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Techbau

Engineering & Construction



00	2024/06/24	Progetto Definitivo	A.B.	A.B.
REV.	DATA Date	DESCRIZIONE Description	PE Drawn by	PM Appr. by

LUOGO Site

MASSERANO - LOCALITA' REGIONE QUATTRO MADAME

PROGETTO Project

AREA EX FORNACI

OGGETTO Subject

REALIZZAZIONE ED ESERCIZIO DI UN LOTTO DI IMPIANTI FOTOVOLTAICI DELLA POTENZA DI 15,73 MWp E DELLE OPERE DI CONNESSIONE

TEAM DI PROGETTO:

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TITOLO DOCUMENTO Document name

SIMULAZIONE DI PRODUZIONE

CODICE ARCHIVIO Document Code

SCALA Scale

F:F

Il tecnico Technical designer

NUMERO Number

REV.

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PVsyst - Simulation report

Grid-Connected System

Project: MASSERANO

Variant: EST-OVEST rev06-2024

No 3D scene defined, no shadings

System power: 15.73 MWp

MASSERANO - Italia

Autore

Ballaré Ing. Arnaldo (Italy)



Project: MASSERANO

Variant: EST-OVEST rev06-2024

PVsyst V7.4.7

VC6, Simulation date:
20/06/24 15:54
with V7.4.7

Ballaré Ing.Arnaldo (Italy)

Project summary

Geographical Site MASSERANO Italia	Situation Latitude 45.55 °N Longitude 8.26 °E Altitude 237 m Time zone UTC+1	Project settings Albedo 0.20
Weather data MASSERANO Meteonorm 8.1 (1996-2015), Sat=100% - Synthetic		

System summary

Grid-Connected System	No 3D scene defined, no shadings	
PV Field Orientation Fixed planes 2 orientations Tilts/azimuths 15 / -93 ° 15 / 87 °	Near Shadings No Shadings	User's needs Unlimited load (grid)
System information		
PV Array Nb. of modules 32768 units Pnom total 15.73 MWp	Inverters Nb. of units 44 units Pnom total 13.20 MWac Grid power limit 13.20 MWac Grid lim. Pnom ratio 1.192	

Results summary

Produced Energy 18945881 kWh/year	Specific production 1205 kWh/kWp/year	Perf. Ratio PR 92.21 %
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Project: MASSERANO

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Ballaré Ing.Arnaldo (Italy)

General parameters

Grid-Connected System	No 3D scene defined, no shadings	
PV Field Orientation	Sheds configuration	Models used
Orientation		Transposition Perez
Fixed planes 2 orientations		Diffuse Perez, Meteonorm
Tilts/azimuths 15 / -93 °		Circumsolar separate
15 / 87 °		
Horizon	Near Shadings	User's needs
Free Horizon	No Shadings	Unlimited load (grid)
Grid power limitation		
Active power 13.20 MWac		
Pnom ratio 1.192		

PV Array Characteristics

PV module	Inverter	
Manufacturer Jinkosolar	Manufacturer Huawei Technologies	
Model JKM480N-60HL4-V	Model SUN2000-330KTL-H1	
(Custom parameters definition)	(Custom parameters definition)	
Unit Nom. Power 480 Wp	Unit Nom. Power 300 kWac	
Number of PV modules 32768 units	Number of inverters 44 units	
Nominal (STC) 15.73 MWp	Total power 13200 kWac	
Array #1 - EST		
Orientation #1		
Tilt/Azimuth 15/-93 °		
Number of PV modules 16384 units	Number of inverters 132 * MPPT 17% 22 units	
Nominal (STC) 7864 kWp	Total power 6600 kWac	
Modules 512 string x 32 In series		
At operating cond. (50°C)	Operating voltage 500-1500 V	
Pmpp 7275 kWp	Max. power (=>30°C) 330 kWac	
U mpp 1037 V	Pnom ratio (DC:AC) 1.19	
I mpp 7012 A	No power sharing between MPPTs	
Array #2 - OVEST		
Orientation #2		
Tilt/Azimuth 15/87 °		
Number of PV modules 16384 units	Number of inverters 132 * MPPT 17% 22 units	
Nominal (STC) 7864 kWp	Total power 6600 kWac	
Modules 512 string x 32 In series		
At operating cond. (50°C)	Operating voltage 500-1500 V	
Pmpp 7275 kWp	Max. power (=>30°C) 330 kWac	
U mpp 1037 V	Pnom ratio (DC:AC) 1.19	
I mpp 7012 A	No power sharing between MPPTs	
Total PV power	Total inverter power	
Nominal (STC) 15729 kWp	Total power 13200 kWac	
Total 32768 modules	Number of inverters 44 units	
Module area 70713 m²	Pnom ratio 1.19	
Cell area 64920 m²	No power sharing	



PVsyst V7.4.7

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Array losses

Thermal Loss factor

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

DC wiring losses

Global array res. 2.4 mΩ
Global wiring resistance 1.2 mΩ
Loss Fraction 1.5 % at STC

LID - Light Induced Degradation

Loss Fraction 0.5 %

Module Quality Loss

Loss Fraction -0.8 %

Module mismatch losses

Loss Fraction 2.5 % at MPP

Strings Mismatch loss

Loss Fraction 0.1 %

IAM loss factor

Incidence effect (IAM): User defined profile

0°	30°	50°	60°	70°	75°	80°	85°	90°
1.000	1.000	1.000	1.000	0.989	0.971	0.931	0.737	0.000

AC wiring losses

Inv. output line up to MV transfo

Inverter voltage 800 Vac tri
Loss Fraction 0.58 % at STC

Inverter: SUN2000-330KTL-H1

Wire section (44 Inv.) Alu 44 x 3 x 300 mm²
Average wires length 100 m

MV line up to Injection

MV Voltage 15 kV
Average each inverter
Wires Alu 3 x 70 mm²
Length 300 m
Loss Fraction 0.23 % at STC

AC losses in transformers

MV transfo

Medium voltage 15 kV

One transfo parameters

Nominal power at STC 3.87 MVA
Iron Loss (24/24 Connexion) 1.91 kVA
Iron loss fraction 0.05 % at STC
Copper loss 46.99 kVA
Copper loss fraction 1.21 % at STC
Coils equivalent resistance 3 x 2.01 mΩ

Operating losses at STC (full system)

Nb. identical MV transfos 4
Nominal power at STC 15.47 MVA
Iron loss (24/24 Connexion) 7.63 kVA
Copper loss 187.98 kVA



Main results

System Production

Produced Energy 18945881 kWh/year

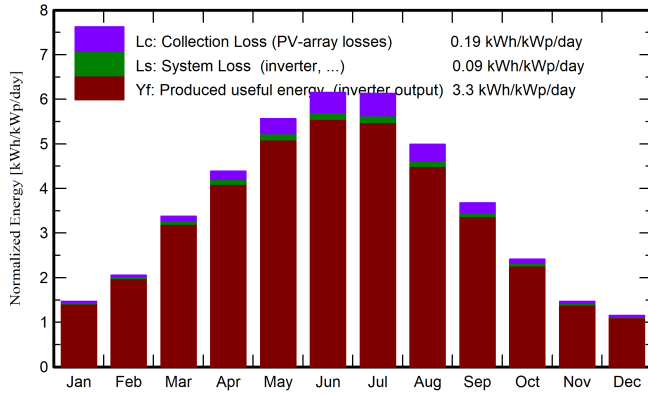
Specific production

1205 kWh/kWp/year

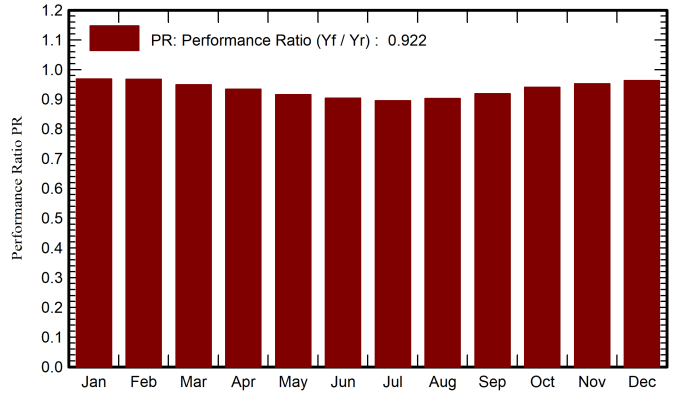
Perf. Ratio PR

92.21 %

Normalized productions (per installed kWp)



Performance Ratio PR



Balances and main results

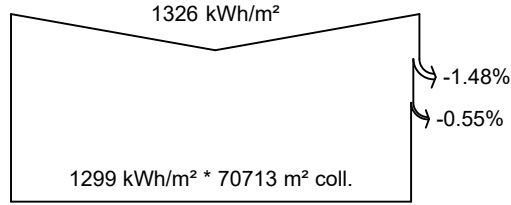
	GlobHor kWh/m ²	DiffHor kWh/m ²	T_Amb °C	GlobInc kWh/m ²	GlobEff kWh/m ²	EArray kWh	E_Grid kWh	PR ratio
January	46.0	22.60	1.43	45.4	44.8	709689	691574	0.968
February	58.3	29.80	3.39	57.5	57.1	896304	874614	0.967
March	106.3	49.73	8.42	104.8	104.2	1603488	1564143	0.949
April	133.8	63.22	12.39	131.7	131.1	1984779	1934277	0.934
May	175.5	79.12	16.98	172.5	171.9	2552051	2484837	0.916
June	187.3	89.22	21.33	184.7	183.9	2695050	2623884	0.903
July	192.8	84.47	23.50	190.1	189.4	2749273	2675661	0.895
August	157.0	78.97	22.85	154.8	154.1	2254514	2196538	0.902
September	112.3	55.16	18.08	110.4	109.8	1636296	1594860	0.919
October	75.7	41.94	13.15	74.8	74.2	1134360	1106727	0.941
November	44.6	22.60	7.17	44.0	43.5	677317	659449	0.952
December	36.3	20.91	2.33	35.6	35.1	554542	539317	0.962
Year	1325.9	637.73	12.64	1306.3	1299.1	19447663	18945881	0.922

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		



Loss diagram



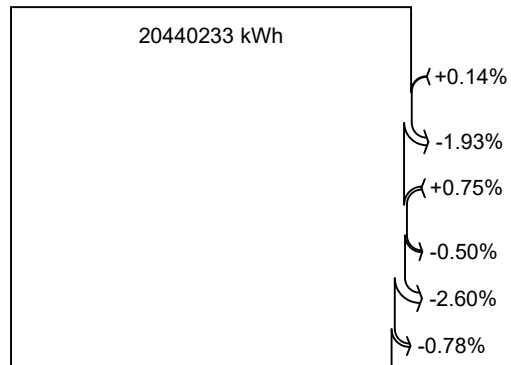
Global horizontal irradiation

Global incident in coll. plane

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

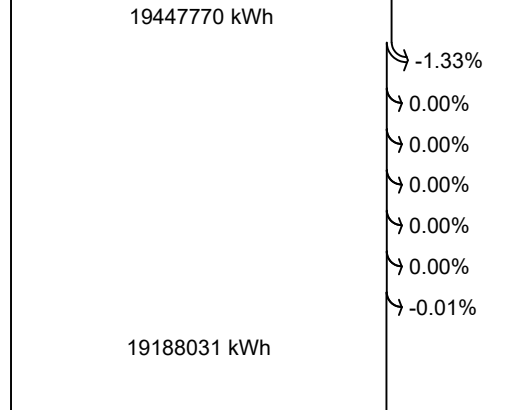
Inverter Loss due to max. input current

Inverter Loss over nominal inv. voltage

Inverter Loss due to power threshold

Inverter Loss due to voltage threshold

Night consumption



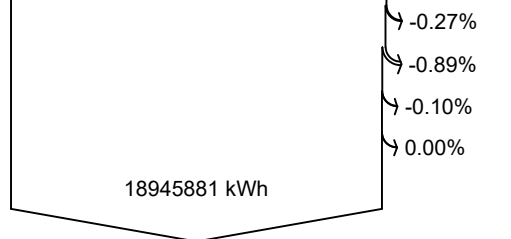
Available Energy at Inverter Output

AC ohmic loss

Medium voltage transfo loss

MV line ohmic loss

Unused energy (grid limitation)

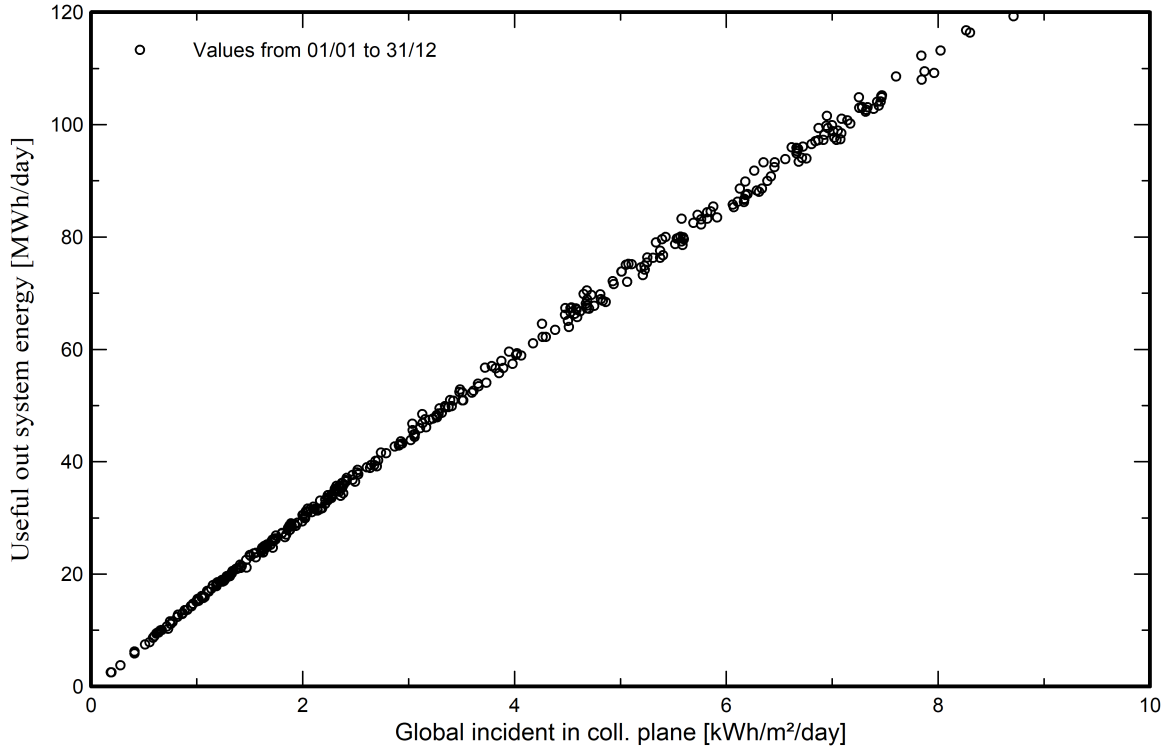


Energy injected into grid



Predef. graphs

Diagramma giornaliero entrata/uscita



Distribuzione potenza in uscita sistema

