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**NOME COMMESSA:**

**COSTRUZIONE ED ESERCIZIO DI NUOVO IMPIANTO AGROVOLTAICO CON NOMINALE PARI A 25.000 kW, POTENZA MODULI PARI A 23.351,90 kWp E SISTEMA DI ACCUMULO PARI A 4.400,00kW/8.250,00kWh CON RELATIVO COLLEGAMENTO ALLA RETE ELETTRICA, SITO NEL COMUNE DI LECCE (LE) - IMPIANTO 90**

**STATO DI AVANZAMENTO COMMESSA:**

**PROGETTO DEFINITIVO PER AUTORIZZAZIONE UNICA**

**CODICE COMMESSA:**

**HE.19.0040**

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**OGGETTO:**

**ANALISI DELLA RISORSA SOLARE E STIMA DI PRODUZIONE ENERGIA**

**SCALA:**

-

**DATA:**

**MARZO 2022**

**NOME FILE:**

BUBY814\_AnalisiRisorsaSolare.pdf

**TAVOLA:**

**DPE.RE01**

N. REV.	DATA	REVISIONE
0	03.2022	Emissione

**ELABORATO**

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**VERIFICATO**

responsabile commessa  
A.Albuzzi

**VALIDATO**

direttore tecnico  
N.Zuech

# PVsyst - Simulation report

## Grid-Connected System

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Project: HE.19.0040 HEPV10 SV.90

Variant: HEPV10 - Sviluppo 90 da 23.3MWp

Trackers single array, with backtracking

System power: 23.35 MWp

Lecce - Italy

**Author**

Heliopolis spa (Italy)

**PVsyst V7.2.9**

VCO, Simulation date:  
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**Project summary**

<b>Geographical Site</b>	<b>Situation</b>	<b>Project settings</b>
<b>Lecce</b>	Latitude 40.35 °N	Albedo 0.20
Italy	Longitude 18.17 °E	
	Altitude 51 m	
	Time zone UTC+1	
<b>Meteo data</b>		
HE190024_90		
PVGIS api TMY		

**System summary**

<b>Grid-Connected System</b>	<b>Trackers single array, with backtracking</b>		
Simulation for year no 1			
<b>PV Field Orientation</b>	<b>Near Shadings</b>	<b>User's needs</b>	
Tracking plane, horizontal N-S axis	Linear shadings	Unlimited load (grid)	
Axis azimuth 0 °			
<b>System information</b>			
<b>PV Array</b>		<b>Inverters</b>	
Nb. of modules 42458 units		Nb. of units 6 units	
Pnom total 23.35 MWp		Pnom total 20.60 MWac	
		Pnom ratio 1.134	

**Results summary**

Produced Energy 43 GWh/year	Specific production 1854 kWh/kWp/year	Perf. Ratio PR 83.64 %
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**General parameters**

<b>Grid-Connected System</b>		<b>Trackers single array, with backtracking</b>			
<b>PV Field Orientation</b>		<b>Backtracking strategy</b>		<b>Models used</b>	
<b>Orientation</b>		Nb. of trackers		Transposition	
Tracking plane, horizontal N-S axis		165 units		Perez	
Axis azimuth		Single array		Diffuse	
0 °		<b>Sizes</b>		Circumsolar	
		Tracker Spacing		separate	
		5.50 m			
		Collector width			
		2.00 m			
		Ground Cov. Ratio (GCR)			
		36.4 %			
		Left inactive band			
		0.02 m			
		Right inactive band			
		0.02 m			
		Phi min / max.			
		-/+ 60.0 °			
		<b>Backtracking limit angle</b>			
		Phi limits			
		+/- 68.0 °			
<b>Horizon</b>		<b>Near Shadings</b>		<b>User's needs</b>	
Average Height		Linear shadings		Unlimited load (grid)	
1.2 °					

**PV Array Characteristics**

<b>Array #1 - Campo 1</b>			
<b>PV module</b>		<b>Inverter</b>	
Manufacturer	Phono Solar	Manufacturer	SMA
Model	PS550M6H-24/TH	Model	Sunny Central 4200 UP
(Custom parameters definition)		(Original PVsyst database)	
Unit Nom. Power	550 Wp	Unit Nom. Power	4200 kWac
Number of PV modules	8762 units	Number of inverters	1 unit
Nominal (STC)	4819 kWp	Total power	4200 kWac
Modules	337 Strings x 26 In series	Operating voltage	921-1325 V
<b>At operating cond. (50°C)</b>		Pnom ratio (DC:AC)	1.15
Pmpp	4360 kWp		
U mpp	973 V		
I mpp	4481 A		
<b>PV module</b>		<b>Inverter</b>	
Manufacturer	Phono Solar	Manufacturer	SMA
Model	PS550M6H-24/TH	Model	Sunny Central 2800 UP (Preliminary)
(Custom parameters definition)		(Custom parameters definition)	
Unit Nom. Power	550 Wp	Unit Nom. Power	2800 kWac
Number of PV modules	18200 units	Number of inverters	3 units
Nominal (STC)	10.01 MWp	Total power	8400 kWac
<b>Array #2 - Campo 2</b>			
Number of PV modules	6630 units	Number of inverters	1 unit
Nominal (STC)	3647 kWp	Total power	2800 kWac
Modules	255 Strings x 26 In series		
<b>At operating cond. (50°C)</b>		Operating voltage	921-1325 V
Pmpp	3299 kWp	Pnom ratio (DC:AC)	1.30
U mpp	973 V		
I mpp	3391 A		



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**PV Array Characteristics**

**Array #4 - Campo 4**

Number of PV modules 11570 units  
Nominal (STC) 6364 kWp  
Modules 445 Strings x 26 In series

**At operating cond. (50°C)**

Pmpp 5757 kWp  
U mpp 973 V  
I mpp 5917 A

Number of inverters 2 units  
Total power 5600 kWac

Operating voltage 921-1325 V  
Pnom ratio (DC:AC) 1.14

**Array #3 - Campo 3**

**PV module**

Manufacturer Phono Solar  
Model PS550M6H-24/TH  
(Custom parameters definition)

Unit Nom. Power 550 Wp  
Number of PV modules 15496 units  
Nominal (STC) 8523 kWp  
Modules 596 Strings x 26 In series

**At operating cond. (50°C)**

Pmpp 7711 kWp  
U mpp 973 V  
I mpp 7925 A

**Inverter**

Manufacturer SMA  
Model Sunny Central 4000 UP  
(Original PVsyst database)

Unit Nom. Power 4000 kWac  
Number of inverters 2 units  
Total power 8000 kWac  
Operating voltage 880-1325 V  
Pnom ratio (DC:AC) 1.07

**Total PV power**

Nominal (STC) 23352 kWp  
Total 42458 modules  
Module area 109728 m<sup>2</sup>  
Cell area 100880 m<sup>2</sup>

**Total inverter power**

Total power 20600 kWac  
Number of inverters 6 units  
Pnom ratio 1.13

**Array losses**

**Array Soiling Losses**

Loss Fraction 1.0 %

**Thermal Loss factor**

Module temperature according to irradiance  
Uc (const) 29.0 W/m<sup>2</sup>K  
Uv (wind) 0.0 W/m<sup>2</sup>K/m/s

**LID - Light Induced Degradation**

Loss Fraction 1.0 %

**Module Quality Loss**

Loss Fraction -0.6 %

**Module mismatch losses**

Loss Fraction 0.7 % at MPP

**Strings Mismatch loss**

Loss Fraction 0.1 %

**Module average degradation**

Year no 1  
Loss factor 0.5 %/year

**Mismatch due to degradation**

Imp RMS dispersion 0 %/year  
Vmp RMS dispersion 0 %/year

**IAM loss factor**

Incidence effect (IAM): User defined profile

0°	20°	40°	60°	70°	75°	80°	85°	90°
1.000	1.000	1.000	0.970	0.910	0.850	0.740	0.440	0.000

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**DC wiring losses**

Global wiring resistance 0.70 mΩ  
Loss Fraction 1.4 % at STC

**Array #1 - Campo 1**

Global array res. 3.4 mΩ  
Loss Fraction 1.4 % at STC

**Array #3 - Campo 3**

Global array res. 1.9 mΩ  
Loss Fraction 1.4 % at STC

**Array #2 - Campo 2**

Global array res. 4.5 mΩ  
Loss Fraction 1.4 % at STC

**Array #4 - Campo 4**

Global array res. 2.6 mΩ  
Loss Fraction 1.4 % at STC

**System losses****Auxiliaries loss**

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

**AC wiring losses****Inv. output line up to MV transfo**

Inverter voltage 630 Vac tri  
Loss Fraction 0.60 % at STC

**Inverters: Sunny Central 4200 UP, Sunny Central 2800 UP (Preliminary), Sunny Central 4000 UP**

Wire section (6 Inv.) Copper 6 x 3 x 3000 mm<sup>2</sup>  
Average wires length 99 m

**AC losses in transformers****MV transfo**

Grid voltage 30 kV

**Operating losses at STC**

Nominal power at STC 22877 kVA  
Iron loss (24/24 Connexion) 45.75 kW  
Loss Fraction 0.20 % at STC  
Coils equivalent resistance 3 x 0.35 mΩ  
Loss Fraction 2.00 % at STC



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**Horizon definition**

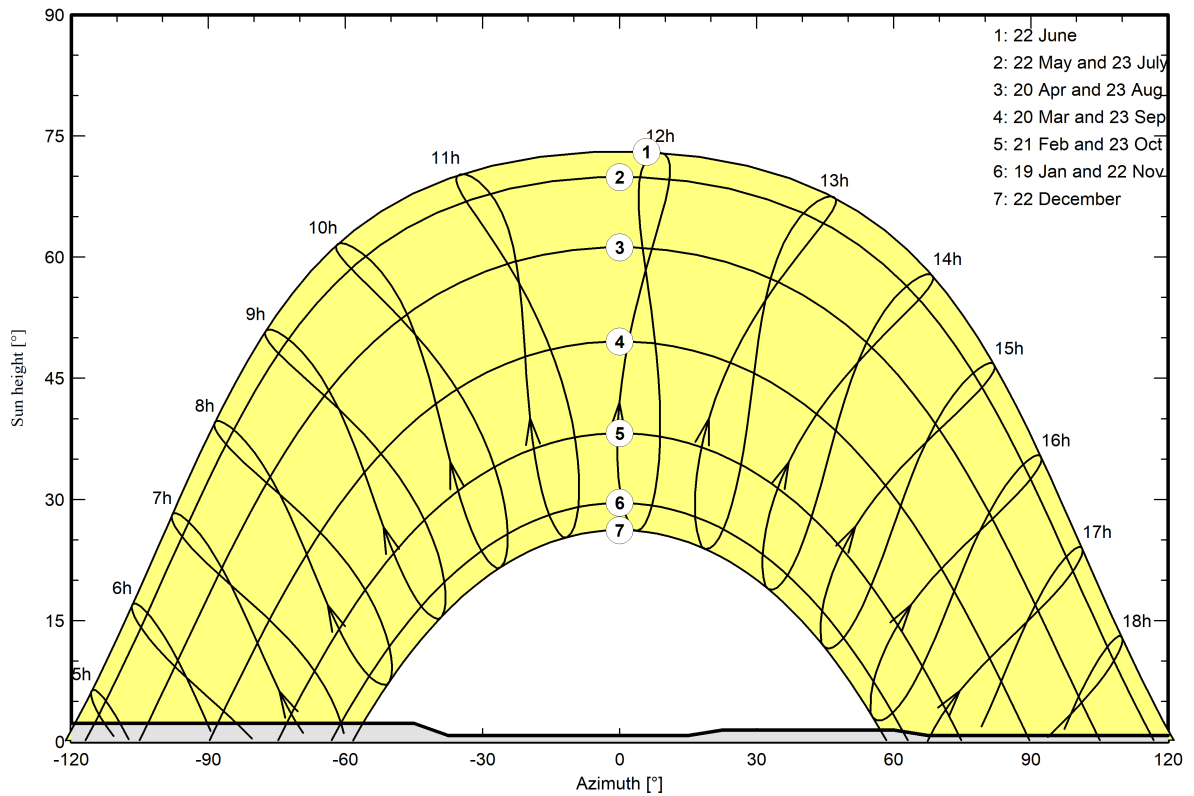
Horizon from PVGIS website API, Lat=40°37'55', Long=17°56'9', Alt=23m

Average Height	1.2 °	Albedo Factor	0.95
Diffuse Factor	0.99	Albedo Fraction	100 %

**Horizon profile**

Azimuth [°]	-180	-173	-165	-143	-135	-45	-38	15
Height [°]	0.8	0.8	0.4	0.4	2.3	2.3	0.8	0.8
Azimuth [°]	23	60	68	150	158	165	173	180
Height [°]	1.5	1.5	0.8	0.8	0.4	0.4	0.8	0.8

**Sun Paths (Height / Azimuth diagram)**





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**Main results**

**System Production**

Produced Energy

43 GWh/year

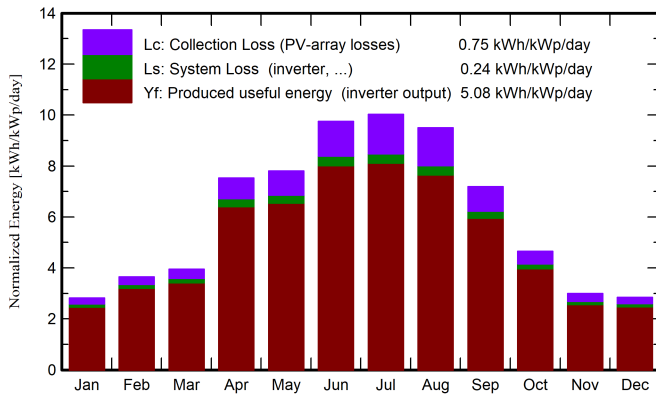
Specific production

1854 kWh/kWp/year

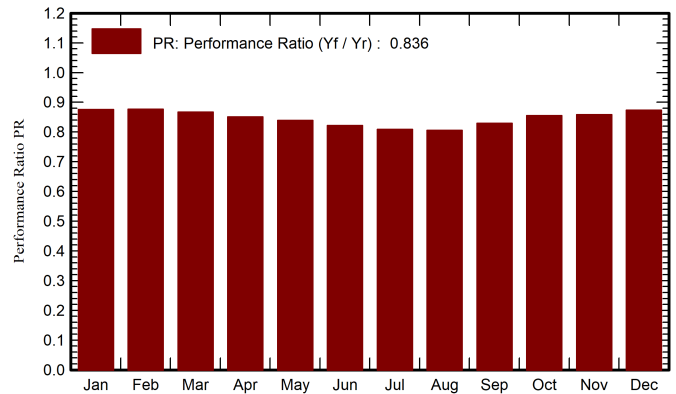
Performance Ratio PR

83.64 %

**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 GWh	E_Grid GWh	PR ratio
January	63.8	27.91	9.72	87.5	82.3	1.882	1.790	0.876
February	77.8	35.69	10.70	102.3	97.1	2.198	2.095	0.877
March	98.7	50.08	12.14	122.6	116.9	2.605	2.482	0.867
April	172.5	63.36	15.17	226.0	217.8	4.708	4.492	0.851
May	188.7	68.38	17.72	242.1	233.4	4.970	4.744	0.839
June	222.4	73.55	22.60	292.7	283.1	5.878	5.616	0.822
July	232.7	67.82	25.88	311.0	300.9	6.146	5.874	0.809
August	218.1	54.83	27.27	294.6	285.5	5.802	5.544	0.806
September	159.0	51.33	23.96	215.6	208.0	4.370	4.179	0.830
October	106.7	42.59	17.77	144.1	137.8	3.012	2.877	0.855
November	66.9	32.61	15.21	89.7	84.4	1.889	1.799	0.859
December	63.2	25.99	10.94	88.1	82.7	1.887	1.797	0.874
Year	1670.5	594.14	17.46	2216.4	2129.9	45.346	43.290	0.836

**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

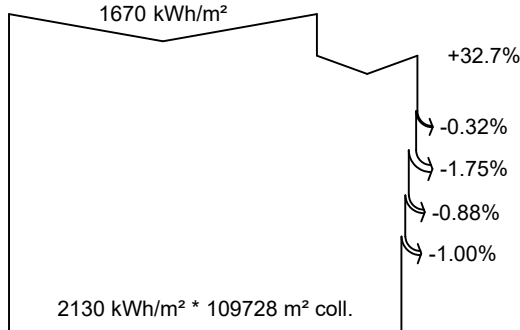




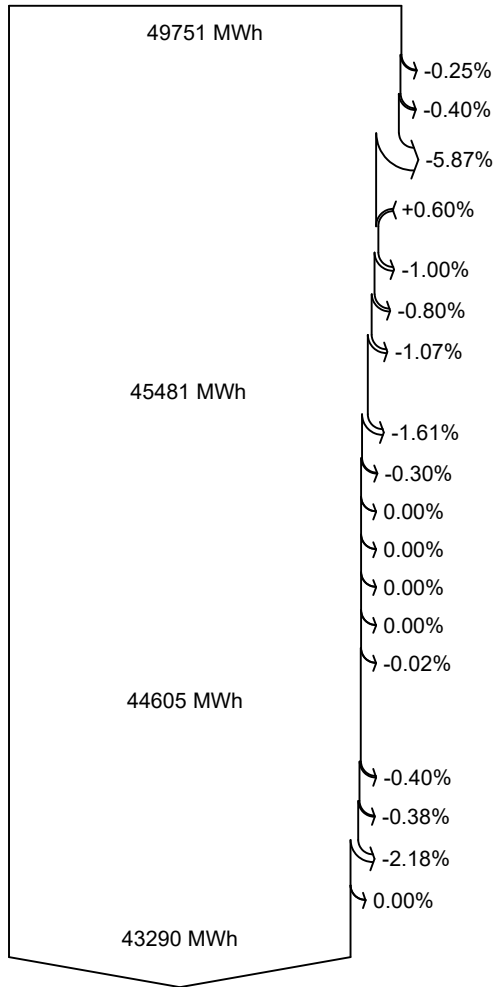
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**Loss diagram**



efficiency at STC = 21.29%



**Global horizontal irradiation**  
**Global incident in coll. plane**

- Far Shadings / Horizon
- Near Shadings: irradiance loss
- IAM factor on global
- Soiling loss factor

**Effective irradiation on collectors**

PV conversion

**Array nominal energy (at STC effic.)**

- Module Degradation Loss ( for year #1)
- PV loss due to irradiance level
- PV loss due to temperature
- Module quality loss

LID - Light induced degradation

Mismatch loss, modules and strings

Ohmic wiring loss

**Array virtual energy at MPP**

- Inverter Loss during operation (efficiency)
- Inverter Loss over nominal inv. power
- Inverter Loss due to max. input current
- Inverter Loss over nominal inv. voltage
- Inverter Loss due to power threshold
- Inverter Loss due to voltage threshold
- Night consumption

**Available Energy at Inverter Output**

- Auxiliaries (fans, other)
- AC ohmic loss
- Medium voltage transfo loss
- MV line ohmic loss

**Energy injected into grid**

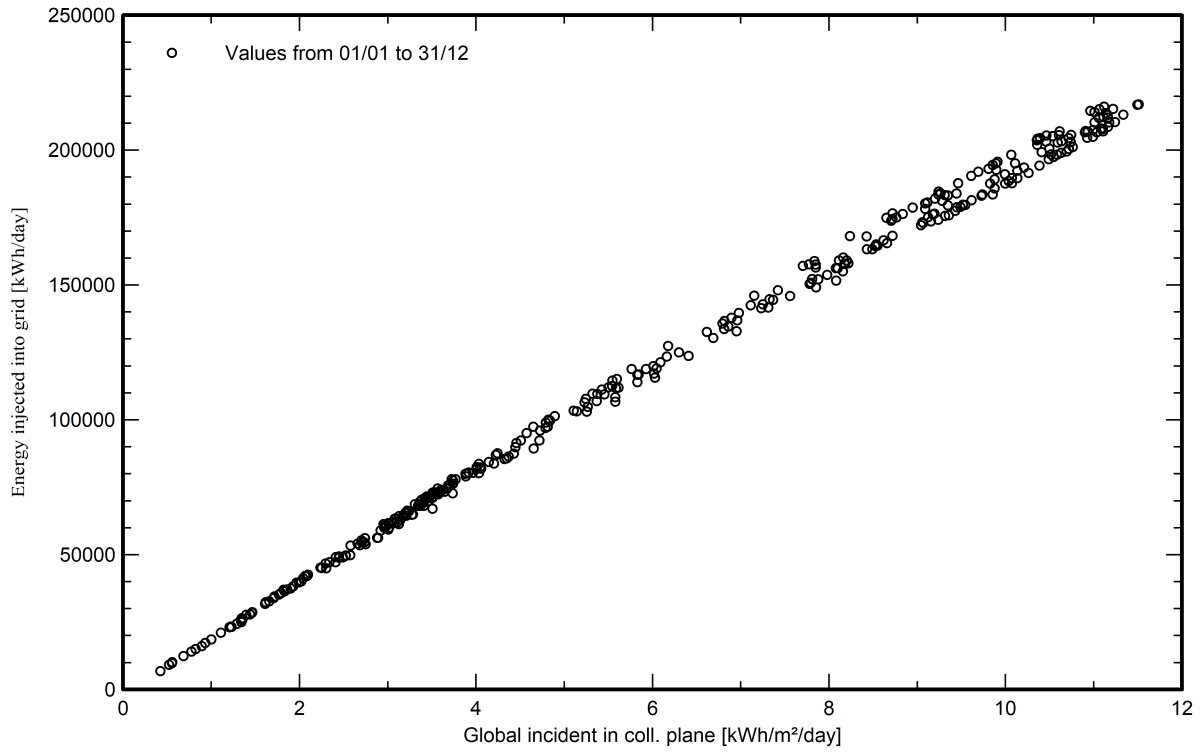


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**Special graphs**

**Daily Input/Output diagram**



**Distribuzione potenza in uscita sistema**

