Grid-Connected System: Simulation parameters

Project :	**Pv Beauregard**			
Geographical Site	**Uccle**		**Country**	**Belgium**
Situation	Latitude	50.5°N	Longitude	4.2°E
Time defined as	Legal Time	Time zone UT+1	Altitude	105 m
	Albedo	0.20		
Meteo data :	Uccle , synthetic hourly data			

Simulation variant :	**Simulation variant**			
	Simulation date	23/10/08 19h23		

Simulation parameters

Collector Plane Orientation	Tilt	35°	Azimuth	-36°
Horizon	Average Height	5.0°		
Near Shadings	No Shadings			

PV Array Characteristics

PV module	Si-mono	Model	**SPR-210-BLK**		
		Manufacturer	SunPower		
Number of PV modules		In series	12 modules	In parallel	6 strings
Total number of PV modules		Nb. modules	72	Unit Nom. Power	210 Wp
Array global power		Nominal (STC)	**15 kWp**	At operating cond.	14 kWp (50°C)
Array operating characteristics (50°C)		U mpp	427 V	I mpp	33 A
Total area		Module area	**89.6 m²**		

PV Array loss factors

Heat Loss Factor	ko (const)	29.0 W/m²K	kv (wind)	0.0 W/m²K / m/s
=> Nominal Oper. Coll. Temp. (800 W/m², Tamb=20°C, wind 1 m/s)			NOCT	45 °C
Wiring Ohmic Loss	Global array res.	422.8 mOhm	Loss Fraction	3.0 % at STC
Serie Diode Loss	Voltage Drop	0.7 V	Loss Fraction	0.2 % at STC
Module Quality Loss			Loss Fraction	3.0 %
Module Mismatch Losses			Loss Fraction	2.0 % at MPP
Incidence effect, ASHRAE parametrization	IAM =	1-bo (1/cos i - 1)	bo Parameter	0.05

System Parameter	System type	**Grid-Connected System**		
Inverter	Model	**Sunny Mini Central 5000A**		
	Manufacturer	SMA		
Inverter Characteristics	Operating Voltage	246-480 V	Unit Nom. Power	5 kW AC
Inverter pack	Number of Inverter	2 units	Total Power	10 kW AC

User's needs : Unlimited load (grid)

Grid-Connected System: Horizon definition

Project : **Pv Beauregard**

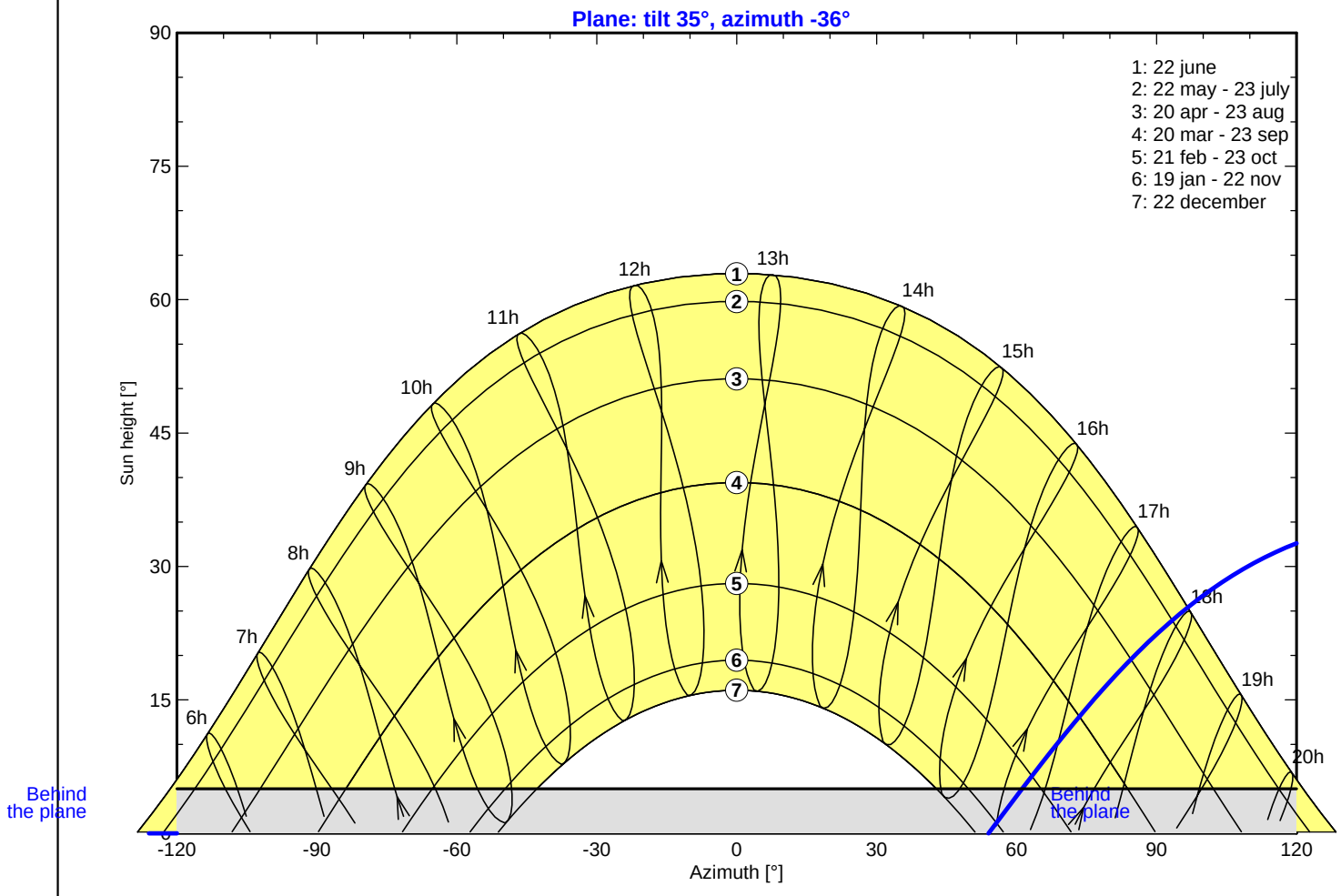
Simulation variant : **Simulation variant**

Main system parameters	System type	**Grid-Connected**		
Horizon	Average Height	5.0°		
PV Field Orientation	tilt	35°	azimuth	-36°
PV modules	Model	SPR-210-BLK	Pnom	210 Wp
PV Array	Nb. of modules	72	Pnom total	**15 kWp**
Inverter	Model	Sunny Mini Central 5000A	Pnom	5.0 kW ac
Inverter pack	Nb. of units	2	Pnom total	**10 kW ac**
User's needs	Unlimited load (grid)			

Horizon	Average Height	5.0°	Diffuse Factor	0.95
	Albedo Factor	92 %	Albedo Fraction	0.69

Height [°]	5.0	5.0	5.0	5.0
Azimuth [°]	-120.0	-40.0	40.0	120.0

Horizon line for Uccle, (Lat. 50.5°N, long. 4.2°E, alt. 105 m)



Grid-Connected System: Main results

Project : **Pv Beauregard**

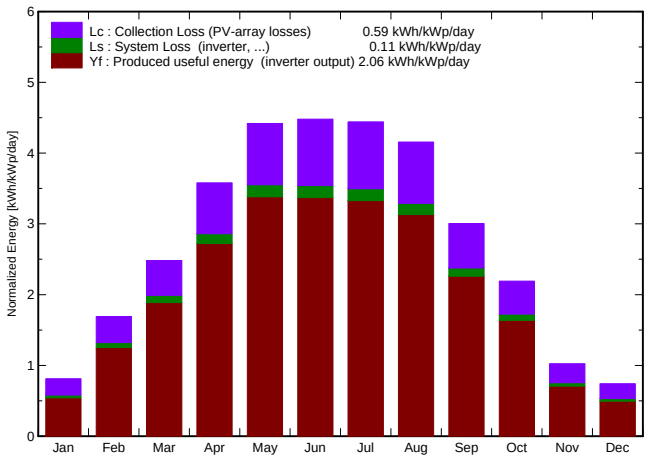
Simulation variant : **Simulation variant**

Main system parameters		System type	**Grid-Connected**		
Horizon		Average Height	5.0°		
PV Field Orientation		tilt	35°	azimuth	-36°
PV modules		Model	SPR-210-BLK	Pnom	210 Wp
PV Array		Nb. of modules	72	Pnom total	**15 kWp**
Inverter		Model	Sunny Mini Central 5000A	Pnom	5.0 kW ac
Inverter pack		Nb. of units	2	Pnom total	**10 kW ac**
User's needs		Unlimited load (grid)			

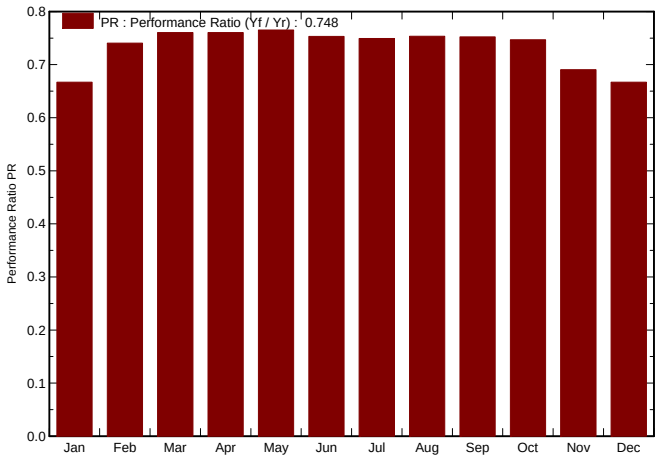
Main simulation results

System Production		**Produced Energy**	**11.39 MWh/year**	Specific	754 kWh/kWp/year
		Performance Ratio PR	74.8 %		
Investment		Global incl. taxes	12100 €	Specific	0.80 €/Wp
Yearly cost		Annuities (Loan 0.0%, 20 years)	605 €/yr	Running Cost	0 €/yr
Energy cost			**0.05 €/kWh**		

Normalized productions (per installed kWp): Nominal power 15 kWp



Performance Ratio PR



Simulation variant

Balances and main results

	GlobHor	T Amb	GlobInc	GlobEff	EArray	EOutInv	EffArrR	EffSysR
	kWh/m²	°C	kWh/m²	kWh/m²	kWh	kWh	%	%
January	20.0	2.50	25.2	23.2	272	254	12.05	11.26
February	36.9	2.99	47.4	44.4	560	530	13.20	12.50
March	66.2	5.71	77.0	72.3	932	885	13.52	12.83
April	102.2	8.55	107.4	100.9	1297	1235	13.49	12.84
May	139.6	12.76	137.0	128.9	1665	1585	13.57	12.92
June	141.0	15.36	134.4	126.1	1607	1530	13.35	12.71
July	142.0	17.36	137.7	129.5	1639	1560	13.29	12.65
August	123.5	17.07	128.9	121.3	1542	1468	13.36	12.72
September	84.2	14.15	90.2	84.4	1078	1025	13.34	12.70
October	53.5	10.40	68.0	63.5	809	767	13.29	12.61
November	24.4	5.87	30.8	28.6	342	321	12.42	11.66
December	15.6	3.57	23.0	21.0	249	232	12.06	11.26
Year	949.2	9.73	1006.7	944.0	11992	11394	13.30	12.63

Legends:

GlobHor	Horizontal global irradiation	EArray	Effective energy at the output of the array
T Amb	Ambient Temperature	EOutInv	Available Energy at Inverter Output
GlobInc	Global incident in coll. plane	EffArrR	Effic. Eout array / rough area
GlobEff	Effective Global, corr. for IAM and shadings	EffSysR	Effic. Eout system / rough area

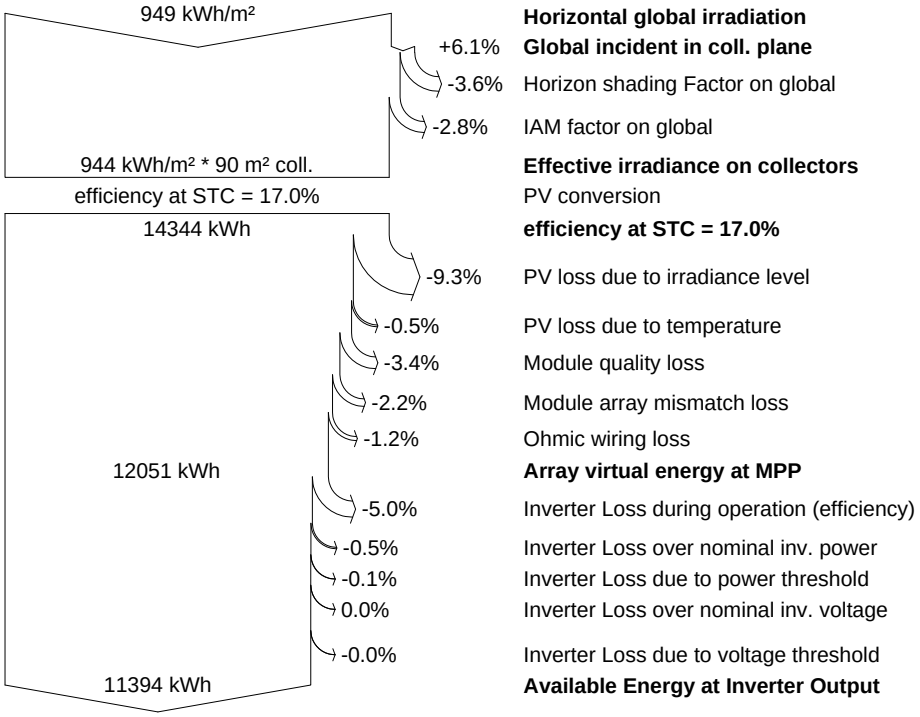
Grid-Connected System: Loss diagram

Project : **Pv Beauregard**

Simulation variant : **Simulation variant**

Main system parameters	System type	**Grid-Connected**		
Horizon	Average Height	5.0°		
PV Field Orientation	tilt	35°	azimuth	-36°
PV modules	Model	SPR-210-BLK	Pnom	210 Wp
PV Array	Nb. of modules	72	Pnom total	**15 kWp**
Inverter	Model	Sunny Mini Central 5000A	Pnom	5.0 kW ac
Inverter pack	Nb. of units	2	Pnom total	**10 kW ac**
User's needs	Unlimited load (grid)			

Loss diagram over the whole year



Grid-Connected System: Economic evaluation

Project : **Pv Beauregard**

Simulation variant : **Simulation variant**

Main system parameters	System type	**Grid-Connected**		
Horizon	Average Height	5.0°		
PV Field Orientation	tilt	35°	azimuth	-36°
PV modules	Model	SPR-210-BLK	Pnom	210 Wp
PV Array	Nb. of modules	72	Pnom total	**15 kWp**
Inverter	Model	Sunny Mini Central 5000A	Pnom	5.0 kW ac
Inverter pack	Nb. of units	2	Pnom total	**10 kW ac**
User's needs	Unlimited load (grid)			

Investment

PV modules (Pnom = 210 Wp)	72 units	0 € / unit	0 €
Supports / Integration		50 € / module	3600 €
Inverters (Pnom = 5.0 kW ac)	2 units	3500 € / unit	7000 €
Settings, wiring, ...			500 €
Substitution underworth			-0 €
Gross investment (without taxes)			**12100 €**

Financing

Gross investment (without taxes)			12100 €
Taxes on investment (VAT)	Rate 0.0 %		0 €
Gross investment (including VAT)			12100 €
Subsidies			-0 €
Net investment (all taxes included)			**12100 €**
Annuities	(Loan 0.0 %	over 20 years)	605 €/year
Annual running costs: maintenance, insurances ...			0 €/year
Total yearly cost			**605 €/year**

Energy cost

Produced Energy	11.4 MWh / year
Cost of produced energy	0.05 € / kWh