Grid-Connected System: Simulation parameters

Project : **BartelCSG**

Geographical Site	**Bartel**		Country	**United States**
Situation	Latitude	44.05° N	Longitude	-92.66° W
Time defined as	Legal Time	Time zone UT-6	Altitude	356 m
	Albedo	0.20		
Meteo data:	**Bartel**	NREL NSRDB Typ. Met. Year PSMv3 - TMY		

Simulation variant : **Fixed tilt, 1MWac, 208 String, For Construction**

Simulation date 30/10/19 18h05

Simulation parameters	System type	**Sheds on ground**		
Collector Plane Orientation	Tilt	30°	Azimuth	0°
Sheds configuration	Nb. of sheds	39	Identical arrays	
	Sheds spacing	7.01 m	Collector width	4.04 m
Shading limit angle	Limit profile angle	29.9°	Ground cov. Ratio (GCR)	57.6 %
Models used	Transposition	Perez	Diffuse	Imported DNI
Horizon	Free Horizon			
Near Shadings	According to strings		Electrical effect	100 %
User's needs :	Unlimited load (grid)			
Grid power limitation	Active Power	1000 kW	Pnom ratio	1.385
Power factor	Cos(phi)	0.960 lagging	Phi	-16.3°

PV Array Characteristics

PV module	Si-mono Model	**Mono Perc WSM-370**		
Custom parameters definition	Manufacturer	Waaree		
Number of PV modules	In series	18 modules	In parallel	208 strings
Total number of PV modules	Nb. modules	3744	Unit Nom. Power	370 Wp
Array global power	Nominal (STC)	**1385 kWp**	At operating cond.	1277 kWp (50°C)
Array operating characteristics (50°C)	U mpp	659 V	I mpp	1938 A
Total area	Module area	**7265 m²**		
Inverter	Model	**CPS SCA50KTL-DO/US-480 V2.0**		
Custom parameters definition	Manufacturer	Chint Power Systems		
Characteristics	Operating Voltage	200-850 V	Unit Nom. Power	50.0 kWac
Inverter pack	Nb. of inverters	20 units	Total Power	1000 kWac
			Pnom ratio	1.39

PV Array loss factors

Array Soiling Losses			Loss Fraction	3.0 %
Thermal Loss factor	Uc (const)	29.0 W/m²K	Uv (wind)	0.0 W/m²K / m/s
Wiring Ohmic Loss	Global array res.	3.5 mOhm	Loss Fraction	0.9 % at STC
LID - Light Induced Degradation			Loss Fraction	2.0 %
Module Quality Loss			Loss Fraction	0.0 %
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

This PVsyst report is a preliminary estimate of energy production.
Westwood does not guarantee the accuracy of the weather data, loss parameters, or energy production.

Grid-Connected System: Simulation parameters

System loss factors

Wiring Ohmic Loss	Wires: 3x1200.0 mm²	135 m	Loss Fraction	1.3 % at STC

Grid-Connected System: Near shading definition

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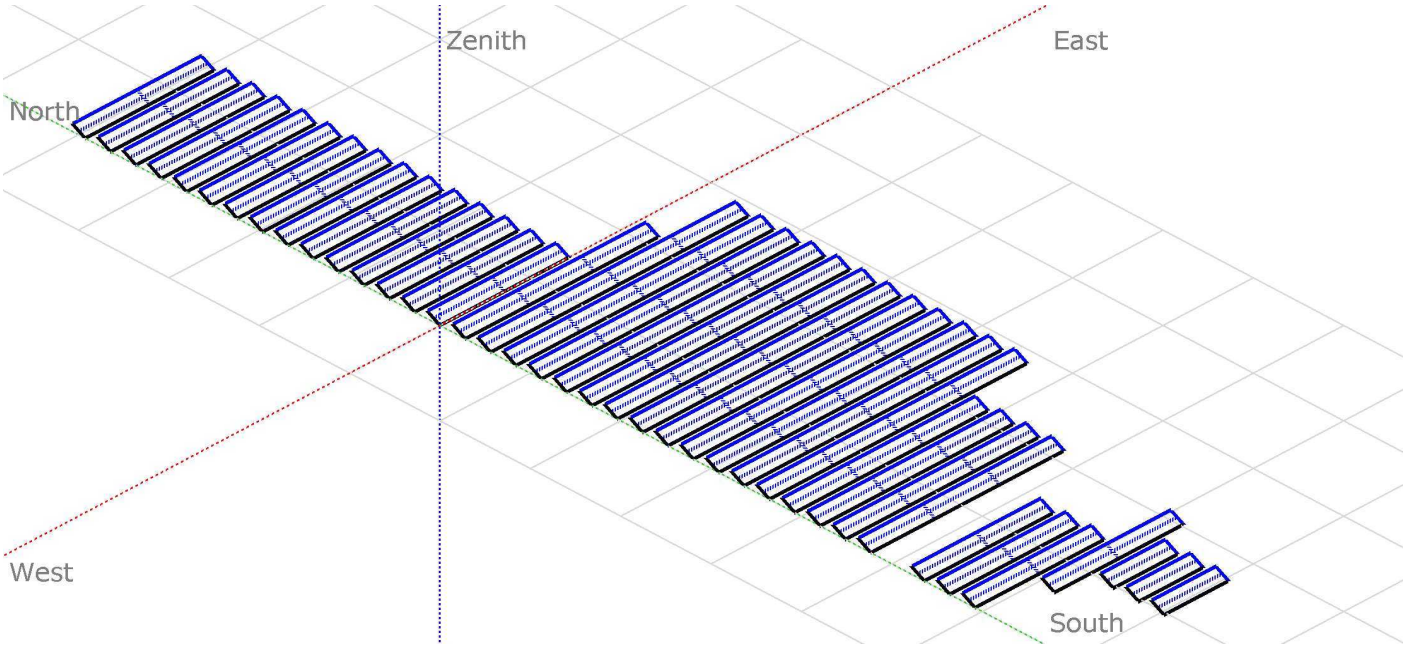
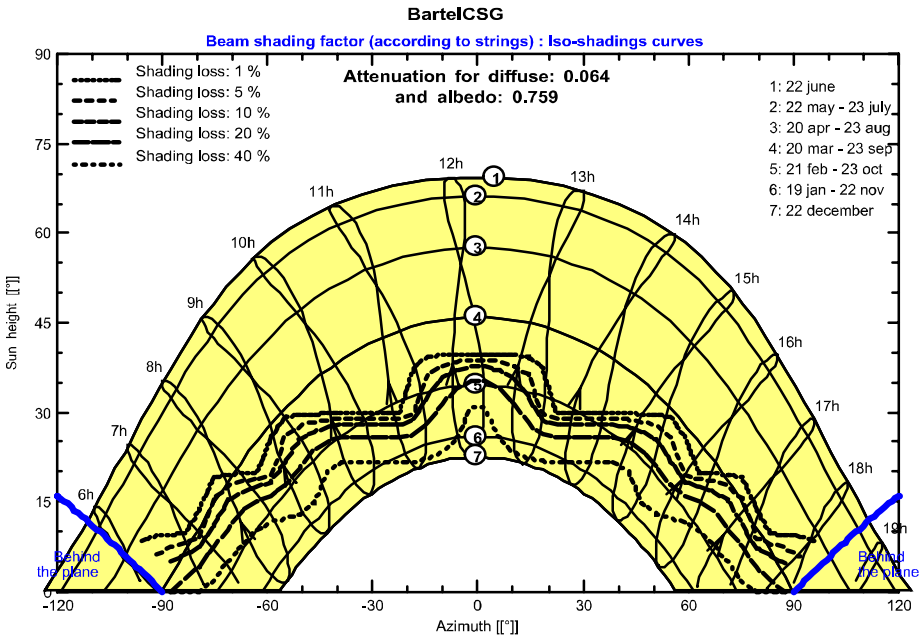
PV Array	Nb. of modules	3744	Pnom total	**1385 kWp**
Inverter	Model	CPS SCA50KTL-DO/US-480 V2.0		50.0 kW ac
Inverter pack	Nb. of units	20.0	Pnom total	**1000 kW ac**
User's needs	Unlimited load (grid)		Cos(Phi)	0.960 lagging

Perspective of the PV-field and surrounding shading scene



Iso-shadings diagram



Grid-Connected System: Main results

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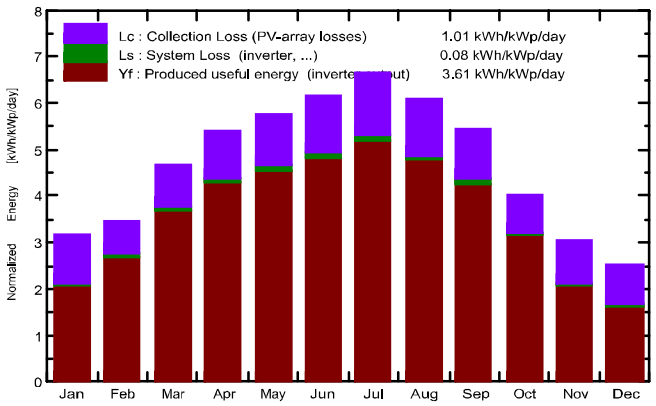
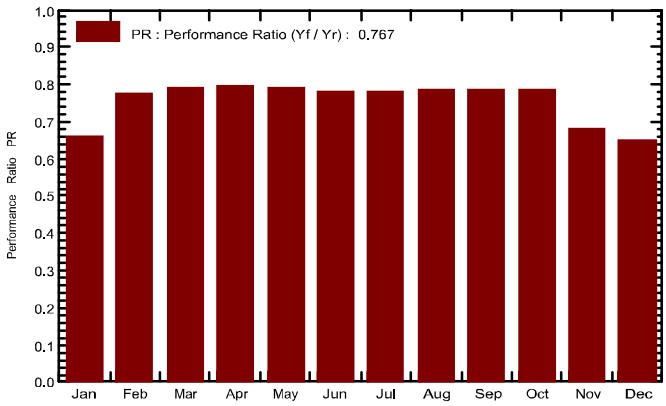
Main simulation results

System Production	**Produced Energy**	**1823 MWh/year**	Specific prod.	1316 kWh/kWp/year
	Apparent energy	1899 MVAh	Perf. Ratio PR	76.69 %

Normalized productions (per installed kWp): Nominal power 1385 kWp



Performance Ratio PR



Fixed tilt, 1MWac, 208 String, For Construction

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
January	54.7	21.83	-10.11	97.8	79.3	91.1	89.2	0.658
February	67.1	30.86	-11.11	97.0	86.2	106.7	104.4	0.776
March	114.5	48.40	-3.21	145.3	132.5	162.7	159.0	0.790
April	145.7	63.33	7.94	162.0	147.6	182.1	178.0	0.793
May	176.3	69.92	12.20	178.5	162.5	199.8	195.3	0.790
June	191.4	68.83	16.73	185.2	168.6	205.5	200.8	0.783
July	208.1	70.97	20.66	206.2	187.9	228.1	222.9	0.780
August	174.4	62.78	20.58	187.9	171.7	209.7	204.9	0.787
September	131.2	42.80	17.49	162.6	149.4	181.5	177.4	0.788
October	86.3	32.50	7.56	124.2	112.1	138.4	135.4	0.787
November	54.3	21.61	3.73	91.5	77.7	87.7	85.8	0.677
December	43.6	21.04	-13.27	77.7	60.8	71.3	69.9	0.649
Year	1447.6	554.86	5.84	1715.9	1536.3	1864.7	1822.9	0.767

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

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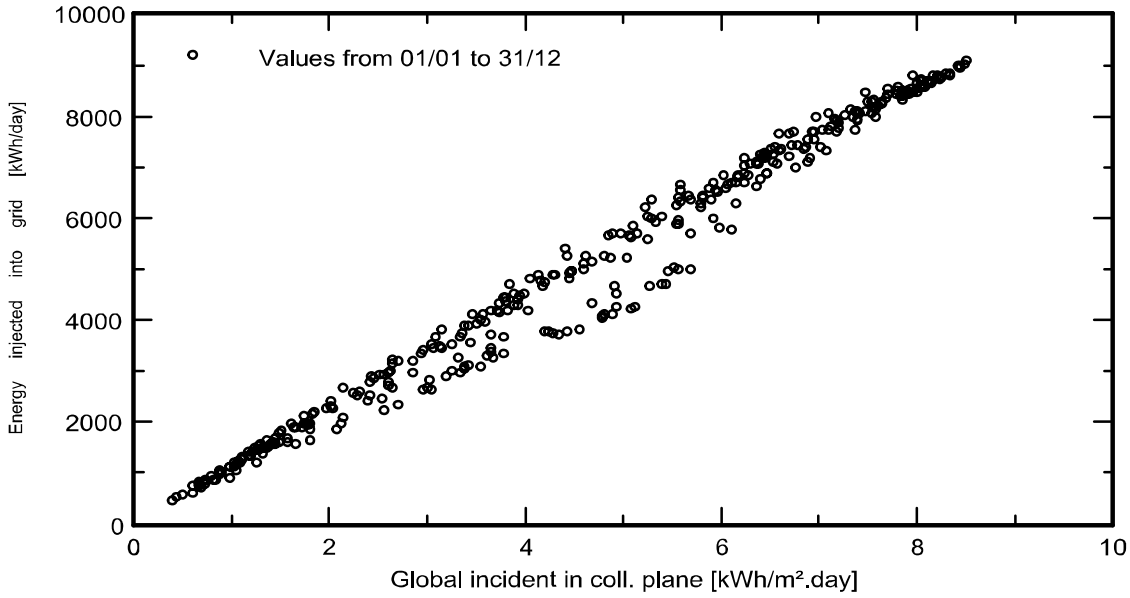
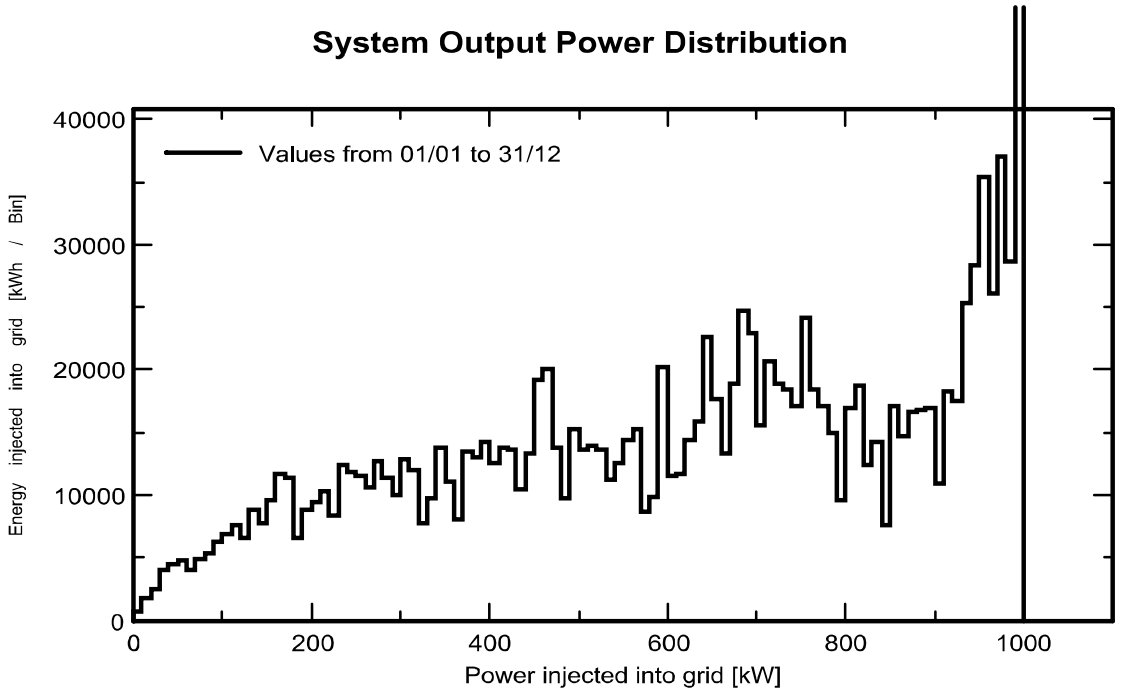
Daily Input/Output diagram



System Output Power Distribution



Grid-Connected System: Loss diagram

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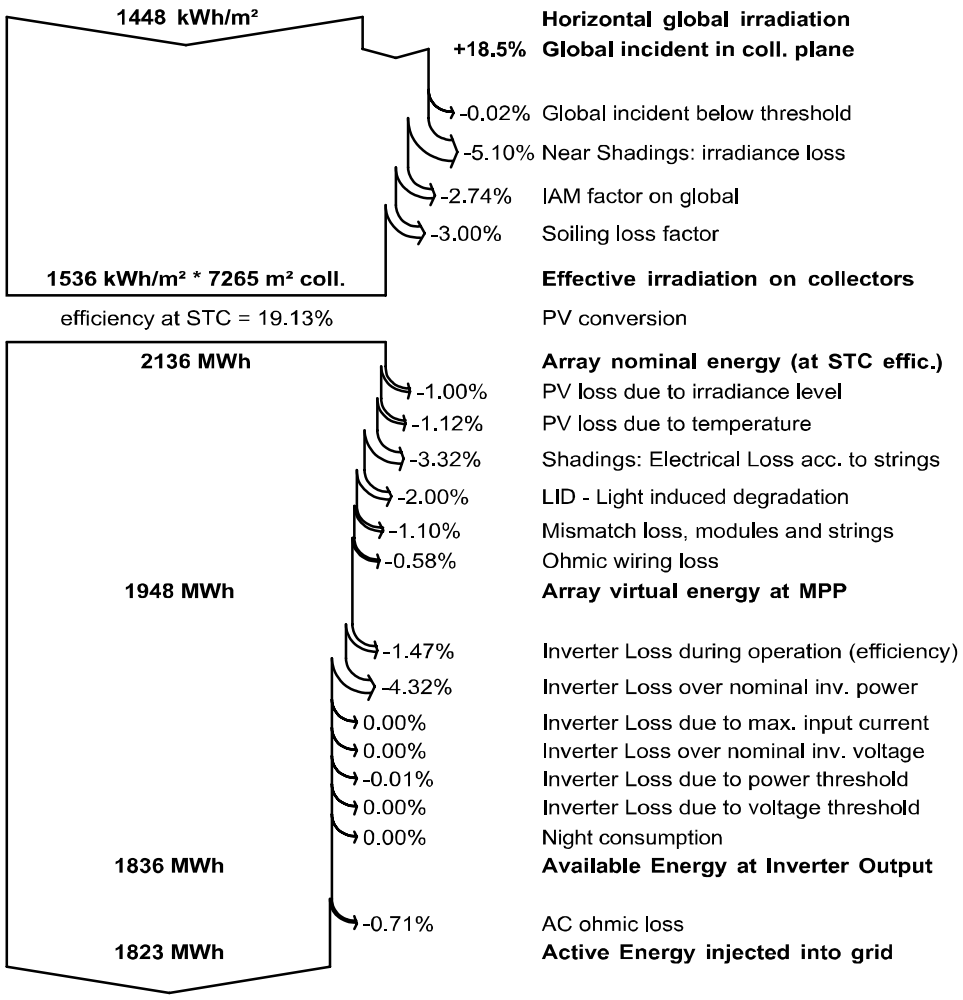
User's needs	Unlimited load (grid)		Cos(Phi)	0.960 lagging

Loss diagram over the whole year



Grid-Connected System: P50 - P90 evaluation

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Evaluation of the Production probability forecast

The probability distribution of the system production forecast for different years is mainly dependent on the meteo data used for the simulation, and depends on the following choices:

Meteo data source		NREL NSRDB Typ. Met. Year PSMv3
Meteo data	Kind	TMY, multi-year
Specified Deviation	Climate change	0.0 %
Year-to-year variability	Variance	4.3 %

The probability distribution variance is also depending on some system parameters uncertainties

Specified Deviation	PV module modelling/parameters	1.0 %	
	Inverter efficiency uncertainty	0.5 %	
	Soiling and mismatch uncertainties	1.0 %	
	Degradation uncertainty	1.0 %	
Global variability (meteo + system)	Variance	4.7 %	(quadratic sum)

Annual production probability	**Variability**	**85 MWh**
	P50	**1823 MWh**
	P90	**1714 MWh**
	P95	**1683 MWh**

Probability distribution