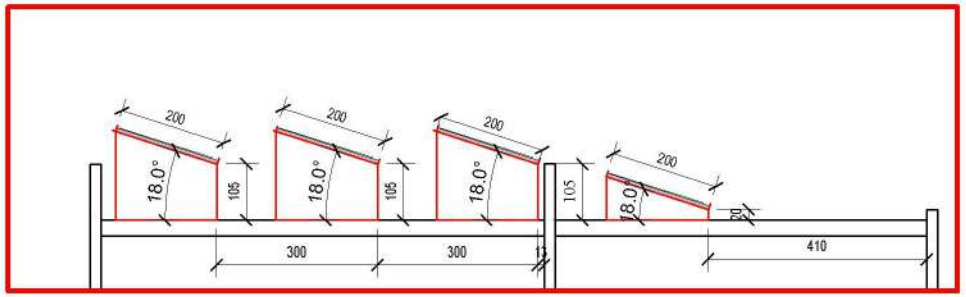
אנרגיה סולארית לישראל
ייצור חשמל סולארי
בדיקת כדאיות כלכלית

אנרגיה
סולארית לישראל בע"מ

עבור אל גליון הקלדת נתונים

בית ספר רמון



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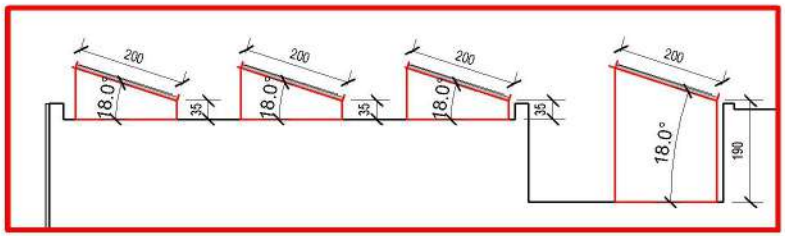

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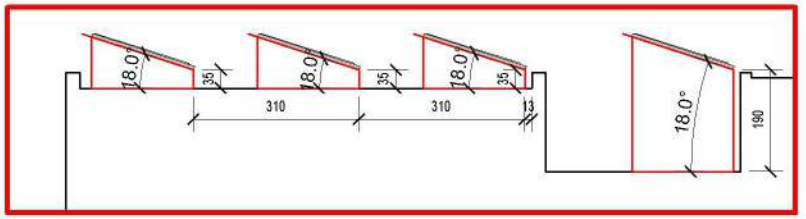

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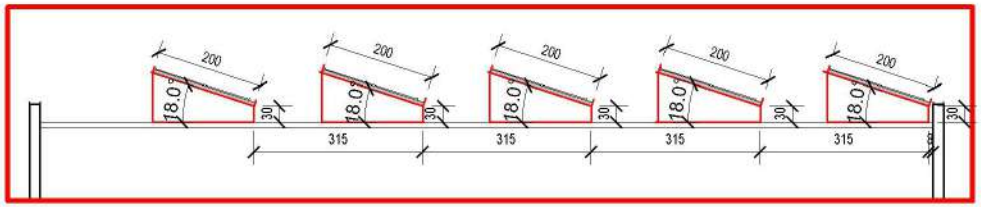

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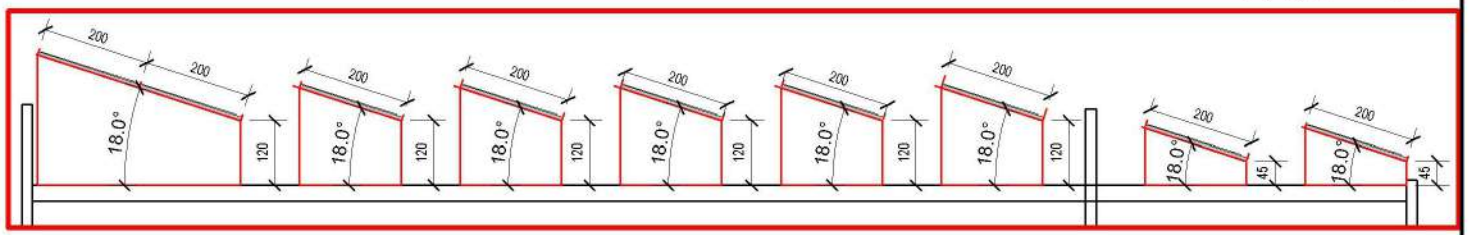

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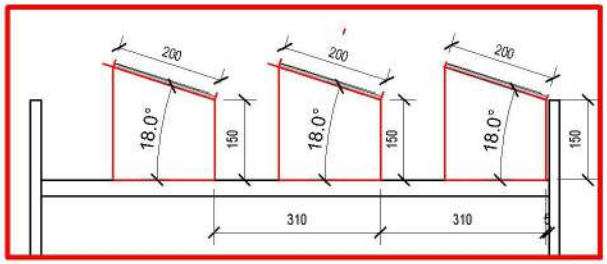

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משא הגיליון	לביצוע
גודל פנל 100*197	
מספר הפרוייקט	-
תאריך	10.10.18
שרטט	Meirav
בדק	Checker
קנה מידה	1 : 100

חתכים-1

שם הלקוח: בית ספר אילן רמון

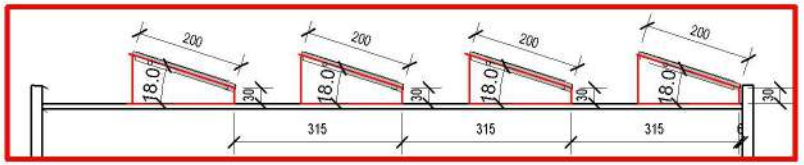
שם הפרוייקט: כפר סבא

rev	השינוי	תאריך
	סוג הפנל -	
	זוית הפנל	
	גודל המערכת	
	מספר הפנלים	
	סוג המזמין	

405 w
18 מעלות
291.600kw
720

אנרגיה סולארית לישראל בע"מ

06/04/2020 16:59:25



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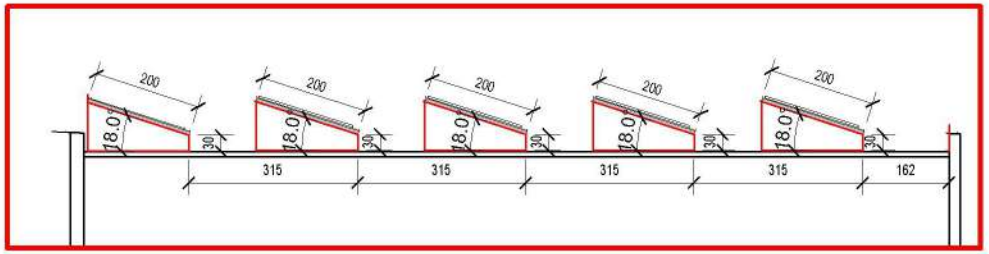

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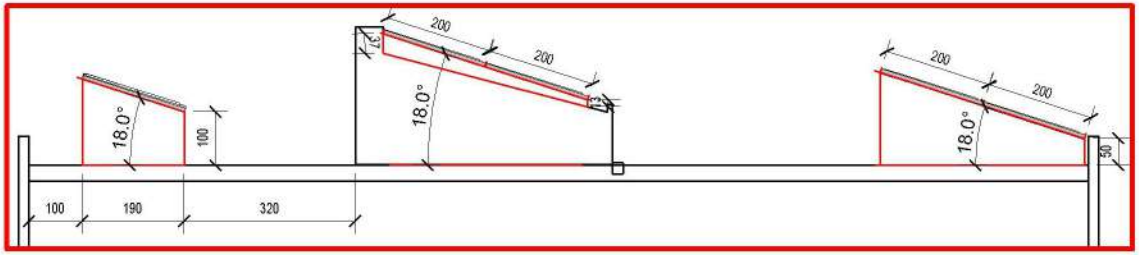

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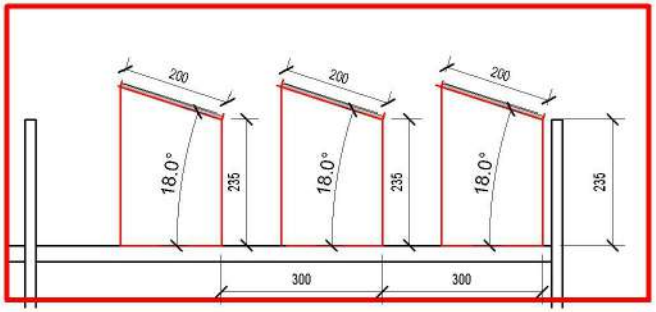

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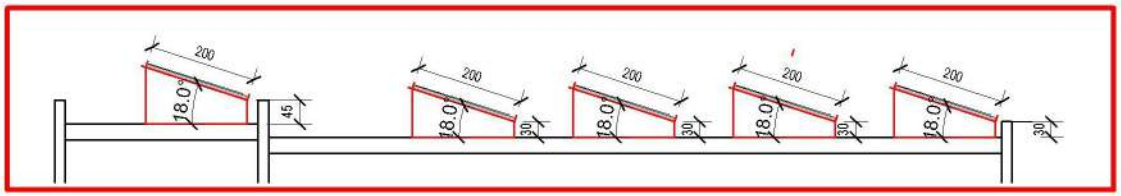


חתך 11

משא הגליון	לביצוע
גודל פנל 197*100	
מספר הפרוייקט	-
תאריך	10.10.18
שרטט	MEIRAV
בדק	Checker
קנה מידה	1 : 100

חתכים 2

שם הלקוח: בית ספר אילן רמון

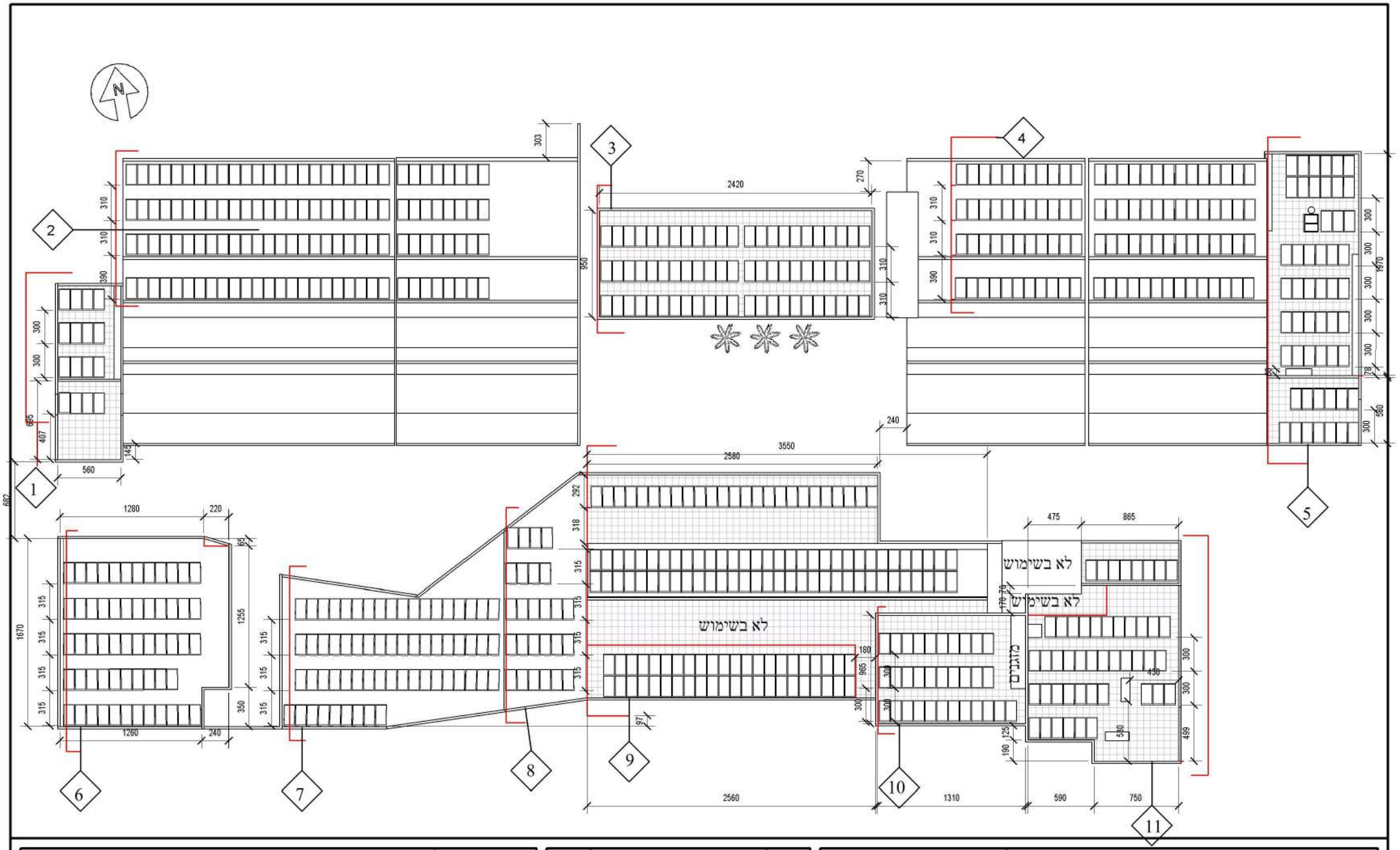
שם הפרוייקט: כפר סבא

תאריך	השינוי	rev
	סוג הפנל -	
	זוית הפנל	
	גודל המערכת	
	מספר הפנלים	
	סוג המממיר	

405 w
18 מעלות
291.600kw
720

אנרגיה סולארית לישראל בע"מ

06/04/2020 17:03:33



נושא הגיליון	מערכת סולארית
גודל פנל	100*197
מספר הפרוייקט	-
תאריך	10.10.18
שרטט	Meirav
בדק	Checker
קנה מידה	1 : 300

לביצוע

שם הלקוח: בית ספר אילן רמון

שם הפרוייקט: כפר סבא

rev	השינוי	תאריך
	סוג הפנל -	
	זוית הפנל	
	גודל המערכת	
	מספר הפנלים	
	סוג המהפך	

405 w
18 מעלות
291.600kw
720

אנרגיה סולארית לישראל בע"מ

06/04/2020 16:54:32

Grid-Connected System: Simulation parameters

Project : **Ilan Ramon School**

Geographical Site	**Kfar Saba - Ilan Ramon**		Country	**Israel**
Situation	Latitude	32.18° N	Longitude	34.91° E
Time defined as	Legal Time	Time zone UT+2	Altitude	50 m
	Albedo	0.20		
Meteo data:	**Kfar Saba - Ilan Ramon**	Meteonorm 7.2 (1990-2004), Sat=100% - Synthetic		

Simulation variant : **New simulation variant**

	Simulation date	06/04/20 23h28		
	Simulation for the	**10th year of operation**		

Simulation parameters	System type	**Tables on a building**		
Collector Plane Orientation	Tilt	18°	Azimuth	-8°
Sheds configuration	Nb. of sheds	59		
	Sheds spacing	3.13 m	Collector width	2.38 m
Shading limit angle	Limit profile angle	40.3°	Ground cov. Ratio (GCR)	76.0 %
Models used	Transposition	Perez	Diffuse	Perez, Meteonorm
Horizon	Free Horizon			
Near Shadings	Linear shadings			
User's needs :	Unlimited load (grid)			

PV Arrays Characteristics (8 kinds of array defined)

PV module	Si-mono	Model	**JAM72S10-405/MR**	
Custom parameters definition		Manufacturer	JA Solar	
SolarEdge Power Optimizer		Model	**P850**	Unit Nom. Power 850 W
PV modules on one optimizer		in series	2	in parallel 1

Sub-array "Sub-array #1"	In series	15	In parallel	3 strings
Total number of PV modules	Nb. modules	90	Unit Nom. Power	405 Wp
Array global power	Nominal (STC)	**36.5 kWp**	At operating cond.	33.3 kWp (50°C)
Output of optimizers	U oper	750 V	I at Poper	44 A
Sub-array "Sub-array #2"	In series	15	In parallel	3 strings
Total number of PV modules	Nb. modules	90	Unit Nom. Power	405 Wp
Array global power	Nominal (STC)	**36.5 kWp**	At operating cond.	33.3 kWp (50°C)
Output of optimizers	U oper	750 V	I at Poper	44 A
Sub-array "Sub-array #3"	In series	15	In parallel	3 strings
Total number of PV modules	Nb. modules	90	Unit Nom. Power	405 Wp
Array global power	Nominal (STC)	**36.5 kWp**	At operating cond.	33.3 kWp (50°C)
Output of optimizers	U oper	750 V	I at Poper	44 A
Sub-array "Sub-array #4"	In series	15	In parallel	3 strings
Total number of PV modules	Nb. modules	90	Unit Nom. Power	405 Wp
Array global power	Nominal (STC)	**36.5 kWp**	At operating cond.	33.3 kWp (50°C)
Output of optimizers	U oper	750 V	I at Poper	44 A
Sub-array "Sub-array #5"	In series	15	In parallel	3 strings
Total number of PV modules	Nb. modules	90	Unit Nom. Power	405 Wp
Array global power	Nominal (STC)	**36.5 kWp**	At operating cond.	33.3 kWp (50°C)
Output of optimizers	U oper	750 V	I at Poper	44 A
Sub-array "Sub-array #6"	In series	15	In parallel	3 strings
Total number of PV modules	Nb. modules	90	Unit Nom. Power	405 Wp
Array global power	Nominal (STC)	**36.5 kWp**	At operating cond.	33.3 kWp (50°C)
Output of optimizers	U oper	750 V	I at Poper	44 A

Grid-Connected System: Simulation parameters

Sub-array "Sub-array #7"		In series	15	In parallel	3 strings
Total number of PV modules		Nb. modules	90	Unit Nom. Power	405 Wp
Array global power		Nominal (STC)	**36.5 kWp**	At operating cond.	33.3 kWp (50°C)
Output of optimizers		U oper	750 V	I at Poper	44 A
Sub-array "Sub-array #8"		In series	15	In parallel	3 strings
Total number of PV modules		Nb. modules	90	Unit Nom. Power	405 Wp
Array global power		Nominal (STC)	**36.5 kWp**	At operating cond.	33.3 kWp (50°C)
Output of optimizers		U oper	750 V	I at Poper	44 A
Total	Arrays global power	Nominal (STC)	**292 kWp**	Total	720 modules
		Module area	**1445 m²**	Cell area	1298 m²

Inverter	Model	**SE25K**		
Original PVsyst database	Manufacturer	SolarEdge		
Characteristics	Operating Voltage	750 V	Unit Nom. Power	25.0 kWac
Sub-array "Sub-array #1"	Nb. of inverters	1 units	Total Power	25 kWac
			Pnom ratio	1.46
Sub-array "Sub-array #2"	Nb. of inverters	1 units	Total Power	25 kWac
			Pnom ratio	1.46
Sub-array "Sub-array #3"	Nb. of inverters	1 units	Total Power	25 kWac
			Pnom ratio	1.46
Sub-array "Sub-array #4"	Nb. of inverters	1 units	Total Power	25 kWac
			Pnom ratio	1.46
Sub-array "Sub-array #5"	Nb. of inverters	1 units	Total Power	25 kWac
			Pnom ratio	1.46
Sub-array "Sub-array #6"	Nb. of inverters	1 units	Total Power	25 kWac
			Pnom ratio	1.46
Sub-array "Sub-array #7"	Nb. of inverters	1 units	Total Power	25 kWac
			Pnom ratio	1.46
Sub-array "Sub-array #8"	Nb. of inverters	1 units	Total Power	25 kWac
			Pnom ratio	1.46
Total	Nb. of inverters	8	Total Power	200 kWac

Physical inverters

SE25K	1 units, 3 strings	3 strings of 15 optimizers P850
SE25K	1 units, 3 strings	2 * 15 and 1 * 15 optimizers P850
SE25K	1 units, 3 strings	1*15, 1*15, 1*15, opt. P850
SE25K	1 units, 3 strings	1*15, 1*15, 1*15, opt. P850
SE25K	1 units, 3 strings	1*15, 1*15, 1*15, opt. P850
SE25K	1 units, 3 strings	1*15, 1*15, 1*15, opt. P850
SE25K	1 units, 3 strings	1*15, 1*15, 1*15, opt. P850
SE25K	1 units, 3 strings	1 * 15 and 2 * 15 optimizers P850

PV Array loss factors

Array Soiling Losses			Loss Fraction	4.0 %
Thermal Loss factor	Uc (const)	20.0 W/m²K	Uv (wind)	0.0 W/m²K / m/s
Wiring Ohmic Loss	Array#1	231 mOhm	Loss Fraction	1.5 % at STC
	Array#2	231 mOhm	Loss Fraction	1.5 % at STC
	Array#3	231 mOhm	Loss Fraction	1.5 % at STC
	Array#4	231 mOhm	Loss Fraction	1.5 % at STC
	Array#5	231 mOhm	Loss Fraction	1.5 % at STC
	Array#6	231 mOhm	Loss Fraction	1.5 % at STC
	Array#7	231 mOhm	Loss Fraction	1.5 % at STC
	Array#8	231 mOhm	Loss Fraction	1.5 % at STC
	Global		Loss Fraction	1.5 % at STC

Grid-Connected System: Simulation parameters

LID - Light Induced Degradation			Loss Fraction	2.0 %
Module Quality Loss			Loss Fraction	-0.3 %
Module Mismatch Losses			Loss Fraction	0.0 % (fixed voltage)
Module average degradation	Year no	10	Loss factor	0.5 %/year
Mismatch due to degradation	Imp RMS dispersion	0 %/year	Vmp RMS dispersion	0 %/year

Incidence effect (IAM): User defined IAM profile

0°	30°	50°	60°	70°	80°	90°
1.000	1.000	1.000	1.000	0.950	0.760	0.000

System loss factors

	Wires: 3x240.0 mm² 55 m	Loss Fraction	0.8 % at STC
Unavailability of the system	7.3 days, 3 periods	Time fraction	2.0 %

Grid-Connected System: Near shading definition

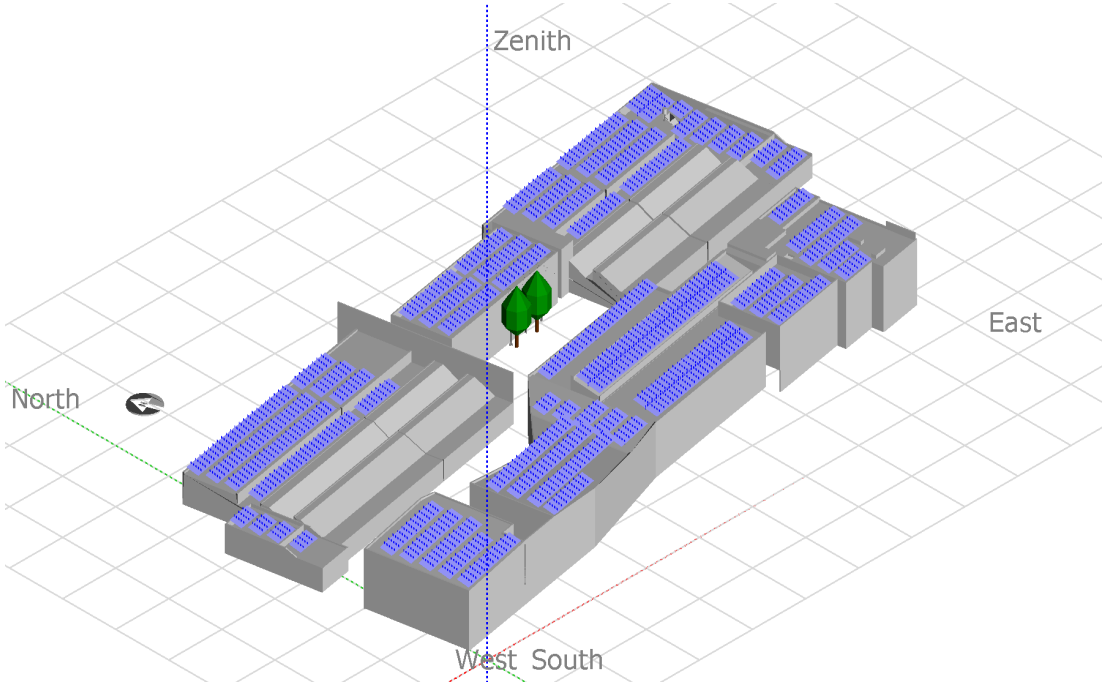
Project : **Ilan Ramon School**

Simulation variant : **New simulation variant**

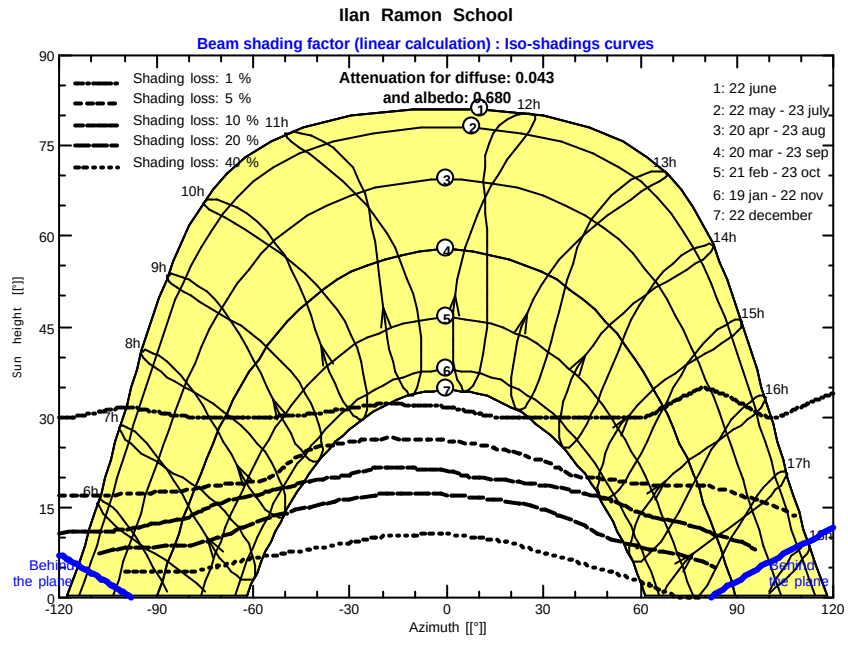
Simulation for the 10th year of operation

Main system parameters	System type	**Tables on a building**		
Near Shadings	Linear shadings			
PV Field Orientation	tilt	18°	azimuth	-8°
PV modules	Model	JAM72S10-405/MR	Pnom	405 Wp
PV Array	Nb. of modules	720	Pnom total	**292 kWp**
Inverter	Model	SE25K	Pnom	25.00 kW ac
Inverter pack	Nb. of units	8.0	Pnom total	**200 kW ac**
User's needs	Unlimited load (grid)			

Perspective of the PV-field and surrounding shading scene



Iso-shadings diagram



Grid-Connected System: Main results

Project : **Ilan Ramon School**

Simulation variant : **New simulation variant**

Simulation for the 10th year of operation

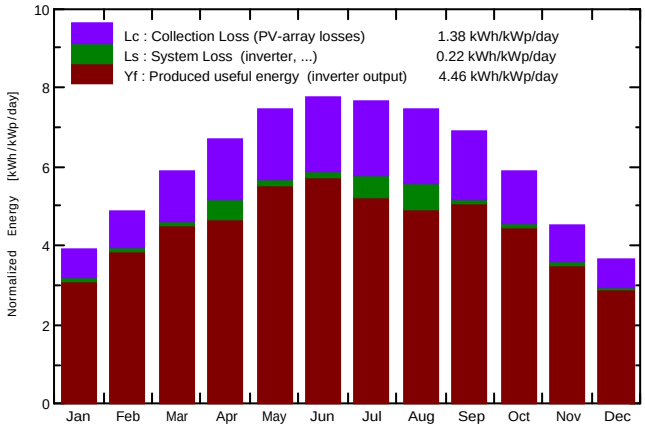
Main system parameters	System type	**Tables on a building**		
Near Shadings	Linear shadings			
PV Field Orientation	tilt	18°	azimuth	-8°
PV modules	Model	JAM72S10-405/MR	Pnom	405 Wp
PV Array	Nb. of modules	720	Pnom total	**292 kWp**
Inverter	Model	SE25K	Pnom	25.00 kW ac
Inverter pack	Nb. of units	8.0	Pnom total	**200 kW ac**
User's needs	Unlimited load (grid)			

Main simulation results

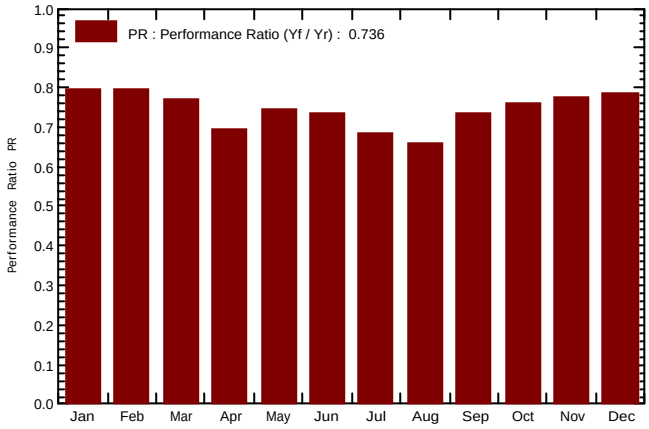
System Production — **Produced Energy** **474.8 MWh/year** — Specific prod. 1628 kWh/kWp/year

Performance Ratio PR 73.58 %

Normalized productions (per installed kWp): Nominal power 292 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
January	92.1	35.99	13.02	121.6	111.1	28.81	28.14	0.794
February	110.9	45.77	13.71	136.2	125.7	32.33	31.58	0.795
March	159.8	54.25	16.34	181.7	169.1	41.71	40.72	0.769
April	190.1	65.73	19.21	200.9	187.0	45.30	40.79	0.696
May	232.9	64.97	22.41	230.4	214.5	51.18	49.96	0.743
June	241.8	59.17	25.05	233.0	217.0	51.31	50.08	0.737
July	243.7	62.73	27.63	237.6	221.3	52.05	47.39	0.684
August	224.7	57.72	27.93	231.4	216.1	50.65	44.45	0.659
September	186.5	44.74	26.06	207.3	193.7	45.39	44.31	0.733
October	149.5	43.91	23.67	182.4	169.4	41.37	40.40	0.760
November	104.9	37.63	18.89	136.3	125.4	31.57	30.85	0.776
December	84.8	36.31	15.08	114.1	103.6	26.77	26.16	0.786
Year	2021.7	608.91	20.79	2212.9	2053.8	498.45	474.82	0.736

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	Ambient Temperature	E_Grid	Energy injected into grid
GlobInc	Global incident in coll. plane	PR	Performance Ratio

Grid-Connected System: Loss diagram

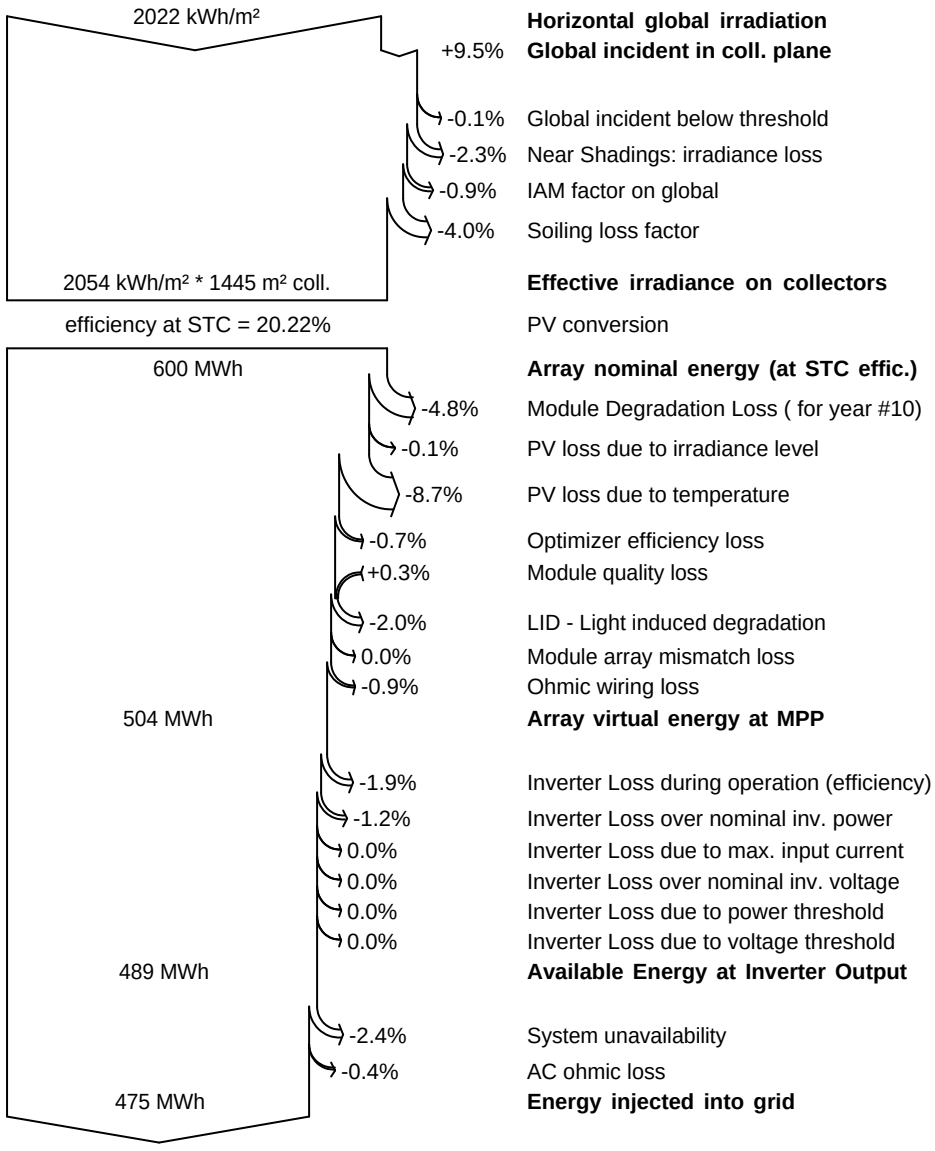
Project : **Ilan Ramon School**

Simulation variant : **New simulation variant**

Simulation for the 10th year of operation

Main system parameters	System type	**Tables on a building**		
Near Shadings	Linear shadings			
PV Field Orientation	tilt	18°	azimuth	-8°
PV modules	Model	JAM72S10-405/MR	Pnom	405 Wp
PV Array	Nb. of modules	720	Pnom total	**292 kWp**
Inverter	Model	SE25K	Pnom	25.00 kW ac
Inverter pack	Nb. of units	8.0	Pnom total	**200 kW ac**
User's needs	Unlimited load (grid)			

Loss diagram over the whole year



Grid-Connected System: P50 - P90 evaluation

Project : **Ilan Ramon School**

Simulation variant : **New simulation variant**

Simulation for the 10th year of operation

Main system parameters	System type	**Tables on a building**		
Near Shadings	Linear shadings			
PV Field Orientation	tilt	18°	azimuth	-8°
PV modules	Model	JAM72S10-405/MR	Pnom	405 Wp
PV Array	Nb. of modules	720	Pnom total	**292 kWp**
Inverter	Model	SE25K	Pnom	25.00 kW ac
Inverter pack	Nb. of units	8.0	Pnom total	**200 kW ac**
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:

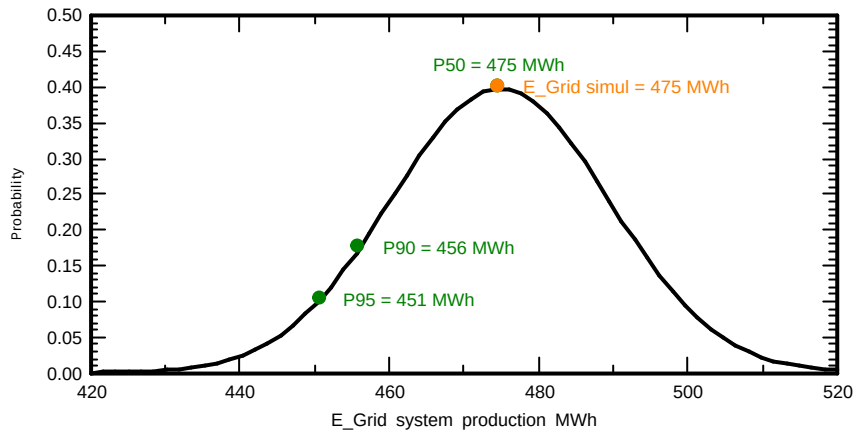
Meteo data source		Meteonorm 7.2 (1990-2004), Sat=100%		
Meteo data	Kind	Monthly averages	Synthetic	Multi-year average
Specified Deviation	Climate change	0.0 %		
Year-to-year variability	Variance	2.5 %		

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	1.0 %	
Global variability (meteo + system)	Variance	3.1 %	(quadratic sum)

Annual production probability	**Variability**	**14.6 MWh**
	P50	**474.8 MWh**
	P90	**456.1 MWh**
	P95	**450.8 MWh**

Probability distribution



חזור לתמצית נתונים

תחזית תזרים מזומנים

בש"ח נומינלי מערכת סולרית 291.6 KWP

אנרגיה סולארית לישראל
ייצור חשמל סולארי
בדיקת כדאיות כלכלית

BDO זיו האפט רואי חשבון

שנה	1	2	3	4	5	6	7	8	9	10
תקבולים	213,626	212,558	211,495	210,438	209,386	208,339	207,297	206,260	205,229	204,203
תשלומים שוטפים										
מזומנים מפעילות שוטפת	213,626	212,558	211,495	210,438	209,386	208,339	207,297	206,260	205,229	204,203
השקעה	-1,078,920									
מזומנים לאחר השקעות	-865,294	212,558	211,495	210,438	209,386	208,339	207,297	206,260	205,229	204,203
הלוואה	863,136									
תשלומי ריבית	-24,866	-22,581	-20,225	-17,799	-15,298	-12,721	-10,066	-7,330	-4,511	-1,606
החזר הלוואה	-75,148	-77,433	-79,789	-82,215	-84,716	-87,293	-89,948	-92,684	-95,503	-98,408
מזומנים נטו מפע' מימון	763,122	-100,014	-100,014	-100,014	-100,014	-100,014	-100,014	-100,014	-100,014	-100,014
יתרת מזומנים	-102,172	112,544	111,481	110,424	109,372	108,325	107,283	106,246	105,215	104,189
יתרה מצטברת- א'₪	-102	10	122	232	342	450	557	664	769	873

שנה	11	12	13	14	15	16	17	18	19	20	21
תקבולים	203,182	202,166	201,155	200,149	199,149	198,153	197,162	196,176	195,196	194,220	193,248
תשלומים שוטפים											
מזומנים מפעילות שוטפת	203,182	202,166	201,155	200,149	199,149	198,153	197,162	196,176	195,196	194,220	193,248
השקעה											
מזומנים לאחר השקעות	203,182	202,166	201,155	200,149	199,149	198,153	197,162	196,176	195,196	194,220	193,248
הוצאות מימון - ריבית											
החזר הלוואה											
מזומנים נטו מפעילות מימון											
יתרת מזומנים	203,182	202,166	201,155	200,149	199,149	198,153	197,162	196,176	195,196	194,220	193,248
יתרה מצטברת- א'₪	1,076	1,278	1,479	1,680	1,879	2,077	2,274	2,470	2,665	2,860	3,053

חזור לתמצית נתונים

ענ"נ - 25 שנה בא'₪	1,481	NPV	7.0% שיעור היוון
שת"פ	109%	IRR	
תשואה להון העצמי	117%		