

REGIONE: LAZIO

PROVINCIA: VITERBO

COMUNI: ACQUAPENDENTE

ELABORATO:

119.21.01.R05

OGGETTO:

**IMPIANTO FOTOVOLTAICO
ACQUAPENDENTE 37.15MWp
PROGETTO DEFINITIVO**

PROPONENTE:

ICA FOR s.r.l.

ICA FOR s.r.l.

via Giorgio Pitacco n.7, 00177 Roma (RM)

**PROGETTO
DEFINITIVO**



**E N E R G Y
E N V I R O N M E N T
E N G I N E E R I N G**

3E Ingegneria S.r.l.

Via G. Volpe n.92 – cap 56121 – Pisa (PI)

3eingegneria@pec.it

www.3eingegneria.it

info@3eingegneria.it

Relazione Autoconsumo Energia Elettrica



Note:

| DATA | REV | DESCRIZIONE | ELABORATO da: | APPROVATO da: |
|------------------|-----|-------------|-------------------|---------------|
| DICEMBRE 2021 | 0 | Emissione | 3E Ingegneria Srl | ICA FOR |

PROPRIETÀ ESCLUSIVA DELLE SOCIETÀ SOPRA INDICATE,
UTILIZZO E DUPLICAZIONE VIETATE SENZA AUTORIZZAZIONE SCRITTA



ENERGY
ENVIRONMENT
ENGINEERING

**Impianto Fotovoltaico “ACQUAPENDENTE ”
da 37.15 MWp
Relazione Autoconsumo Energia Elettrica**

OGGETTO / SUBJECT

ICA FOR s.r.l.

CLIENTE / CUSTOMER

S O M M A R I O

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1 SCOPO DEL DOCUMENTO

Il presente documento ha l'obiettivo di illustrare i valori di producibilità annua e l'autoconsumo di energia elettrica dell'impianto fotovoltaico della ICA FOR srl denominato "Acquapendente". Si precisa che l'impianto fotovoltaico opererà in regime di cessione totale in quanto tutta l'energia elettrica prodotta, al netto dei servizi ausiliari di impianto, verrà immessa in rete e non autoconsumata.

1.1 Producibilità di impianto e autoconsumo energia elettrica

La stima della producibilità dell'impianto è stata effettuata con l'impiego del simulatore PVsyst, inserendo l'irraggiamento e la meteorologia specifici del luogo, la geometria delle strutture di sostegno dei moduli, le caratteristiche di producibilità dei moduli.

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Version 7.2.10

PVsyst - Simulation report

Grid-Connected System

Project: Acquapendente

Variant: Acquapendente 37.15 Mw 55454 TRINA670 Sie1415Idd
Tracking system with backtracking
System power: 37.15 MWp
La Sbarra - Italy

| | | | | | |
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with v7.2.10

 Project: Acquapendente
Variant: Acquapendente 37.15 Mw 55454 TRINA670 Sie1415Idd

Project summary

| | | |
|---|--|--|
| Geographical Site La Sbarra Italy | Situation Latitude 42.73 °N Longitude 11.84 °E Altitude 457 m Time zone UTC+1 | Project settings Albedo 0.20 |
| Meteo data La Sbarra PVGIS api TMY | | |

System summary

| | | |
|--|---|--|
| Grid-Connected System PV Field Orientation Tracking plane, horizontal N-S axis Axis azimuth 0 ° | Tracking system with backtracking Near Shadings According to strings Electrical effect 100 % | User's needs Unlimited load (grid) |
| System information PV Array Nb. of modules 55454 units Pnom total 37.15 MWp | Inverters Nb. of units 28 units Pnom total 39.62 MWac Grid power limit 33.77 MWac Grid lim. Pnom ratio 1.100 | |

Results summary

| | | | | | |
|-----------------|-------------|---------------------|-------------------|----------------|---------|
| Produced Energy | 64 GWh/year | Specific production | 1710 kWh/kWp/year | Perf. Ratio PR | 84.83 % |
| Apparent energy | 65585 MVAh | | | | |

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 Project: Acquapendente
Variant: Acquapendente 37.15 Mw 55454 TRINA670 Sie1415ldd

General parameters

| | | | |
|-------------------------------------|------------|--|------------|
| Grid-Connected System | | Tracking system with backtracking | |
| PV Field Orientation | | | |
| Orientation | | Backtracking strategy | |
| Tracking plane, horizontal N-S axis | | Nb. of trackers | 879 units |
| Axis azimuth 0 ° | | Sizes | |
| | | Tracker Spacing | 11.1 m |
| | | Collector width | 4.70 m |
| | | Ground Cov. Ratio (GCR) | 42.5 % |
| | | Phi min / max. | -/+ 60.0 ° |
| | | Backtracking limit angle | |
| | | Phi limits | +/- 64.8 ° |
| Horizon | | Near Shadings | |
| Free Horizon | | According to strings | |
| | | Electrical effect | 100 % |
| | | User's needs | |
| | | Unlimited load (grid) | |
| Grid injection point | | | |
| Grid power limitation | | Power factor | |
| Active Power | 33.77 MWac | Cos(phi) (leading) | 0.970 |
| Pnom ratio | 1.100 | | |

PV Array Characteristics

| | | | |
|----------------------------------|-----------------------------|--------------------------------|--------------------------|
| PV module | | Inverter | |
| Manufacturer | Generic | Manufacturer | Generic |
| Model | TSM-670DEG21C.20 | Model | SOLEIL1415 P(Text) REV04 |
| (Original PVsyst database) | | (Custom parameters definition) | |
| Unit Nom. Power | 670 Wp | Unit Nom. Power | 1415 kVA |
| Number of PV modules | 55454 units | Number of inverters | 28 units |
| Nominal (STC) | 37.15 MWp | Total power | 39620 kVA |
| Modules | 1631 Strings x 34 In series | Operating voltage | 950-1400 V |
| At operating cond. (50°C) | | Max. power (=>20°C) | 1443 kVA |
| Pmpp | 34.04 MWp | Pnom ratio (DC:AC) | 0.94 |
| U mpp | 1078 V | | |
| I mpp | 31582 A | | |
| Total PV power | | Total inverter power | |
| Nominal (STC) | 37154 kWp | Total power | 39620 kVA |
| Total | 55454 modules | Number of inverters | 28 units |
| Module area | 174408 m ² | Pnom ratio | 0.94 |
| Cell area | 161038 m ² | | |

Array losses

| | | | | | |
|--|-------|--|----------------------------|-------------------------------|--------------|
| Array Soiling Losses | | Thermal Loss factor | | DC wiring losses | |
| Loss Fraction | 2.0 % | Module temperature according to irradiance | | Global array res. | 0.56 mΩ |
| | | Uc (const) | 20.0 W/m ² K | Loss Fraction | 1.5 % at STC |
| | | Uv (wind) | 0.0 W/m ² K/m/s | | |
| LID - Light Induced Degradation | | Module Quality Loss | | Module mismatch losses | |
| Loss Fraction | | Loss Fraction | | 2.0 % at MPP | |
| Strings Mismatch loss | | | | | |
| Loss Fraction | 0.1 % | | | | |


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Array losses
IAM loss factor

Incidence effect (IAM): User defined profile

| | | | | | | | | | |
|--|--|--|--|--|--|--|--|--|--|
| | | | | | | | | | |
| | | | | | | | | | |

Auxiliaries loss

 constant (fans) 15.00 kW
 0.0 kW from Power thresh.
 Proportional to Power 1.0 W/kW
 0.0 kW from Power thresh.
 Night aux. cons. 6.00 kW

AC wiring losses
Inv. output line up to MV transfo

 Inverter voltage 640 Vac tri
 Loss Fraction 0.32 % at STC

Inverter: SOLEIL1415 P(Text) REV04

 Wire section (28 Inv.) Alu 28 x 3 x 1000 mm²
 Average wires length 30 m

MV line up to Injection

 MV Voltage 36 kV
 Average each inverter
 Wires Alu 3 x 500 mm²
 Length 20000 m
 Loss Fraction 0.48 % at STC

AC losses in transformers
MV transfo

Grid voltage 36 kV

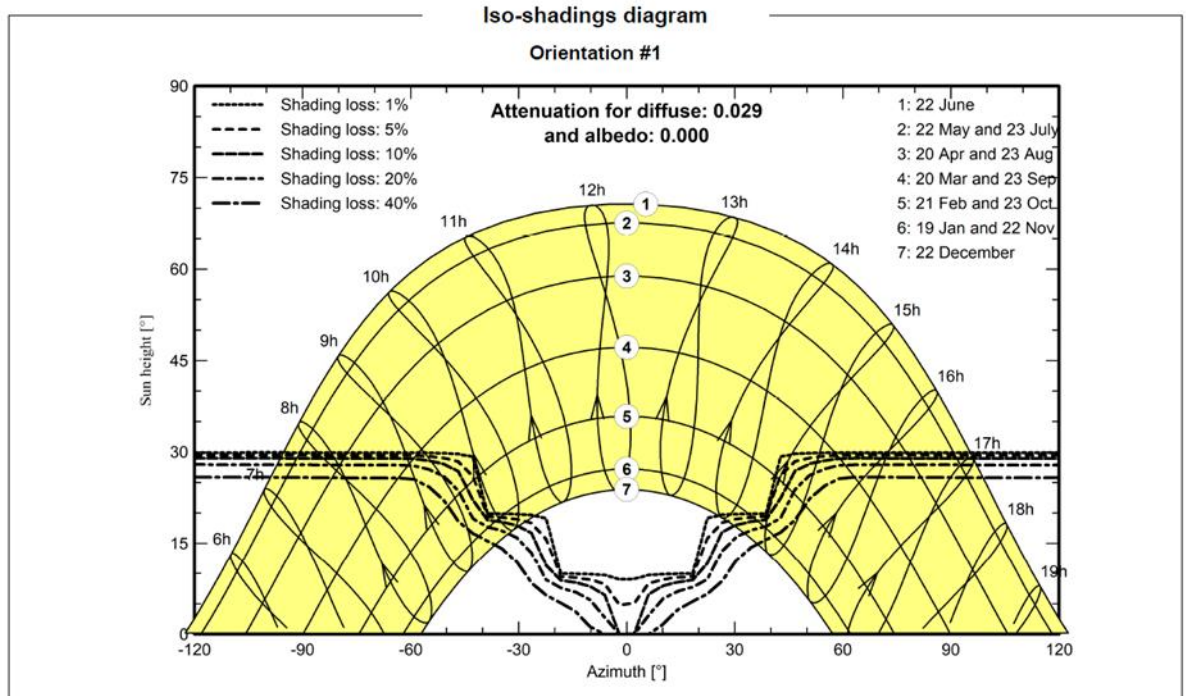
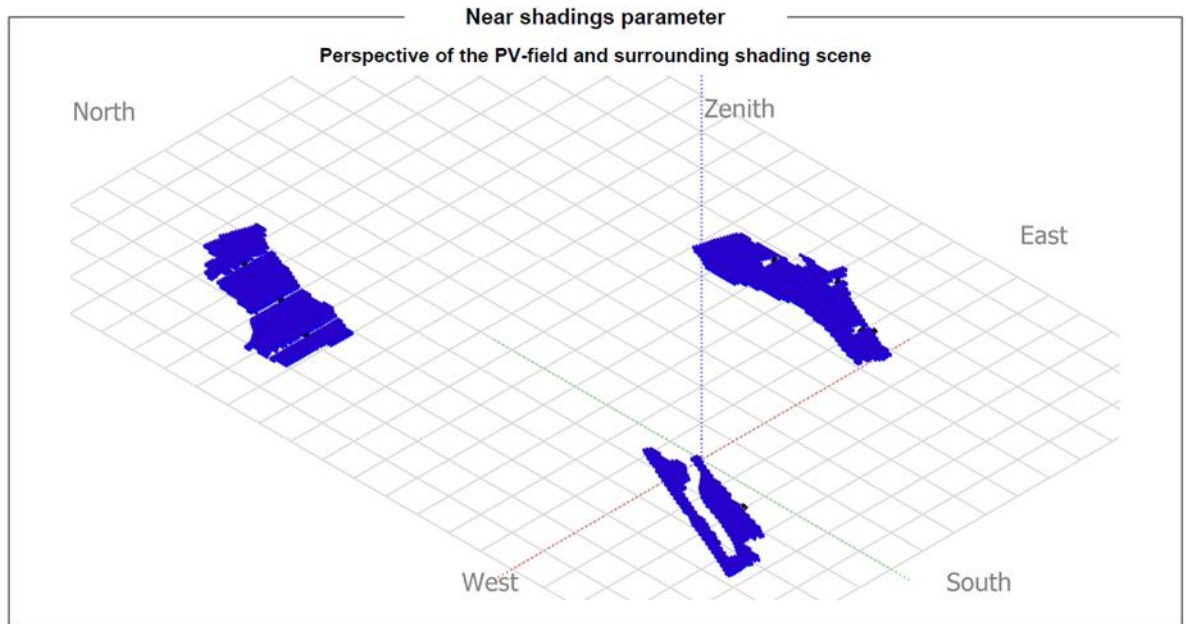
Operating losses at STC

 Nominal power at STC 36861 kVA
 Iron loss (24/24 Connexion) 5.53 kW/Inv.
 Loss Fraction 0.12 % at STC
 Coils equivalent resistance 3 x 0.89 mΩ/inv.
 Loss Fraction 1.00 % at STC



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Project: Acquapendente

Variant: Acquapendente 37.15 Mw 55454 TRINA670 Sie1415ldd

Main results

System Production

Produced Energy

64 GWh/year

Specific production

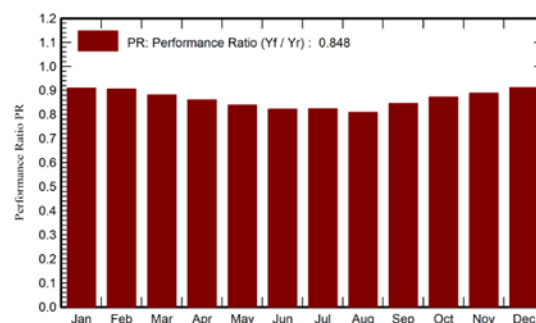
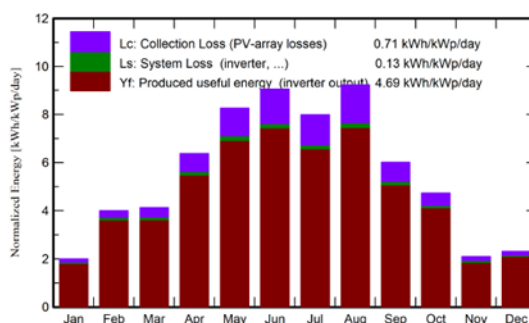
1710 kWh/kWp/year

Apparent energy

65585 MVAh

Performance Ratio PR

84.83 %



| | GlobHor | DiffHor | T_Amb | GlobInc | GlobEff | EArray | E_Grid | PR |
|-----------|--------------------|--------------------|-------|--------------------|--------------------|--------|--------|-------|
| | kWh/m ² | kWh/m ² | °C | kWh/m ² | kWh/m ² | GWh | GWh | ratio |
| January | 47.8 | 25.29 | 5.35 | 61.8 | 59.2 | 2.165 | 2.087 | 0.909 |
| February | 81.8 | 30.65 | 5.23 | 112.1 | 108.1 | 3.879 | 3.771 | 0.906 |
| March | 100.6 | 50.07 | 8.00 | 128.0 | 123.3 | 4.315 | 4.189 | 0.881 |
| April | 151.0 | 67.61 | 12.00 | 191.3 | 184.9 | 6.287 | 6.120 | 0.861 |
| May | 199.2 | 76.34 | 15.57 | 256.0 | 247.8 | 8.200 | 7.984 | 0.839 |
| June | 211.0 | 74.00 | 20.00 | 271.8 | 263.2 | 8.518 | 8.295 | 0.822 |
| July | 193.3 | 81.53 | 21.24 | 247.8 | 239.6 | 7.782 | 7.580 | 0.823 |
| August | 211.7 | 57.71 | 24.04 | 286.1 | 277.6 | 8.829 | 8.605 | 0.809 |
| September | 137.7 | 54.45 | 18.45 | 180.4 | 174.5 | 5.820 | 5.667 | 0.845 |
| October | 107.5 | 40.76 | 14.04 | 146.6 | 141.7 | 4.882 | 4.752 | 0.873 |
| November | 50.1 | 26.91 | 10.16 | 62.7 | 60.1 | 2.151 | 2.072 | 0.889 |
| December | 52.1 | 22.40 | 5.67 | 71.4 | 68.5 | 2.502 | 2.420 | 0.912 |
| Year | 1543.9 | 607.73 | 13.36 | 2016.0 | 1948.6 | 65.329 | 63.542 | 0.848 |

Legends

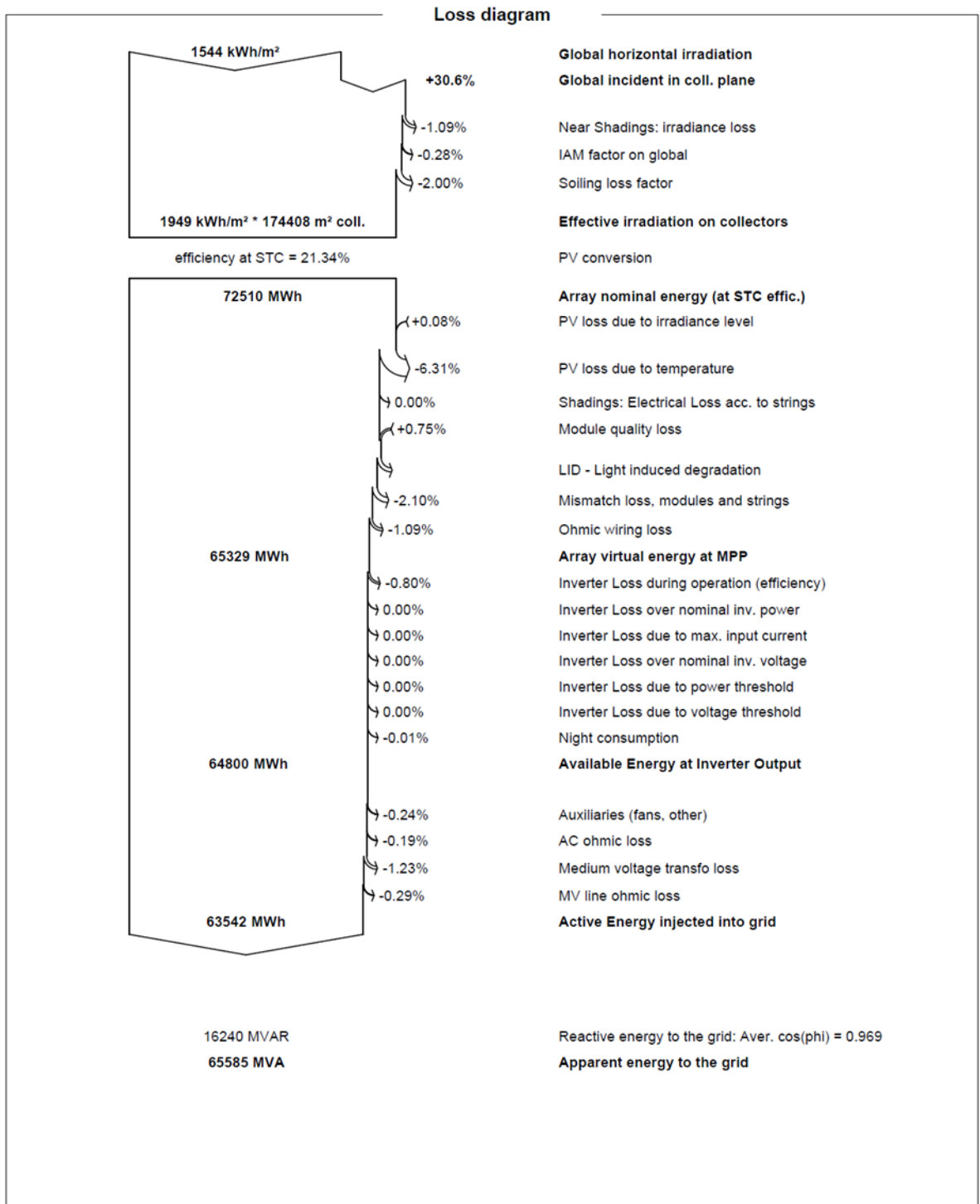
GlobHor Global horizontal irradiation
 DiffHor Horizontal diffuse irradiation
 T_Amb Ambient Temperature
 GlobInc Global incident in coll. plane
 GlobEff Effective Global, corr. for IAM and shadings

EArray Effective energy at the output of the array
 E_Grid Energy injected into grid
 PR Performance Ratio



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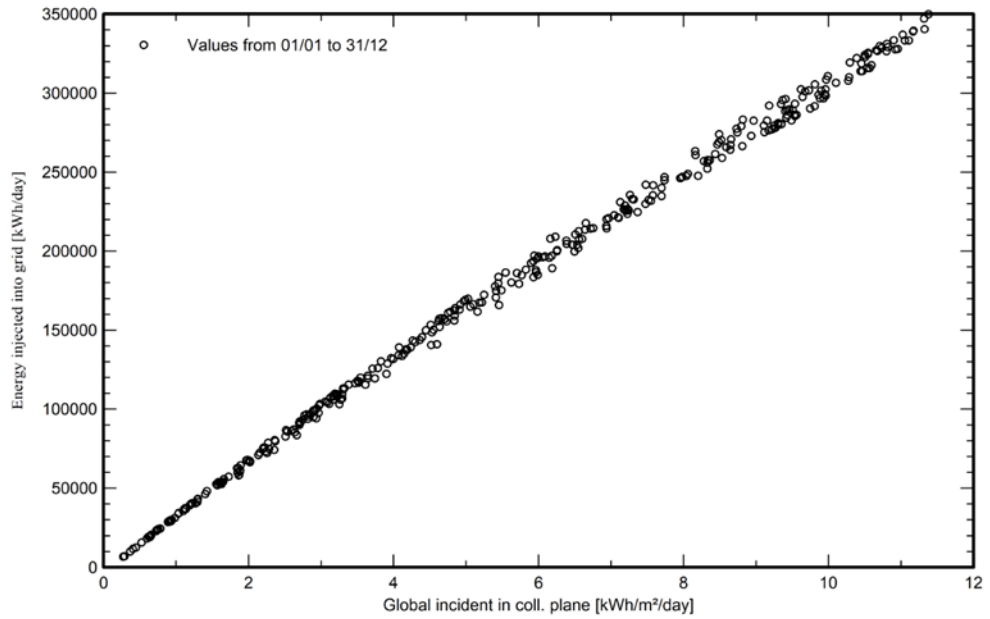


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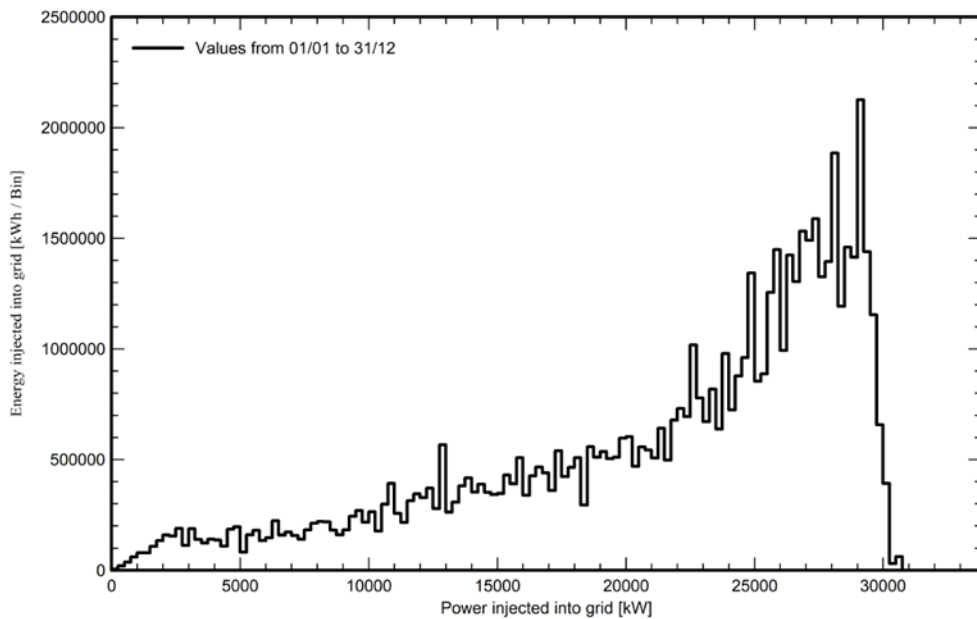
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Special graphs

Diagramma giornaliero entrata/uscita



Distribuzione potenza in uscita sistema



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P50 - P90 evaluation
Meteo data

 Source PVGIS api TMY
Kind Not defined
Year-to-year variability(Variance) 0.0 %

Specified Deviation
Global variability (meteo + system)

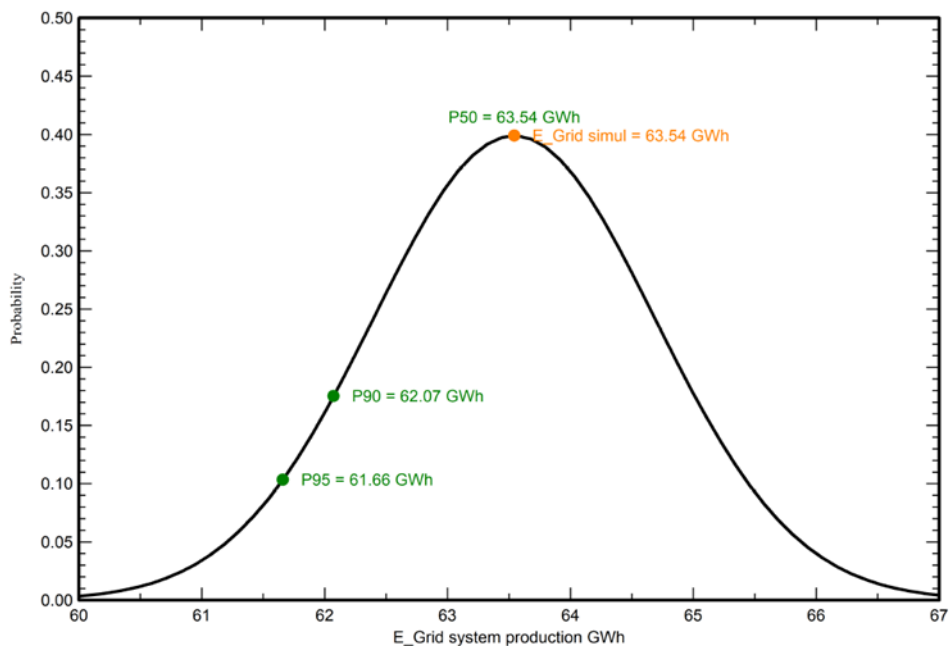
Variability (Quadratic sum) 1.8 %

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 1.15 GWh
P50 63.54 GWh
P90 62.07 GWh
P95 61.66 GWh

Probability distribution


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|  E N E R G Y E N V I R O N M E N T E N G I N E E R I N G | Impianto Fotovoltaico “ACQUAPENDENTE ” da 37.15 MWp Relazione Autoconsumo Energia Elettrica OGGETTO / SUBJECT | ICA FOR s.r.l. CLIENTE / CUSTOMER |
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Come riportato nel diagramma di flusso di cui sopra, si evidenzia che:

- l'energia elettrica disponibile all'uscita degli inverter (energia elettrica in corrente alternata) è pari a circa 64.800 MWh/anno;
- le perdite di impianto sulla sezione in corrente alternata (perdite di linea e di trasformazione) sono pari a circa 1.098 MWh/anno;
- l'energia elettrica necessaria per l'alimentazione dei servizi ausiliari di impianto è stimabile con buona approssimazione in 150 MWh/anno;
- il sistema di videosorveglianza e controllo presenta un consumo elettrico annuo molto contenuto, dell'ordine dei 10 MWh/anno.

La produzione elettrica netta immessa nella rete elettrica nazionale è pari a circa:

63.542 MWh/anno.

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