Grid-Connected System: Simulation parameters

Project :   **Subarray System, Germany**

Geographical Site	**Subarray System, Munich**	Country	**Germany**

Situation

	Latitude	48.21° N	Longitude	11.43° E
Time defined as	Legal Time	Time zone UT+1	Altitude	496 m
	Albedo	0.20		

Meteo data: **Subarray System, Munich**   Meteonorm 7.2 (1996-2015), Sat=55% - Synthetic

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Simulation variant :   **Subarray System**

	Simulation date	30/04/22 02h36

Simulation parameters	System type	**No 3D scene defined, no shadings**		
3 orientations	tilts/azimuths	15°/90°, 15°/-90°, 10°/0°		
Models used	Transposition	Perez	Diffuse	Perez, Meteonorm
Horizon	Free Horizon			
Near Shadings	No Shadings			
User's needs :	Unlimited load (grid)			

PV Arrays Characteristics   **(3 kinds of array defined)**

PV module	Si-mono	Model	**REC 360TP2S 72M**		
Original PVsyst database		Manufacturer	REC		

Sub-array "West array #1"	Orientation	#1	Tilt/Azimuth	15°/90°
Number of PV modules	In series	18 modules	In parallel	14 strings
Total number of PV modules	Nb. modules	252	Unit Nom. Power	360 Wp
Array global power	Nominal (STC)	**90.7 kWp**	At operating cond.	83.1 kWp (50°C)
Array operating characteristics (50°C)	U mpp	625 V	I mpp	133 A

Sub-array "East array #2"	Orientation	#2	Tilt/Azimuth	15°/-90°
Number of PV modules	In series	19 modules	In parallel	17 strings
Total number of PV modules	Nb. modules	323	Unit Nom. Power	360 Wp
Array global power	Nominal (STC)	**116 kWp**	At operating cond.	107 kWp (50°C)
Array operating characteristics (50°C)	U mpp	659 V	I mpp	162 A

Sub-array "South array #3"	Orientation	#3	Tilt/Azimuth	10°/0°
Number of PV modules	In series	18 modules	In parallel	9 strings
Total number of PV modules	Nb. modules	162	Unit Nom. Power	360 Wp
Array global power	Nominal (STC)	**58.3 kWp**	At operating cond.	53.5 kWp (50°C)
Array operating characteristics (50°C)	U mpp	625 V	I mpp	86 A

Total Arrays global power	Nominal (STC)	**265 kWp**	Total	737 modules
	Module area	**1479 m²**	Cell area	1297 m²

Sub-array "West array #1" : Inverter	Model	**SG30KTL-M**		
Original PVsyst database	Manufacturer	Sungrow		
Characteristics	Operating Voltage	280-950 V	Unit Nom. Power	30.0 kWac
Inverter pack	Nb. of inverters	3 units	Total Power	90 kWac
			Pnom ratio	1.01

Sub-array "East array #2" : Inverter	Model	**TRIO-TM-60_0-480**		
Original PVsyst database	Manufacturer	ABB		
Characteristics	Operating Voltage	360-950 V	Unit Nom. Power	60.0 kWac
Inverter pack	Nb. of inverters	2 units	Total Power	120 kWac
			Pnom ratio	0.97

Grid-Connected System: Simulation parameters

Sub-array "South array #3" : Inverter   Model   **TRIO-27.6-TL-OUTD-400**
   Original PVsyst database   Manufacturer   ABB
Characteristics   Operating Voltage   200-950 V   Unit Nom. Power   30.0 kWac
Inverter pack   Nb. of inverters   2 units   Total Power   60 kWac
                                                       Pnom ratio   0.97

Total   Nb. of inverters   7   Total Power   270 kWac

PV Array loss factors

Array Soiling Losses   Loss Fraction   2.0 %
Thermal Loss factor   Uc (const)   15.0 W/m²K   Uv (wind)   0.0 W/m²K / m/s
Wiring Ohmic Loss   Array#1   78 mOhm   Loss Fraction   1.5 % at STC
                                 Array#2   67 mOhm   Loss Fraction   1.5 % at STC
                                 Array#3   121 mOhm   Loss Fraction   1.5 % at STC
                                 Global   Loss Fraction   1.5 % at STC
LID - Light Induced Degradation   Loss Fraction   2.0 %
Module Quality Loss   Loss Fraction   -0.3 %
Module Mismatch Losses   Loss Fraction   1.0 % at MPP
Strings Mismatch loss   Loss Fraction   0.10 %
Incidence effect (IAM): User defined profile

0°	30°	45°	60°	70°	75°	80°	85°	90°
1.000	1.000	1.000	0.974	0.907	0.832	0.688	0.445	0.000

System loss factors

                     Wires: 3x240.0 mm²   149 m   Loss Fraction   1.9 % at STC
Unavailability of the system   1.8 days, 3 periods   Time fraction   0.5 %

Grid-Connected System: Main results

Project : **Subarray System, Germany**

Simulation variant : **Subarray System**

Main system parameters

System type	**No 3D scene defined, no shadings**		
PV Field Orientation	3 orientations	Tilt/Azimuth = 15°/90°, 15°/-90°, 10°/0°	
PV modules	Model	REC 360TP2S 72M	Pnom	360 Wp
PV Array	Nb. of modules	737	Pnom total	**265 kWp**
Inverter	Model	SG30KTL-M	Pnom	30.0 kW ac
Inverter	Model	TRIO-TM-60_0-480	Pnom	60.0 kW ac
Inverter	Model	TRIO-27.6-TL-OUTD-400	Pnom	30.0 kW ac
Inverter pack	Nb. of units	7.0	Pnom total	**270 kW ac**
User's needs	Unlimited load (grid)		

Main simulation results

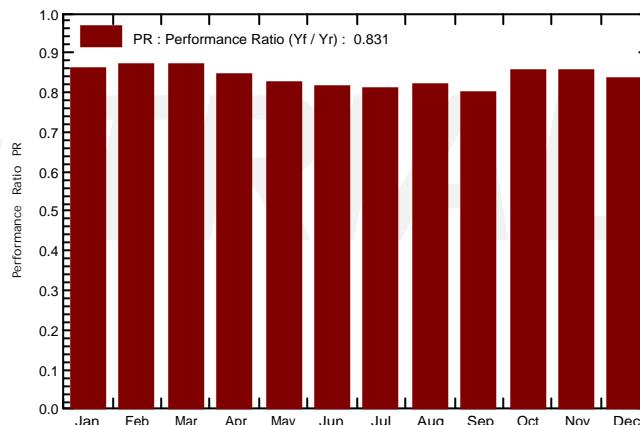|				
System Production	**Produced Energy**	**261.3 MWh/year**	Specific prod.	985 kWh/kWp/year
	Performance Ratio PR	83.12 %		

Normalized productions (per installed kWp): Nominal power 265 kWp

Lc : Collection Loss (PV-array losses)   0.45 kWh/kWp/day
Ls : System Loss (inverter, ...)   0.09 kWh/kWp/day
Yf : Produced useful energy (inverter output)   2.7 kWh/kWp/day

Performance Ratio PR

PR : Performance Ratio (Yf / Yr) : 0.831
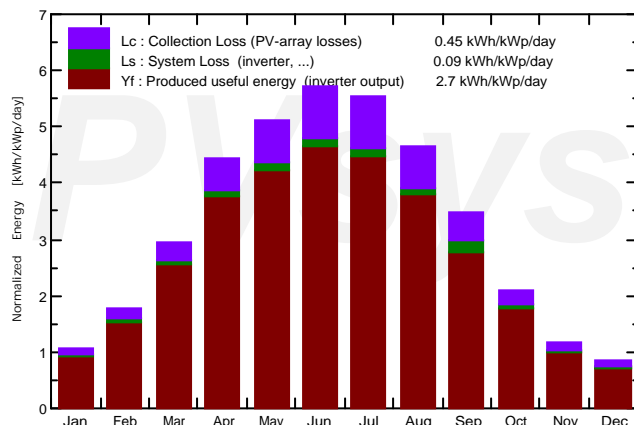
Subarray System
Balances and main results

	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_Grid	PR
	kWh/m²	kWh/m²	°C	kWh/m²	kWh/m²	MWh	MWh	
January	32.4	17.73	-0.72	33.9	31.2	8.04	7.77	0.863
February	48.2	25.84	0.96	49.8	46.6	11.98	11.51	0.871
March	90.1	43.37	4.57	91.6	87.0	21.78	21.19	0.872
April	131.9	56.49	9.20	132.7	126.7	30.72	29.88	0.849
May	159.4	77.11	14.14	158.4	151.5	35.79	34.80	0.828
June	172.7	82.46	17.24	171.4	163.8	38.19	37.12	0.816
July	172.1	72.93	18.52	171.2	163.8	37.86	36.77	0.810
August	144.2	73.87	18.26	144.2	137.6	32.26	31.38	0.820
September	102.8	51.21	13.34	104.0	98.9	23.87	22.03	0.798
October	63.3	36.32	9.55	64.8	61.1	15.12	14.71	0.856
November	34.5	20.18	3.98	35.7	33.2	8.38	8.11	0.857
December	25.9	15.94	0.29	27.3	24.9	6.39	6.07	0.838
Year	1177.7	573.43	9.16	1185.0	1126.2	270.39	261.34	0.831

Legends:	GlobHor	Horizontal global irradiation	GlobEff	Effective Global, corr. for IAM and shadings
	DiffHor	Horizontal diffuse irradiation	EArray	Effective energy at the output of the array
	T_Amb	T amb.	E_Grid	Energy injected into grid
	GlobInc	Global incident in coll. plane	PR	Performance Ratio

Grid-Connected System: Special graphs

Project : **Subarray System, Germany**

Simulation variant : **Subarray System**

Main system parameters		
	System type	**No 3D scene defined, no shadings**
PV Field Orientation	3 orientations	Tilt/Azimuth = 15°/90°, 15°/-90°, 10°/0°
PV modules	Model	REC 360TP2S 72M Pnom 360 Wp
PV Array	Nb. of modules 737	Pnom total **265 kWp**
Inverter	Model	SG30KTL-M Pnom 30.0 kW ac
Inverter	Model	TRIO-TM-60_0-480 Pnom 60.0 kW ac
Inverter	Model	TRIO-27.6-TL-OUTD-400 Pnom 30.0 kW ac
Inverter pack	Nb. of units 7.0	Pnom total **270 kW ac**
User's needs	Unlimited load (grid)	

Daily Input/Output diagram
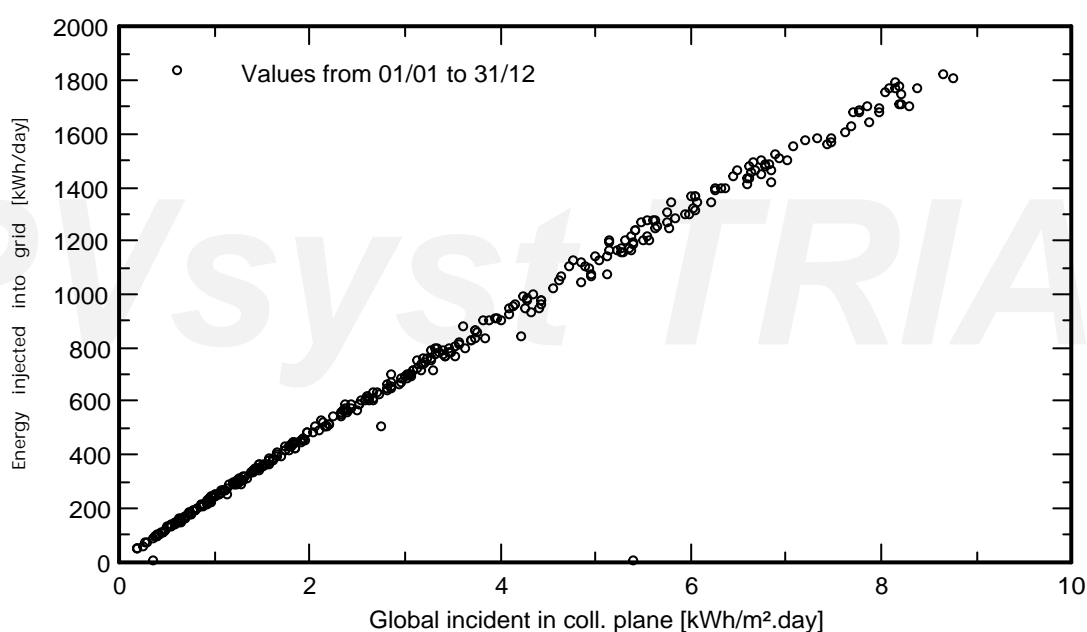
System Output Power Distribution

PVsyst Evaluation mode
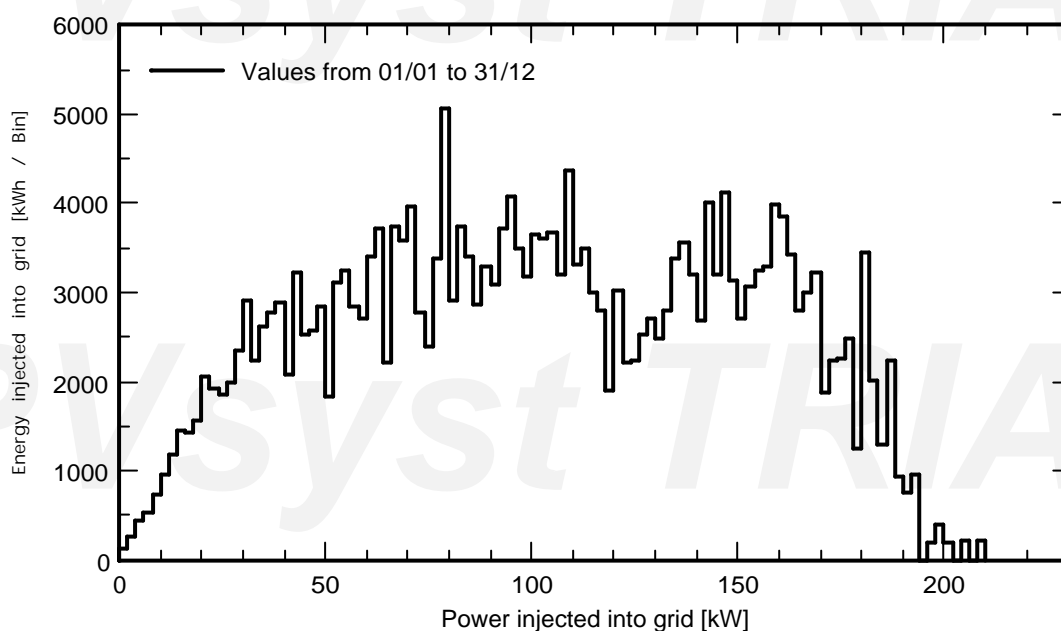
Grid-Connected System: Loss diagram

Project : **Subarray System, Germany**

Simulation variant : **Subarray System**

Main system parameters		System type	**No 3D scene defined, no shadings**		
PV Field Orientation		3 orientations	Tilt/Azimuth = 15°/90°, 15°/-90°, 10°/0°		
PV modules		Model	REC 360TP2S 72M	Pnom	360 Wp
PV Array		Nb. of modules 737		Pnom total	**265 kWp**
Inverter		Model	SG30KTL-M	Pnom	30.0 kW ac
Inverter		Model	TRIO-TM-60_0-480	Pnom	60.0 kW ac
Inverter		Model	TRIO-27.6-TL-OUTD-400	Pnom	30.0 kW ac
Inverter pack		Nb. of units 7.0		Pnom total	**270 kW ac**
User's needs		Unlimited load (grid)			

Loss diagram over the whole year

1178 kWh/m²	**Horizontal global irradiation**
+0.6%	**Global incident in coll. plane**
-0.09%	Global incident below threshold
-3.02%	IAM factor on global
-2.00%	Soiling loss factor
1126 kWh/m² * 1479 m² coll.	**Effective irradiation on collectors**
efficiency at STC = 18.12%	PV conversion
301.8 MWh	**Array nominal energy (at STC effic.)**
-1.71%	PV loss due to irradiance level
-5.56%	PV loss due to temperature
+0.35%	Module quality loss
-2.00%	LID - Light induced degradation
-1.10%	Mismatch loss, modules and strings
-0.77%	Ohmic wiring loss
270.4 MWh	**Array virtual energy at MPP**
-2.06%	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
-0.02%	Inverter Loss due to power threshold
0.00%	Inverter Loss due to voltage threshold
264.8 MWh	**Available Energy at Inverter Output**
-0.54%	System unavailability
-0.76%	AC ohmic loss
261.3 MWh	**Energy injected into grid**