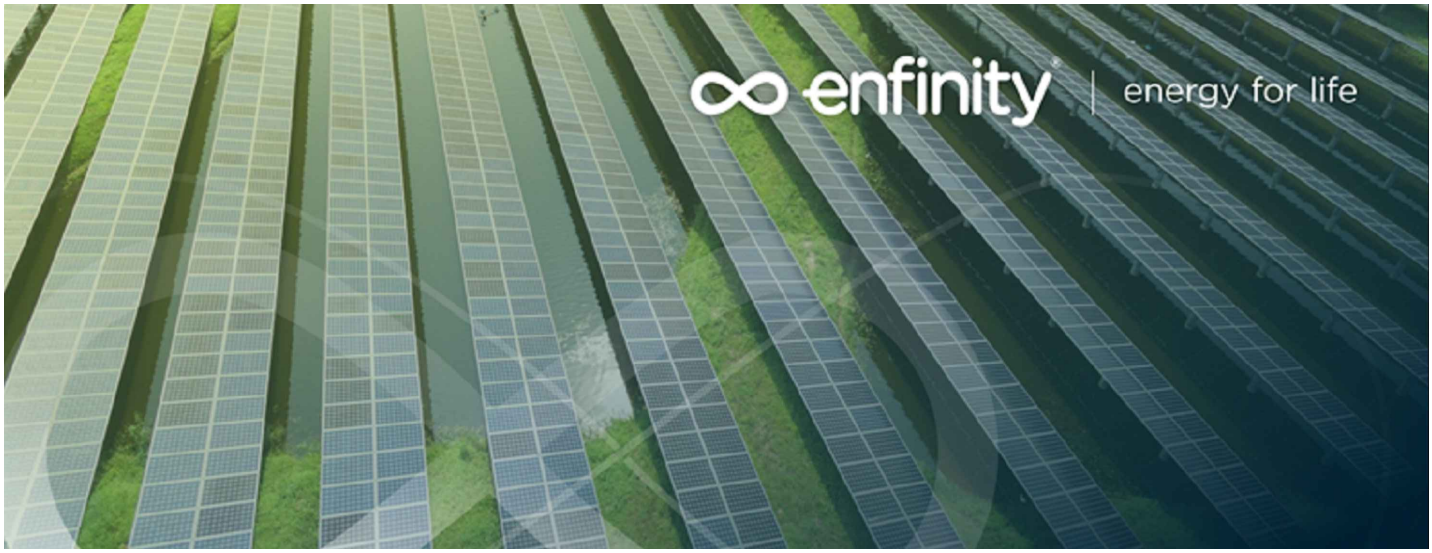

IMPIANTO FOTOVOLTAICO EG Laguna
E OPERE CONNESSE
POTENZA IMPIANTO 13.8 MWp - COMUNE DI PORTOMAGGIORE

Proponente

EG Laguna S.R.L.
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Progettazione

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Titolo Elaborato

Stima producibilità

LIVELLO PROGETTAZIONE	CODICE ELABORATO	FILENAME	FORMATO	DATA	SCALA
Progetto definitivo	VIA.REL 28	-	A4	07/21	-

Revisioni

REV.	DATA	DESCRIZIONE	ESEGUITO	VERIFICATO	APPROVATO
00	20/07/2021	-	AF	PF	ENF

COMUNE DI PORTOMAGGIORE
REGIONE EMILIA ROMAGNA

STIMA PRODUCIBILITA’

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DATI PROGETTO

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Grid-Connected System: Simulation parameters

Project :	**Ferrara Baruffino**			
Geographical Site	**Portomaggiore**		Country	**Italy**
Situation	Latitude	44.69° N	Longitude	11.88° E
Time defined as	Legal Time	Time zone UT	Altitude	-2 m
	Albedo	0.20		
Meteo data:	**Portomaggiore**	SolarGIS Monthly aver. , period not spec. - Synthetic		

Simulation variant : Ferrara Baruffino_Best case_string_13.8MWp(TR 580W, 10.5m) - 1646

Simulation date 19/07/21 17h48

Simulation parameters	System type	**Trackers single array, with backtracking**		
Tracking plane, tilted axis	Axis Tilt	0°	Axis azimuth	0°
Rotation Limitations	Minimum Phi	-60°	Maximum Phi	60°
	Tracking algorithm	Astronomic calculation		
Backtracking strategy	Nb. of trackers	75	Single array	
	Tracker Spacing	10.5 m	Collector width	4.64 m
Inactive band	Left	0.02 m	Right	0.02 m
Backtracking limit angle	Phi limits	+/- 63.4°	Ground Cov. Ratio (GCR)	44.2%
Models used	Transposition	Perez	Diffuse	Perez, Meteonorm
			Circumsolar	separate
Horizon	Free Horizon			
Near Shadings	According to module strings		Electrical effect	80 %
Bifacial system	Model	, unlimited trackers 2D Calculation		
	Tracker Spacing	10.50 m	Tracker width	4.68 m
	Backtracking limit angle	63.4°	GCR	44.6 %
	Ground albedo	0.20	Axis height above ground	2.10 m
	Module bifaciality factor	70 %	Rear shading factor	4.0 %
	Module transparency	4.0 %	Rear mismatch loss	3.5 %
User's needs :	Unlimited load (grid)			
Grid power limitation	Active Power	12.0 MW	Pnom ratio	1.150
Power factor	Cos(phi)	0.990 leading	Phi	8.1°

PV Array Characteristics

PV module	Si-mono	Model	**TSM-580DEG20C.20**	
Custom parameters definition		Manufacturer	Trina Solar	
Number of PV modules		In series	32 modules	In parallel 744 strings
Total number of PV modules		nb. modules	23808	Unit Nom. Power 580 Wp
Array global power		Nominal (STC)	**13809 kWp**	At operating cond. 12639 kWp (50°C)
Array operating characteristics (50°C)		U mpp	979 V	I mpp 12908 A
Total area		Module area	**67379 m²**	Cell area 62996 m²
Inverter		Model	**SUN2000-215KTL-H0**	
Custom parameters definition		Manufacturer	Huawei Technologies	
Characteristics		Unit Nom. Power	**200 kWac**	Oper. Voltage 500-1500 V
		Max. power (=>33°C)	215 kWac	
Inverter pack		Total power	**12000 kWac**	Pnom ratio 1.15
		Nb. of inverters	60 units	
Total		Total power	**12000 kWac**	Pnom ratio 1.15

Grid-Connected System: Simulation parameters

PV Array loss factors

Array Soiling Losses			Loss Fraction	1.5 %
Thermal Loss factor	Uc (const)	31.0 W/m²K	Uv (wind)	1.6 W/m²K / m/s
Wiring Ohmic Loss	Global array res.	0.62 mΩ	Loss Fraction	0.7 % at STC
LID - Light Induced Degradation			Loss Fraction	1.5 %
Module Quality Loss			Loss Fraction	-0.7 %
Module mismatch losses			Loss Fraction	0.4 % at MPP
Strings Mismatch loss			Loss Fraction	0.10 %

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 loss factors

AC wire loss inverter to transfo	Inverter voltage	800 Vac tri		
	Wires: 3 x 10000 mm²	615 m	Loss Fraction	2.5 % at STC
MV transfo	Grid Voltage	30 kV		
One MV transfo				
Operating losses at STC	Iron loss (24/24 Connexion)	20.41 kW	Loss Fraction	0.2 % at STC
	Copper (resistive) loss	3 x 0.78 mΩ	Loss Fraction	1.7 % at STC
MV line up to Injection	MV Voltage	30 kV		
	Wires: 3 x 185 mm²	10400 m	Loss Fraction	1.60 % at STC

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

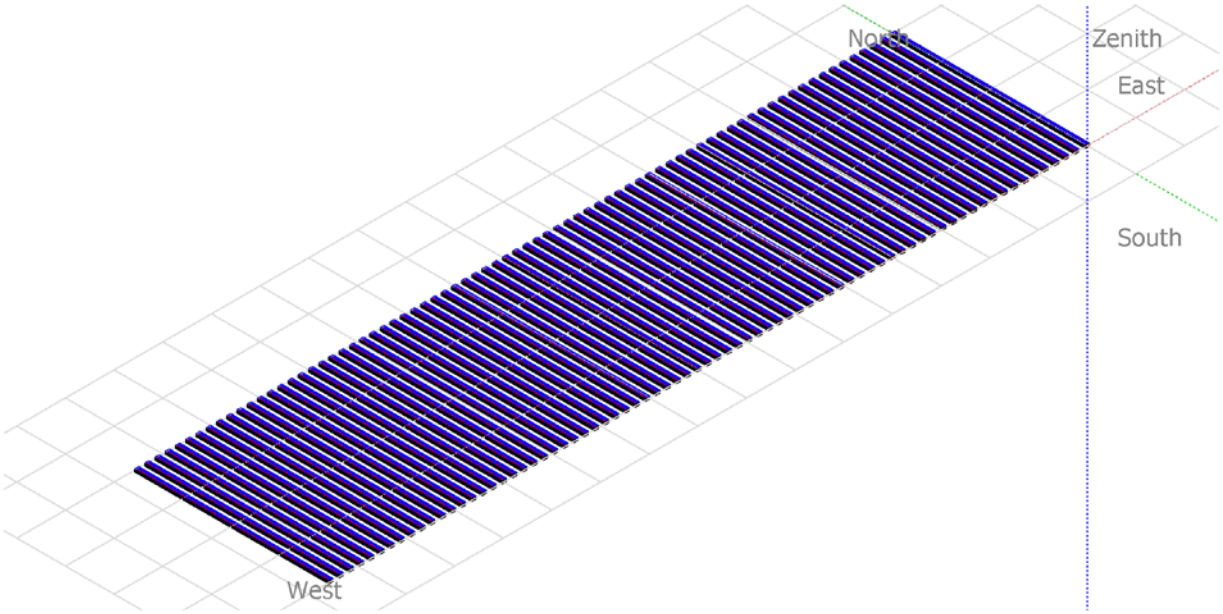
Grid-Connected System: Near shading definition

Project : **Ferrara Baruffino**

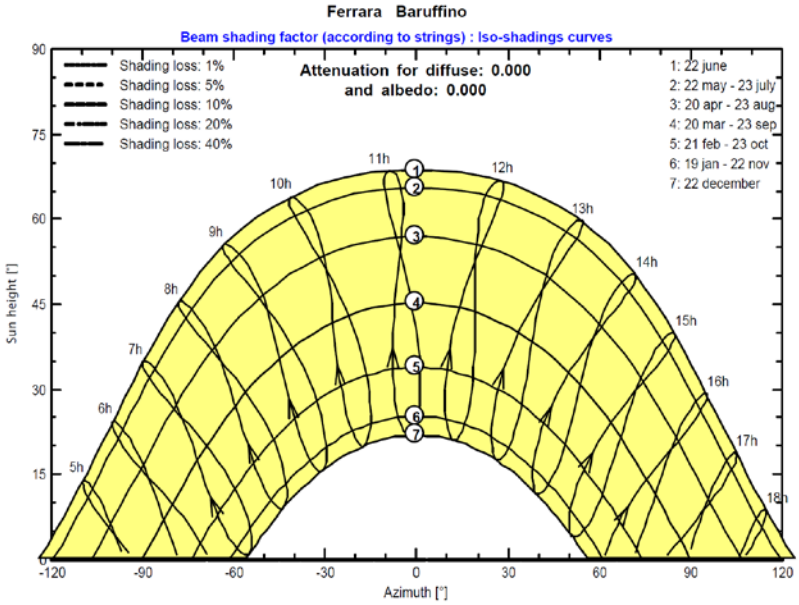
Simulation variant : **Ferrara Baruffino_Best case_string_13.8MWp(TR 580W, 10.5m) - 1646**

Main system parameters	System type	**Trackers single array, with backtracking**		
Near Shadings	According to module strings		Electrical effect	80 %
PV Field Orientation	tracking, tilted axis, Axis Tilt	0°	Axis azimuth	0°
PV modules	Model	TSM-580DEG20C.20	Pnom	580 Wp
PV Array	Nb. of modules	23808	Pnom total	**13809 kWp**
Inverter	Model	SUN2000-215KTL-H0	Pnom	200 kW ac
Inverter pack	Nb. of units	60.0	Pnom total	**12000 kW ac**
User's needs	Unlimited load (grid)		Cos(phi)	0.990 leading

Perspective of the PV-field and surrounding shading scene



Iso-shadings diagram



RISULTATI PRINCIPALI

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Grid-Connected System: Main results

Project : **Ferrara Baruffino**

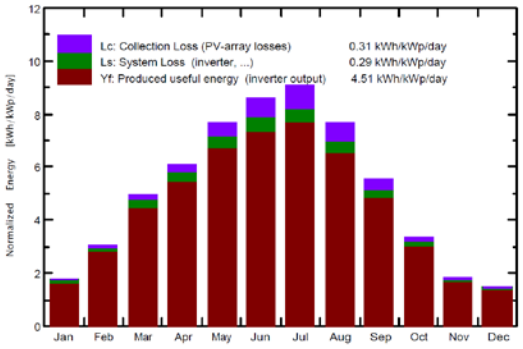
Simulation variant : **Ferrara Baruffino_Best case_string_13.8MWp(TR 580W, 10.5m) - 1646**

Main system parameters	System type	**Trackers single array, with backtracking**			
Near Shadings	According to module strings			Electrical effect	80 %
PV Field Orientation	tracking, tilted axis, Axis Tilt	0°		Axis azimuth	0°
PV modules	Model	TSM-580DEG20C.20		Pnom	580 Wp
PV Array	Nb. of modules	23808		Pnom total	**13809 kWp**
Inverter	Model	SUN2000-215KTL-H0		Pnom	200 kW ac
Inverter pack	Nb. of units	60.0		Pnom total	**12000 kW ac**
User's needs	Unlimited load (grid)			Cos(phi)	0.990 leading

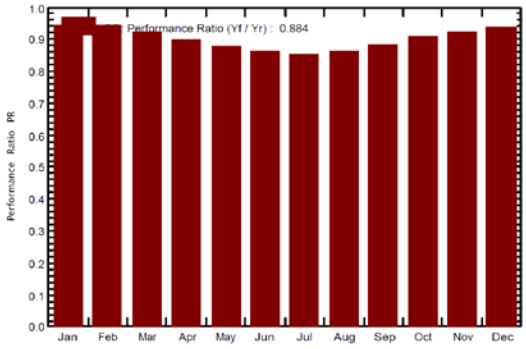
Main simulation results

System Production	**Produced Energy**	**22727 MWh/year**	Specific prod.	1646 kWh/kWp/year
	Apparent energy	22955 MVAh	Perf. Ratio PR	88.38 %

Normalized productions (per installed kWp): Nominal power 13809 kWp



Performance Ratio PR



Ferrara Baruffino_Best case_string_13.8MWp(TR 580W, 10.5m) - 1646

Balances and main results

	GlobHor kWh/m²	DiffHor kWh/m²	T_Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray MWh	E_Grid MWh	PR ratio
January	42.2	22.70	4.60	54.6	52.0	752	710	0.942
February	64.4	30.50	5.90	85.1	81.6	1168	1106	0.941
March	115.5	49.60	10.20	152.5	147.0	2054	1937	0.920
April	142.8	63.10	14.30	183.4	176.9	2421	2276	0.899
May	186.6	78.20	19.50	238.6	230.4	3075	2884	0.875
June	200.3	81.60	24.00	257.0	248.6	3264	3060	0.862
July	214.5	77.50	26.40	281.4	272.5	3528	3304	0.850
August	180.6	70.00	25.70	236.8	229.1	2994	2810	0.859
September	127.5	55.00	20.80	166.2	160.2	2147	2020	0.880
October	80.9	41.20	15.80	104.3	100.0	1384	1309	0.909
November	44.1	24.50	10.40	55.7	53.0	751	708	0.921
December	35.1	19.00	5.19	46.7	44.4	639	603	0.936
Year	1434.5	612.90	15.29	1862.2	1795.8	24176	22727	0.884

Legends:

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

GRAFICI SPECIALI

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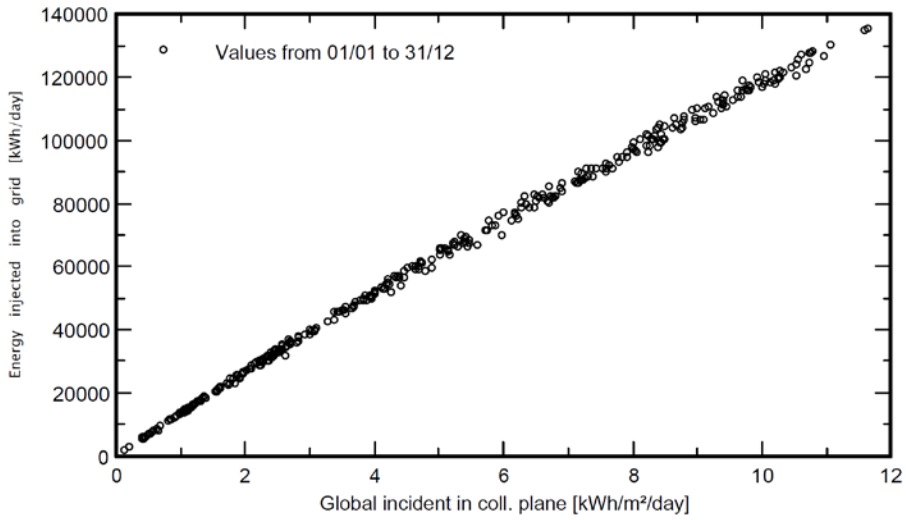
Grid-Connected System: Special graphs

Project : **Ferrara Baruffino**

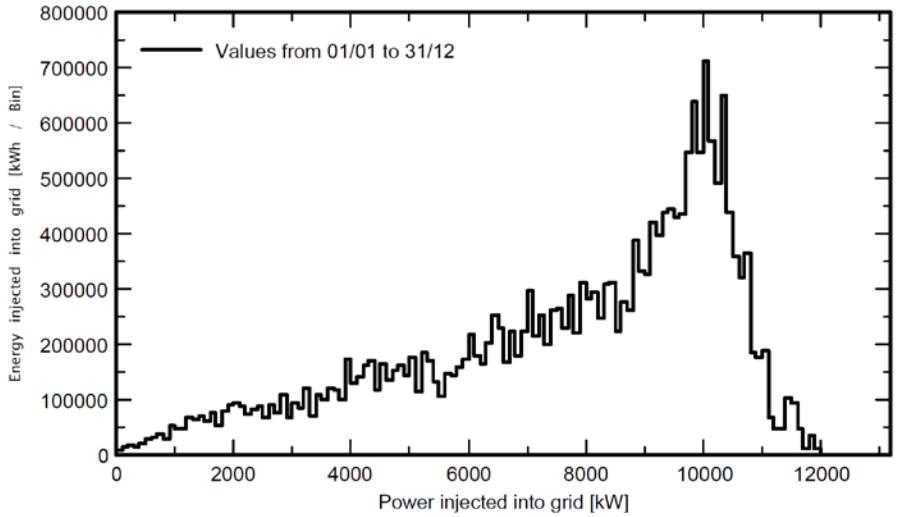
Simulation variant : **Ferrara Baruffino_Best case_string_13.8MWp(TR 580W, 10.5m) - 1646**

Main system parameters	System type	**Trackers single array, with backtracking**			
Near Shadings	According to module strings			Electrical effect	80 %
PV Field Orientation	tracking, tilted axis, Axis Tilt	0°		Axis azimuth	0°
PV modules	Model	TSM-580DEG20C.20		Pnom	580 Wp
PV Array	Nb. of modules	23808		Pnom total	**13809 kWp**
Inverter	Model	SUN2000-215KTL-H0		Pnom	200 kW ac
Inverter pack	Nb. of units	60.0		Pnom total	**12000 kW ac**
User's needs	Unlimited load (grid)			Cos(phi)	0.990 leading

Daily Input/Output diagram



System Output Power Distribution



Loss diagram over the whole year