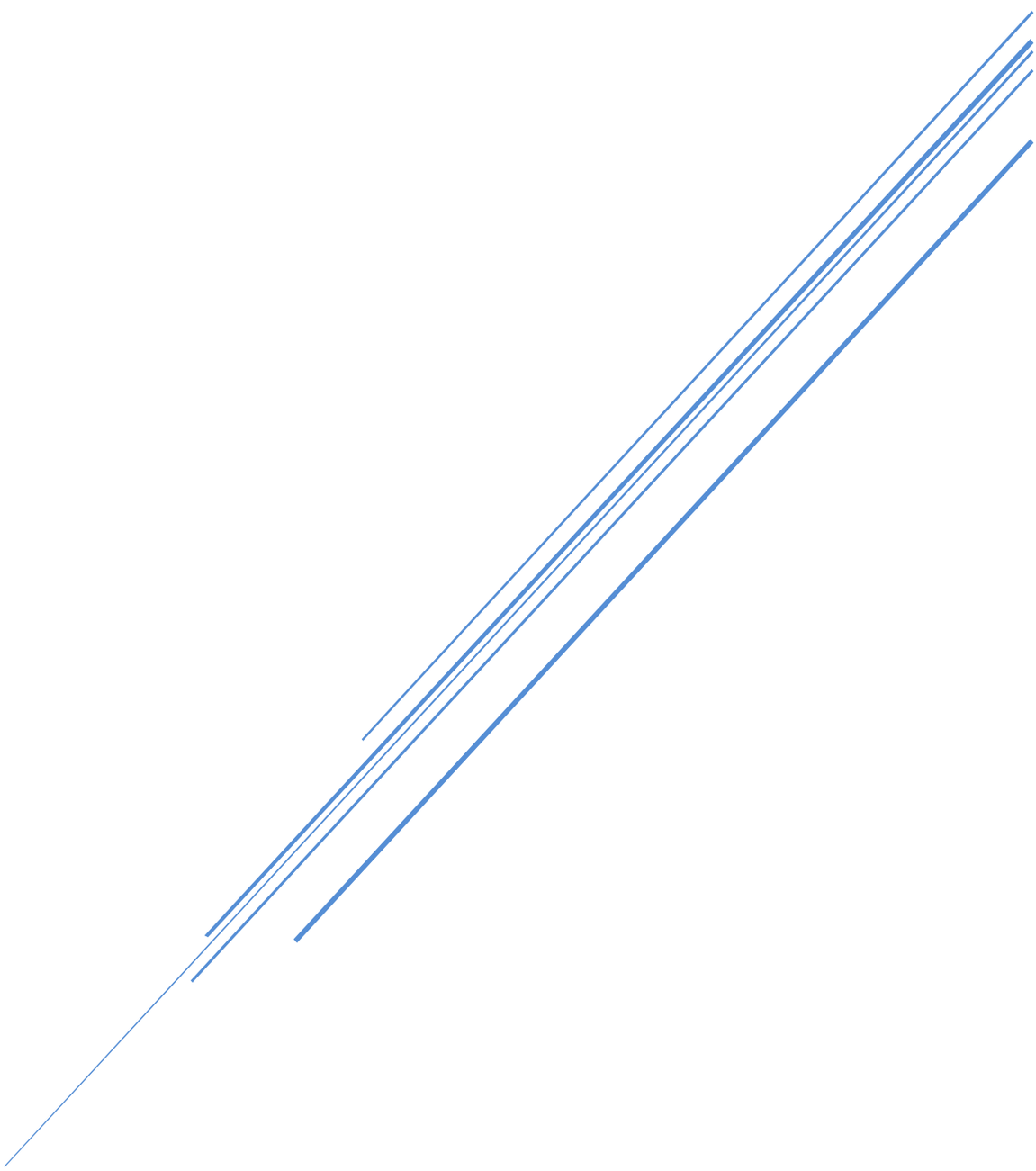
POWER OF THE SUN

Case study of 3 kW rooftop solar power system



Shaktisteller Energy Solutions

Grid-Connect Solar Energy Solutions

Shaktisteller Solar systems – numero uno in solar installations

Energy Efficiency installers trust the expertise of SSE energy systems to deliver & install their renewable energy products, photovoltaic systems and components with no exception to metering solutions and different department liasions.

Expert client consultation

Customer service and added value are at the top of our priority list. SSE Energy Solution's dedicated technical team offers each customer expert technical solution to any photovoltaic scheme you may encounter.

Trusted Brands form world's leading manufacturers

We offer our customers a wide selection of high efficiency solar modules, inverters and accessories for grid-connect systems from world class manufacturers. Custom mounting structure as per site requirement and customer demand is made available by our trained professionals. We offer the best product at the most competitive price & ensure your supply chain and management service is a pleasant experience.

- **Mounting systems**
- **Inverter string configurations**
- **Product specifications & recommendations**
- **Yield calculation projection**
- **In house photovoltaic system designs**

Adhering to MNRE Compliance

SSE energy solution product management & technical team operate alongside our suppliers on product quality and service, every component is carefully selected on its technical performance, longevity and warranty for a better customer experience.

Case Study

Residential Consumer, Bhopal

Installation	
Property Type:	Residential House 10 kW load
Installer:	Shaktisteller ESPL
Property Location:	Chunabhatti, Bhopal
Roof Orientation:	South

Photovoltaic System	
Module Type:	Anchor Panasonic 260 W_p mono
PV System Size:	3 kW_p
Inverter:	Growatt, 3000-s, 3 kW_p Grid connect
Mounting System:	SSE, on-roof
Generation per month:	495 kWh

Grid-Connected System: Simulation parameters

Project :	**Grid-Connected Project at Bhopal**			
Geographical Site	**Bhopal**		**Country**	**India**
Situation	Latitude	23.3°N	Longitude	77.6°E
Time defined as	Legal Time	Time zone UT+6	Altitude	521 m
	Albedo	0.30		
Meteo data :	Bhopal, Synthetic Hourly data			

Simulation variant :	**New simulation variant**			
	Simulation date	21/03/17 12h05		

Simulation parameters

Collector Plane Orientation	Tilt	23°	Azimuth	0°
Horizon	Free Horizon			
Near Shadings	No Shadings			

PV Array Characteristics

PV module	Si-poly	Model	**AE6P250WB3A**	
		Manufacturer	PANASONIC	
Number of PV modules		In series	12 modules	In parallel 1 strings
Total number of PV modules		Nb. modules	12	Unit Nom. Power 250 Wp
Array global power		Nominal (STC)	**3.0 kWp**	At operating cond. 2.71 kWp (50°C)
Array operating characteristics (50°C)		U mpp	339 V	I mpp 8 A
Total area		Module area	**19.5 m²**	Cell area 17.5 m²

Inverter		Model	**GROWATT 3000-S**	
		Manufacturer	SHENZEN GROWATT	
Characteristics		Operating Voltage	70-500 V	Unit Nom. Power 3.0 kW AC

PV Array loss factors

Thermal Loss factor		Uc (const)	29.0 W/m²K	Uv (wind) 0.0 W/m²K / m/s
=> Nominal Oper. Coll. Temp. (G=800 W/m², Tamb=20°C, Wind velocity = 1m/s.)				NOCT 45 °C
Wiring Ohmic Loss		Global array res.	702 mOhm	Loss Fraction 1.5 % at STC
Module Quality Loss				Loss Fraction 2.5 %
Module Mismatch Losses				Loss Fraction 2.0 % at MPP
Incidence effect, ASHRAE parametrization		IAM =	1 - bo (1/cos i - 1)	bo Parameter 0.05

Bill Number	**883346490764**		
Mr./Ms	**KAILASH NARAYAN/ SHYAM LAL**		
Address	**H.NO.49 NIRMAL KALPNA SOCIETY, CHUNA BHATTI,. BHOPAL . MP**		
Phone Number		Mobile.	**9039915880**
Meter Serial Number	**20020298**	Phase given	**THREE**
Roof Area Available	**440 sq ft**	Load Sanctioned	**9200 W**
Area required	**389 sq ft**		

Consumption Details of previous Months*

Reading Month	Reading Date	Reading	Units Consumed
AUG-2017	**03/08/2017**	**6947**	**271**
SEP-2017	**04/09/2017**	**7270**	**323**
OCT-2017	**05/10/2017**	**7615**	**345**
NOV-2017	**04/11/2017**	**7916**	**301**
DEC-2017	**04/12/2017**	**8140**	**224**
JAN-2018	**04/01/2018**	**8380**	**240**

Daily Average of current Bill **21** Unit
Average Daily Units Consumed **16** Unit

Recomended solar plant: **3 kW On-Grid**
Daily Aveerage Generation: **16.5 Unit**

Structure Design

Roof Area Available	440 sq ft	Surge Protection	32 kA
Area required	389 sq ft	Structure Width	14 ft
Structure Height	7.5 ft	Structure length	10 ft
Horizon	Free	System Config.	1 Phase / 13 A, 230 V AC

Cost Benefit Analysis

** Solar Panel detioration makes output reduced by 10% at the end of 15 years and 20% at the end of 25 years*
** Consumption pattern increases over the years by 10 % every 5 years*
** Rate of electricity tariff increases at a rate of 9% per year inflation rate*
** Insurance and maintenance cost varies as per projected inflation rates*

Cost of material	Cost of installation	Total Cost of set up	Material Cost / Watt	Installation cost / Watt	Down Payment	Loan Amount (60%)	Tenure	Interest Rate	EMI	Total amount	Panel Detioration rate
₹ 165,000.00	₹ 42,075.00	₹ 217,575.00	₹ 55.00	₹ 14.03	₹ 87,030.00	₹ -	2	14%	₹ -	₹ 228,453.75	0.150%

Finance required? (1=Y, 0=N)	O&M	Average Units consumption per month	Avg. Generation per month	Monthly bill reduction	Old billing amount	Generated energy amount	New Bill amount	Saving	Plant Size in kW	ROI (with subsidy)	Area covered (sq ft.)
₹ -	₹ 4,950.00	786	₹ 495.00	63%	₹ 9,776.13	₹ 3,465.00	₹ 2,057.01	₹ 7,719.12	3	2.1	300.330

Year	PPA cost	Unit cost of energy (Tariff)	Solar Generation (Yearly)	Self consumption (Yearly electricity units)	Energy sent to grid	Income from net metering scheme	Gross reduction in utility bill	Insurance Premium	Maintenance cost	Annual Instalment	Savings
1	₹ 2.97	₹ 7.00	₹ 5,940.00	9432.00	0.00	₹ -	₹ 41,580.00	761.51	1631.81	₹ -	37129.67
2	₹ 2.97	₹ 7.63	₹ 5,940.00	9432.00	0.00	₹ -	₹ 45,322.20	776.45	1663.81	₹ -	40824.93
3	₹ 2.97	₹ 8.32	₹ 5,940.00	9432.00	0.00	₹ -	₹ 49,401.20	791.67	1696.44	₹ -	44856.08
4	₹ 2.97	₹ 9.07	₹ 5,940.00	9432.00	0.00	₹ -	₹ 53,847.31	807.20	1729.71	₹ -	49253.39
5	₹ 2.97	₹ 9.88	₹ 5,940.00	9432.00	0.00	₹ -	₹ 58,693.56	823.03	1763.63	₹ -	54049.90
6	₹ 2.97	₹ 10.77	₹ 5,940.00	9432.00	0.00	₹ -	₹ 63,975.98	839.17	1798.21	₹ -	59281.60
7	₹ 2.97	₹ 11.74	₹ 5,931.09	9526.32	0.00	₹ -	₹ 69,629.22	855.62	1833.47	₹ -	₹ 64,883.12
8	₹ 2.97	₹ 12.80	₹ 5,922.19	9526.32	0.00	₹ -	₹ 75,782.01	872.40	1869.43	₹ -	₹ 70,983.17
9	₹ 2.97	₹ 13.95	₹ 5,913.31	9526.32	0.00	₹ -	₹ 82,478.49	889.51	1906.09	₹ -	₹ 77,625.88
10	₹ 2.97	₹ 15.20	₹ 5,904.44	9526.32	0.00	₹ -	₹ 89,766.70	906.95	1943.47	₹ -	₹ 84,859.27
11	₹ 2.97	₹ 16.57	₹ 5,895.58	9526.32	0.00	₹ -	₹ 97,698.93	924.74	1981.58	₹ -	₹ 92,735.61
12	₹ 2.97	₹ 18.06	₹ 5,886.74	9526.32	0.00	₹ -	₹ 106,332.10	942.87	2020.44	₹ -	₹ 101,311.78
13	₹ 2.97	₹ 19.69	₹ 5,877.91	9620.64	0.00	₹ -	₹ 115,728.13	961.36	2060.06	₹ -	₹ 110,649.71
14	₹ 2.97	₹ 21.46	₹ 5,869.09	9620.64	0.00	₹ -	₹ 125,954.45	980.21	2100.45	₹ -	₹ 120,816.77
15	₹ 2.97	₹ 23.39	₹ 5,860.29	9620.64	0.00	₹ -	₹ 137,084.41	999.43	2141.64	₹ -	₹ 131,886.32
16	₹ 2.97	₹ 25.50	₹ 5,558.48	9620.64	0.00	₹ -	₹ 141,726.78	1019.03	2183.64	₹ -	₹ 136,467.09
17	₹ 2.97	₹ 27.79	₹ 5,272.22	9620.64	0.00	₹ -	₹ 146,526.35	1039.02	2226.46	₹ -	₹ 141,203.86
18	₹ 2.97	₹ 30.29	₹ 5,000.70	9620.64	0.00	₹ -	₹ 151,488.47	1059.39	2270.12	₹ -	₹ 146,101.94
19	₹ 2.97	₹ 33.02	₹ 4,743.17	9714.96	0.00	₹ -	₹ 156,618.63	1080.17	2314.64	₹ -	₹ 151,166.81
20	₹ 2.97	₹ 35.99	₹ 4,498.89	9714.96	0.00	₹ -	₹ 161,922.52	1101.35	2360.03	₹ -	₹ 156,404.13
21	₹ 2.97	₹ 39.23	₹ 4,267.20	9714.96	0.00	₹ -	₹ 167,406.02	1122.95	2406.31	₹ -	₹ 161,819.75
22	₹ 2.97	₹ 42.76	₹ 4,047.44	9714.96	0.00	₹ -	₹ 173,075.23	1144.97	2453.50	₹ -	₹ 167,419.75
23	₹ 2.97	₹ 46.61	₹ 3,839.00	9714.96	0.00	₹ -	₹ 178,936.42	1167.42	2501.61	₹ -	₹ 173,210.38
24	₹ 2.97	₹ 50.81	₹ 3,641.29	9714.96	0.00	₹ -	₹ 184,996.10	1190.31	2550.67	₹ -	₹ 179,198.11
25	₹ 2.97	₹ 55.38	₹ 3,635.83	9903.60	0.00	₹ -	₹ 201,343.28	1213.65	2600.69	₹ -	₹ 195,471.93

7, Surbhi Homes - 462023-Bhopal - India
Redefining Solar Engineerng

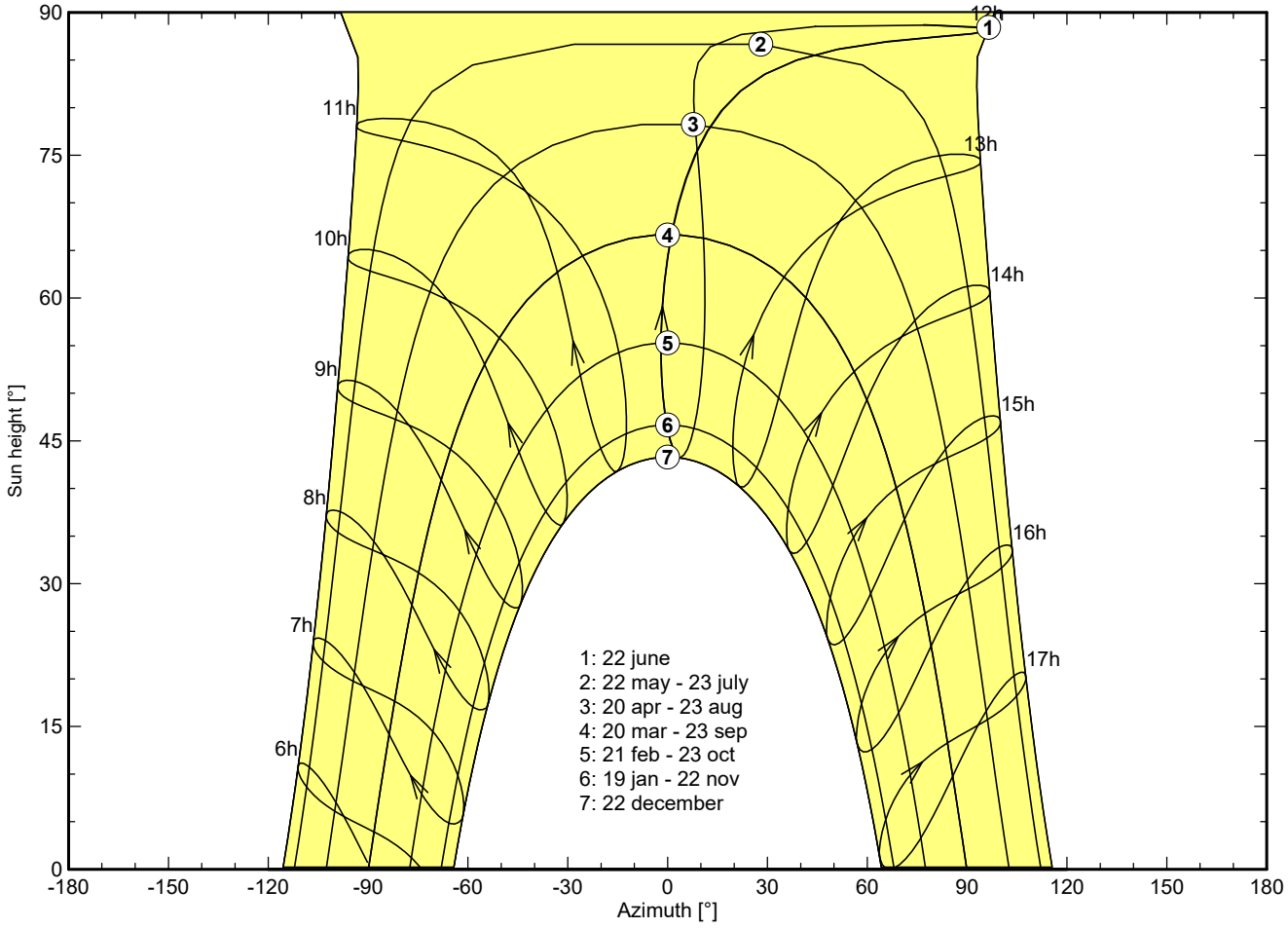
: **No shading effects**

File Bhopal.HOR of 12/07/18 16h37

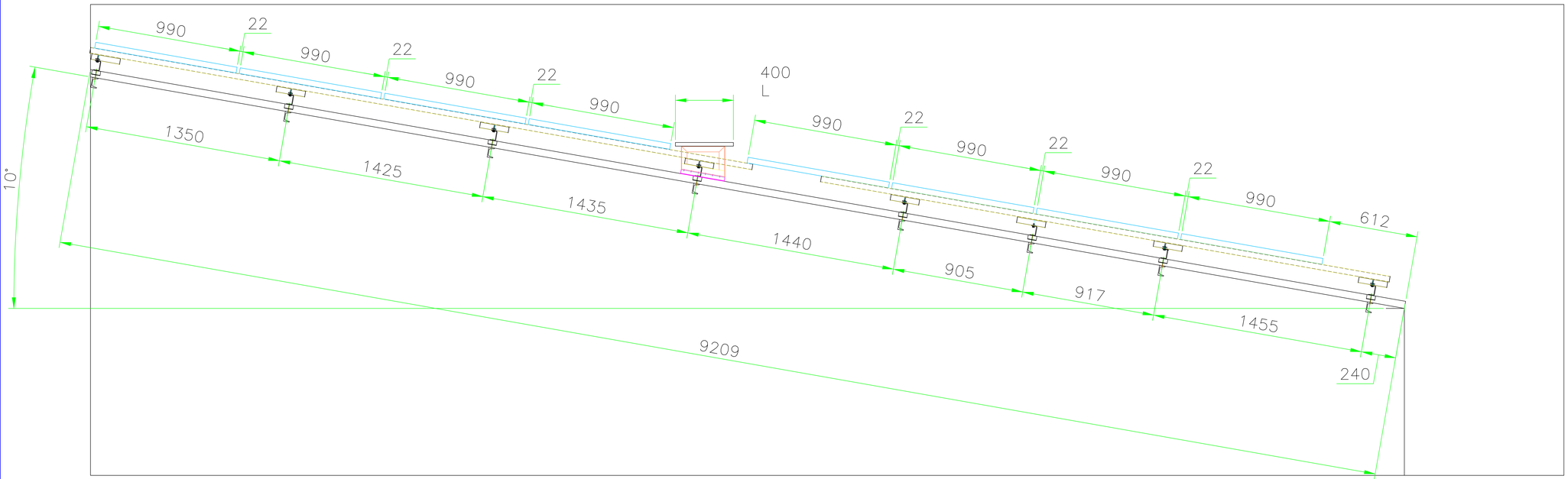
Geographical Site	**Bhopal**		**Country**	**India**
Situation	Latitude	23.3°N	Longitude	77.4°E
Time defined as	Legal Time	Time zone UT+5	Altitude	527 m
Horizon	Average Height	0.0°		

Height [°]	0.0	0.0	0.0	0.0
Azimuth [°]	-120	-40	40	120

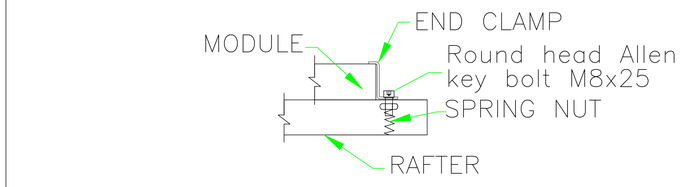
Horizon line at Bhopal



Cross Section View Of MMS



C\S AT A-A



END CLAMP ASSEMBLY

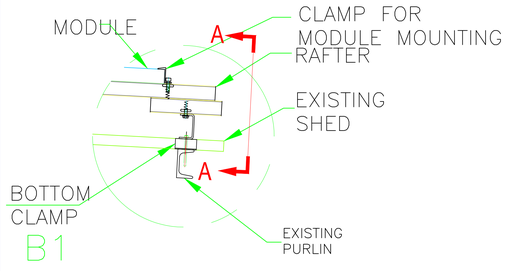
LEGEND:

- Solar PV Modules
- Inverter
- Solar LT Panel
- Earth Pit for Chemical Earthing
- Lightning Arrestor

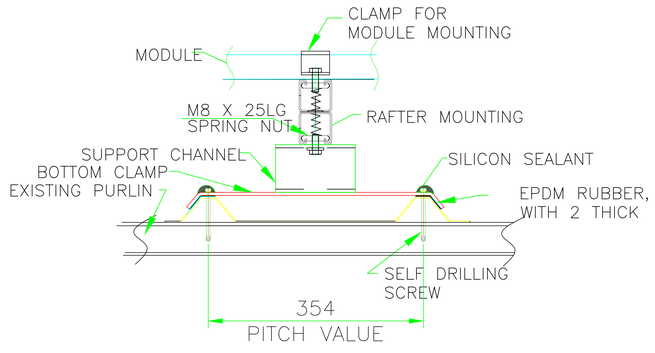
FOR APPROVAL

REV NO	DESCRIPTION	REV DATE	REV BY
00	FOR APPROVAL	MAY 10,2018	GKR

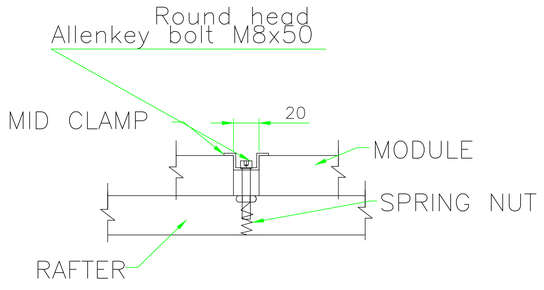
REVISIONS



BOTTOM CLAMP ARRANGEMENT



SECTION A-A



MID CLAMP ASSEMBLY

PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT
PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT

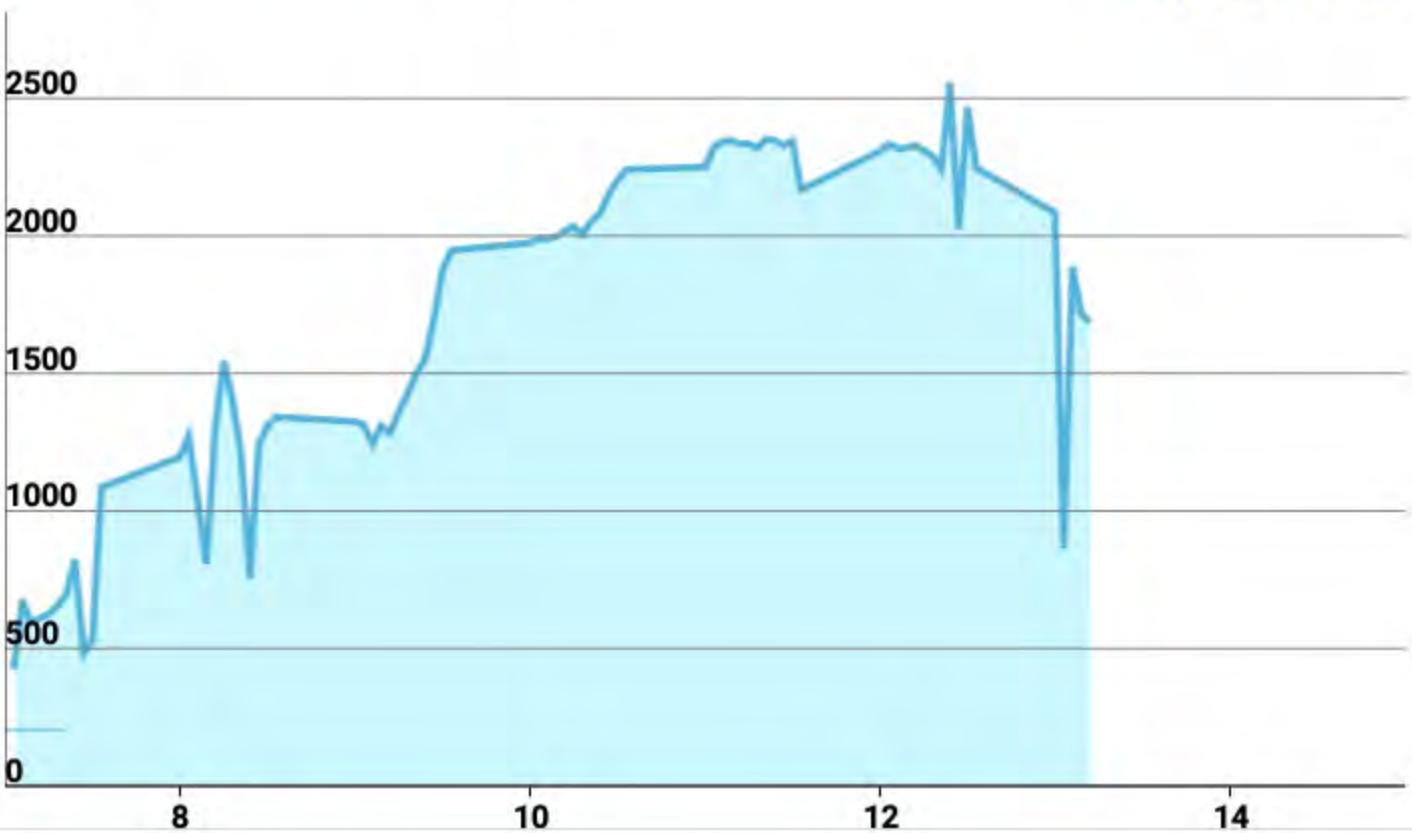
1585.1w
Current Power

10.2kWh
Energy today

155kWh
Lifetime energy

Daily power chart(W)

Time:7.15
Value:593.2



2017-05-09

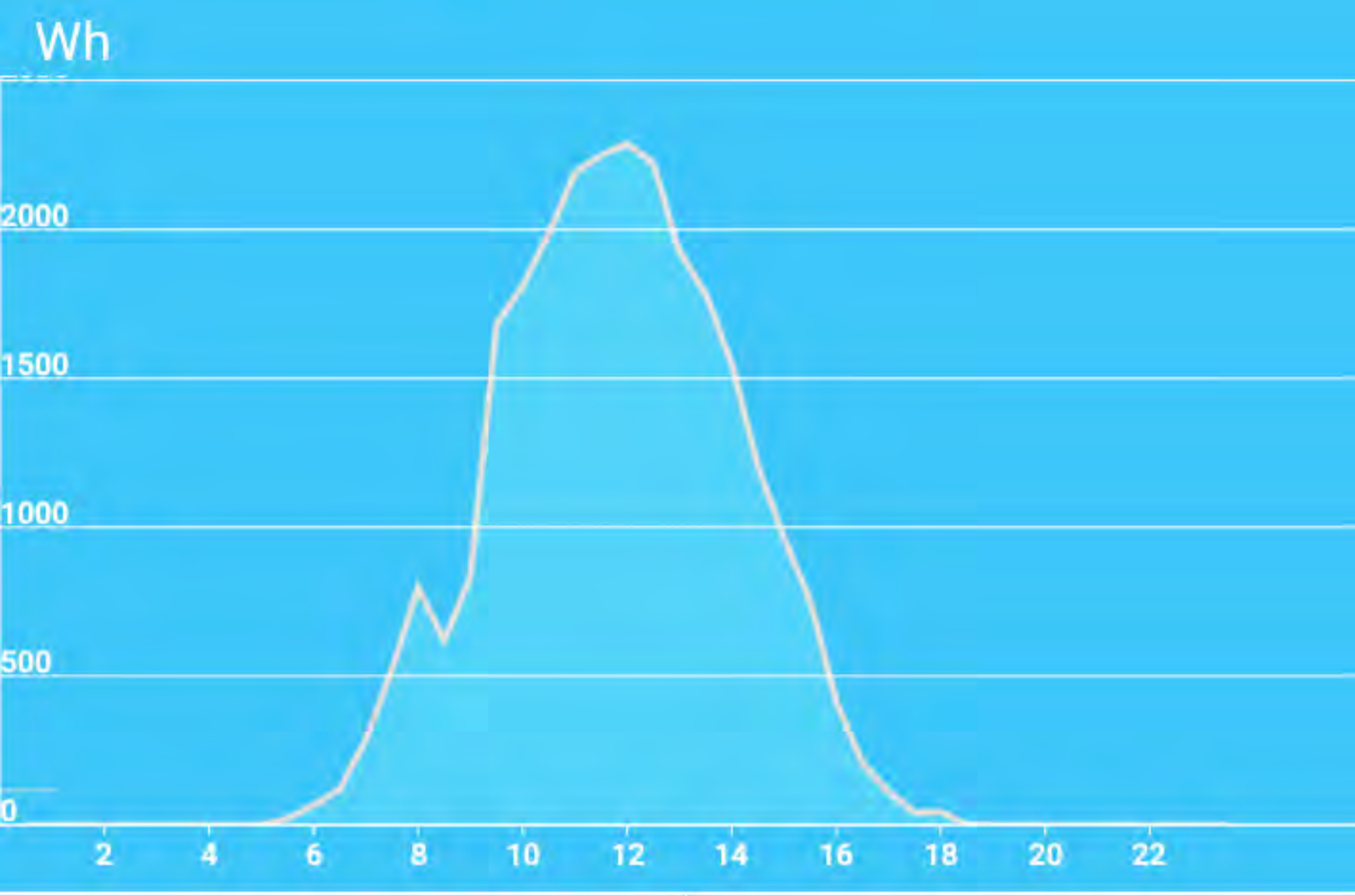
Sun	Mon	Tue	Wed	Thu	Fri	Sat
7	8	9	10	11	12	13

1270.9W	8:05
1047.0W	8:10
808.09W	8:15
1293.59W	8:20
1544.4W	8:25
1402.65W	8:30
1205.5W	8:35
757.09W	8:40
1243.09W	8:45
1309.8W	8:50
1341.59W	8:55
1324.8W	9:00
1314.8W	9:05

Solar energy

DAY | MONTH | YEAR | TOTAL

2017-05-12

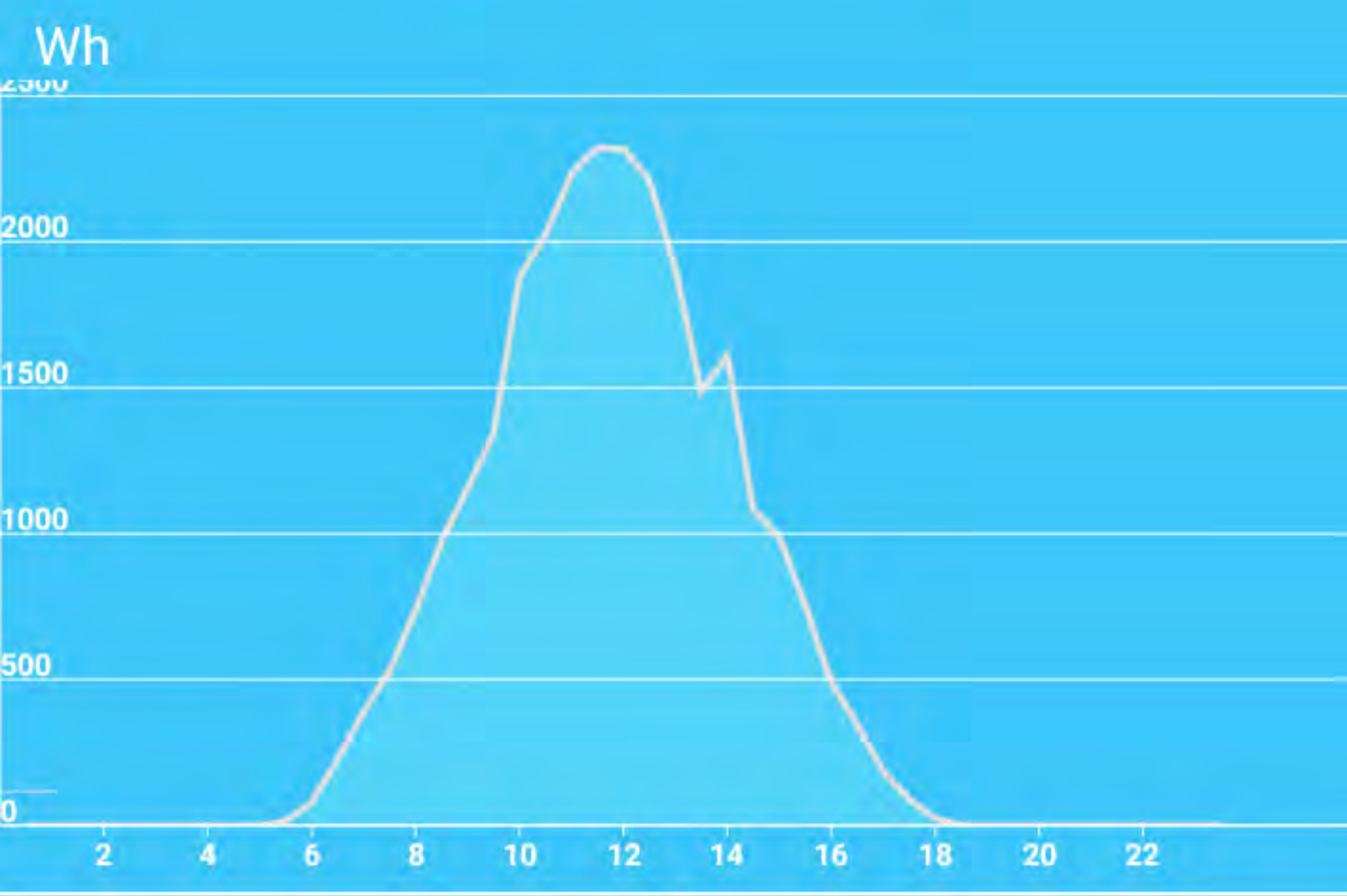


Energy yield	18.8 kWh
Max value	2288.85Wh
Average value	556.33Wh

Solar energy

DAY | MONTH | YEAR | TOTAL

2017-05-10

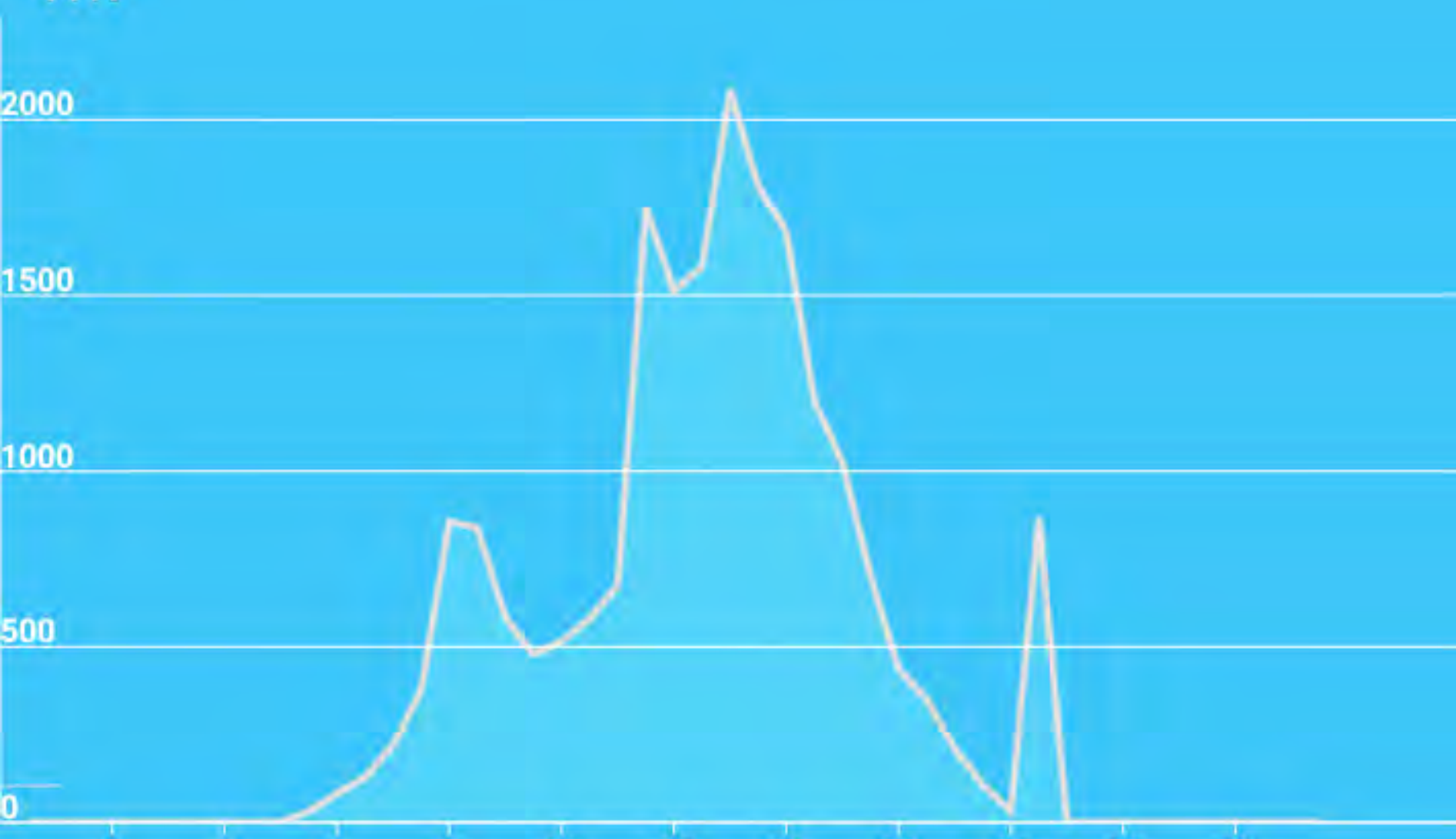


Energy yield	13.7 kWh
Max value	2321.18Wh
Average value	571.05Wh

Solar energy

DAY | MONTH | YEAR | TOTAL

2017-05-11



Energy yield	4.6 kWh
Max value	2085.77Wh
Average value	431.94Wh

Solar energy

DAY | MONTH | YEAR | TOTAL

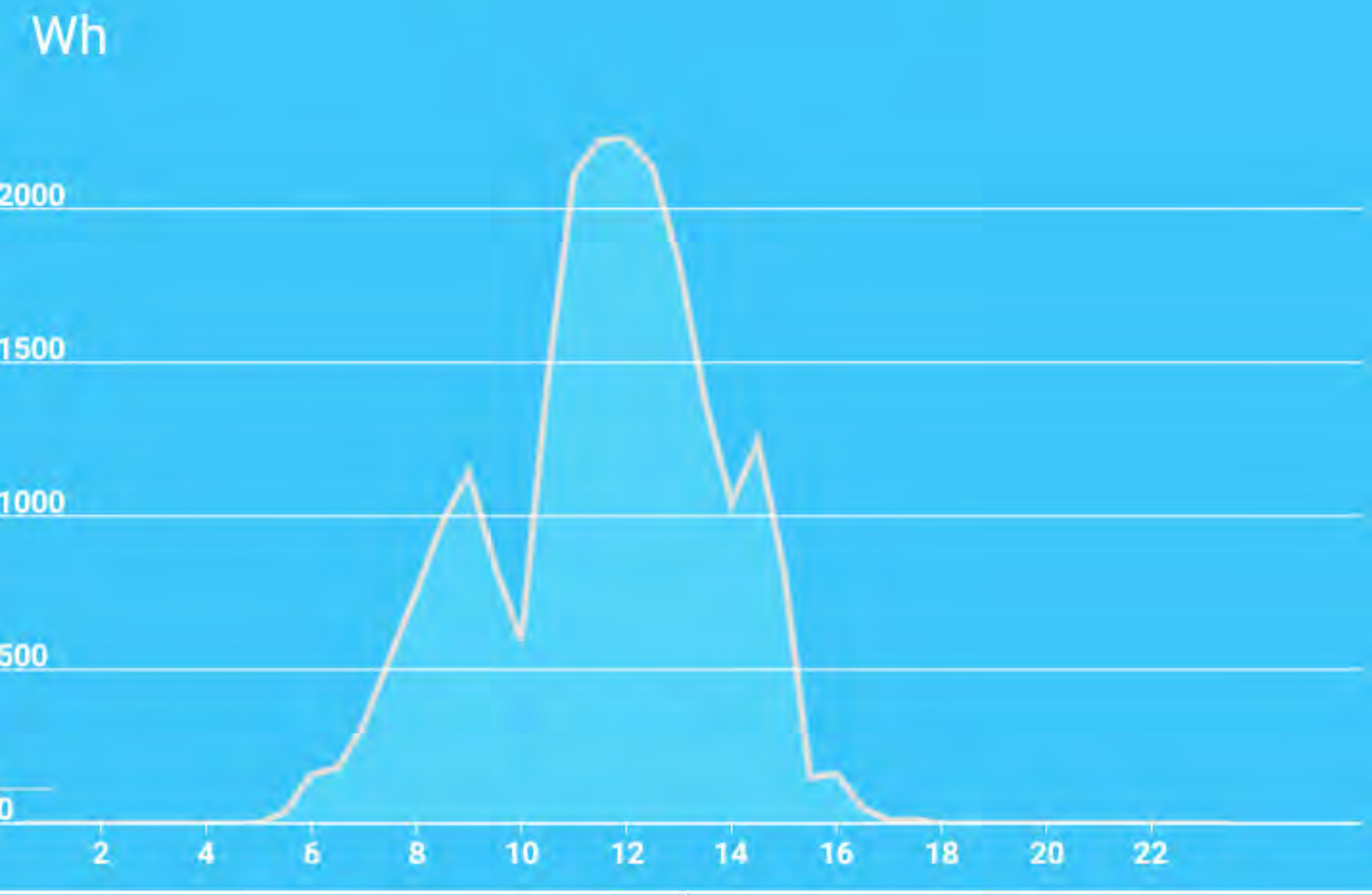
2017-05-09

Energy yield	12.4 kWh
Max value	2228.98Wh
Average value	518.14Wh

Solar energy

DAY | MONTH | YEAR | TOTAL

2017-05-08

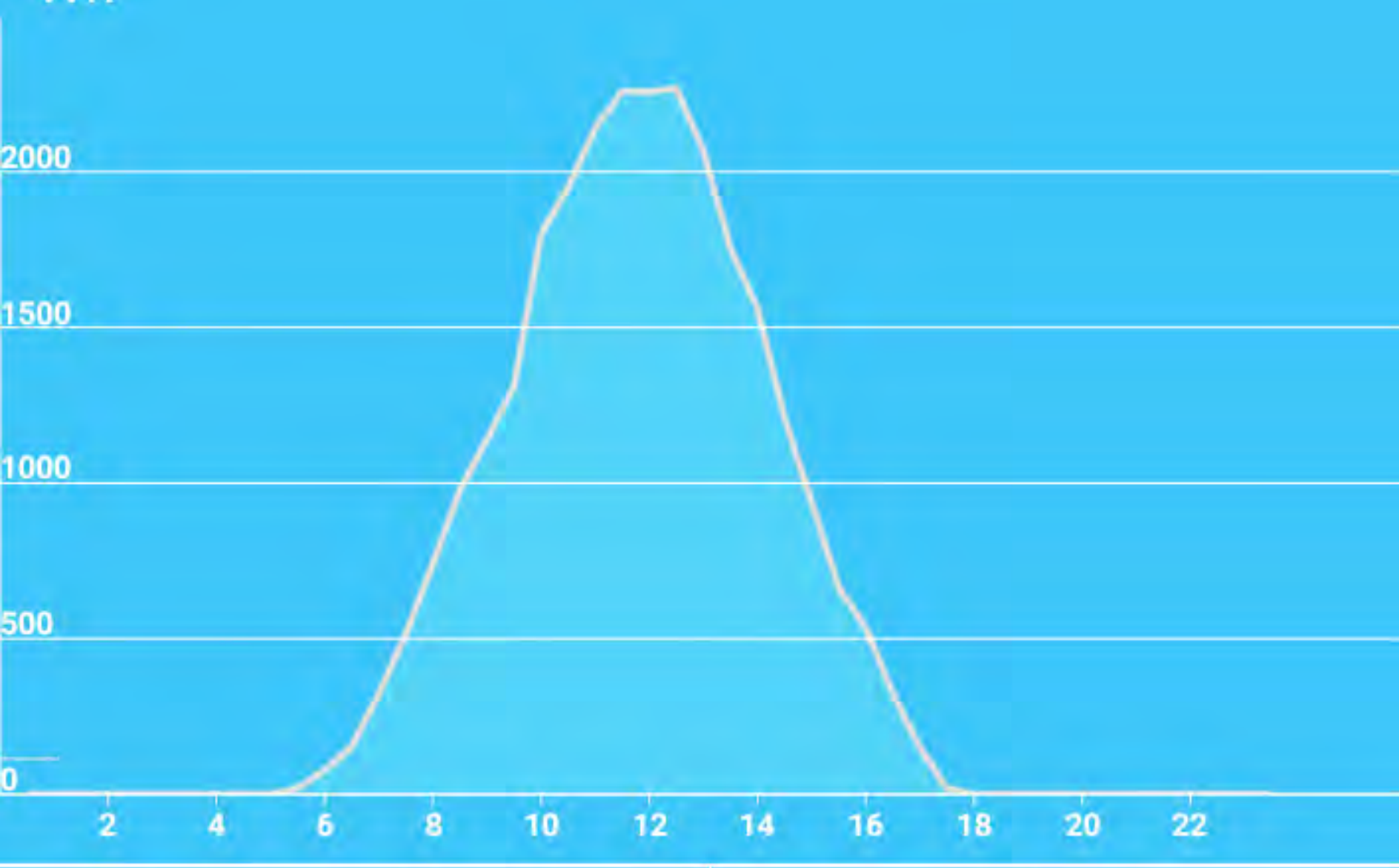


Energy yield	12.4 kWh
Max value	2228.98Wh
Average value	518.14Wh

Solar energy

DAY | MONTH | YEAR | TOTAL

2017-05-07

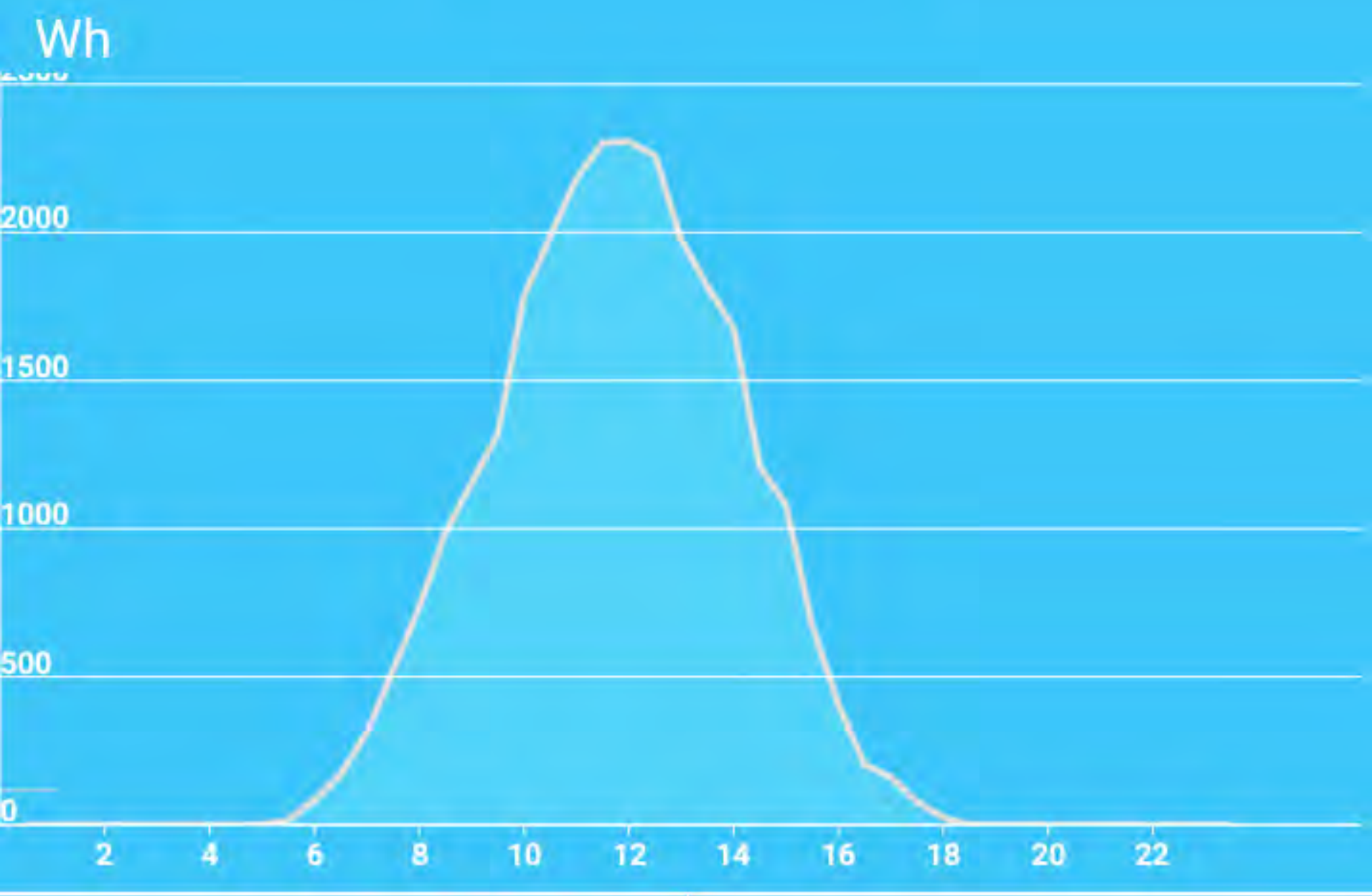


Energy yield	13.6 kWh
Max value	2267.65Wh
Average value	566.03Wh

Solar energy

DAY | MONTH | YEAR | TOTAL

2017-05-04

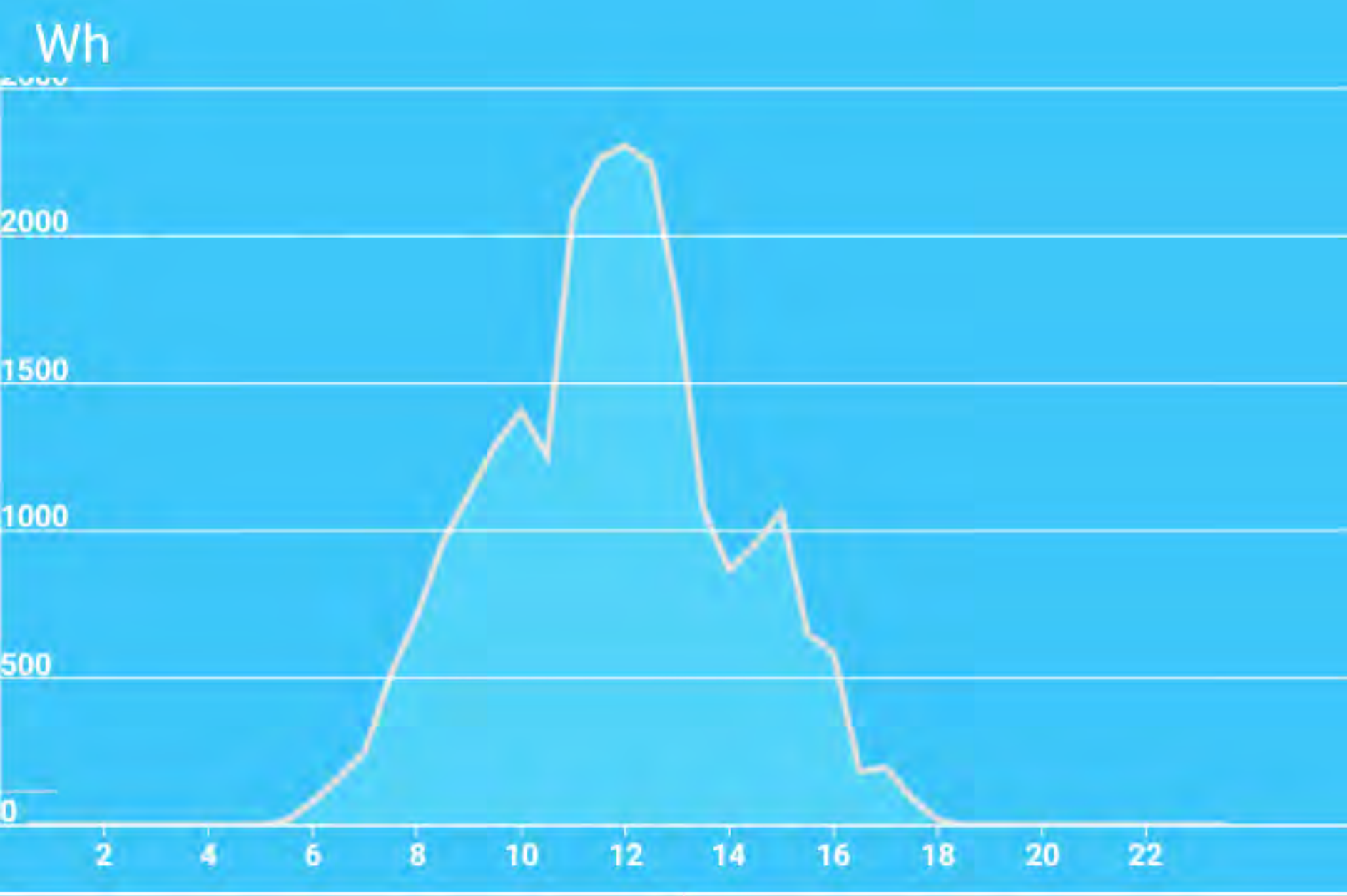


Energy yield	13.7 kWh
Max value	2307.22Wh
Average value	571.69Wh

Solar energy

DAY | MONTH | YEAR | TOTAL

2017-05-03

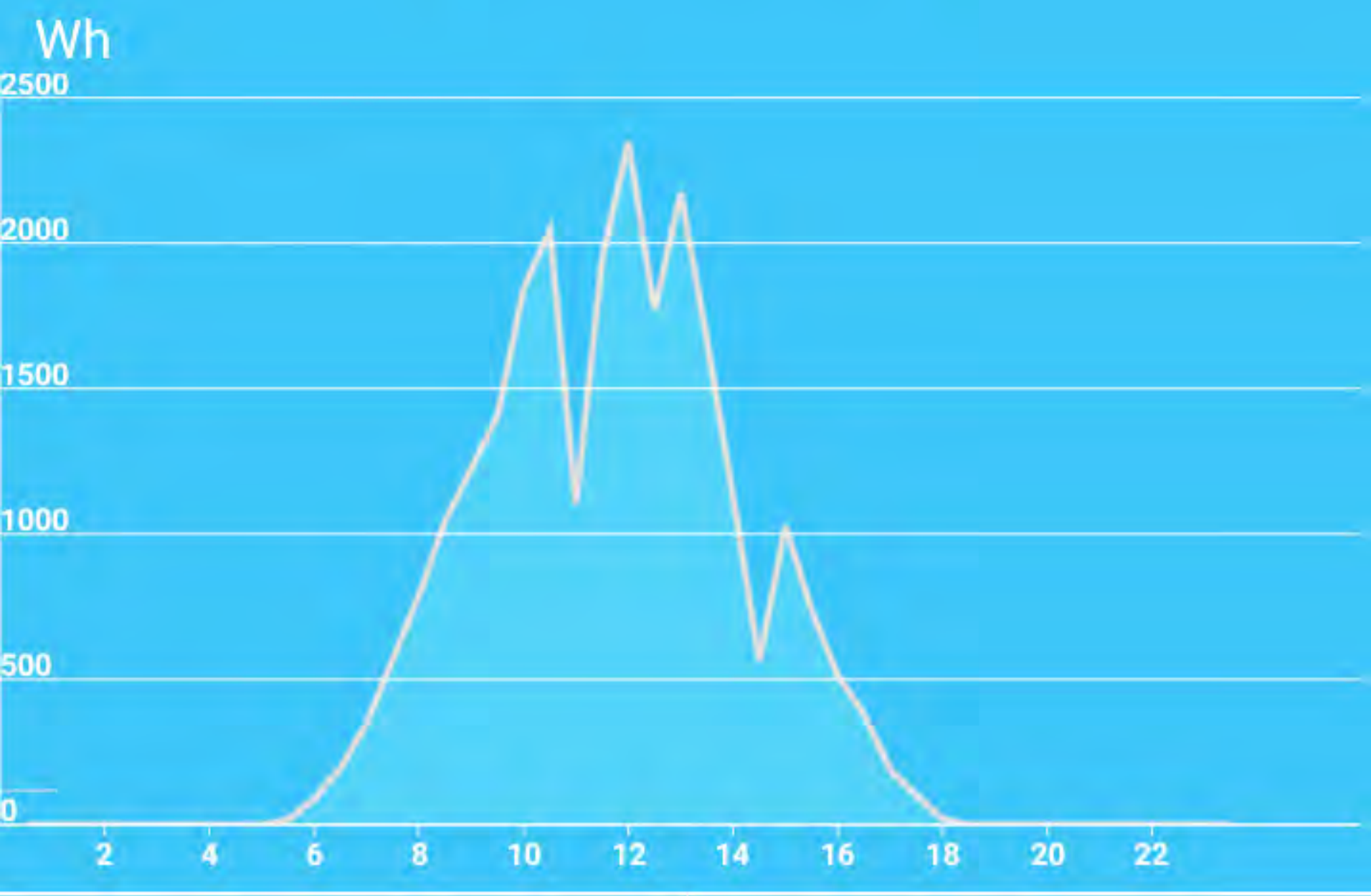


Energy yield	12 kWh
Max value	2306.95Wh
Average value	502.73Wh

Solar energy

DAY | MONTH | YEAR | TOTAL

2017-05-01

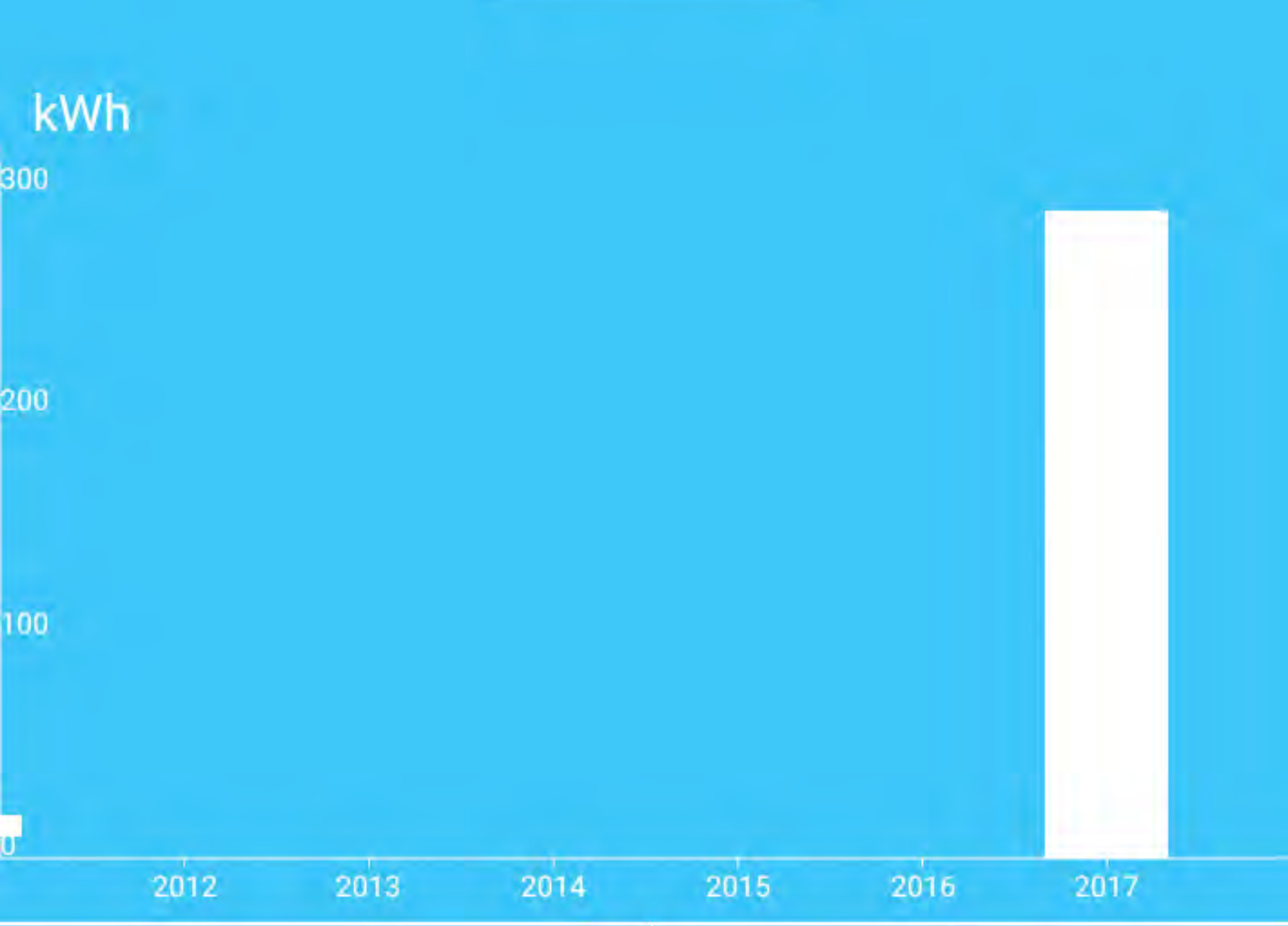


Energy yield	12.6 kWh
Max value	2348.23Wh
Average value	526.05Wh

Solar energy

DAY | MONTH | YEAR | TOTAL

TOTAL

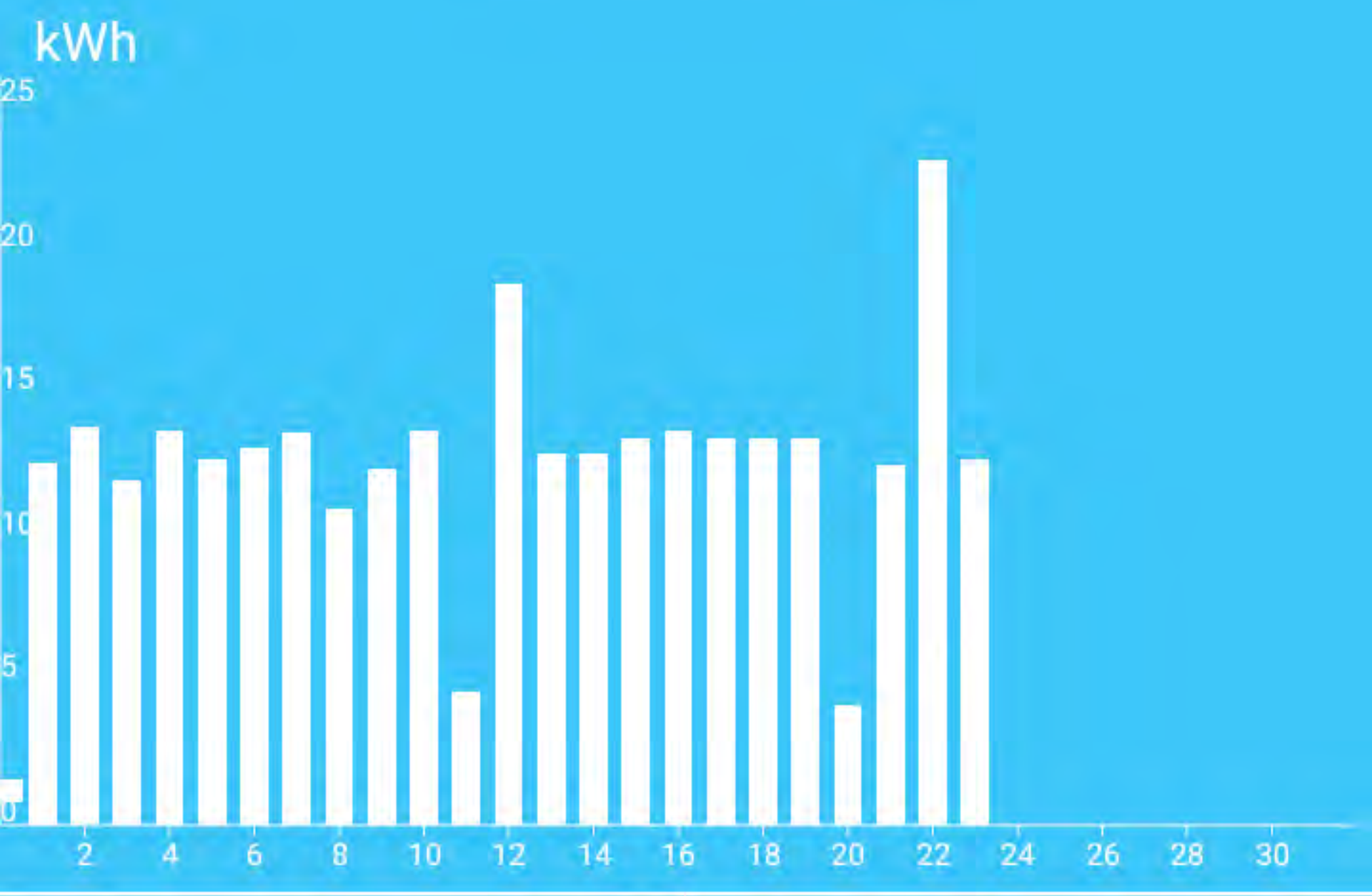


Energy yield	291.6 kWh
Max value	291.6kWh
Average value	48.60kWh

Solar energy

DAY | MONTH | YEAR | TOTAL

2017-05



Energy yield	297.6 kWh
Max value	23.1kWh
Average value	9.92kWh

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SHAKTI STELLER