PVsyst - Simulation report

Grid-Connected System

Project: Test Bifi SAT

Variant: SAT Alb060 (bifi)

Trackers single array, with backtracking

System power: 2558 kWp

Sacramento/McClellan Park - United States

Author

DNV (USA)

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Project summary

Geographical Site	Situation		Project settings	
Sacramento/McClellan Park	Latitude	38.67 °N	Albedo	0.20
United States	Longitude	-121.40 °W		
	Altitude	18 m		
	Time zone	UTC-8		

Meteo data
Sacramento/McClellan Park
MeteoNorm 8.1 station - Synthetic

System summary

Grid-Connected System   **Trackers single array, with backtracking**

PV Field Orientation

Near Shadings

Orientation	Tracking algorithm	Linear shadings	
Tracking plane, horizontal N-S axis	Astronomic calculation	Diffuse shading	Automatic
Axis azimuth 0 °	Backtracking activated		

System information

PV Array		Inverters	
Nb. of modules	4410 units	Nb. of units	1 unit
Pnom total	2558 kWp	Pnom total	2200 kWac
		Pnom ratio	1.163

User's needs
Unlimited load (grid)

Results summary

Produced Energy	5559471 kWh/year	Specific production	2174 kWh/kWp/year	Perf. Ratio PR	93.20 %

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General parameters

Grid-Connected System

Trackers single array, with backtracking

PV Field Orientation

Orientation		Tracking algorithm		Backtracking array	
Tracking plane, horizontal N-S axis		Astronomic calculation		Nb. of trackers	49 units
Axis azimuth	0 °	Backtracking activated		Single array	
				Sizes	
				Tracker Spacing	5.00 m
				Collector width	2.47 m
				Ground Cov. Ratio (GCR)	49.3 %
				Phi min / max.	-/+ 60.0 °
				Backtracking strategy	
				Phi limits for BT	-/+ 60.3 °
				Backtracking pitch	5.00 m
				Backtracking width	2.47 m

Models used

Transposition	Perez
Diffuse	Perez, Meteonorm
Circumsolar	separate

Horizon		**Near Shadings**		**User's needs**	
Free Horizon		Linear shadings		Unlimited load (grid)	
		Diffuse shading	Automatic		

Bifacial system

Model	2D Calculation
	unlimited trackers

Bifacial model geometry		**Bifacial model definitions**	
Tracker Spacing	5.00 m	Ground albedo	0.60
Tracker width	2.47 m	Bifaciality factor	70 %
GCR	49.3 %	Rear shading factor	5.0 %
Axis height above ground	2.10 m	Rear mismatch loss	10.0 %
		Shed transparent fraction	0.0 %

PV Array Characteristics

PV module		**Inverter**	
Manufacturer	HT-SAAE	Manufacturer	SMA
Model	HT78-18X-580 Bifacial	Model	Sunny Central 2200
(Original PVsyst database)		(Original PVsyst database)	
Unit Nom. Power	580 Wp	Unit Nom. Power	2200 kWac
Number of PV modules	4410 units	Number of inverters	1 unit
Nominal (STC)	2558 kWp	Total power	2200 kWac
Modules	245 Strings x 18 In series	Operating voltage	570-950 V
At operating cond. (50°C)		Pnom ratio (DC:AC)	1.16
Pmpp	2351 kWp		
U mpp	731 V		
I mpp	3219 A		

Total PV power		**Total inverter power**	
Nominal (STC)	2558 kWp	Total power	2200 kWac
Total	4410 modules	Number of inverters	1 unit
Module area	12327 m²	Pnom ratio	1.16
Cell area	11351 m²		

PVsyst V7.3.4
VC2, Simulation date:
12/28/23 19:10
with v7.3.4

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Array losses

Thermal Loss factor

Module temperature according to irradiance

Uc (const)	25.0 W/m²K
Uv (wind)	1.2 W/m²K/m/s

DC wiring losses

Global array res.	3.7 mΩ
Loss Fraction	1.5 % at STC

LID - Light Induced Degradation

Loss Fraction	1.0 %

Module Quality Loss

Loss Fraction	-0.8 %

Module mismatch losses

Loss Fraction	1.0 % at MPP

Strings Mismatch loss

Loss Fraction	0.2 %

IAM loss factor

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

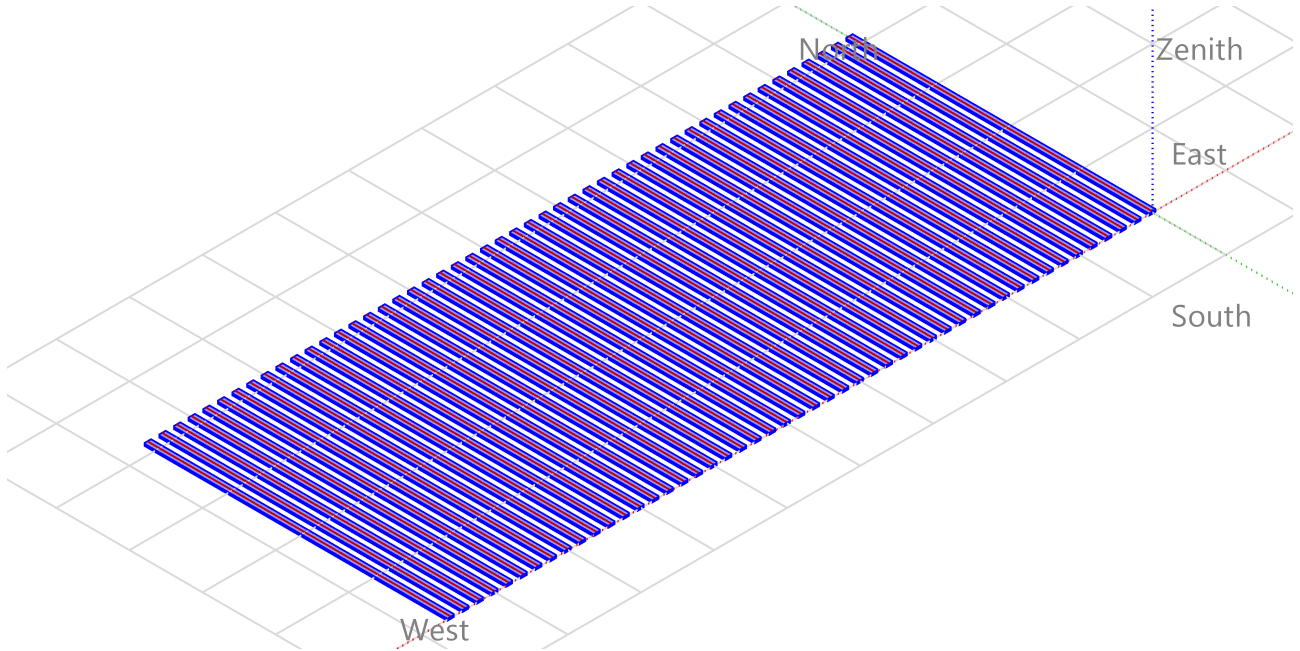| 0°	30°	50°	60°	70°	75°	80°	85°	90°
1.000	0.998	0.981	0.948	0.862	0.776	0.636	0.403	0.000

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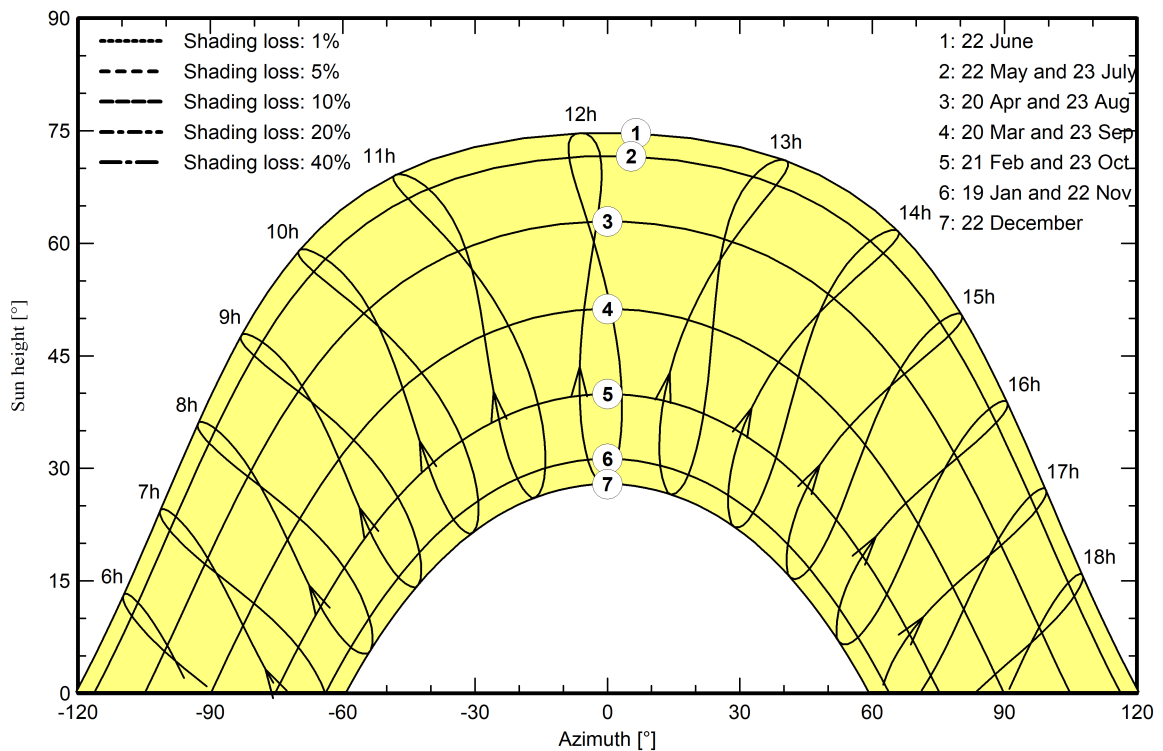## Near shadings parameter

Perspective of the PV-field and surrounding shading scene

Iso-shadings diagram

Orientation #1

Legend:
- Shading loss: 1%
- Shading loss: 5%
- Shading loss: 10%
- Shading loss: 20%
- Shading loss: 40%

1: 22 June
2: 22 May and 23 July
3: 20 Apr and 23 Aug
4: 20 Mar and 23 Sep
5: 21 Feb and 23 Oct
6: 19 Jan and 22 Nov
7: 22 December

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Main results

System Production

Produced Energy	5559471 kWh/year	Specific production	2174 kWh/kWp/year
		Perf. Ratio PR	93.20 %

Normalized productions (per installed kWp)

Lc: Collection Loss (PV-array losses)   0.31 kWh/kWp/day
Ls: System Loss (inverter, ...)   0.12 kWh/kWp/day
Yf: Produced useful energy (inverter output)   5.95 kWh/kWp/day

Performance Ratio PR

PR: Performance Ratio (Yf / Yr) : 0.932
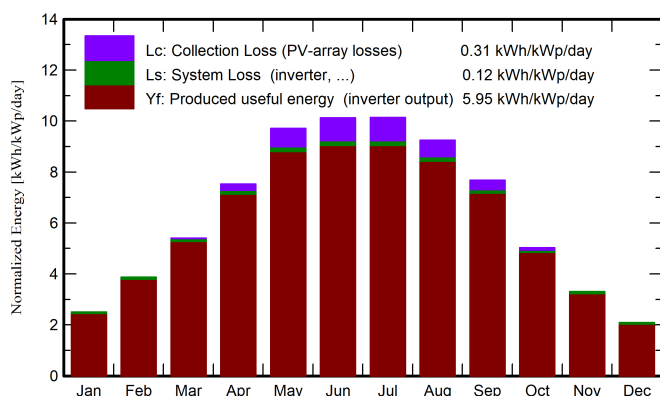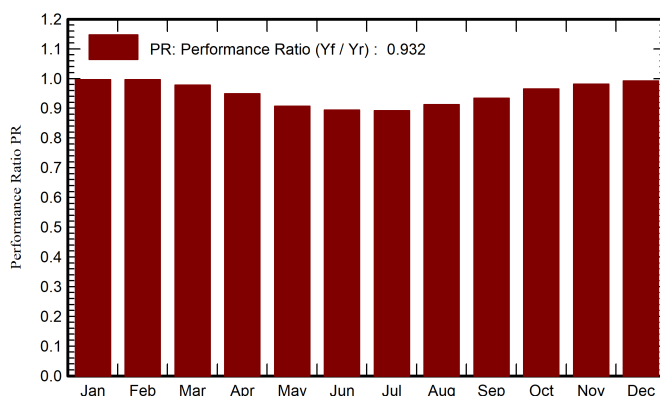
Balances and main results

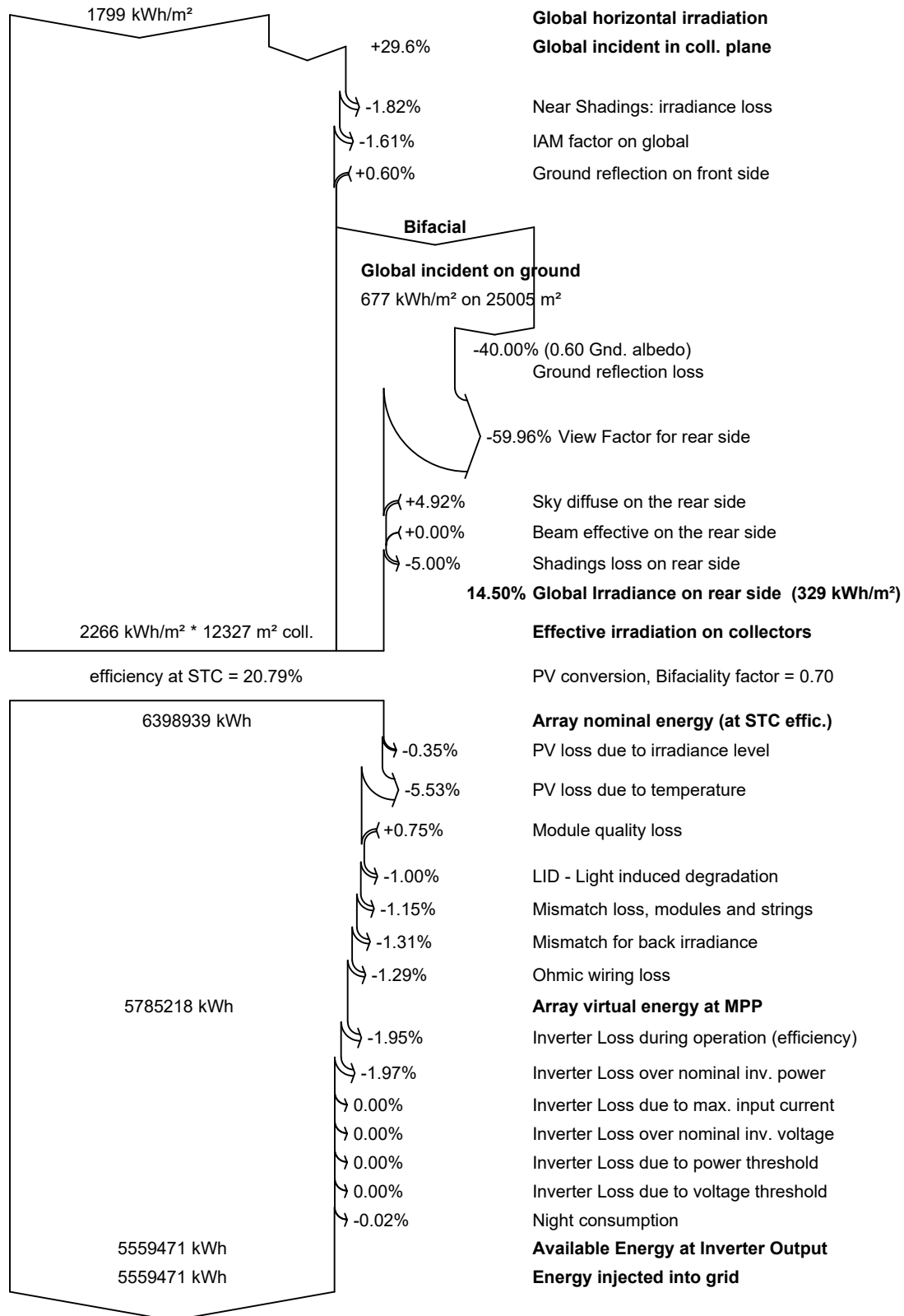|	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_Grid	PR
	kWh/m²	kWh/m²	°C	kWh/m²	kWh/m²	kWh	kWh	ratio
January	61.4	32.80	7.00	76.3	71.7	198509	194432	0.997
February	83.2	36.20	9.10	106.7	102.0	277334	271876	0.996
March	133.6	60.00	12.60	167.6	161.8	427643	419043	0.978
April	176.1	61.40	15.30	225.8	220.1	559364	548006	0.949
May	231.1	61.70	19.70	301.1	294.9	713187	698492	0.907
June	234.9	64.30	23.20	304.0	297.5	709249	694843	0.894
July	241.8	61.00	24.80	314.5	308.2	732728	717872	0.892
August	217.5	51.60	23.70	286.8	281.4	682914	669179	0.912
September	172.8	39.60	20.90	230.5	224.9	561437	550310	0.933
October	119.1	40.70	16.40	155.8	150.3	392089	384616	0.965
November	76.5	30.60	10.40	99.0	93.9	253597	248627	0.982
December	51.3	27.00	6.70	63.9	59.6	165678	162175	0.992
Year	1799.3	566.90	15.85	2332.1	2266.3	5673731	5559471	0.932

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

1799 kWh/m²	**Global horizontal irradiation**
+29.6%	**Global incident in coll. plane**
-1.82%	Near Shadings: irradiance loss
-1.61%	IAM factor on global
+0.60%	Ground reflection on front side
	Bifacial
	Global incident on ground
	677 kWh/m² on 25005 m²
-40.00% (0.60 Gnd. albedo)	Ground reflection loss
-59.96%	View Factor for rear side
+4.92%	Sky diffuse on the rear side
+0.00%	Beam effective on the rear side
-5.00%	Shadings loss on rear side
14.50%	**Global Irradiance on rear side (329 kWh/m²)**
2266 kWh/m² * 12327 m² coll.	**Effective irradiation on collectors**
efficiency at STC = 20.79%	PV conversion, Bifaciality factor = 0.70
6398939 kWh	**Array nominal energy (at STC effic.)**
-0.35%	PV loss due to irradiance level
-5.53%	PV loss due to temperature
+0.75%	Module quality loss
-1.00%	LID - Light induced degradation
-1.15%	Mismatch loss, modules and strings
-1.31%	Mismatch for back irradiance
-1.29%	Ohmic wiring loss
5785218 kWh	**Array virtual energy at MPP**
-1.95%	Inverter Loss during operation (efficiency)
-1.97%	Inverter Loss over nominal inv. power
0.00%	Inverter Loss due to max. input current
0.00%	Inverter Loss over nominal inv. voltage
0.00%	Inverter Loss due to power threshold
0.00%	Inverter Loss due to voltage threshold
-0.02%	Night consumption
5559471 kWh	**Available Energy at Inverter Output**
5559471 kWh	**Energy injected into grid**

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Predef. graphs

Daily Input/Output diagram
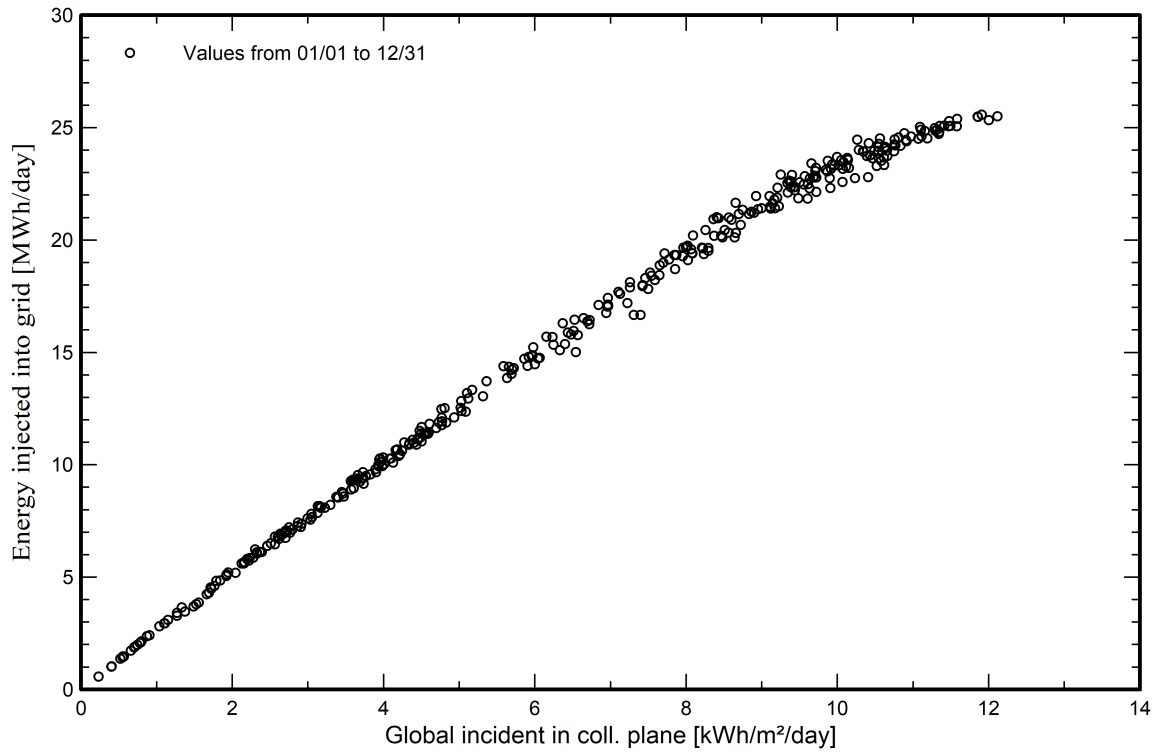
System Output Power Distribution
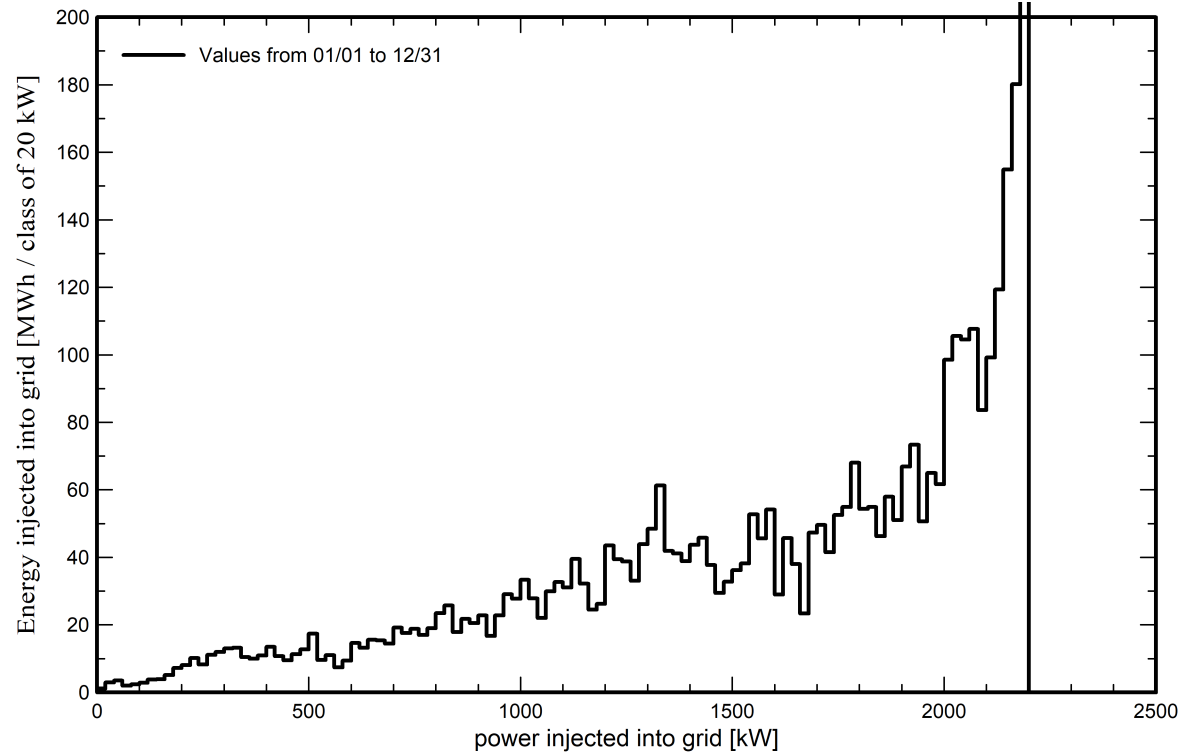
Single-line diagram

18 x HT78-18X-580 Bifacial
245 Strings

Inverter (2200 kVA)

Injection point
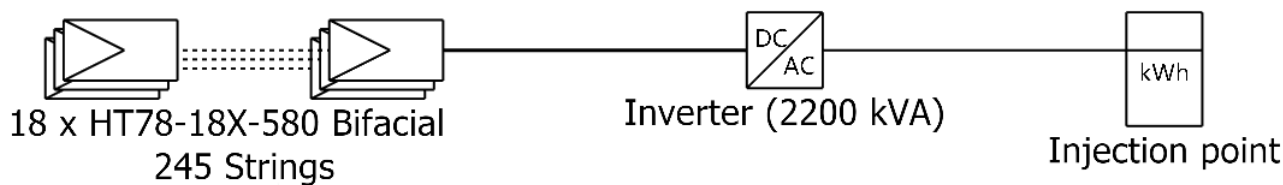
PV module	HT78-18X-580 Bifacial
Inverter	Sunny Central 2200
String	18 x HT78-18X-580 Bifacial

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VC2 : SAT Alb060 (bifi)	12/28/23