

# IMPIANTO FOTOVOLTAICO EG LAGO SRL E OPERE CONNESSE

POTENZA IMPIANTO 12,67 MWp - COMUNE DI ARGENTA (FE)

## Proponente

**EG LAGO S.R.L.**

VIA DEI PELLEGRINI 22 · 20122 MILANO (MI) · P.IVA: 12084550966 · PEC: eglago@pec.it

## Progettazione



**TECNOSTUDIO S.R.L. Arch. Diego Zanaica**

Via Aquileia, 56 - 35035 Mestrino (PD)

tel.: +39 0499000684 · email: [info@tecnostudio-pd.it](mailto:info@tecnostudio-pd.it)

PEC: [tecnostudio@legalmail.com](mailto:tecnostudio@legalmail.com)



**QUATTROE S.R.L. Ing. Luigi De Santi**

Via Primo Maggio, 12A - 35035 Mestrino (PD)

cell.: 340 3309775 email: [info@quattroe.eu](mailto:info@quattroe.eu)

## Coordinamento progettuale



**SOLAR IT S.R.L.**

VIA ILARIA ALPI, 4 · 46100 MANTOVA (MN) · P.IVA: 02627240209 · email: [solarit@lamiapec.it](mailto:solarit@lamiapec.it)

## Titolo Elaborato

### STIMA DI PRODUCIBILITA' DELL'IMPIANTO

LIVELLO PROGETTAZIONE	CODICE ELABORATO	FILENAME	RIFERIMENTO	DATA	SCALA
DEFINITIVO	REL20	-	-	30/11/23	

## Revisioni

REV.	DATA	DESCRIZIONE	ESEGUITO	VERIFICATO	APPROVATO
0	30/11/23		FB - GB - SC	EF	DZ



COMUNE DI ARGENTA (FE)  
REGIONE EMILIA ROMAGNA



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# STIMA PRODUCIBILITA'

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## 1. STIMA PRODUCIBILITA'

### Project summary

<b>Geographical Site</b> <b>Boccaleone, Argenta</b> Italy	<b>Situation</b> Latitude 44.65 °N Longitude 11.83 °E Altitude -3 m Time zone UTC	<b>Project settings</b> Albedo 0.20
<b>Meteo data</b> Boccaleone, Argenta SolarGIS Monthly aver. , period not spec. - Synthetic		

### System summary

<b>Grid-Connected System</b>		<b>Sheds system</b>		<b>User's needs</b>	
<b>PV Field Orientation</b>		<b>Near Shadings</b>		Unlimited load (grid)	
Fixed plane Tilt/Azimuth 20 / 0.2 °		Linear shadings : Fast (table)			
<b>System information</b>		<b>Inverters</b>			
<b>PV Array</b>		Nb. of units		9 units	
Nb. of modules	18228 units	Pnom total		9900 kVA	
Pnom total	12.67 MWp	Grid power limit		10.50 MVA	
		Grid lim. Pnom ratio		1.206	

### Results summary

Produced Energy	18359259 kWh/year	Specific production	1434 kWh/kWp/year	Perf. Ratio PR	88.3 %
Apparent energy	18359259 kVAh/year				

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## General parameters

### Grid-Connected System

#### PV Field Orientation

##### Orientation

Fixed plane  
Tilt/Azimuth 20 / 0.2 °

### Sheds system

#### Sheds configuration

Nb. of sheds 362 units  
**Sizes**  
Sheds spacing 8.10 m  
Collector width 4.82 m  
Ground Cov. Ratio (GCR) 59.5 %

#### Shading limit angle

Limit profile angle 24.8 °

#### Models used

Transposition Perez  
Diffuse Perez, Meteonorm  
Circumsolar separate

### Horizon

Free Horizon

### Near Shadings

Linear shadings : Fast (table)

### User's needs

Unlimited load (grid)

### Bifacial system

Model 2D Calculation  
unlimited sheds

#### Bifacial model geometry

Sheds spacing 8.10 m  
Sheds width 4.82 m  
Limit profile angle 24.8 °  
GCR 59.5 %  
Height above ground 0.50 m

#### Bifacial model definitions

Ground albedo average 0.16  
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
0.13	0.16	0.17	0.19	0.19	0.20	0.19	0.17	0.16	0.14	0.13	0.13	0.16

### Grid injection point

#### Grid power limitation

Apparent power 10.50 MVA  
Pnom ratio 1.206

#### Power factor

Cos(phi) (lagging) 1.000

## PV Array Characteristics

### PV module

Manufacturer CSI Solar Co., Ltd.  
Model CS7N-695TB-AG 1500V  
(Custom parameters definition)

Unit Nom. Power 695 Wp  
Number of PV modules 18228 units  
Nominal (STC) 12.67 MWp  
Modules 651 Strings x 28 In series  
**At operating cond. (50°C)**  
Pmpp 11.72 MWp  
U mpp 1045 V  
I mpp 11215 A

#### Total PV power

Nominal (STC) 12668 kWp  
Total 18228 modules  
Module area 56623 m²

### Inverter

Manufacturer Sungrow  
Model SG1100UD  
(Custom parameters definition)

Unit Nom. Power 1100 kVA  
Number of inverters 9 units  
Total power 9900 kVA  
Operating voltage 895-1500 V  
Max. power (=>22°C) 1265 kVA  
Pnom ratio (DC:AC) 1.29

#### Total inverter power

Total power 9900 kVA  
Max. power 11385 kVA  
Number of inverters 9 units  
Pnom ratio 1.29

### Array losses

#### Array Soiling Losses

Loss Fraction 1.5 %

#### 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. 1.4 mΩ

Loss Fraction 1.5 % at STC

#### Serie Diode Loss

Voltage drop 0.7 V

Loss Fraction 0.1 % at STC

#### LID - Light Induced Degradation

Loss Fraction 0.5 %

#### 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 630 Vac tri

Loss Fraction 0.50 % at STC

#### Inverter: SG1100UD

Wire section (9 Inv.) Alu 9 x 3 x 3000 mm²

Average wires length 135 m

#### MV line up to Injection

MV Voltage 30 kV

Wires Copper 3 x 95 mm²

Length 3619 m

Loss Fraction 1.00 % at STC

### AC losses in transformers

#### MV transfo

Medium voltage 30 kV

#### Transformer parameters

Nominal power at STC 12.57 MVA

Iron Loss (night disconnect) 12.57 kVA

Iron loss fraction 0.10 % at STC

Copper loss 138.22 kVA

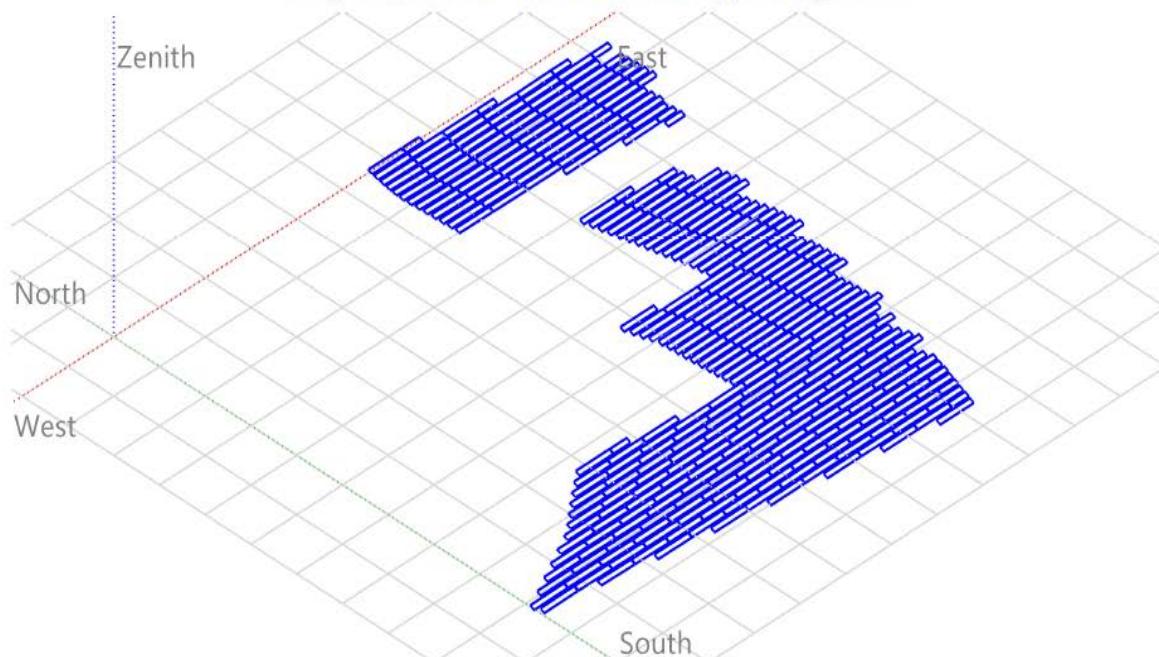
Copper loss fraction 1.10 % at STC

Coils equivalent resistance 3 x 0.35 mΩ



### Near shadings parameter

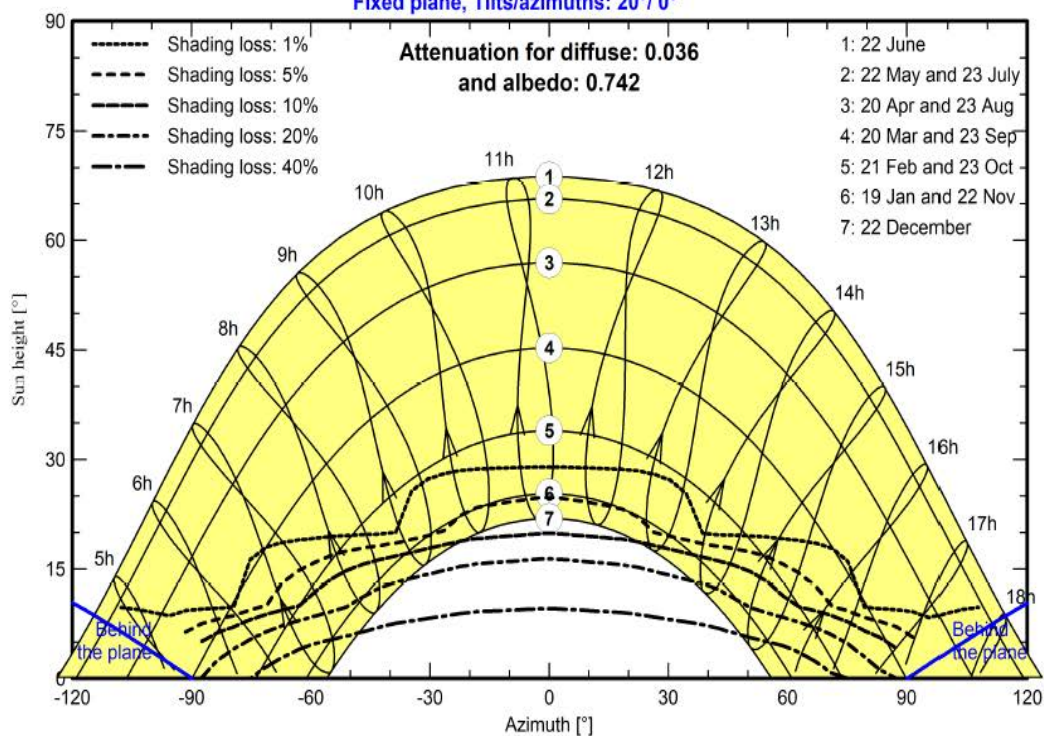
Perspective of the PV-field and surrounding shading scene



### Iso-shadings diagram

Orientation #1

Fixed plane, Tilts/azimuths: 20°/ 0°

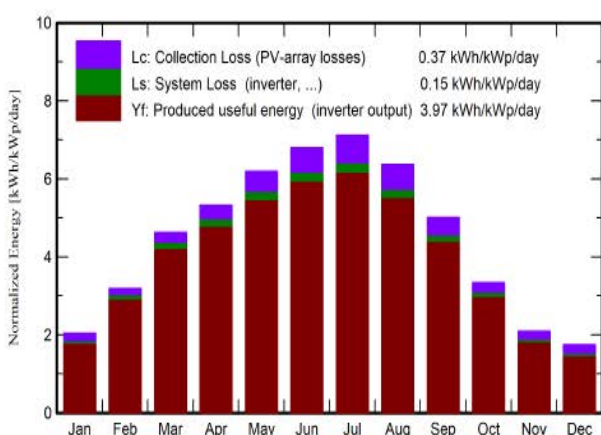


## Main results

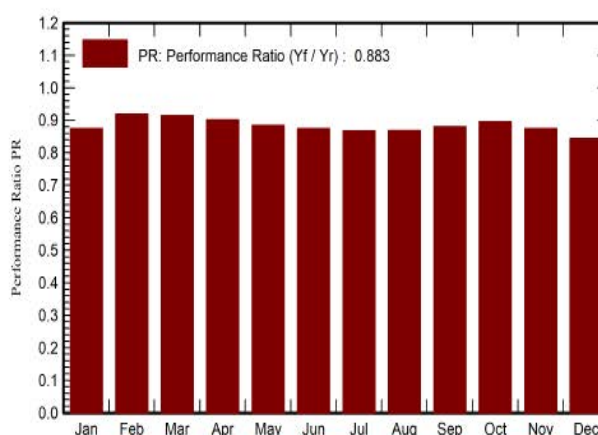
### System Production

Produced Energy (P50)	8359259 kWh/year	Specific production (P50)	1434 kWh/kWp/year	Perf. Ratio PR	88.3 %
Produced Energy (P75)	7904660 kWh/year	Specific production (P75)	1398 kWh/kWp/year		
Produced Energy (P90)	7494597 kWh/year	Specific production (P90)	1366 kWh/kWp/year		
Apparent energy	18359259 kVAh/year				

Normalized productions (per installed kWp)



Performance Ratio PR



### Balances and main results

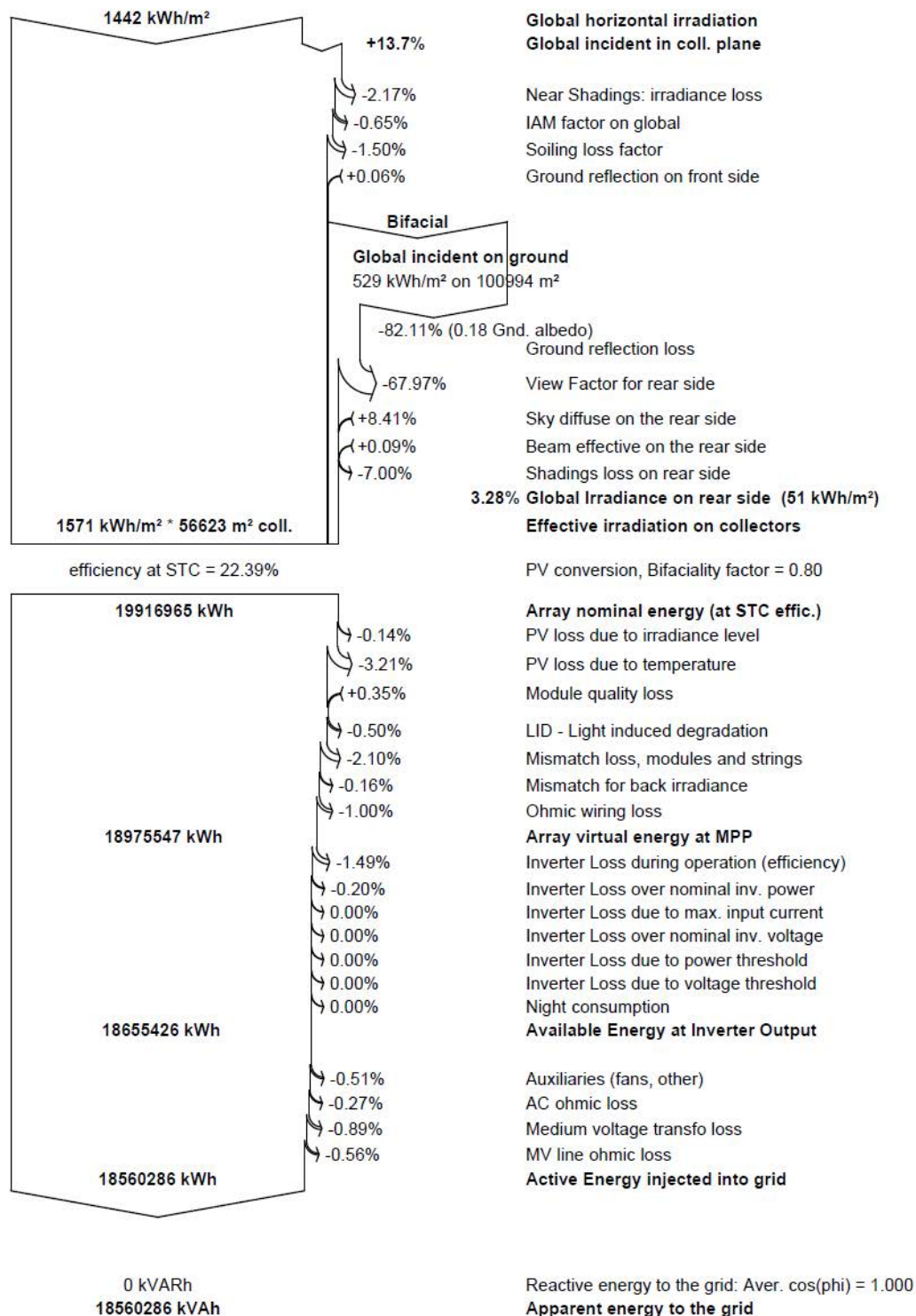
	GlobHor kWh/m <sup>2</sup>	DiffHor kWh/m <sup>2</sup>	T_Amb °C	GlobInc kWh/m <sup>2</sup>	GlobEff kWh/m <sup>2</sup>	EArray kWh	E_Grid kWh	PR ratio
January	43.0	23.20	4.60	63.3	57.1	727211	702039	0.875
February	65.8	30.30	6.10	89.3	85.2	1077903	1039943	0.919
March	116.4	49.50	10.30	143.3	138.3	1722469	1659365	0.914
April	143.8	62.70	14.30	159.7	154.3	1893631	1823407	0.901
May	185.3	77.90	19.40	192.0	185.5	2235214	2151988	0.885
June	201.7	80.50	24.10	203.9	197.2	2349836	2261777	0.876
July	214.9	76.80	26.40	220.6	213.7	2520579	2425328	0.868
August	181.2	69.60	25.70	197.4	191.0	2254614	2171229	0.868
September	128.5	54.90	20.80	150.2	145.0	1738813	1675417	0.881
October	81.5	41.30	15.80	103.5	99.2	1216526	1173800	0.895
November	44.4	24.50	10.40	62.9	57.6	722488	697123	0.875
December	35.4	19.10	5.29	54.0	47.1	599673	577844	0.845
Year	1441.9	610.30	15.32	1640.0	1571.1	19058958	18359261	0.883

### 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		

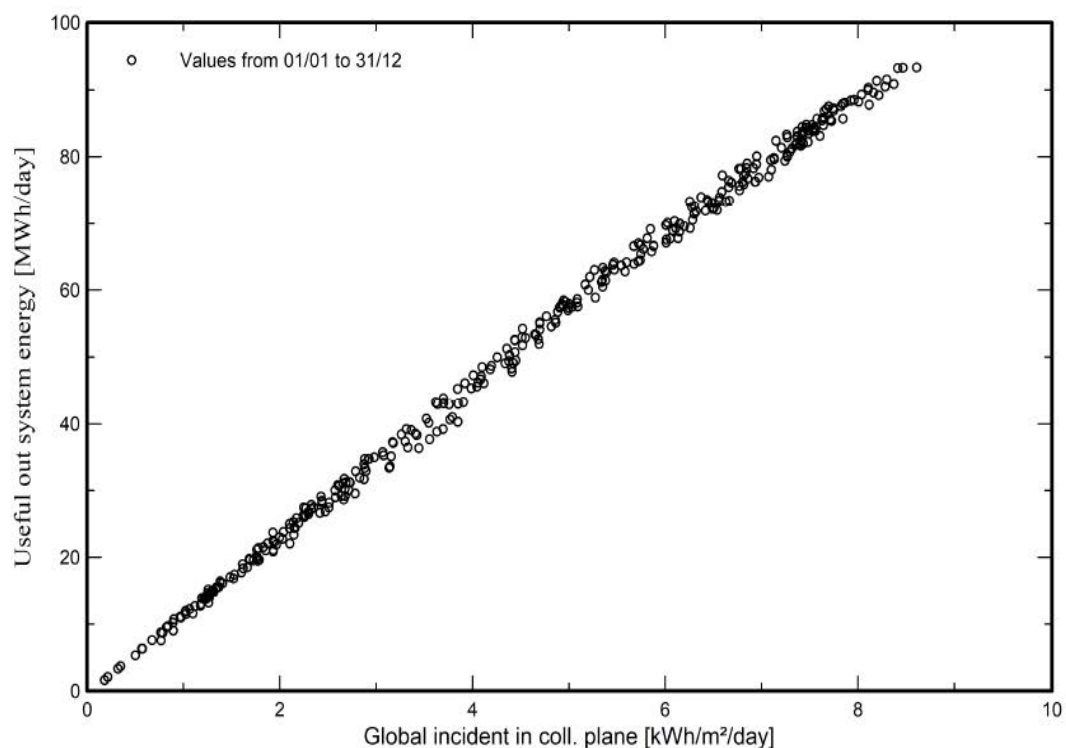


## Loss diagram

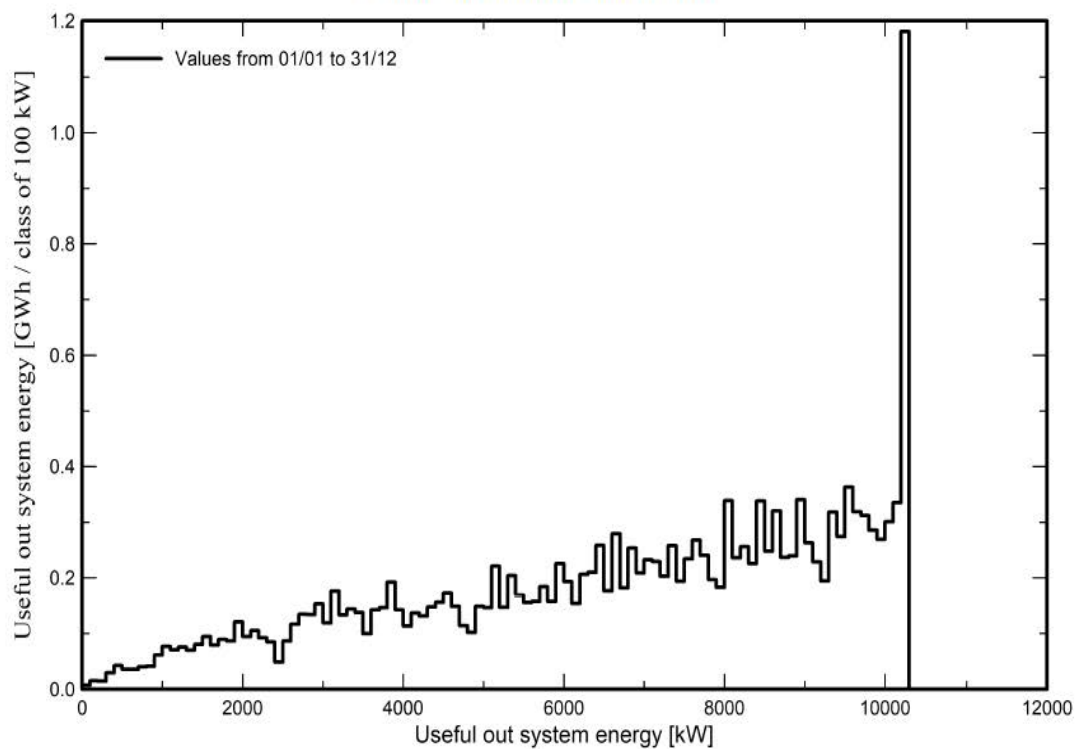


# Predef. graphs

## Daily Input/Output diagram



## System Output Power Distribution



## P50 - P90 evaluation

### Meteo data

Source	SolarGIS Monthly aver. , period not spec.
Kind	TMY, multi-year
Year-to-year variability(Variance)	3.2 %
<b>Specified Deviation</b>	
Climate change	0.0 %

### Global variability (meteo + system)

Variability (Quadratic sum)	3.7 %
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### 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	674 MWh
P50	18360 MWh
P75	17904 MWh
P90	17495 MWh

Probability distribution

