Version 7.4.8

PVsyst - Simulation report

Grid-Connected System

Project: CSF Pereiro

Variant: CSF Pereiro

Tracking system with backtracking

System power: 122.2 MWp

Marim - Portugal

Author

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Project summary

Geographical Site
Marim
Portugal

Situation

Latitude	37.44 °N
Longitude	-7.64 °W
Altitude	265 m
Time zone	UTC

Project settings
Albedo 0.15

Weather data
Marim
Meteonorm 8.0 (1996-2015), Sat=100% - Synthetic

System summary

Grid-Connected System

Tracking system with backtracking

PV Field Orientation
Orientation
Tracking plane, tilted axis
Avg axis tilt 0.4 °
Avg axis azim. 0 °

Tracking algorithm
Astronomic calculation
Backtracking activated

Near Shadings
According to strings : Fast (table)
Electrical effect 90 %
Diffuse shading Automatic

System information

PV Array

Nb. of modules	198720 units
Pnom total	122.2 MWp

Inverters

Nb. of units	24 units
Pnom total	105.6 MVA
Grid power limit	99.00 MVA
Grid lim. Pnom ratio	1.234

User's needs
Unlimited load (grid)

Results summary

Produced Energy	269.32 GWh/year	Specific production	2204 kWh/kWp/year	Perf. Ratio PR	84.49 %
Apparent energy	269.32 GVAh/year				

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General parameters

Grid-Connected System

Tracking system with backtracking

PV Field Orientation

Orientation	
Tracking plane, tilted axis	
Avg axis tilt	0.4 °
Avg axis azim.	0 °

Tracking algorithm
Astronomic calculation
Backtracking activated

Backtracking array	
Nb. of trackers	3682 units
Sizes	
Tracker Spacing	11.7 m
Collector width	4.78 m
Ground Cov. Ratio (GCR)	40.9 %
Phi min / max.	-/+ 55.0 °
Backtracking strategy	
Phi limits for BT	-/+ 65.7 °
Backtracking pitch	11.7 m
Backtracking width	4.78 m

Models used

Transposition	Perez
Diffuse	Perez, Meteonorm
Circumsolar	separate

Horizon
Free Horizon

Near Shadings
According to strings : Fast (table)

Electrical effect	90 %
Diffuse shading	Automatic

User's needs
Unlimited load (grid)

Grid injection point

Grid power limitation	
Apparent power	99.00 MVA
Pnom ratio	1.234

Power factor	
Cos(phi) (lagging)	1.000

PV Array Characteristics

PV module

Manufacturer	Longi Solar
Model	LR8-66HGD-615M
(Custom parameters definition)	
Unit Nom. Power	615 Wp
Number of PV modules	198720 units
Nominal (STC)	122.2 MWp
Modules	7360 string x 27 In series
At operating cond. (50°C)	
Pmpp	113.7 MWp
U mpp	1005 V
I mpp	113167 A

Inverter

Manufacturer	SMA
Model	Sunny Central 4400 UP
(Original PVsyst database)	
Unit Nom. Power	4400 kVA
Number of inverters	24 units
Total power	105600 kVA
Operating voltage	962-1325 V
Pnom ratio (DC:AC)	1.16

Total PV power

Nominal (STC)	122213 kWp
Total	198720 modules
Module area	536780 m²
Cell area	501275 m²

Total inverter power

Total power	105600 kVA
Number of inverters	24 units
Pnom ratio	1.16

Array losses

Array Soiling Losses
Loss Fraction 1.0 %

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. 0.14 mΩ
Loss Fraction 1.5 % at STC

LID - Light Induced Degradation
Loss Fraction 0.6 %

Module Quality Loss
Loss Fraction -0.8 %

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

0°	40°	50°	60°	70°	75°	80°	85°	90°
1.000	1.000	1.000	1.000	0.990	0.970	0.910	0.810	0.000

System losses

Auxiliaries loss
Night aux. cons. 5.00 kW

AC wiring losses

Inv. output line up to MV transfo
Inverter voltage 660 Vac tri
Loss Fraction 0.07 % at STC
Inverter: Sunny Central 4400 UP
Wire section (24 Inv.) Copper 24 x 3 x 3000 mm²
Average wires length 10 m

MV line up to HV Transfo
MV Voltage 33 kV
Average each inverter
Wires Copper 3 x 185 mm²
Length 15790 m
Loss Fraction 0.74 % at STC

HV line up to Injection
HV line voltage 150 kV
Wires Copper 3 x 400 mm²
Length 3820 m
Loss Fraction 0.10 % at STC

AC losses in transformers

MV transfo
Medium voltage 33 kV

One transfo parameters
Nominal power at STC 5.00 MVA
Iron Loss (24/24 Connexion) 5.40 kVA
Iron loss fraction 0.11 % at STC
Copper loss 46.12 kVA
Copper loss fraction 0.92 % at STC
Coils equivalent resistance 3 x 0.80 mΩ

Operating losses at STC (full system)
Nb. identical MV transfos 24
Nominal power at STC 120.0 MVA
Iron loss (24/24 Connexion) 129.66 kVA
Copper loss 1106.91 kVA

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AC losses in transformers

HV transfo	
Grid voltage	150 kV
Transformer from Datasheets	
Nominal power	100000 kVA
Iron Loss (24/24 Connexion)	200.00 kVA
Iron loss fraction	0.20 % of PNom
Copper loss	300.00 kVA
Copper loss fraction	0.30 % at PNom
Coils equivalent resistance	3 x 32.67 mΩ

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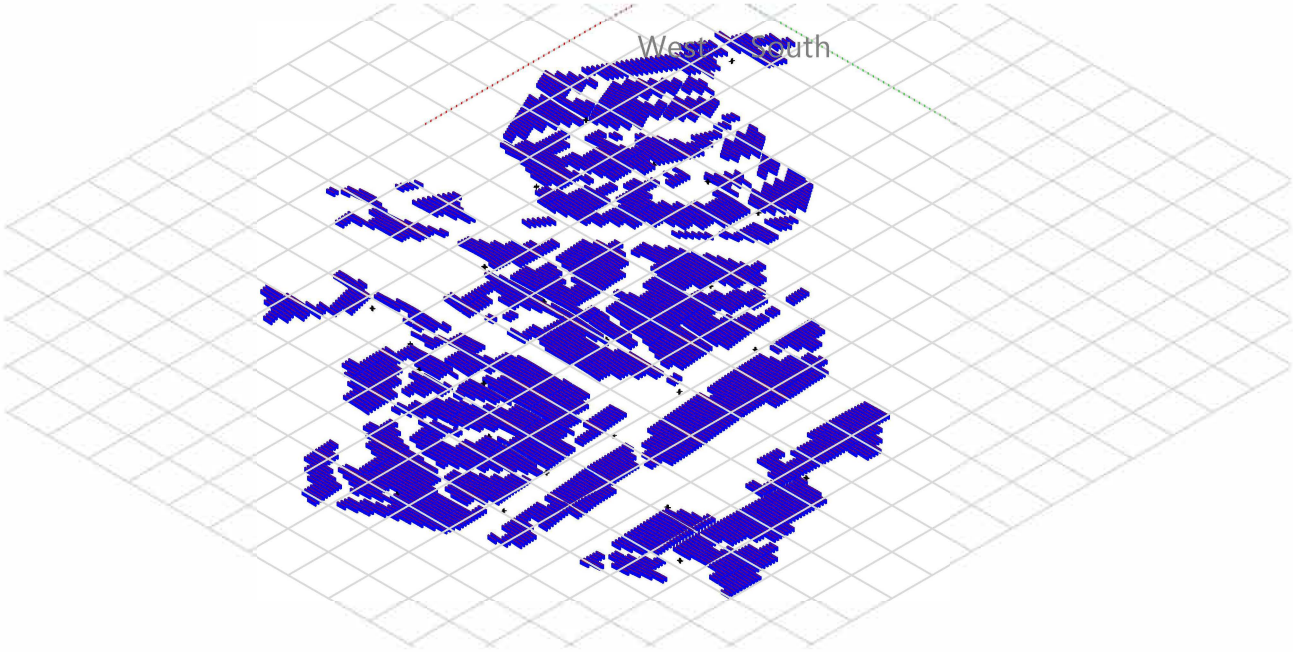
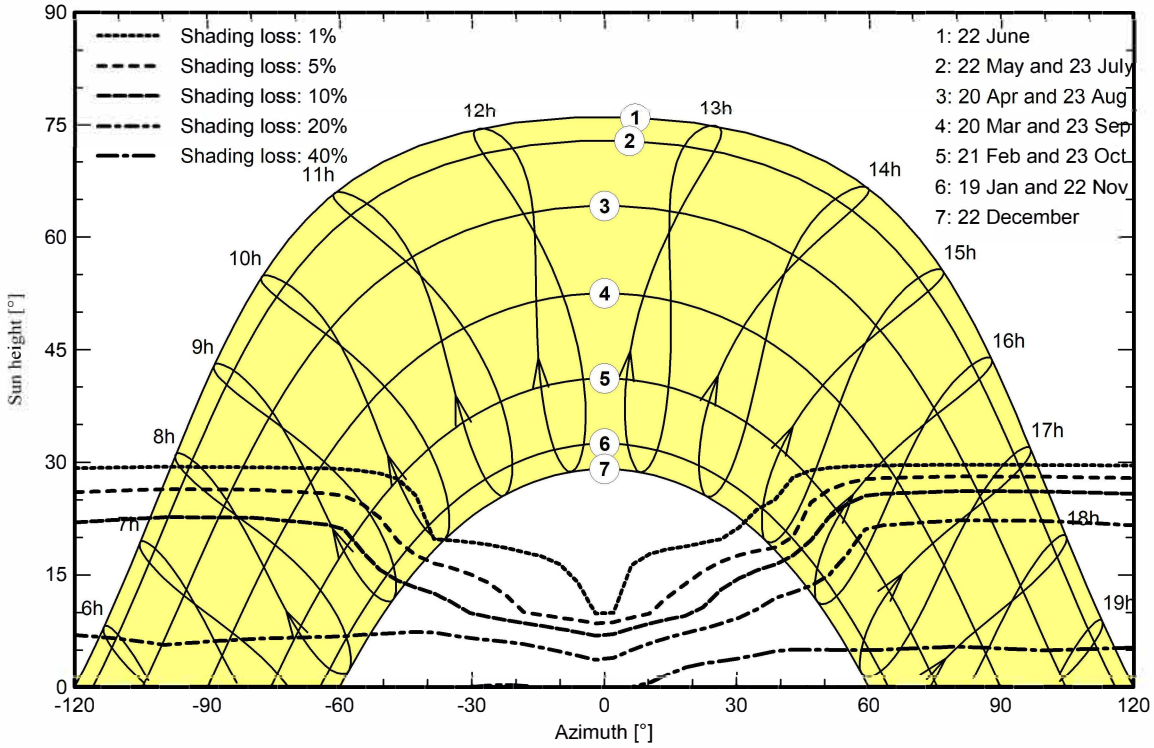
Near shadings parameter

Perspective of the PV-field and surrounding shading scene



Iso-shadings diagram

Orientation #1



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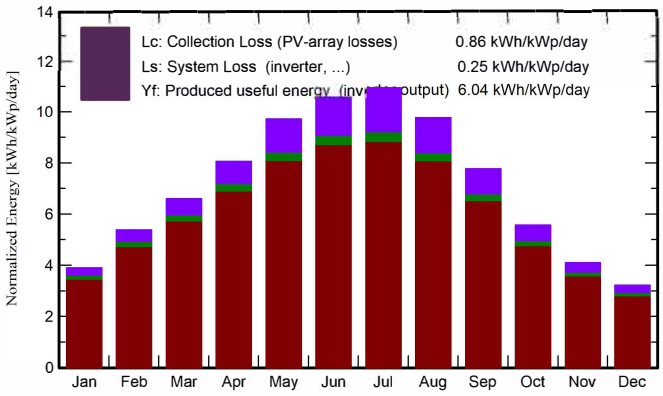
Main results

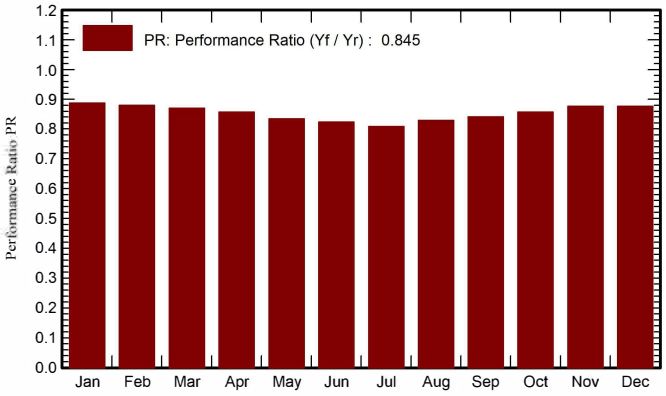
System Production

Produced Energy	269.32 GWh/year	Specific production	2204 kWh/kWp/year
Apparent energy	269.32 GVAh/year	Perf. Ratio PR	84.49 %

Normalized productions (per installed kWp)



Performance Ratio PR



Balances and main results

	GlobHor kWh/m²	DiffHor kWh/m²	T_Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray GWh	E_Grid GWh	PR ratio
January	85.5	25.83	9.30	121.0	116.2	13.71	13.14	0.888
February	108.1	28.48	10.08	150.8	145.3	16.90	16.22	0.880
March	152.5	52.47	12.72	204.7	197.3	22.67	21.78	0.871
April	183.0	57.84	14.59	241.9	233.8	26.40	25.34	0.857
May	227.7	64.91	18.29	301.0	291.5	31.95	30.69	0.834
June	239.0	57.15	22.05	318.2	308.8	33.32	32.00	0.823
July	252.8	46.23	24.03	339.4	329.6	34.94	33.54	0.808
August	223.9	49.84	24.64	302.7	293.4	31.90	30.65	0.828
September	170.6	45.21	21.71	233.0	225.2	24.94	23.97	0.842
October	127.2	44.14	18.31	172.9	166.2	18.87	18.13	0.858
November	89.3	27.73	12.70	122.9	118.1	13.75	13.17	0.877
December	72.1	28.98	10.04	99.7	94.9	11.19	10.69	0.877
Year	1931.8	528.81	16.58	2608.4	2520.4	280.54	269.32	0.845

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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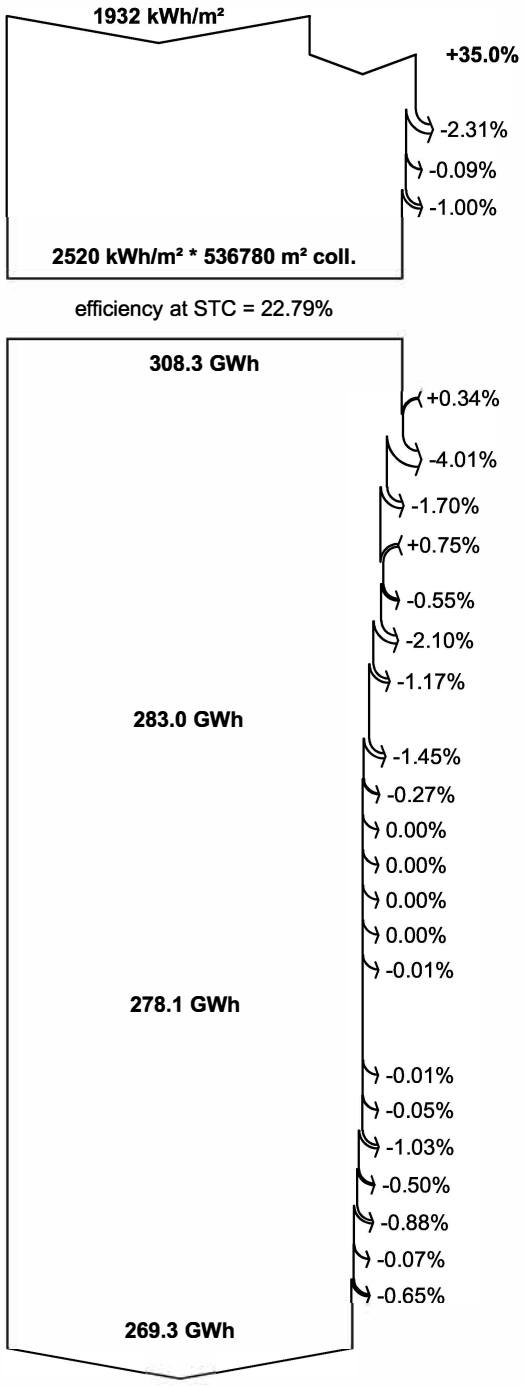
Loss diagram



0.0 GVARh — Reactive energy to the grid: Aver. cos(phi) = 1.000

269.3 GVAh — **Apparent energy to the grid**

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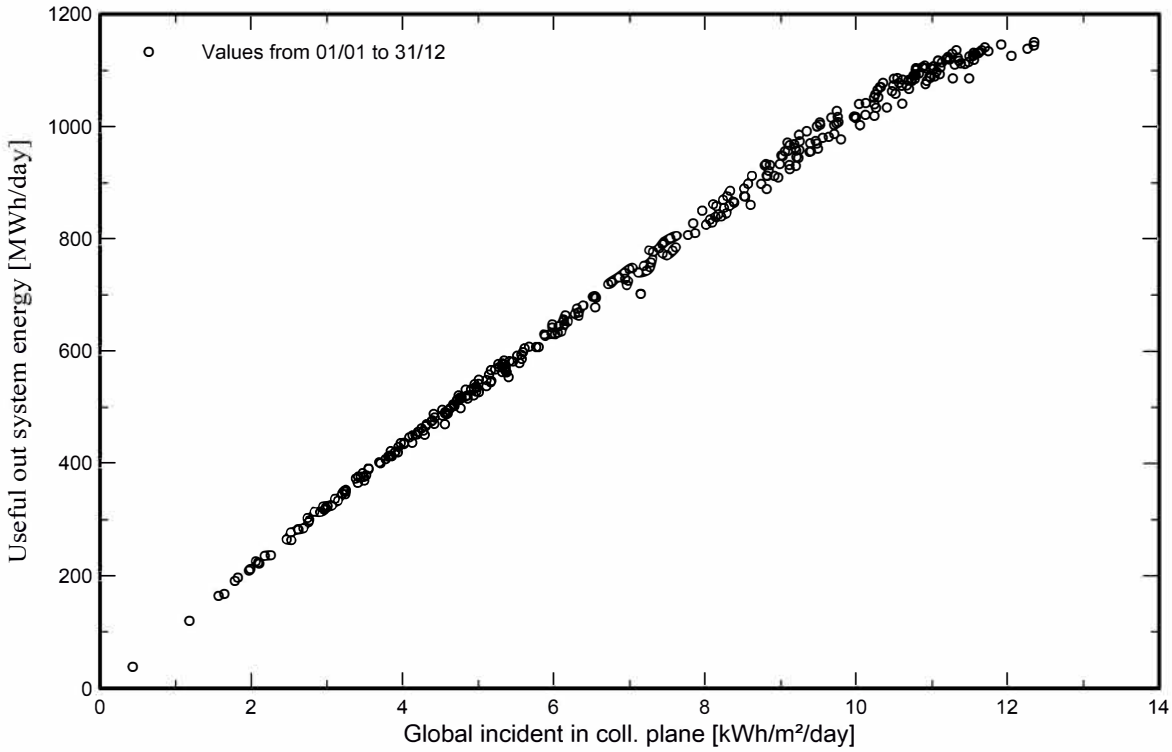
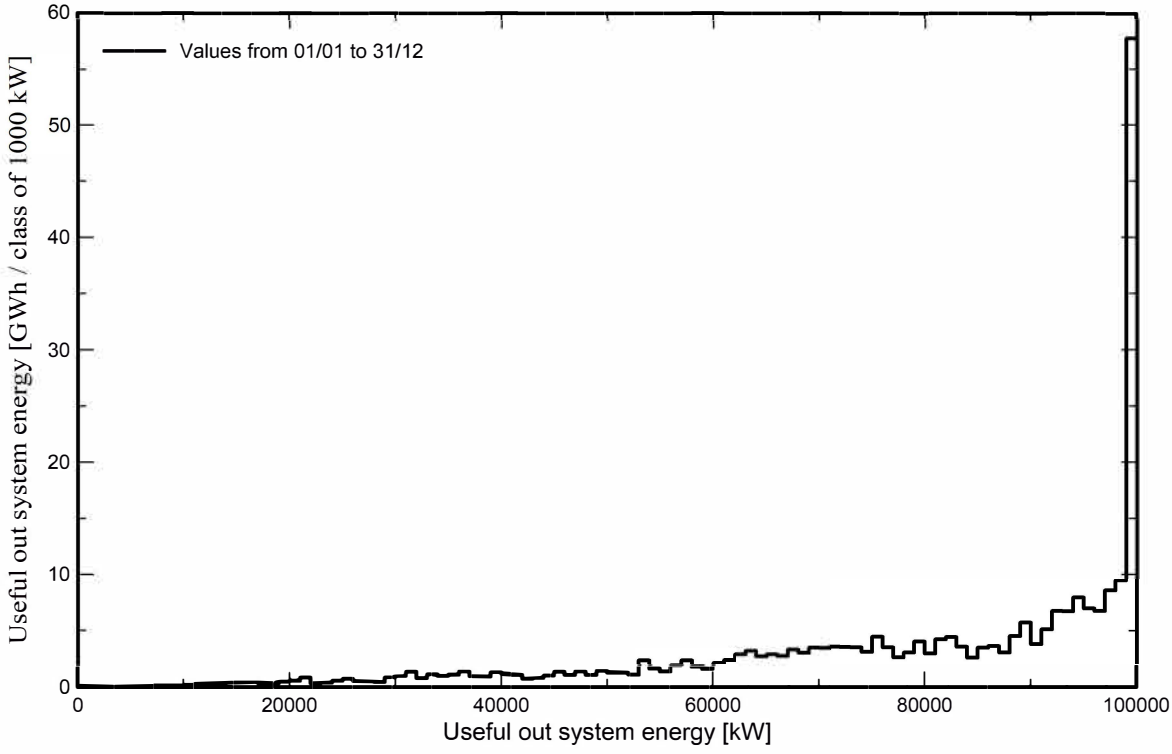
Predef. graphs

Daily Input/Output diagram



System Output Power Distribution



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P50 - P90 evaluation

Weather data

Source	Meteonorm 8.0 (1996-2015), Sat=100%
Kind	Monthly averages
Synthetic - Multi-year average	
Year-to-year variability(Variance)	3.1 %

Specified Deviation

Climate change	0.0 %

Global variability (weather data + system)

Variability (Quadratic sum)	3.6 %

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	9.7 GWh
P50	269.3 GWh
P90	256.8 GWh
P95	253.3 GWh

Probability distribution