

IMPIANTO FOTOVOLTAICO EG LAGO SRL E OPERE CONNESSE

POTENZA IMPIANTO 10,30 MWp - COMUNE DI ARGENTA (FE)

Proponente

EG LAGO S.R.L.

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Titolo Elaborato

STIMA DI PRODUCIBILITA' DELL'IMPIANTO

| LIVELLO PROGETTAZIONE | CODICE ELABORATO | FILENAME | RIFERIMENTO | DATA | SCALA |
|-----------------------|------------------|----------|-------------|----------|-------|
| DEFINITIVO | REL20 | - | - | 10/09/24 | |

Revisioni

| REV. | DATA | DESCRIZIONE | ESEGUITO | VERIFICATO | APPROVATO |
|------|----------|-------------|--------------|------------|-----------|
| 1 | 10/09/24 | | FB - GB - SC | EF | DZ |



COMUNE DI ARGENTA (FE)
REGIONE EMILIA ROMAGNA





STIMA PRODUCIBILITA'

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1. STIMA PRODUCIBILITA'

Project: 175_01_07_EG LAGO ARGENTA_AGGIORNAMENTO

Variant: configurazione 4

QuattroE S.r.l. (Italy)

Project summary

| | | | | |
|---|------------------|----------|-------------------------|------|
| Geographical Site Argenta Italy | Situation | | Project settings | |
| | Latitude | 44.61 °N | Albedo | 0.20 |
| | Longitude | 11.84 °E | | |
| | Altitude | 8 m | | |
| | Time zone | UTC+1 | | |
| Weather data Argenta PVGIS api TMY | | | | |

System summary

| System summary | | | |
|-------------------------------------|-------------|-----------------------------------|-----------|
| Grid-Connected System | | Tracking system with backtracking | |
| PV Field Orientation | | Near Shadings | |
| Orientation | | Linear shadings : Fast (table) | |
| Tracking plane, horizontal N-S axis | | Diffuse shading Automatic | |
| Axis azimuth 0 ° | | | |
| System information | | | |
| PV Array | | Inverters | |
| Nb. of modules | 14300 units | Nb. of units | 24 units |
| Pnom total | 10.30 MWp | Pnom total | 8304 kWac |
| | | Pnom ratio | 1.240 |
| User's needs | | | |
| Unlimited load (grid) | | | |

Results summary

| | | | | | |
|-----------------|-------------------|---------------------|-------------------|----------------|---------|
| Produced Energy | 15889036 kWh/year | Specific production | 1543 kWh/kWp/year | Perf. Ratio PR | 83.77 % |
|-----------------|-------------------|---------------------|-------------------|----------------|---------|

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General parameters

| | | | |
|-------------------------------------|--|--|--|
| Grid-Connected System | | Tracking system with backtracking | |
| PV Field Orientation | | Tracking algorithm | |
| Orientation | | Astronomic calculation | |
| Tracking plane, horizontal N-S axis | | Backtracking activated | |
| Axis azimuth | | 0 ° | |
| Models used | | Backtracking array | |
| Transposition | | Nb. of trackers | |
| Diffuse | | 550 units | |
| Circumsolar | | Sizes | |
| Perez | | Tracker Spacing | |
| Imported | | 10.3 m | |
| separate | | Collector width | |
| | | 4.77 m | |
| | | Ground Cov. Ratio (GCR) | |
| | | 46.3 % | |
| | | Phi min / max. | |
| | | -/+ 60.0 ° | |
| | | Backtracking strategy | |
| | | Phi limits for BT | |
| | | -/+ 62.3 ° | |
| | | Backtracking pitch | |
| | | 10.3 m | |
| | | Backtracking width | |
| | | 4.77 m | |
| Horizon | | Near Shadings | |
| Free Horizon | | Linear shadings : Fast (table) | |
| | | Diffuse shading | |
| | | Automatic | |
| | | User's needs | |
| | | Unlimited load (grid) | |

PV Array Characteristics

| | | | |
|-----------------------------------|--|------------------------------------|--|
| PV module | | Inverter | |
| Manufacturer | | Manufacturer | |
| CanadianSolar | | Ingeteam | |
| Model | | Model | |
| Bifacial TOPBiHiKu7 CS7N-720TB-AG | | Ingecon Sun 350TL M12 | |
| (Custom parameters definition) | | (Custom parameters definition) | |
| Unit Nom. Power | | Unit Nom. Power | |
| 720 Wp | | 346 kWac | |
| Number of PV modules | | Number of inverters | |
| 14300 units | | 24 units | |
| Nominal (STC) | | Total power | |
| 10.30 MWp | | 8304 kWac | |
| Array #1 - Area 1 | | Number of inverters | |
| Number of PV modules | | 6 units | |
| Nominal (STC) | | Total power | |
| 2565 kWp | | 2076 kWac | |
| Modules | | Operating voltage | |
| 137 string x 26 In series | | 850-1300 V | |
| At operating cond. (50°C) | | Pnom ratio (DC:AC) | |
| Pmpp | | 1.24 | |
| 2310 kWp | | Power sharing within this inverter | |
| U mpp | | | |
| 944 V | | | |
| I mpp | | | |
| 2448 A | | | |
| Array #2 - Area 2 | | Number of inverters | |
| Number of PV modules | | 18 units | |
| Nominal (STC) | | Total power | |
| 7731 kWp | | 6228 kWac | |
| Modules | | Operating voltage | |
| 413 string x 26 In series | | 850-1300 V | |
| At operating cond. (50°C) | | Pnom ratio (DC:AC) | |
| Pmpp | | 1.24 | |
| 6963 kWp | | Power sharing within this inverter | |
| U mpp | | | |
| 944 V | | | |
| I mpp | | | |
| 7380 A | | | |
| Total PV power | | Total inverter power | |
| Nominal (STC) | | Total power | |
| 10296 kWp | | 8304 kWac | |
| Total | | Number of inverters | |
| 14300 modules | | 24 units | |
| Module area | | Pnom ratio | |
| 44421 m² | | 1.24 | |
| Cell area | | | |
| 42471 m² | | | |

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Array losses

Array Soiling Losses

Loss Fraction 3.0 %

Thermal Loss factor

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

Serie Diode Loss

Voltage drop 0.7 V
Loss Fraction 0.1 % at STC

LID - Light Induced Degradation

Loss Fraction 2.0 %

Module Quality Loss

Loss Fraction -0.8 %

Module mismatch losses

Loss Fraction 2.0 % at MPP

Strings Mismatch loss

Loss Fraction 0.1 %

IAM loss factor

Incidence effect (IAM): Fresnel smooth glass, n = 1.526

| 0° | 30° | 50° | 60° | 70° | 75° | 80° | 85° | 90° |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1.000 | 0.998 | 0.981 | 0.948 | 0.862 | 0.776 | 0.636 | 0.403 | 0.000 |

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 |

DC wiring losses

Global wiring resistance 1.6 mΩ
Loss Fraction 1.5 % at STC

Array #1 - Area 1

Global array res. 6.5 mΩ
Loss Fraction 1.5 % at STC

Array #2 - Area 2

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

AC wiring losses

Inv. output line up to MV transfo

Inverter voltage 800 Vac tri
Loss Fraction 0.67 % at STC

Inverter: Ingecon Sun 350TL M12

Wire section (24 Inv.) Copper 24 x 3 x 185 mm²
Average wires length 100 m

MV line up to Injection

MV Voltage 36 kV
Average each inverter
Wires Copper 3 x 95 mm²
Length 100 m
Loss Fraction 0.01 % at STC

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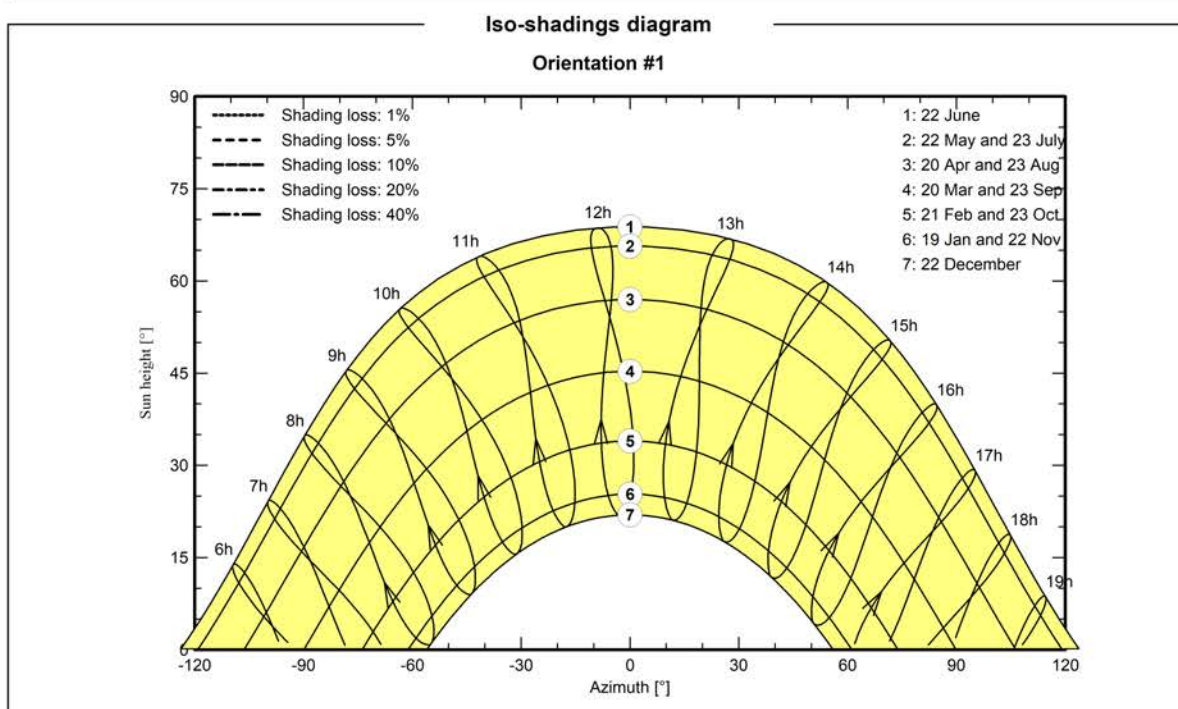
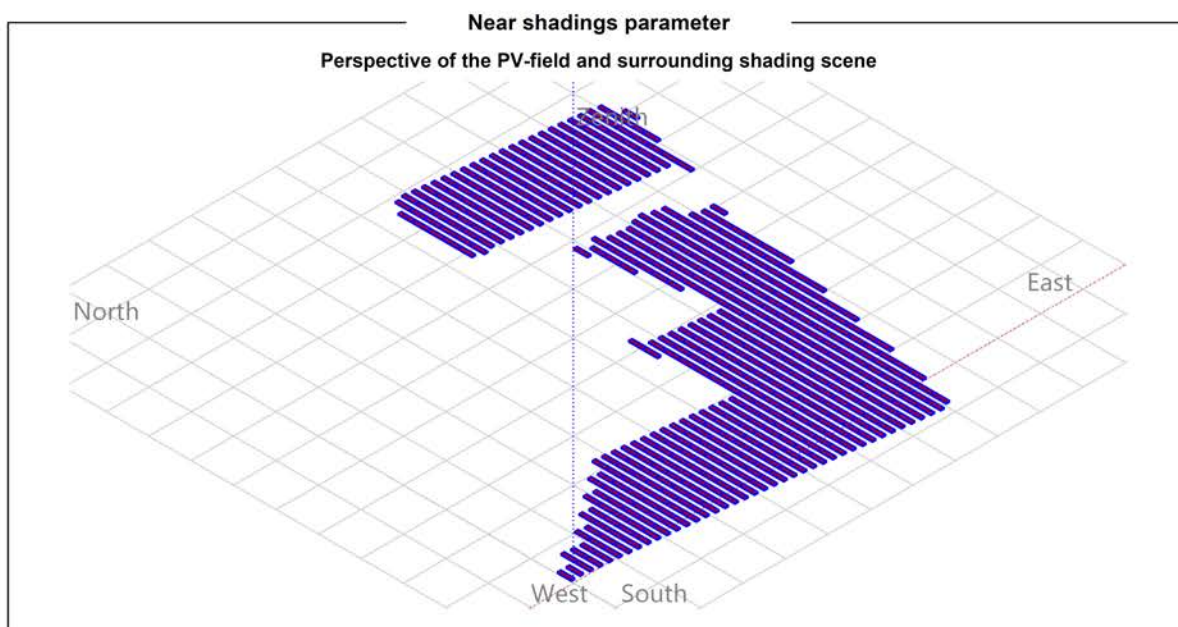
AC losses in transformers

| AC losses in transformers | | | |
|------------------------------------|----------------|--|---------------|
| MV transfo | | | |
| Medium voltage | 36 kV | | |
| Transformer from Datasheets | | Operating losses at STC (full system) | |
| Nominal power | 4900 kVA | Nb. identical MV transfos | 2 |
| Iron Loss | 4.00 kVA | Nominal power at STC | 10.18 MVA |
| Iron loss fraction | 0.08 % of PNom | Iron loss | 8.00 kVA |
| Copper loss | 49.00 kVA | Iron loss fraction | 0.08 % at STC |
| Copper loss fraction | 1.00 % at PNom | Copper loss | 105.67 kVA |
| Coils equivalent resistance | 3 x 1.31 mΩ | Copper loss fraction | 1.04 % at STC |

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Variant: configurazione 4

QuattroE S.r.l. (Italy)

Main results

System Production

Produced Energy

15889036 kWh/year

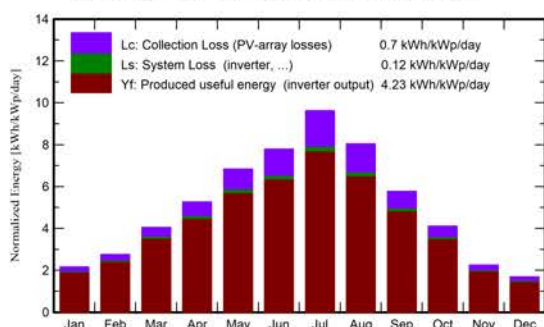
Specific production

1543 kWh/kWp/year

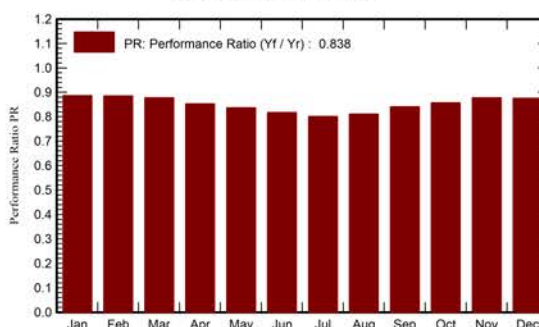
Perf. Ratio PR

83.77 %

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 | 51.4 | 24.33 | 3.32 | 67.3 | 60.9 | 631010 | 614343 | 0.887 |
| February | 61.5 | 33.04 | 8.19 | 77.3 | 71.8 | 723465 | 704356 | 0.885 |
| March | 100.5 | 49.06 | 8.22 | 125.4 | 118.2 | 1164819 | 1133182 | 0.878 |
| April | 126.9 | 58.24 | 14.05 | 158.0 | 150.0 | 1429033 | 1388681 | 0.854 |
| May | 169.3 | 72.88 | 17.20 | 212.0 | 202.0 | 1880302 | 1826761 | 0.837 |
| June | 186.1 | 80.88 | 22.65 | 233.7 | 222.7 | 2024820 | 1968323 | 0.818 |
| July | 229.4 | 69.06 | 26.93 | 298.4 | 285.7 | 2534009 | 2462001 | 0.801 |
| August | 191.4 | 63.73 | 26.26 | 249.5 | 238.4 | 2143330 | 2082900 | 0.811 |
| September | 134.1 | 54.09 | 20.04 | 173.2 | 164.2 | 1542521 | 1500254 | 0.841 |
| October | 95.8 | 36.71 | 14.88 | 127.4 | 119.6 | 1156128 | 1124511 | 0.857 |
| November | 52.4 | 25.87 | 9.28 | 67.6 | 61.9 | 628407 | 611313 | 0.878 |
| December | 41.2 | 21.79 | 5.08 | 52.4 | 47.1 | 486583 | 472411 | 0.876 |
| Year | 1439.8 | 589.69 | 14.71 | 1842.2 | 1742.6 | 16344425 | 15889036 | 0.838 |

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

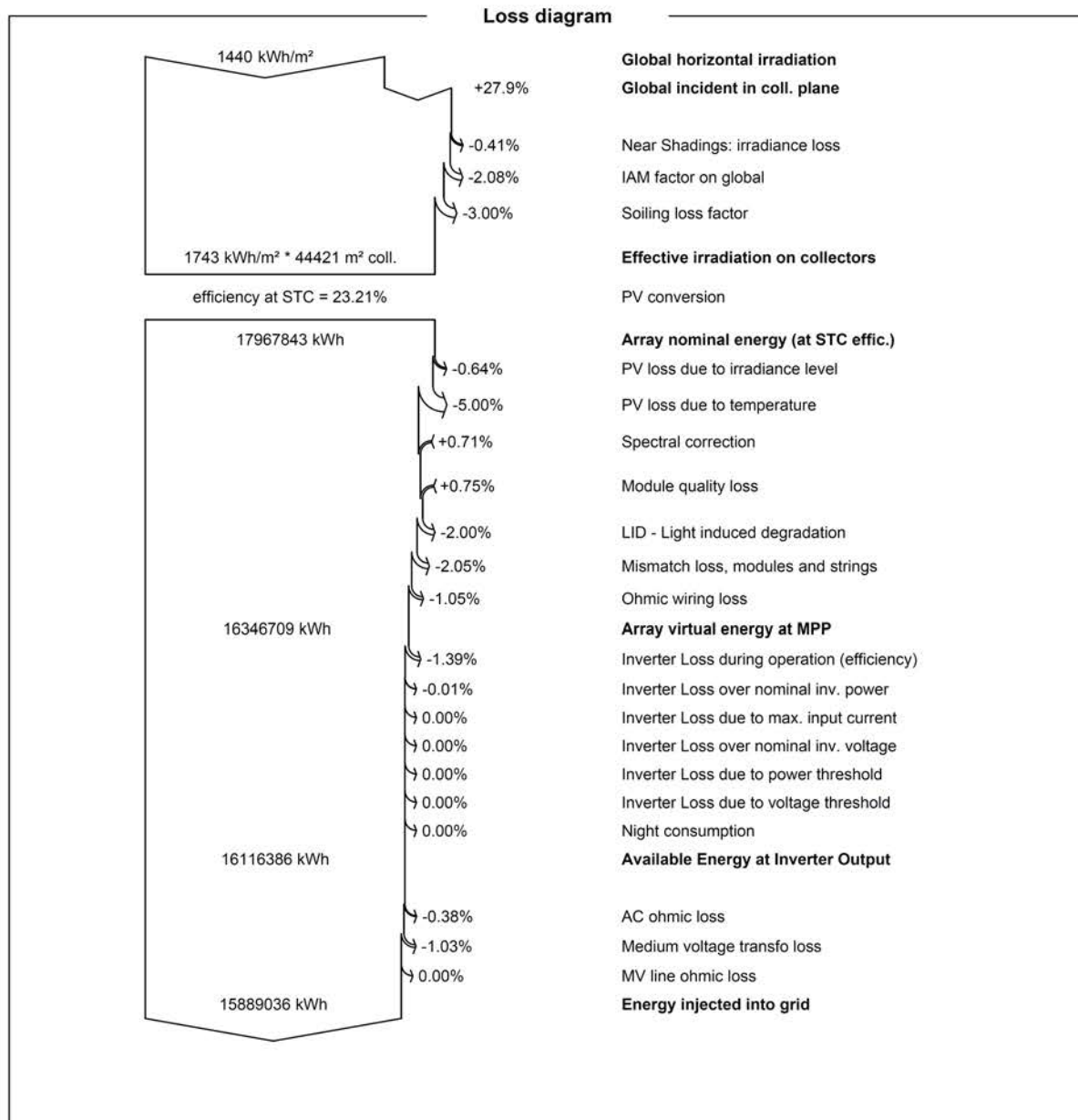
E_Grid Energy injected into grid

PR Performance Ratio

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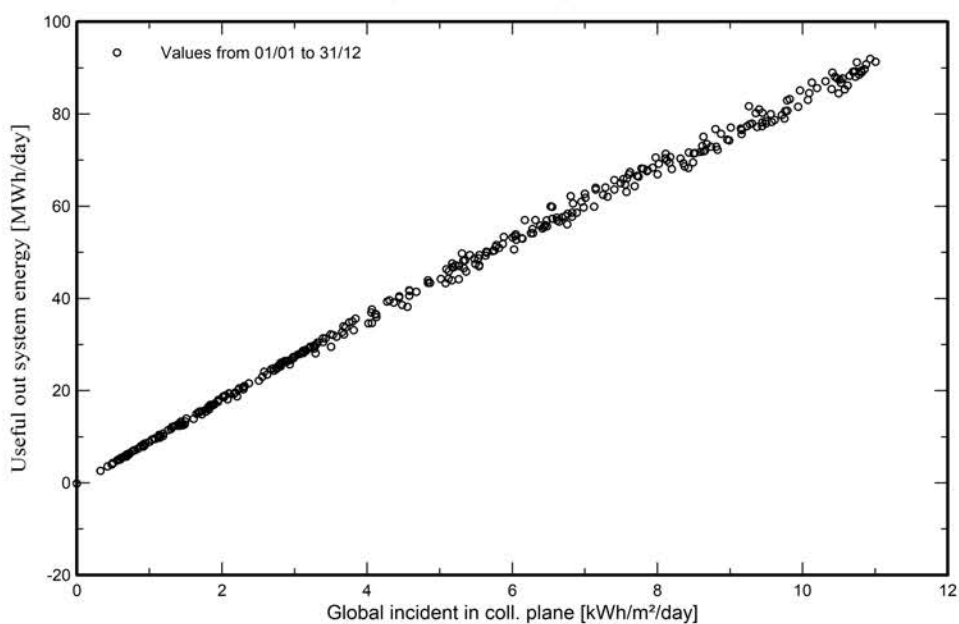
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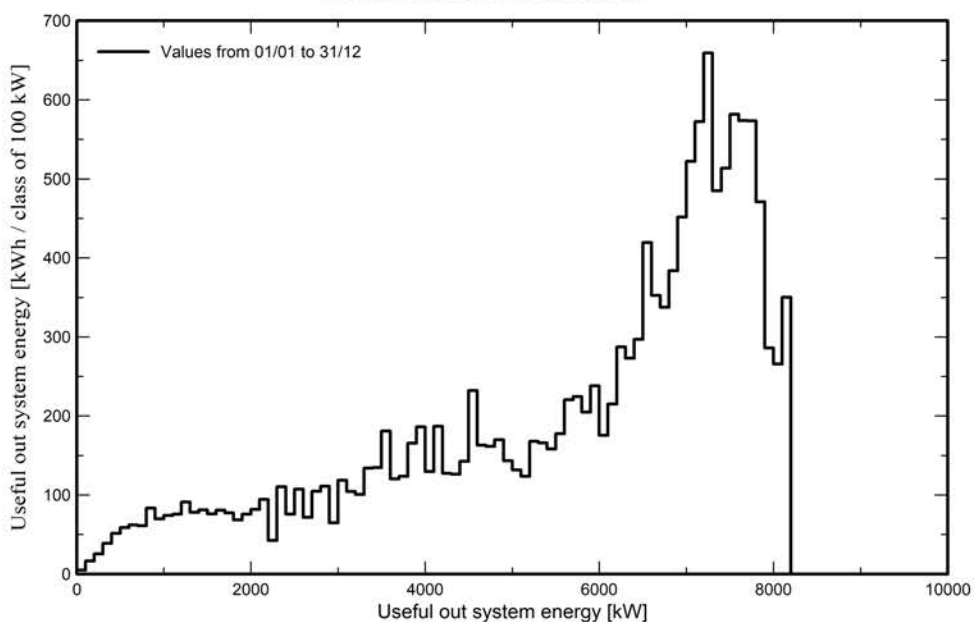
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Predef. graphs

Daily Input/Output diagram



System Output Power Distribution



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P50 - P90 evaluation

Weather data

| | |
|------------------------------------|-----------------|
| Source | PVGIS api TMY |
| Kind | TMY, multi-year |
| Year-to-year variability(Variance) | 4.3 % |
| Specified Deviation | |
| Climate change | 0.0 % |

Global variability (weather data + system)

| | |
|-----------------------------|-------|
| Variability (Quadratic sum) | 4.7 % |
|-----------------------------|-------|

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 | 739 MWh |
| P50 | 15889 MWh |
| P90 | 14941 MWh |
| P95 | 14674 MWh |

Probability distribution

