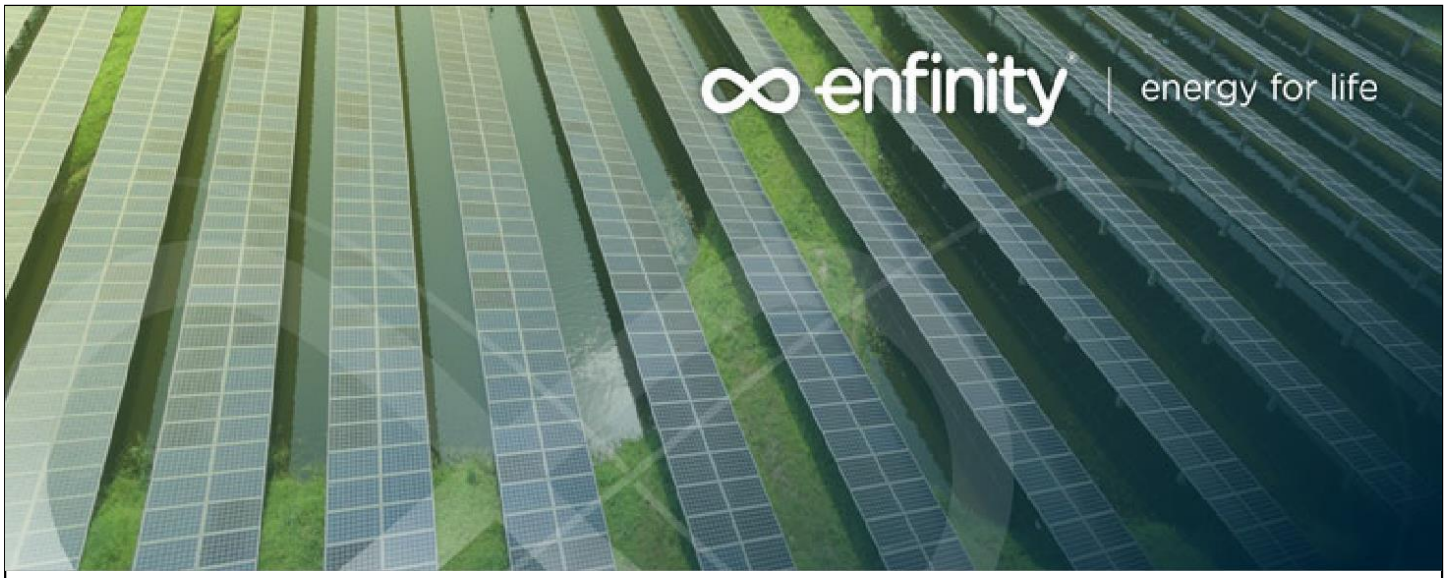

IMPIANTO FOTOVOLTAICO EG PINETA SRL E OPERE CONNESSE

POTENZA IMPIANTO 29,65 MW - COMUNE DI VOLTA MANTOVANA (MN)

Proponente

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Collaboratori

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Titolo Elaborato

STIMA PRODUCIBILITA'

LIVELLO PROGETTAZIONE	CODICE ELABORATO	FILE NAME	DATA
DEFINITIVO	PD_REL04	IT-2022-0239_PD_REL04.00-Stima producibilità.docx	30/09/2022

Revisioni

REV.	DATA	DESCRIZIONE	ESEGUITO	VERIFICATO	APPROVATO
0	30/09/22	EMISSIONE PER PERMITTING	LBO	MLA	ARI

COMUNE DI VOLTA MANTOVANA (MN)

REGIONE LOMBARDIA

STIMA PRODUCIBILITA’

INDICE

Contenuto del documento

1. STIMA PRODUCIBILITA'

Project summary

Geographical Site
Volta Mantovana
Italy

Situation

Latitude	45.34 °N
Longitude	10.64 °E
Altitude	93 m
Time zone	UTC

Project settings

Albedo	0.20

Meteo data
Volta Mantovana
SolarGIS Monthly aver. , period not spec. - Synthetic

System summary

Grid-Connected System

Ground system (tables) on a hill

PV Field Orientation

Fixed plane	
Tilt/Azimuth	20 / 0 °

Near Shadings

According to strings	
Electrical effect	80 %

User's needs
Unlimited load (grid)

System information

PV Array

Nb. of modules	46200 units
Pnom total	31.88 MWp

Inverters

Nb. of units	10 units
Pnom total	35.47 MWac
Grid power limit	29.65 MVA
Grid lim. Pnom ratio	1.075

Results summary

Produced Energy	45 GWh/year	Specific production	1405 kWh/kWp/year	Perf. Ratio PR	85.14 %
Apparent energy	44793 MVAh				

Table of contents

General parameters

Grid-Connected System — **Ground system (tables) on a hill**

PV Field Orientation

Orientation

Fixed plane	
Tilt/Azimuth	20 / 0 °

Sheds configuration

Nb. of sheds	615 units

Sizes

Sheds spacing	7.60 m
Collector width	4.79 m
Ground Cov. Ratio (GCR)	63.0 %

Shading limit angle

Limit profile angle	27.9 °

Models used

Transposition	Perez
Diffuse	Perez, Meteonorm
Circumsolar	separate

Horizon

Free Horizon

Near Shadings

According to strings

Electrical effect 80 %

User's needs

Unlimited load (grid)

Bifacial system

Model 2D Calculation
unlimited sheds

Bifacial model geometry

Sheds spacing	7.60 m
Sheds width	4.79 m
Limit profile angle	27.9 °
GCR	63.0 %
Height above ground	1.50 m

Bifacial model definitions

Ground albedo average	0.17
Bifaciality factor	80 %
Rear shading factor	7.0 %
Rear mismatch loss	5.0 %
Shed transparent fraction	4.0 %

Monthly ground albedo values

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year
0.16	0.16	0.17	0.18	0.19	0.19	0.19	0.18	0.17	0.16	0.14	0.16	0.17

Grid injection point

Grid power limitation

Apparent power	29.65 MVA
Pnom ratio	1.075

Power factor

Cos(phi) (lagging)	1.000

PV Array Characteristics

PV module

Manufacturer	CSI Solar Co., Ltd.
Model	CS7N-690TB-AG 1500V
(Custom parameters definition)	
Unit Nom. Power	690 Wp
Number of PV modules	46200 units
Nominal (STC)	31.88 MWp
Modules	1650 Strings x 28 In series
At operating cond. (50°C)	
Pmpp	29.50 MWp
U mpp	1016 V
I mpp	29026 A

Inverter

Manufacturer	Ingeteam
Model	IS_3Power_3825TL_C640_IP65 [2021-12-03_up to 50°C]
(Custom parameters definition)	
Unit Nom. Power	3547 kVA
Number of inverters	10 units
Total power	35470 kVA
Operating voltage	909-1300 V
Pnom ratio (DC:AC)	0.90

Total PV power

Nominal (STC)	31878 kWp
Total	46200 modules
Module area	143513 m²

Total inverter power

Total power	35470 kVA
Number of inverters	10 units
Pnom ratio	0.90

Array losses

Array Soiling Losses
Loss Fraction 1.5 %

Thermal Loss factor
Module temperature according to irradiance
Uc (const) 30.0 W/m²K
Uv (wind) 1.2 W/m²K/m/s

DC wiring losses
Global array res. 0.64 mΩ
Loss Fraction 1.7 % at STC

LID - Light Induced Degradation
Loss Fraction 1.5 %

Module Quality Loss
Loss Fraction -0.4 %

Module mismatch losses
Loss Fraction 2.0 % at MPP

Strings Mismatch loss
Loss Fraction 0.1 %

IAM loss factor
Incidence effect (IAM): User defined profile

20°	40°	60°	65°	70°	75°	80°	85°	90°
1.000	1.000	1.000	0.990	0.960	0.920	0.840	0.720	0.000

System losses

Auxiliaries loss
Proportionnal to Power 4.0 W/kW
20.0 kW from Power thresh.
Night aux. cons. 5.00 kW

AC wiring losses

Inv. output line up to MV transfo
Inverter voltage 640 Vac tri
Loss Fraction 0.79 % at STC
Inverter: IS_3Power_3825TL_C640_IP65 [2021-12-03_up to 50°C]
Wire section (10 Inv.) Copper 10 x 3 x 2500 mm²
Average wires length 138 m

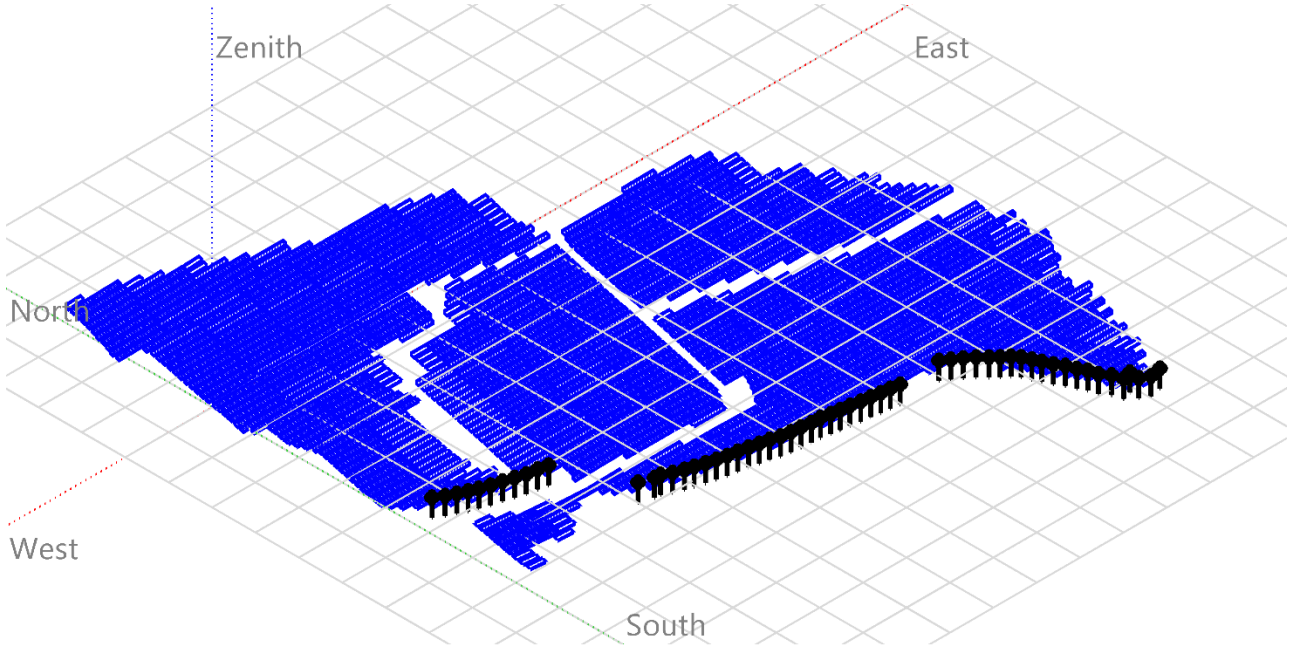
MV line up to Injection
MV Voltage 36 kV
Wires Alu 3 x 1000 mm²
Length 19200 m
Loss Fraction 1.46 % at STC

AC losses in transformers

MV transfo
Grid voltage 36 kV
Operating losses at STC
Nominal power at STC 31350 kVA
Iron loss (night disconnect) 31.35 kW
Loss Fraction 0.10 % at STC
Coils equivalent resistance 3 x 0.14 mΩ
Loss Fraction 1.10 % at STC

Near shadings parameter

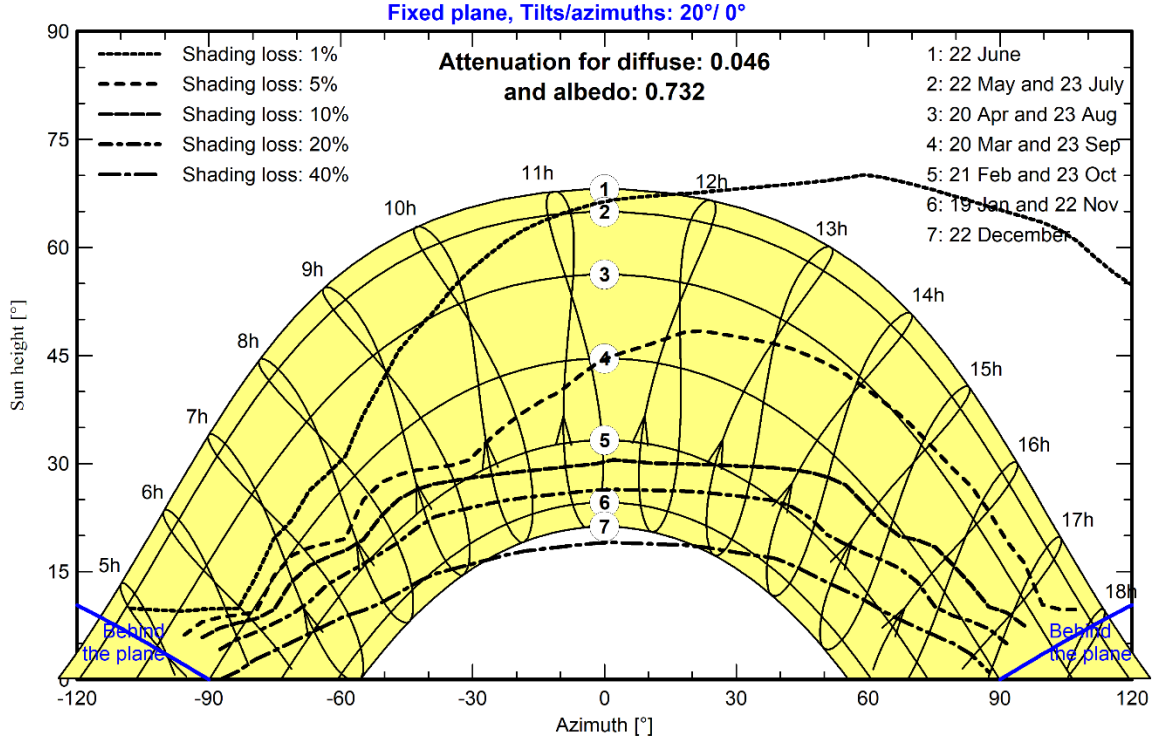
Perspective of the PV-field and surrounding shading scene



Iso-shadings diagram

Orientation #1

Fixed plane, Tilts/azimuths: 20°/ 0°

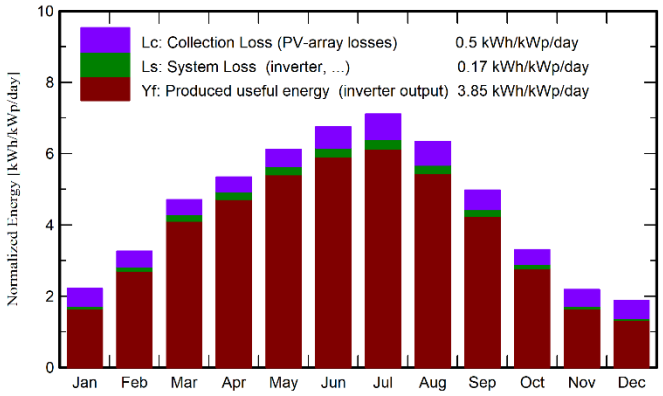


Main results

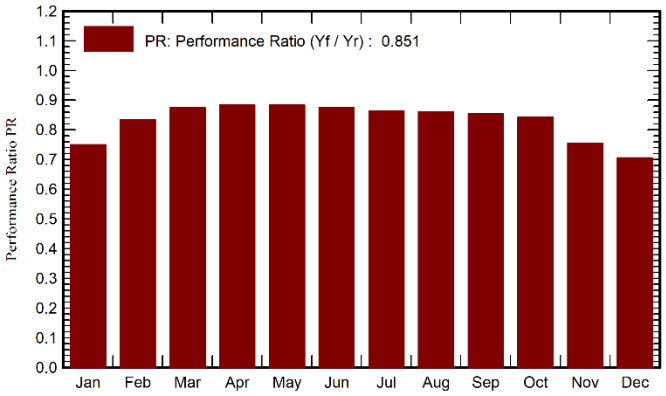
System Production

Produced Energy (P50)	45 GWh/year	Specific production (P50)	1405 kWh/kWp/year	Performance Ratio PR	85.14 %
Produced Energy (P90)	43.7 GWh/year	Specific production (P90)	1371 kWh/kWp/year		
Produced Energy (P95)	43.4 GWh/year	Specific production (P95)	1362 kWh/kWp/year		
Apparent energy	44793 MVAh				

Normalized productions (per installed kWp)



Performance Ratio PR



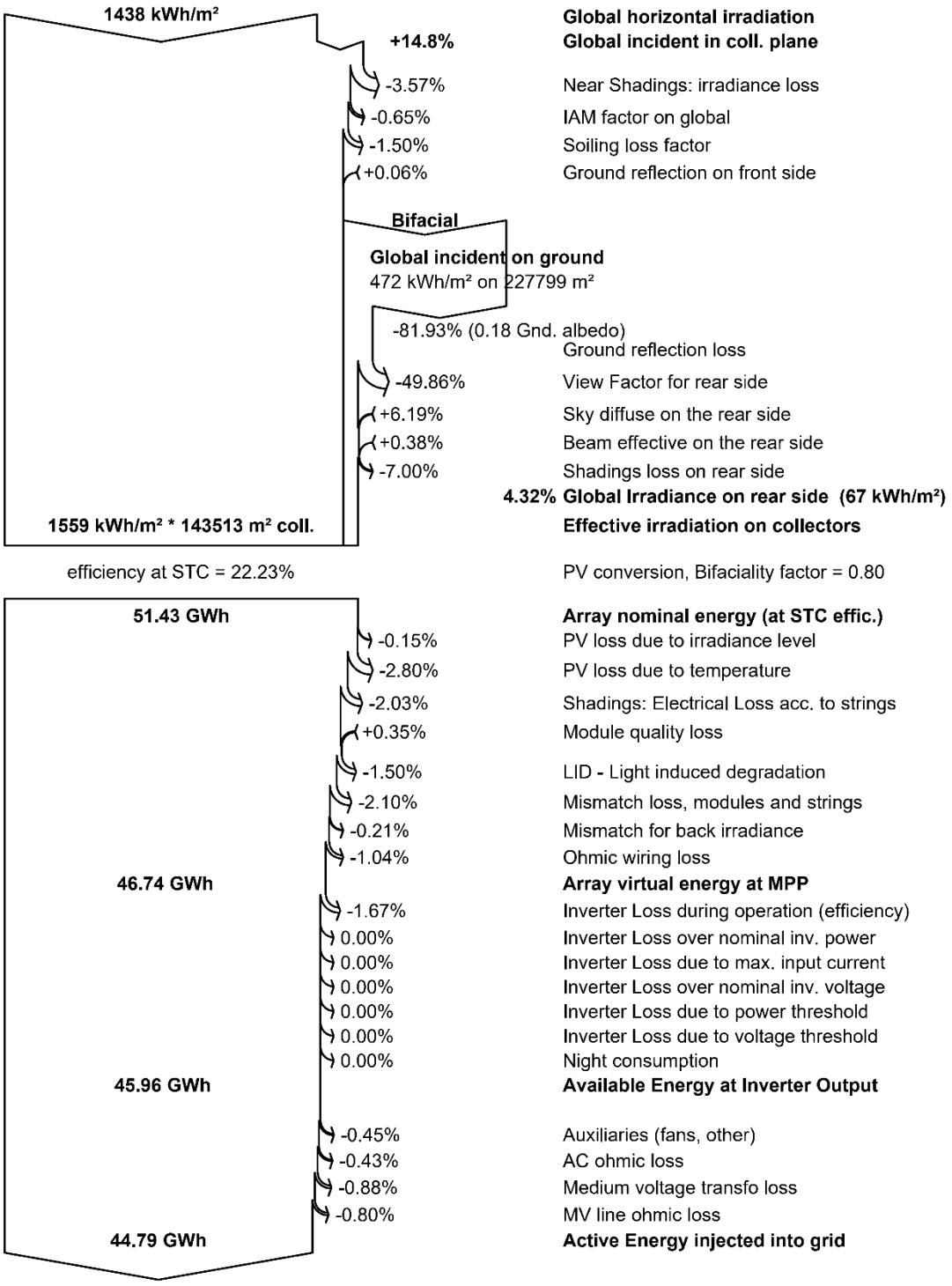
Balances and main results

	GlobHor kWh/m²	DiffHor kWh/m²	T_Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray GWh	E_Grid GWh	PR ratio
January	45.5	22.40	4.20	68.6	59.6	1.710	1.639	0.749
February	65.8	28.40	5.90	91.2	84.5	2.524	2.424	0.834
March	118.0	48.00	9.90	145.8	138.4	4.239	4.065	0.874
April	143.3	61.80	14.10	160.4	153.4	4.719	4.518	0.884
May	182.6	79.10	18.70	189.9	182.5	5.584	5.350	0.884
June	200.2	82.10	23.00	202.4	194.9	5.897	5.649	0.875
July	214.5	77.60	25.40	220.3	212.2	6.329	6.059	0.863
August	179.7	69.70	24.90	196.4	188.7	5.617	5.385	0.860
September	126.6	54.60	20.20	149.2	141.9	4.240	4.064	0.854
October	79.5	38.90	15.10	102.4	95.9	2.864	2.750	0.843
November	45.1	23.60	9.70	65.5	57.6	1.644	1.577	0.756
December	36.7	18.10	4.99	58.4	48.7	1.371	1.314	0.706
Year	1437.5	604.30	14.72	1650.5	1558.5	46.739	44.793	0.851

Legends

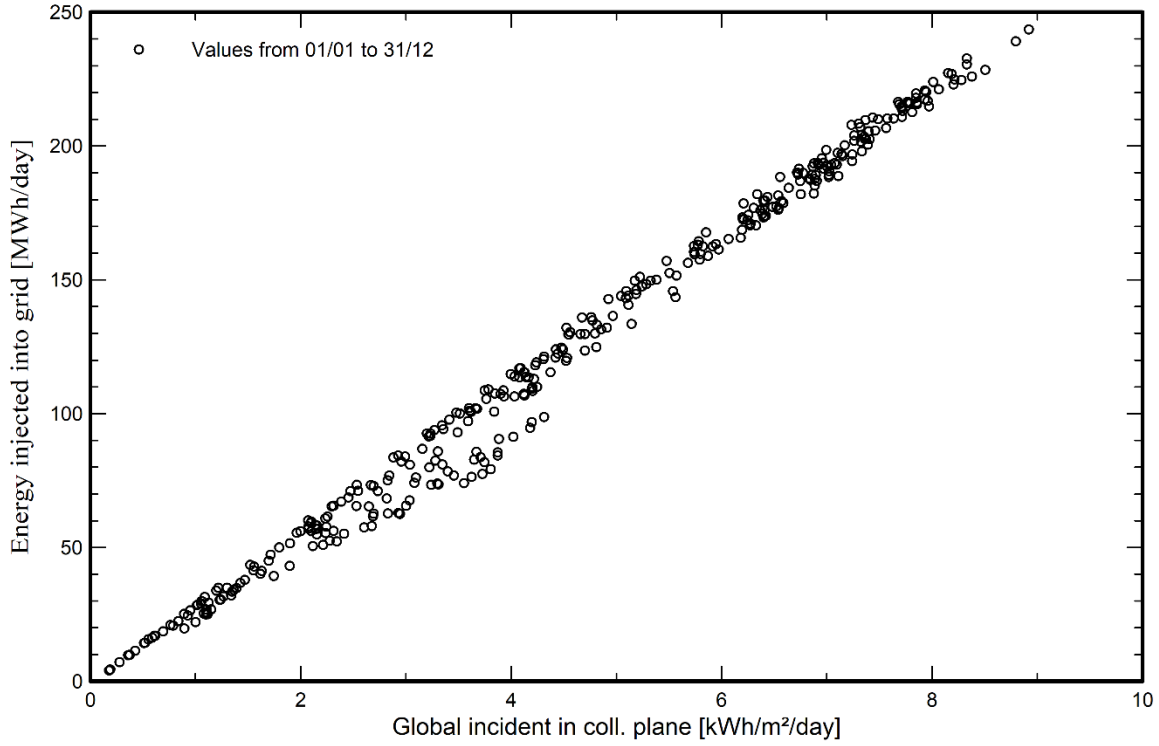
GlobHor	Global horizontal irradiation
DiffHor	Horizontal diffuse irradiation
T_Amb	Ambient Temperature
GlobInc	Global incident in coll. plane
GlobEff	Effective Global, corr. for IAM and shadings
EArray	Effective energy at the output of the array
E_Grid	Energy injected into grid
PR	Performance Ratio

Loss diagram

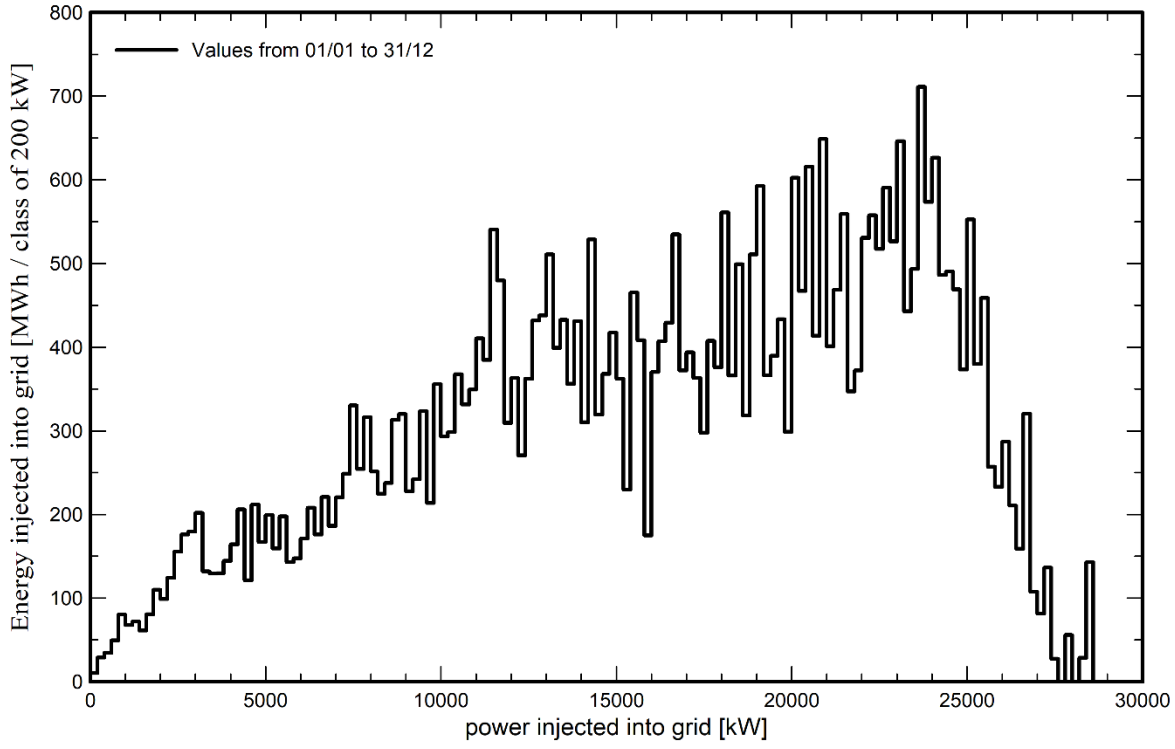


Special graphs

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	

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 %

Global variability (meteo + system)

Variability (Quadratic sum)	1.9 %

Annual production probability

Variability	0.84 GWh
P50	44.79 GWh
P90	43.72 GWh
P95	43.42 GWh

Probability distribution