![PVsyst logo](PVsyst PHOTOVOLTAIC SOFTWARE)

PVsyst - Simulation report

Grid-Connected System

Project: Sim00

Variant: BIFACIAL_Row9

Unlimited Trackers with backtracking

System power: 57.7 kWp

NREL BEST Field - United States

Author

National renewable energy laboratory (United states)

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VC3, Simulation date:
06/16/23 09:08
with v7.3.4

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Project summary

Geographical Site
NREL BEST Field
United States

Situation
Latitude	39.74 °N
Longitude	-105.17 °W
Altitude	1765 m
Time zone	UTC-7

Meteo data
DENVER/CENTENNIAL [GOLDEN - NREL]

NREL BEST Field - TMY

Monthly albedo values

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Albedo	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.20	0.20

System summary

Grid-Connected System   **Unlimited Trackers with backtracking**

PV Field Orientation
Orientation

Tracking horizontal axis

Tracking algorithm

Astronomic calculation

Backtracking activated

Near Shadings
No Shadings

System information

PV Array

Nb. of modules	144 units
Pnom total	57.7 kWp

Inverters

Nb. of units	3 units
Pnom total	72.0 kWac
Pnom ratio	0.801

User's needs
Unlimited load (grid)

Results summary

Produced Energy	120370 kWh/year	Specific production	2088 kWh/kWp/year	Perf. Ratio PR	88.36 %

Table of contents

PVsyst V7.3.4
VC3, Simulation date:
06/16/23 09:08
with v7.3.4

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General parameters

Grid-Connected System **Unlimited Trackers with backtracking**

PV Field Orientation

Orientation

Tracking horizontal axis

Tracking algorithm

Astronomic calculation
Backtracking activated

Backtracking array

Nb. of trackers	10 units
Unlimited trackers	
Sizes	
Tracker Spacing	5.70 m
Collector width	2.00 m
Ground Cov. Ratio (GCR)	35.1 %
Left inactive band	0.02 m
Right inactive band	0.02 m
Phi min / max.	-/+ 50.0 °
Backtracking strategy	
Phi limits for BT	-/+ 68.9 °
Backtracking pitch	5.70 m
Backtracking width	2.00 m

Models used

Transposition	Perez
Diffuse	Imported
Circumsolar	with diffuse

Horizon
Free Horizon

Near Shadings
No Shadings

User's needs
Unlimited load (grid)

Bifacial system

Model — 2D Calculation
unlimited trackers

Bifacial model geometry			**Bifacial model definitions**	
Tracker Spacing	5.70 m		Ground albedo	0.20
Tracker width	2.04 m		Bifaciality factor	87 %
GCR	35.8 %		Rear shading factor	5.0 %
Axis height above ground	1.50 m		Rear mismatch loss	10.0 %
			Shed transparent fraction	0.0 %

PV Array Characteristics

PV module

Manufacturer	Sunpreme
Model	Bifi 400 Wp 150 cells Bifacial
(Custom parameters definition)	
Unit Nom. Power	400.4 Wp
Number of PV modules	144 units
Nominal (STC)	57.7 kWp
Modules	9 Strings x 16 In series
At operating cond. (50°C)	
Pmpp	54.3 kWp
U mpp	703 V
I mpp	77 A

Inverter

Manufacturer	Fronius USA
Model	Symo Advanced 24.0-3 480
(Original PVsyst database)	
Unit Nom. Power	24.0 kWac
Number of inverters	3 * MPPT 0.57 3 units
Total power	72.0 kWac
Operating voltage	200-800 V
Pnom ratio (DC:AC)	0.80

Total PV power

Nominal (STC)	58 kWp
Total	144 modules
Module area	294 m²
Cell area	246 m²

Total inverter power

Total power	72 kWac
Number of inverters	3 units
Pnom ratio	0.80

PVsyst V7.3.4
VC3, Simulation date:
06/16/23 09:08
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Array losses

Thermal Loss factor

Module temperature according to irradiance

Uc (const)	20.0 W/m²K
Uv (wind)	0.0 W/m²K/m/s

Module mismatch losses

Loss Fraction	2.0 % at MPP

IAM loss factor

Incidence effect (IAM): Fresnel smooth glass, n = 1.526

DC wiring losses

Global array res.	149 mΩ
Loss Fraction	1.5 % at STC

Strings Mismatch loss

Loss Fraction	0.2 %

Module Quality Loss

Loss Fraction	-0.8 %

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

PVsyst V7.3.4
VC3, Simulation date:
06/16/23 09:08
with v7.3.4

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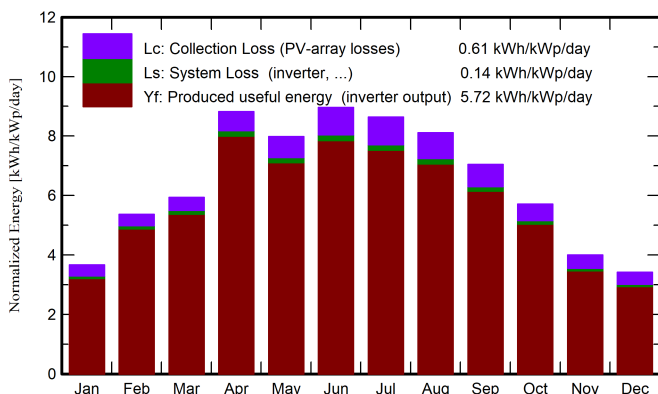
Main results

System Production

Produced Energy	120370 kWh/year	Specific production	2088 kWh/kWp/year
		Perf. Ratio PR	88.36 %

Normalized productions (per installed kWp)

Lc: Collection Loss (PV-array losses)   0.61 kWh/kWp/day
Ls: System Loss (inverter, ...)   0.14 kWh/kWp/day
Yf: Produced useful energy (inverter output)   5.72 kWh/kWp/day

Performance Ratio PR

PR: Performance Ratio (Yf / Yr) : 0.884
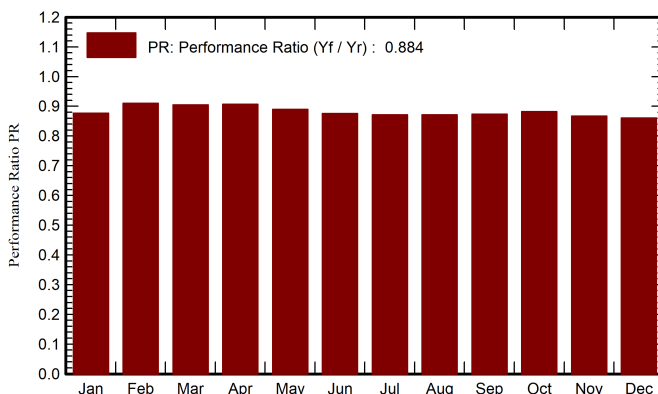
Balances and main results

	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_Grid	PR
	kWh/m²	kWh/m²	°C	kWh/m²	kWh/m²	kWh	kWh	ratio
January	81.2	28.03	1.69	113.6	107.0	5891	5748	0.877
February	108.6	32.46	-0.42	150.1	143.5	8056	7875	0.910
March	142.7	55.33	5.08	184.2	176.5	9841	9612	0.905
April	197.1	56.45	9.87	264.6	256.4	14157	13837	0.907
May	195.2	72.55	13.83	247.6	238.7	13018	12708	0.890
June	209.8	67.86	21.86	269.0	260.2	13921	13587	0.876
July	211.3	68.73	24.14	267.7	259.0	13792	13457	0.872
August	194.5	68.72	23.50	251.5	242.6	12952	12640	0.872
September	155.8	43.00	20.31	211.5	204.4	10907	10648	0.873
October	126.1	30.14	12.96	177.1	170.4	9222	9007	0.882
November	84.5	25.42	9.39	119.9	113.5	6145	5997	0.868
December	74.1	23.40	5.14	105.9	99.1	5389	5254	0.861
Year	1781.0	572.09	12.35	2362.6	2271.2	123291	120370	0.884

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

1781 kWh/m²	**Global horizontal irradiation**
+32.7%	**Global incident in coll. plane**
-2.16%	Near Shadings: irradiance loss
-2.10%	IAM factor on global
+0.37%	Ground reflection on front side

Bifacial

Global incident on ground

985 kWh/m² on 821 m²

-80.00% (0.20 Gnd. albedo)	Ground reflection loss
-75.43%	View Factor for rear side
+24.42%	Sky diffuse on the rear side
+0.00%	Beam effective on the rear side
-5.00%	Shadings loss on rear side
7.04%	**Global Irradiance on rear side (160 kWh/m²)**

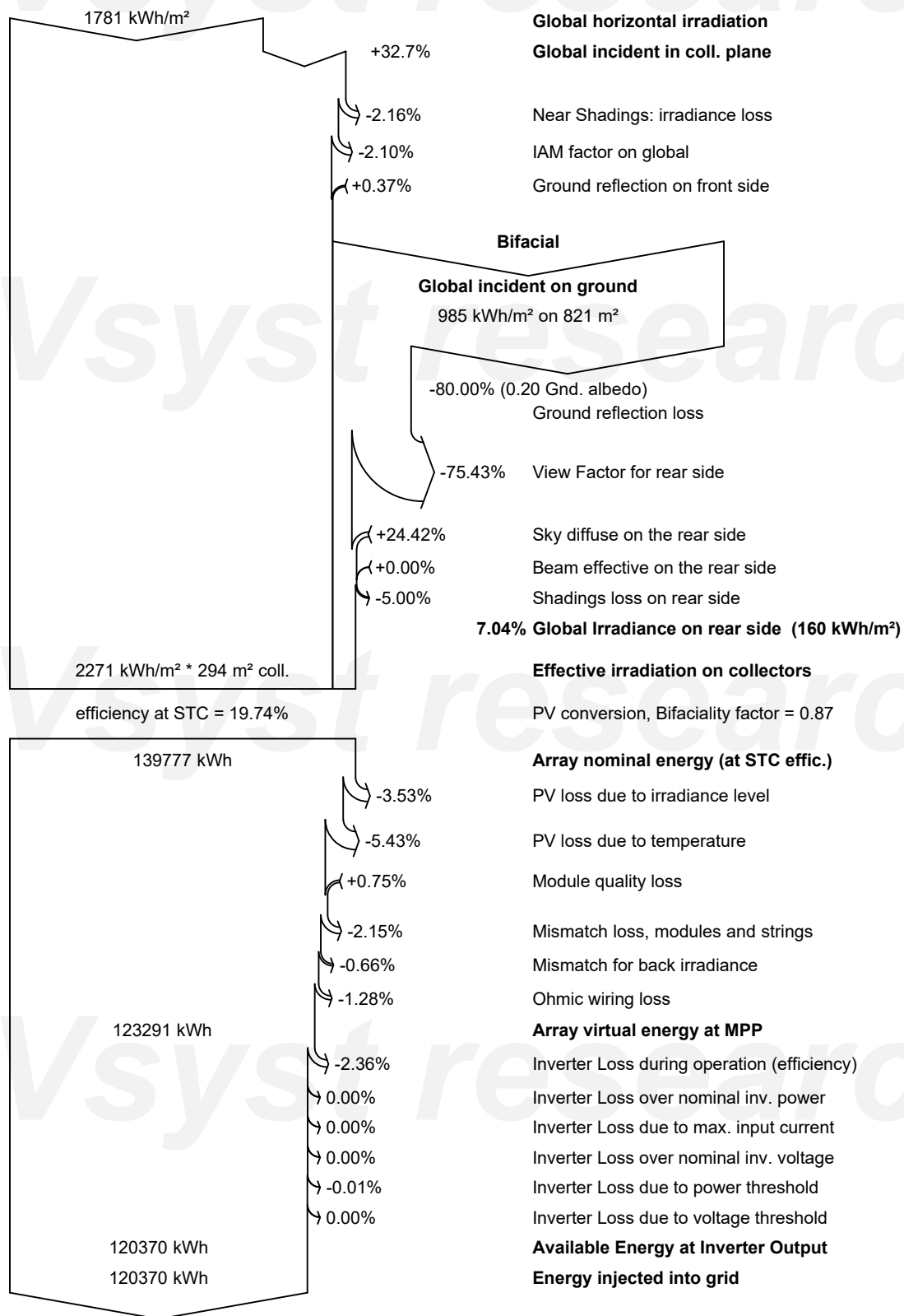|	
2271 kWh/m² * 294 m² coll.	**Effective irradiation on collectors**
efficiency at STC = 19.74%	PV conversion, Bifaciality factor = 0.87
139777 kWh	**Array nominal energy (at STC effic.)**
-3.53%	PV loss due to irradiance level
-5.43%	PV loss due to temperature
+0.75%	Module quality loss
-2.15%	Mismatch loss, modules and strings
-0.66%	Mismatch for back irradiance
-1.28%	Ohmic wiring loss
123291 kWh	**Array virtual energy at MPP**
-2.36%	Inverter Loss during operation (efficiency)
0.00%	Inverter Loss over nominal inv. power
0.00%	Inverter Loss due to max. input current
0.00%	Inverter Loss over nominal inv. voltage
-0.01%	Inverter Loss due to power threshold
0.00%	Inverter Loss due to voltage threshold
120370 kWh	**Available Energy at Inverter Output**
120370 kWh	**Energy injected into grid**

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Predef. graphs
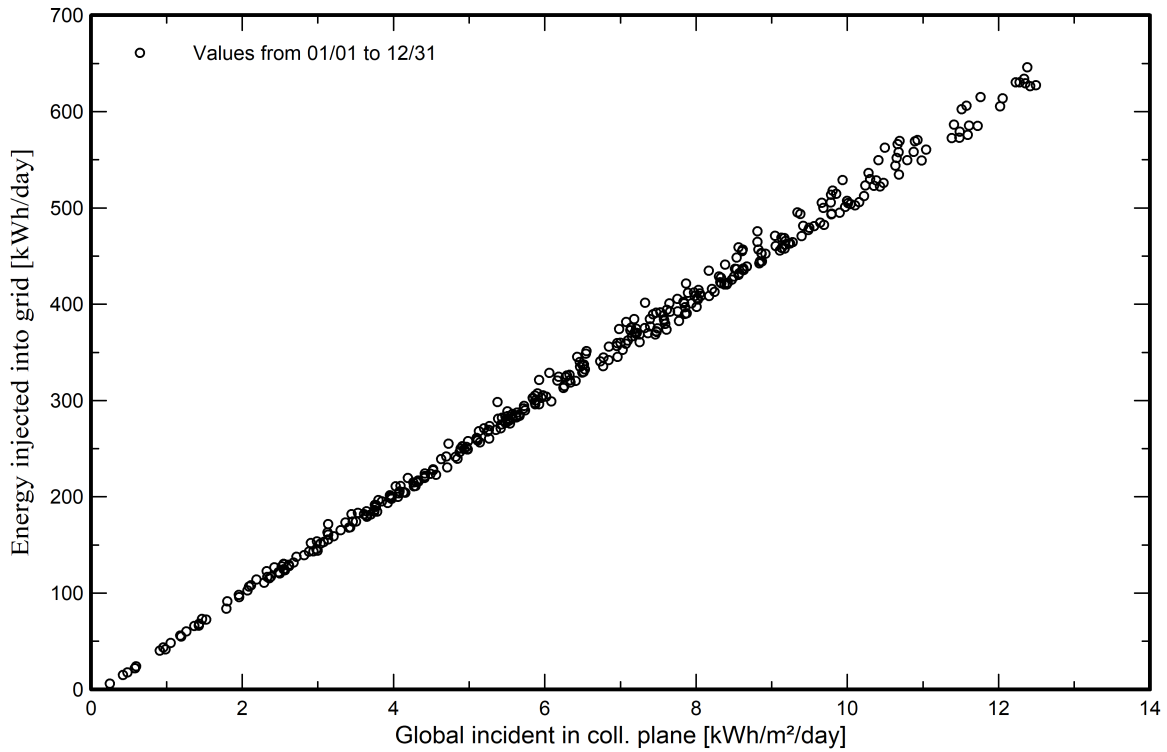
Daily Input/Output diagram

System Output Power Distribution