Grid-Connected System: Simulation parameters

Project : **184 - "Стар Сървиз" ЕООД, с. Чоба, общ. Брезово, обл. Пловдив**

Geographical Site **184** **Country** **Bulgaria**

Situation Latitude 42.3°N Longitude 25.1°E
Time defined as Legal Time Time zone UT+2 Altitude 228 m
Monthly albedo values

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Albedo	0.60	0.60	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.40

Meteo data : 184 - с. Чоба, общ. Брезово, обл. Пловдив

Simulation variant : **Simulation variant**

Simulation date 29/03/09 18h53

Simulation parameters

Collector Plane Orientation Tilt 30° Azimuth -15°

Horizon Average Height 0.5°

Near Shadings according to module

PV Array Characteristics

PV module Si-mono Model **SSM-170/24M**
Manufacturer STS_Solar Swiss AG
Number of PV modules In series 12 modules In parallel 36 strings
Total number of PV modules Nb. modules 432 Unit Nom. Power 170 Wp
Array global power Nominal (STC) **73 kWp** At operating cond. 65 kWp (50°C)
Array operating characteristics (50°C) U mpp 375 V I mpp 173 A
Total area Module area **551 ml** Cell area 467 ml

PV Array loss factors

Heat Loss Factor ko (const) 29.0 W/mIK kv (wind) 0.0 W/mIK / m/s
=> Nominal Oper. Coll. Temp. (800 W/ml, Tamb=20°C, wind 1 m/s) NOCT 45 °C
Wiring Ohmic Loss Global array res. 4.3 mOhm Loss Fraction 0.2 % at STC
Serie Diode Loss Voltage Drop 0.7 V Loss Fraction 0.2 % at STC
Array Soiling Losses

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
2.0%	1.0%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	1.0%

Module Quality Loss Loss Fraction 1.0 %
Module Mismatch Losses Loss Fraction 1.0 % 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 8000 TL**
Manufacturer SMA
Inverter Characteristics Operating Voltage 335-500 V Unit Nom. Power 8 kW AC
Inverter pack Number of Inverter 9 units Total Power 72 kW AC

User's needs : Unlimited load (grid)

Grid-Connected System: Horizon definition

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Simulation variant : **Simulation variant**

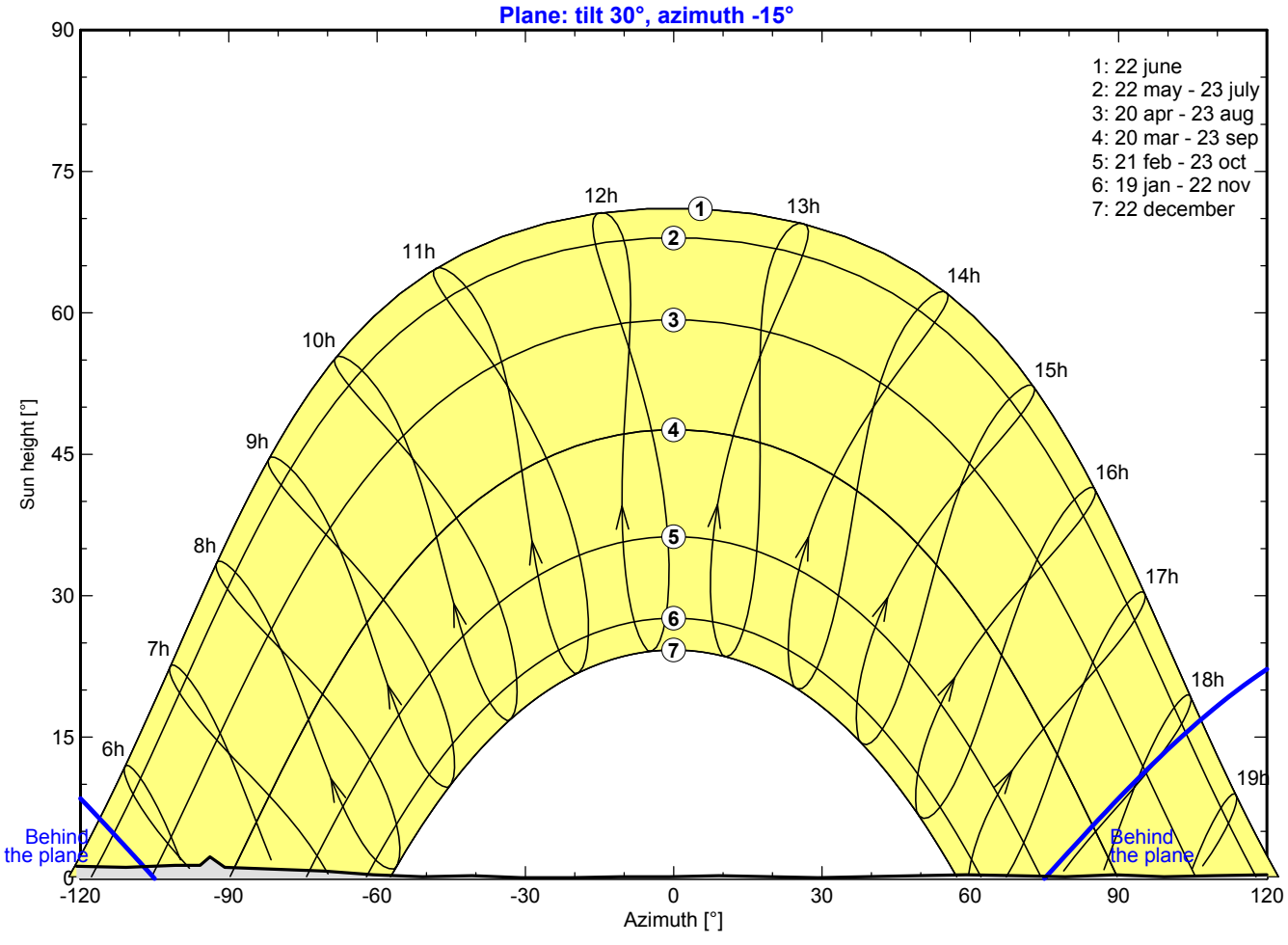
Main system parameters	System type	**Grid-Connected**		
Horizon	Average Height	0.5°		
Near Shadings	according to module			
PV Field Orientation	tilt	30°	azimuth	-15°
PV modules	Model	SSM-170/24M	Pnom	170 Wp
PV Array	Nb. of modules	432	Pnom total	**73 kWp**
Inverter	Model	Sunny Mini Central 8000 TL	Pnom	8.0 kW ac
Inverter pack	Nb. of units	9	Pnom total	**72 kW ac**
User's needs	Unlimited load (grid)			

Horizon

Average Height	0.5°	Diffuse Factor	1.00
Albedo Factor	100 %	Albedo Fraction	0.99

Height [°]	1.3	1.2	1.4	1.4	2.3	1.2	1.0	0.8	0.4	0.2	0.3	0.1	0.1
Azimuth [°]	-120.8	-110.8	-100.8	-95.8	-93.8	-90.8	-80.8	-70.8	-60.8	-50.8	-40.8	-30.8	-20.8
Height [°]	0.2	0.2	0.3	0.1	0.3	0.4	0.3	0.2	0.4	0.2	0.3	0.4	
Azimuth [°]	-10.8	-0.8	9.2	29.2	49.2	59.2	69.2	79.2	89.2	99.2	109.2	120.0	

Horizon line for 184, (Lat. 42.3°N, long. 25.1°E, alt. 228 m)



Grid-Connected System: Near shading definition

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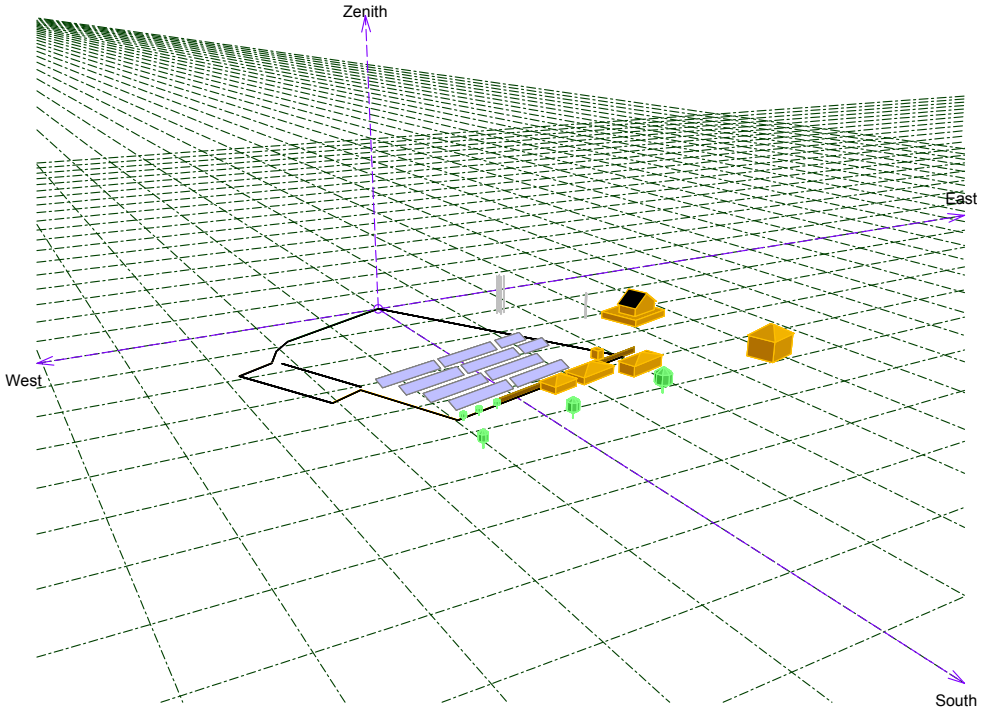
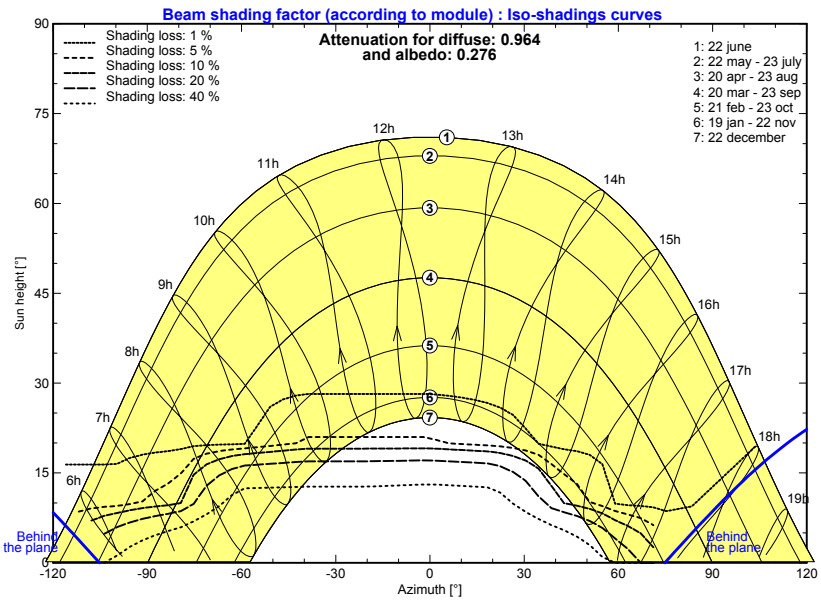
User's needs	Unlimited load (grid)			

Perspective of the PV-field and surrounding shading scene



Iso-shadings diagram

184 - "Стар Сървиз" ЕООД, с. Чоба, общ. Брезово, обл. Пловдив: Реална ситуация



Grid-Connected System: Main results

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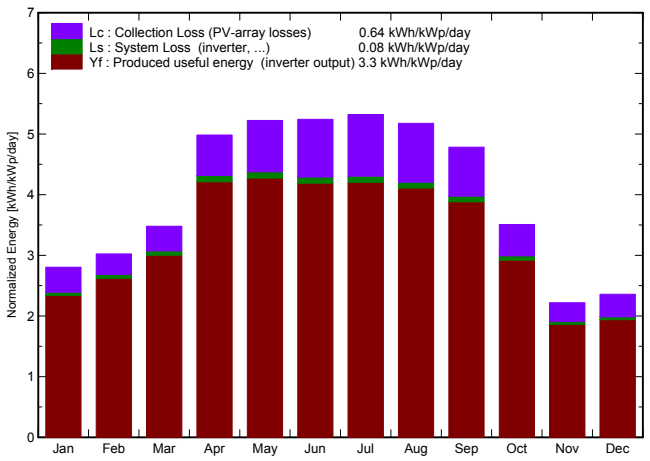
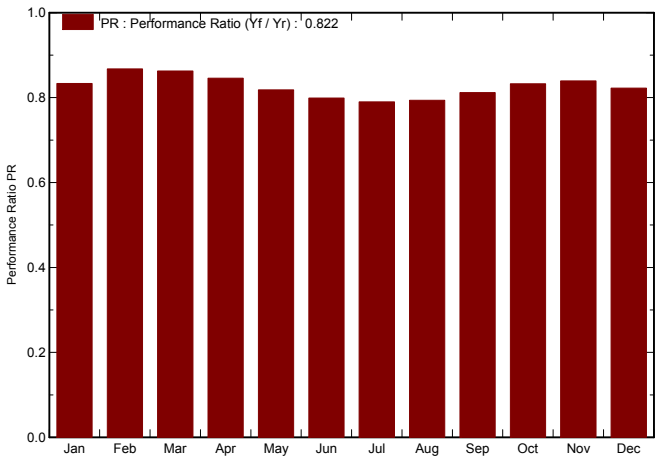
Main simulation results

System Production	**Produced Energy**	**88.4 MWh/year**	Specific	1204 kWh/kWp/year
	Performance Ratio PR	82.2 %		

Normalized productions (per installed kWp): Nominal power 73 kWp



Performance Ratio PR



Simulation variant

Balances and main results

	GlobHor kWh/ml	T Amb °C	GlobInc kWh/ml	GlobEff kWh/ml	EArray kWh	EOutInv kWh	EffArrR %	EffSysR %
January	53.5	-0.69	86.9	77.0	5448	5321	11.37	11.10
February	64.3	0.62	84.6	77.9	5521	5394	11.83	11.56
March	96.0	5.78	107.9	101.1	6995	6835	11.76	11.49
April	139.0	11.30	149.5	141.1	9509	9285	11.54	11.27
May	164.7	16.62	161.9	152.0	9963	9732	11.16	10.90
June	165.8	20.70	157.3	146.9	9450	9229	10.90	10.65
July	171.0	23.10	165.0	154.9	9803	9573	10.78	10.53
August	157.9	22.99	160.5	151.2	9575	9355	10.83	10.58
September	124.8	19.14	143.5	135.8	8761	8556	11.07	10.82
October	85.3	13.46	108.8	102.0	6810	6651	11.36	11.09
November	48.9	6.75	66.5	61.1	4204	4102	11.46	11.18
December	45.5	2.08	73.1	64.2	4520	4414	11.22	10.96
Year	1316.6	11.88	1465.6	1365.2	90559	88449	11.21	10.95

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

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Loss diagram over the whole year