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Δ/ΝΣΗ ΤΕΧΝΙΚΩΝ ΥΠΗΡΕΣΙΩΝ

ΕΡΓΟ :

Ενεργειακή αναβάθμιση του ΕΠΑ.Λ. Ν. Μουδανιών  
(Αρ. Μελ. 11/2018)

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ΚΩΔ. ΜΕΛ.: 221202

ΣΥΝΤΑΧΘΗΚΕ  
Ν. ΜΟΥΔΑΝΙΑ / 2023

ΘΕΩΡΗΘΗΚΕ:  
Ν. ΜΟΥΔΑΝΙΑ / 2023

ΕΛΕΝΗ ΣΙΜΟΥ  
ΜΗΧΑΝΟΛΟΓΟΣ ΜΗΧΑΝΙΚΟΣ Π.Ε.

ΙΩΑΝΝΗΣ ΕΛΕΥΘΕΡΟΥΔΗΣ  
ΠΟΛΙΤΙΚΟΣ ΜΗΧΑΝΙΚΟΣ Π.Ε.

# PVsyst - Simulation report

## Grid-Connected System

Project: ΕΝΕΡΓΕΙΑΚΗ ΑΝΑΒΑΘΜΙΣΗ ΚΤΙΡΙΟΥ ΕΠΑΛ, ΝΕΑ ΜΟΥΔΑΝΙΑ

Variant: New simulation variant

No 3D scene defined, no shadings

System power: 59.9 kWp

Νέα Μουδhaniά - Greece



# Project: ΕΝΕΡΓΕΙΑΚΗ ΑΝΑΒΑΘΜΙΣΗ ΚΤΙΡΙΟΥ ΕΠΑΛ, ΝΕΑ ΜΟΥΔΑΝΙΑ

PVsyst V7.4.2

VC0, Simulation date:  
01/10/23 22:51  
with v7.4.2

Variant: New simulation variant

## Project summary

### Geographical Site

Νέα Μουδhaniá  
Greece

### Situation

Latitude 40.24 °N  
Longitude 23.28 °E  
Altitude 7 m  
Time zone UTC+2

### Project settings

Albedo 0.20

### Meteo data

Νέα Μουδhaniá

Meteonorm 8.1 (1992-2006), Sat=100% - Synthetic

## System summary

### Grid-Connected System

No 3D scene defined, no shadings

### PV Field Orientation

Fixed plane  
Tilt/Azimuth 39 / 0 °

### Near Shadings

No Shadings

### User's needs

Unlimited load (grid)

### System information

#### PV Array

Nb. of modules 108 units  
Pnom total 59.9 kWp

#### Inverters

Nb. of units 1 unit  
Pnom total 70.0 kWac  
Pnom ratio 0.856

## Results summary

Produced Energy 95533 kWh/year Specific production 1594 kWh/kWp/year Perf. Ratio PR 88.15 %

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# Project: ΕΝΕΡΓΕΙΑΚΗ ΑΝΑΒΑΘΜΙΣΗ ΚΤΙΡΙΟΥ ΕΠΑΛ, ΝΕΑ ΜΟΥΔΑΝΙΑ

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## PVsyst V7.4.2

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### General parameters

#### Grid-Connected System

No 3D scene defined, no shadings

#### PV Field Orientation

##### Orientation

Fixed plane

Tilt/Azimuth 39 / 0 °

##### Sheds configuration

No 3D scene defined

##### Models used

Transposition Perez  
Diffuse Perez, Meteonorm  
Circumsolar separate

##### Horizon

Free Horizon

##### Near Shadings

No Shadings

##### User's needs

Unlimited load (grid)

### PV Array Characteristics

#### PV module

Manufacturer

Generic

Model

JKM-555N-72HL4-BDV

(Original PVsyst database)

Unit Nom. Power

555 Wp

Number of PV modules

108 units

Nominal (STC)

59.9 kWp

Modules

9 Strings x 12 In series

#### At operating cond. (50°C)

Pmpp

55.4 kWp

U mpp

461 V

I mpp

120 A

#### Total PV power

Nominal (STC)

60 kWp

Total

108 modules

Module area

279 m<sup>2</sup>

#### Inverter

Manufacturer

Generic

Model

SUN2000-70KTL-C1

(Original PVsyst database)

Unit Nom. Power

70.0 kWac

Number of inverters

1 unit

Total power

70.0 kWac

Operating voltage

200-1000 V

Max. power (=>30°C)

77.0 kWac

Pnom ratio (DC:AC)

0.86

Power sharing within this inverter

#### Total inverter power

Total power

70 kWac

Max. power

77 kWac

Number of inverters

1 unit

Pnom ratio

0.86

### Array losses

#### Thermal Loss factor

Module temperature according to irradiance

Uc (const) 20.0 W/m<sup>2</sup>K

Uv (wind) 0.0 W/m<sup>2</sup>K/m/s

#### DC wiring losses

Global array res.

62 mΩ

Loss Fraction

1.5 % at STC

#### Module Quality Loss

Loss Fraction

-0.8 %

#### Module mismatch losses

Loss Fraction

2.0 % at MPP

#### Strings Mismatch loss

Loss Fraction

0.2 %

#### IAM loss factor

Incidence effect (IAM): Fresnel, AR coating, n(glass)=1.526, n(AR)=1.290

0°	30°	50°	60°	70°	75°	80°	85°	90°
1.000	0.999	0.987	0.962	0.892	0.816	0.681	0.440	0.000



# Project: ΕΝΕΡΓΕΙΑΚΗ ΑΝΑΒΑΘΜΙΣΗ ΚΤΙΡΙΟΥ ΕΠΑΛ, ΝΕΑ ΜΟΥΔΑΝΙΑ

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## Main results

### System Production

Produced Energy 95533 kWh/year

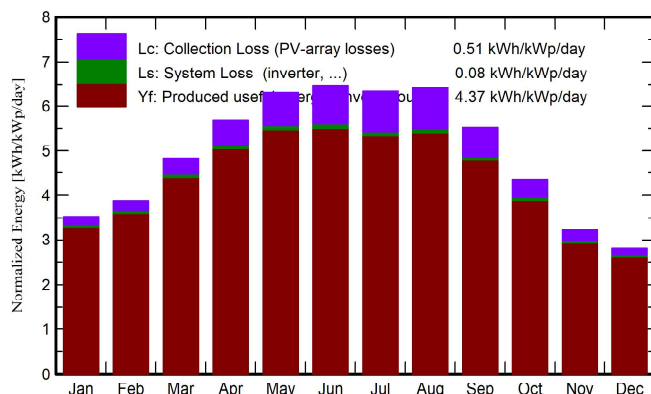
Specific production

1594 kWh/kWp/year

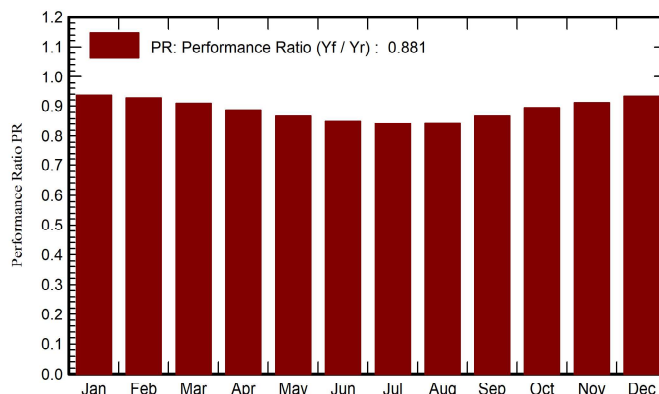
Perf. Ratio PR

88.15 %

Normalized productions (per installed kWp)



Performance Ratio PR



## Balances and main results

	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_Grid	PR
	kWh/m²	kWh/m²	°C	kWh/m²	kWh/m²	kWh	kWh	ratio
January	61.7	26.86	4.19	109.2	107.8	6246	6136	0.937
February	75.1	38.23	6.19	108.7	107.1	6155	6047	0.928
March	122.0	62.16	10.01	150.1	147.4	8323	8179	0.909
April	157.3	66.39	14.21	170.8	167.3	9243	9082	0.887
May	204.2	84.84	20.17	195.5	191.0	10358	10180	0.869
June	215.4	80.56	25.06	194.4	189.6	10087	9910	0.851
July	212.0	81.52	27.91	196.4	191.7	10105	9927	0.843
August	192.7	69.00	27.44	198.8	194.8	10240	10065	0.845
September	140.4	59.65	21.09	165.6	162.3	8772	8620	0.868
October	98.5	49.95	15.86	134.8	132.6	7364	7236	0.895
November	59.7	29.33	10.83	96.5	95.1	5367	5269	0.911
December	50.5	27.00	5.86	87.1	86.0	4971	4879	0.934
Year	1589.6	675.50	15.79	1808.1	1772.7	97231	95533	0.881

### 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

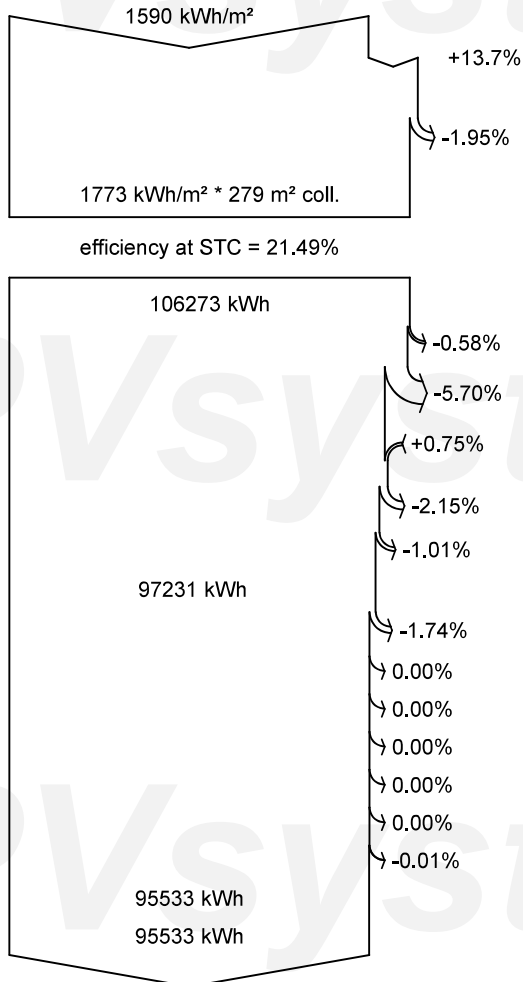
PR Performance Ratio



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### Loss diagram



Global horizontal irradiation

Global incident in coll. plane

IAM factor on global

Effective irradiation on collectors

PV conversion

Array nominal energy (at STC effic.)

PV loss due to irradiance level

PV loss due to temperature

Module quality loss

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

Energy injected into grid



PVsyst V7.4.2

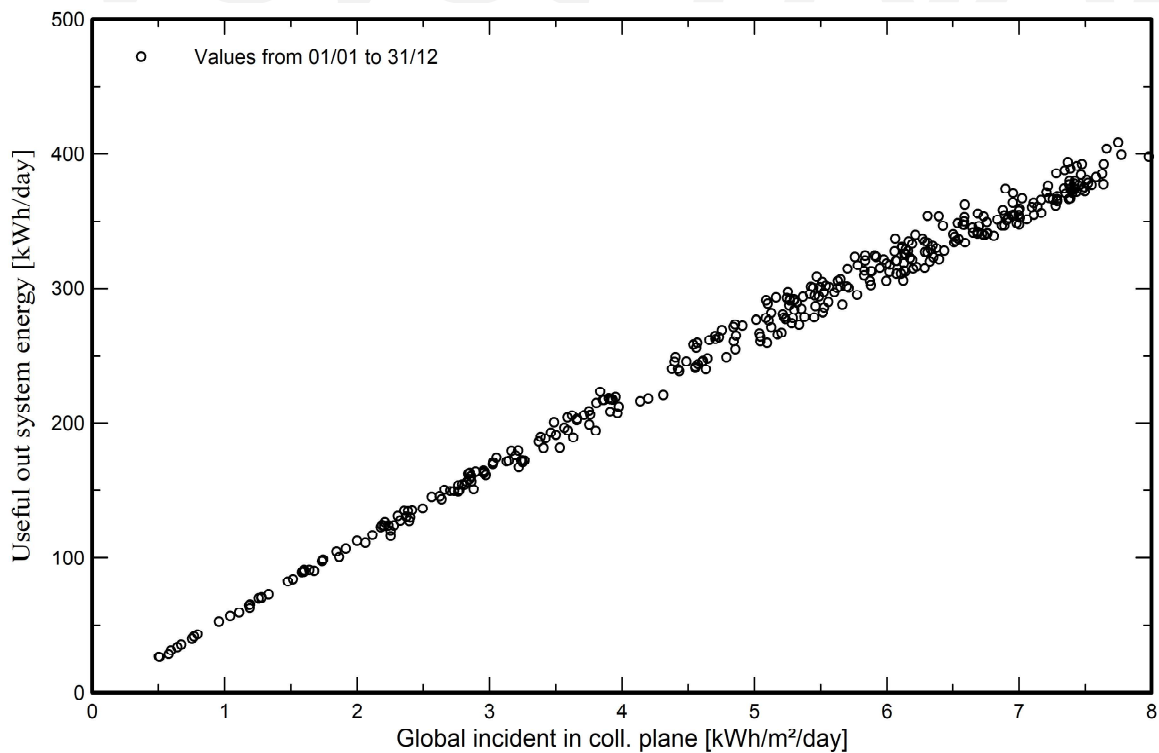
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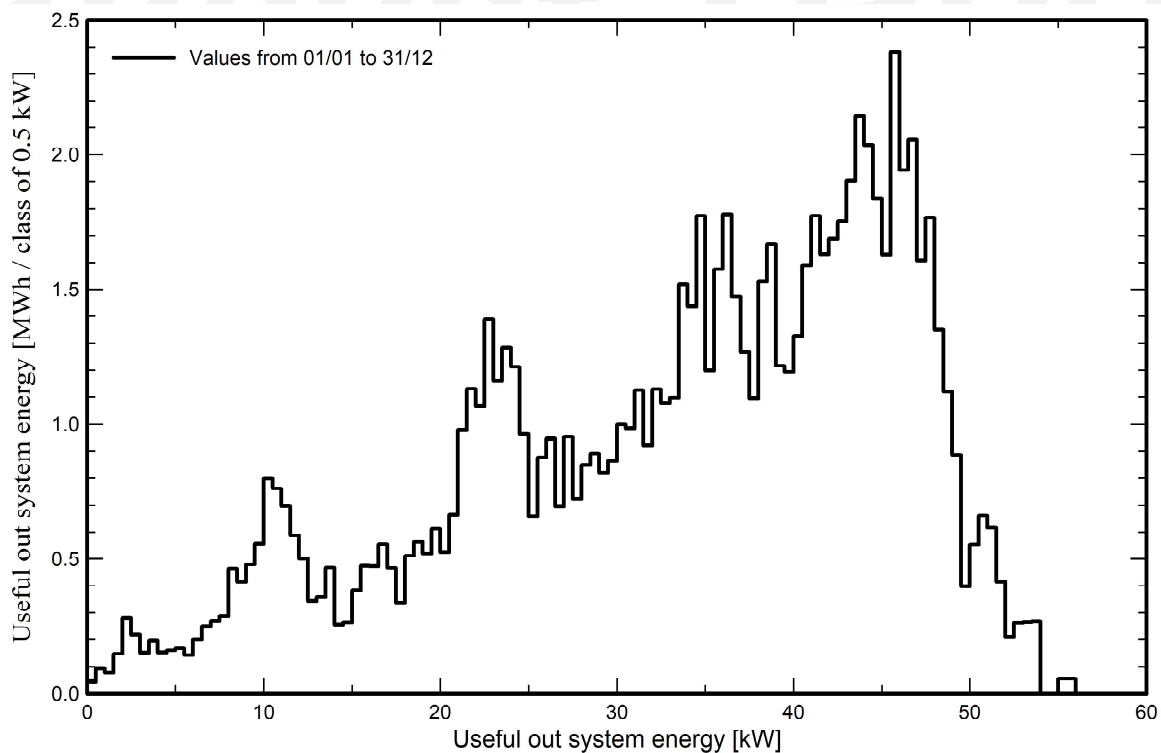
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### Predef. graphs

#### Daily Input/Output diagram



#### System Output Power Distribution





**PVsyst V7.4.2**

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**P50 - P90 evaluation**

**Meteo data**

Source Meteonorm 8.1 (1992-2006), Sat=100%  
Kind Monthly averages  
Synthetic - Multi-year average  
Year-to-year variability(Variance) 4.1 %

**Specified Deviation**

Climate change 0.0 %

**Global variability (meteo + system)**

Variability (Quadratic sum) 4.5 %

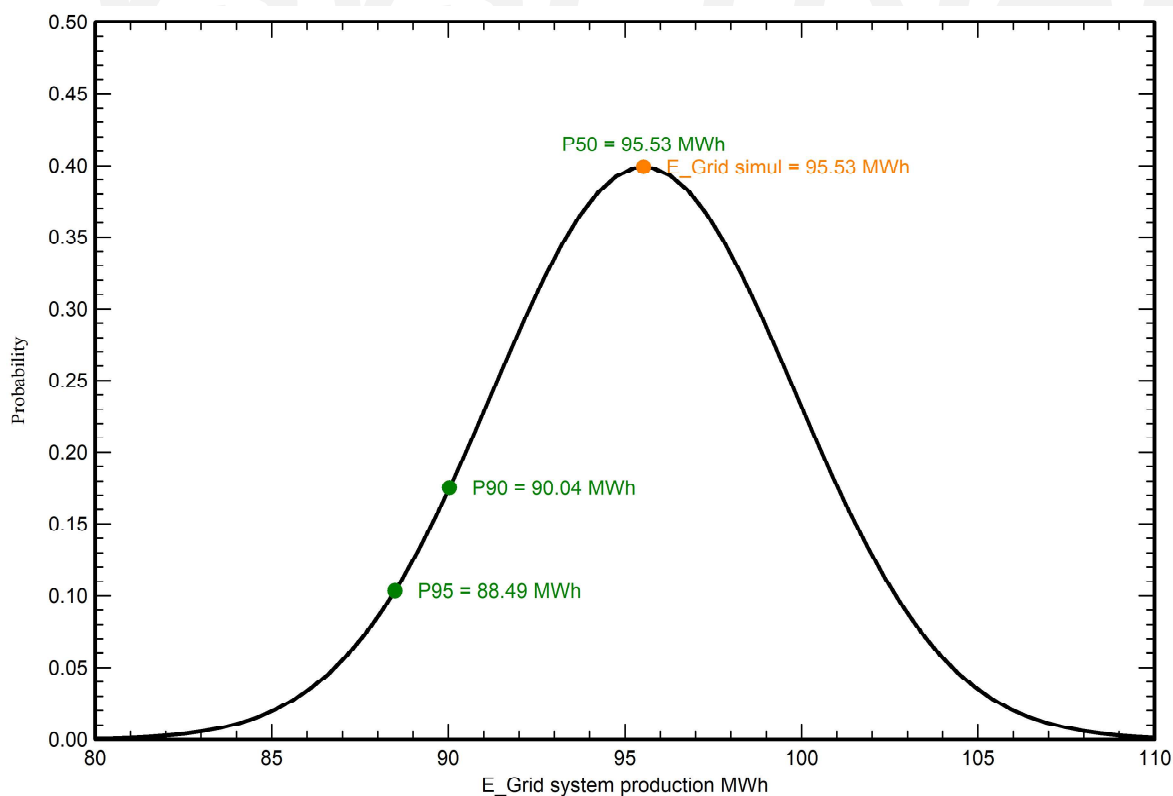
**Simulation and parameters uncertainties**

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 4.29 MWh  
P50 95.53 MWh  
P90 90.04 MWh  
P95 88.49 MWh

**Probability distribution**







**PVsyst V7.4.2**

VCO, Simulation date:  
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with v7.4.2

**CO<sub>2</sub> Emission Balance**

Total: 1700.9 tCO<sub>2</sub>

**Generated emissions**

Total: 114.40 tCO<sub>2</sub>

Source: Detailed calculation from table below

**Replaced Emissions**

Total: 2092.2 tCO<sub>2</sub>

System production: 95.53 MWh/yr

Grid Lifecycle Emissions: 730 gCO<sub>2</sub>/kWh

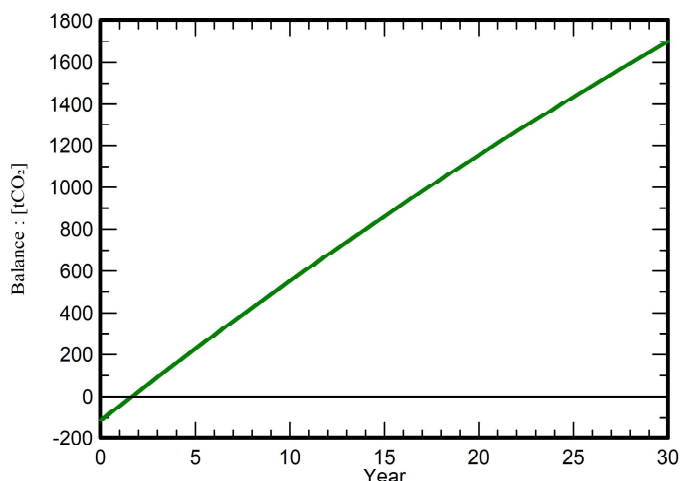
Source: IEA List

Country: Greece

Lifetime: 30 years

Annual degradation: 1.0 %

**Saved CO<sub>2</sub> Emission vs. Time**



**System Lifecycle Emissions Details**

Item	LCE	Quantity	Subtotal
			[kgCO <sub>2</sub> ]
Modules	1713 kgCO <sub>2</sub> /kWp	63.3 kWp	108364
Supports	4.87 kgCO <sub>2</sub> /kg	1140 kg	5551
Inverters	482 kgCO <sub>2</sub> /	1.00	482