

Impianto Fotovoltaico  
"NOVI BRETELLA AUTOSTRADALE"  
di potenza nominale pari a  
15,621 MWp nel comune  
di Novi Ligure (AL)

Verifica di assoggettabilità  
(art. 19 D.lgs. 152/2006)

RELAZIONE TECNICA – SIMULAZIONE PVSYST  
03\_NOV\_CIV\_00

GRUPPO DI LAVORO



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REV	DATA	DESCRIZIONE	REDATTO	CONTROL	APPROV.
02					
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00	07/07/25	Prima Emissione	ING. S. SOTTILE	ING. S. SOTTILE	ING. S. SOTTILE

# PVsyst - Simulation report

## Grid-Connected System

Project: Novi Bretella 02\_25

Variant: New simulation variant

Tracking system with backtracking

System power: 15.62 MWp

Pozzolo Formigaro - Italy



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PVsyst V8.0.6

VC0, Simulation date:

11/06/25 17:34

with V8.0.6

A2A Rinnovabili Spa (Italy)

## Project summary

Geographical Site	Situation	Project settings
Pozzolo Formigaro	Latitude 44.81 °N	Albedo 0.20
Italy	Longitude 8.77 °E	
	Altitude 156 m	
	Time zone UTC+1	
Weather data		
Pozzolo Formigaro		
PVGIS api TMY		

## System summary

Grid-Connected System	Tracking system with backtracking	
Orientation #1	Near Shadings	User's needs
Tracking plane, tilted axis	Linear shadings : Fast (table)	Unlimited load (grid)
Avg axis tilt -0.4 °		
Avg axis azim. 0 °		
Phi min / max. -/+ 55 °		
Diffuse shading all trackers		
Tracking algorithm		
Astronomic calculation		
Backtracking activated		
System information		
PV Array	Inverters	
Nb. of modules 24600 units	Nb. of units 50 units	
Pnom total 15.62 MWp	Pnom total 16.00 MWac	
	Grid power limit 15.45 MWac	
	Grid lim. Pnom ratio 1.011	

## Results summary

Produced Energy 24196 MWh/year	Specific production 1549 kWh/kWp/year	Perf. Ratio PR 85.37 %
Apparent energy 26157 MVAh/year		

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## General parameters

## Grid-Connected System

## Orientation #1

Tracking plane, tilted axis

Avg axis tilt -0.4 °

Avg axis azimuth 0 °

Phi min / max. +/- 55 °

Diffuse shading all trackers

Tracking algorithm

Astronomic calculation

Backtracking activated

## Tracking system with backtracking

Field properties

Nb. of trackers 712 units

Tracking plane, tilted axis

Sizes

Tracker Spacing 5.00 m

Collector width 2.46 m

Average GCR 49.3 %

Backtracking limit angle

Phi limits +/- 60.5 °

Backtracking parameters

Backtracking pitch 5.00 m

Backtracking width 2.47 m

Left inactive band 0.00 m

Right inactive band 0.00 m

Backtracking GCR 49.3 %

Parameters choice:Automatic

## Models used

Transposition

Perez

Diffuse

Imported

Circumsolar

separate

## Horizon

Free Horizon

## Near Shadings

Linear shadings : Fast (table)

## User's needs

Unlimited load (grid)

## Bifacial system definition

## Orientation #1

## Bifacial system

Model Unlimited Trackers 2D model

Bifacial model geometry

Tracker Spacing 5.00 m

Tracker width 2.46 m

GCR 49.3 %

Axis height above ground 1.60 m

Nb. of sheds 712 units

## Bifacial model definitions

Ground albedo 0.20

Bifaciality factor 80 %

Rear shading factor 15.0 %

Rear mismatch loss 3.5 %

Shed transparent fraction 1.3 %

## Grid injection point

Grid power limitation

Power factor

Active power 15.45 MWac

Cos(phi) (lagging) 0.932

Pnom ratio 1.011

## PV Array Characteristics

## PV module

Manufacturer

Jinkosolar 2023

Model

JKM635N-78HL4-BDV

(Custom parameters definition)

Unit Nom. Power 635 Wp

Number of PV modules 24600 units

Nominal (STC) 15.62 MWp

## Inverter

Manufacturer

Sungrow

Model

SG350HX-16MPPT

(Custom parameters definition)

Unit Nom. Power 320 kWac

Number of inverters 50 units

Total power 16000 kWac



## PV Array Characteristics

## Array #1 - PV Array

Number of PV modules	13200 units	Number of inverters	27 units
Nominal (STC)	8382 kWp	Total power	8640 kWac
Modules	550 string x 24 In series		
At operating cond. (50°C)		Operating voltage	500-1500 V
Pmpp	7785 kWp	Max. power (=>30°C)	352 kWac
U mpp	1058 V	Pnom ratio (DC:AC)	0.97
I mpp	7356 A	Power sharing within this inverter	

## Array #2 - Sub-array #2

Number of PV modules	11400 units	Number of inverters	23 units
Nominal (STC)	7239 kWp	Total power	7360 kWac
Modules	475 string x 24 In series		
At operating cond. (50°C)		Operating voltage	500-1500 V
Pmpp	6723 kWp	Max. power (=>30°C)	352 kWac
U mpp	1058 V	Pnom ratio (DC:AC)	0.98
I mpp	6353 A	Power sharing within this inverter	

## Total PV power

Nominal (STC)	15621 kWp	Total inverter power	
Total	24600 modules	Total power	16000 kWac
Module area	68765 m <sup>2</sup>	Max. power	17600 kWac
		Number of inverters	50 units
		Pnom ratio	0.98
		PNom limit forced to active power	

## Array losses

Array Soiling Losses		Thermal Loss factor		Serie Diode Loss	
Loss Fraction	2.5 %	Module temperature according to irradiance		Voltage drop	0.7 V
		Uc (const)	25.0 W/m <sup>2</sup> K	Loss Fraction	0.1 % at STC
		Uv (wind)	1.2 W/m <sup>2</sup> K/m/s		
LID - Light Induced Degradation		Module Quality Loss		Module mismatch losses	
Loss Fraction	0.5 %	Loss Fraction	-0.8 %	Loss Fraction	1.0 % at MPP
Strings Mismatch loss		IAM loss factor			
Loss Fraction	0.1 %	ASHRAE Param.: IAM = 1 - bo (1/cosi - 1)			
		bo Param.	0.05		

## DC wiring losses

Global wiring resistance	1.3 mΩ		
Loss Fraction	1.5 % at STC		
Array #1 - PV Array		Array #2 - Sub-array #2	
Global array res.	2.3 mΩ	Global array res.	2.7 mΩ
Loss Fraction	1.5 % at STC	Loss Fraction	1.5 % at STC

## System losses

Unavailability of the system		Auxiliaries loss	
Time fraction	2.5 %		
	9.1 days,		
	3 periods		



## AC wiring losses

Inv. output line up to MV transfo	
Inverter voltage	800 Vac tri
Loss Fraction	0.04 % at STC
Inverter: SG350HX-16MPPT	
Wire section (50 Inv.)	Copper 50 x 3 x 185 mm <sup>2</sup>
Average wires length	7 m
MV line up to Injection	
MV Voltage	15 kV
Average each inverter	
Wires	Alu 3 x 95 mm <sup>2</sup>
Length	1500 m
Loss Fraction	0.36 % at STC

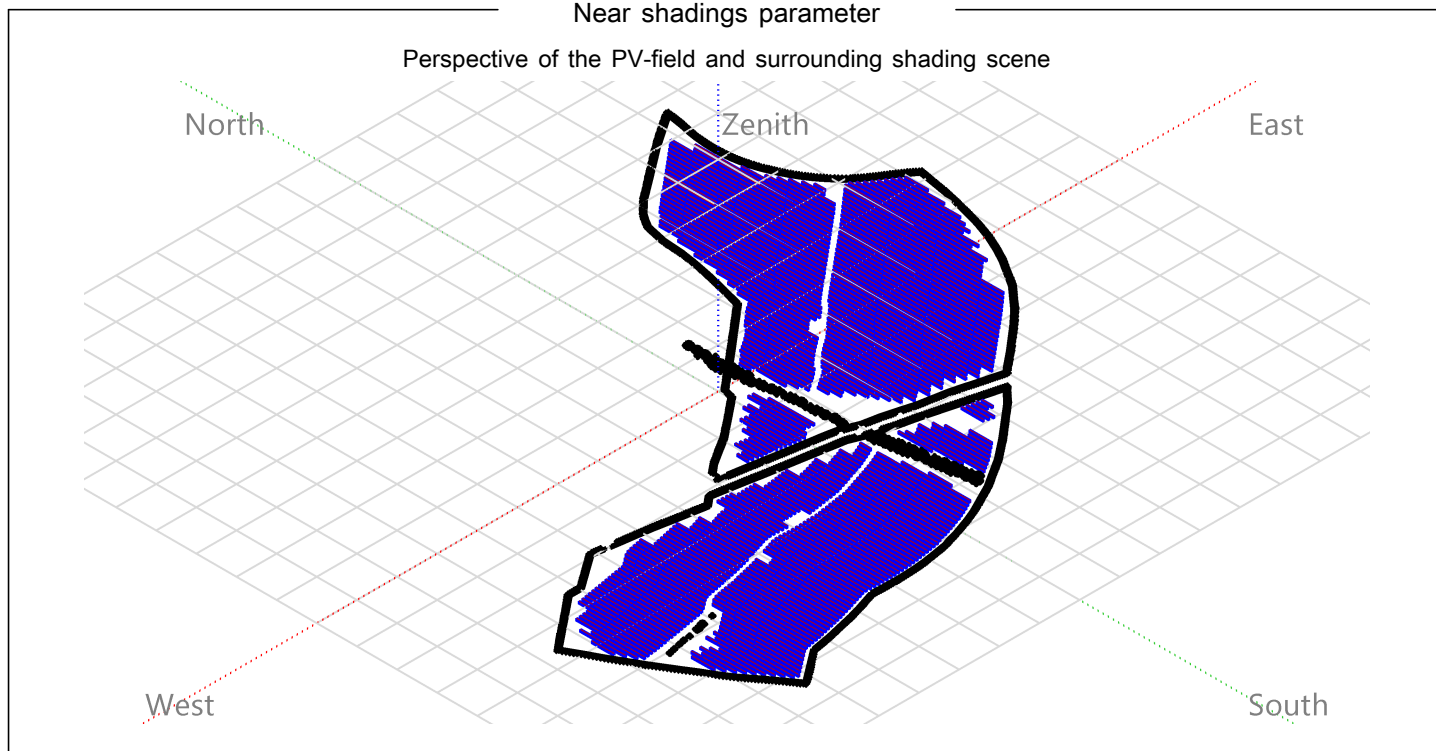
## AC losses in transformers

MV transfo			
Medium voltage	15 kV		
One transfo parameters		Operating losses at STC (full system)	
Nominal power at STC	1.40 MVA	Nb. identical MV transfos	11
Iron Loss (24/24 Connexion)	1.50 kVA	Nominal power at STC	15.38 MVA
Iron loss fraction	0.11 % at STC	Iron loss (24/24 Connexion)	16.48 kVA
Copper loss	13.06 kVA	Copper loss	143.64 kVA
Copper loss fraction	0.93 % at STC		
Coils equivalent resistance	3 x 4.27 mΩ		



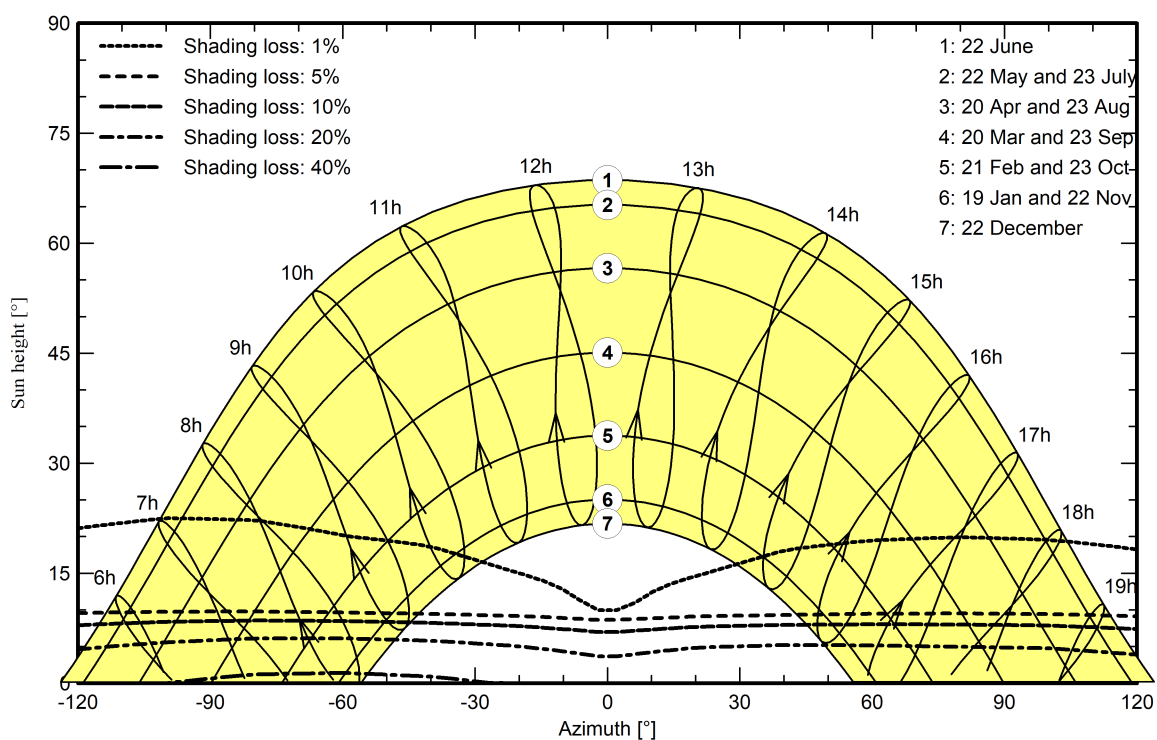
### Near shadings parameter

Perspective of the PV-field and surrounding shading scene



### Iso-shadings diagram

Orientation #1





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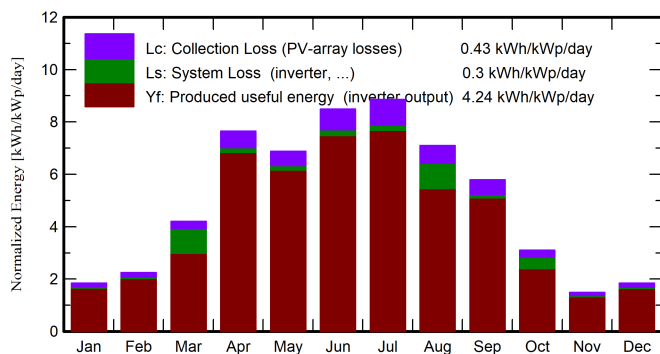
### Main results

#### System Production

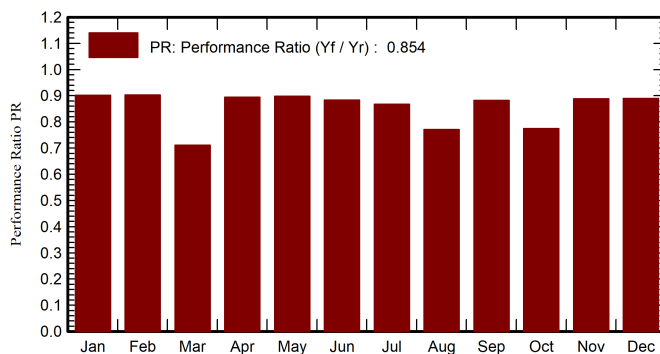
Produced Energy 24196 MWh/year  
Apparent energy 26157 MVAh/year

Specific production 1549 kWh/kWp/year  
Perf. Ratio PR 85.37 %

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 MWh	E_Grid MWh	PR ratio
January	44.7	19.95	4.02	57.2	51.1	834	806	0.901
February	50.5	26.37	6.67	62.9	56.6	917	887	0.903
March	102.8	42.94	7.70	130.4	120.5	1910	1448	0.711
April	176.8	56.68	14.36	229.4	215.4	3292	3205	0.894
May	171.8	77.02	15.52	213.1	199.5	3073	2990	0.898
June	204.7	77.18	20.95	254.6	240.1	3611	3513	0.883
July	215.4	66.27	25.08	274.5	259.4	3825	3720	0.868
August	175.1	68.55	21.59	219.9	206.1	3113	2647	0.771
September	135.0	49.10	20.03	173.6	161.9	2458	2392	0.882
October	76.9	39.85	14.88	96.3	87.5	1386	1166	0.775
November	37.5	23.41	9.04	44.9	39.8	649	624	0.889
December	44.4	20.76	4.01	57.4	50.6	825	798	0.889
Year	1435.7	568.08	13.68	1814.4	1688.4	25895	24196	0.854

#### Legends

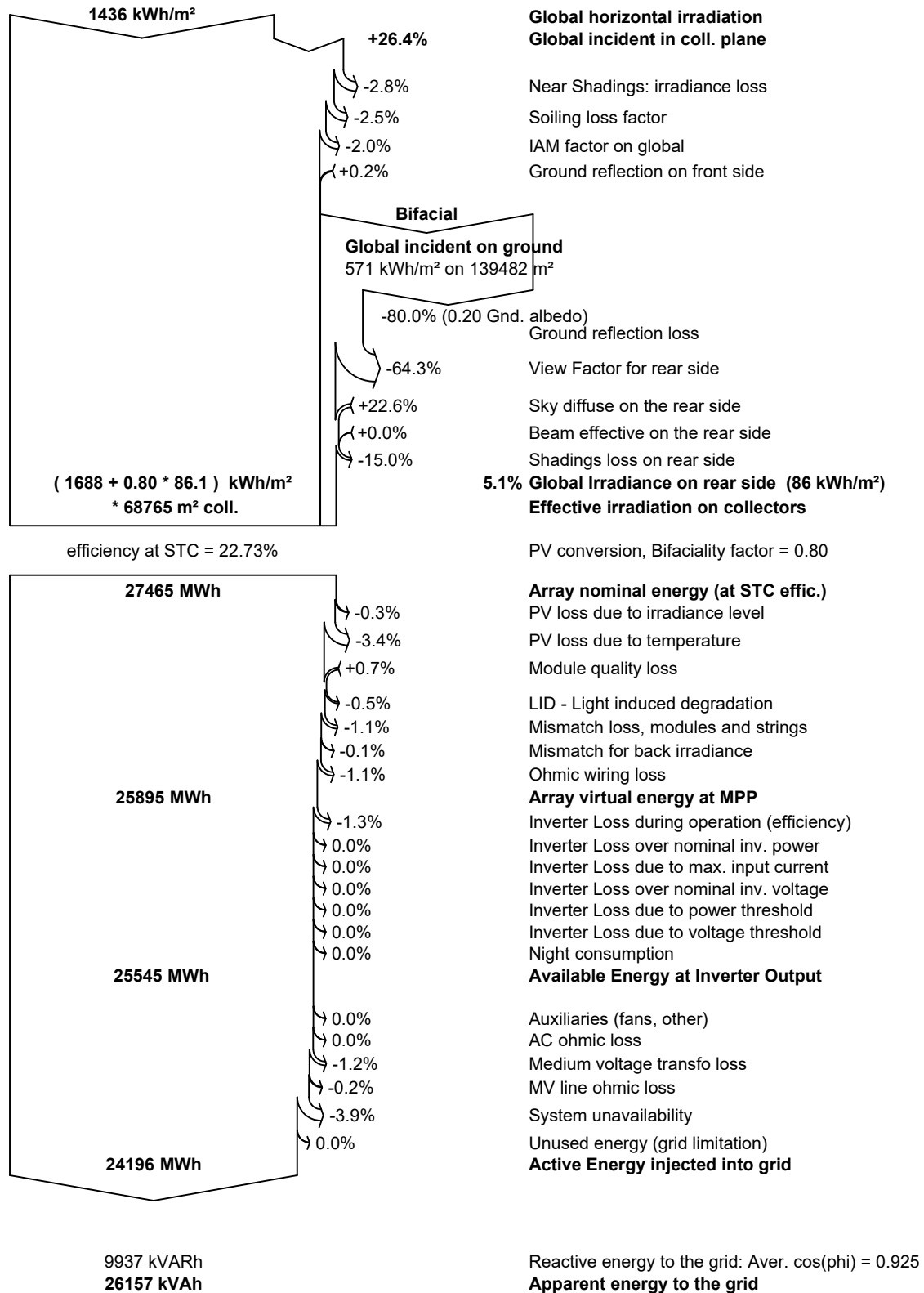
GlobHor Global horizontal irradiation  
DiffHor Horizontal diffuse irradiation  
T\_Amb Ambient Temperature  
GlobInc Global incident in coll. plane  
GlobEff Effective Global, corr. for IAM and shadings

EArray Effective energy at the output of the array  
E\_Grid Energy injected into grid  
PR Performance Ratio





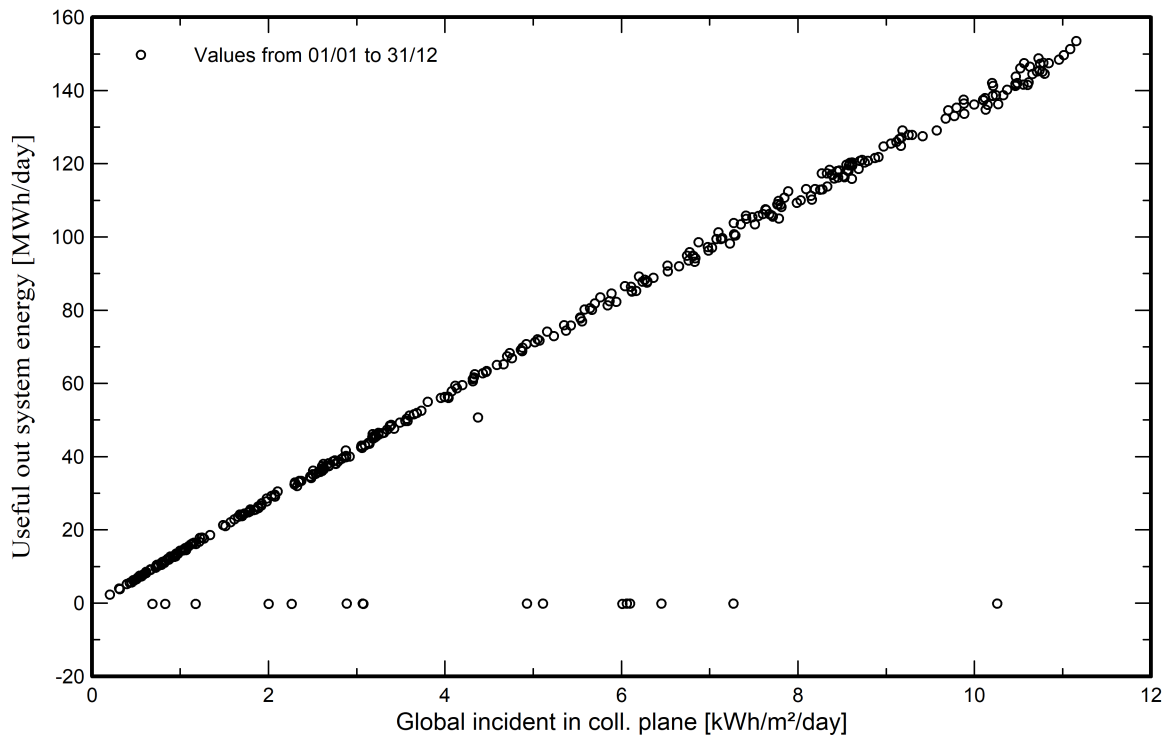
## Loss diagram



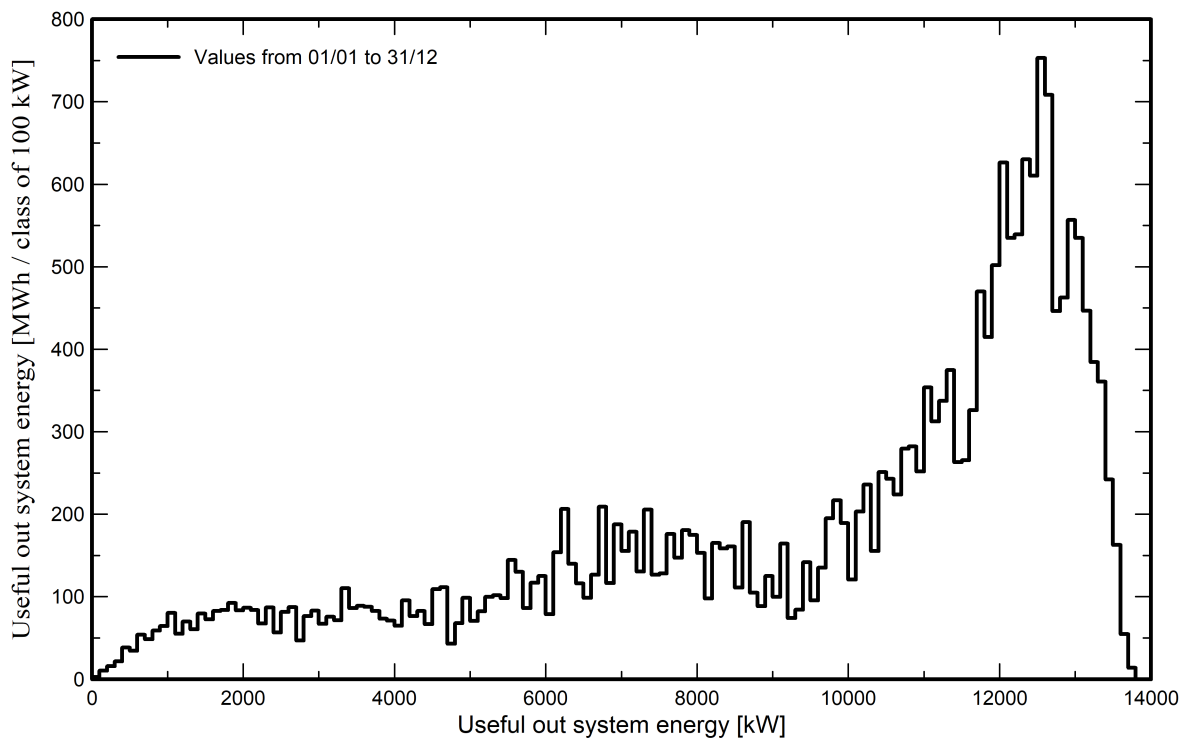


Predef. graphs

Daily Input/Output diagram



System Output Power Distribution





### P50 - P90 evaluation

#### Weather data

Source	PVGIS api TMY
Kind	TMY, multi-year
Year-to-year variability(Variance)	4.4 %
Specified Deviation	
Climate change	0.0 %

#### 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 %

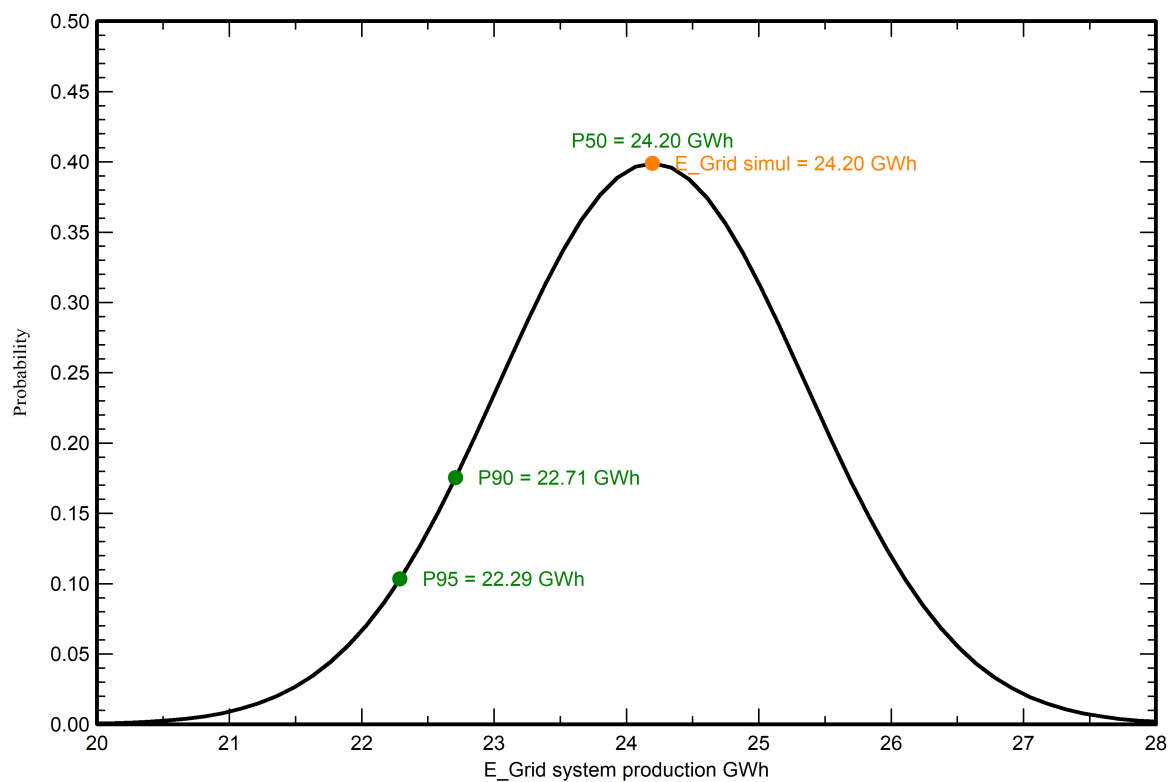
#### Global variability (weather data + system)

Variability (Quadratic sum)	4.8 %
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#### Annual production probability

Variability	1.16 GWh
P50	24.20 GWh
P90	22.71 GWh
P95	22.29 GWh

### Probability distribution





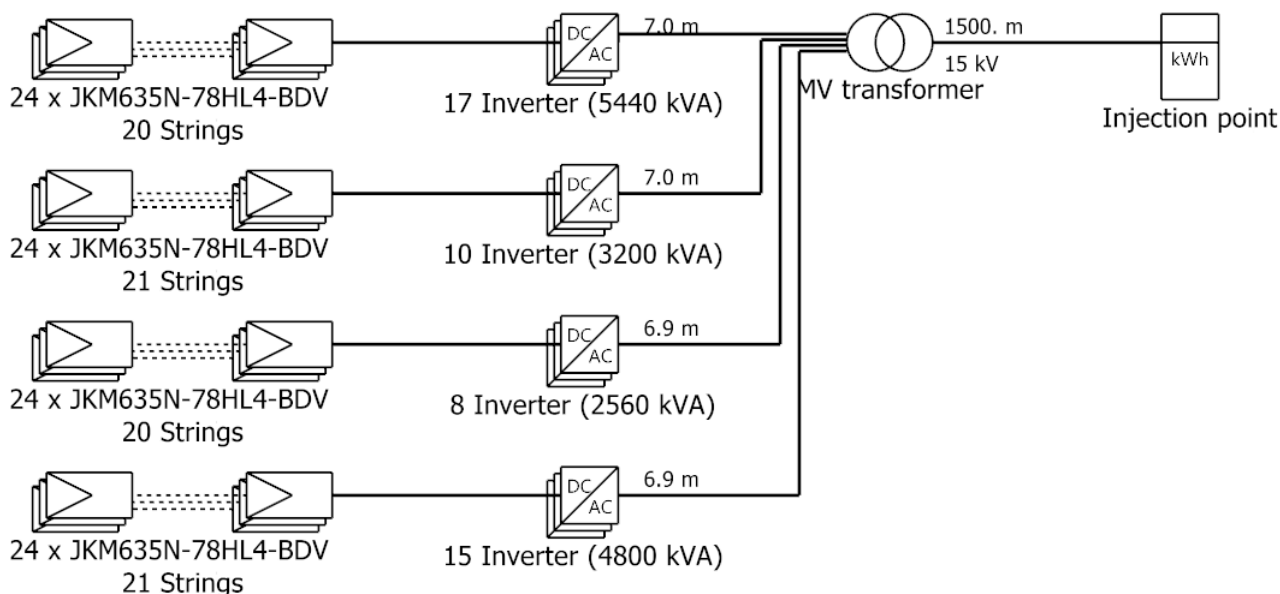
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# Single-line diagram



PV module	JKM635N-78HL4-BDV
Inverter	SG350HX-16MPPT
String	24 x JKM635N-78HL4-BDV

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