

## Grid-Connected System: Simulation parameters

**Project :** **MCV OnGrid System**

<b>Geographical Site</b>	<b>Cairo</b>	<b>Country</b>	<b>Egypt</b>
<b>Situation</b>	Latitude 30.08° N	Longitude	31.28° E
Time defined as	Legal Time Time zone UT+2	Altitude	27 m
	Albedo 0.20		
<b>Meteo data:</b>	<b>Cairo</b>	Meteonorm 7.1 (1981-2009) - Synthetic	

**Simulation variant :** **MCV Warehouse STP330\_ABB**

Simulation date 24/02/19 10h35

<b>Simulation parameters</b>	System type	<b>Sheds on a building</b>	
<b>Collector Plane Orientation</b>	Tilt	6°	Azimuth 162°
<b>Models used</b>	Transposition	Perez	Diffuse Perez, Meteonorm
<b>Horizon</b>	Free Horizon		
<b>Near Shadings</b>	Detailed electrical calculation	(acc. to module layout)	
<b>PV Arrays Characteristics (3 kinds of array defined)</b>			
<b>PV module</b>	Si-poly	Model	<b>STP-330-24/Vfw</b>
Custom parameters definition		Manufacturer	SUNTECH
<b>Sub-array "Sub-array #1"</b>			
Number of PV modules	In series	16 modules	In parallel 52 strings
Total number of PV modules	Nb. modules	832	Unit Nom. Power 330 Wp
Array global power	Nominal (STC)	<b>275 kWp</b>	At operating cond. 251 kWp (50°C)
Array operating characteristics (50°C)	U mpp	544 V	I mpp 462 A
<b>Sub-array "Sub-array #2"</b>			
Number of PV modules	In series	15 modules	In parallel 68 strings
Total number of PV modules	Nb. modules	1020	Unit Nom. Power 330 Wp
Array global power	Nominal (STC)	<b>337 kWp</b>	At operating cond. 308 kWp (50°C)
Array operating characteristics (50°C)	U mpp	510 V	I mpp 604 A
<b>Sub-array "Sub-array #3"</b>			
Number of PV modules	In series	20 modules	In parallel 6 strings
Total number of PV modules	Nb. modules	120	Unit Nom. Power 330 Wp
Array global power	Nominal (STC)	<b>39.6 kWp</b>	At operating cond. 36.2 kWp (50°C)
Array operating characteristics (50°C)	U mpp	680 V	I mpp 53 A
<b>Total</b>	Arrays global power	Nominal (STC)	<b>651 kWp</b>
		Module area	<b>3834 m²</b>
		Total	1972 modules
<b>Sub-array "Sub-array #1" : Inverter</b>			
Original PVsyst database	Model	<b>PVS-100-TL</b>	
Characteristics	Manufacturer	ABB	
Inverter pack	Operating Voltage	360-1000 V	Unit Nom. Power 100 kWac
	Nb. of inverters	13 * MPPT 17 %	Total Power 217 kWac
			Pnom ratio 1.27
<b>Sub-array "Sub-array #2" : Inverter</b>			
Original PVsyst database	Model	<b>PVS-100-TL</b>	
Characteristics	Manufacturer	ABB	
Inverter pack	Operating Voltage	360-1000 V	Unit Nom. Power 100 kWac
	Nb. of inverters	17 * MPPT 17 %	Total Power 283 kWac
			Pnom ratio 1.19

## Grid-Connected System: Simulation parameters

### Sub-array "Sub-array #3" : Inverter

Original PVsyst database	Model	<b>PRO-33.0-TL-OUTD-400</b>		
Characteristics	Manufacturer	ABB		
Inverter pack	Operating Voltage	580-850 V	Unit Nom. Power	33.0 kWac
	Nb. of inverters	1 units	Total Power	33 kWac
			Pnom ratio	1.20

<b>Total</b>	Nb. of inverters	6	Total Power	533 kWac
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### PV Array loss factors

Array Soiling Losses			Loss Fraction	4.0 %
Thermal Loss factor	Uc (const)	20.0 W/m <sup>2</sup> K	Uv (wind)	0.0 W/m <sup>2</sup> K / m/s
Wiring Ohmic Loss	Array#1	13 mOhm	Loss Fraction	1.0 % at STC
	Array#2	9.4 mOhm	Loss Fraction	1.0 % at STC
	Array#3	142 mOhm	Loss Fraction	1.0 % at STC
	Global		Loss Fraction	1.0 % at STC
Serie Diode Loss	Voltage Drop	0.7 V	Loss Fraction	0.1 % at STC
LID - Light Induced Degradation			Loss Fraction	2.0 %
Module Quality Loss			Loss Fraction	3.0 %
Module Mismatch Losses			Loss Fraction	1.0 % at MPP
Strings Mismatch loss			Loss Fraction	4.00 %
Incidence effect, ASHRAE parametrization	IAM =	1 - bo (1/cos i - 1)	bo Param.	0.05

### System loss factors

Wires: 3x300.0 mm <sup>2</sup>	40 m	Loss Fraction	1.0 % at STC
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### User's needs :

Unlimited load (grid)

## Grid-Connected System: Near shading definition

**Project :** MCV OnGrid System  
**Simulation variant :** MCV Warehouse STP330\_ABB

**Main system parameters**

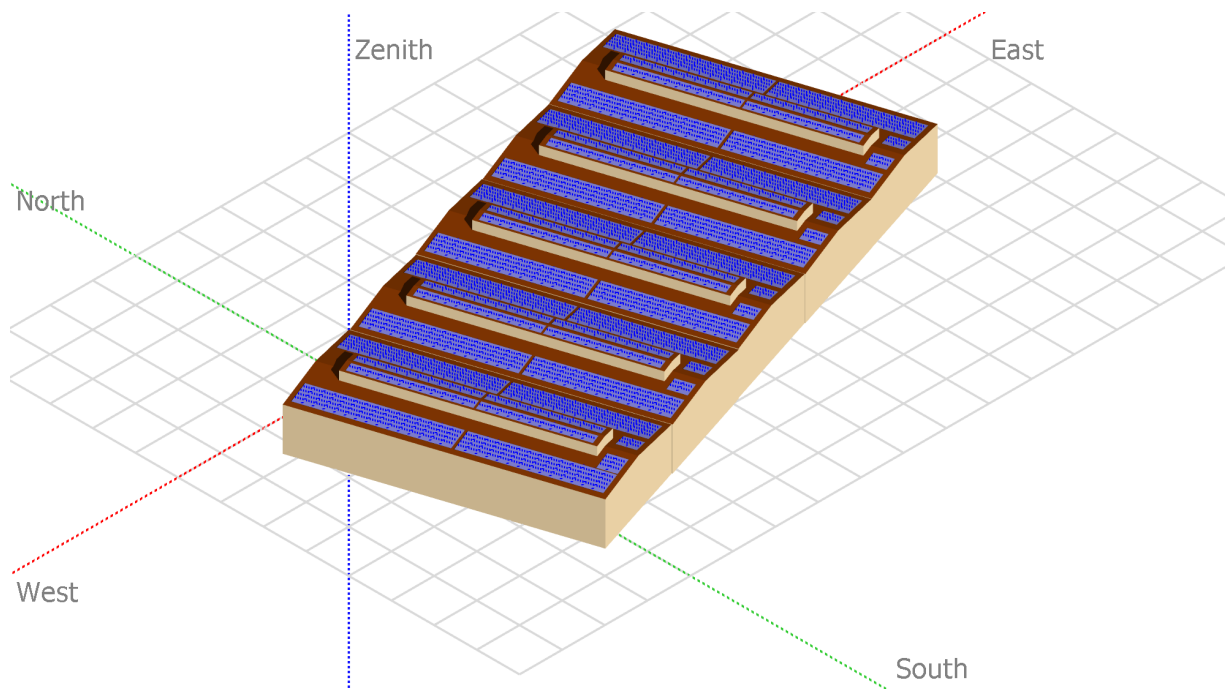
**Near Shadings**

PV Field Orientation  
 PV modules  
 PV Array  
 Inverter  
 Inverter  
 Inverter pack  
 User's needs

**System type Sheds on a building**

Detailed electrical calculation (acc. to module layout)  
 tilt 6° azimuth 162°  
 Model STP-330-24/Vfw Pnom 330 Wp  
 Nb. of modules 1972 Pnom total **651 kWp**  
 Model PVS-100-TL Pnom 100 kW ac  
 Model PRO-33.0-TL-OUTD-400 Pnom 33.0 kW ac  
 Nb. of units 6.0 Pnom total **533 kW ac**  
 Unlimited load (grid)

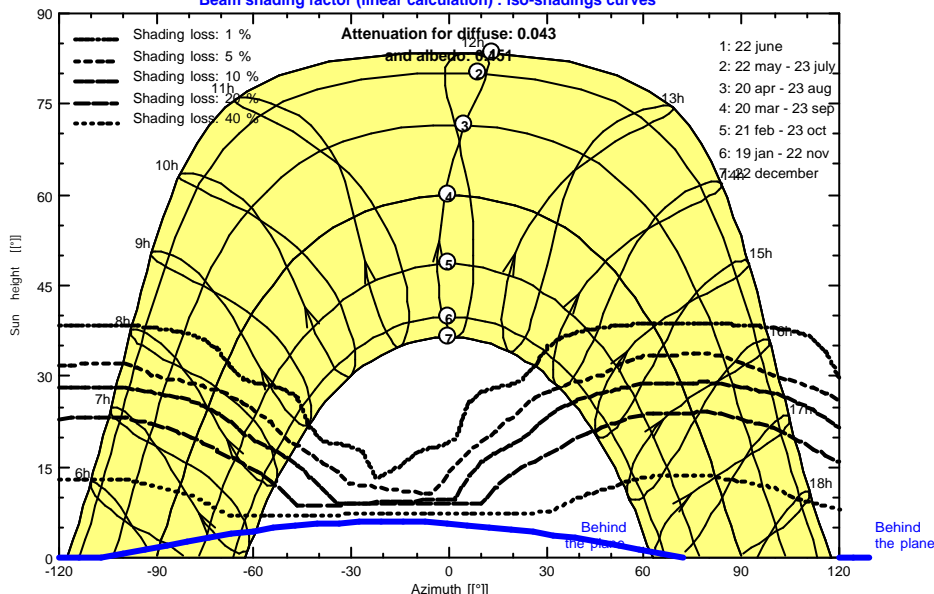
### Perspective of the PV-field and surrounding shading scene



### Iso-shadings diagram

MCV OnGrid System

Beam shading factor (linear calculation) : Iso-shadings curves



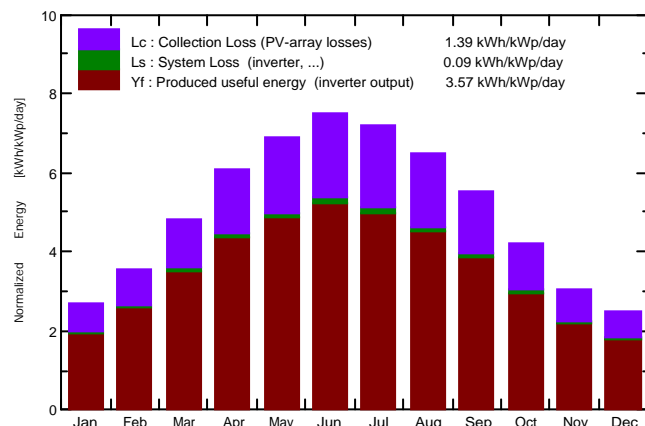
## Grid-Connected System: Main results

**Project :** MCV OnGrid System  
**Simulation variant :** MCV Warehouse STP330\_ABB

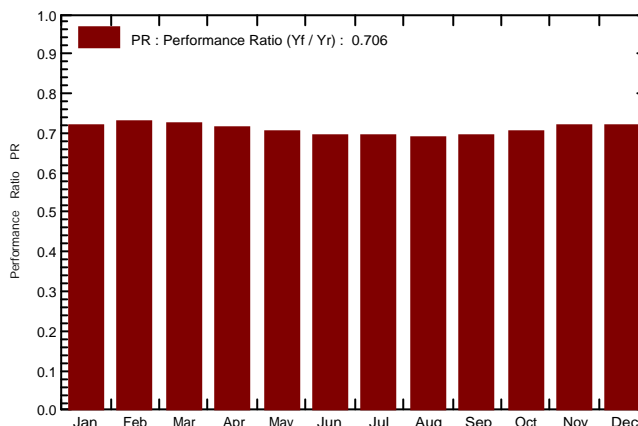
<b>Main system parameters</b>		<b>System type</b>	<b>Sheds on a building</b>	
<b>Near Shadings</b>	Detailed electrical calculation		(acc. to module layout)	
PV Field Orientation	tilt	6°	azimuth	162°
PV modules	Model	STP-330-24/Vfw	Pnom	330 Wp
PV Array	Nb. of modules	1972	Pnom total	<b>651 kWp</b>
Inverter	Model	PVS-100-TL	Pnom	100 kW ac
Inverter	Model	PRO-33.0-TL-OUTD-400	Pnom	33.0 kW ac
Inverter pack	Nb. of units	6.0	Pnom total	<b>533 kW ac</b>
User's needs	Unlimited load (grid)			

**Main simulation results**  
 System Production **Produced Energy 848.1 MWh/year** Specific prod. 1303 kWh/kWp/year  
 Performance Ratio PR 70.62 %

Normalized productions (per installed kWp): Nominal power 651 kWp



Performance Ratio PR



### MCV Warehouse STP330\_ABB Balances and main results

	GlobHor kWh/m <sup>2</sup>	DiffHor kWh/m <sup>2</sup>	T Amb °C	GlobInc kWh/m <sup>2</sup>	GlobEff kWh/m <sup>2</sup>	EArray MWh	E_Grid MWh	PR
<b>January</b>	93.7	38.49	14.43	84.0	73.0	40.3	39.4	0.721
<b>February</b>	107.5	53.20	15.44	100.0	88.4	48.7	47.6	0.732
<b>March</b>	157.1	68.31	18.56	149.7	133.8	72.5	70.8	0.726
<b>April</b>	186.8	80.39	21.50	182.6	164.4	87.0	84.9	0.715
<b>May</b>	215.6	84.40	25.41	214.4	194.6	100.8	98.1	0.703
<b>June</b>	225.0	78.78	27.85	225.5	204.8	104.8	102.0	0.695
<b>July</b>	224.1	75.81	29.56	223.7	203.8	103.6	100.8	0.693
<b>August</b>	205.0	76.51	29.36	201.7	182.4	93.1	90.8	0.691
<b>September</b>	172.9	64.38	27.36	165.9	148.7	77.0	75.2	0.696
<b>October</b>	139.0	58.57	24.34	130.0	115.4	61.2	59.8	0.707
<b>November</b>	100.2	44.32	19.65	90.9	79.8	43.6	42.6	0.720
<b>December</b>	86.3	37.28	16.13	77.1	67.0	36.9	36.1	0.719
<b>Year</b>	1913.2	760.44	22.51	1845.5	1656.1	869.7	848.1	0.706

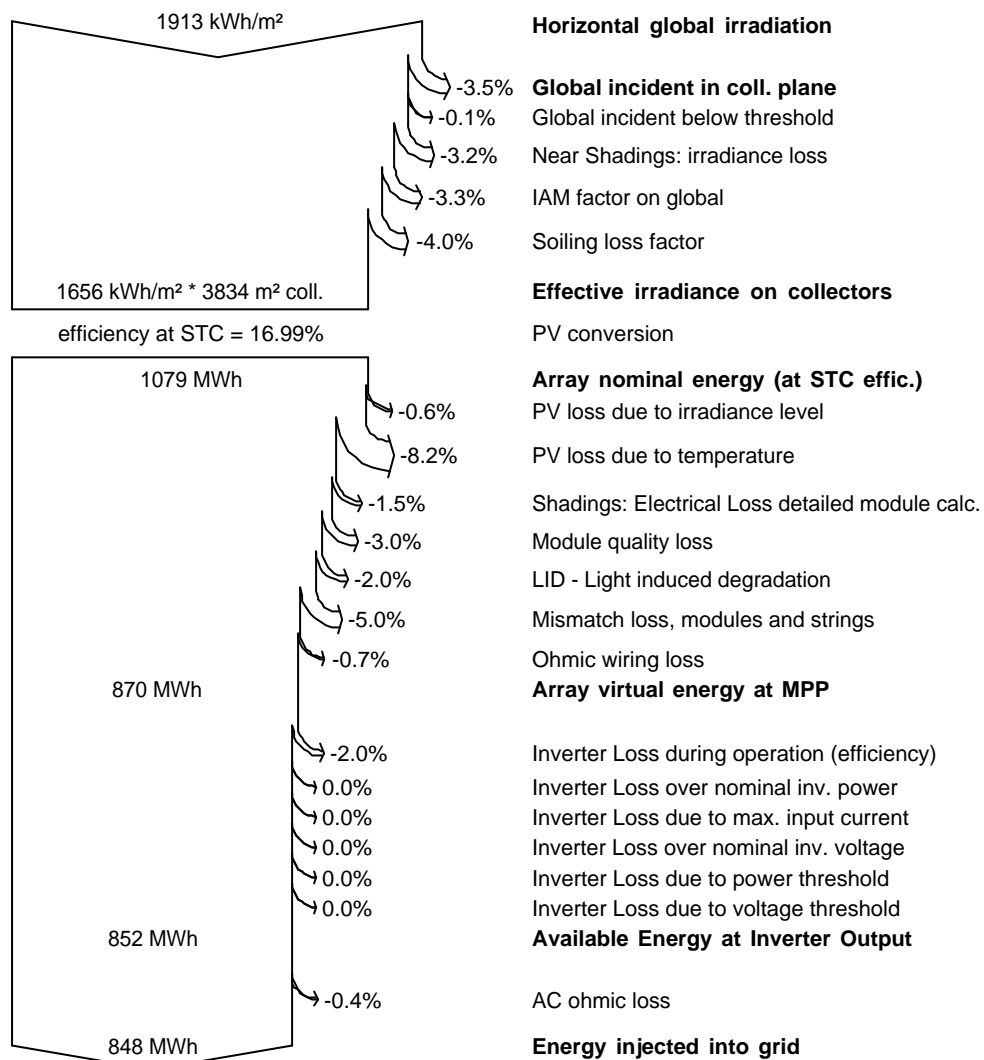
Legends: GlobHor Horizontal global irradiation  
 DiffHor Horizontal diffuse irradiation  
 T Amb Ambient Temperature  
 GlobInc Global incident in coll. plane  
 GlobEff Effective Global, corr. for IAM and shadings  
 EArray Effective energy at the output of the array  
 E\_Grid Energy injected into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

## Grid-Connected System: Loss diagram

**Project :** MCV OnGrid System  
**Simulation variant :** MCV Warehouse STP330\_ABB

Main system parameters	System type	Sheds on a building
<b>Near Shadings</b>	Detailed electrical calculation	(acc. to module layout)
PV Field Orientation	tilt	6° azimuth 162°
PV modules	Model	STP-330-24/Vfw Pnom 330 Wp
PV Array	Nb. of modules	1972 Pnom total <b>651 kWp</b>
Inverter	Model	PVS-100-TL Pnom 100 kW ac
Inverter	Model	PRO-33.0-TL-OUTD-400 Pnom 33.0 kW ac
Inverter pack	Nb. of units	6.0 Pnom total <b>533 kW ac</b>
User's needs	Unlimited load (grid)	

**Loss diagram over the whole year**



## Grid-Connected System: P50 - P90 evaluation

**Project :** MCV OnGrid System  
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Main system parameters		System type	Sheds on a building	
<b>Near Shadings</b>	Detailed electrical calculation	(acc. to module layout)		
PV Field Orientation	tilt	6°	azimuth	162°
PV modules	Model	STP-330-24/Vfw	Pnom	330 Wp
PV Array	Nb. of modules	1972	Pnom total	<b>651 kWp</b>
Inverter	Model	PVS-100-TL	Pnom	100 kW ac
Inverter	Model	PRO-33.0-TL-OUTD-400	Pnom	33.0 kW ac
Inverter pack	Nb. of units	6.0	Pnom total	<b>533 kW ac</b>
User's needs	Unlimited load (grid)			

### 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	Meteonorm 7.1 (1981-2009)		
Meteo data	Kind	Not defined	Year 1995
Specified Deviation	Year deviation from aver.	3 %	
Year-to-year variability	Variance	2.5 %	

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	5.8 %	
Global variability (meteo + system)	Variance	6.5 %	(quadratic sum)

Annual production probability	<b>Variability</b>	<b>55.1 MWh</b>
	<b>P50</b>	<b>848.1 MWh</b>
	<b>P90</b>	<b>777.5 MWh</b>
	<b>P75</b>	<b>811.0 MWh</b>

**Probability distribution**

