

IMPIANTO FOTOVOLTAICO EG DANTE SRL E OPERE CONNESSE

POTENZA IMPIANTO 19,01 MWp - COMUNE DI PORTOMAGGIORE (FE)

Proponente

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Titolo Elaborato

STIMA PRODUCIBILITÀ

LIVELLO PROGETTAZIONE	CODICE ELABORATO	FILENAME	RIFERIMENTO	DATA	SCALA
DEFINITIVO	REL03_00	-	-	15/12/2021	-

Revisioni

REV.	DATA	DESCRIZIONE	ESEGUITO	VERIFICATO	APPROVATO
	15/12/2021	RT	LP	MB/MP	EG



Comune di Portomaggiore (FE)

Regione EMILIA ROMAGNA



STIMA PRODUCIBILITÀ

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1. STIMA PRODUCIBILITA'

Di seguito si riportano il dettaglio di calcolo relativo alla stima di producibilità degli impianti in esame.

Project summary			
Geographical Site Ferrara BANDO Italy	Situation Latitude Longitude Altitude Time zone	44.86 °N 11.88 °E 10 m UTC+1	Project settings Albedo 0.20
Meteo data Ferrara BANDO SolarGIS Monthly aver. , period not spec. - Synthetic			

System summary			
Grid-Connected System	Tracking system with backtracking		
PV Field Orientation Orientation Tracking plane, tilted axis Axis Tilt 0 ° Azimuth 0 °	Tracking algorithm Astronomic calculation Backtracking activated	Near Shadings Linear shadings	
System information PV Array Nb. of modules 32224 units Pnom total 19.01 MWp	Inverters Nb. of units 84 units Pnom total 16.80 MWac Grid power limit 16.00 MVA Grid lim. Pnom ratio 1.188		
User's needs Unlimited load (grid)			

Results summary					
Produced Energy	30479 MWh/year	Specific production	1603 kWh/kWp/year	Perf. Ratio PR	88.03 %
Apparent energy	30479 MVAh				

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General parameters

Grid-Connected System		Tracking system with backtracking										
PV Field Orientation		Tracking algorithm	Backtracking strategy									
Orientation		Astronomic calculation	Nb. of trackers 356 units									
Tracking plane, tilted axis		Backtracking activated	Sizes									
Axis Tilt	0 °		Tracker Spacing 9.00 m									
Azimuth	0 °		Collector width 4.49 m									
			Ground Cov. Ratio (GCR) 49.9 %									
			Phi min / max. +/- 60.0 °									
			Backtracking limit angle									
			Phi limits +/- 59.9 °									
Models used												
Transposition	Perez											
Diffuse	Perez, Meteonom											
Circumsolar	separate											
Horizon		Near Shadings	User's needs									
Free Horizon		Linear shadings	Unlimited load (grid)									
Bifacial system												
Model	2D Calculation unlimited trackers											
Bifacial model geometry		Bifacial model definitions										
Tracker Spacing	9.00 m	Ground albedo average	0.15									
Tracker width	4.49 m	Bifaciality factor	70 %									
GCR	49.9 %	Rear shading factor	4.0 %									
Axis height above ground	2.10 m	Rear mismatch loss	3.5 %									
		Shed transparent fraction	4.0 %									
Monthly ground albedo values												
Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year
0.11	0.15	0.16	0.18	0.18	0.19	0.17	0.17	0.16	0.13	0.11	0.12	0.15
Grid injection point												
Grid power limitation		Power factor										
Apparent power	16.00 MVA	Cos(phi) (leading)	1.000									
Pnom ratio	1.188											

PV Array Characteristics

PV module		Inverter	
Manufacturer	Trina Solar	Manufacturer	Huawei Technologies
Model	TSM-560DEG20C.20	Model	SUN2000-215KTL-H3
(Custom parameters definition)		(Custom parameters definition)	
Unit Nom. Power	590 Wp	Unit Nom. Power	200 kVA
Number of PV modules	32224 units	Number of inverters	84 units
Nominal (STC)	19.01 MWp	Total power	16800 kVA
Modules	1007 Strings x 32 In series	Operating voltage	500-1500 V
At operating cond. (50°C)		Max. power (=>33°C)	215 kVA
Pmpp	17.40 MWp	Pnom ratio (DC:AC)	1.13
U mpp	990 V		
I mpp	17575 A		

PV Array Characteristics

Total PV power		Total inverter power	
Nominal (STC)	19012 kWp	Total power	16800 kVA
Total	32224 modules	Nb. of inverters	84 units
Module area	91198 m ²	Phom ratio	1.13
Cell area	85265 m ²		

Array losses

Array Soiling Losses		Thermal Loss factor		DC wiring losses				
Loss Fraction	1.5 %	Module temperature according to irradiance		Global array res.	0.48 mΩ			
		Uc (const)	30.0 W/m ² K	Loss Fraction	0.7 % at STC			
		Uv (wind)	1.2 W/m ² K/m/s					
LID - Light Induced Degradation		Module Quality Loss		Module mismatch losses				
Loss Fraction	1.5 %	Loss Fraction	-0.8 %	Loss Fraction	0.4 % at MPP			
Strings Mismatch loss								
Loss Fraction	0.1 %							
IAM loss factor								
Incidence effect (IAM): User defined profile								
0°	40°	50°	60°	70°	75°	80°	85°	90°
1.000	1.000	0.998	0.992	0.983	0.961	0.933	0.853	0.000

System losses

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

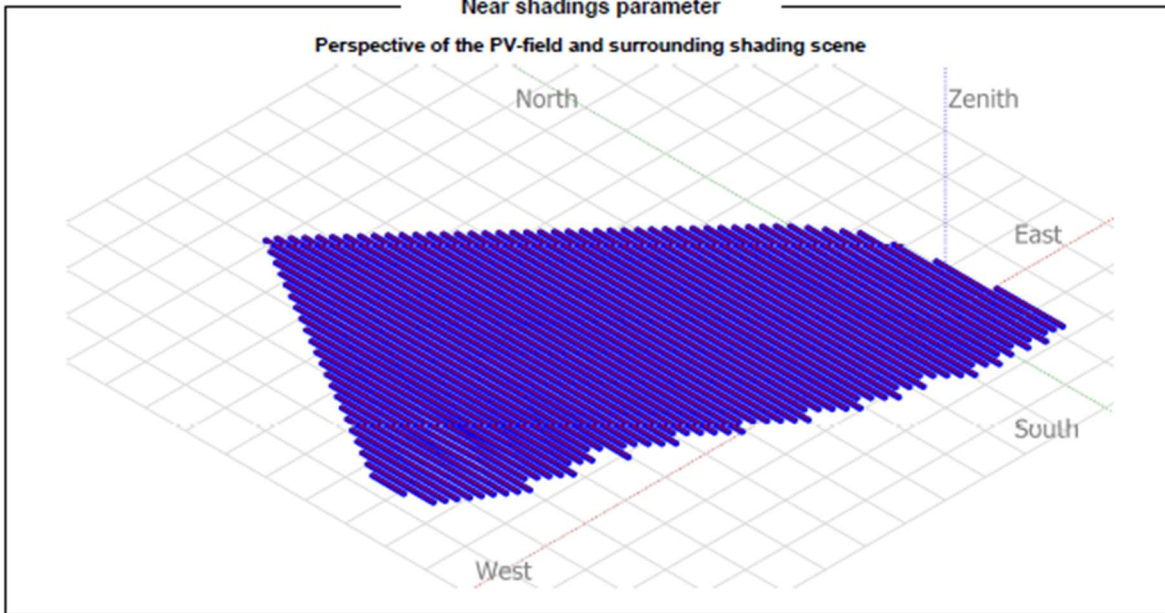
AC wiring losses

Inv. output line up to MV transfo	
Inverter voltage	800 Vac tri
Loss Fraction	1.70 % at STC
Inverter: SUN2000-215KTL-H3	
Wire section (84 Inv.)	Copper 84 x 3 x 70 mm ²
Average wires length	182 m
MV line up to Injection	
MV Voltage	30 kV
Wires	Alu 3 x 400 mm ²
Length	6735 m
Loss Fraction	1.10 % at STC

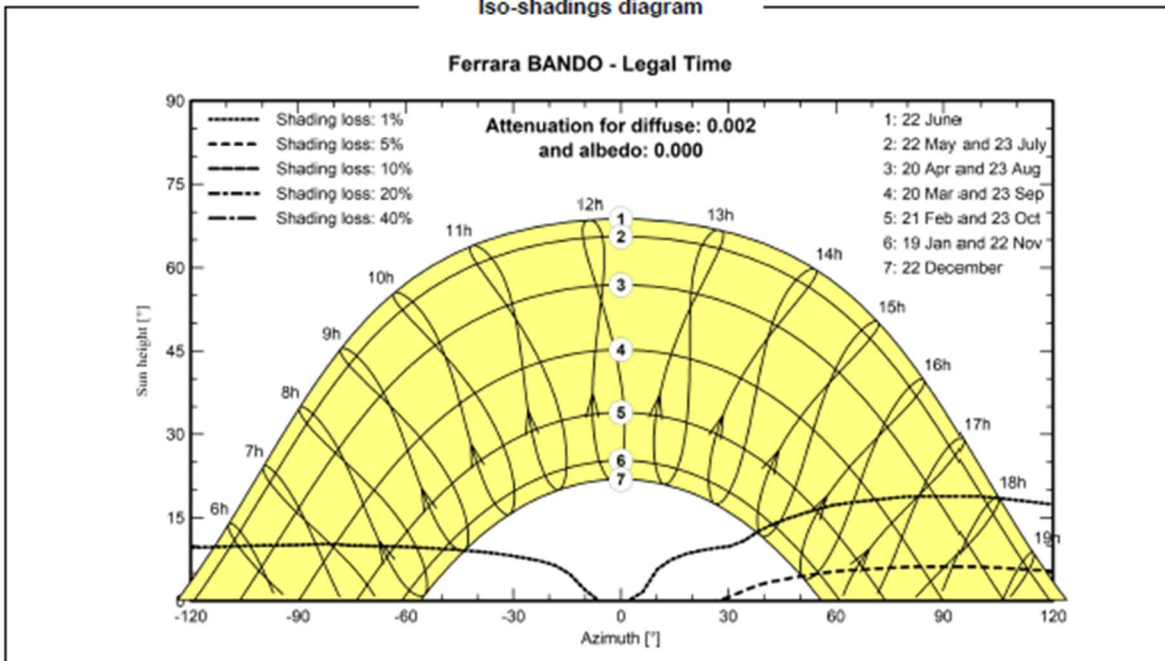
AC losses in transformers

MV transfo	
Grid voltage	30 kV
Operating losses at STC	
Nominal power at STC	18867 kVA
Iron loss (24/24 Connexion)	28.00 kW
Loss Fraction	0.15 % at STC
Coils equivalent resistance	3 x 0.57 mΩ
Loss Fraction	1.65 % at STC

Near shadings parameter



Iso-shadings diagram

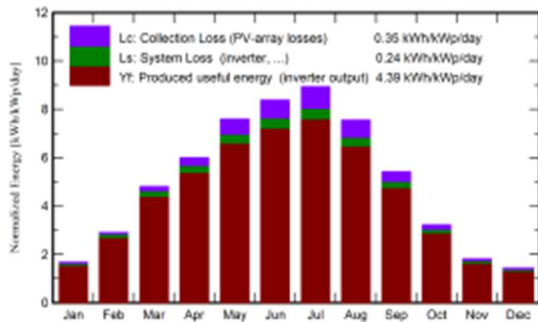


Main results

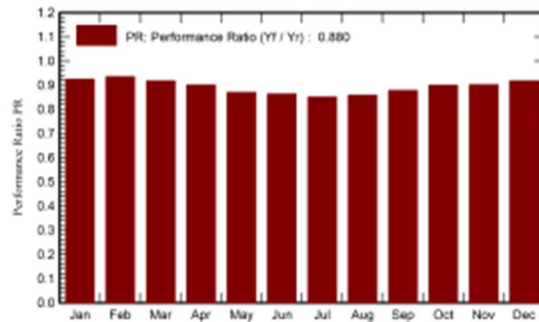
System Production

Produced Energy (P50)	30479 MWh/year	Specific production (P50)	1603 kWh/kWp/year	Performance Ratio PR	88.03 %
Produced Energy (P90)	29.7 GWh/year	Specific production (P90)	1565 kWh/kWp/year		
Produced Energy (P95)	29.5 GWh/year	Specific production (P95)	1554 kWh/kWp/year		
Apparent energy	30479 MVAh				

Normalized productions (per installed kWp)



Performance Ratio PR

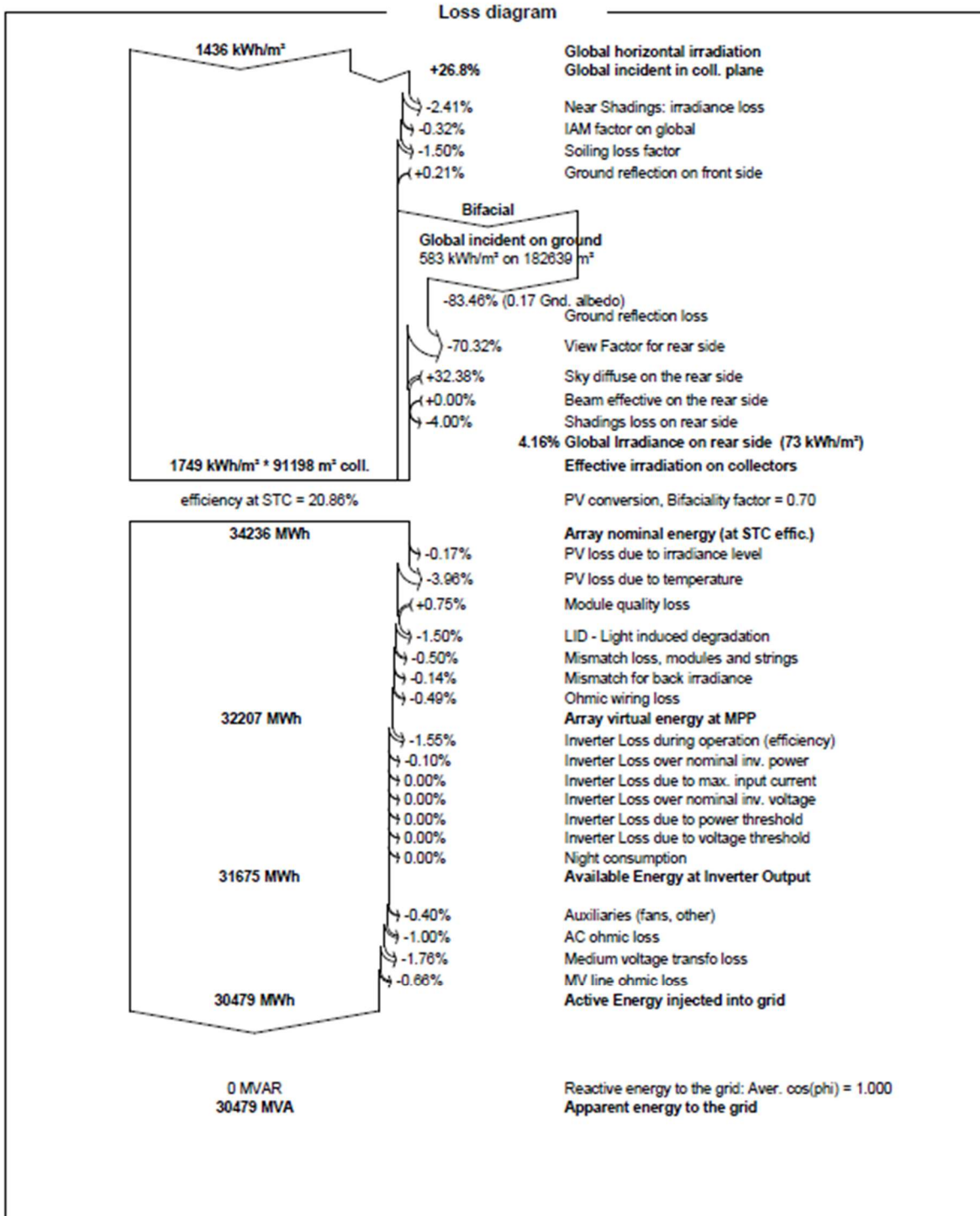


Balances and main results

	GlobHor kWh/m ²	DiffHor kWh/m ²	T_Amb °C	GlobInc kWh/m ²	GlobEff kWh/m ²	EArray MWh	E_Grid MWh	PR ratio
January	42.0	23.00	4.60	51.9	49.0	963	912	0.924
February	64.0	30.00	5.90	81.1	77.5	1514	1442	0.935
March	116.0	49.00	10.20	148.9	142.8	2734	2599	0.918
April	143.0	63.00	14.30	179.9	172.9	3247	3079	0.900
May	187.0	78.00	19.50	235.3	226.5	4113	3892	0.870
June	200.0	81.00	24.00	251.3	242.3	4360	4122	0.863
July	215.0	77.00	26.40	277.1	267.5	4741	4482	0.851
August	181.0	70.00	25.70	234.2	225.7	4039	3824	0.859
September	128.0	55.00	20.80	162.7	156.0	2862	2714	0.878
October	81.0	41.00	15.80	99.8	95.1	1795	1707	0.899
November	44.0	24.00	10.40	54.5	51.6	989	935	0.902
December	35.0	19.00	5.19	44.2	41.8	818	772	0.918
Year	1436.0	610.00	15.29	1821.1	1748.8	32175	30479	0.880

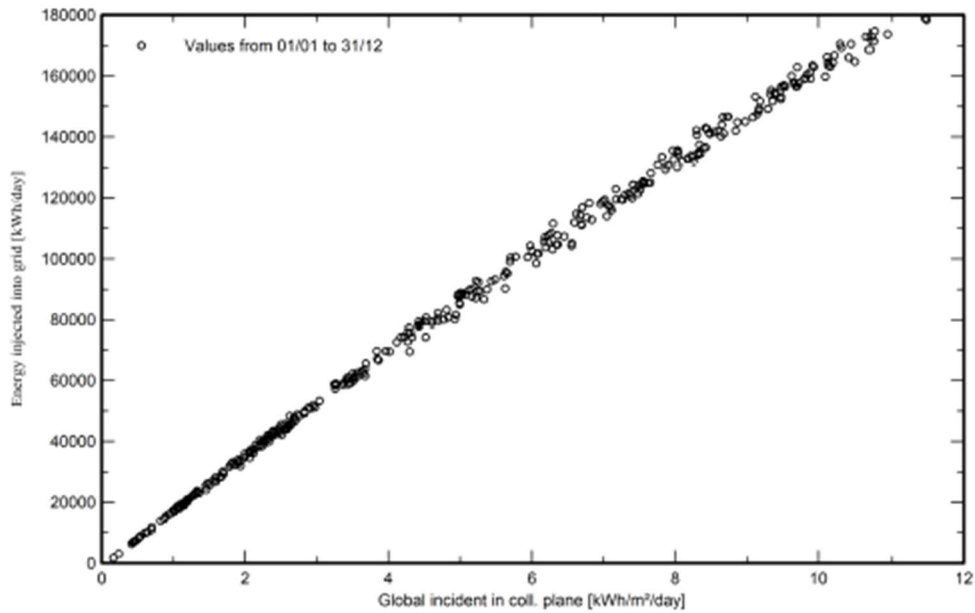
Legends

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		

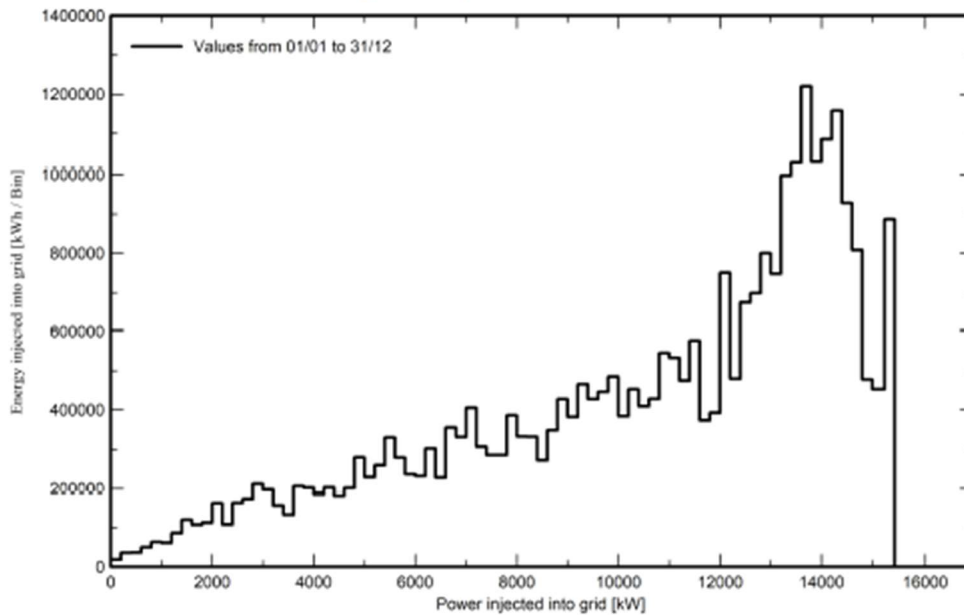


Special graphs

Daily Input/Output diagram



System Output Power Distribution



P50 - P90 evaluation

Meteo data

Source SolarGIS Monthly aver. , period not spec.
 Kind Not defined
 Year-to-year variability(Variance) 0.5 %
 Specified Deviation

Global variability (meteo + system)

Variability (Quadratic sum) 1.9 %

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 0.57 GWh
 P50 30.48 GWh
 P90 29.75 GWh
 P95 29.54 GWh

Probability distribution

