Version 7.4.8

PVsyst - Simulation report

Grid-Connected System

Project: PFV soles del Nordeste

Variant: New simulation variant

Sheds on ground

System power: 113.8 MWp

Jobo Grande - Dominican Republic

ORGM

PVsyst V7.4.8
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with V7.4.8

Project summary

Geographical Site
Jobo Grande
Dominican Republic

Situation

Latitude	18.68 °N
Longitude	-69.75 °W
Altitude	31 m
Time zone	UTC-4

Project settings
Albedo 0.20

Weather data
Jobo Grande
Meteonorm 8.1 (1996-2015), Sat=100% - Synthetic

System summary

Grid-Connected System
Sheds on ground

PV Field Orientation
Fixed plane
Tilt/Azimuth 18 / 0 °

Near Shadings
According to strings : Fast (table)
Electrical effect 100 %

User's needs
Unlimited load (grid)

System information

PV Array

Nb. of modules	171100 units
Pnom total	113.8 MWp

Inverters

Nb. of units	22 units
Pnom total	96.80 MWac
Grid power limit	70.00 MWac
Grid lim. Pnom ratio	1.625

Battery pack
Storage strategy: Peak shaving

Nb. of units	74 units
Voltage	1210 V
Capacity	128316 Ah

Results summary

Produced Energy	181879.34 MWh/year	Specific production	1598 kWh/kWp/year	Perf. Ratio PR	80.10 %

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General parameters

Grid-Connected System — **Sheds on ground**

PV Field Orientation

Orientation	
Fixed plane	
Tilt/Azimuth	18 / 0 °

Sheds configuration	
Nb. of sheds	8519 units
Sizes	
Sheds spacing	3.00 m
Collector width	2.63 m
Ground Cov. Ratio (GCR)	87.5 %
Shading limit angle	
Limit profile angle	58.2 °

Models used	
Transposition	Perez
Diffuse	Perez, Meteonorm
Circumsolar	separate

Horizon
Free Horizon

Near Shadings
According to strings : Fast (table)
Electrical effect 100 %

User's needs
Unlimited load (grid)

Storage
Kind Peak shaving

Charging strategy
Available power over Grid 70000.0 kW

Discharging strategy
As soon as power is needed

Grid power limitation

Active power	70.00 MWac
Pnom ratio	1.625

PV Array Characteristics

PV module

Manufacturer	Generic
Model	TSM-DEG21C-20-665Wp Vertex
(Original PVsyst database)	
Unit Nom. Power	665 Wp
Number of PV modules	171100 units
Nominal (STC)	113.8 MWp
Modules	5900 string x 29 In series
At operating cond. (50°C)	
Pmpp	104.3 MWp
U mpp	1007 V
I mpp	103484 A

Inverter

Manufacturer	Generic
Model	Sunny Central 4400 UP
(Custom parameters definition)	
Unit Nom. Power	4400 kWac
Number of inverters	44 * MPPT 50% 22 units
Total power	96800 kWac
Operating voltage	962-1325 V
Pnom ratio (DC:AC)	1.18
No power sharing between MPPTs	

Total PV power

Nominal (STC)	113782 kWp
Total	171100 modules
Module area	531497 m²

Total inverter power

Total power	96800 kWac
Number of inverters	22 units
Pnom ratio	1.18

Battery Storage

Battery

Manufacturer	Generic
Model	Luna2000 - 2.0 MWh - 2H0

Battery pack

Nb. of units	74 in parallel
Discharging min. SOC	15.0 %
Stored energy	131929.4 kWh

Battery Pack Characteristics

Voltage	1210 V
Nominal Capacity	128316 Ah (C10)
Temperature	External ambient temperature

Battery input charger

Model	Generic
Max. charg. power	31.0 MWdc
Max./Euro effic.	97.0/95.0 %

Battery to Grid inverter

Model	Generic
Max. disch. power	31.0 MWac
Max./Euro effic.	97.0/95.0 %

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Array losses

Array Soiling Losses
Loss Fraction 3.0 %

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. 0.16 mΩ
Loss Fraction 1.5 % at STC

Serie Diode Loss
Voltage drop 0.7 V
Loss Fraction 0.1 % at STC

Module Quality Loss
Loss Fraction -0.4 %

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

System losses

Unavailability of the system
Time fraction 2.0 %
7.3 days,
3 periods

Auxiliaries loss
constant (fans) 44.0 kW
44.0 kW from Power thresh.

AC wiring losses

Inv. output line up to MV transfo
Inverter voltage 660 Vac tri
Loss Fraction 4.38 % at STC
Inverter: Sunny Central 4400 UP
Wire section (22 Inv.) Copper 22 x 3 x 3000 mm²
Average wires length 600 m

MV line up to HV Transfo
MV Voltage 34.5 kV
Average each inverter
Wires Copper 3 x 1200 mm²
Length 600 m
Loss Fraction 0.04 % at STC

HV line up to Injection
HV line voltage 138000 kV
Wires Copper 3 x 1500 mm²
Length 10000 m
Loss Fraction 0.00 % at STC

AC losses in transformers

MV transfo
Medium voltage 34.5 kV
Transformer from Datasheets
Nominal power 60000 kVA
Iron Loss 80.00 kVA
Iron loss fraction 0.13 % of PNom
Copper loss 500.00 kVA
Copper loss fraction 0.83 % at PNom
Coils equivalent resistance 3 x 0.06 mΩ

Operating losses at STC (full system)
Nb. identical MV transfos 2
Nominal power at STC 111.7 MVA
Iron loss 160.00 kVA
Iron loss fraction 0.14 % at STC
Copper loss 866.46 kVA
Copper loss fraction 0.78 % at STC

AC losses in transformers

HV transfo

Grid voltage	138000 kV

Transformer from Datasheets

Nominal power	120000 kVA
Iron Loss (night disconnect)	70.00 kVA
Iron loss fraction	0.06 % of PNom
Copper loss	1130.00 kVA
Copper loss fraction	0.94 % at PNom
Coils equivalent resistance	3 x 93.40 mΩ

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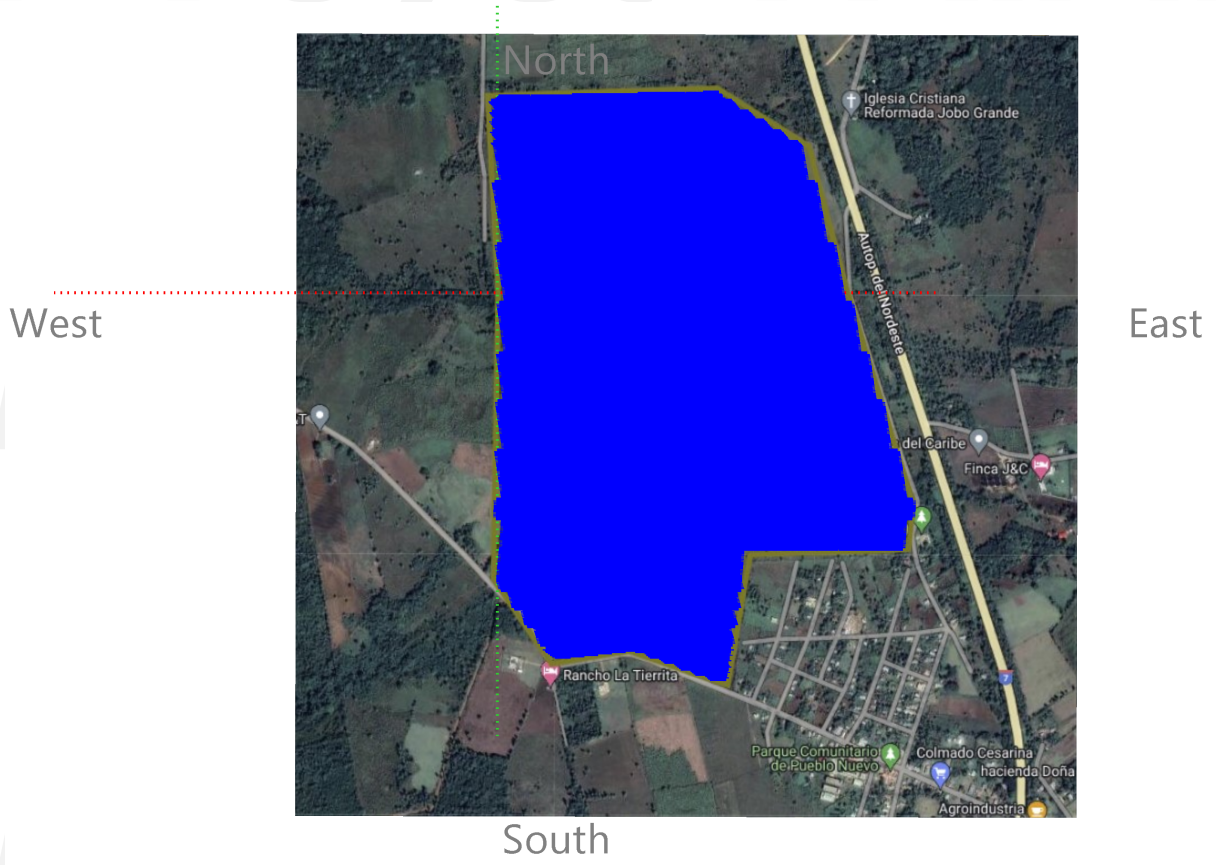
Near shadings parameter

Perspective of the PV-field and surrounding shading scene



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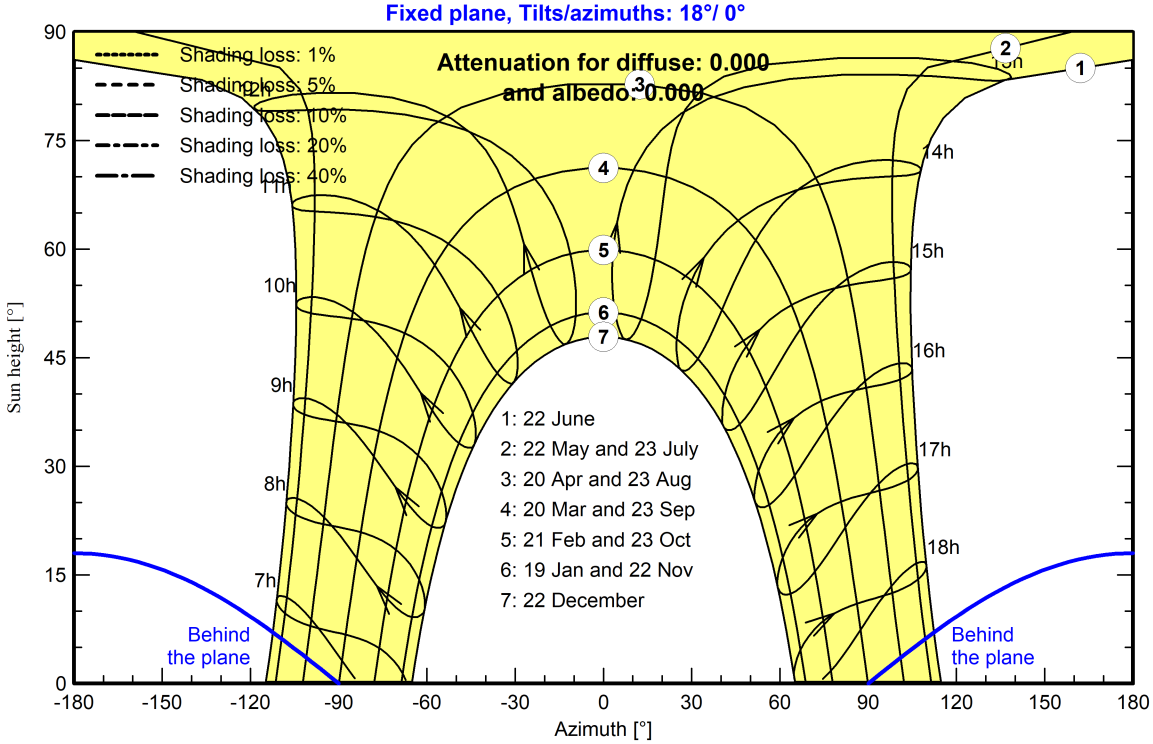
Iso-shadings diagram

Orientation #1

Fixed plane, Tilts/azimuths: 18°/ 0°



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Main results

System Production

Produced Energy	181879.34 MWh/year	Specific production	1598 kWh/kWp/year
		Perf. Ratio PR	80.10 %

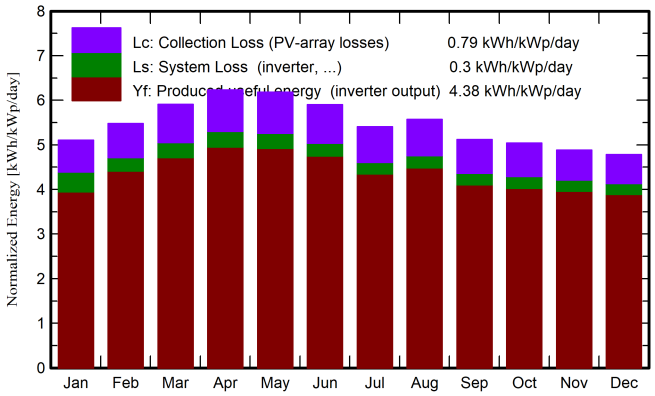
Battery aging (State of Wear)

Cycles SOW	98.7 %
Static SOW	88.9 %

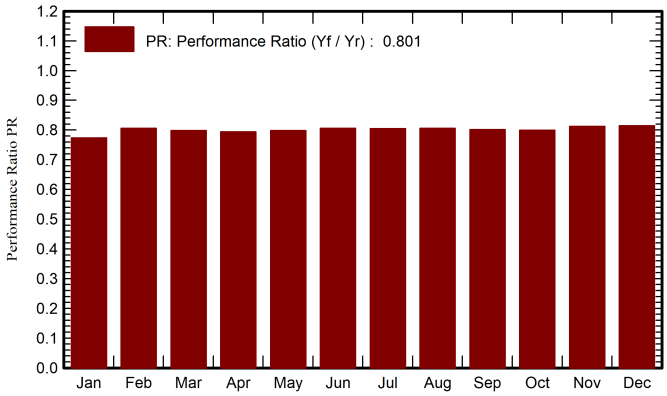
Economic evaluation

Investment		Yearly cost		LCOE	
Global	100,696,100.00 USD	Annuities	0.00 USD/yr	Energy cost	0.12 USD/kWh
Specific	0.88 USD/Wp	Run. costs	17,008,158.86 USD/yr		
		Payback period	10.2 years		

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 MWh	E_Grid MWh	EBatDis MWh	PR ratio
January	131.7	47.84	24.40	158.2	150.6	15518	13926	845	0.774
February	135.6	56.66	24.65	153.5	146.3	15037	14077	787	0.806
March	172.6	69.78	25.18	183.2	174.1	17822	16651	1120	0.799
April	188.1	68.82	25.69	187.1	177.6	18124	16911	1233	0.794
May	203.9	74.82	26.68	191.6	181.5	18571	17390	914	0.798
June	192.2	86.66	27.02	177.0	167.4	17220	16234	384	0.806
July	179.9	89.79	27.51	167.7	158.4	16275	15361	383	0.805
August	177.8	92.58	27.51	172.7	163.6	16784	15823	472	0.805
September	149.8	74.63	27.05	153.6	145.7	14910	14014	644	0.802
October	141.2	60.82	26.91	156.2	148.3	15152	14202	800	0.799
November	125.9	58.88	25.49	146.6	139.2	14380	13544	473	0.812
December	122.8	53.16	25.12	148.4	141.2	14597	13745	463	0.814
Year	1921.5	834.44	26.11	1995.7	1893.9	194391	181879	8518	0.801

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
EBatDis	Battery Discharging Energy
PR	Performance Ratio

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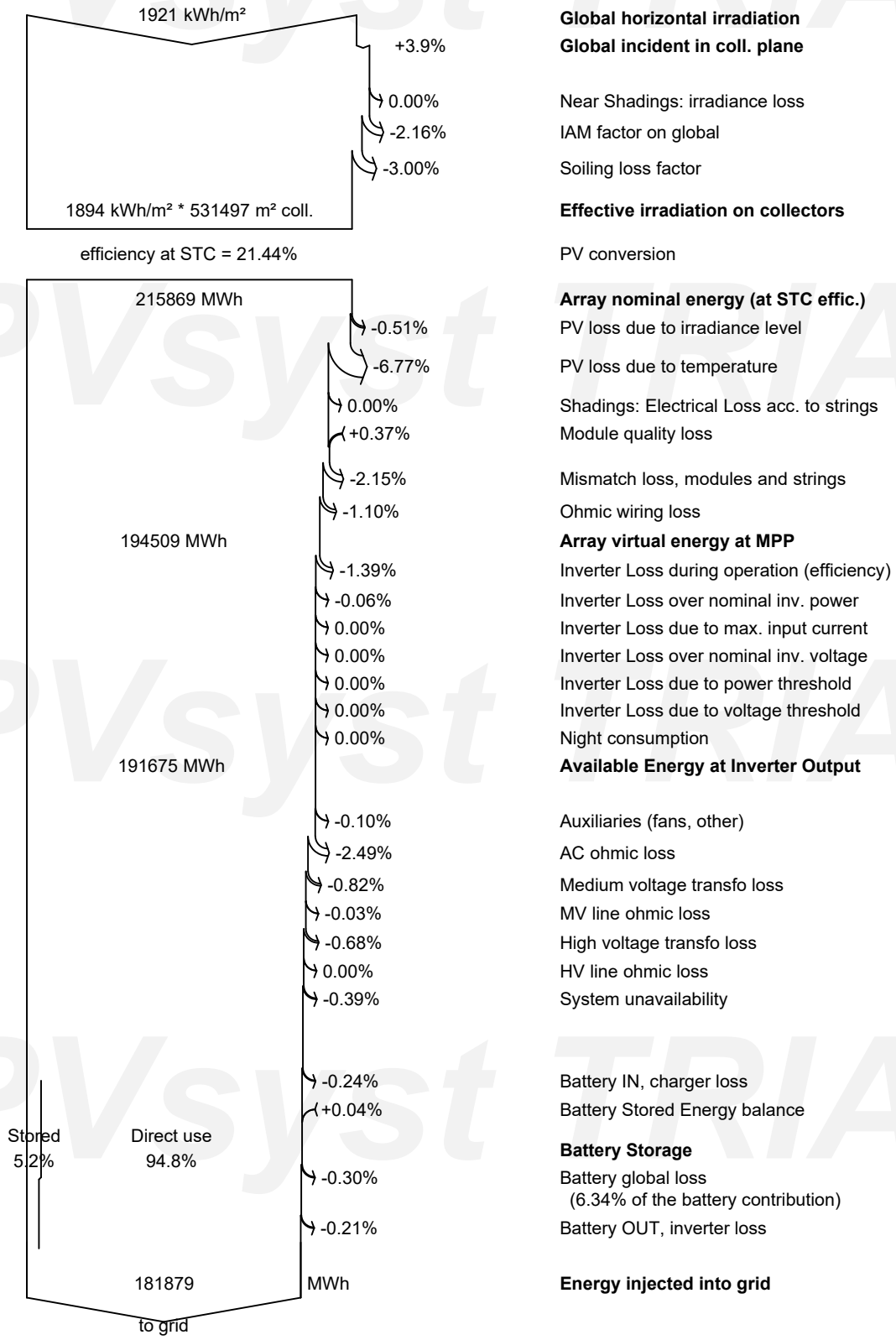
Loss diagram



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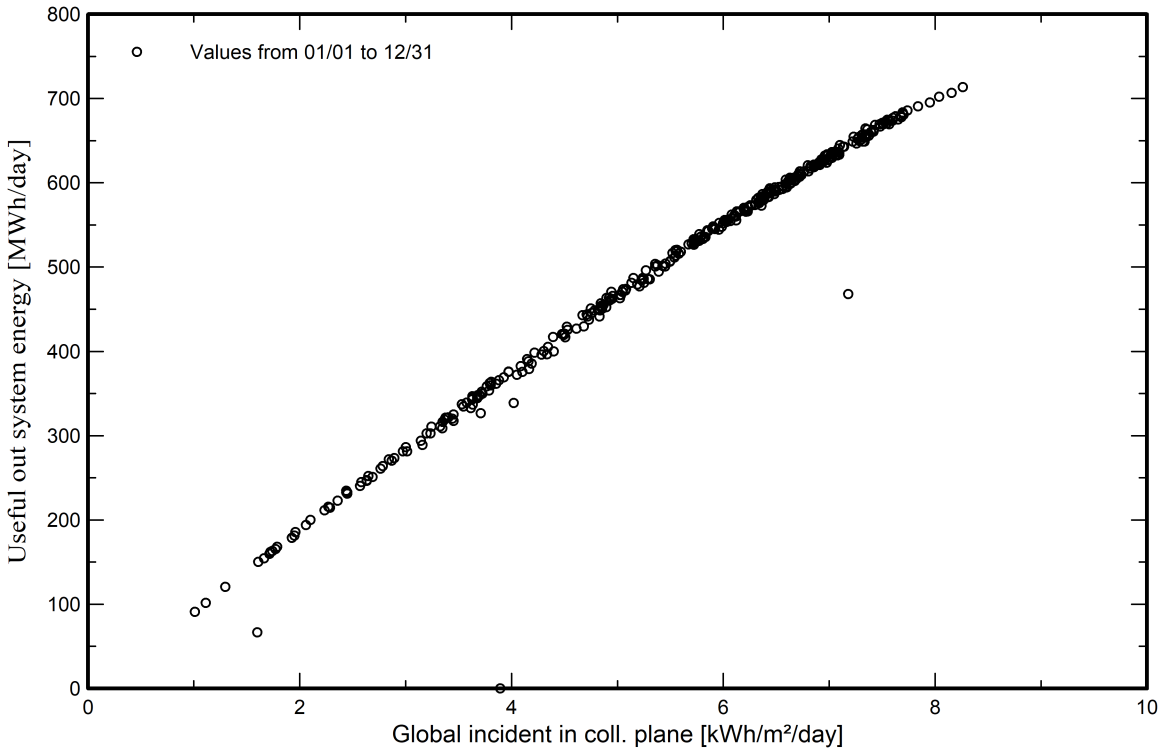
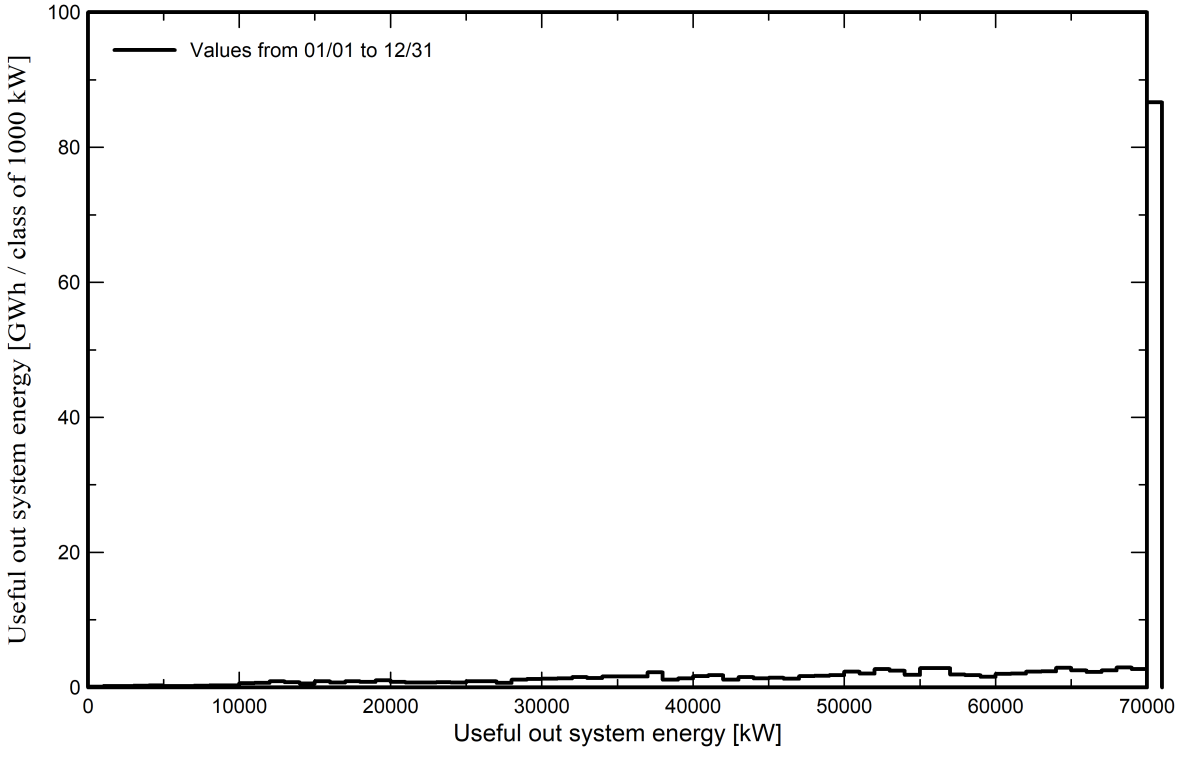
Predef. graphs

Daily Input/Output diagram



System Output Power Distribution



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Cost of the system

Installation costs

Item	Quantity units	Cost USD	Total USD
PV modules			
TSM-DEG21C-20-665Wp Vertex	171100	79.00	13,516,900.00
Supports for modules	171100	46.00	7,870,600.00
Inverters			
Sunny Central 4400 UP	22	478,000.00	10,516,000.00
Batteries	74	400,000.00	29,600,000.00
Studies and analysis			
Engineering	1	2,400,000.00	2,400,000.00
Installation			
Global installation cost per module	171100	66.00	11,292,600.00
Transport	1	12,000,000.00	12,000,000.00
Land costs			
Land purchase	1	2,000,000.00	2,000,000.00
Land preparation	1	1,500,000.00	1,500,000.00
Loan bank charges			10,000,000.00
		Total	100,696,100.00
		Depreciable asset	61,503,500.00

Operating costs

Item	Total USD/year
Maintenance	
Provision for inverter replacement	2,000,000.00
Salaries	500,000.00
Repairs	1,000,000.00
Cleaning	500,000.00
Provision for battery replacement	6,000,000.00
Security fund	1,000,000.00
Administrative, accounting	3,000,000.00
Total (OPEX)	14,000,000.00
Including inflation (2.00%)	17,008,158.86

System summary

Total installation cost	100,696,100.00 USD
Operating costs (incl. inflation 2.00%/year)	17,008,158.86 USD/year
Produced Energy	181879 MWh/year
Cost of produced energy (LCOE)	0.1224 USD/kWh

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Financial analysis

Simulation period

Project lifetime	20 years	Start year	2025

Income variation over time

Inflation	2.00 %/year
Production variation (aging)	0.00 %/year
Discount rate	0.50 %/year

Income dependent expenses

Income tax rate	0.00 %/year
Other income tax	0.00 %/year
Dividends	5.00 %/year

Depreciable assets

Asset	Depreciation method	Depreciation period (years)	Salvage value (USD)	Depreciable (USD)
PV modules				
TSM-DEG21C-20-665Wp Vertex	Straight-line	20	0.00	13,516,900.00
Supports for modules	Straight-line	20	0.00	7,870,600.00
Inverters				
Sunny Central 4400 UP	Straight-line	20	0.00	10,516,000.00
Batteries	Straight-line	20	0.00	29,600,000.00
		Total	0.00	61,503,500.00

Financing

Own funds	100,696,100.00 USD

Electricity sale

Feed-in tariff	0.14000 USD/kWh
Duration of tariff warranty	20 years
Annual connection tax	0.00 USD/kWh
Annual tariff variation	0.0 %/year
Feed-in tariff decrease after warranty	0.00 %

Return on investment

Payback period	10.2 years
Net present value (NPV)	60,898,465.64 USD
Internal rate of return (IRR)	6.50 %
Return on investment (ROI)	60.5 %
Paid dividends	8,454,949.28 USD

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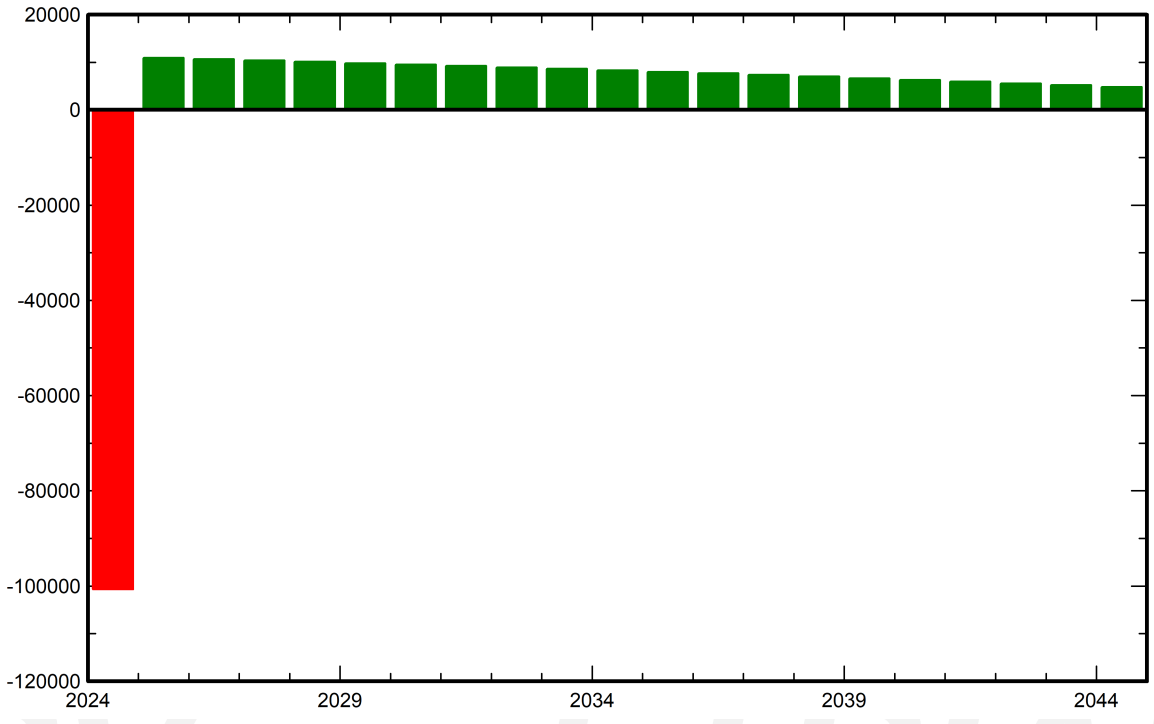
Financial analysis

Detailed economic results (kUSD)

Year	Electricity sale	Own funds	Run. costs	Deprec. allow.	Taxable income	Taxes	After-tax profit	Divid. 5.00%	Cumul. profit	% amorti.
0	0	100,696,100	0	0	0	0	0	0	-100,696,100	0.0%
1	25,463,108	0	14,000,000	3,075,175	8,387,933	0	11,463,108	573,155	-89,290,022	11.3%
2	25,463,108	0	14,280,000	3,075,175	8,107,933	0	11,183,108	559,155	-78,217,912	22.3%
3	25,463,108	0	14,565,600	3,075,175	7,822,333	0	10,897,508	544,875	-67,482,245	33.0%
4	25,463,108	0	14,856,912	3,075,175	7,531,021	0	10,606,196	530,310	-57,085,548	43.3%
5	25,463,108	0	15,154,050	3,075,175	7,233,883	0	10,309,058	515,453	-47,030,395	53.3%
6	25,463,108	0	15,457,131	3,075,175	6,930,802	0	10,005,977	500,299	-37,319,414	62.9%
7	25,463,108	0	15,766,274	3,075,175	6,621,659	0	9,696,834	484,842	-27,955,281	72.2%
8	25,463,108	0	16,081,599	3,075,175	6,306,334	0	9,381,509	469,075	-18,940,728	81.2%
9	25,463,108	0	16,403,231	3,075,175	5,984,702	0	9,059,877	452,994	-10,278,538	89.8%
10	25,463,108	0	16,731,296	3,075,175	5,656,637	0	8,731,812	436,591	-1,971,546	98.0%
11	25,463,108	0	17,065,922	3,075,175	5,322,011	0	8,397,186	419,859	5,977,355	105.9%
12	25,463,108	0	17,407,240	3,075,175	4,980,693	0	8,055,868	402,793	13,565,220	113.5%
13	25,463,108	0	17,755,385	3,075,175	4,632,548	0	7,707,723	385,386	20,789,046	120.6%
14	25,463,108	0	18,110,493	3,075,175	4,277,440	0	7,352,615	367,631	27,645,775	127.5%
15	25,463,108	0	18,472,703	3,075,175	3,915,230	0	6,990,405	349,520	34,132,290	133.9%
16	25,463,108	0	18,842,157	3,075,175	3,545,776	0	6,620,951	331,048	40,245,417	140.0%
17	25,463,108	0	19,219,000	3,075,175	3,168,933	0	6,244,108	312,205	45,981,922	145.7%
18	25,463,108	0	19,603,380	3,075,175	2,784,553	0	5,859,728	292,986	51,338,512	151.0%
19	25,463,108	0	19,995,447	3,075,175	2,392,486	0	5,467,661	273,383	56,311,832	155.9%
20	25,463,108	0	20,395,356	3,075,175	1,992,577	0	5,067,752	253,388	60,898,466	160.5%
Total	**509,262,163**	**100,696,100**	**340,163,177**	**61,503,500**	**107,595,486**	**0**	**169,098,986**	**8,454,949**	**60,898,466**	**160.5%**

Yearly net profit (kUSD)



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Financial analysis

Cumulative cashflow (kUSD)