Grid-Connected System: Simulation parameters

Project : **Eindhoven**

Geographical Site	**Eindhoven**		Country	**Netherlands**
Situation	Latitude	51.44° N	Longitude	5.48° E
Time defined as	Legal Time	Time zone UT+1	Altitude	14 m
	Albedo	0.20		
Meteo data:	**Eindhoven**	Meteonorm 7.3 (1986-2005), Sat=100% - Synthetic		

Simulation variant : **New simulation variant**

	Simulation date	29/06/20 21h07		
Simulation parameters	System type	**No 3D scene defined, no shadings**		
Collector Plane Orientation	Tilt	35°	Azimuth	0°
Models used	Transposition	Perez	Diffuse Circumsolar	Perez, Meteonorm separate
Horizon	Free Horizon			
Near Shadings	No Shadings			
User's needs :	Unlimited load (grid)			

PV Array Characteristics

PV module	Si-poly	Model	**TSM-320PEG14**		
Original PVsyst database		Manufacturer	Trina Solar		
Number of PV modules		In series	19 modules	In parallel	4 strings
Total number of PV modules		nb. modules	76	Unit Nom. Power	320 Wp
Array global power		Nominal (STC)	**24.32 kWp**	At operating cond.	21.82 kWp (50°C)
Array operating characteristics (50°C)		U mpp	633 V	I mpp	34 A
Total area		Module area	**149 m²**	Cell area	133 m²
Inverter		Model	**Sunny Tripower 25000TL-30**		
Original PVsyst database		Manufacturer	SMA		
Characteristics		Unit Nom. Power	**25.0 kWac**	Oper. Voltage	390-800 V
Inverter pack		Total power	**25 kWac**	Pnom ratio	0.97
		Nb. of inverters	1 units		
Total		Total power	**25 kWac**	Pnom ratio	0.97

PV Array loss factors

Thermal Loss factor	Uc (const)	20.0 W/m²K	Uv (wind)	0.0 W/m²K / m/s
Wiring Ohmic Loss	Global array res.	310 mΩ	Loss Fraction	1.5 % at STC
Module Quality Loss			Loss Fraction	-0.4 %
Module mismatch losses			Loss Fraction	1.0 % at MPP
Strings Mismatch loss			Loss Fraction	0.10 %
Incidence effect, ASHRAE parametrization	IAM =	1 - bo (1/cos i - 1)	bo Param.	0.05

Grid-Connected System: Main results

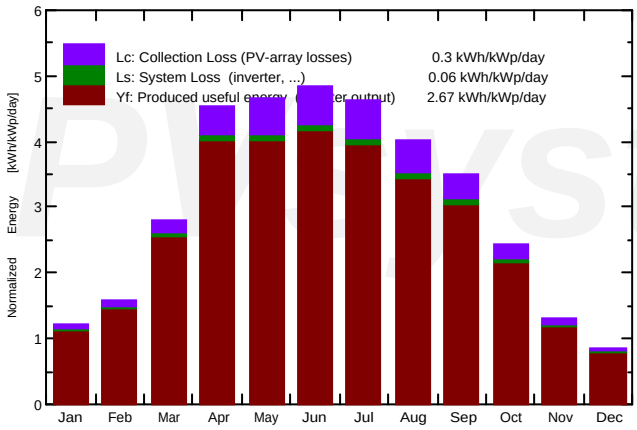
Project : **Eindhoven**

Simulation variant : **New simulation variant**

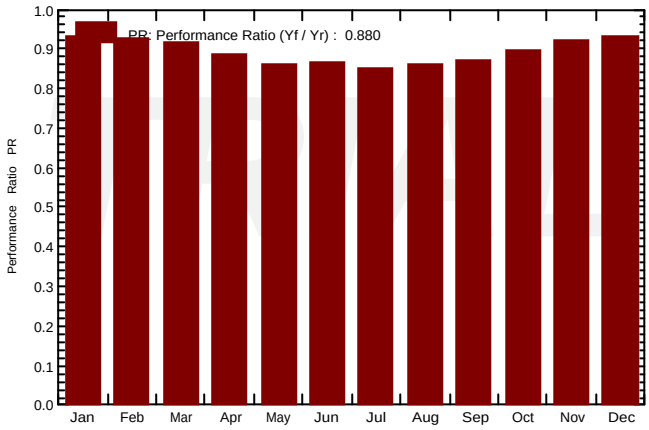
Main system parameters				
System type		**No 3D scene defined, no shadings**		
PV Field Orientation	tilt	35°	azimuth	0°
PV modules	Model	TSM-320PEG14	Pnom	320 Wp
PV Array	Nb. of modules	76	Pnom total	**24.32 kWp**
Inverter	Model	Sunny Tripower 25000TL-30		25.00 kW ac
User's needs	Unlimited load (grid)			

Main simulation results				
System Production	**Produced Energy**	**23.73 MWh/year**	Specific prod.	976 kWh/kWp/year
	Performance Ratio PR	87.99 %		
Investment	Global	0.00 EUR	Specific	0.00 EUR/Wp
Yearly cost	Annuities	0.00 EUR/yr	Running Costs	0.00 EUR/yr
LCOE		**0.00 EUR/kWh**	Payback period	**Unprofitable**

Normalized productions (per installed kWp): Nominal power 24.32 kWp



Performance Ratio PR



New simulation variant

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	21.6	14.71	3.59	38.0	36.9	0.884	0.859	0.931
February	29.5	18.82	4.26	44.5	43.3	1.029	1.001	0.925
March	69.1	45.24	6.40	86.9	84.5	1.986	1.942	0.919
April	118.7	63.90	10.17	136.0	131.2	2.994	2.932	0.887
May	141.2	73.73	14.35	144.6	139.0	3.097	3.030	0.861
June	148.9	90.92	16.79	144.9	139.7	3.110	3.044	0.864
July	146.5	77.42	18.61	143.7	138.1	3.043	2.977	0.852
August	117.4	70.75	18.23	124.4	120.3	2.661	2.604	0.861
September	85.6	48.20	14.81	105.2	101.7	2.278	2.228	0.871
October	53.5	32.50	11.25	75.3	73.2	1.675	1.637	0.894
November	24.5	17.48	7.16	39.4	38.2	0.905	0.881	0.920
December	15.6	12.15	3.36	26.5	25.7	0.619	0.598	0.930
Year	972.1	565.81	10.78	1109.1	1072.0	24.282	23.734	0.880

Legends:

GlobHor	Global horizontal 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 : **Eindhoven**

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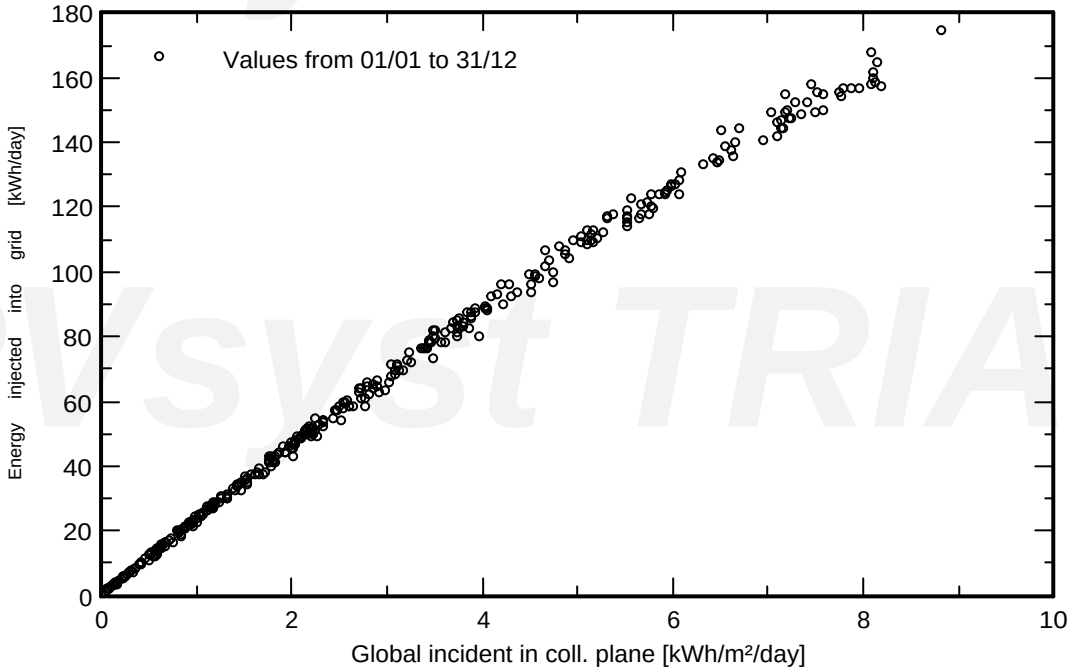
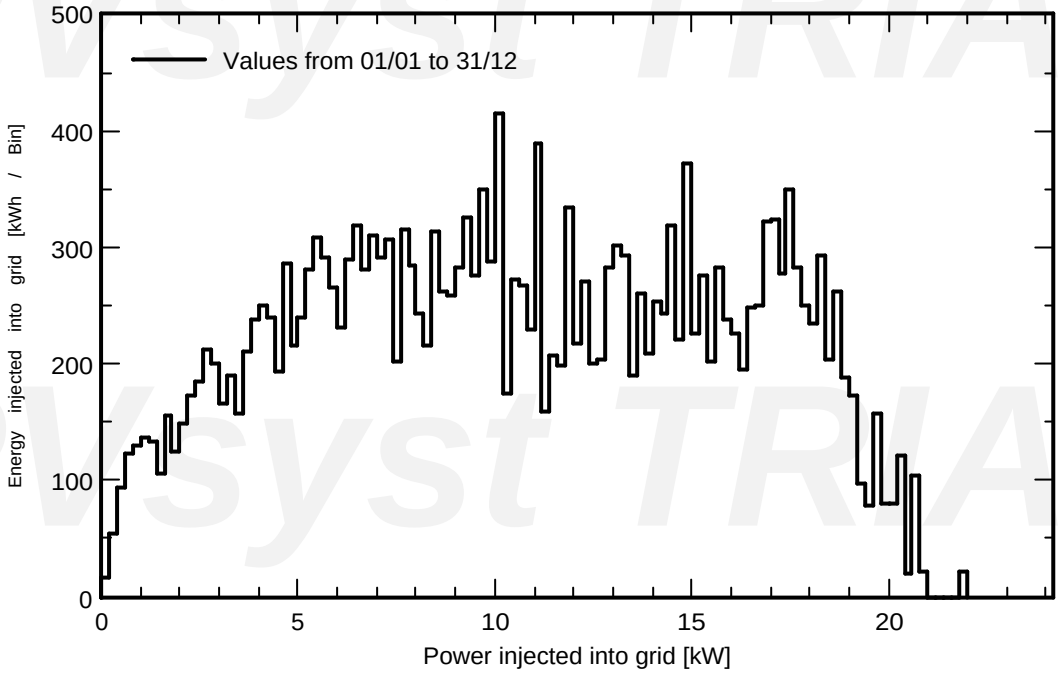
Daily Input/Output diagram



System Output Power Distribution



Grid-Connected System: Loss diagram

Project : **Eindhoven**

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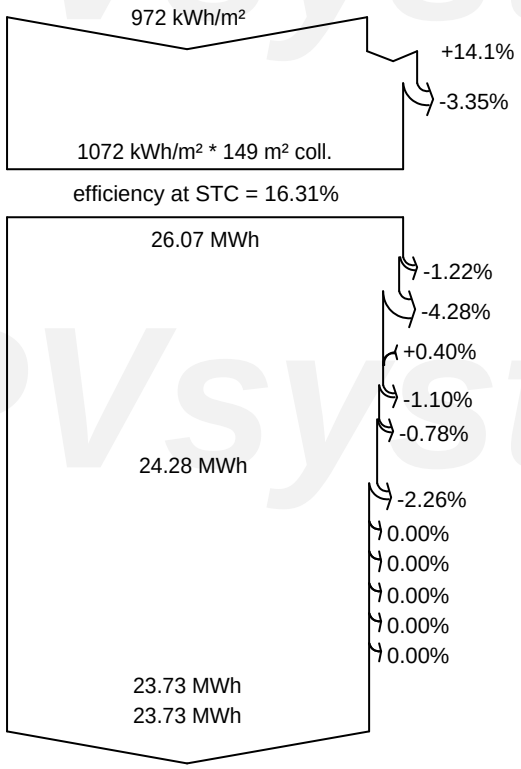
User's needs	Unlimited load (grid)			

Loss diagram over the whole year



Global horizontal irradiation
Global incident in coll. plane
IAM factor on global
Effective irradiation on collectors
PV conversion
Array nominal energy (at STC effic.)
PV loss due to irradiance level
PV loss due to temperature
Module quality loss
Mismatch loss, modules and strings
Ohmic wiring loss
Array virtual energy at MPP
Inverter Loss during operation (efficiency)
Inverter Loss over nominal inv. power
Inverter Loss due to max. input current
Inverter Loss over nominal inv. voltage
Inverter Loss due to power threshold
Inverter Loss due to voltage threshold
Available Energy at Inverter Output
Energy injected into grid

Grid-Connected System: Cost of the system

Project : **Eindhoven**

Simulation variant : **New simulation variant**

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User's needs	Unlimited load (grid)			

Installation costs

Total	**0.00 EUR**
Depreciable asset	0.00 EUR

Operating costs

Total (OPEX)	**0.00 EUR/year**

System summary

Total installation cost	**0.00 EUR**
Operating costs	**0.00 EUR/year**
Produced Energy	**23.7 MWh/year**
Cost of produced energy (LCOE)	**0.000 EUR/kWh**

Grid-Connected System: CO2 Balance

Project : **Eindhoven**

Simulation variant : **New simulation variant**

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Inverter	Model	Sunny Tripower 25000TL-30		25.00 kW ac
User's needs	Unlimited load (grid)			

Generated emissions **Total:** **43.81 tCO_2**
Source: Detailed calculation from table below:

Replaced Emissions **Total:** **302.6 tCO_2**
System production: 23.73 MWh/yr Lifetime: 30 years
Annual degradation: 1.0%
Grid Lifecycle Emissions: 425 gCO_2/kWh
Source: IEA List Country: Netherlands

CO_2 Emission Balance **Total:** **218.8 tCO_2**

System Lifecycle Emissions Details:

Item	Modules	Supports
LCE	1713 kgCO2/kWp	2.83 kgCO2/kg
Quantity	24.3 kWp	760 kg
Subtotal [$kgCO_2$]	41653	2154

Saved CO_2 Emission vs. Time