

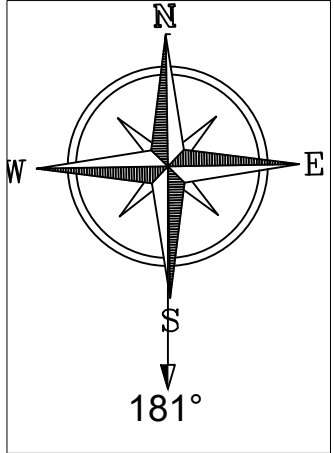
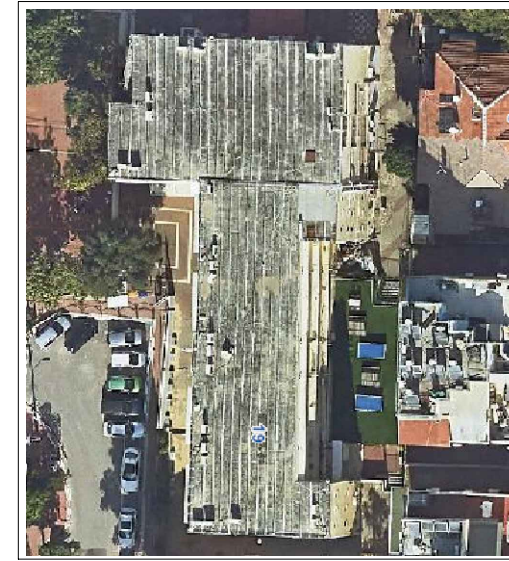
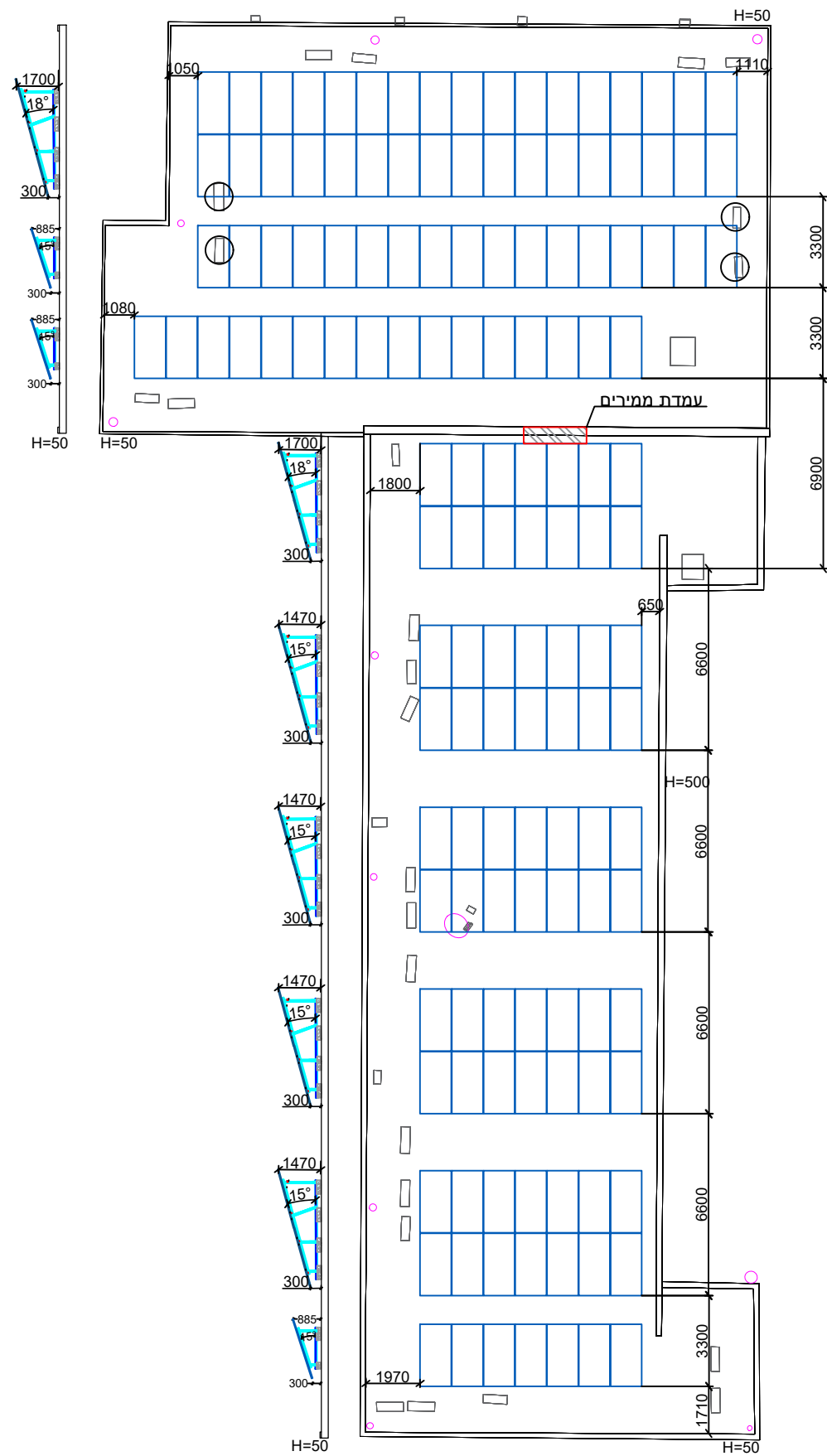
# שחר אנרגיה - בית ספר מורדי הגטאות מערכת סולארית מתח נמוך –77.76kW



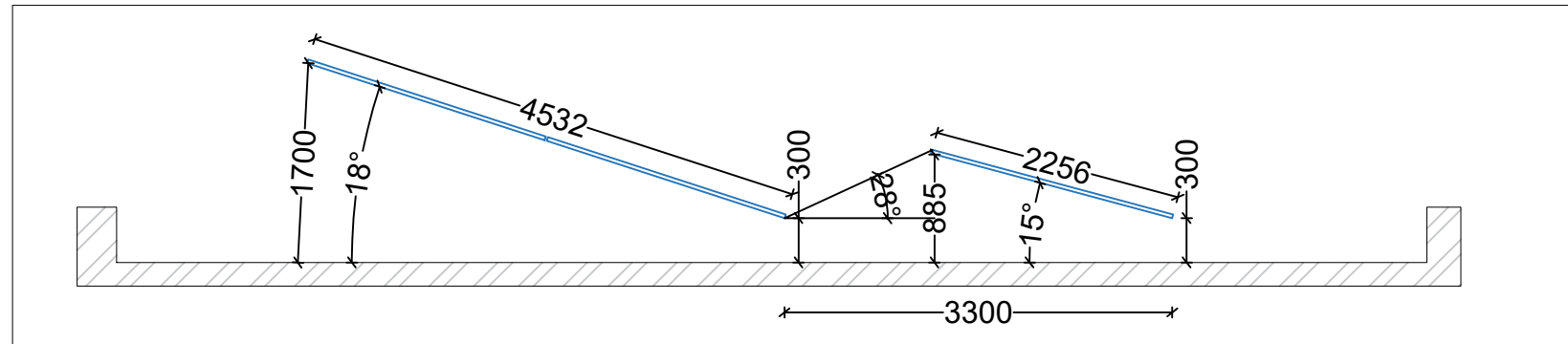
## רשימת תוכניות:

- הצבת פאנלים – Mordihagetaot School - G001
- חיווט פאנלים – Mordihagetaot School - G002
- קונסטרוקציה – Mordihagetaot School - B002
- חד קווי – Mordihagetaot School - E001
- הפסדי הולכה DC – Mordihagetaot School - C001
- הפסדי הולכה AC – Mordihagetaot School - C001
- סימולציה PVSystem – Mordihagetaot School - C001

# מורדי הגטאות - הצבת פאנלים



ביצוע כל עבודה בכפוף להוראות ממונה הבטיחות

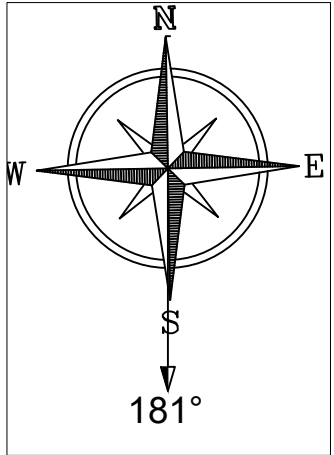
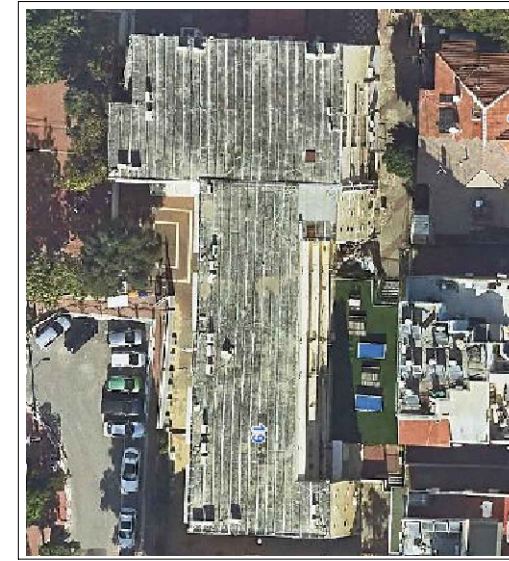
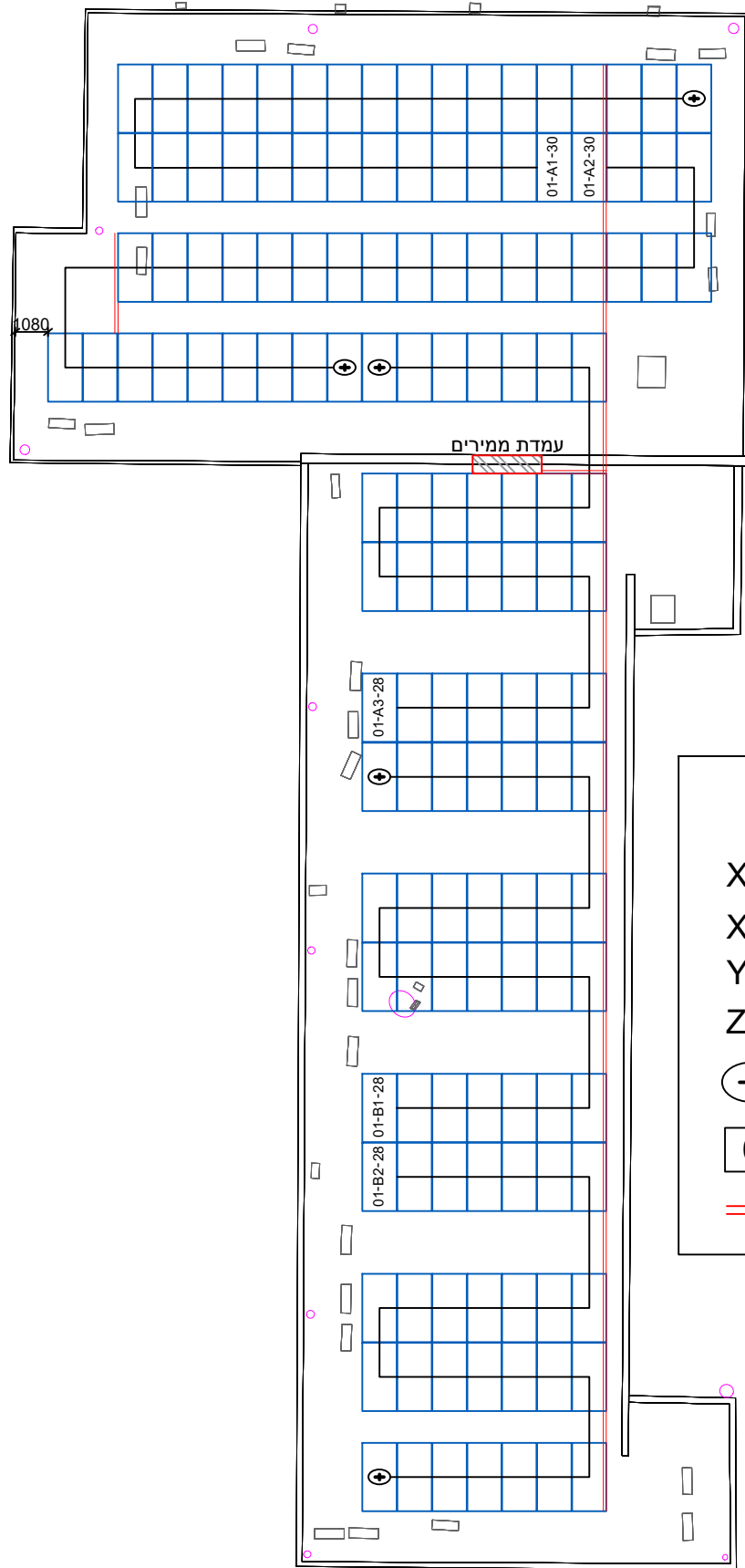


בית ספר מורדי הגטאות, רמת גן - חלוקה לסטרינגים/ממירים				540	הספק פאנל בודד (W)				
				144	מ"ס פאנלים כללי:				
				66.6	הספק כללי AC (KW):				
				77.76	הספק כללי DC (KW):				
				116.76%	יחס AC/DC:				
AC/DC	(kW) AC	הספק (kW) DC	מ"ס פאנלים	אופטימיזרים P1100	מ"ס סטרינגים	כניסת mppt	סוג ממיר (kW)	ממיר	גג
116.76%	66.6	77.76	30	15	3	Center	SE 66.6kW	1	בטון
			30	15					
			28	14	2	Left			
			28	14					
			28	14					
116.76%	66.6	77.76	144	72					סה"כ כמות:

Title: הצבת פאנלים		DRAWING NUMBER: SHR - MordiHagetaot				REV	DATE	DRAWN	COMMENTS	Panels		Inverters		Quant'
Client: שחר אנרגיה	Site location: רמת גן	DATE: 23/8/21	Scale: ###	Print size: A2	Sheet: 1/1	AO	####	####	####	Manuf': Chint [2256x1133x35]	Manuf': SolarEdge			
Designer: RoiN		APPROVAL / STAMP								Model: 540W	Model A: 66.6kW			1
Approved:										Quant': 144	Model B:			
STATUS: לאישור		REV: AO								Tilt: 15°	Model C:			
										Azimuth: 181°	Model D:			
										T.Power: 77.76kWp	T.Power: 66.6 kVA			



# מורדי הגטאות - חיווט פאנלים



ביצוע כל עבודה בכפוף להוראות ממונה הבטיחות

מקרא חיווט:

XX - YY - ZZ

XX - מספר ממיר

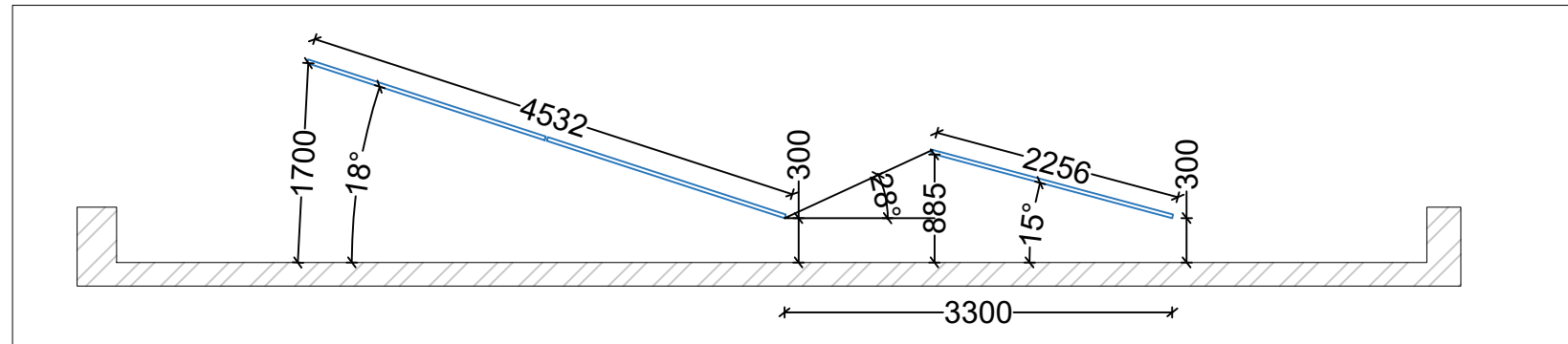
YY - mppt

ZZ - כמות פאנלים

⊕ - כיוון חיבור סטרינג

01-A - קופסת איסוף סטרינג

== DC רשת

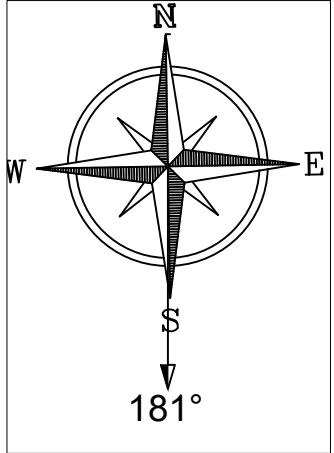
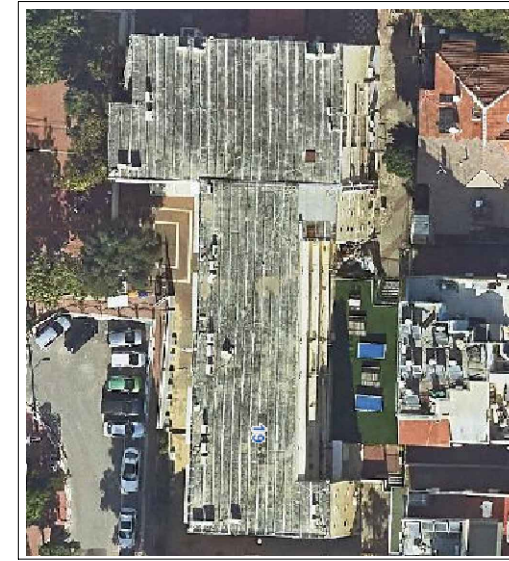


בית ספר מורדי הגטאות, רמת גן - חלוקה לסטרינגים/ממירים							540	144	66.6	77.76	116.76%			
AC/DC	(kW) AC	הספק (kW) DC	מ"ס פאנלים	אופטימיזרים P1100	מ"ס סטרינגים	mppt	סוג ממיר (kW)	ממיר	ג	ק פאנל בודד (W)	פאנלים כלי:	ק כלי AC (kW)	ק כלי DC (kW)	AC/DC
116.76%	66.6	77.76	30	15	3	Center	SE 66.6kW	1	טון					
116.76%	66.6	77.76	144	72					כמות:					

Title: <b>חיווט פאנלים</b>		DRAWING NUMBER: <b>SHR - MordiHagetaot</b>				REV	DATE	DRAWN	COMMENTS	Panels		Inverters		Quant
Client: <b>שחר אנרגיה</b>	Site location: <b>רמת גן</b>	DATE: <b>23/8/21</b>	Scale: <b>###</b>	Print size: <b>A2</b>	Sheet: <b>1/1</b>	<b>AO</b>	<b>####</b>	<b>####</b>	<b>####</b>	Manuf: <b>Chint [2256x1133x35]</b>	Manuf: <b>SolarEdge</b>			
Designer: <b>RoiN</b>		APPROVAL / STAMP								Model: <b>540W</b>	Model A: <b>66.6kW</b>			
Approved:										Quant: <b>144</b>	Model B:			
STATUS: <b>לאישור</b>		REV: <b>AO</b>								Tilt: <b>15°</b>	Model C:			
										Azimuth: <b>181°</b>	Model D:			
										T.Power: <b>77.76kWp</b>	T.Power: <b>66.6 kVA</b>			

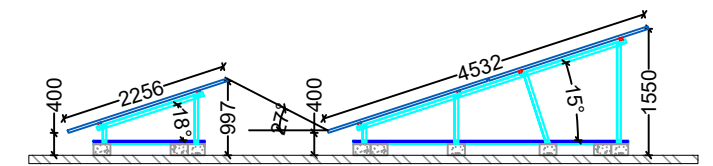


# מורדי הגטאות - קונסטרוקציה



ביצוע כל עבודה בכפוף להוראות ממונה הבטיחות

## פרט התקנת קונסטרוקציה



יש לוודא מול קונסטרוקטור את תוכנית ההצבה, כמות האבנים וחוזק הקונסטרוקציה הנושאת לפני ביצוע ההתקנה

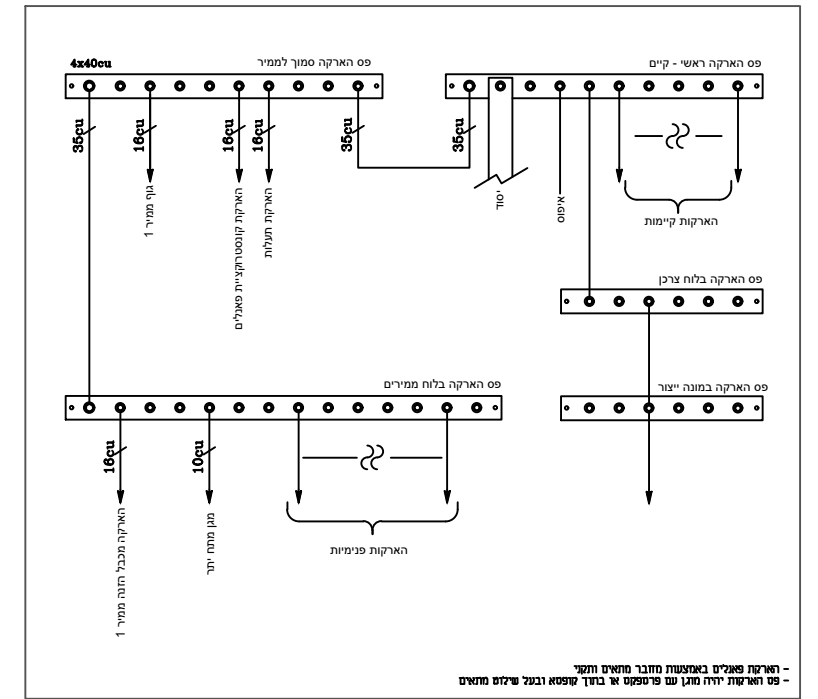
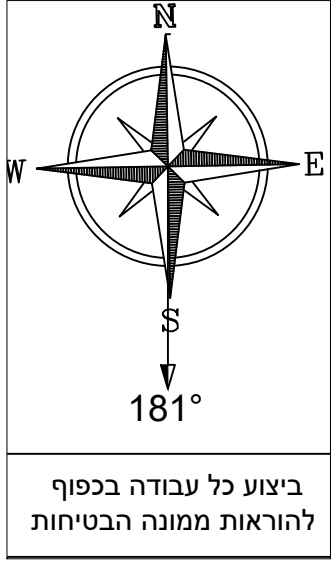
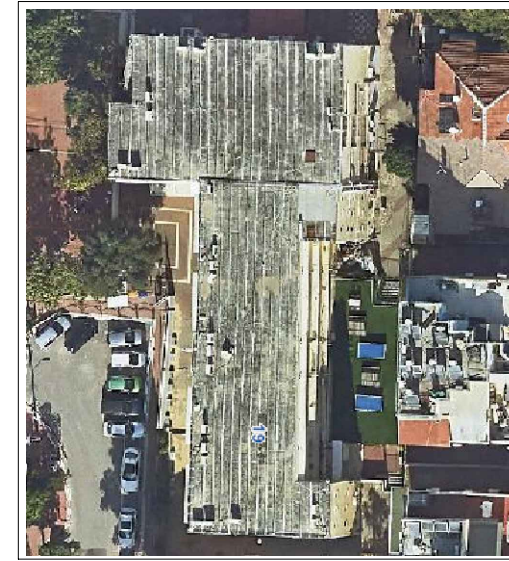
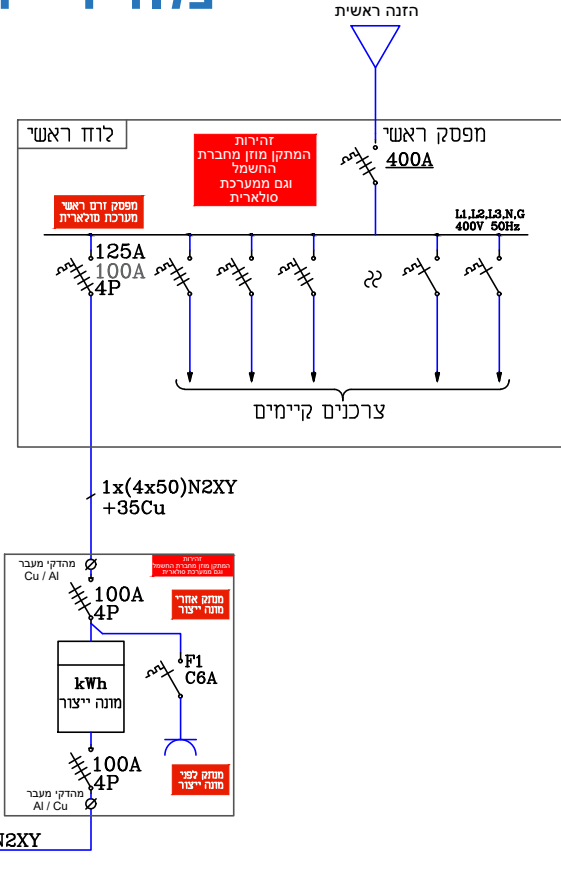
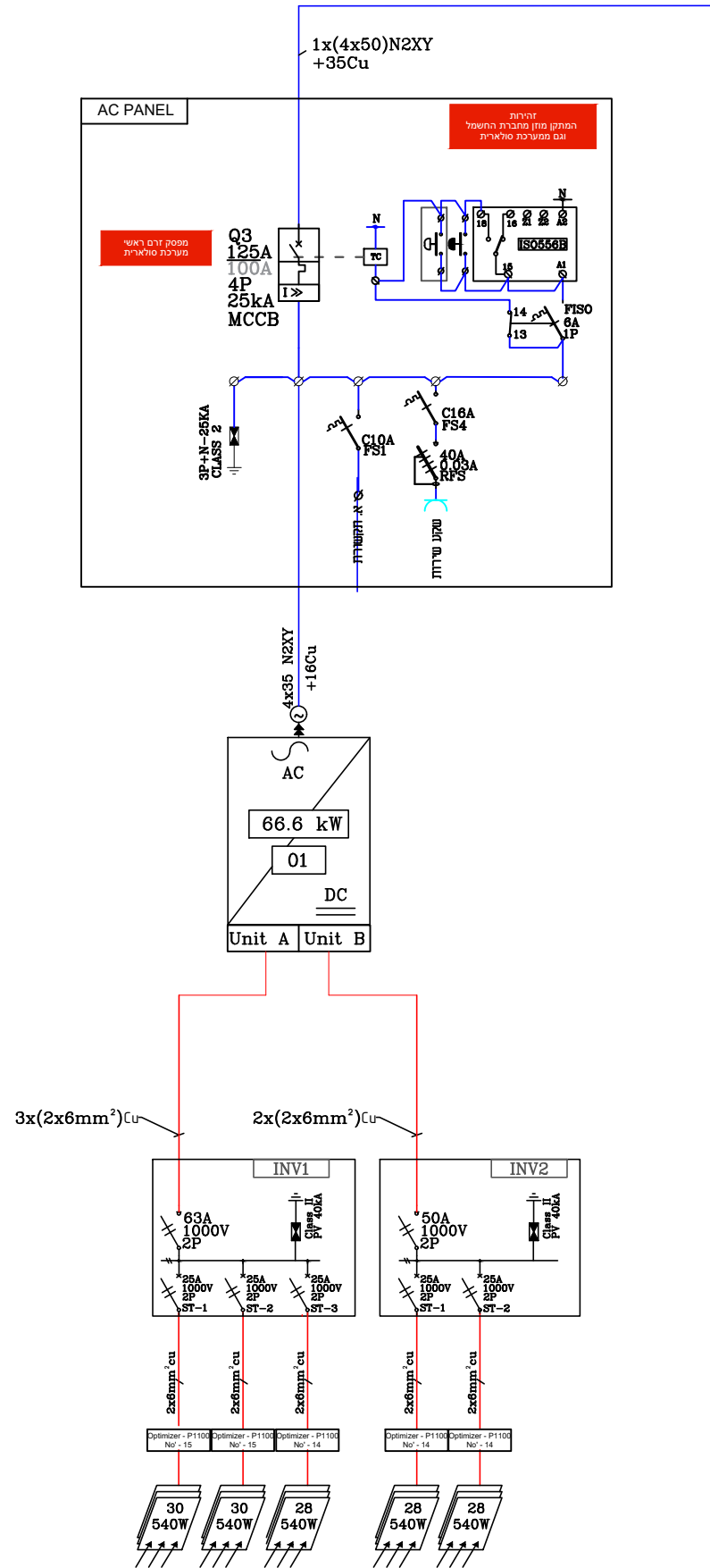
## כתב כמויות - רגליים מורדי הגטאות

כמות	תיאור	פריט
26	גובה מהרצפה: 400 מ"מ זווית: 18°	פאנל בודד
36	גובה מהרצפה: 400 מ"מ זווית: 18°	פאנל כפול
45	אורך 2.3 מ	דיאגונל
340	39 ק"ג גובה: 150, רוחב: 230, אורך: 500	אבנים

Title: <b>קונסטרוקציה</b>		DRAWING NUMBER: <b>SHR - MordiHagetaot</b>				REV	DATE	DRAWN	COMMENTS	Panels		Inverters	Quant'
Client: <b>שחר אנרגיה</b>	Site location: <b>רמת גן</b>	DATE: <b>23/8/21</b>	Scale: <b>###</b>	Print size: <b>A2</b>	Sheet: <b>1/1</b>	<b>A0</b>	<b>####</b>	<b>####</b>	<b>####</b>	Manuf: <b>Chint [2256x1133x35]</b>	Manuf: <b>SolarEdge</b>		
Designer: <b>RoiN</b>		APPROVAL / STAMP								Model: <b>540W</b>	Model A: <b>66.6kW</b>	<b>1</b>	
Approved:										Quant: <b>144</b>	Model B:		
STATUS: <b>לאישור</b>		REV: <b>A0</b>								Tilt: <b>15°</b>	Model C:		
										Azimuth: <b>181°</b>	Model D:		
										T.Power: <b>77.76kWp</b>	T.Power: <b>66.6 kVA</b>		



# מורדי הגטאות - חד קווי



- Notes:
1. Elec. panel should be compatible with IL elec. norm 61439
  2. Cables, cores, ducts and modules should be marked with proper marking
  3. Live elec. contacts must be insulated

AC/DC (kW)	הספק AC (kW)	הספק DC (kW)	מ"ס פאנלים	אופטימיזרים P1100	מ"ס טרינגים	כניסת mppt (kW)	סוג ממיר	ממיר	ק"ק כולל (kW)	ק"ק כולל (kW)	ק"ק כולל (W)
116.76%	66.6	77.76	30	15	3	Center	SE 66.6kW	1	66.6	77.76	540
116.76%	66.6	77.76	30	15	3	Center	SE 66.6kW	1	66.6	77.76	540
116.76%	66.6	77.76	28	14	2	Left	SE 66.6kW	1	66.6	77.76	540
116.76%	66.6	77.76	28	14	2	Left	SE 66.6kW	1	66.6	77.76	540
116.76%	66.6	77.76	144	72					66.6	77.76	540

Title: <b>חד קווי</b>		DRAWING NUMBER: <b>SHR - MordiHagetaot</b>			REV: <b>AO</b>	DATE: <b>####</b>	DRAWN: <b>####</b>	COMMENTS: <b>####</b>	Panels		Inverters		Quant'
Client: <b>שחר אנרגיה</b>	Site location: <b>רמת גן</b>	DATE: <b>23/8/21</b>	Scale: <b>####</b>	Print size: <b>A2</b>	Sheet: <b>1/1</b>				Manuf': <b>Chint [2256x1133x35]</b>	Manuf': <b>SolarEdge</b>			
Designer: <b>RoiN</b>		APPROVAL / STAMP							Model: <b>540W</b>	Model A: <b>66.6kW</b>			
Approved:									Quant': <b>144</b>	Model B:			
STATUS: <b>לאישור</b>		REV: <b>AO</b>							Tilt: <b>15°</b>	Model C:			
									Azimuth: <b>181°</b>	Model D:			
									T.Power: <b>77.76kWp</b>	T.Power: <b>66.6 kVA</b>			



## DC CABLE CALCULATION & POWER LOSSES

DATA		Cable Calculation									Production Losses		
Module Type	540	mm <sup>2</sup>	Copper			Aluminum						Grid Load	100%
Imp [A]	12.86		4	6	16	25	35	50	95	120	240	Power Losses	0.18%
Vmp [V]	41.60												
Module amount	144	Length	0	310	0	0	0	0	0	0	0		142W
Total Power [kWp]	77,760												

Inverter	Module No'	Module No' Inv/String	Parallel Strings	Power [W]	Current [A]	Max Current Carrying Capacity [A]	Resistance [ $\Omega$ /1000m]	No' Cable Sets	Cross section [mm <sup>2</sup> ]	Cable Lengh [M]	Voltage Drop [V]	Power losses [W]	$\Delta P$ %	
Inv01	144	144		77760										
ST-1	30	30	1	16200	12.86	36.75	3.59	1	6	35	3	42	0.26%	String Losses
ST-2	30	30	1	16200	12.86	36.75	3.59	1	6	25	2	30	0.18%	
ST-3	28	28	1	15120	12.86	36.75	3.59	1	6	30	3	36	0.24%	
ST-4	28	28	1	15120	12.86	36.75	3.59	1	6	30	3	36	0.24%	
ST-5	28	28	1	15120	12.86	36.75	3.59	1	6	35	3	42	0.27%	
												142	0.18%	Total losses
				77,760								142	0.18%	TOTAL

DATA				AC CABLE CALCULATION & POWER LOSSES												Production Losses			
Module Type	540	Voltage [V]	400	<b>בית ספר מורדי הגטאות</b>												Avg' Voltage Drop	0.96%		
Imp [A]	12.86	Load [%]	100%													Max Voltage Drop	0.96%		
Vmp [V]	41.60	Cos Ph	1													Power Losses	0.95%		
Module amount	144	Total Power [kVA]	68.00														629.58W		
Total Power [kWp]	77,760																		

FROM	TO	Module amount DC	DC Power [kW]	AC Power [kVA]	MAX AC Current [A]	Cable Length [m]	Cable Type	Cross Section [mm^2]	No' Cable sets	Installation type	K1 Ambient Temp'	K2 No' Cable sets	K3 No' Cables in Conduit	K4 Thermal resistance (W/km)	Max Current Carrying Capacity [A]	R (at cable temp.) [Ω/Km]	Z (impedance) [Ω/Km]	ΔU Cable [V]	Power Losses [W]	ΔU Cable [%]	ΔU AC Line [%]	Power Losses [%]	
INV 1	LVP	144	77.8	66.60	96.13	4	4x35 NA2XY Copper	35	1	Air	0.95	0.88	1	1	94.5	0.555	0.561	0.37	61.5	0.09%	0.96%	0.04%	
LVP	IEC Meter	144	77.8	66.60	96.13	50	4x50 NA2XY Copper	50	1	Air	0.95	1	1	1	127.3	0.410	0.418	3.48	568.0	0.87%	<b>0.87%</b>	0.39%	
AC [kVA]	66.60																			629.6	Total Losses		0.95%

# PVsyst - Simulation report

## Grid-Connected System

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Project: SHR Ramat Gan MordiHagetaot

Variant: New simulation variant

Sheds, single array

System power: 77.8 kWp

Ramat Yitzhak - Israel

**Author**

Green Panel (Israel)





# Project: SHR Ramat Gan MordiHageaot

Variant: New simulation variant

## PVsyst V7.2.8

VC2, Simulation date:  
09/11/21 10:37  
with v7.2.8

### Project summary

<b>Geographical Site</b>		<b>Situation</b>		<b>Project settings</b>	
Ramat Yitzhak		Latitude	32.08 °N	Albedo	0.20
Israel		Longitude	34.83 °E		
		Altitude	48 m		
		Time zone	UTC+2		
<b>Meteo data</b>					
Ramat Yitzhak					
Meteonorm 7.3 (1990-2004), Sat=100% - Synthetic					

### System summary

<b>Grid-Connected System</b>		<b>Sheds, single array</b>		<b>User's needs</b>	
<b>PV Field Orientation</b>		<b>Near Shadings</b>		Unlimited load (grid)	
Fixed plane		According to strings			
Tilt/Azimuth	15 / 7 °	Electrical effect	100 %		
<b>System information</b>					
<b>PV Array</b>					
Nb. of modules	144 units	<b>Inverters</b>		2 units	
Pnom total	77.8 kWp	Nb. of units		66.6 kWac	
		Pnom total		1.168	
		Pnom ratio			

### Results summary

Produced Energy	130.4 MWh/year	Specific production	1677 kWh/kWp/year	Perf. Ratio PR	76.94 %
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### Table of contents

Project and results summary	2
General parameters, PV Array Characteristics, System losses	3
Near shading definition - Iso-shadings diagram	5
Main results	6
Loss diagram	7
Special graphs	8



# Project: SHR Ramat Gan MordiHagetaot

Variant: New simulation variant

## PVsyst V7.2.8

VC2, Simulation date:  
09/11/21 10:37  
with v7.2.8

### General parameters

Grid-Connected System		Sheds, single array			
<b>PV Field Orientation</b>		<b>Sheds configuration</b>		<b>Models used</b>	
<b>Orientation</b>		<b>Nb. of sheds</b>	9 units	<b>Transposition</b>	Perez
Fixed plane		<b>Sizes</b>		<b>Diffuse</b>	Perez, Meteororm
Tilt/Azimuth	15 / 7 °	<b>Sheds spacing</b>	5.84 m	<b>Circumsolar</b>	separate
		<b>Collector width</b>	3.90 m		
		<b>Ground Cov. Ratio (GCR)</b>	66.9 %		
<b>Horizon</b>		<b>Near Shadings</b>		<b>User's needs</b>	
Free Horizon		<b>According to strings</b>		Unlimited load (grid)	
		<b>Electrical effect</b>	100 %		

### PV Array Characteristics

<b>PV module</b>		<b>Inverter</b>	
Manufacturer	Longi Solar	Manufacturer	SolarEdge
Model	LR5-72 HPH 540 M	Model	SE66.6K/SE100K-EU-APAC/AUS Unit (400V)
(Original PVsyst database)		(Original PVsyst database)	
Unit Nom. Power	540 Wp	Unit Nom. Power	33.3 kWac
Number of PV modules	144 units	Number of inverters	2 units
Nominal (STC)	77.8 kWp	Total power	66.6 kWac
<b>SolarEdge Power Optimizer</b>			
Model	P1100 Worldwide		
Unit Nom. Power	1100 W		
Modules	1 String x 2 in series		
<b>Array #1 - PV Array</b>			
Number of PV modules	84 units	Number of inverters	1.2 unit
Nominal (STC)	45.4 kWp	Total power	38.9 kWac
Optimizer Array	3 Strings x 14 In series		
<b>At operating cond. (50°C)</b>		Operating voltage	750 V
Pmpp	41.5 kWp	Pnom ratio (DC:AC)	1.09
Output of optimizers			
Voper	750 V		
I at Poper	55 A		
<b>Array #2 - Sub-array #2</b>			
Number of PV modules	60 units	Number of inverters	0.8 unit
Nominal (STC)	32.4 kWp	Total power	27.8 kWac
Optimizer Array	2 Strings x 15 In series		
<b>At operating cond. (50°C)</b>		Operating voltage	750 V
Pmpp	29.62 kWp	Pnom ratio (DC:AC)	1.09
Output of optimizers			
Voper	750 V		
I at Poper	39 A		
<b>Total PV power</b>		<b>Total inverter power</b>	
Nominal (STC)	78 kWp	Total power	66.6 kWac
Total	144 modules	Nb. of inverters	2 units
Module area	368 m <sup>2</sup>	Pnom ratio	1.17
Cell area	334 m <sup>2</sup>		



**PVsyst V7.2.8**

VC2, Simulation date:  
09/11/21 10:37  
with v7.2.8

**Array losses**

<b>Array Soiling Losses</b>		<b>Thermal Loss factor</b>		<b>LID - Light Induced Degradation</b>	
Loss Fraction	3.0 %	Module temperature according to irradiance		Loss Fraction	2.0 %
		Uc (const)	23.0 W/m²K		
		Uv (wind)	0.0 W/m²K/m/s		
<b>Module Quality Loss</b>		<b>Module mismatch losses</b>		<b>Strings Mismatch loss</b>	
Loss Fraction	0.0 %	Loss Fraction (Fixed voltage) 0.0 %		Loss Fraction	0.1 %
<b>IAM loss factor</b>					
ASHRAE Param: IAM = 1 - bo(1/cosi -1)					
bo Param.	0.05				

**DC wiring losses**

Global wiring resistance	10 mΩ				
Loss Fraction	1.5 % at STC				
<b>Array #1 - PV Array</b>		<b>Array #2 - Sub-array #2</b>			
Global array res.	186 mΩ	Global array res.	260 mΩ		
Loss Fraction	1.5 % at STC	Loss Fraction	1.5 % at STC		

**System losses**

<b>Unavailability of the system</b>	
Time fraction	2.5 %
	9.1 days,
	3 periods

**AC wiring losses**

<b>Inv. output line up to injection point</b>	
Inverter voltage	400 Vac tri
Loss Fraction	1.50 % at STC
<b>Global System</b>	
Wire section	Alu 3 x 70 mm²
Wires length	70 m

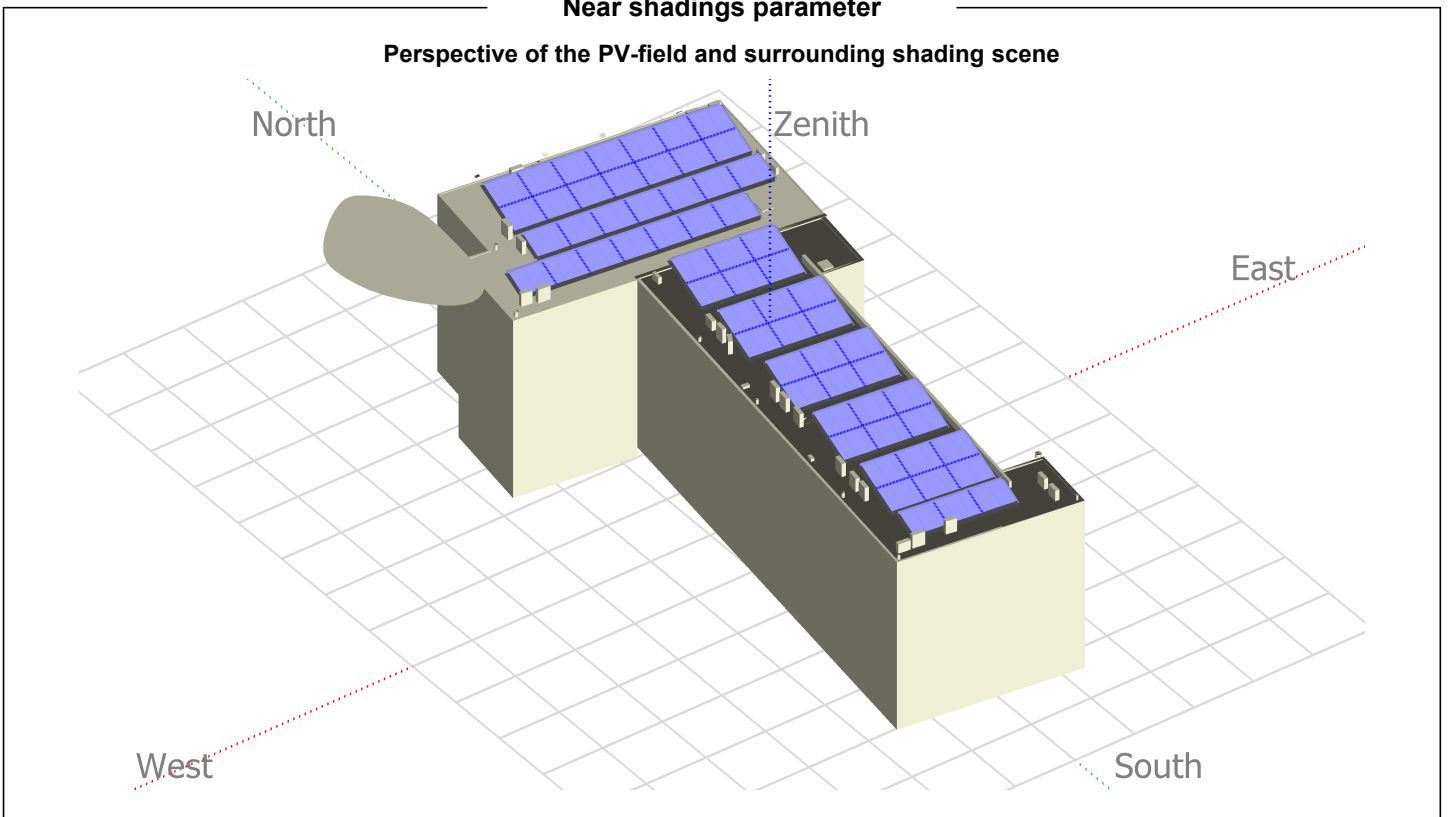


PVsyst V7.2.8

VC2, Simulation date:  
09/11/21 10:37  
with v7.2.8

Near shadings parameter

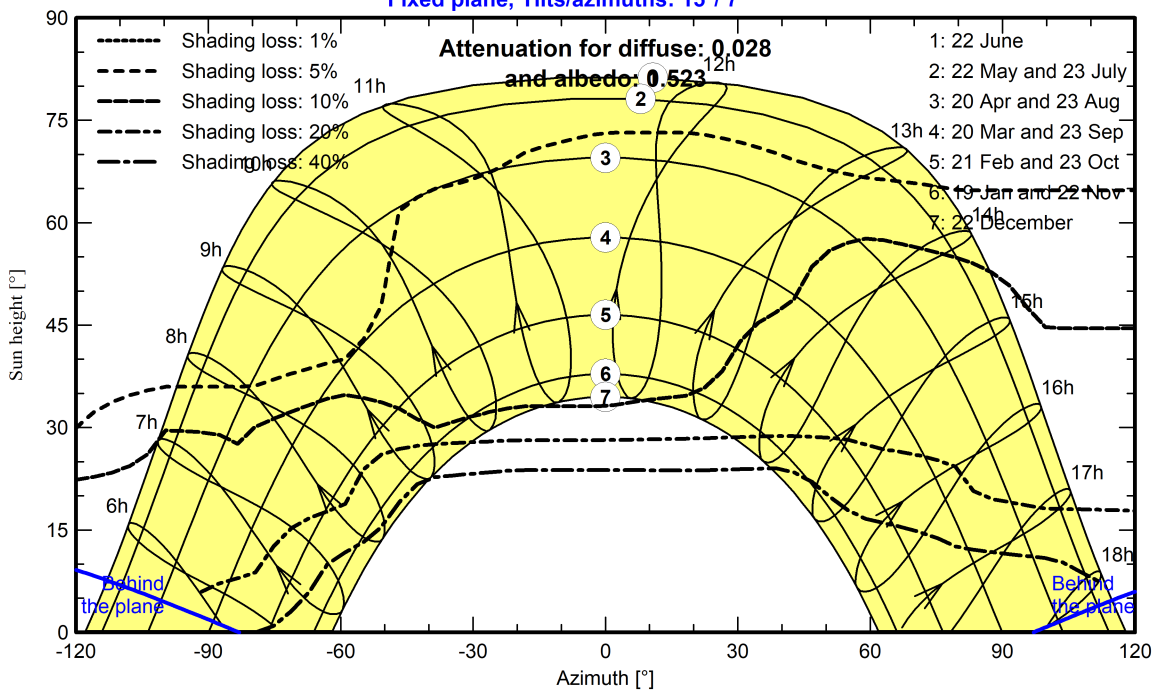
Perspective of the PV-field and surrounding shading scene



Iso-shadings diagram

SHR Ramat Gan MordiHageaot - Legal Time

Fixed plane, Tilts/azimuths: 15°/ 7°





**PVsyst V7.2.8**

VC2, Simulation date:  
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**Main results**

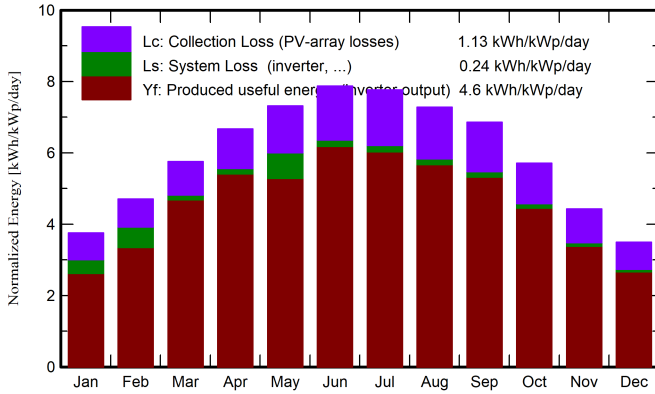
**System Production**

Produced Energy 130.4 MWh/year

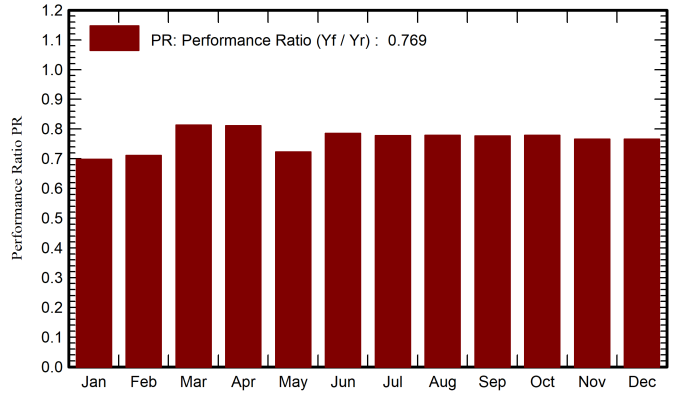
Specific production  
Performance Ratio PR

1677 kWh/kWp/year  
76.94 %

**Normalized productions (per installed kWp)**



**Performance Ratio PR**



**Balances and main results**

	<b>GlobHor</b> kWh/m <sup>2</sup>	<b>DiffHor</b> kWh/m <sup>2</sup>	<b>T_Amb</b> °C	<b>GlobInc</b> kWh/m <sup>2</sup>	<b>GlobEff</b> kWh/m <sup>2</sup>	<b>EArray</b> MWh	<b>E_Grid</b> MWh	<b>PR</b> ratio
<b>January</b>	92.1	38.67	12.89	116.5	107.1	7.27	6.32	0.698
<b>February</b>	110.6	46.31	13.53	131.9	122.4	8.55	7.29	0.711
<b>March</b>	159.8	62.32	16.27	178.4	167.0	11.61	11.29	0.814
<b>April</b>	190.0	71.88	19.23	200.1	187.8	12.99	12.62	0.811
<b>May</b>	226.6	76.21	22.47	226.7	212.7	14.49	12.74	0.723
<b>June</b>	241.9	59.57	25.29	236.1	221.7	14.85	14.42	0.786
<b>July</b>	244.0	61.51	28.18	240.6	226.2	14.98	14.55	0.778
<b>August</b>	218.2	67.04	28.43	225.8	212.1	14.07	13.67	0.779
<b>September</b>	186.5	47.45	26.36	205.7	193.1	12.78	12.42	0.777
<b>October</b>	149.5	46.08	23.76	177.1	165.2	11.03	10.73	0.779
<b>November</b>	105.0	34.10	18.84	132.8	122.8	8.12	7.91	0.766
<b>December</b>	84.7	38.07	15.00	108.2	99.0	6.61	6.44	0.766
<b>Year</b>	2008.9	649.21	20.90	2179.9	2037.1	137.35	130.42	0.769

**Legends**

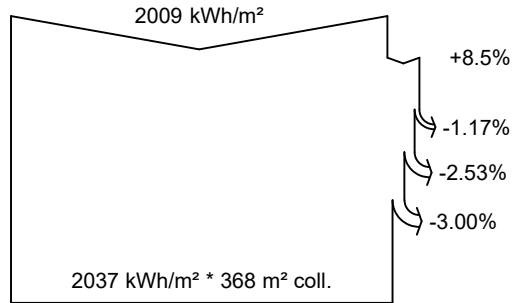
- GlobHor Global horizontal irradiation
- DiffHor Horizontal diffuse irradiation
- T\_Amb Ambient Temperature
- GlobInc Global incident in coll. plane
- GlobEff Effective Global, corr. for IAM and shadings
- EArray Effective energy at the output of the array
- E\_Grid Energy injected into grid
- PR Performance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



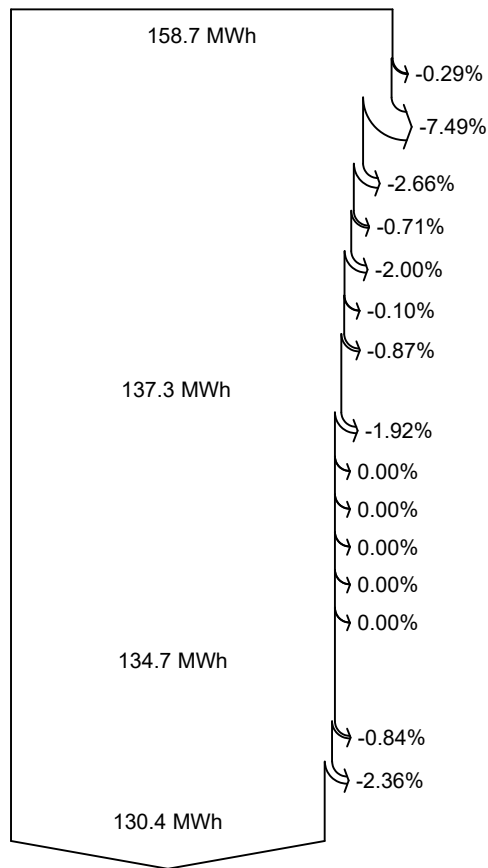
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Loss diagram



efficiency at STC = 21.17%



**Global horizontal irradiation**

**Global incident in coll. plane**

Near Shadings: irradiance loss

IAM factor on global

Soiling loss factor

**Effective irradiation on collectors**

PV conversion

**Array nominal energy (at STC effic.)**

PV loss due to irradiance level

PV loss due to temperature

Shadings: Electrical Loss acc. to strings

Optimizer efficiency loss

LID - Light induced degradation

Mismatch loss, modules and strings

Ohmic wiring loss

**Array virtual energy at MPP**

Inverter Loss during operation (efficiency)

Inverter Loss over nominal inv. power

Inverter Loss due to max. input current

Inverter Loss over nominal inv. voltage

Inverter Loss due to power threshold

Inverter Loss due to voltage threshold

**Available Energy at Inverter Output**

AC ohmic loss

System unavailability

**Energy injected into grid**

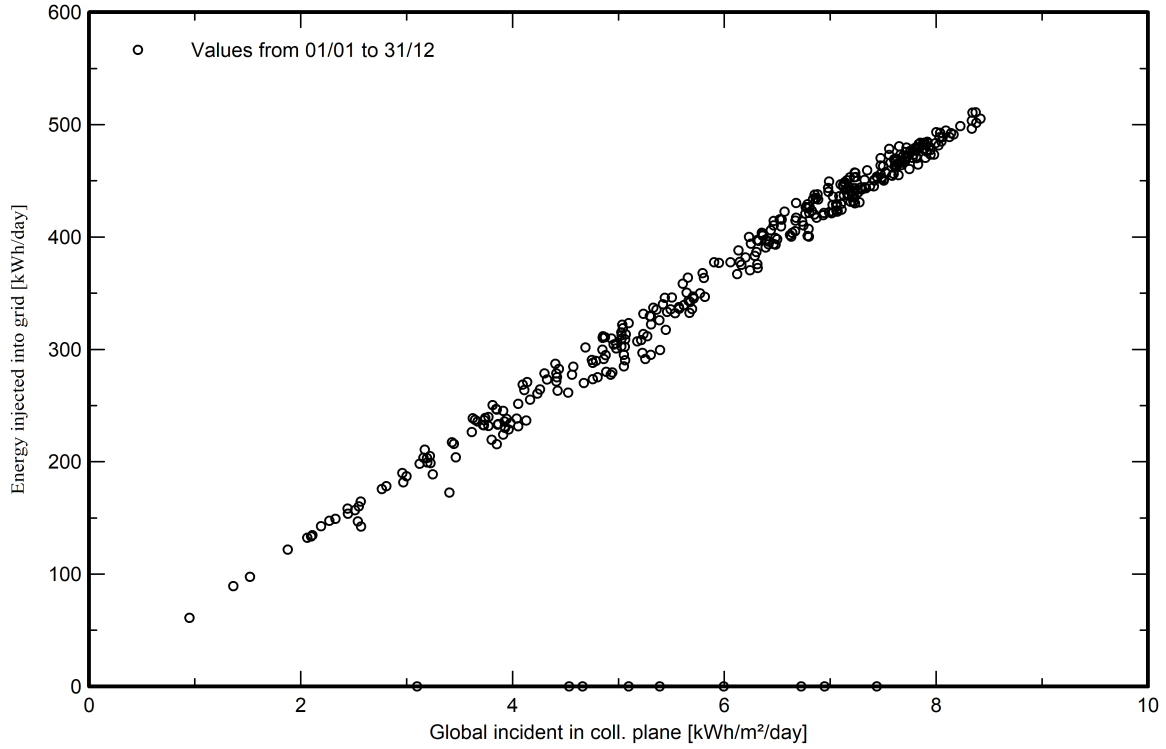


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**Special graphs**

**Daily Input/Output diagram**



**System Output Power Distribution**

