

REGIONE TOSCANA

Provincia di Grosseto (GR)

COMUNE DI GROSSETO

PROGETTO DI IMPIANTO AGRIVOLTAICO AVENTE POTENZA NOMINALE PARI A 44,00 MW E POTENZA DI PICCO DI 45,78 MWp

ARCA.LAB.



ARCA.LAB S.R.L.
Largo della Fiera 21 - Venturina Terme (LI)
tel. 0565 855314
mail: info@bernardinieiacovazzi.com
www.bernardinieiacovazzi.com

D.R.E.A.M. ITALIA Soc. Coop. Agr. For.
Via Garibaldi, 3 - Pratovecchio Stia (AR)
tel. 0575 529514
mail: ar@dream-italia.it
www.dream-italia.it

Tuscany Engineering
Via Aldo Rossi 31 - Montecatini Terme (PT)
tel. 0572 74912
mail: info@tsng.it
http://www.tuscanyengineering.com

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| | | | | | | | | |
|---|---|---|------------|-----------------------|---|--------------------------------|------------------|-----|
| | | | 28/06/2024 | DATA/Date | COMMITTENTE/Purchaser: | LOCALITA'/Place: | COMMESSA/P.o.: | |
| | | | | | SOLEROSELLE S.R.L. | LOCALITA' POGGIONE (GR) | 24-AV-001 | |
| | | | Eseguita | ESECUTIVA/Carried out | TITOLO/Title: Calcolo della producibilità dell'impianto agrivoltaico | | | |
| | | | 0 | Prima emissione | | | | |
| | | | | MODIFICA/Modified | | | | |
| | | | | | DISEGNATO/Drawn | GM | 28/06/2024 | |
| | | | | | VERIFICATO/Designed | LP | 28/06/2024 | |
| | | | | | CONTROLLATO/Checked | LP | 28/06/2024 | |
| | | | | | SCALA/Scale | - | | |
| | | | | | 24-AV-001-E06 | | 0 | |
| | | | | | Anno | Commessa | Gruppo | |
| | | | | | | | Tavola | |
| 3 | 2 | 1 | 0 | N° | This document is property of ARCA.LAB srl. Reproduction and divulgation forbidden without written permission. | | | REV |



Project: poggione

Variant: GR12 FV Standard

tuscany engineering (Italy)

PVsyst V7.4.7

VC2, Simulation date:
20/06/24 16:44
with V7.4.7

Project summary

| | | |
|---|---|--|
| Geographical Site Poggione Grosseto Italia | Situation Latitude 42.79 °N Longitude 11.13 °E Altitude 10 m Time zone UTC+1 | Project settings Albedo 0.20 |
| Weather data Poggione Grosseto Meteonorm 8.1 (1991-2014), Sat=100% - Sintetico | | |

System summary

| | | | |
|--|---|--|--|
| Grid-Connected System Simulation for year no 10 | No 3D scene defined, no shadings | | |
| PV Field Orientation Fixed plane Tilt/Azimuth 10 / 12 ° | Near Shadings No Shadings | User's needs Unlimited load (grid) | |
| System information | | | |
| PV Array | | Inverters | |
| Nb. of modules 120874 units | | Nb. of units 18 units | |
| Pnom total 85.82 MWp | | Pnom total 79.20 MWac | |
| | | Pnom ratio 1.084 | |

Results summary

| | | |
|------------------------------------|---------------------------------------|------------------------|
| Produced Energy 109438945 kWh/year | Specific production 1275 kWh/kWp/year | Perf. Ratio PR 79.56 % |
|------------------------------------|---------------------------------------|------------------------|

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General parameters

| | | | |
|------------------------------|-----------|---|--------------------------|
| Grid-Connected System | | No 3D scene defined, no shadings | |
| PV Field Orientation | | Sheds configuration | Models used |
| Orientation | | No 3D scene defined | Transposition Perez |
| Fixed plane | | | Diffuse Perez, Meteonorm |
| Tilt/Azimuth | 10 / 12 ° | | Circumsolar separate |
| Horizon | | Near Shadings | User's needs |
| Average Height | 2.0 ° | No Shadings | Unlimited load (grid) |

PV Array Characteristics

| | | | |
|----------------------------------|----------------------------|-----------------------------|-----------------------|
| PV module | | Inverter | |
| Manufacturer | mysolar | Manufacturer | SMA |
| Model | MS710N-HJTGB | Model | Sunny Central 4400 UP |
| (Custom parameters definition) | | (Original PVsyst database) | |
| Unit Nom. Power | 710 Wp | Unit Nom. Power | 4400 kWac |
| Number of PV modules | 120874 units | Number of inverters | 18 units |
| Nominal (STC) | 85.82 MWp | Total power | 79200 kWac |
| Modules | 4649 string x 26 In series | Operating voltage | 962-1325 V |
| At operating cond. (50°C) | | Pnom ratio (DC:AC) | 1.08 |
| Pmpp | 78.72 MWp | | |
| U mpp | 1006 V | | |
| I mpp | 78260 A | | |
| Total PV power | | Total inverter power | |
| Nominal (STC) | 85821 kWp | Total power | 79200 kWac |
| Total | 120874 modules | Number of inverters | 18 units |
| Module area | 375477 m ² | Pnom ratio | 1.08 |
| Cell area | 351816 m ² | | |

Array losses

| | | | | | | | | |
|--|--------------|--|----------------------------|------------------------------------|--------------|-------|-------|-------|
| Array Soiling Losses | | Thermal Loss factor | | DC wiring losses | | | | |
| Loss Fraction | 3.0 % | Module temperature according to irradiance | | Global array res. | 0.28 mΩ | | | |
| | | Uc (const) | 29.0 W/m ² K | Loss Fraction | 2.0 % at STC | | | |
| | | Uv (wind) | 0.0 W/m ² K/m/s | | | | | |
| Serie Diode Loss | | LID - Light Induced Degradation | | Module Quality Loss | | | | |
| Voltage drop | 0.7 V | Loss Fraction | 2.0 % | Loss Fraction | -0.4 % | | | |
| Loss Fraction | 0.1 % at STC | | | | | | | |
| Module mismatch losses | | Strings Mismatch loss | | Module average degradation | | | | |
| Loss Fraction | 2.0 % at MPP | Loss Fraction | 0.2 % | Year no | 10 | | | |
| | | | | Loss factor | 0.4 %/year | | | |
| | | | | Mismatch due to degradation | | | | |
| | | | | Imp RMS dispersion | 0.4 %/year | | | |
| | | | | Vmp RMS dispersion | 0.4 %/year | | | |
| 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 |



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Array losses

Spectral correction

FirstSolar model

Precipitable water estimated from relative humidity

| Coefficient Set | C0 | C1 | C2 | C3 | C4 | C5 |
|--------------------|---------|----------|------------|---------|----------|-----------|
| Monocrystalline Si | 0,85914 | -0,02088 | -0,0058853 | 0,12029 | 0,026814 | -0,001781 |

System losses

Auxiliaries loss

constant (fans) 30.0 kW

0.0 kW from Power thresh.

AC wiring losses

Inv. output line up to injection point

Inverter voltage 660 Vac tri

Loss Fraction 0.00 % at STC

Inverter: Sunny Central 4400 UP

Wire section (18 Inv.) Alu 18 x 3 x 4000 mm²

Average wires length 0 m



Horizon definition

Horizon from PVGIS website API, Lat=42°47'26", Long=11°8'5", Alt=10m

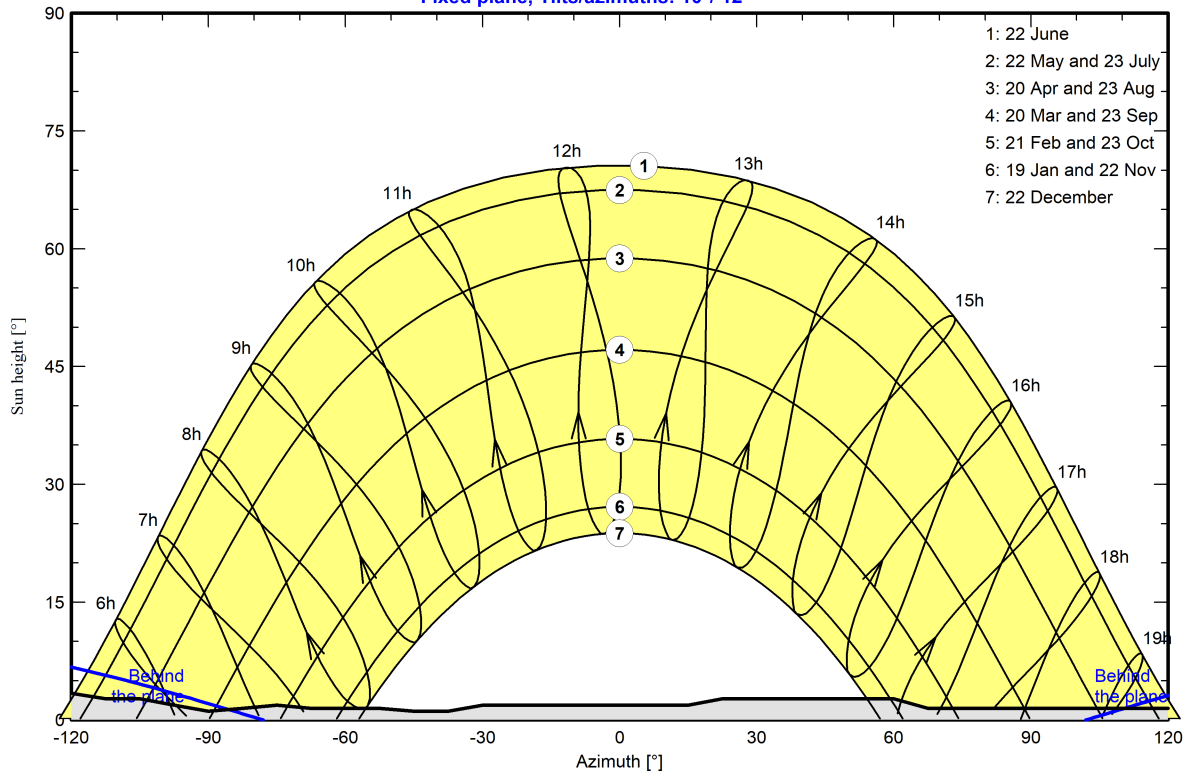
| | | | |
|----------------|-------|-----------------|-------|
| Average Height | 2.0 ° | Albedo Factor | 0.89 |
| Diffuse Factor | 0.99 | Albedo Fraction | 100 % |

Horizon profile

| | | | | | | | | | | |
|-------------|------|------|------|------|------|------|------|------|------|------|
| Azimuth [°] | -180 | -173 | -165 | -158 | -150 | -143 | -135 | -128 | -120 | -113 |
| Height [°] | 1.1 | 1.9 | 2.3 | 4.6 | 5.0 | 4.2 | 3.4 | 2.3 | 3.4 | 2.7 |
| Azimuth [°] | -105 | -98 | -90 | -83 | -75 | -68 | -53 | -45 | -38 | -30 |
| Height [°] | 2.7 | 1.9 | 1.1 | 1.5 | 1.9 | 1.5 | 1.5 | 1.1 | 1.1 | 1.9 |
| Azimuth [°] | 15 | 23 | 60 | 68 | 143 | 150 | 158 | 165 | 173 | 180 |
| Height [°] | 1.9 | 2.7 | 2.7 | 1.5 | 1.5 | 0.8 | 1.1 | 1.1 | 1.5 | 1.1 |

Sun Paths (Height / Azimuth diagram)

Fixed plane, Tilts/azimuths: 10°/ 12°





Main results

System Production

Produced Energy 109438945 kWh/year

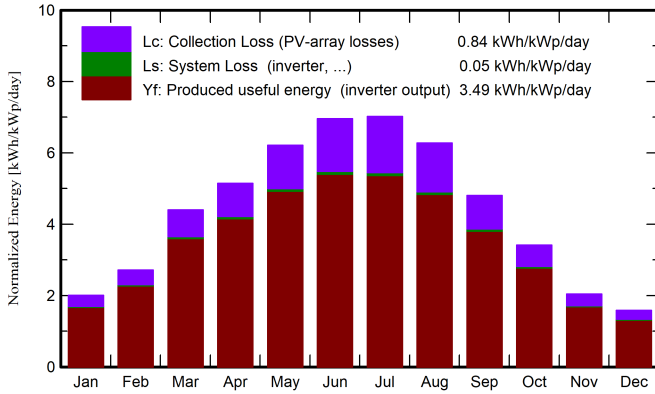
Specific production

1275 kWh/kWp/year

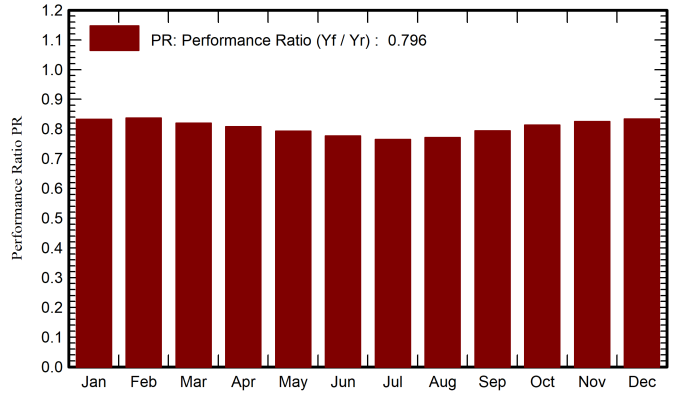
Perf. Ratio PR

79.56 %

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_Grid kWh | PR ratio |
|-----------|-------------------------------|-------------------------------|-------------|-------------------------------|-------------------------------|---------------|---------------|-------------|
| January | 50.5 | 26.80 | 5.92 | 62.2 | 57.1 | 4522290 | 4446017 | 0.833 |
| February | 65.7 | 35.62 | 7.02 | 76.0 | 70.9 | 5543329 | 5455509 | 0.837 |
| March | 121.2 | 44.99 | 10.60 | 136.3 | 127.9 | 9737706 | 9591855 | 0.820 |
| April | 146.0 | 67.59 | 14.13 | 154.4 | 145.5 | 10861988 | 10701715 | 0.808 |
| May | 188.3 | 87.65 | 18.77 | 192.7 | 182.1 | 13299015 | 13106797 | 0.793 |
| June | 206.9 | 81.73 | 23.39 | 208.8 | 197.5 | 14128000 | 13925827 | 0.777 |
| July | 213.8 | 73.72 | 26.33 | 217.6 | 205.9 | 14488898 | 14282415 | 0.765 |
| August | 185.4 | 74.23 | 25.96 | 194.6 | 183.7 | 13067412 | 12882025 | 0.771 |
| September | 132.1 | 58.21 | 20.62 | 144.1 | 135.5 | 9960215 | 9816134 | 0.794 |
| October | 92.1 | 45.80 | 16.73 | 105.8 | 99.0 | 7495353 | 7382915 | 0.813 |
| November | 51.8 | 30.08 | 11.36 | 61.3 | 56.8 | 4419616 | 4345938 | 0.826 |
| December | 40.1 | 24.47 | 7.32 | 49.0 | 45.0 | 3565784 | 3501798 | 0.833 |
| Year | 1493.8 | 650.89 | 15.73 | 1602.9 | 1506.9 | 111089606 | 109438945 | 0.796 |

Legends

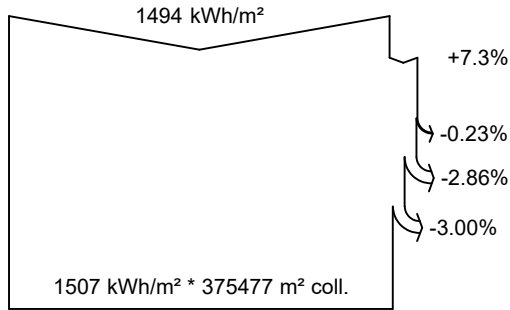
| | | | |
|---------|--|--------|---|
| GlobHor | Global horizontal irradiation | EArray | Effective energy at the output of the array |
| DiffHor | Horizontal diffuse irradiation | E_Grid | Energy injected into grid |
| T_Amb | Ambient Temperature | PR | Performance Ratio |
| GlobInc | Global incident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



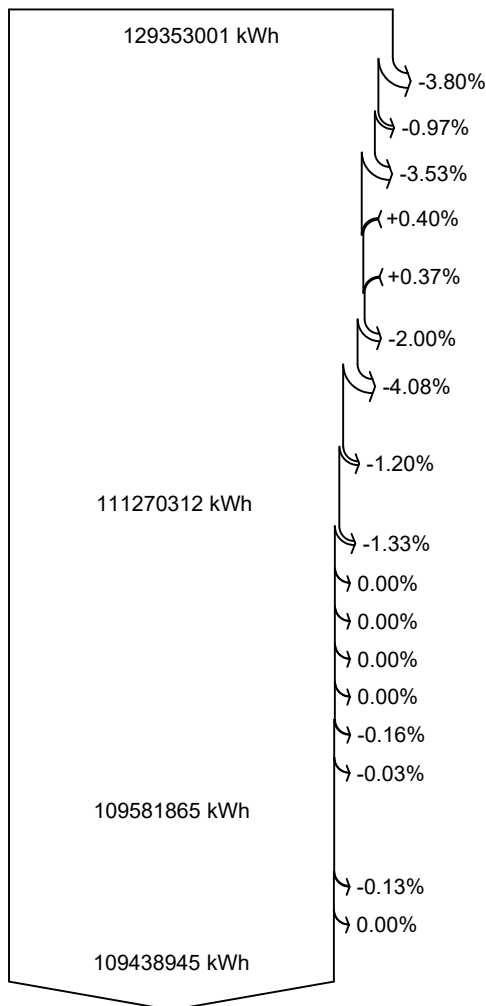
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Loss diagram



efficiency at STC = 22.86%



Global horizontal irradiation

Global incident in coll. plane

Far Shadings / Horizon

IAM factor on global

Soiling loss factor

Effective irradiation on collectors

PV conversion

Array nominal energy (at STC effic.)

Module Degradation Loss (for year #10)

PV loss due to irradiance level

PV loss due to temperature

Spectral correction

Module quality loss

LID - Light induced degradation

Mismatch loss, modules and strings
(including 1.9% for degradation dispersion)

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

Auxiliaries (fans, other)

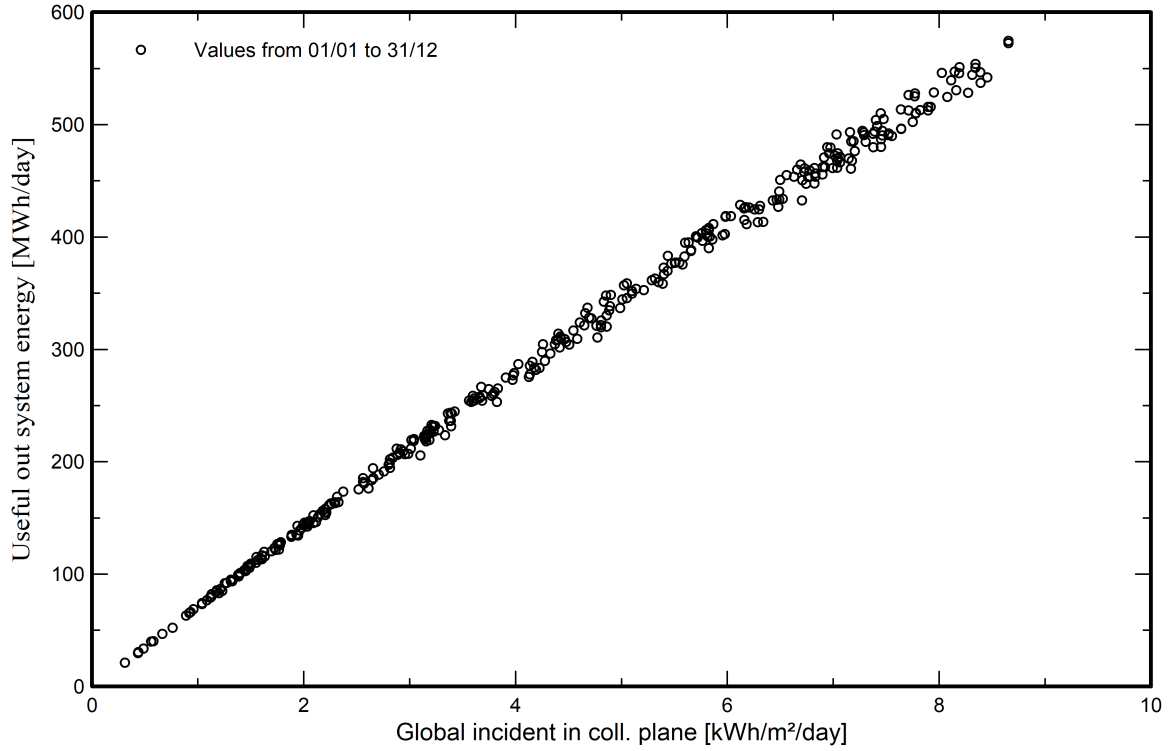
AC ohmic loss

Energy injected into grid



Predef. graphs

Diagramma giornaliero entrata/uscita



Distribuzione potenza in uscita sistema

