Version 7.2.8

PVsyst - Simulation report

Grid-Connected System

Project: Gilmaziv_v03

Variant: Gilmaziv9MW_25_2x26_huawei_v02

Sheds on ground

System power: 13.05 MWp

Hel'myaziv - Ukraine

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Project summary

Geographical Site
Hel'myaziv
Ukraine

Situation

Latitude	49.84 °N
Longitude	31.84 °E
Altitude	84 m
Time zone	UTC+2

Meteo data
Grey Global - Gilmyaziv
SolarGIS Monthly aver. , period not spec. - Synthetic

Monthly albedo values

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Albedo	0.38	0.42	0.25	0.16	0.18	0.19	0.18	0.17	0.16	0.14	0.14	0.27

System summary

Grid-Connected System
Simulation for year no 1

Sheds on ground

PV Field Orientation
Fixed plane
Tilt/Azimuth 25 / 0 °

Near Shadings
According to strings
Electrical effect 50 %

User's needs
Unlimited load (grid)

System information

PV Array

Nb. of modules	31824 units
Pnom total	13.05 MWp

Inverters

Nb. of units	72 units
Pnom total	13.32 MWac
Grid power limit	9000 kWac
Grid lim. Pnom ratio	1.450

Results summary

Produced Energy	15613 MWh/year	Specific production	1197 kWh/kWp/year	Perf. Ratio PR	84.50 %

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General parameters

Grid-Connected System

Sheds on ground

PV Field Orientation

Orientation	
Fixed plane	
Tilt/Azimuth	25 / 0 °

Sheds configuration	
Nb. of sheds	612 units
Sizes	
Sheds spacing	9.00 m
Collector width	4.10 m
Ground Cov. Ratio (GCR)	45.5 %
Shading limit angle	
Limit profile angle	18.1 °

Models used	
Transposition	Perez
Diffuse	Perez, Meteonorm
Circumsolar	separate

Horizon
Free Horizon

Near Shadings
According to strings
Electrical effect 50 %

User's needs
Unlimited load (grid)

Bifacial system
Model 2D Calculation
unlimited sheds

Bifacial model geometry		Bifacial model definitions	
Sheds spacing	9.00 m	Ground albedo average	0.22
Sheds width	4.10 m	Bifaciality factor	70 %
Limit profile angle	18.1 °	Rear shading factor	5.0 %
GCR	45.5 %	Rear mismatch loss	10.0 %
Height above ground	0.70 m	Shed transparent fraction	0.0 %

Monthly ground albedo values

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year
0.38	0.42	0.25	0.16	0.18	0.19	0.18	0.17	0.16	0.14	0.14	0.27	0.22

Grid power limitation

Active Power	9000 kWac
Pnom ratio	1.450

PV Array Characteristics

PV module

Manufacturer	Astronergy
Model	CHSM72M-DG-F-BH-410-Bifacial
(Original PVsyst database)	
Unit Nom. Power	410 Wp
Number of PV modules	31824 units
Nominal (STC)	13.05 MWp
Modules	1224 Strings x 26 In series
At operating cond. (50°C)	
Pmpp	11.91 MWp
U mpp	971 V
I mpp	12269 A

Inverter

Manufacturer	Huawei Technologies
Model	SUN2000-185KTL-H1
(Custom parameters definition)	
Unit Nom. Power	185 kWac
Number of inverters	72 units
Total power	13320 kWac
Operating voltage	500-1500 V
Pnom ratio (DC:AC)	0.98

Total PV power

Nominal (STC)	13048 kWp
Total	31824 modules
Module area	65506 m²

Total inverter power

Total power	13320 kWac
Nb. of inverters	72 units
Pnom ratio	0.98

Array losses

Array Soiling Losses
Loss Fraction 1.5 %

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. 0.87 mΩ
Loss Fraction 1.0 % at STC

LID - Light Induced Degradation
Loss Fraction 2.0 %

Module Quality Loss
Loss Fraction -0.8 %

Module mismatch losses
Loss Fraction 0.5 % at MPP

Strings Mismatch loss
Loss Fraction 0.1 %

Module average degradation
Year no 1
Loss factor 0.68 %/year
Mismatch due to degradation
Imp RMS dispersion 0.4 %/year
Vmp RMS dispersion 0.4 %/year

IAM loss factor
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	0.403	0.000

System losses

Unavailability of the system
Time fraction 1.0 %
3.7 days,
3 periods

AC wiring losses

Inv. output line up to MV transfo
Inverter voltage 800 Vac tri
Loss Fraction 0.70 % at STC
Inverter: SUN2000-185KTL-H1
Wire section (72 Inv.) Copper 72 x 3 x 300 mm²
Average wires length 400 m

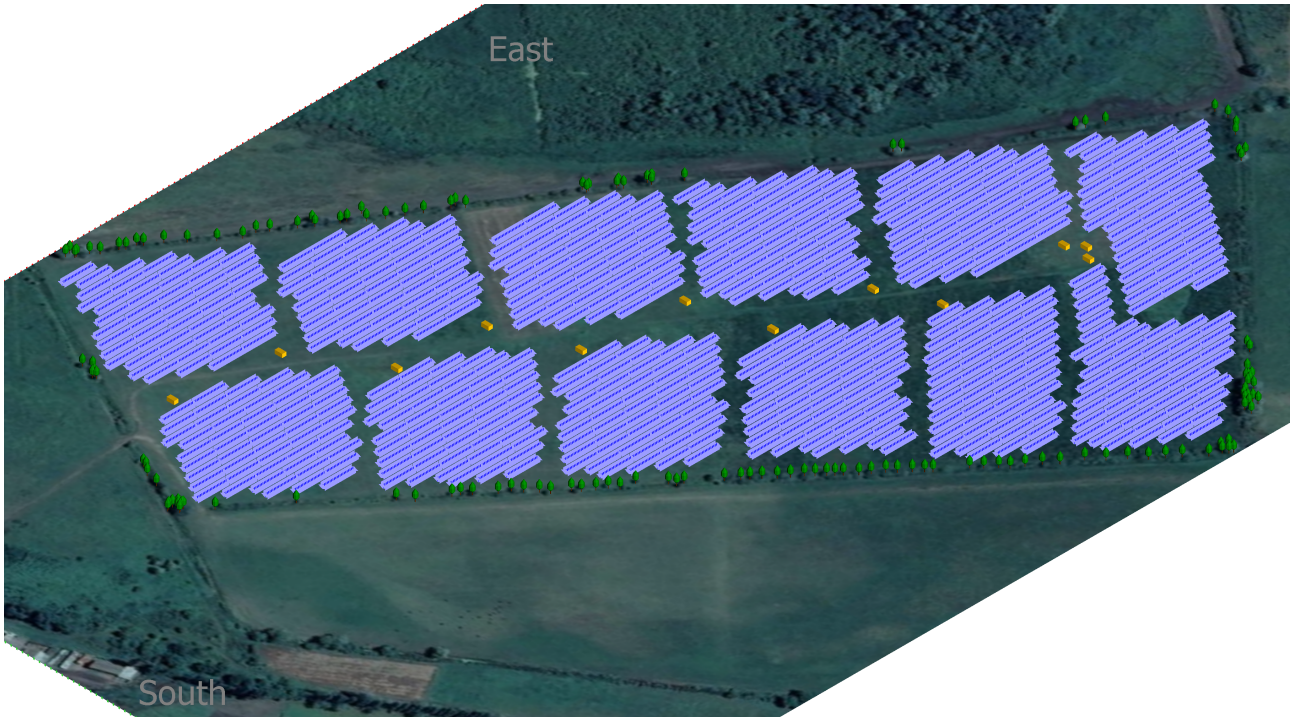
MV line up to Injection
MV Voltage 33 kV
Average each inverter
Wires Copper 3 x 25 mm²
Length 3000 m
Loss Fraction 0.22 % at STC

AC losses in transformers

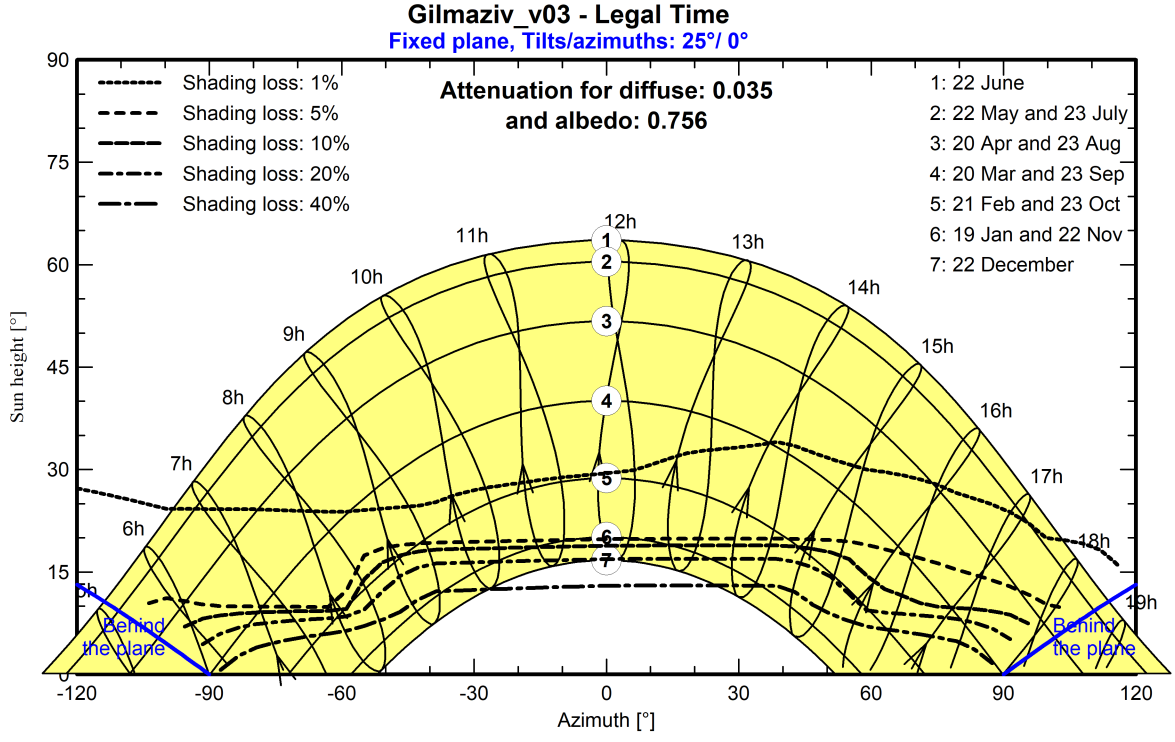
MV transfo
Grid voltage 33 kV
Operating losses at STC
Nominal power at STC 12859 kVA
Iron loss (24/24 Connexion) 1.07 kW/Inv.
Loss Fraction 0.10 % at STC
Coils equivalent resistance 3 x 5.97 mΩ/inv.
Loss Fraction 1.00 % at STC

Near shadings parameter

Perspective of the PV-field and surrounding shading scene



Iso-shadings diagram

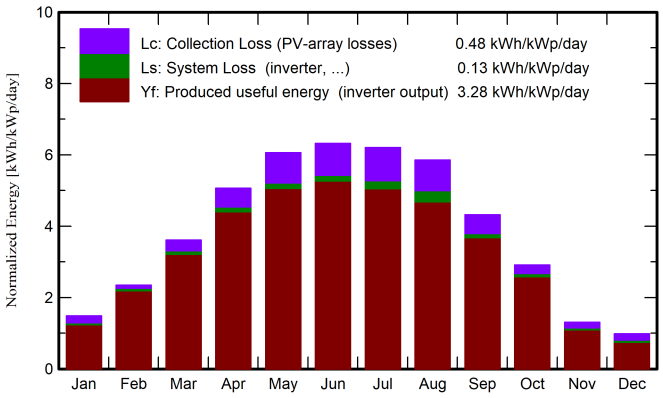


Main results

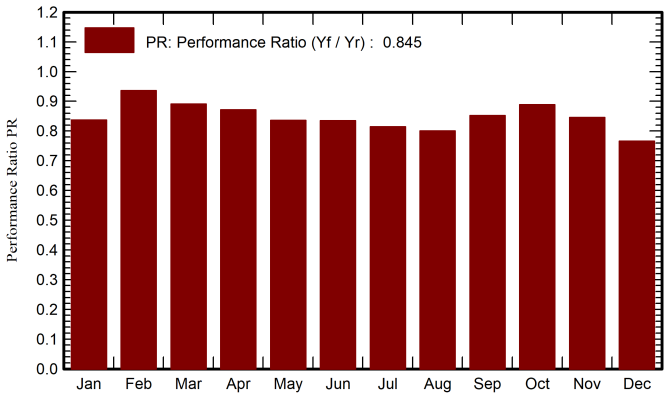
System Production

Produced Energy	15613 MWh/year	Specific production	1197 kWh/kWp/year
		Performance Ratio PR	84.50 %

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	PR ratio
January	27.0	16.00	-4.20	46.1	39.5	524	503	0.837
February	45.0	25.00	-2.90	65.7	60.5	829	802	0.936
March	89.0	45.00	2.40	112.0	105.0	1342	1302	0.891
April	132.0	63.00	10.10	151.8	143.2	1777	1727	0.872
May	179.0	75.00	15.90	187.8	177.1	2110	2050	0.836
June	187.0	79.00	19.20	189.5	178.5	2125	2063	0.834
July	186.0	82.00	21.40	192.2	181.2	2135	2043	0.815
August	162.0	70.00	20.20	181.6	171.8	2024	1897	0.801
September	105.0	48.00	14.70	129.5	122.1	1486	1441	0.852
October	65.0	34.00	8.00	90.4	84.6	1083	1049	0.889
November	27.0	18.00	2.60	39.1	35.0	451	431	0.845
December	19.0	13.00	-2.40	30.5	25.4	329	305	0.766
Year	1223.0	568.00	8.81	1416.1	1323.8	16214	15613	0.845

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		
GlobEff	Effective Global, corr. for IAM and shadings		

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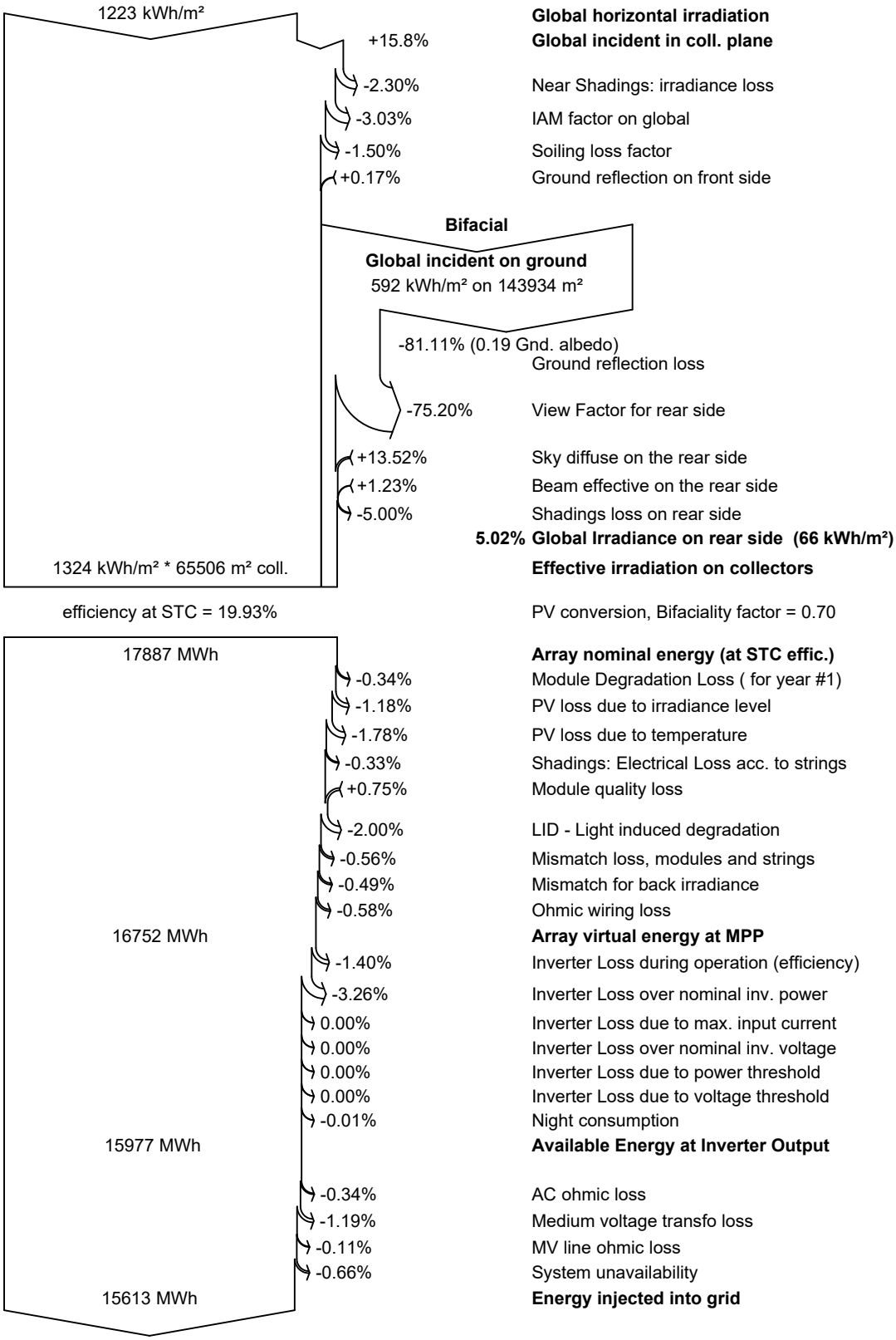
Loss diagram



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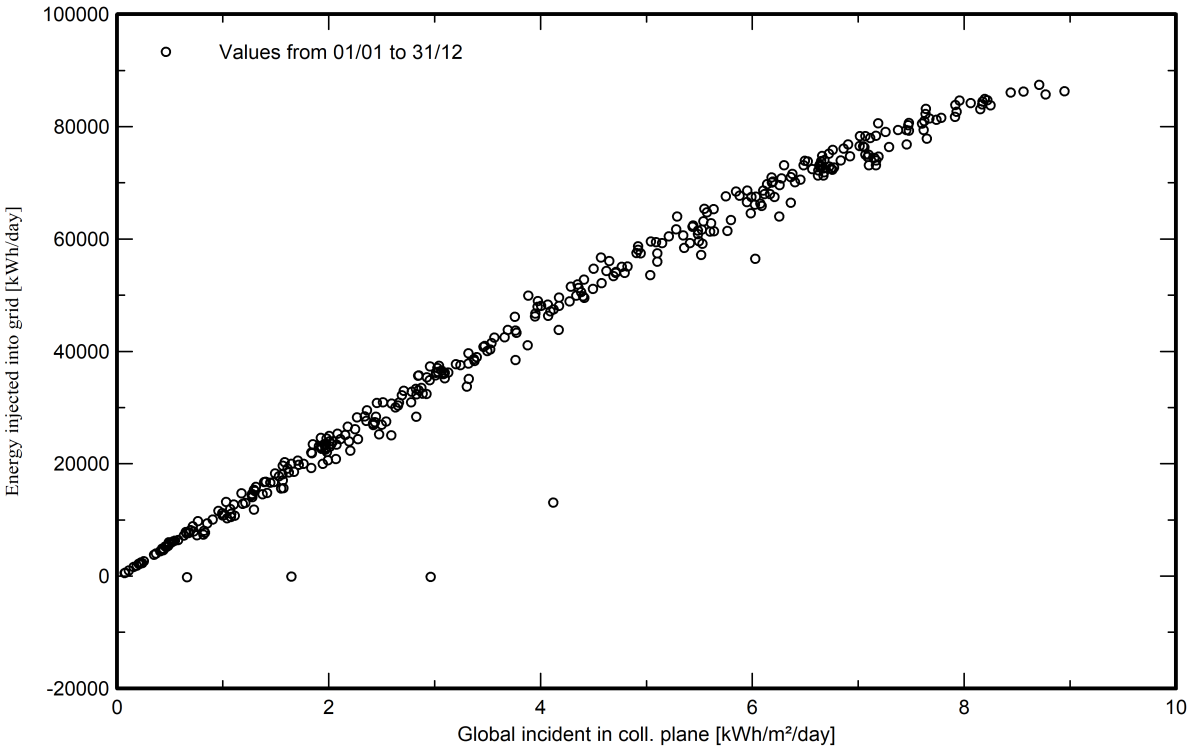
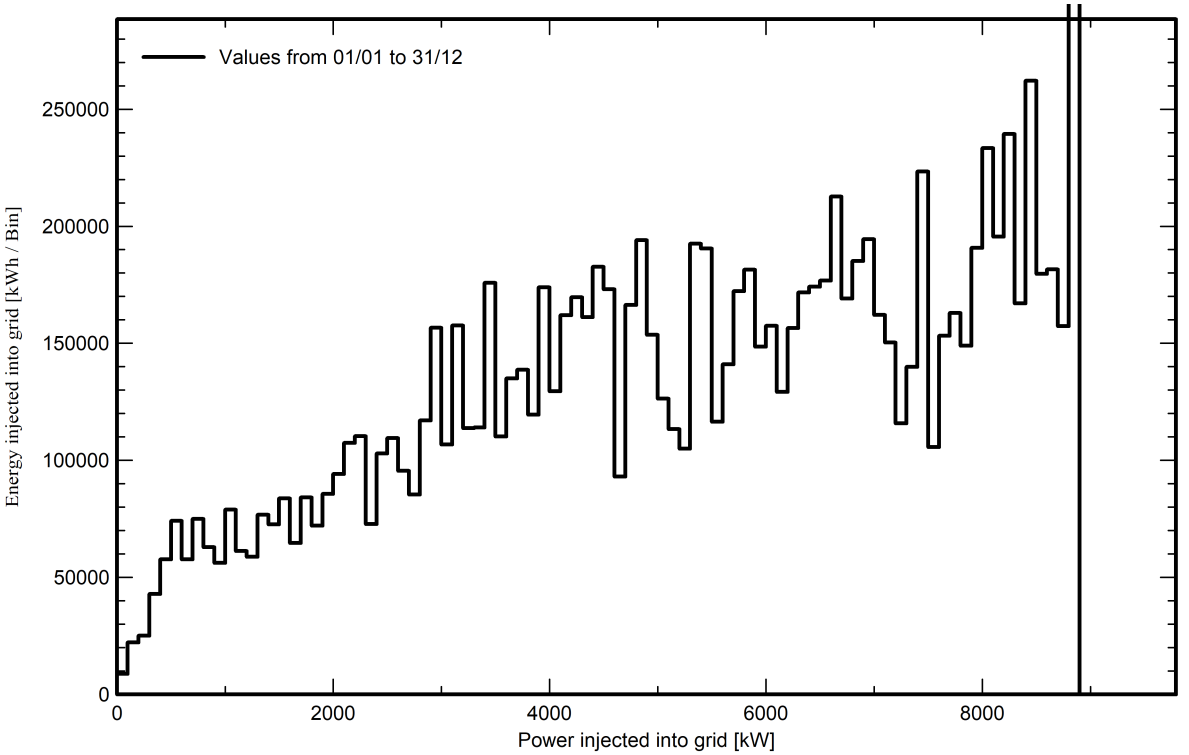
Special graphs

Daily Input/Output diagram



System Output Power Distribution



Aging Tool

Aging Parameters

Time span of simulation 25 years

Module average degradation

Loss factor 0.68 %/year

Mismatch due to degradation

Imp RMS dispersion 0.4 %/year

Vmp RMS dispersion 0.4 %/year

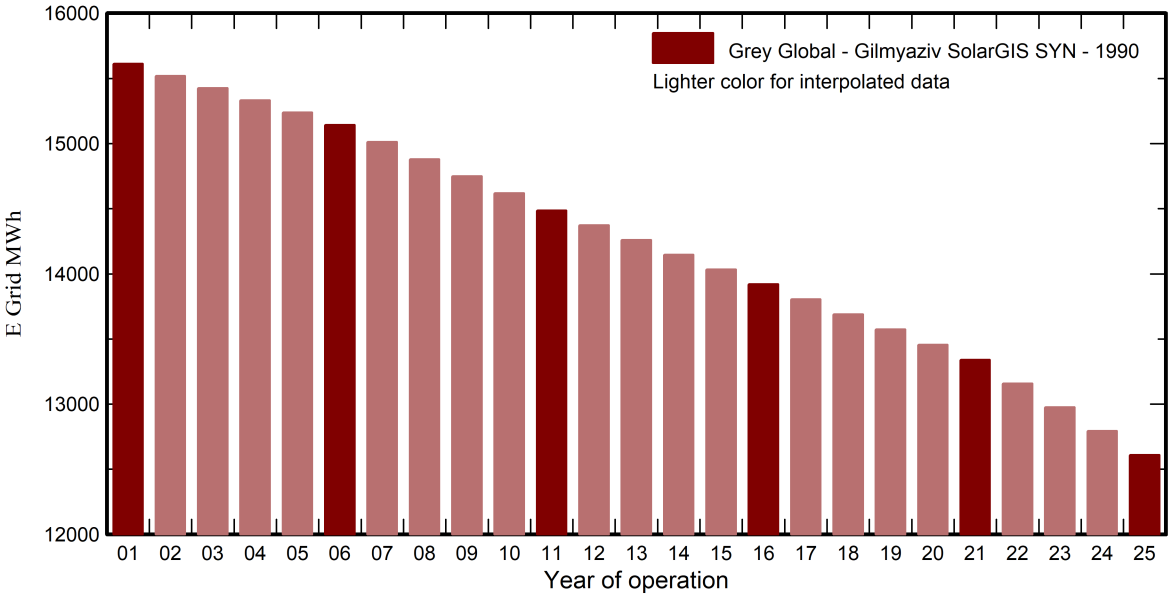
Meteo used in the simulation

#1 Grey Global - Gilmyaziv SolarGIS SYN

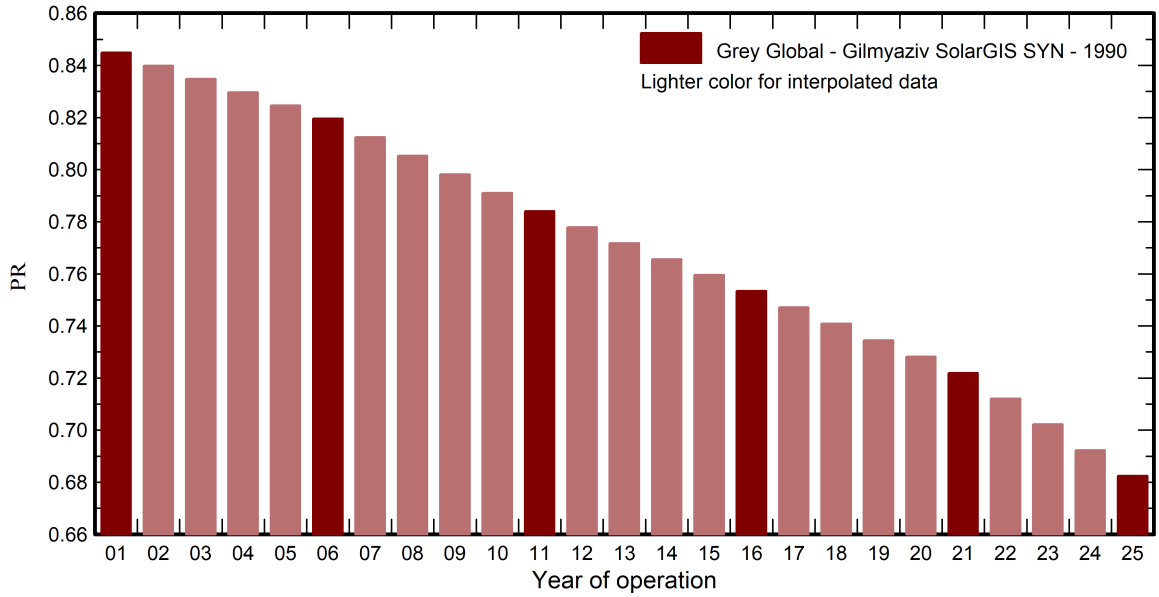
Years 1990 (reference year)

Years simulated 1,6,11,16,21,25

Energy injected into grid



Performance Ratio



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Grey Global - Gilmyaziv SolarGIS SYN

Year	E Grid	PR	PR loss
	MWh		%
1	15613	0.845	0%
2	15519	0.84	-0.6%
3	15425	0.835	-1.2%
4	15331	0.83	-1.8%
5	15237	0.825	-2.4%
6	15143	0.82	-3%
7	15012	0.812	-3.8%
8	14880	0.805	-4.7%
9	14749	0.798	-5.5%
10	14618	0.791	-6.4%
11	14486	0.784	-7.2%
12	14373	0.778	-7.9%
13	14260	0.772	-8.7%
14	14147	0.766	-9.4%
15	14034	0.76	-10.1%
16	13921	0.753	-10.8%
17	13805	0.747	-11.6%
18	13689	0.741	-12.3%
19	13572	0.735	-13.1%
20	13456	0.728	-13.8%
21	13340	0.722	-14.6%
22	13158	0.712	-15.7%
23	12975	0.702	-16.9%
24	12793	0.692	-18.1%
25	12610	0.682	-19.2%

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P50 - P90 evaluation

Meteo data

Source	SolarGIS Monthly aver. , period not spec.
Kind	Monthly averages
Synthetic - Multi-year average	
Year-to-year variability(Variance)	2.5 %

Specified Deviation

Climate change	0.0 %

Global variability (meteo + system)

Variability (Quadratic sum)	3.1 %

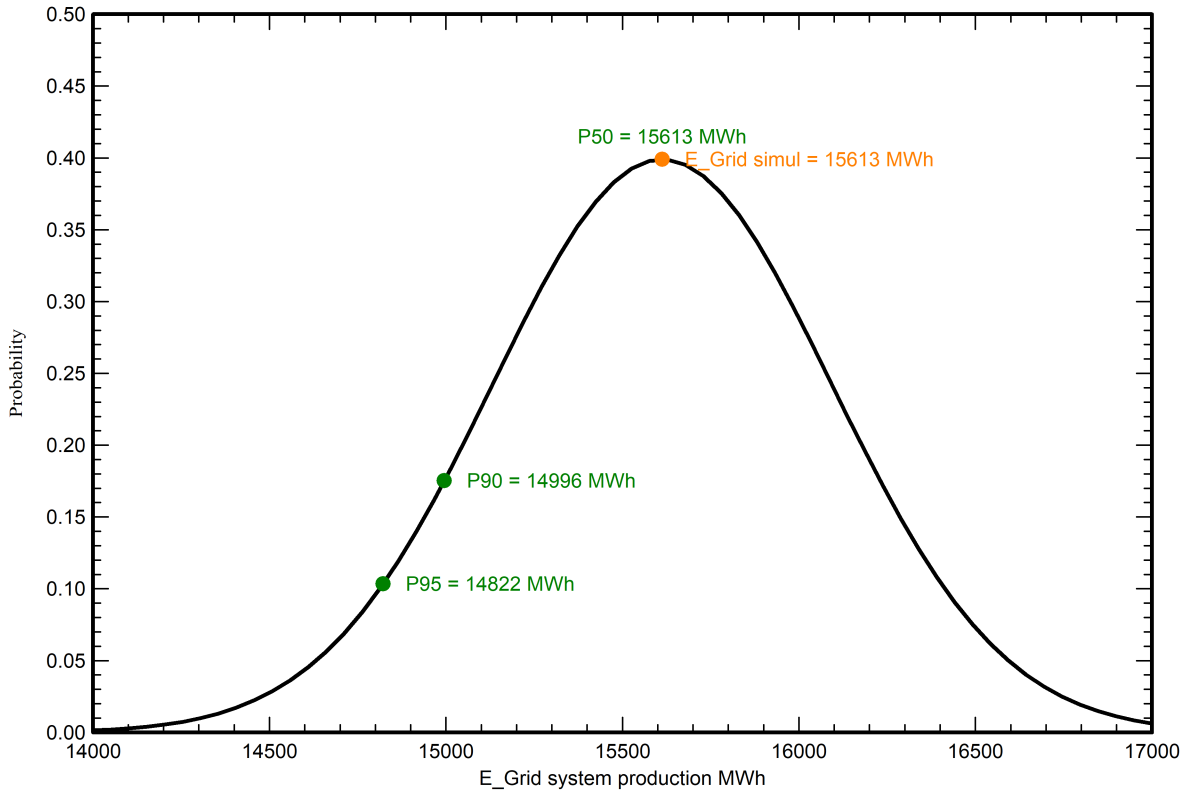
Simulation and parameters uncertainties

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	481 MWh
P50	15613 MWh
P90	14996 MWh
P95	14822 MWh

Probability distribution



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CO_2 Emission Balance

Total: 147098.9 tCO_2

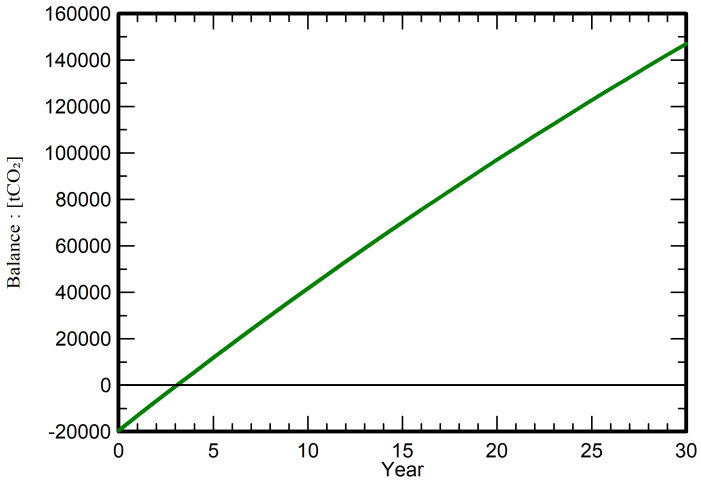
Generated emissions

Total: 19524.24 tCO_2
Source: Detailed calculation from table below:

Replaced Emissions

Total: 192036.1 tCO_2
System production: 15612.69 MWh/yr
Grid Lifecycle Emissions: 410 gCO_2/kWh
Source: IEA List
Country: Ukraine
Lifetime: 30 years
Annual degradation: 1.0 %

Saved CO_2 Emission vs. Time



System Lifecycle Emissions Details

Item	LCE	Quantity	Subtotal
			[$kgCO_2$]
Modules	1629 kgCO2/kWp	11513 kWp	18756339
Supports	2.73 kgCO2/kg	280800 kg	767904