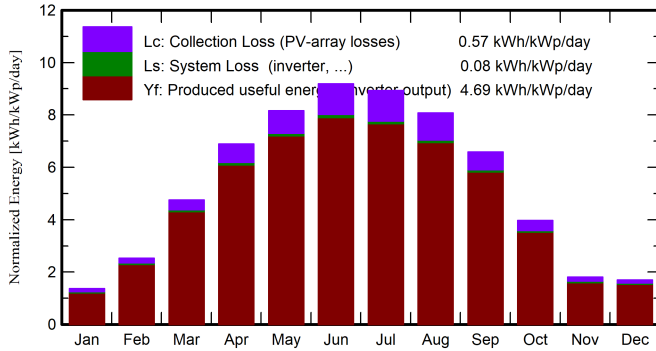
Specific production

1713 kWh/kWp/year

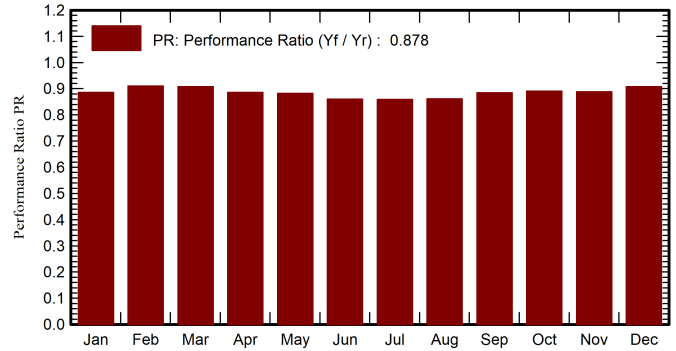
Perf. Ratio PR

87.82 %

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 GWh | E_Grid GWh | PR ratio |
|-----------|-------------------------------|-------------------------------|-------------|-------------------------------|-------------------------------|---------------|---------------|-------------|
| January | 34.9 | 22.41 | 3.84 | 42.5 | 40.1 | 4.53 | 4.35 | 0.886 |
| February | 55.5 | 28.95 | 5.13 | 70.9 | 67.7 | 7.64 | 7.45 | 0.910 |
| March | 111.7 | 47.27 | 9.24 | 147.3 | 141.8 | 15.70 | 15.44 | 0.907 |
| April | 159.5 | 59.03 | 15.75 | 206.8 | 199.8 | 21.48 | 21.16 | 0.886 |
| May | 198.5 | 72.65 | 17.14 | 253.2 | 244.8 | 26.19 | 25.81 | 0.882 |
| June | 214.5 | 78.26 | 25.34 | 275.7 | 266.8 | 27.81 | 27.42 | 0.861 |
| July | 215.9 | 73.65 | 25.65 | 276.7 | 268.0 | 27.86 | 27.48 | 0.859 |
| August | 190.8 | 60.51 | 26.43 | 250.2 | 242.5 | 25.25 | 24.90 | 0.861 |
| September | 148.6 | 50.23 | 19.30 | 197.8 | 191.3 | 20.50 | 20.21 | 0.885 |
| October | 93.7 | 40.21 | 16.74 | 123.1 | 118.4 | 12.89 | 12.66 | 0.890 |
| November | 42.5 | 22.87 | 9.76 | 54.2 | 51.7 | 5.75 | 5.57 | 0.889 |
| December | 38.8 | 19.58 | 2.90 | 52.6 | 49.8 | 5.68 | 5.51 | 0.907 |
| Year | 1504.8 | 575.62 | 14.82 | 1950.8 | 1882.5 | 201.28 | 197.97 | 0.878 |

Legends

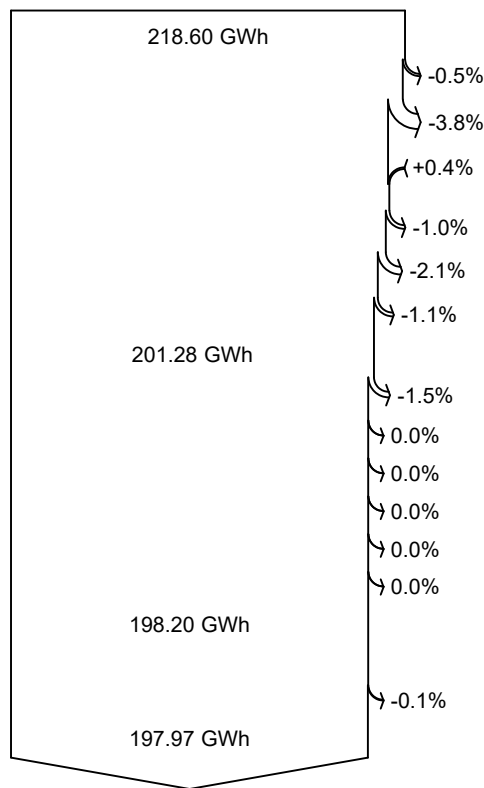
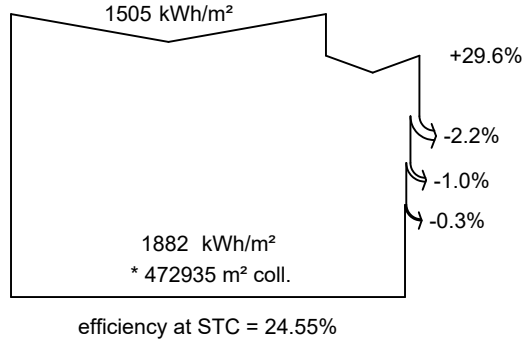
| | | | |
|---------|--|--------|---|
| GlobHor | Global horizontal irradiation | EArray | Effective energy at the output of the array |
| DiffHor | Horizontal diffuse irradiation | E_Grid | Energy injected into grid |
| T_Amb | Ambient Temperature | PR | Performance Ratio |
| GlobInc | Global incident in coll. plane | | |
| GlobEff | Effective Global, corr. for IAM and shadings | | |



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Loss diagram



Global horizontal irradiation

Global incident in coll. plane

Near Shadings: irradiance loss

Soiling loss factor

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

Available Energy at Inverter Output

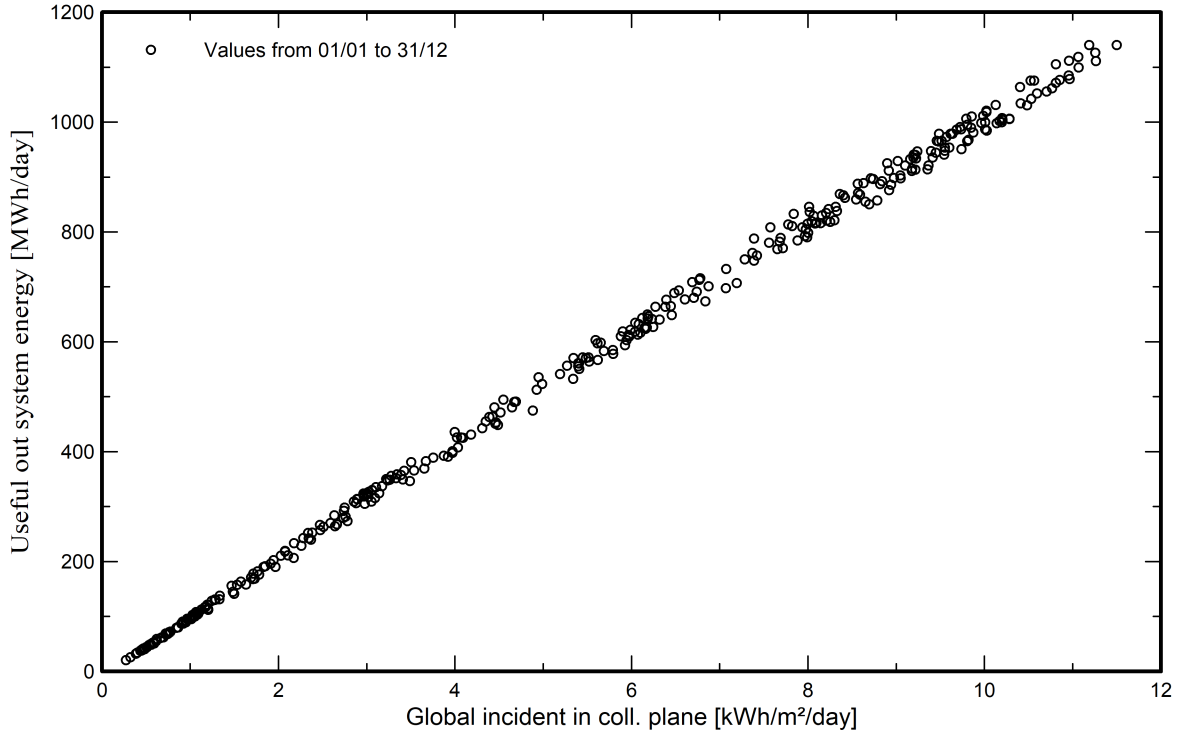
AC ohmic loss

Energy injected into grid

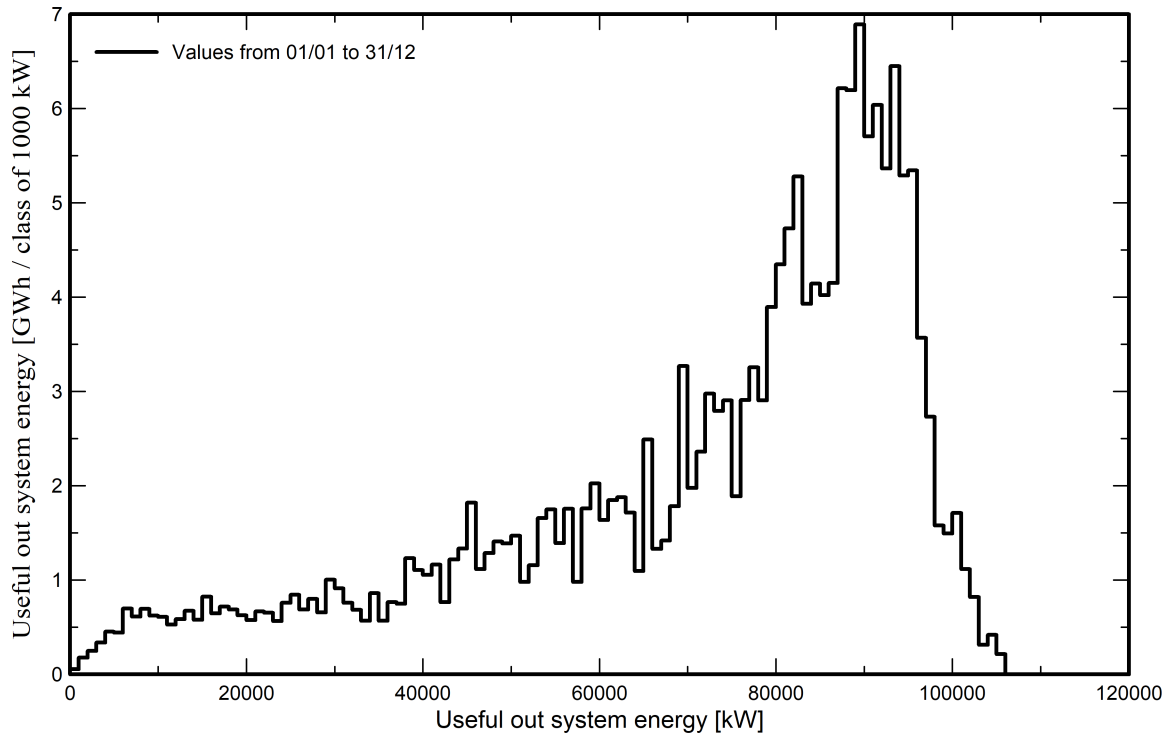


Predef. graphs

Daily Input/Output diagram



System Output Power Distribution

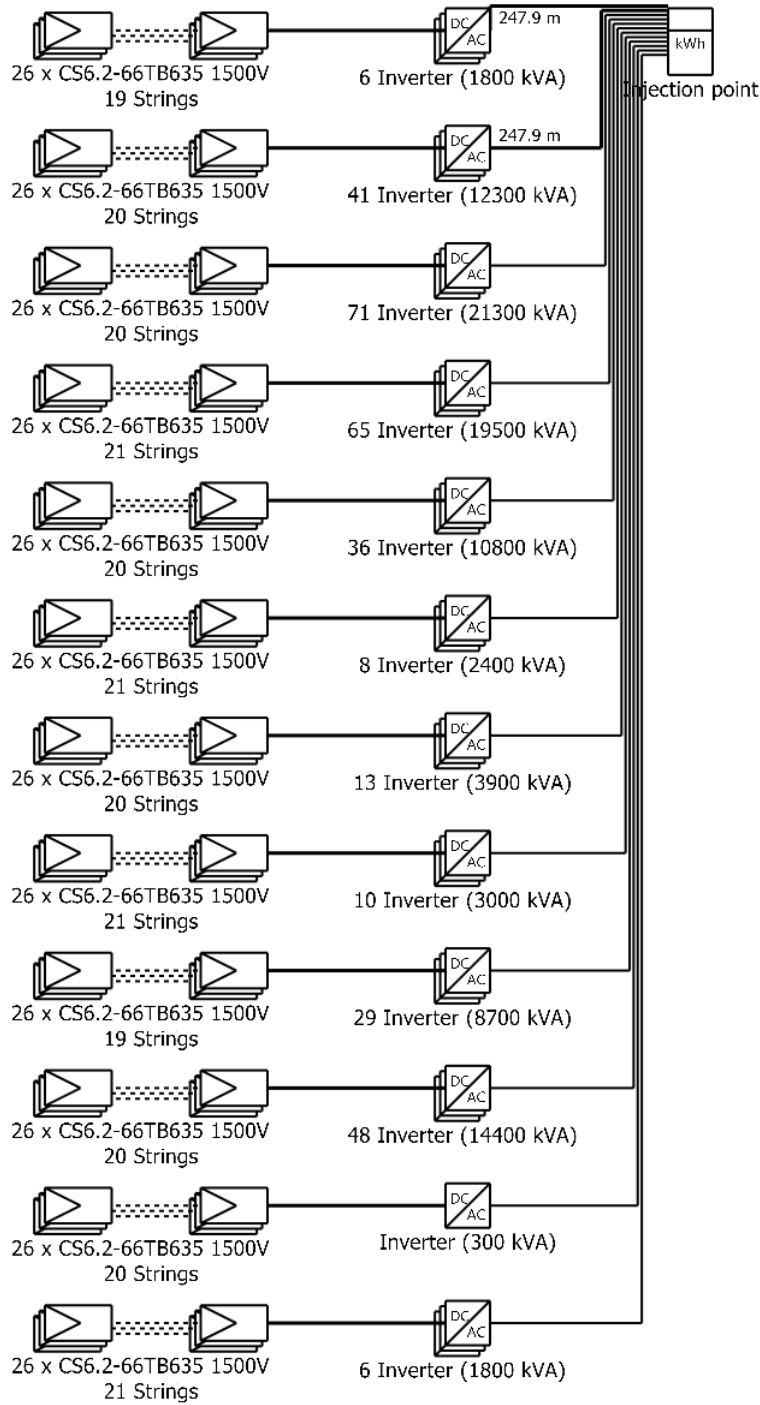




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Single-line diagram



| | |
|-----------|--------------------------|
| PV module | CS6.2-66TB635 1500V |
| Inverter | SUN2000-330KTL-H1 |
| String | 26 x CS6.2-66TB635 1500V |

1037 Bondeno Gavello

GRID SHAPE SRL (Italy)

VC1 : 11.2025

19/11/25