




# Impianto agrivoltaico avanzato denominato “Portomaggiore Fossa” di potenza pari a 24,97 MWp e relative opere di connessione ricadenti nei Comuni di Portomaggiore e Argenta (FE)

## Relazione di Calcolo Producibilità Impianto



<b>11/2025</b>	<b>00</b>	<b>Emissione per Autorizzazione</b>	 Ing. Edoardo Coda	<b>Marabeti L. D'Amico G.</b>	<b>Boni Castagnetti F.</b>
Data	Rev.	Descrizione Emissione	Preparato	Verificato	Approvato
Logo Committente e Denominazione Commerciale  Iren Green Generation Tech s.r.l.			ID Documento Committente  <b>CoD_098_FV_00018_BER</b>		
Logo Appaltatore e Denominazione Commerciale 			ID Documento Appaltatore		

# PVsyst - Simulation report

## Grid-Connected System

Project: PORTOMAGGIORE FOSSA e opere connesse

Variant: PORTOMAGGIORE FOSSA e opere connesse

Tracking system with backtracking

System power: 24.98 MWp

Ponte Botticino - Italy

**Author**

KELSE ENGINEERING SRL (Italy)



# Project: PORTOMAGGIORE FOSSA e opere connesse

Variant: PORTOMAGGIORE FOSSA e opere connesse

**PVsyst V8.0.18**

VC2, Simulation date:  
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## Project summary

<b>Geographical Site</b>	<b>Situation</b>	<b>Project settings</b>
<b>Ponte Botticino</b>	Latitude 44.67 °(N)	Albedo 0.20
Italia	Longitude 11.78 °(E)	
	Altitude 10 m	
	Time zone UTC+1	
<b>Weather data</b>		
Ponte Botticino		
PVGIS api TMY		

## System summary

<b>Grid-Connected System</b>	<b>Tracking system with backtracking</b>	
<b>Orientation #1</b>	<b>Near Shadings</b>	<b>User's needs</b>
<b>Tracking plane, horizontal N-S axis</b>	Linear shadings : Fast (table)	Unlimited load (grid)
Axis azimuth 0 °		
Phi min / max. +/- 50 °		
Diffuse shading all trackers		
<b>Tracking algorithm</b>		
Astronomic calculation		
Backtracking activated		
<b>System information</b>		
<b>PV Array</b>	<b>Inverters</b>	
Nb. of modules 37848 units	Nb. of units 82 units	
Pnom total 24.98 MWp	Total power 24600 kWac	
	Pnom ratio 1.02	

## Results summary

Produced Energy 41852 MWh/year	Specific production 1675 kWh/kWp/year	Perf. Ratio PR 85.56 %
		Bifacial perf. ratio 80.12 %

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**General parameters**

Grid-Connected System		Tracking system with backtracking		Models used	
<b>Orientation #1</b>		<b>Field properties</b>		Transposition	
<b>Tracking plane, horizontal N-S axis</b>		<b>Nb. of trackers</b>		Perez	
Axis azimuth	0 °	1639 units		Diffuse	
Phi min / max.	-/+ 50 °	<b>Tracking plane, horizontal N-S axis</b>		Circumsolar	
Diffuse shading	all trackers	<b>Sizes</b>		separate	
<b>Tracking algorithm</b>		Tracker Spacing			
Astronomic calculation		5.99 m			
Backtracking activated		Sensitive width			
		2.38 m			
		GCR Shading			
		39.7 %			
		<b>Backtracking limit angle</b>			
		Phi limits			
		+/- 66.6 °			
		<b>Backtracking parameters</b>			
		Backtracking pitch			
		5.99 m			
		Backtracking width			
		2.38 m			
		Left inactive band			
		0.00 m			
		Right inactive band			
		0.00 m			
		GCR Backtracking			
		39.7 %			
		Parameters choice			
		Automatic			
<b>Horizon</b>		<b>Near Shadings</b>		<b>User's needs</b>	
Free Horizon		Linear shadings : Fast (table)		Unlimited load (grid)	
<b>Bifacial system definition</b>					
<b>Orientation #1</b>					
<b>Bifacial system</b>					
Model		Unlimited Trackers 2D model			
<b>Bifacial model geometry</b>					
Tracker Spacing		5.99 m			
Tracker width		2.38 m			
Axis height above ground		2.10 m			
Nb. of sheds		233 units			
<b>Bifacial model definitions</b>					
Ground albedo		0.30			
Bifaciality factor		70 %			
Rear shading factor		5.0 %			
Rear mismatch loss		10.0 %			
Shed transparent fraction		0.0 %			

**PV Array Characteristics**

PV module		Inverter	
Manufacturer	Longi Solar	Manufacturer	Huawei Technologies
Model	LR7-72HVH-660M	Model	SUN2000-330KTL-H1
(Custom parameters definition)		(Original PVsyst database)	
Longi_LR7_72HVH_660M.PAN		Unit Nom. Power	300 kWac
Unit Nom. Power	660 Wp		
<b>Array #1 - CU. 1</b>			
Number of PV modules	3792 units	Number of inverters	9 units
Nominal (STC)	2503 kWp	Total power	2700 kWac
Modules	158 string x 24 In series		
<b>At operating cond. (50°C)</b>			
Pmpp	2341 kWp	Operating voltage	550-1500 V
U mpp	1003 V	Max. power (=>30°C)	330 kWac
I mpp	2333 A	Pnom ratio (DC:AC)	0.93
		Power sharing within this inverter	



**PV Array Characteristics**

**Array #2 - CU. 2**

Number of PV modules	4248 units	Number of inverters	9 units
Nominal (STC)	2804 kWp	Total power	2700 kWac
Modules	177 string x 24 In series		
<b>At operating cond. (50°C)</b>		Operating voltage	550-1500 V
Pmpp	2623 kWp	Max. power (=>30°C)	330 kWac
U mpp	1003 V	Pnom ratio (DC:AC)	1.04
I mpp	2614 A	Power sharing within this inverter	

**Array #3 - CU.3**

Number of PV modules	4608 units	Number of inverters	10 units
Nominal (STC)	3041 kWp	Total power	3000 kWac
Modules	192 string x 24 In series		
<b>At operating cond. (50°C)</b>		Operating voltage	550-1500 V
Pmpp	2845 kWp	Max. power (=>30°C)	330 kWac
U mpp	1003 V	Pnom ratio (DC:AC)	1.01
I mpp	2836 A	Power sharing within this inverter	

**Array #4 - CU. 4**

Number of PV modules	4248 units	Number of inverters	9 units
Nominal (STC)	2804 kWp	Total power	2700 kWac
Modules	177 string x 24 In series		
<b>At operating cond. (50°C)</b>		Operating voltage	550-1500 V
Pmpp	2623 kWp	Max. power (=>30°C)	330 kWac
U mpp	1003 V	Pnom ratio (DC:AC)	1.04
I mpp	2614 A	Power sharing within this inverter	

**Array #5 - CU.5**

Number of PV modules	4248 units	Number of inverters	9 units
Nominal (STC)	2804 kWp	Total power	2700 kWac
Modules	177 string x 24 In series		
<b>At operating cond. (50°C)</b>		Operating voltage	550-1500 V
Pmpp	2623 kWp	Max. power (=>30°C)	330 kWac
U mpp	1003 V	Pnom ratio (DC:AC)	1.04
I mpp	2614 A	Power sharing within this inverter	

**Array #6 - CU. 6**

Number of PV modules	4272 units	Number of inverters	9 units
Nominal (STC)	2820 kWp	Total power	2700 kWac
Modules	178 string x 24 In series		
<b>At operating cond. (50°C)</b>		Operating voltage	550-1500 V
Pmpp	2638 kWp	Max. power (=>30°C)	330 kWac
U mpp	1003 V	Pnom ratio (DC:AC)	1.04
I mpp	2629 A	Power sharing within this inverter	

**Array #7 - CU. 7**

Number of PV modules	4128 units	Number of inverters	9 units
Nominal (STC)	2724 kWp	Total power	2700 kWac
Modules	172 string x 24 In series		
<b>At operating cond. (50°C)</b>		Operating voltage	550-1500 V
Pmpp	2549 kWp	Max. power (=>30°C)	330 kWac
U mpp	1003 V	Pnom ratio (DC:AC)	1.01
I mpp	2540 A	Power sharing within this inverter	



**PV Array Characteristics**

<b>Array #8 - CU. 8</b>			
Number of PV modules	4128 units	Number of inverters	9 units
Nominal (STC)	2724 kWp	Total power	2700 kWac
Modules	172 string x 24 In series		
<b>At operating cond. (50°C)</b>			
Pmpp	2549 kWp	Operating voltage	550-1500 V
U mpp	1003 V	Max. power (=>30°C)	330 kWac
I mpp	2540 A	Pnom ratio (DC:AC)	1.01
		Power sharing within this inverter	
<b>Array #9 - CU. 9</b>			
Number of PV modules	4176 units	Number of inverters	9 units
Nominal (STC)	2756 kWp	Total power	2700 kWac
Modules	174 string x 24 In series		
<b>At operating cond. (50°C)</b>			
Pmpp	2578 kWp	Operating voltage	550-1500 V
U mpp	1003 V	Max. power (=>30°C)	330 kWac
I mpp	2570 A	Pnom ratio (DC:AC)	1.02
		Power sharing within this inverter	
<b>Total PV power</b>		<b>Total inverter power</b>	
Nominal (STC)	24980 kWp	Total power	24600 kWac
Total	37848 modules	Max. power	27060 kWac
Module area	102235 m <sup>2</sup>	Number of inverters	82 units
Cell area	90265 m <sup>2</sup>	Pnom ratio	1.02

**Array losses**

<b>Array Soiling Losses</b>		<b>Thermal Loss factor</b>		<b>Serie Diode Loss</b>				
Loss Fraction	3.0 %	Module temperature according to irradiance		Voltage drop	0.7 V			
		Uc (const)	20.0 W/m <sup>2</sup> K	Loss Fraction	0.1 % at STC			
		Uv (wind)	0.0 W/m <sup>2</sup> K/m/s					
<b>LID - Light Induced Degradation</b>		<b>Module Quality Loss</b>		<b>Module mismatch losses</b>				
Loss Fraction	2.0 %	Loss Fraction	-0.75 %	Loss Fraction	2.00 % at MPP			
<b>Strings Mismatch loss</b>								
Loss Fraction	0.10 %							
<b>IAM loss factor</b>								
Incidence effect (IAM): Fresnel smooth glass, n = 1.526								
0°	30°	50°	60°	70°	75°	80°	85°	90°
1.000	0.998	0.981	0.948	0.862	0.776	0.636	0.402	0.000

**DC wiring losses**

Global wiring resistance	0.70 mΩ		
Loss Fraction	1.5 % at STC		
<b>Array #1 - CU. 1</b>		<b>Array #2 - CU. 2</b>	
Global array res.	7.0 mΩ	Global array res.	6.2 mΩ
Loss Fraction	1.5 % at STC	Loss Fraction	1.5 % at STC
<b>Array #3 - CU.3</b>		<b>Array #4 - CU. 4</b>	
Global array res.	5.7 mΩ	Global array res.	6.2 mΩ
Loss Fraction	1.5 % at STC	Loss Fraction	1.5 % at STC
<b>Array #5 - CU.5</b>		<b>Array #6 - CU. 6</b>	
Global array res.	6.2 mΩ	Global array res.	6.2 mΩ
Loss Fraction	1.5 % at STC	Loss Fraction	1.5 % at STC



**DC wiring losses**

<b>Array #7 - CU. 7</b>		<b>Array #8 - CU. 8</b>	
Global array res.	6.4 mΩ	Global array res.	6.4 mΩ
Loss Fraction	1.5 % at STC	Loss Fraction	1.5 % at STC
<b>Array #9 - CU. 9</b>			
Global array res.	6.3 mΩ		
Loss Fraction	1.5 % at STC		

**AC wiring losses**

<b>Inv. output line up to MV transfo</b>			
Inverter voltage	800 Vac tri		
Loss Fraction	3.53 % at STC		
<b>Inverter: SUN2000-330KTL-H1</b>			
Wire section (82 Inv.)	Alu 82 x 3 x 300 mm <sup>2</sup>		
Average wires length	714 m		
<b>MV line up to Injection</b>			
MV Voltage	36 kV		
Average loss Fraction	0.01 % at STC		
<b>Array #1 - CU. 1</b>		<b>Array #2 - CU. 2</b>	
Wires	Alu 3 x 185 mm <sup>2</sup>	Wires	Alu 3 x 185 mm <sup>2</sup>
Length	650 m	Length	255 m
<b>Array #3 - CU.3</b>		<b>Array #4 - CU. 4</b>	
Wires	Alu 3 x 185 mm <sup>2</sup>	Wires	Alu 3 x 185 mm <sup>2</sup>
Length	650 m	Length	175 m
<b>Array #5 - CU.5</b>		<b>Array #6 - CU. 6</b>	
Wires	Alu 3 x 185 mm <sup>2</sup>	Wires	Alu 3 x 185 mm <sup>2</sup>
Length	135 m	Length	700 m
<b>Array #7 - CU. 7</b>		<b>Array #8 - CU. 8</b>	
Wires	Alu 3 x 185 mm <sup>2</sup>	Wires	Alu 3 x 185 mm <sup>2</sup>
Length	185 m	Length	210 m
<b>Array #9 - CU. 9</b>			
Wires	Alu 3 x 185 mm <sup>2</sup>		
Length	250 m		



**AC losses in transformers**

**MV transfo**

Grid voltage 36 kV

One transfo in each sub-array

**Array #1 - CU. 1**

**Transformer from Datasheets**

Nominal power 3150 kVA  
Iron Loss (24/24 Connexion) 3.20 kVA  
Iron loss fraction 0.10 % of PNom  
Copper loss 30.00 kVA  
Copper loss fraction 0.95 % at PNom  
Coils equivalent resistance 3 x 1.93 mΩ

**Array #2 - CU. 2**

**Transformer from Datasheets**

Nominal power 3150 kVA  
Iron Loss (24/24 Connexion) 3.20 kVA  
Iron loss fraction 0.10 % of PNom  
Copper loss 30.00 kVA  
Copper loss fraction 0.95 % at PNom  
Coils equivalent resistance 3 x 1.93 mΩ

**Array #3 - CU.3**

**Transformer from Datasheets**

Nominal power 4000 kVA  
Iron Loss (24/24 Connexion) 4.00 kVA  
Iron loss fraction 0.10 % of PNom  
Copper loss 37.00 kVA  
Copper loss fraction 0.93 % at PNom  
Coils equivalent resistance 3 x 1.48 mΩ

**Array #4 - CU. 4**

**Transformer from Datasheets**

Nominal power 3150 kVA  
Iron Loss (24/24 Connexion) 3.20 kVA  
Iron loss fraction 0.10 % of PNom  
Copper loss 30.00 kVA  
Copper loss fraction 0.95 % at PNom  
Coils equivalent resistance 3 x 1.93 mΩ

**Array #5 - CU.5**

**Transformer from Datasheets**

Nominal power 3150 kVA  
Iron Loss (24/24 Connexion) 3.20 kVA  
Iron loss fraction 0.10 % of PNom  
Copper loss 30.00 kVA  
Copper loss fraction 0.95 % at PNom  
Coils equivalent resistance 3 x 1.93 mΩ

**Array #6 - CU. 6**

**Transformer from Datasheets**

Nominal power 3150 kVA  
Iron Loss (24/24 Connexion) 3.20 kVA  
Iron loss fraction 0.10 % of PNom  
Copper loss 30.00 kVA  
Copper loss fraction 0.95 % at PNom  
Coils equivalent resistance 3 x 1.93 mΩ



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**AC losses in transformers**

**MV transfo**

Grid voltage 36 kV

One transfo in each sub-array

**Array #7 - CU. 7**

**Transformer from Datasheets**

Nominal power 3150 kVA  
Iron Loss (24/24 Connexion) 3.20 kVA  
Iron loss fraction 0.10 % of PNom  
Copper loss 30.00 kVA  
Copper loss fraction 0.95 % at PNom  
Coils equivalent resistance 3 x 1.93 mΩ

**Array #8 - CU. 8**

**Transformer from Datasheets**

Nominal power 3150 kVA  
Iron Loss (24/24 Connexion) 3.20 kVA  
Iron loss fraction 0.10 % of PNom  
Copper loss 30.00 kVA  
Copper loss fraction 0.95 % at PNom  
Coils equivalent resistance 3 x 1.93 mΩ

**Array #9 - CU. 9**

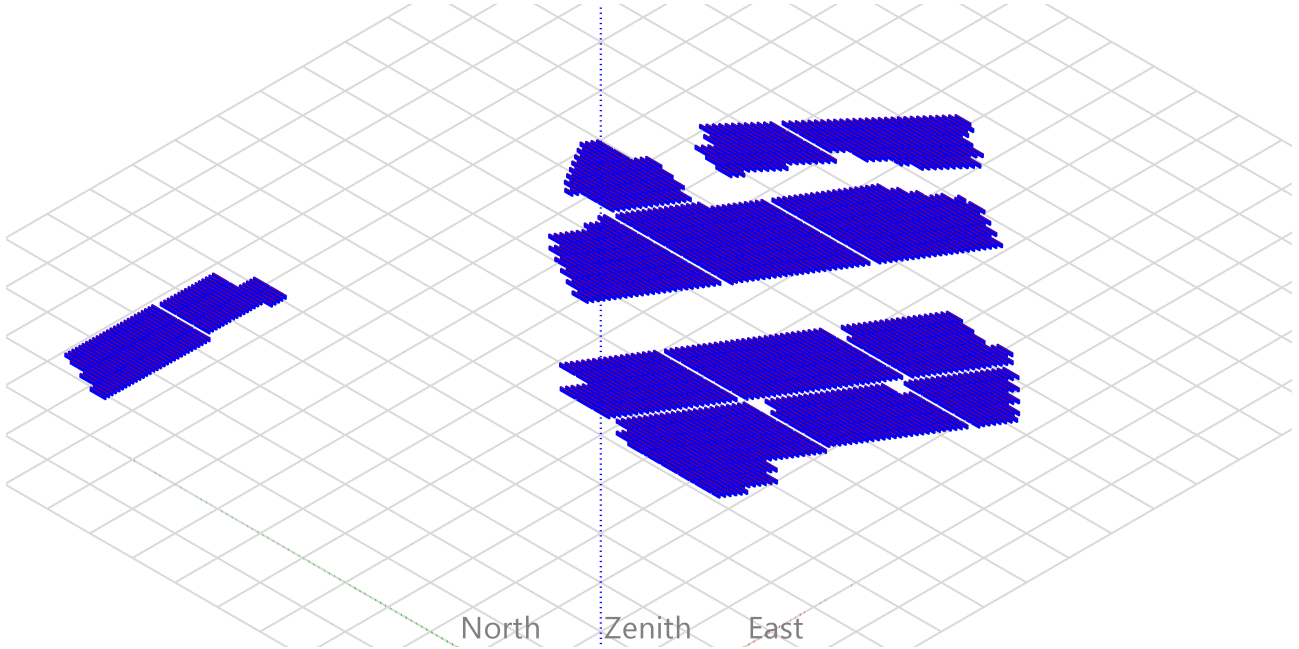
**Transformer from Datasheets**

Nominal power 3150 kVA  
Iron Loss (24/24 Connexion) 3.20 kVA  
Iron loss fraction 0.10 % of PNom  
Copper loss 30.00 kVA  
Copper loss fraction 0.95 % at PNom  
Coils equivalent resistance 3 x 1.93 mΩ



### Near shadings parameter

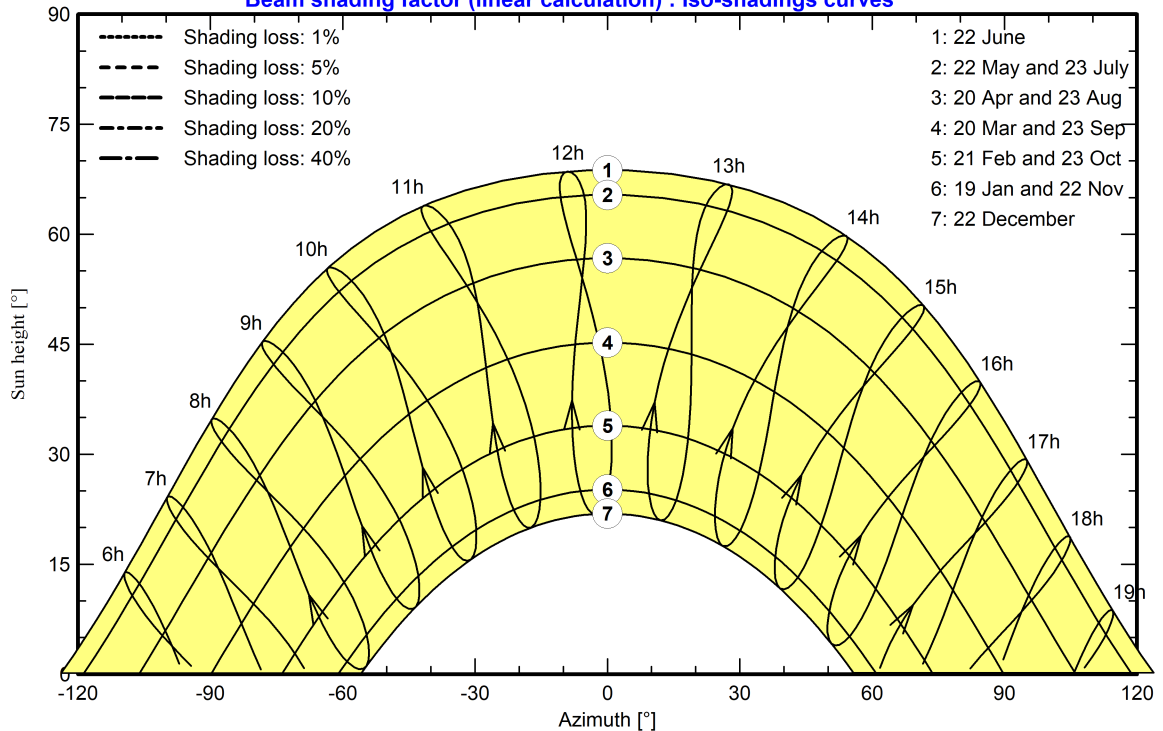
Perspective of the PV-field and surrounding shading scene



### Iso-shadings diagram

Orientation #1 -

Beam shading factor (linear calculation) - ISO-shadings curves





# Project: PORTOMAGGIORE FOSSA e opere connesse

Variant: PORTOMAGGIORE FOSSA e opere connesse

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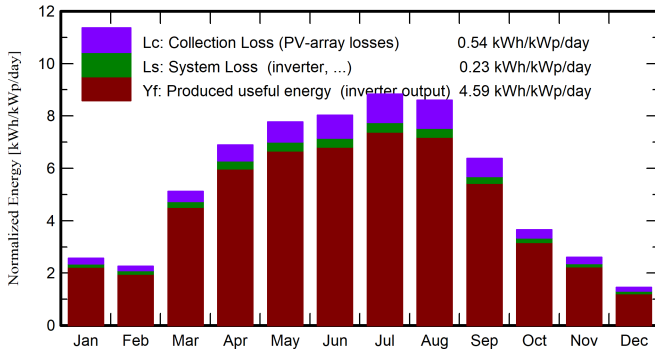
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## Main results

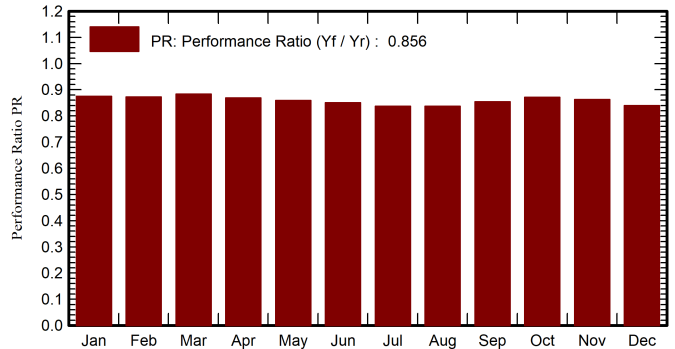
### System Production

Produced Energy	41852 MWh/year	Specific production	1675 kWh/kWp/year
		Perf. Ratio PR	85.56 %
		Bifacial perf. ratio	80.12 %

### Normalized productions (per installed kWp)



### Performance Ratio PR



## Balances and main results

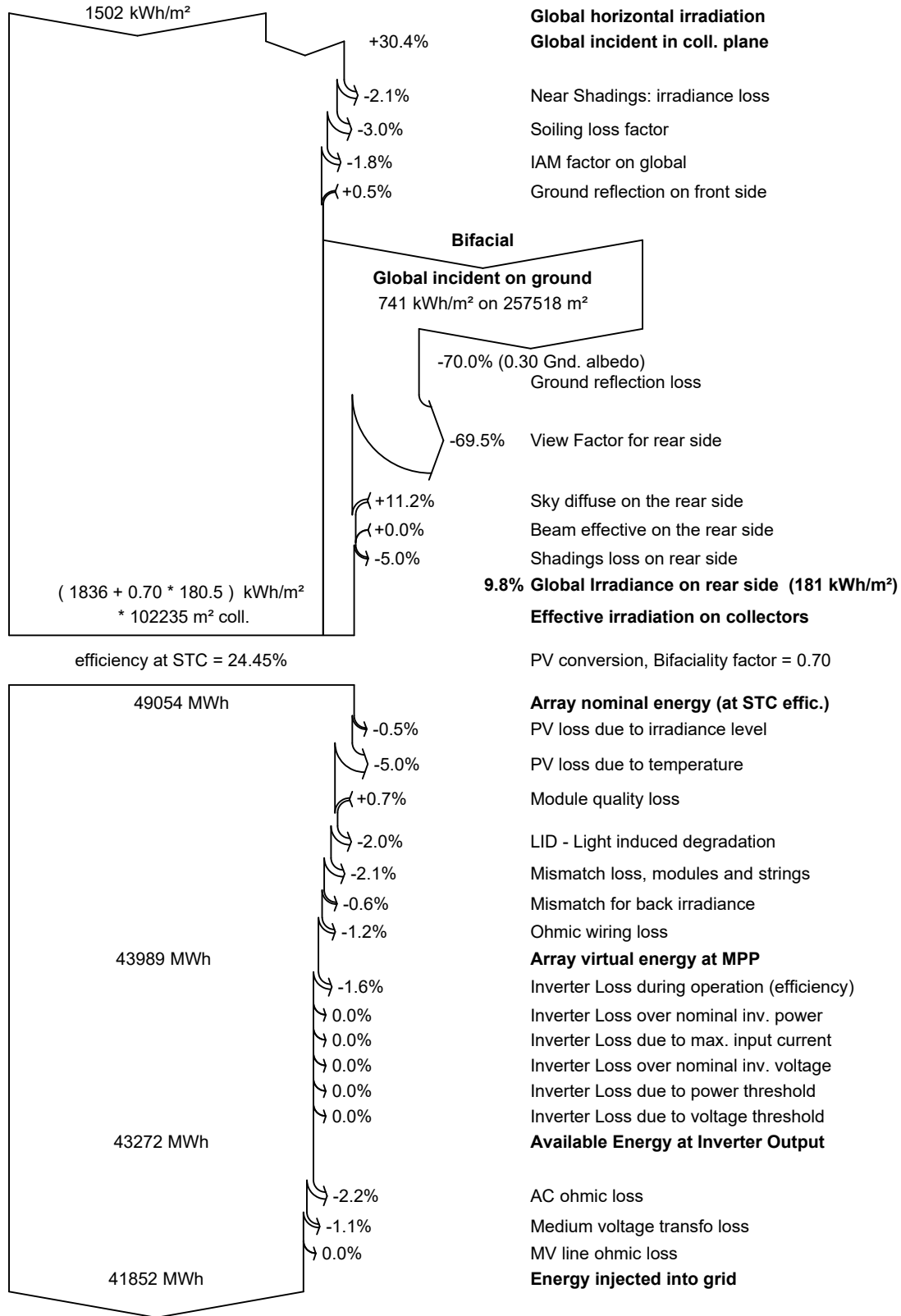
	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_Grid	PR	PRBifi
	kWh/m <sup>2</sup>	kWh/m <sup>2</sup>	°C	kWh/m <sup>2</sup>	kWh/m <sup>2</sup>	MWh	MWh	ratio	ratio
January	56.8	22.80	1.83	79.5	71.4	1829	1735	0.874	0.824
February	50.2	27.96	5.25	63.4	58.0	1471	1381	0.872	0.813
March	120.3	48.43	9.46	158.7	148.5	3671	3499	0.883	0.827
April	157.9	60.41	12.87	206.8	194.9	4714	4488	0.869	0.814
May	192.3	76.39	18.25	240.7	227.5	5428	5165	0.859	0.801
June	190.9	78.79	21.83	240.8	227.3	5370	5113	0.850	0.793
July	211.0	73.04	26.78	273.9	259.5	6009	5725	0.837	0.784
August	200.1	62.08	27.43	266.8	253.0	5841	5575	0.837	0.786
September	141.1	47.90	21.79	191.3	180.2	4271	4078	0.854	0.803
October	86.9	40.80	14.80	113.2	104.9	2589	2465	0.872	0.815
November	57.7	25.36	10.48	78.2	70.9	1775	1683	0.862	0.810
December	36.4	24.23	6.48	45.0	39.8	1020	944	0.839	0.779
Year	1501.6	588.20	14.83	1958.3	1835.9	43989	41852	0.856	0.801

### 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	PRBifi	Bifacial Performance Ratio
GlobEff	Effective Global, corr. for IAM and shadings		



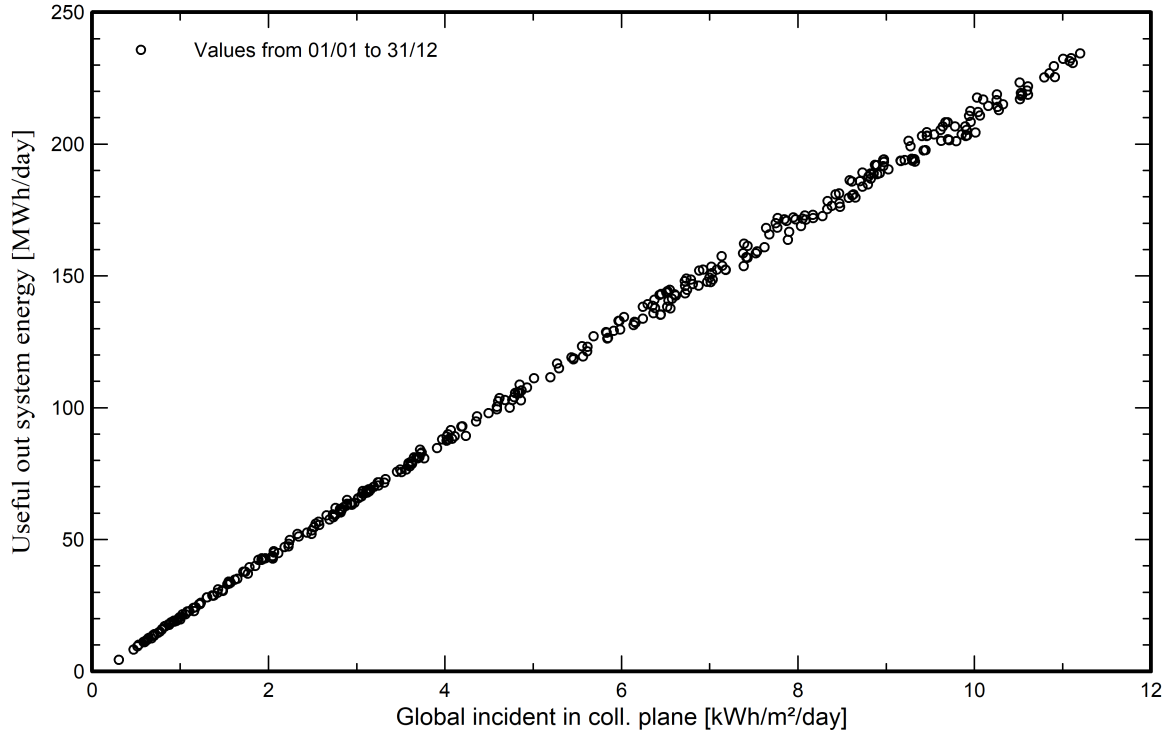
**Loss diagram**



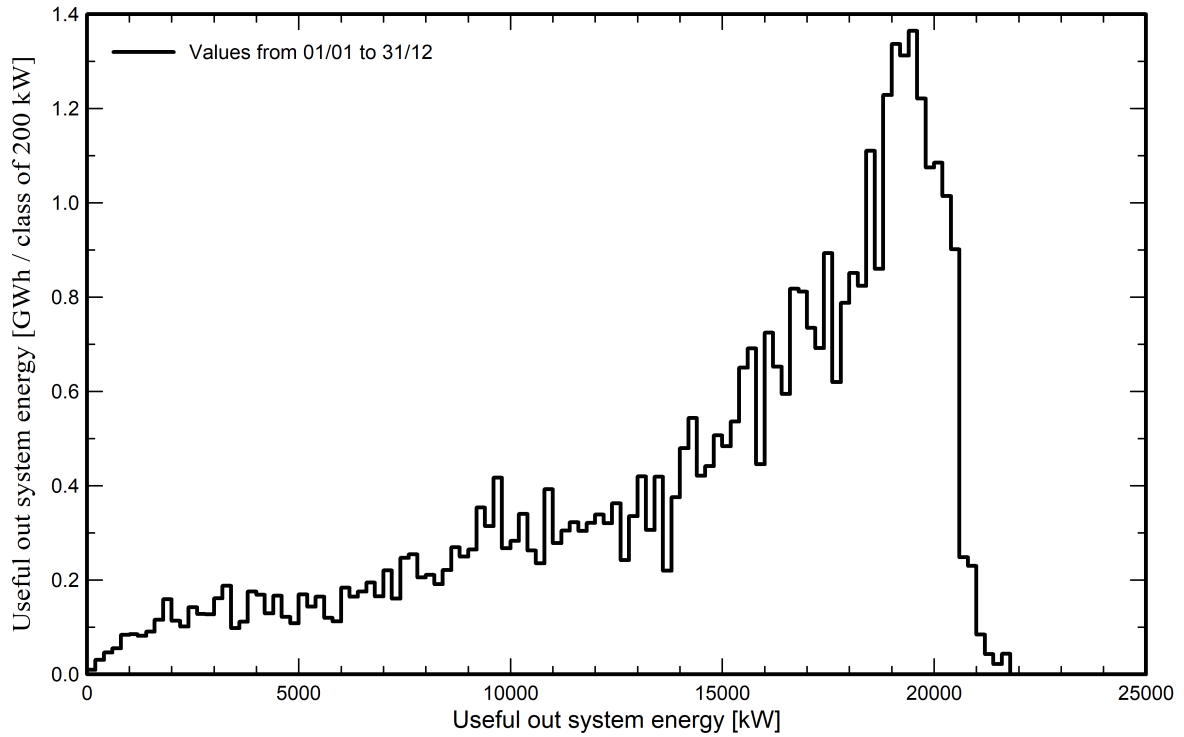


Predef. graphs

Daily Input/Output diagram



System Output Power Distribution

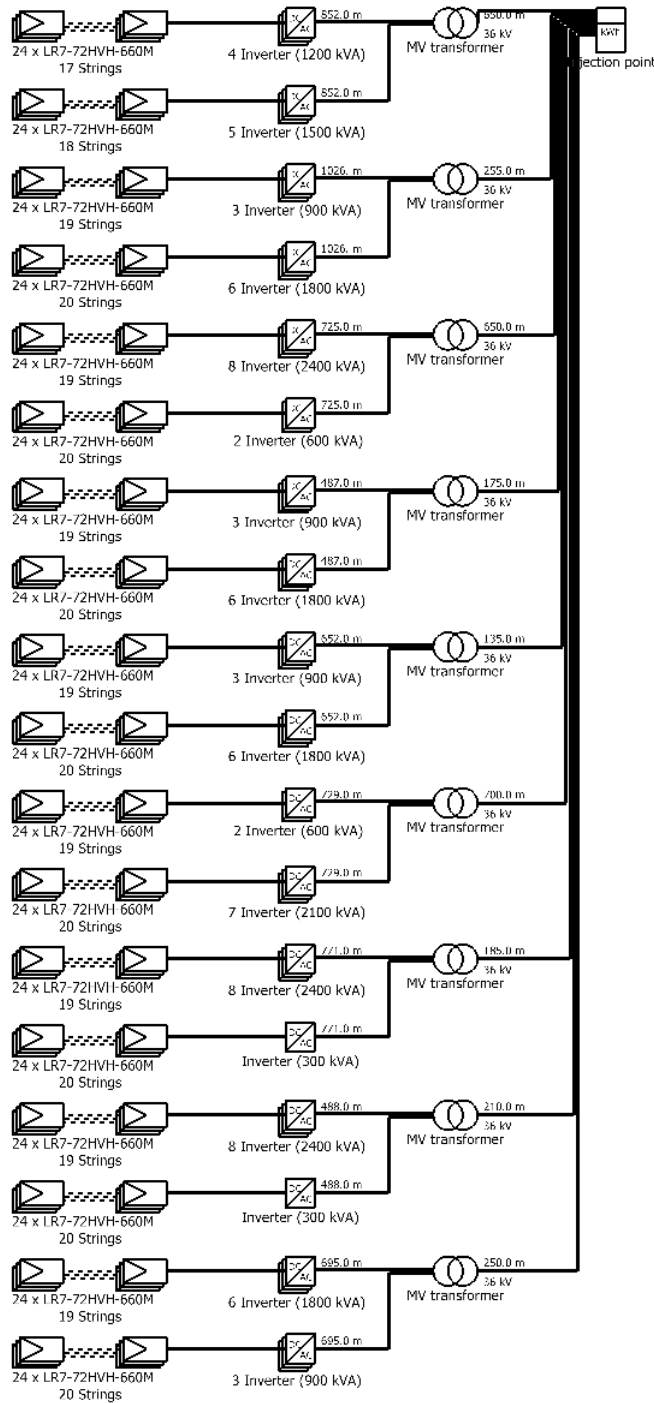




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# Single-line diagram



PV module	LR7-72HVH-660M
Inverter	SUN2000-330KTL-H1
String	24 x LR7-72HVH-660M

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**VC2 : PORTOMAGGIORE FOSSA e opere connesse**

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