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NOME COMMESSA:

CONSTRUZIONE ED ESERCIZIO NUOVO IMPIANTO AGRIVOLTAICO AVENTE POTENZA NOMINALE PARI A 9.400 kW E POTENZA MODULI PARI A 11.466,65 kWp, CON RELATIVO COLLEGAMENTO ALLA RETE ELETTRICA, SITO NEL COMUNE DI GUAGNANO (LE) - IMPIANTO SV03

STATO DI AVANZAMENTO COMMESSA:

PROGETTO DEFINITIVO PER AUTORIZZAZIONE UNICA

CODICE COMMESSA:

HE.19.0049

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COLLABORATORE: Girardi per.ind. Mirko

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dott.ing.Vito Calò Ambiente idraulica strutture
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dott. Gianfranco Dimitri archeologo
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Gruppo di Lavoro LL Ambiente Idraulica Agronomica Acustica Archeologica Geologica
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OGGETTO:

Analisi della risorsa solare e stima di produzione energia

SCALA:

-

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NOVEMBRE 2022

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N. REV.	DATA	REVISIONE
0	11/2022	Emissione

ELABORATO
Girardi per.ind. Mirko

VERIFICATO
responsabile commessa
Girardi per.ind. Mirko

VALIDATO
direttore tecnico
dott.ing. Alberto Albuzzi

PVsyst - Simulation report

Grid-Connected System

Project: HE.19.0024 HEPV19 SV03

Variant: SARAH

Tracking system with backtracking

System power: 11.47 MWp

HE190024_FZ03 - Italy

Author

Heliopolis spa (Italy)



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Heliopolis spa (Italy)

Project summary

Geographical Site HE190024_FZ03 Italy	Situation Latitude 40.41 °N Longitude 17.99 °E Altitude 34 m Time zone UTC+1	Project settings Albedo 0.20
Meteo data HE190024_FZ03 PVGIS TMY: SARAH, COSMO or NSRDB - Synthetic		

System summary

Grid-Connected System Simulation for year no 1	Tracking system with backtracking		
PV Field Orientation Orientation Tracking plane, horizontal N-S axis Axis azimuth 0 °	Tracking algorithm Astronomic calculation Backtracking activated		Near Shadings Linear shadings
System information			
PV Array Nb. of modules Pnom total	19942 units 11.47 MWp	Inverters Nb. of units Pnom total Pnom ratio	30 units 8830 kWac 1.299
User's needs Unlimited load (grid)			

Results summary

Produced Energy	21.21 GWh/year	Specific production	1850 kWh/kWp/year	Perf. Ratio PR	82.40 %
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**PVsyst V7.2.21**

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General parameters**Grid-Connected System****PV Field Orientation****Orientation**

Tracking plane, horizontal N-S axis
Axis azimuth 0 °

Models used

Transposition Perez
Diffuse Perez, Meteonorm
Circumsolar separate

Horizon

Free Horizon

Tracking system with backtracking**Tracking algorithm**

Astronomic calculation
Backtracking activated

Near Shadings

Linear shadings

Backtracking array

Nb. of trackers 153 units

Sizes

Tracker Spacing 5.50 m
Collector width 2.28 m
Ground Cov. Ratio (GCR) 41.4 %
Phi min / max. +/- 60.0 °

Backtracking strategy

Phi limits +/- 65.4 °
Backtracking pitch 5.50 m
Backtracking width 2.28 m

User's needs

Unlimited load (grid)

PV Array Characteristics**PV module**

Manufacturer Jinkosolar
Model JKM-575N-72HL4-V_HE
(Custom parameters definition)

Unit Nom. Power 575 Wp
Number of PV modules 5746 units
Nominal (STC) 3304 kWp

Array #1 - Sub-array NORD

Number of PV modules 5200 units
Nominal (STC) 2990 kWp
Modules 200 Strings x 26 In series

At operating cond. (50°C)

Pmpp 2750 kWp
U mpp 1004 V
I mpp 2738 A

Array #5 - Sub-array SUD3B

Number of PV modules 546 units
Nominal (STC) 314 kWp
Modules 21 Strings x 26 In series

At operating cond. (50°C)

Pmpp 289 kWp
U mpp 1004 V
I mpp 288 A

PV module

Manufacturer Jinkosolar
Model JKM-575N-72HL4-V_HE
(Custom parameters definition)

Unit Nom. Power 575 Wp
Number of PV modules 14196 units
Nominal (STC) 8163 kWp

Inverter

Manufacturer Sungrow
Model SG250-HX
(Original PVsyst database)

Unit Nom. Power 250 kWac
Number of inverters 11 units
Total power 2750 kWac

Number of inverters 120 * MPPT 8% 10 units
Total power 2500 kWac

Operating voltage 500-1450 V
Pnom ratio (DC:AC) 1.20

Number of inverters 12 * MPPT 8% 1 unit
Total power 250 kWac

Operating voltage 500-1450 V
Pnom ratio (DC:AC) 1.26

Inverter

Manufacturer Sungrow
Model SG350HX-20A-Preliminary
(Custom parameters definition)

Unit Nom. Power 320 kWac
Number of inverters 19 units
Total power 6080 kWac



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PV Array Characteristics

Array #2 - Sub-array SUD1			
Number of PV modules	4602 units	Number of inverters	72 * MPPT 8% 6 units
Nominal (STC)	2646 kWp	Total power	1920 kWac
Modules	177 Strings x 26 In series		
At operating cond. (50°C)			
Pmpp	2434 kWp	Operating voltage	500-1500 V
U mpp	1004 V	Max. power (=>30°C)	352 kWac
I mpp	2423 A	Pnom ratio (DC:AC)	1.38
Array #3 - Sub-array SUD2			
Number of PV modules	4680 units	Number of inverters	72 * MPPT 8% 6 units
Nominal (STC)	2691 kWp	Total power	1920 kWac
Modules	180 Strings x 26 In series		
At operating cond. (50°C)			
Pmpp	2475 kWp	Operating voltage	500-1500 V
U mpp	1004 V	Max. power (=>30°C)	352 kWac
I mpp	2464 A	Pnom ratio (DC:AC)	1.40
Array #4 - Sub-array SUD3A			
Number of PV modules	4914 units	Number of inverters	84 * MPPT 8% 7 units
Nominal (STC)	2826 kWp	Total power	2240 kWac
Modules	189 Strings x 26 In series		
At operating cond. (50°C)			
Pmpp	2599 kWp	Operating voltage	500-1500 V
U mpp	1004 V	Max. power (=>30°C)	352 kWac
I mpp	2588 A	Pnom ratio (DC:AC)	1.26
Total PV power		Total inverter power	
Nominal (STC)	11467 kWp	Total power	8830 kWac
Total	19942 modules	Number of inverters	30 units
Module area	51515 m ²	Pnom ratio	1.30

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	-0.6 %	Loss Fraction	0.7 % at MPP	Loss Fraction	0.1 %			
Module average degradation								
Year no	1							
Loss factor	0.5 %/year							
Mismatch due to degradation								
Imp RMS dispersion	0 %/year							
Vmp RMS dispersion	0 %/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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DC wiring losses

Global wiring resistance 0.42 mΩ
Loss Fraction 0.4 % at STC

Array #1 - Sub-array NORD

Global array res. 1.6 mΩ
Loss Fraction 0.4 % at STC

Array #3 - Sub-array SUD2

Global array res. 1.8 mΩ
Loss Fraction 0.4 % at STC

Array #5 - Sub-array SUD3B

Global array res. 15 mΩ
Loss Fraction 0.4 % at STC

Array #2 - Sub-array SUD1

Global array res. 1.8 mΩ
Loss Fraction 0.4 % at STC

Array #4 - Sub-array SUD3A

Global array res. 1.7 mΩ
Loss Fraction 0.4 % at STC

System losses

Auxiliaries loss

Proportionnal to Power 4.0 W/kW
0.0 kW from Power thresh.

AC wiring losses

Inv. output line up to MV transfo

Inverter voltage 800 Vac tri
Loss Fraction 1.40 % at STC

Global System

Wire section Copper 3 x 4000 mm²
Wires length 169 m

AC losses in transformers

MV transfo

Grid voltage 20 kV

Operating losses at STC

Nominal power at STC 11312 kVA
Iron loss (night disconnect) 11.31 kW
Loss Fraction 0.10 % at STC
Coils equivalent resistance 3 x 0.57 mΩ
Loss Fraction 1.00 % at STC



Main results

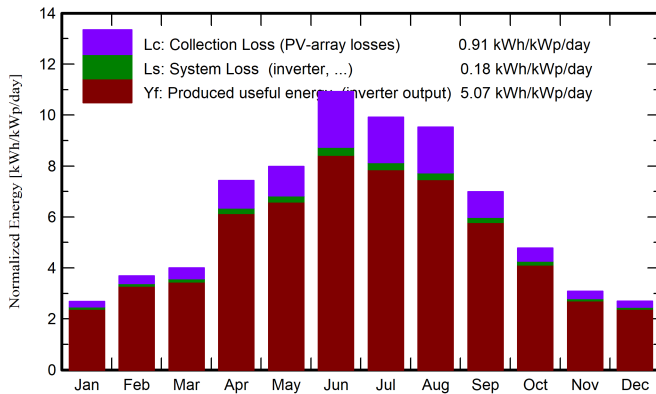
System Production

Produced Energy 21.21 GWh/year

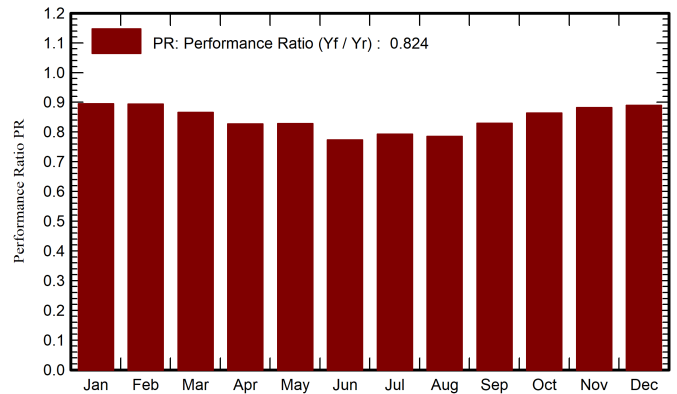
Specific production
Performance Ratio PR

1850 kWh/kWp/year
82.40 %

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	63.3	31.40	7.76	83.1	77.8	0.881	0.852	0.895
February	79.2	37.30	9.74	103.1	97.5	1.092	1.057	0.894
March	101.1	53.60	11.26	124.0	117.6	1.274	1.232	0.866
April	170.2	64.80	14.84	222.8	214.2	2.187	2.113	0.827
May	189.3	69.70	17.70	247.2	238.2	2.429	2.347	0.828
June	247.1	62.40	24.45	327.5	317.2	3.007	2.903	0.773
July	230.3	67.10	26.32	307.5	297.2	2.894	2.795	0.793
August	219.1	54.90	27.63	295.4	286.0	2.754	2.658	0.785
September	156.8	52.70	23.41	209.7	201.7	2.065	1.994	0.829
October	112.1	45.70	18.77	148.2	141.1	1.518	1.469	0.864
November	69.2	29.40	13.46	92.7	87.1	0.968	0.937	0.882
December	60.8	25.80	9.57	83.4	77.7	0.877	0.850	0.889
Year	1698.5	594.80	17.11	2244.5	2153.4	21.947	21.208	0.824

Legends

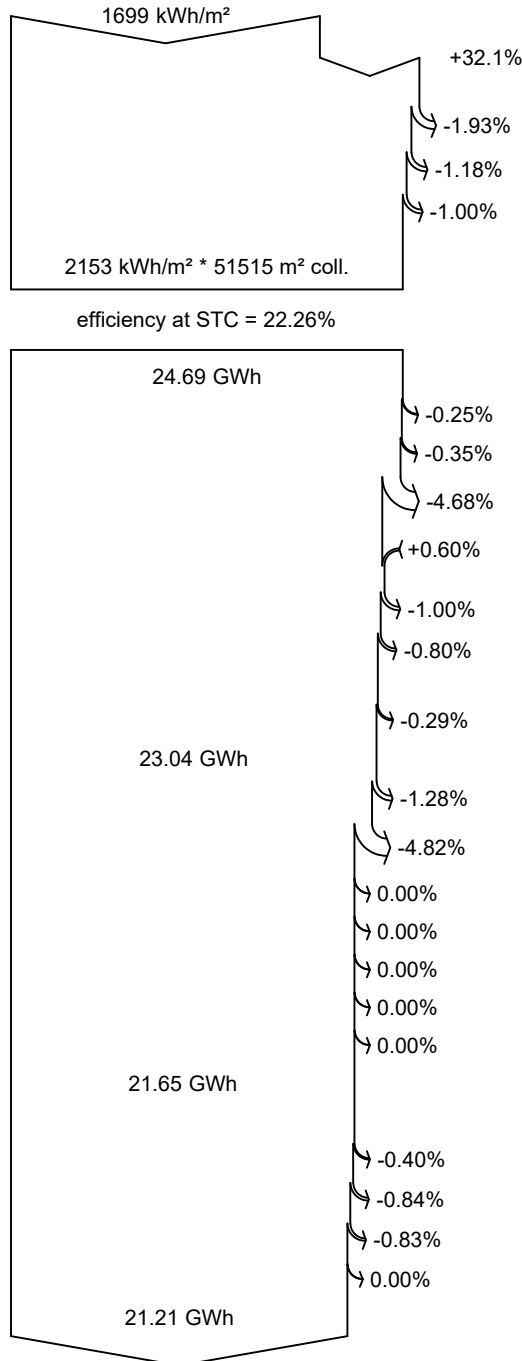
- GlobHor Global horizontal irradiation
- DiffHor Horizontal diffuse irradiation
- T_Amb Ambient Temperature
- GlobInc Global incident in coll. plane
- GlobEff Effective Global, corr. for IAM and shadings
- EArray Effective energy at the output of the array
- E_Grid Energy injected into grid
- PR Performance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



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Loss diagram



- Global horizontal irradiation**
- Global incident in coll. plane**
- Near Shadings: irradiance loss
- IAM factor on global
- Soiling loss factor
- Effective irradiation on collectors**
- PV conversion
- Array nominal energy (at STC effic.)**
- Module Degradation Loss (for year #1)
- PV loss due to irradiance level
- PV loss due to temperature
- Module quality loss
- LID - Light induced degradation
- Mismatch loss, modules and strings (including 0% 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
- Medium voltage transfo loss
- MV line ohmic loss
- Energy injected into grid**

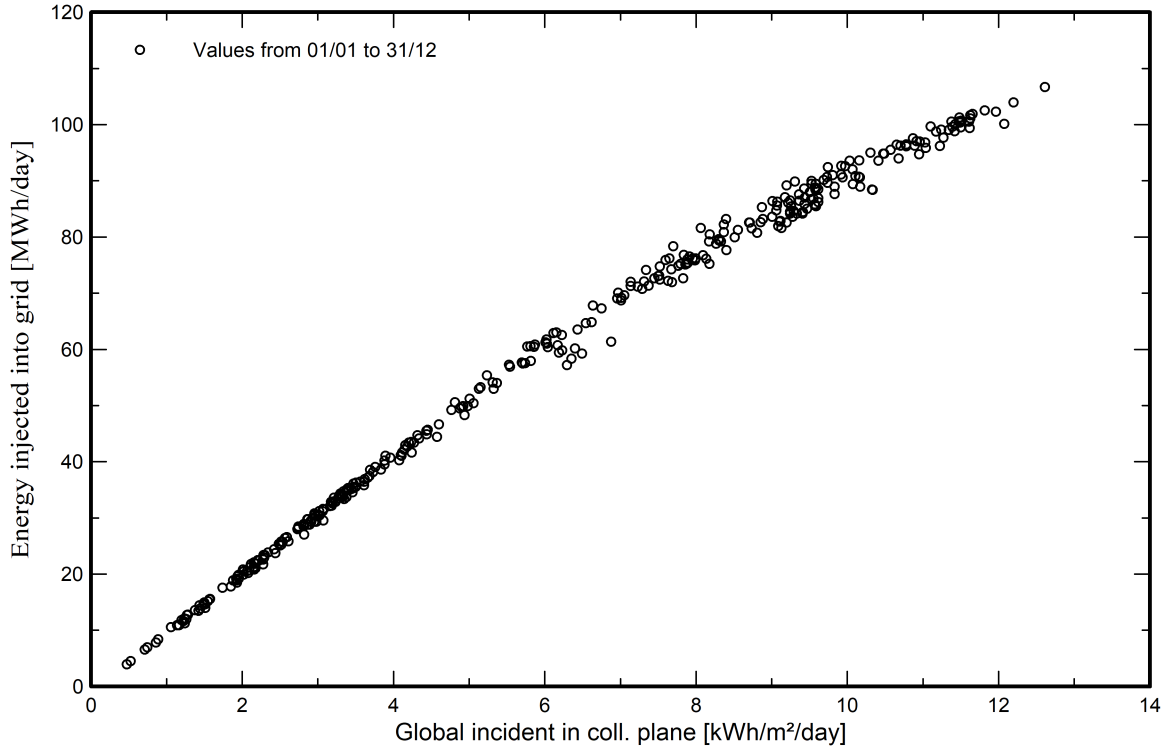


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Special graphs

Daily Input/Output diagram



System Output Power Distribution

