Solar Panel Project Report

Sample Site

03/14/17

Package prepared by:

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Solar project report

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Project description

Sample Site

The Simpson house

Homer Simpson
123 Main Street
Springfield
State 95608

Site location 36.82° N 121° W

Timezone GMT-8   Inverter: 95% efficient optimizer

Telephone: 919-555-1212 Cell phone: 415-555-1212

Utility: SMUD

homer.simpson@gmail.com

Cloud cover (solar insolation)

January	February	March	April	May	June	July	August	September	October	November	December
43%	35%	21%	19%	16%	12%	11%	11%	12%	17%	30%	40%

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Array Summary

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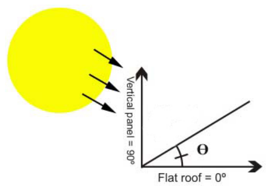
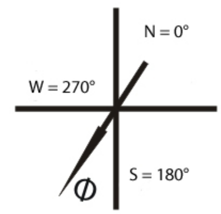
Sample Site

<table>
<tr><th colspan="2">Orientation and cost</th></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>Roof section angle</td><td>Roof section direction</td></tr>
</table>

<table>
<tr><th colspan="13">Roof sections used in this site</th></tr>
<tr><td>Array #</td><td colspan="6">Name</td><td>Angle</td><td colspan="2">Direction</td><td>Watts</td><td colspan="2">Cost</td></tr>
<tr><td>1</td><td colspan="6">Array 1</td><td>18°</td><td colspan="2">248°</td><td>8,000</td><td colspan="2">$15000</td></tr>
<tr><td>Shade, %</td><td>Jan: 8%</td><td>Feb: 6%</td><td>Mar: 4%</td><td>Apr: 2%</td><td>May: 0%</td><td>Jun: 0%</td><td>Jul: 0%</td><td>Aug: 0%</td><td>Sep: 2%</td><td>Oct: 4%</td><td>Nov: 6%</td><td>Dec: 8%</td></tr>
<tr><td>2</td><td colspan="6">Array 2</td><td>45°</td><td colspan="2">180°</td><td>4,000</td><td colspan="2">$12000</td></tr>
<tr><td>Shade, %</td><td>Jan: 20%</td><td>Feb: 10%</td><td>Mar: 5%</td><td>Apr: 0%</td><td>May: 0%</td><td>Jun: 0%</td><td>Jul: 0%</td><td>Aug: 0%</td><td>Sep: 0%</td><td>Oct: 5%</td><td>Nov: 10%</td><td>Dec: 20%</td></tr>
<tr><td>3</td><td colspan="6">Array 3</td><td>90°</td><td colspan="2">270°</td><td>3,000</td><td colspan="2">$1000</td></tr>
<tr><td>Shade, %</td><td>Jan: 20%</td><td>Feb: 10%</td><td>Mar: 5%</td><td>Apr: 0%</td><td>May: 0%</td><td>Jun: 0%</td><td>Jul: 0%</td><td>Aug: 0%</td><td>Sep: 0%</td><td>Oct: 5%</td><td>Nov: 10%</td><td>Dec: 20%</td></tr>
<tr><td colspan="13"></td></tr>
<tr><td colspan="10">Totals for roof sections used</td><td>15,000</td><td colspan="2">$28000</td></tr>
<tr><th colspan="13">Roof sections not used in this site</th></tr>
<tr><td>4</td><td colspan="6">Array 4</td><td>90°</td><td colspan="2">90°</td><td>2,000</td><td colspan="2">$1000</td></tr>
<tr><td colspan="13"></td></tr>
<tr><td colspan="10">Totals for roof sections not used</td><td>2,000</td><td colspan="2">$1000</td></tr>
</table>

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Definitions:

Discount rate:

The definition of the discount rate is a critical component of the discounted cash flow calculation, an equation that determines how much a series of future cash flows is worth as a single lump sum value today. This calculation is a powerful tool for valuing your investment in a solar system. Cash flow in the future is not worth as much as it is today. An investment in a solar system ties up money which could be otherwise invested or saved. Think of it this way, if someone were to give you a dollar today, they might want two dollars back when they are repaid in ten years. The interest that money would command would depend on several factors, inflation, risk and alternative investments.

For example, I might feel that I can make a better return investing in the stock market, but I must understand that the risk is higher than if I were to invest in a savings account or treasury bonds, which carry a much lower interest rate. These factors combine to form the theoretical basis for the discount rate. A higher discount rate implies greater uncertainty, the lower the present value of our future cash flow.

Selecting what discount rate to use in your discounted cash flow calculation depends on your personal risk tolerance and alternative investment choices. Remember that an investment in solar is a pretty safe bet. The sun will come out as planned and electric rates will probably go up, so perhaps we should compare the rate with similar safe investments. As of early 2017, the safest (no risk) of investments, long term treasury bills, are paying just less than 2.5% interest. Most people put the return on stock market funds at about 7% long term, however there is a risk of loss in any given year. The preselected (default) value here is 3%.

Escalation

This is the expected yearly rise in electricity costs. According to the US Energy information Administration, the average price increase from 2008 to 2015 was 2.2% (source http://www.eia.gov/todayinenergy/detail.php?id=20372 accessed February 1, 2017). However, in certain areas of the country, the escalation was higher, as high as 9%! In California and New England, this number is higher. The default for this number is 3%, which is slightly higher than the average due to the imposition and increase in fees, which are de facto rate increases.

Degradation

All solar systems gradually lose generating power. Panels lose generating capacity, get dirty, and do not produce electricity at the same rate as when they were new. This number is usually described on the panel description sheet, and is usually listed at 0.5 percent. The default here is 1%, a more conservative number. This loss of power generation capacity results in substantial redudtions of power over time. A 1.0% loss per year results in a system that produces 22% less power after 25 years. This affects your payback period and return on investment.

Project life

The life of the project in years, This number is used to calculate the Internal Rate of Return. In general, the longer the life of the system, the higher the rate of return, as the sytem will continue to supply savings for a longer period of time. In no case can you specify a life longer than 25 years.

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Payment:

Either a single lump sum payment is assumed if the payment is on the panel page, or a series of annual payments can be input. Either the multiple payment scheduled or the payment specified in the section defining used arrays is used. If you have multiple roof sections and can split the costs, using the "used/unused" feature of the array table. Only the "used" arrays are used for the calulation of the rates of returns. Once the optimum configuration is determined you may choose to put in annual payments for another picture of your cash flows.

Escalation

How you work out the financing is up to you. Assuming equal payments, the number of payments and the payment amount will be determined by the interest rate you pay.
The payment is aggregated your payment into years, for example 36 monthly payment is 3 years, where 41 payments is 4.42 years.

Calculated values:

Payback period:

The net value of the system to you is determined by the discount rate and the cash lows. Any payment is treated as a negative cash flow, and expected savings are treated as positive cash flows. In general, the shorter the payback period the better. If the payback period exceeds the life of the system, DO NOT MAKE THIS INVESTMENT: It means that you are better off paying for electricity than you are investing in solar. A long payback period may be indicative of low electricity rates, expensive installation (such as structural or roofing changes required) or extensive shade. In these cases perhaps you could benefit more by purchasing a battery than investing in solar panels.

Net present value (NPV):

The life of the project in years, This number is used to calculate the Internal rate of return. In general, the longer the life of the system, the higher the rate of return, as the sytem will continue to supply savings for a longer period of time. Remember, in no case can you specify a life longer than 25 years.

Internal Rate of Return (IRR):

This is also a measure of the return on investment. Technically it is the computed interest rate the series of savings minus the series of payments. This return should be better than an alternative investment. For example, if the IRR of the solar panels is 1%, but you can make 3% on another investment then you should make the alternative investment and not buy the solar panels. However, if the IRR is more than you could make elsewhere it is a good investment.

Please note: All of the calculated investment values are determined by the system as defined by the loads, rates and panels. There is no way to calculate the overall return on investment, the rate of return or the payback period without storing all the specifics about your system.

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ROI Summary

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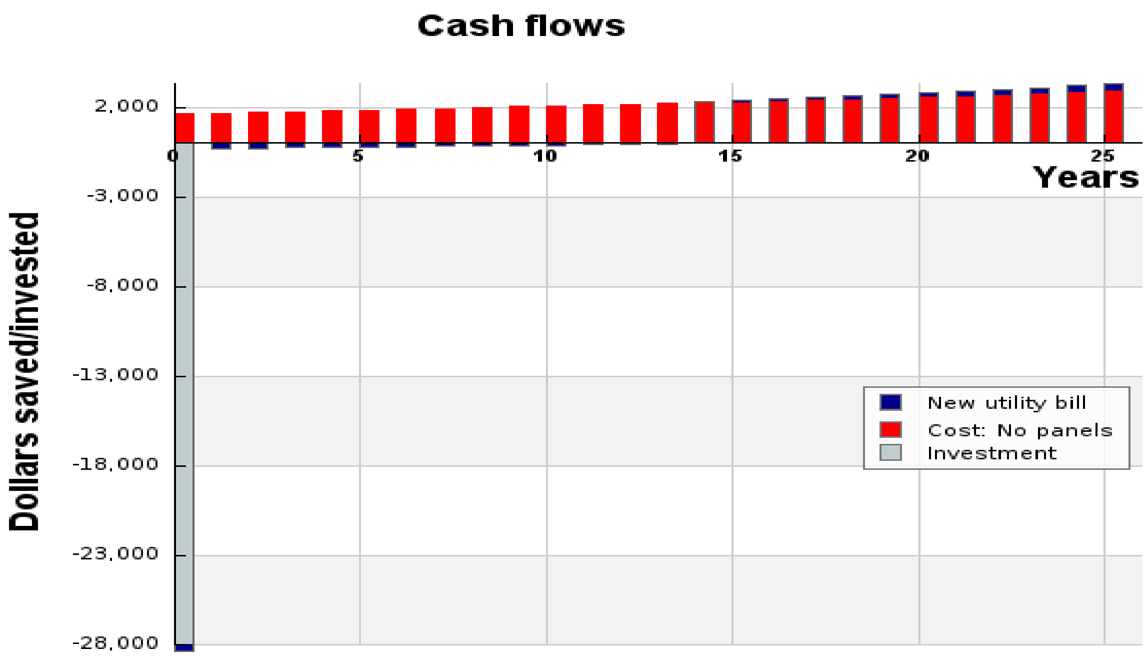
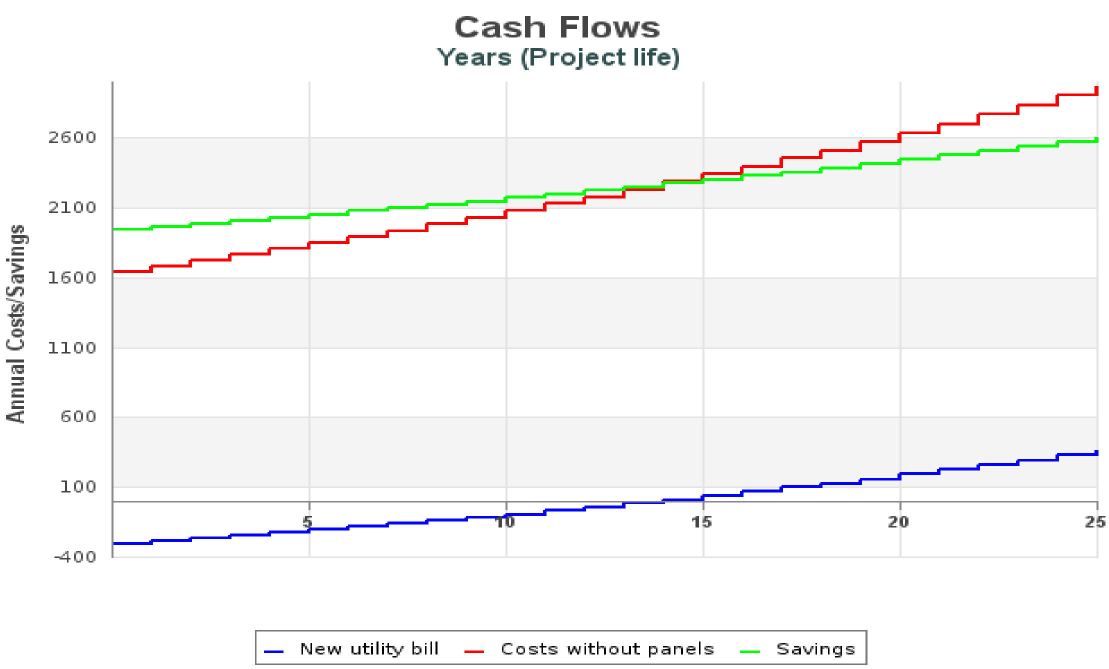
Inputs		Calculated	
Escalation:	3.00%	Rate of return (IRR):	6.7%
Degradation:	1.00%	Payback period:	19.19 yrs
Discount rate:	5.00%	Net Present value (NPV):	$4,118.28
System life:	25 yrs		





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Rate report

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Sample Site

Time of use rate: SMUD 2017 Residential Time-of-use

Sitename: Sample Site Sitenumber: 287

Use Daylight Saving Time?	Yes	Net metering rate:	5.96¢

First rate period

Start date: January 1	0:00 AM	8.66¢	Weekdays only
	9:00 AM	14.85¢	X
	9:00 PM	8.66¢	
	unused	0.00	
	unused	0.00	
	unused	0.00	
	unused	0.00	

Second rate period

Start date: June 1	0:00 AM	8.66¢	Weekdays only
	9:00 AM	14.85¢	X
	4:00 PM	31.61¢	X
	7:00 PM	14.85¢	X
	9:00 PM	8.66¢	
	unused	0.00	
	unused	0.00	

Third rate period

Start date: October 1	0:00 AM	8.66¢	Weekdays only
	9:00 AM	14.85¢	X
	9:00 PM	8.66¢	
	unused	0.00	
	unused	0.00	
	unused	0.00	
	unused	0.00	

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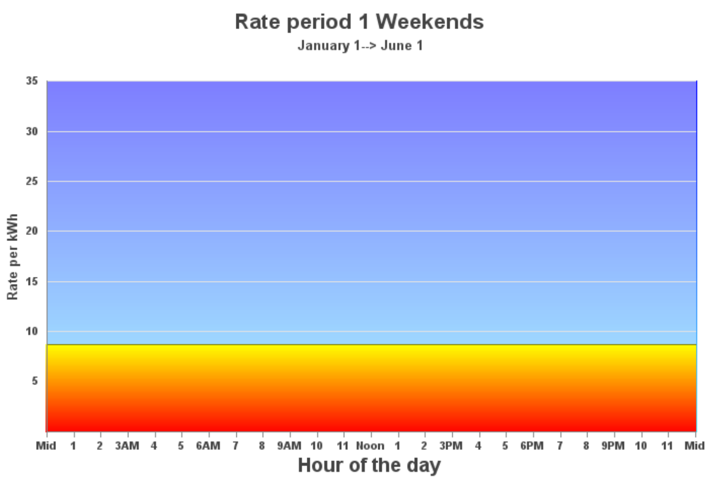
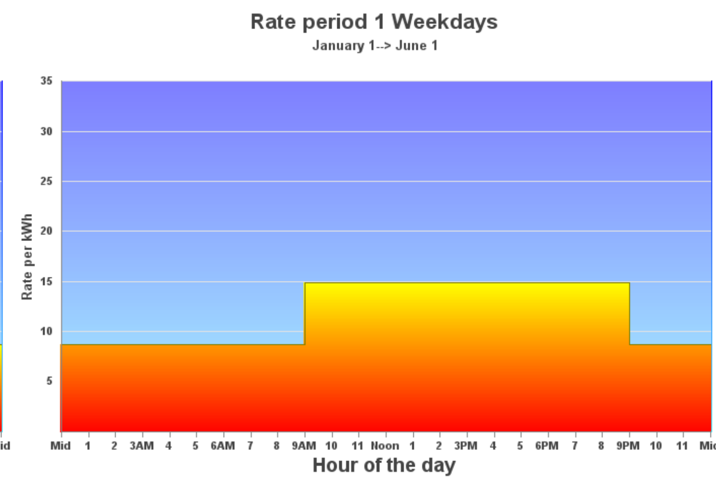
Rate summary: SMUD 2017 Residential Time-of-use

Site: Sample Site

The rate schedule: SMUD 2017 Residential Time-of-use has 3 different periods:

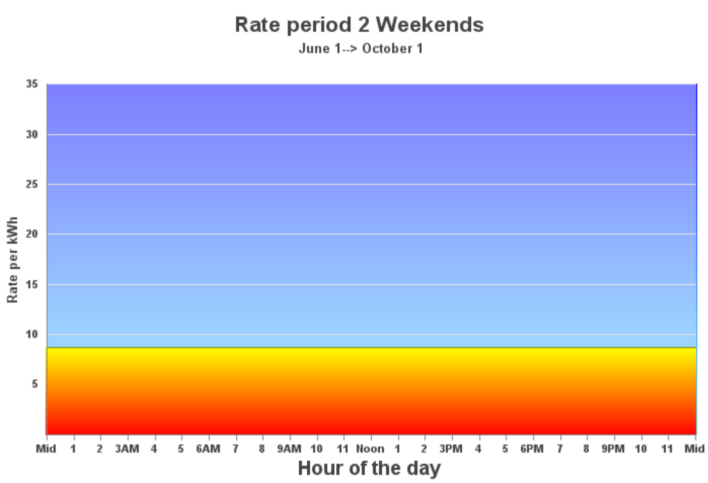
Rate period 1

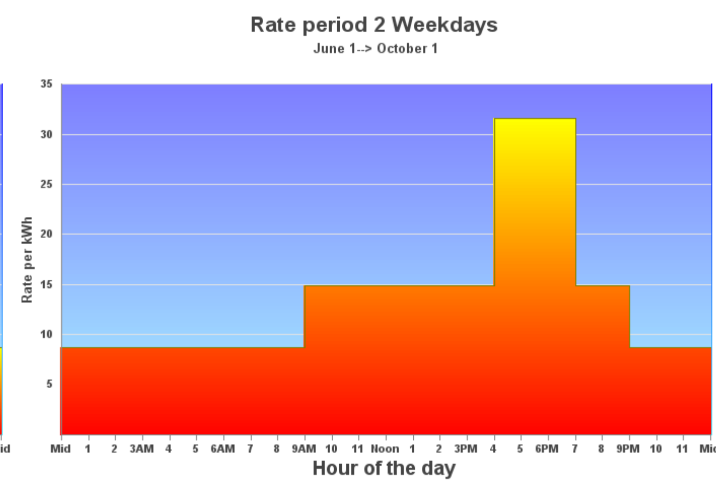




Minimum rate: : 8.66¢ per kWh	Maximum rate: : 14.85¢ per kWh

Rate period 2





Minimum rate: : 8.66¢ per kWh	Maximum rate: : 31.61¢ per kWh

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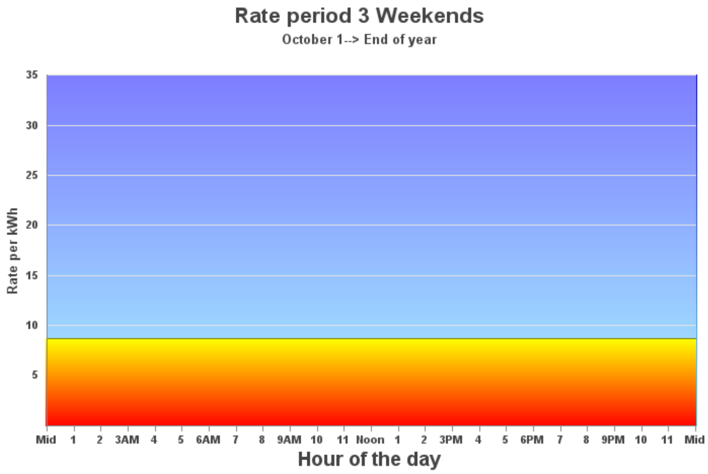
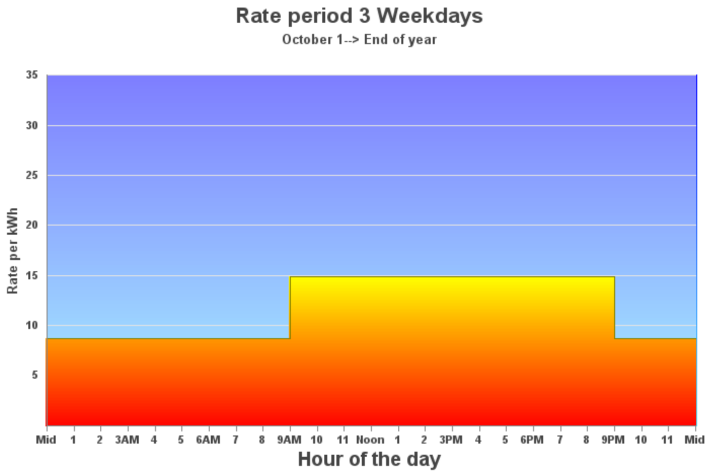
Rate period 3





Minimum rate: : 8.66¢ per kWh	Maximum rate: : 14.85¢ per kWh

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Rate report

Loads table

Site name: Sample Site   Site number: 287

Name of loads	Generic loads
Base load, All day 24 hrs	500 Watts
Lights, day, 6 AM - 6 PM	200 Watts
Morning load, 6 AM - 9 AM	1500 Watts
Evening load, 6 PM - 9 PM	2000 Watts

Variable load: heating

Heat load	1800 Watts
Heat time (center) on the longest day	12:00 AM
The day of the longest heat	February 15
The time the heater runs on the longest day	5.9 hours
The number of months you need heat	6.2 months

Variable load: cooling

Cool load	5000 Watts
Cool time (center) on the longest day	4:00 PM
The day of the longest cooling	July 17
The time the Air conditioner runs on the longest day	4.0 hours
The number of months you need air conditioning	6.8 months

Miscellaneous load 1: Pool pumps

Pool pumps power	1500 Watts
Pool pumps start time	1:30 PM
Pool pumps end time	3:00 PM

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Miscellaneous load 2: Misc Name 2 'unused'

Misc Name 2 'unused' power	unused Watts
Misc Name 2 'unused' start time	12:00 AM
Misc Name 2 'unused' end time	12:00 AM

Miscellaneous load 3: Misc Name 3 'unused'

Misc Name 3 'unused' power	unused Watts
Misc Name 3 'unused' start time	12:00 AM
Misc Name 3 'unused' end time	12:00 AM

Miscellaneous load 4: Misc Name 4 'unused'

Misc Name 4 'unused' power	unused Watts
Misc Name 4 'unused' start time	12:00 AM
Misc Name 4 'unused' end time	12:00 AM

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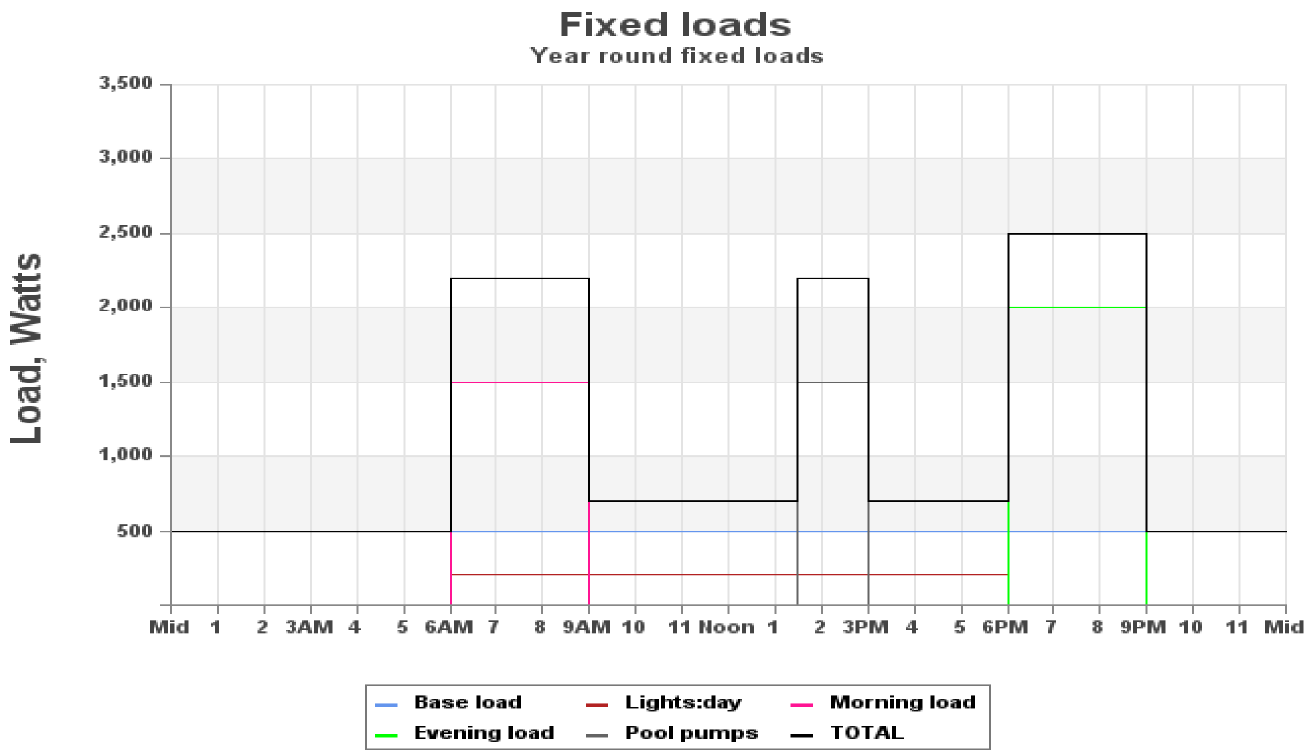
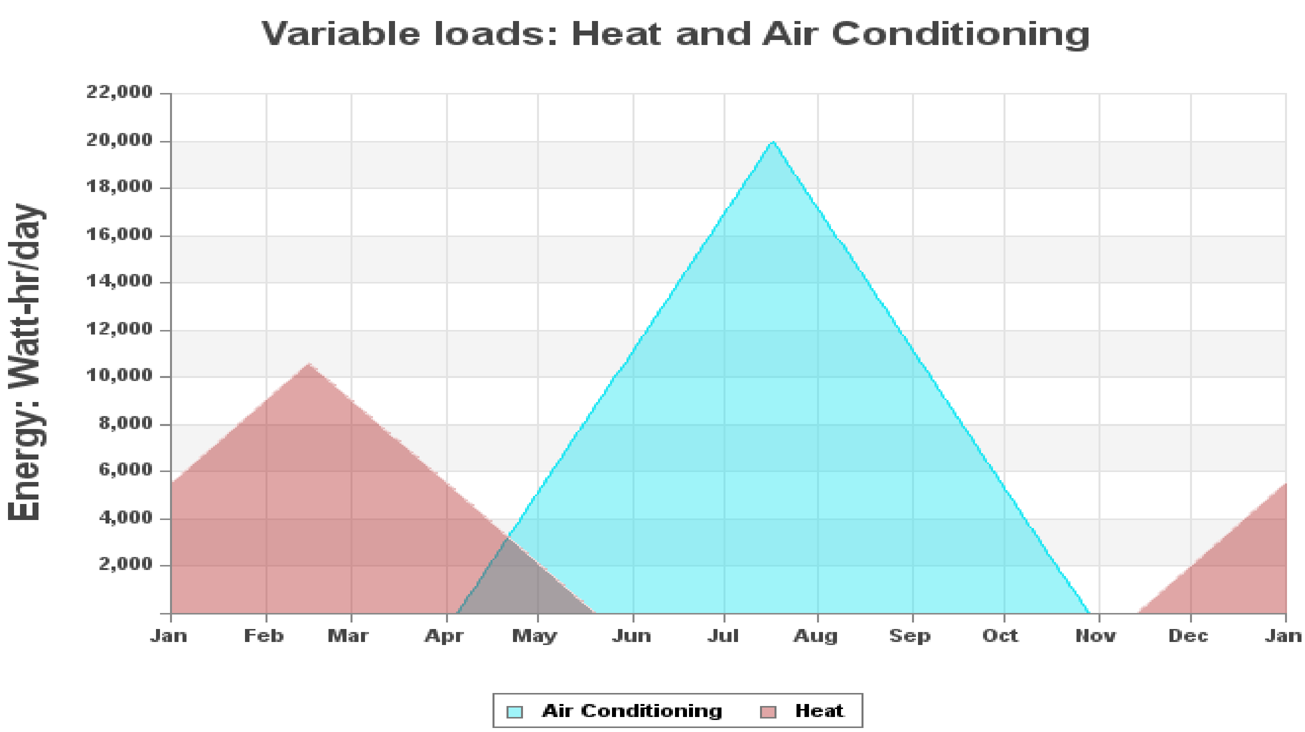
Loads. Site: Sample Site

Fixed and Variable loads





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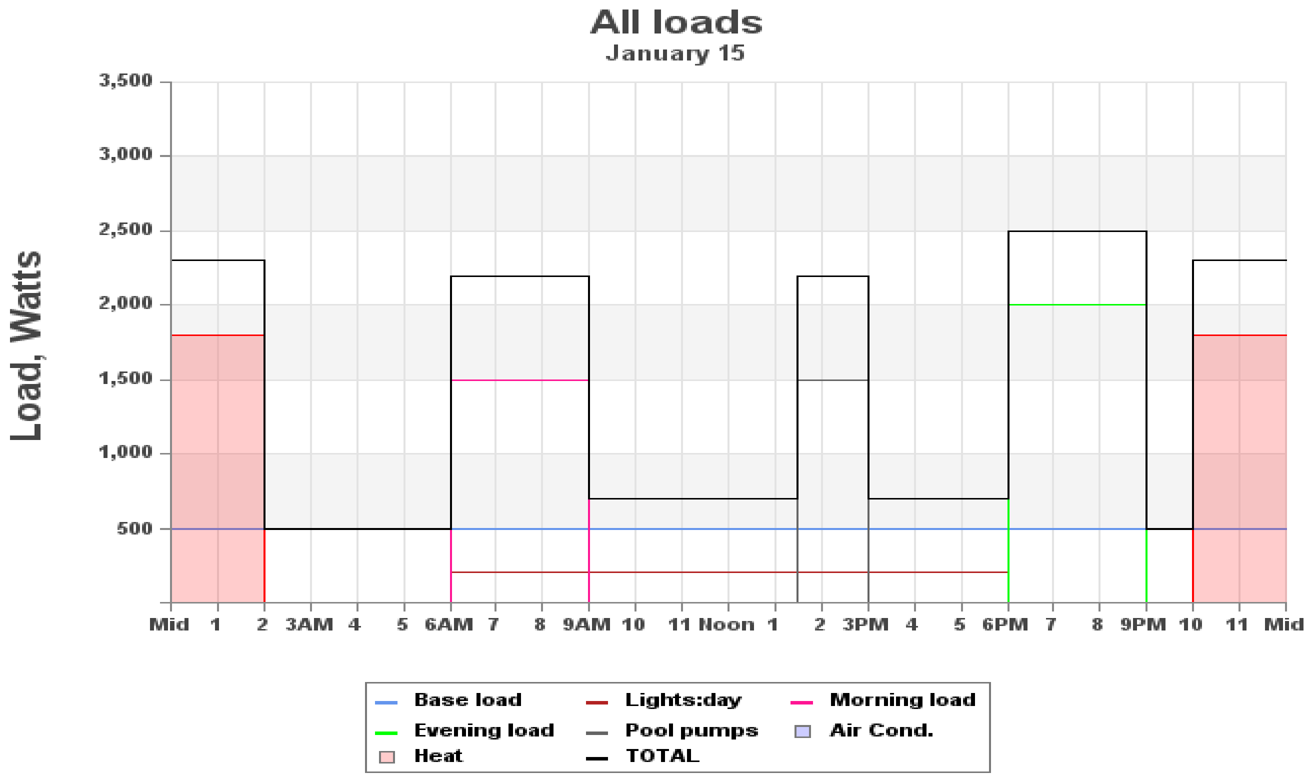
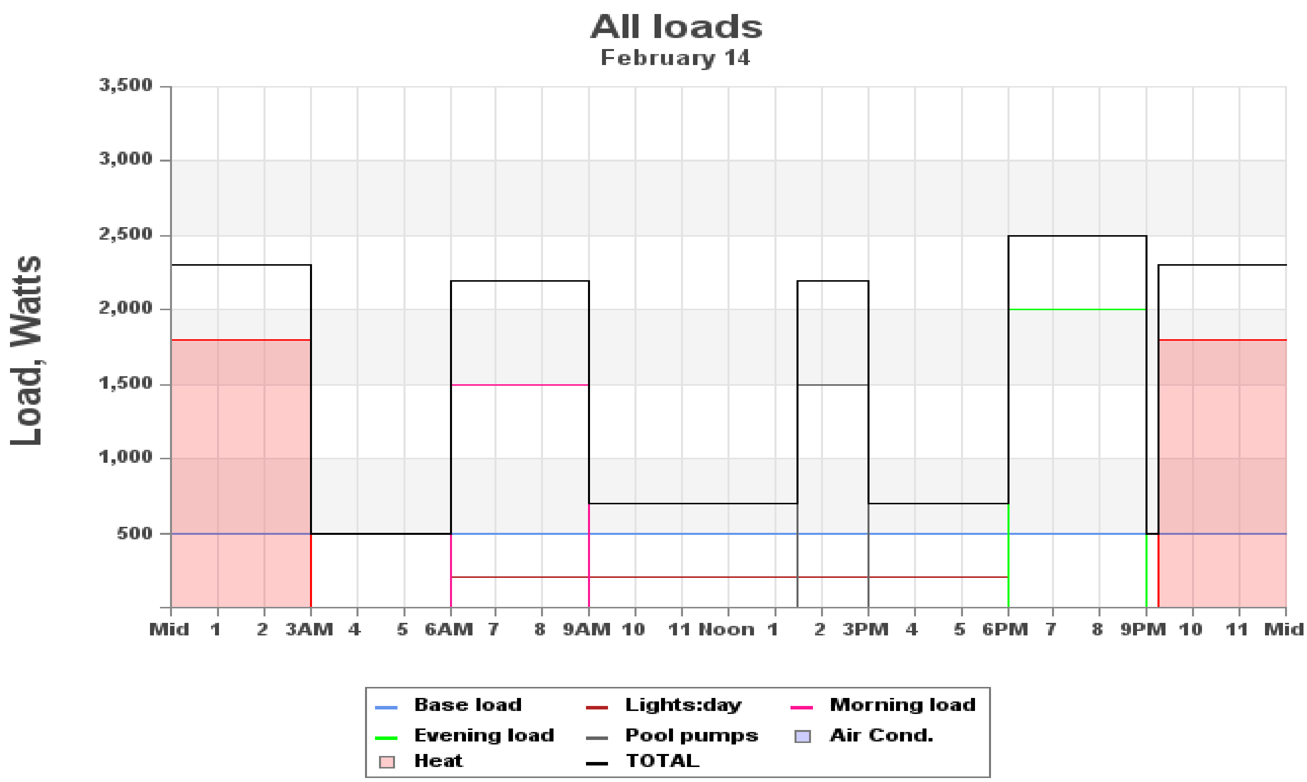
Loads. Site: Sample Site

Monthly loads





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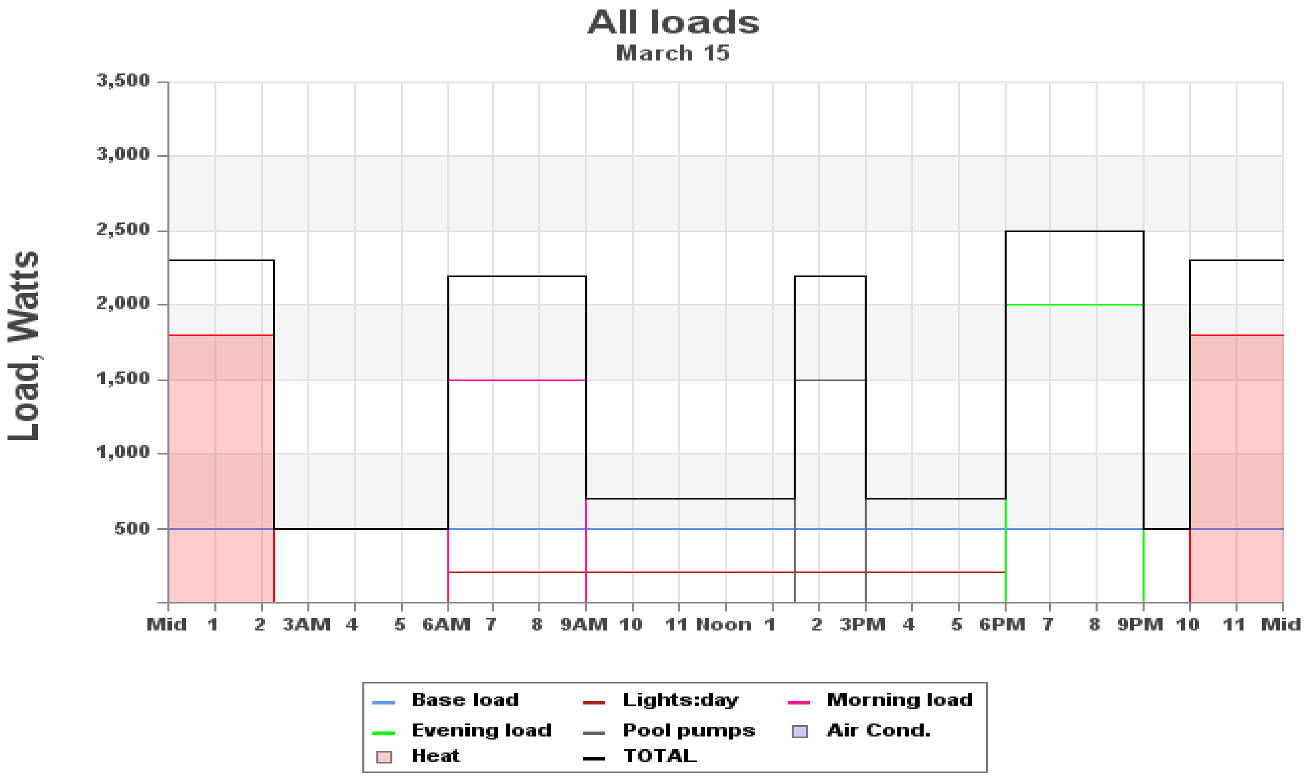
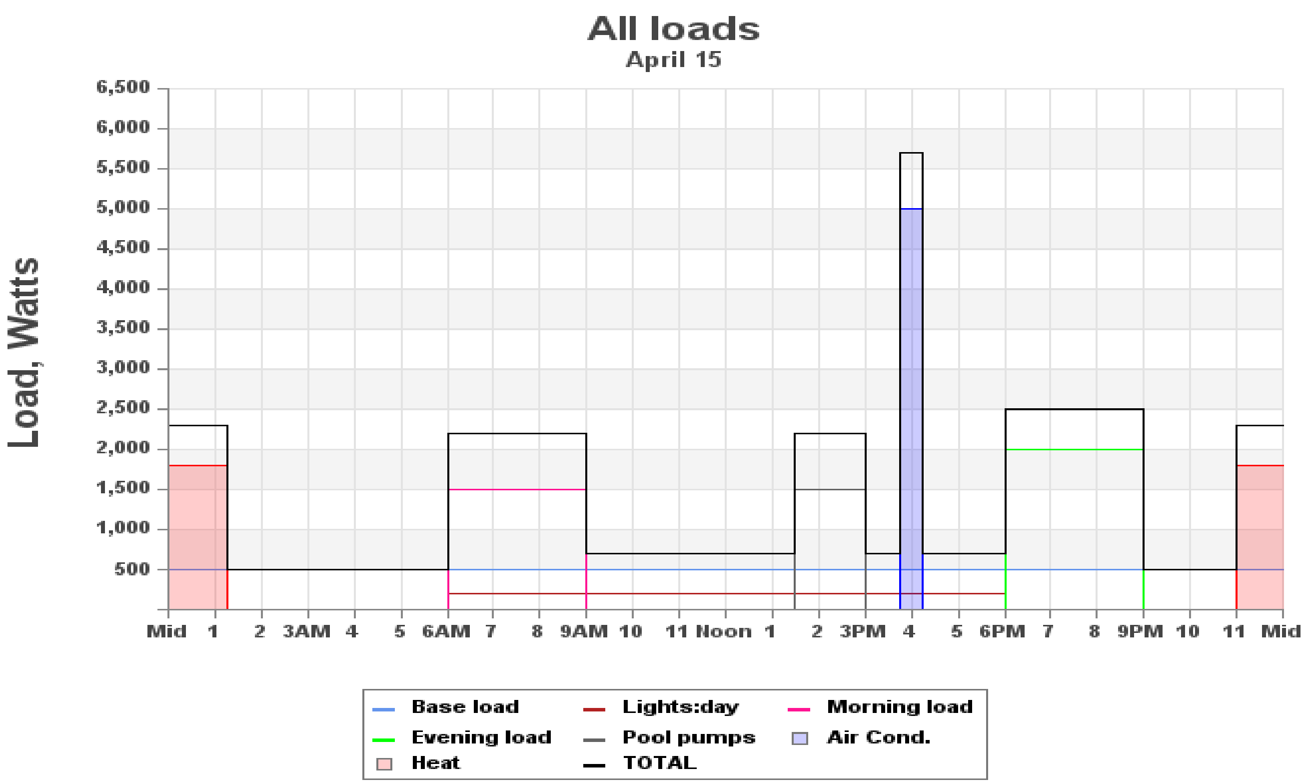
Loads. Site: Sample Site

Monthly loads, continued





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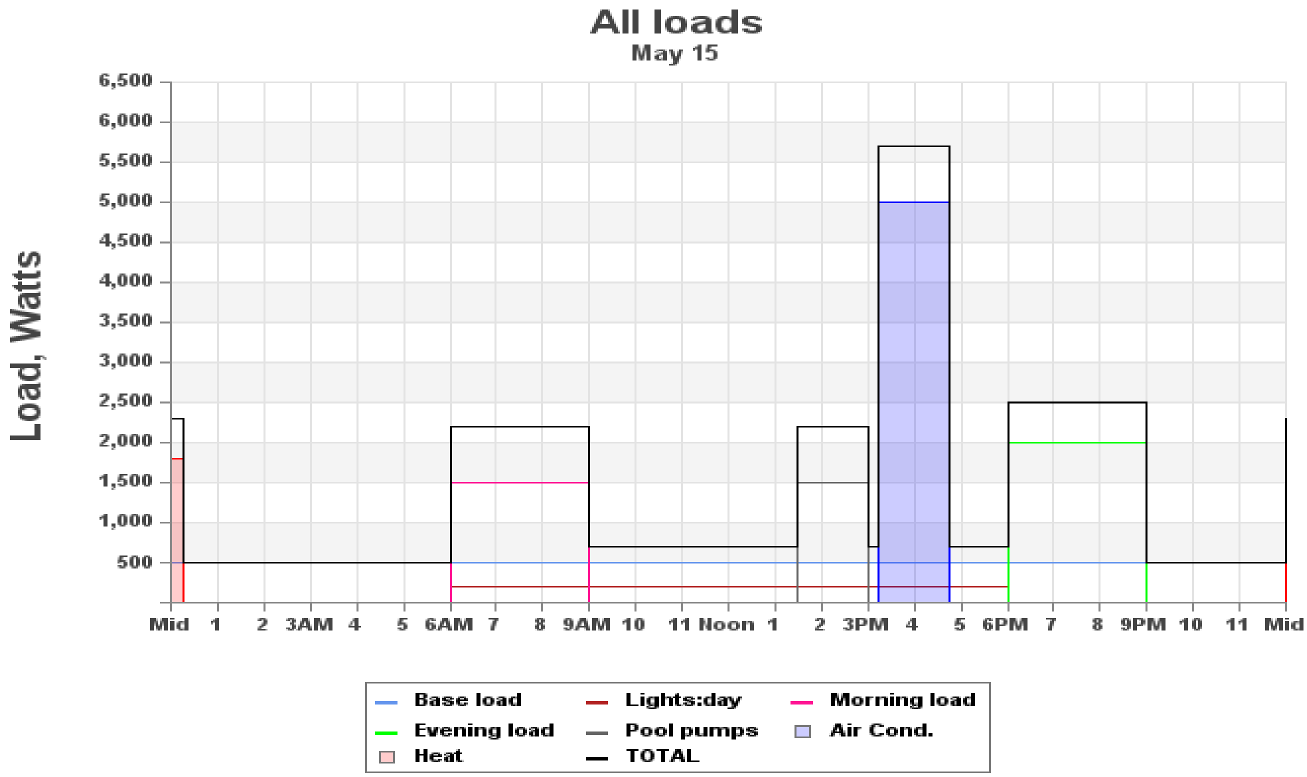
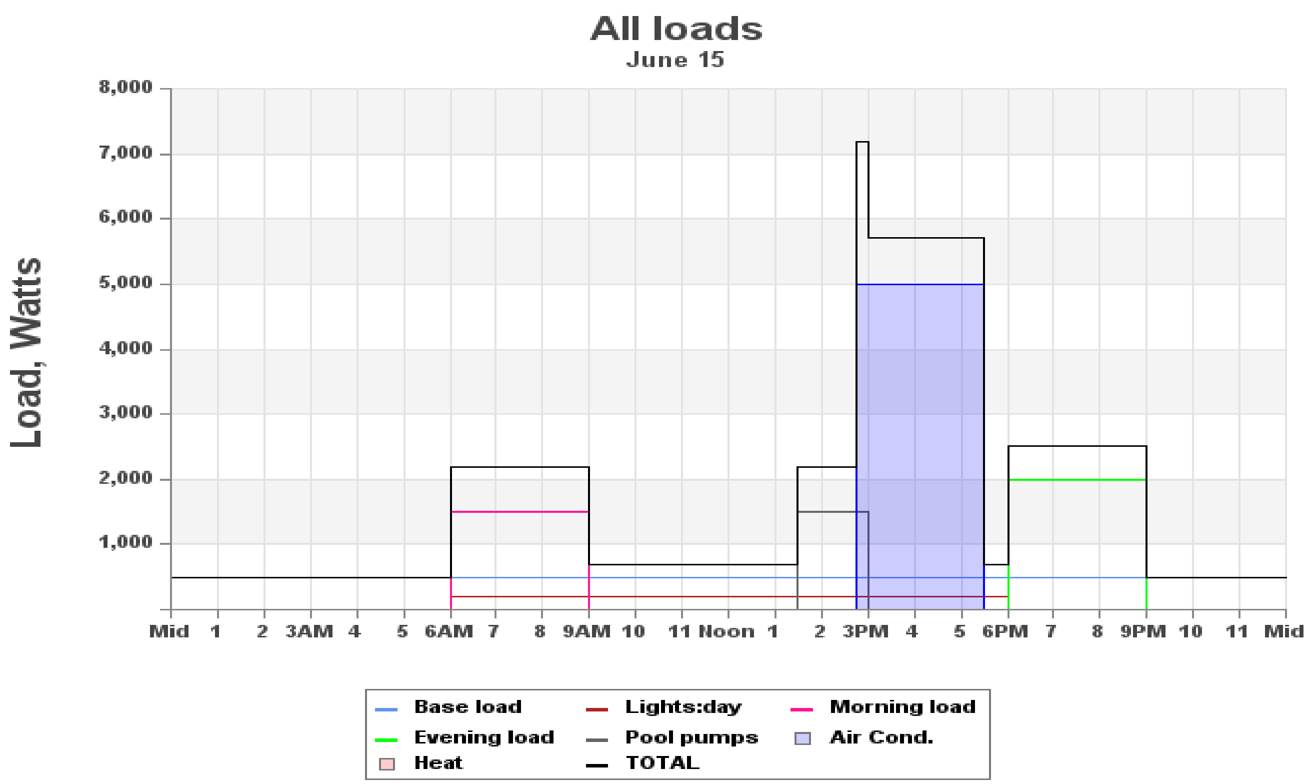
Loads. Site: Sample Site

Monthly loads, continued





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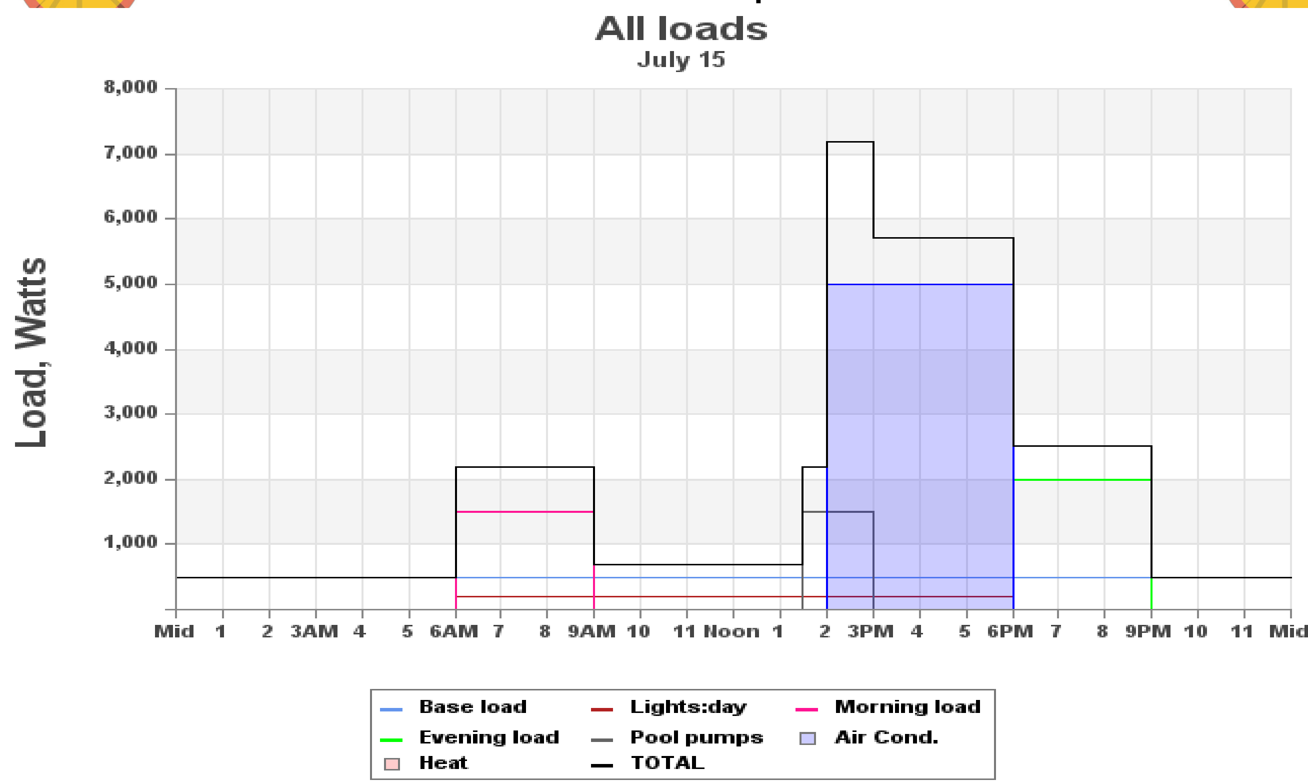
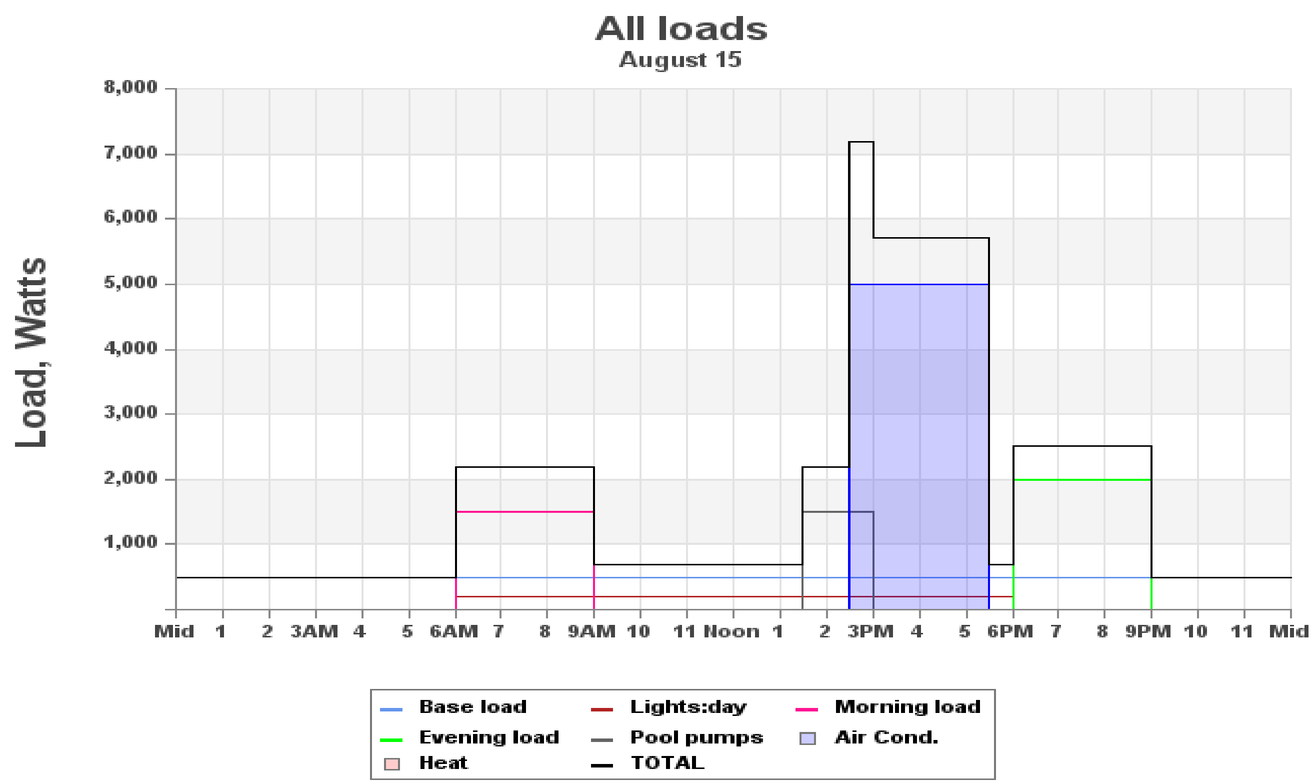
Loads. Site: Sample Site





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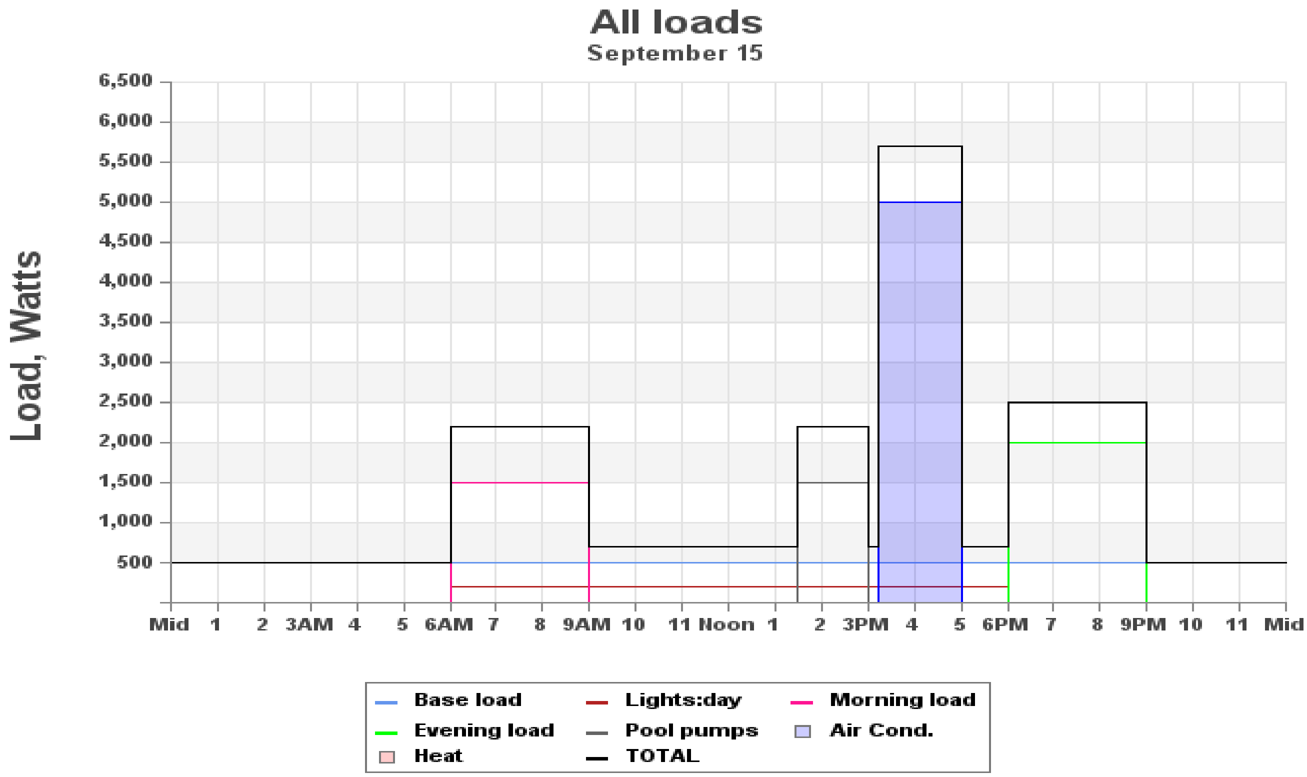
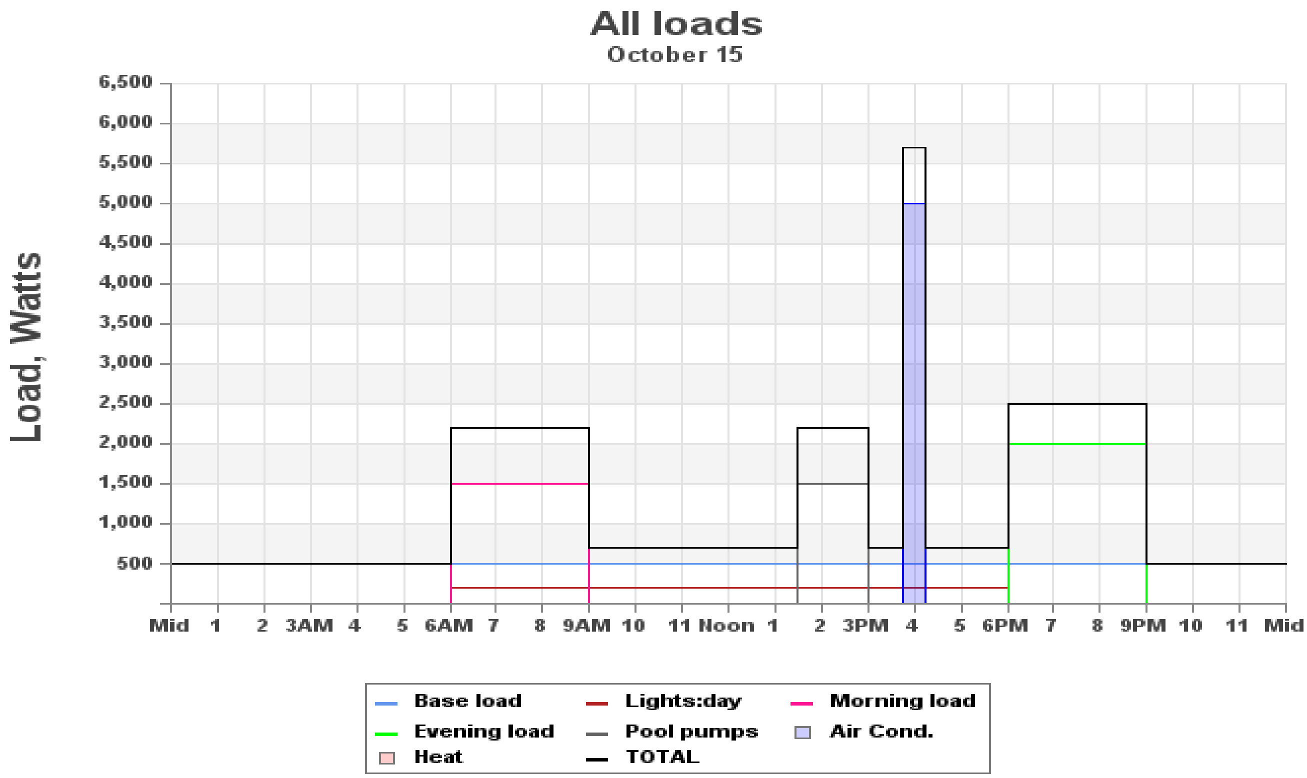
Loads. Site: Sample Site

Monthly loads, continued





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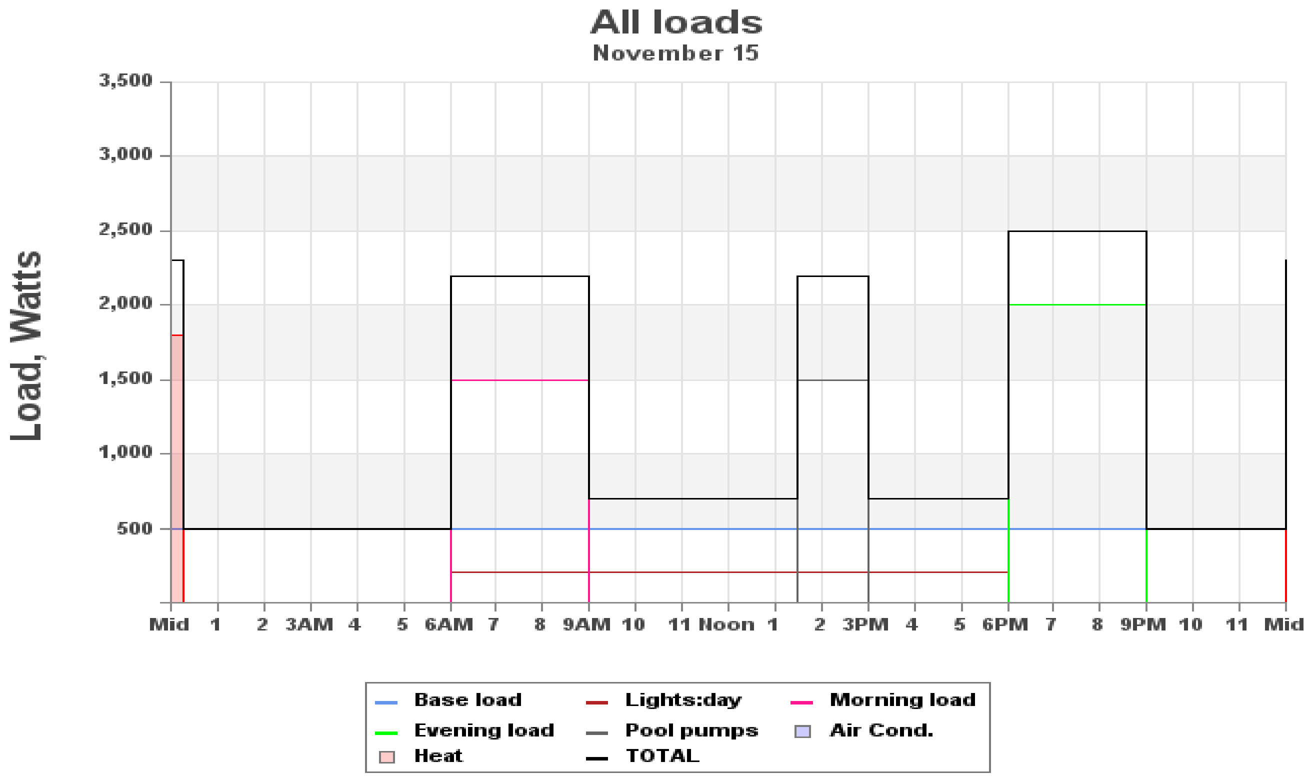
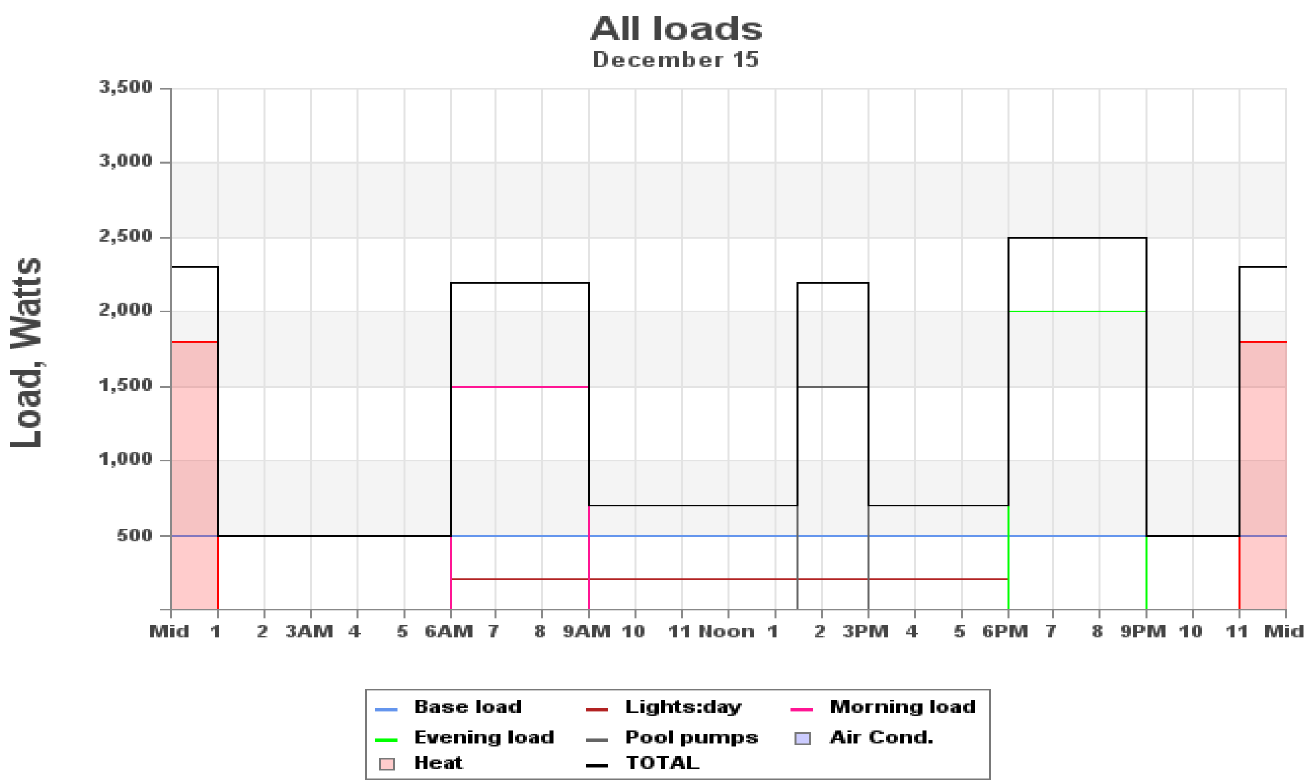
Loads. Site: Sample Site

Monthly loads, continued





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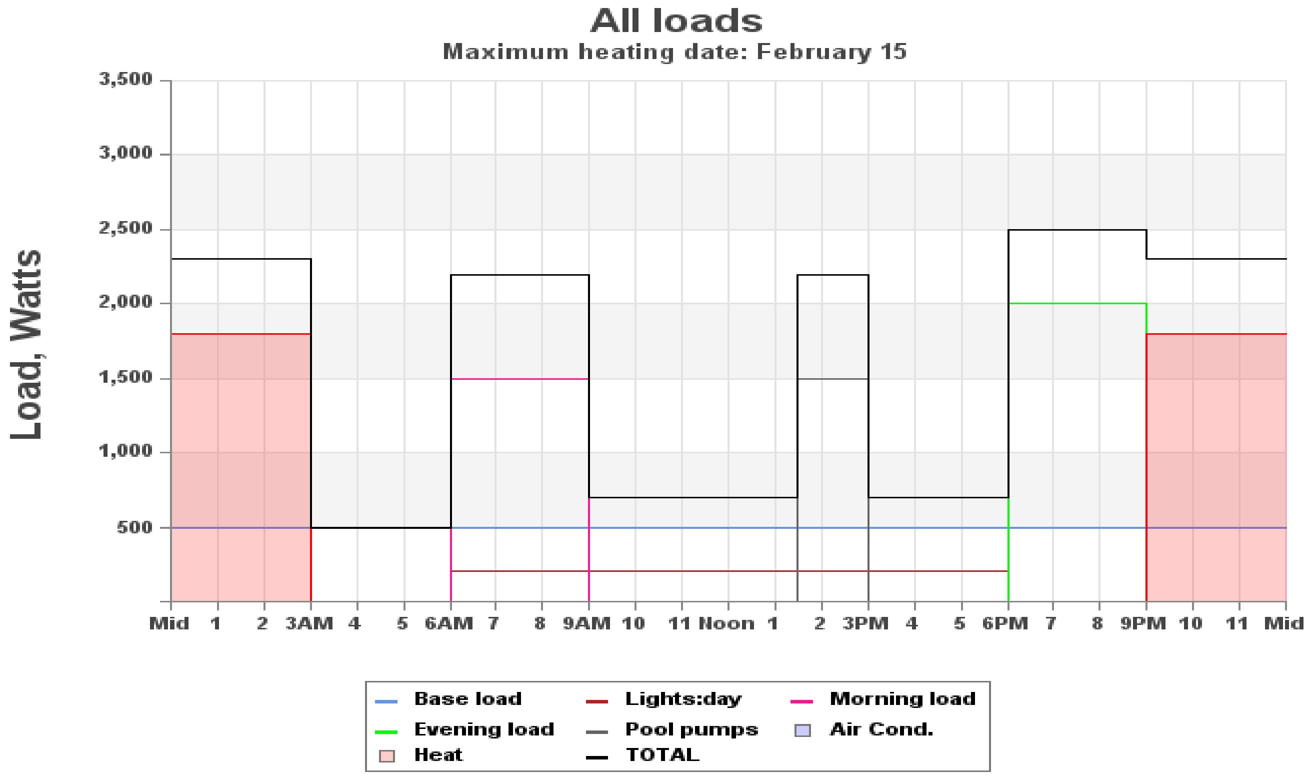
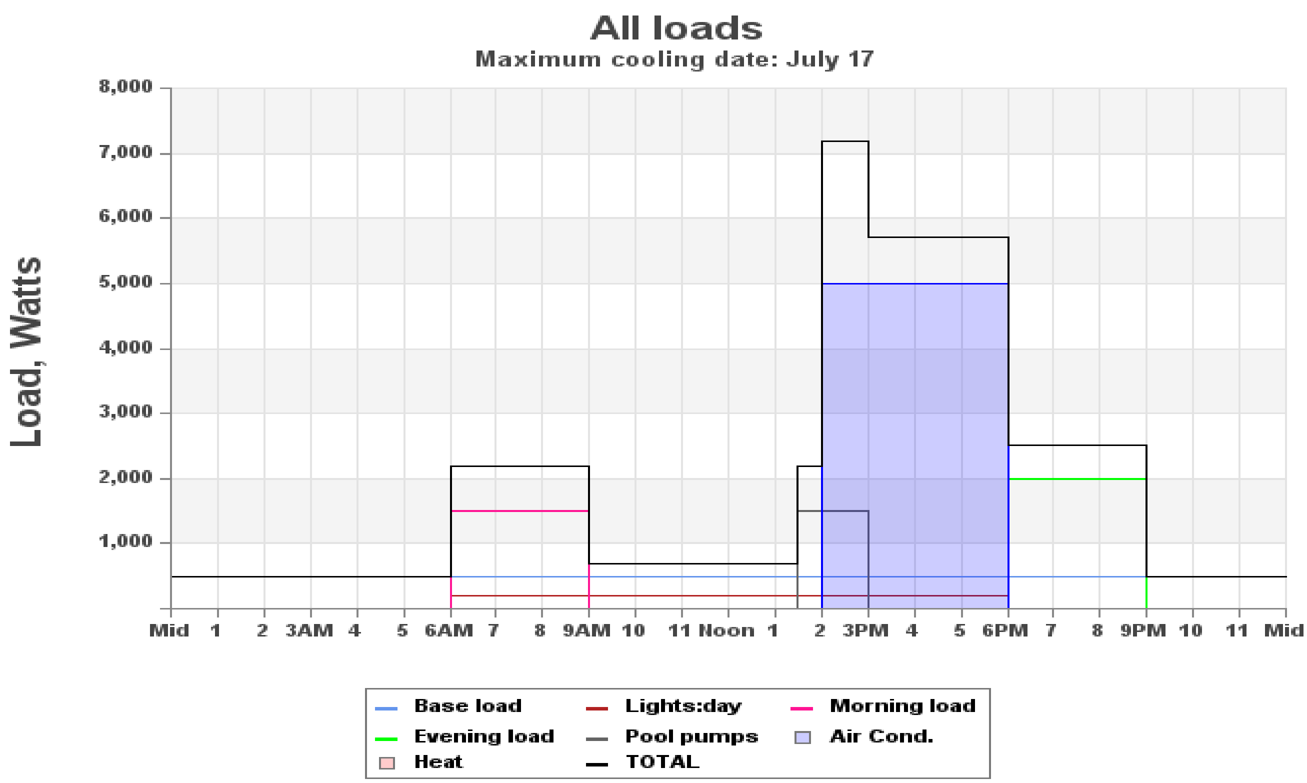
Loads. Site: Sample Site

Maximum heating and cooling days





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Power, load and rate charts

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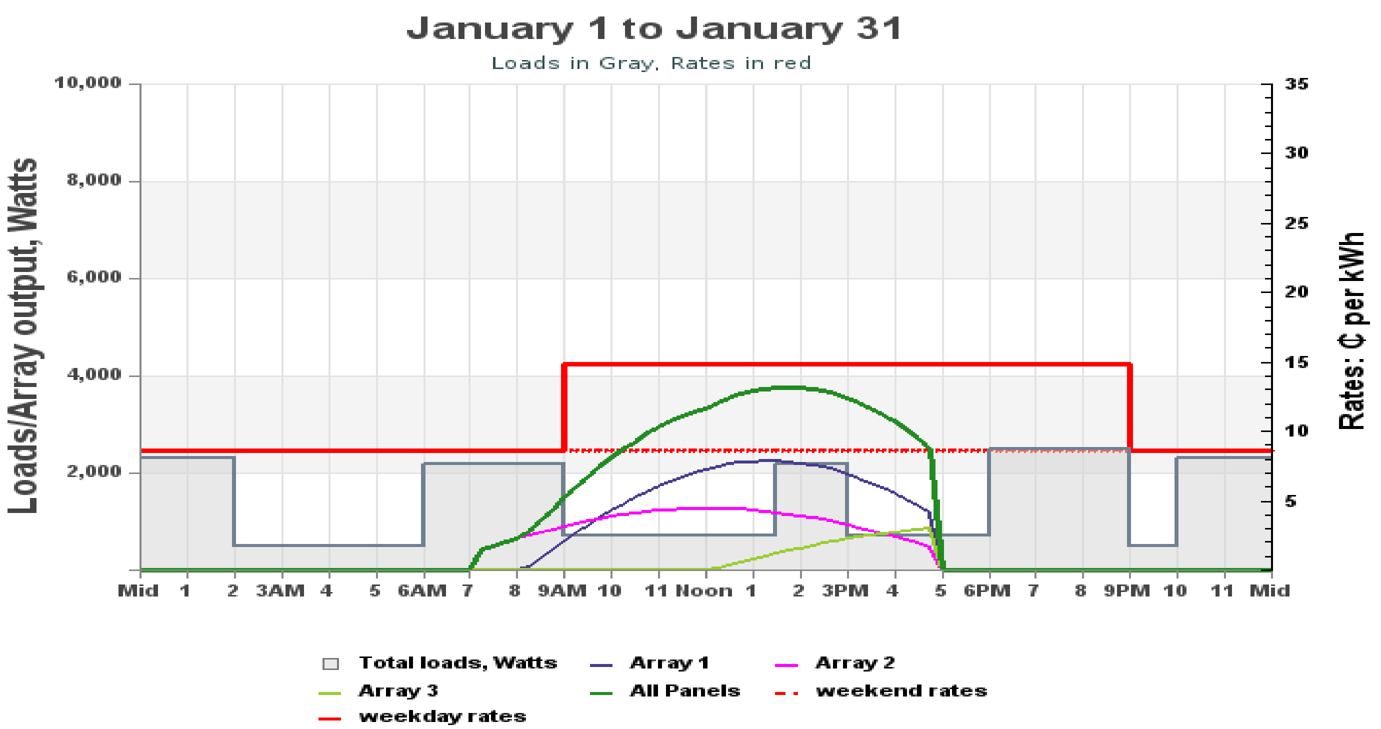
Sample Site

Panel output is shown here in Watts, as are the loads, which are shown shaded gray. As long as the panels are producing more power than the loads, the load power is coming from the panels, not the utility. There are usually more "spans" than months. A "span" occurs whever somethin of relevance happens to the solar production or rate schedule. A "span" occurs each month, since the billing cycle for electricity is usually monthly. A "span" also occurs whenever there is a change in the rate structure, although if the rate structure changes coincident with the beginning of the month, only a single "span" is generated. A span also occurs when Daylight Saving Time begins and ends, as these dates correspond to periods when the clock time and solar time change.



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Power, load and rate charts, continued

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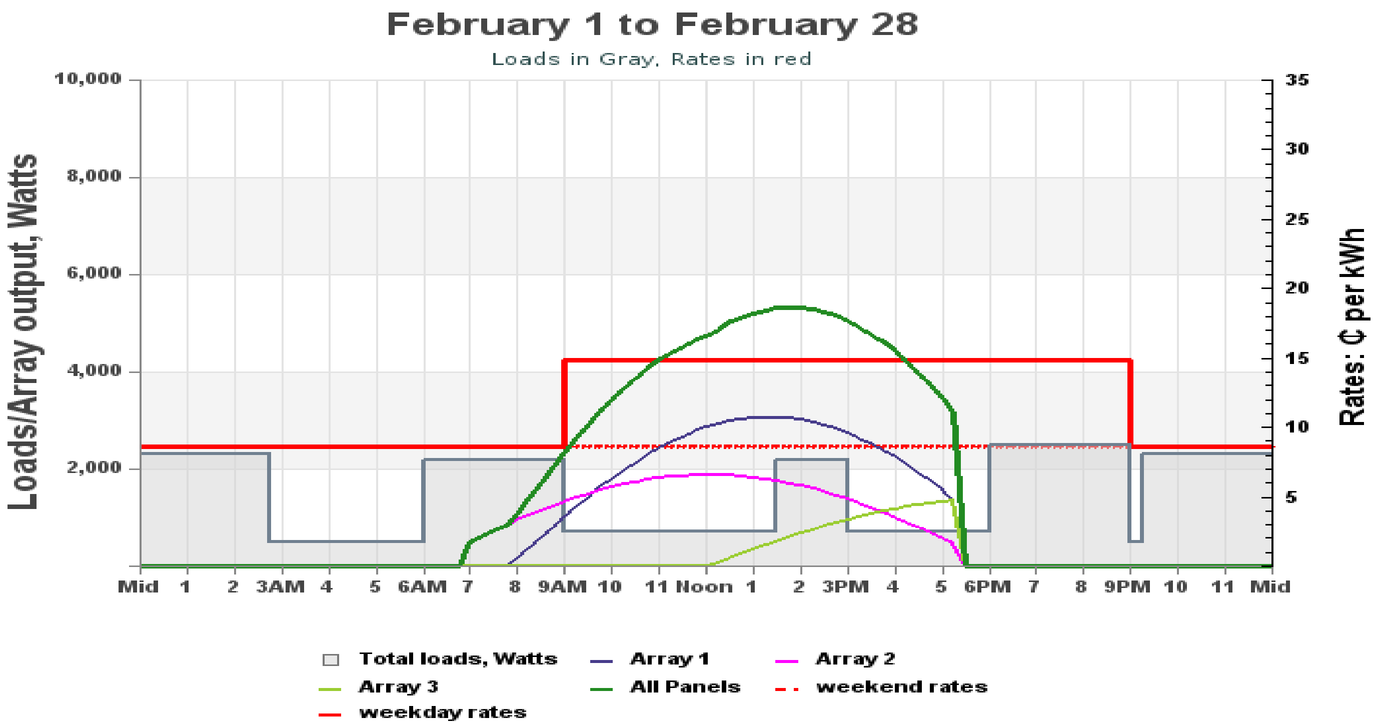
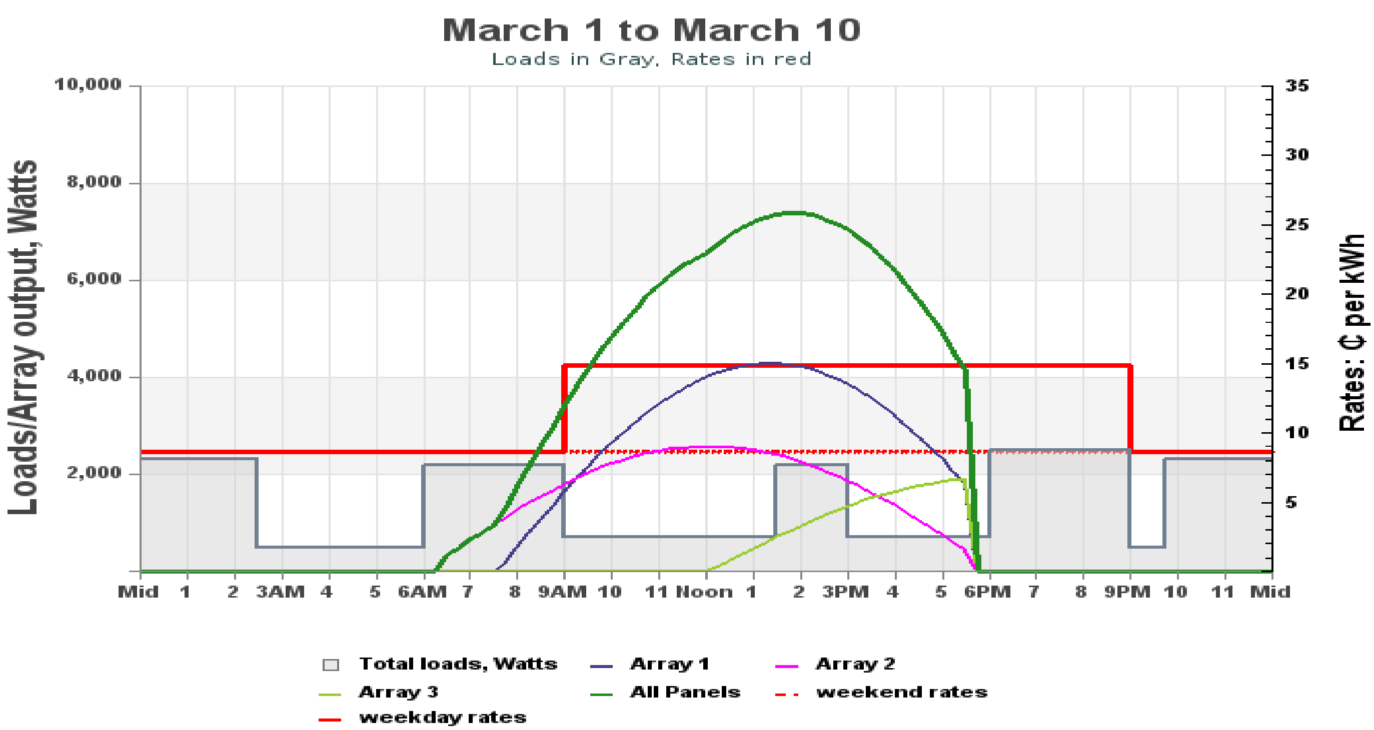
Sample Site





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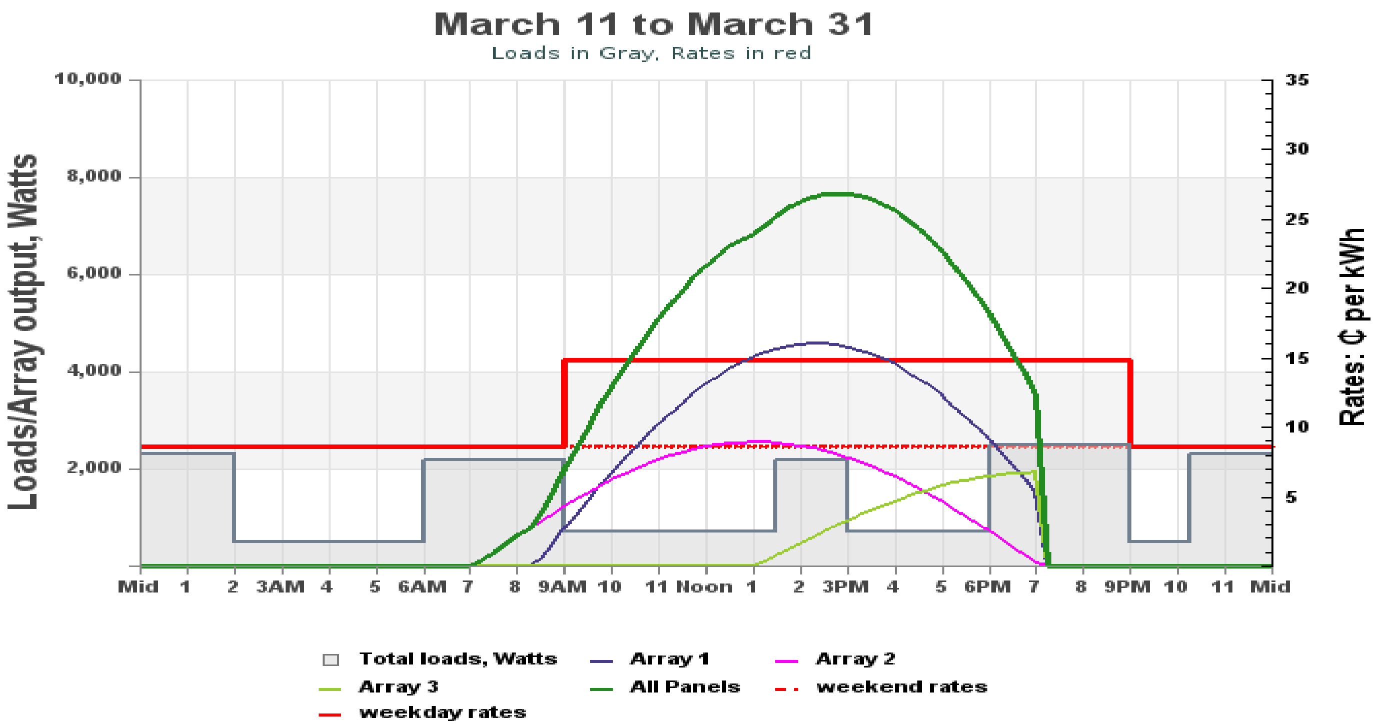
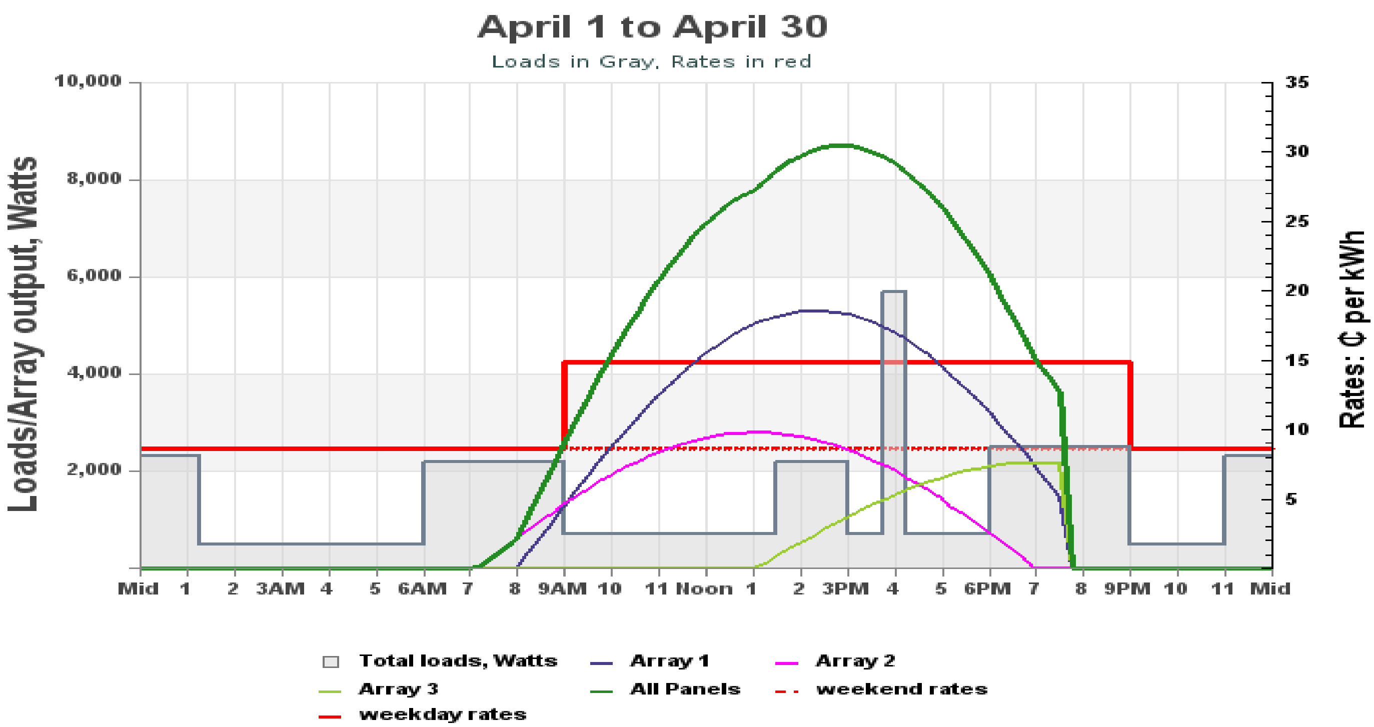
Solar Panel Optimizer

Power, load and rate charts, continued

Solar Panel Optimizer

Sample Site





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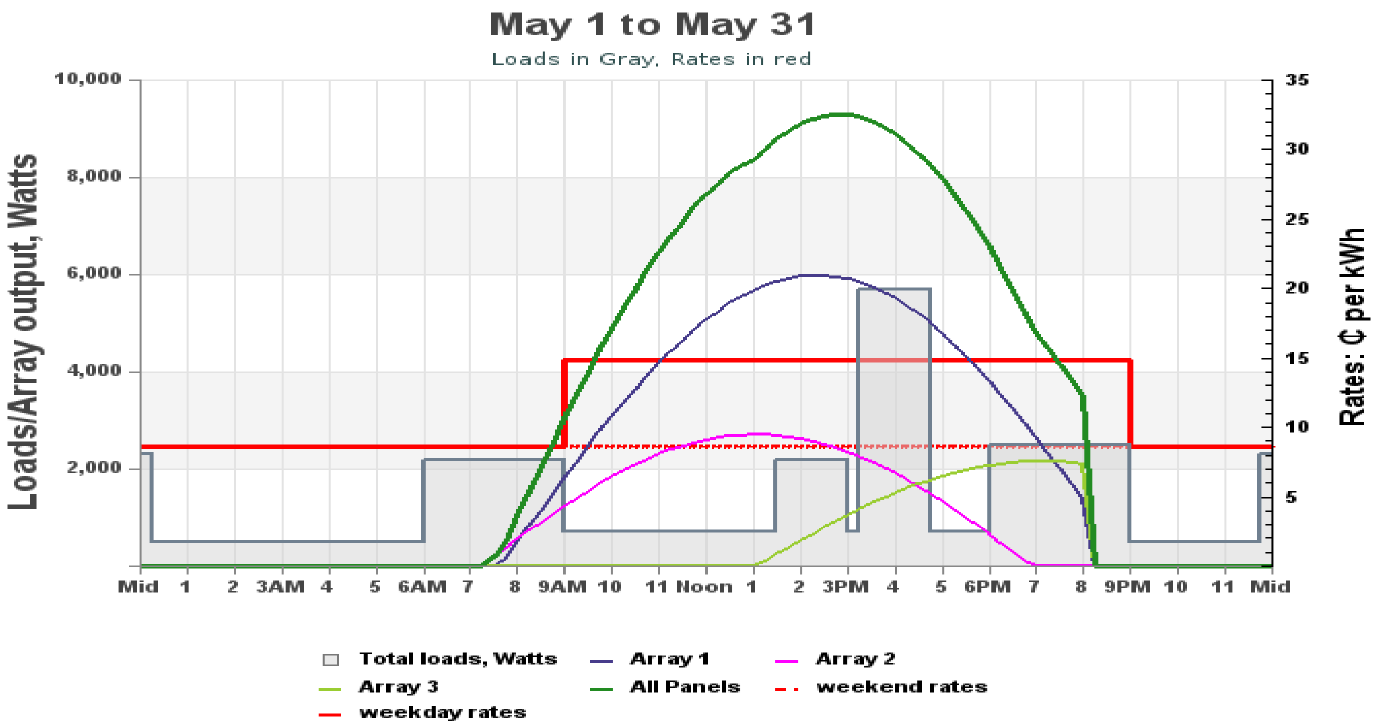
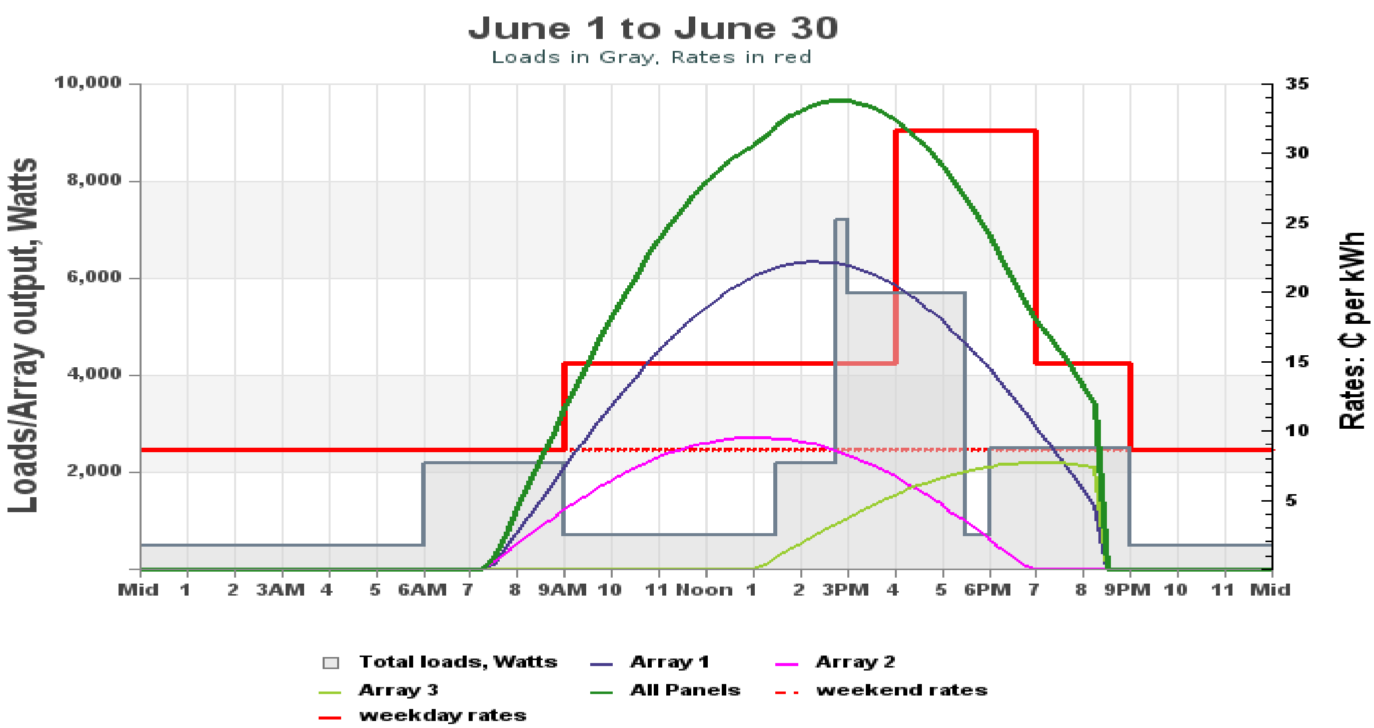
Solar Panel Optimizer

Power, load and rate charts, continued

Solar Panel Optimizer

Sample Site





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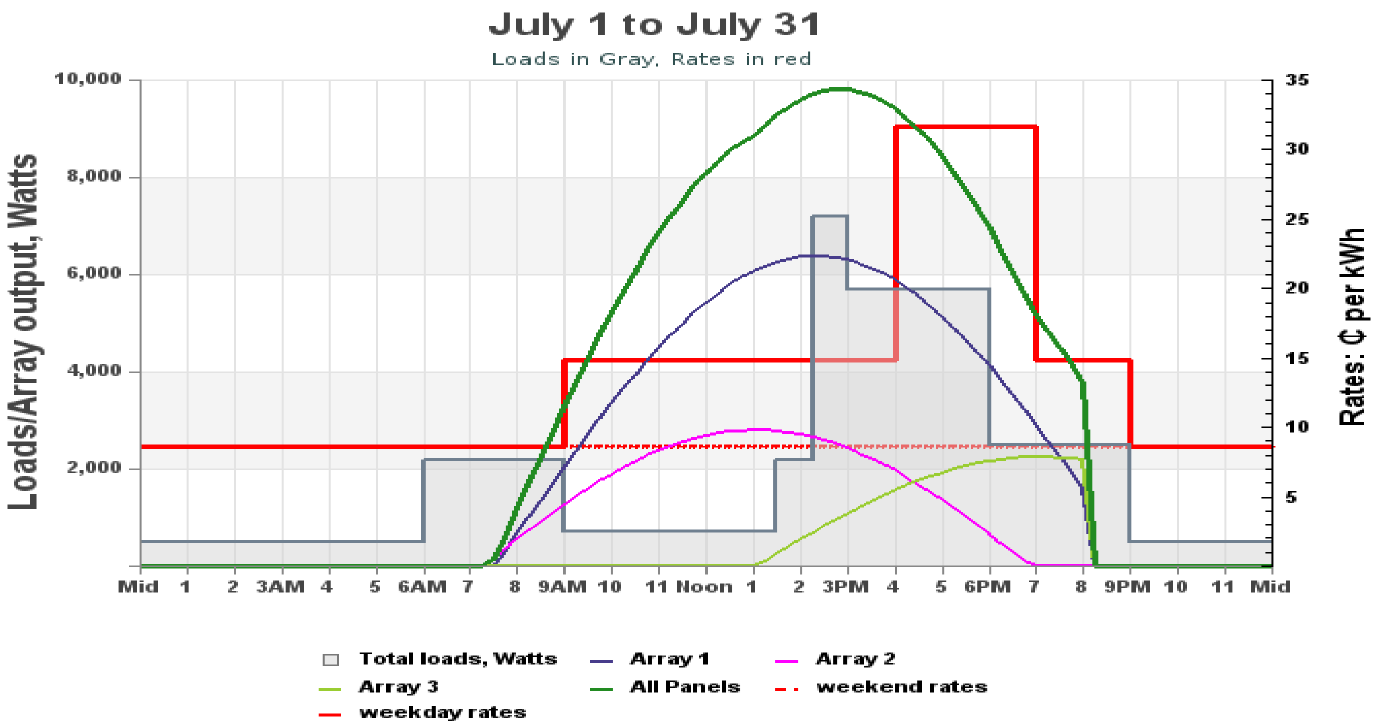
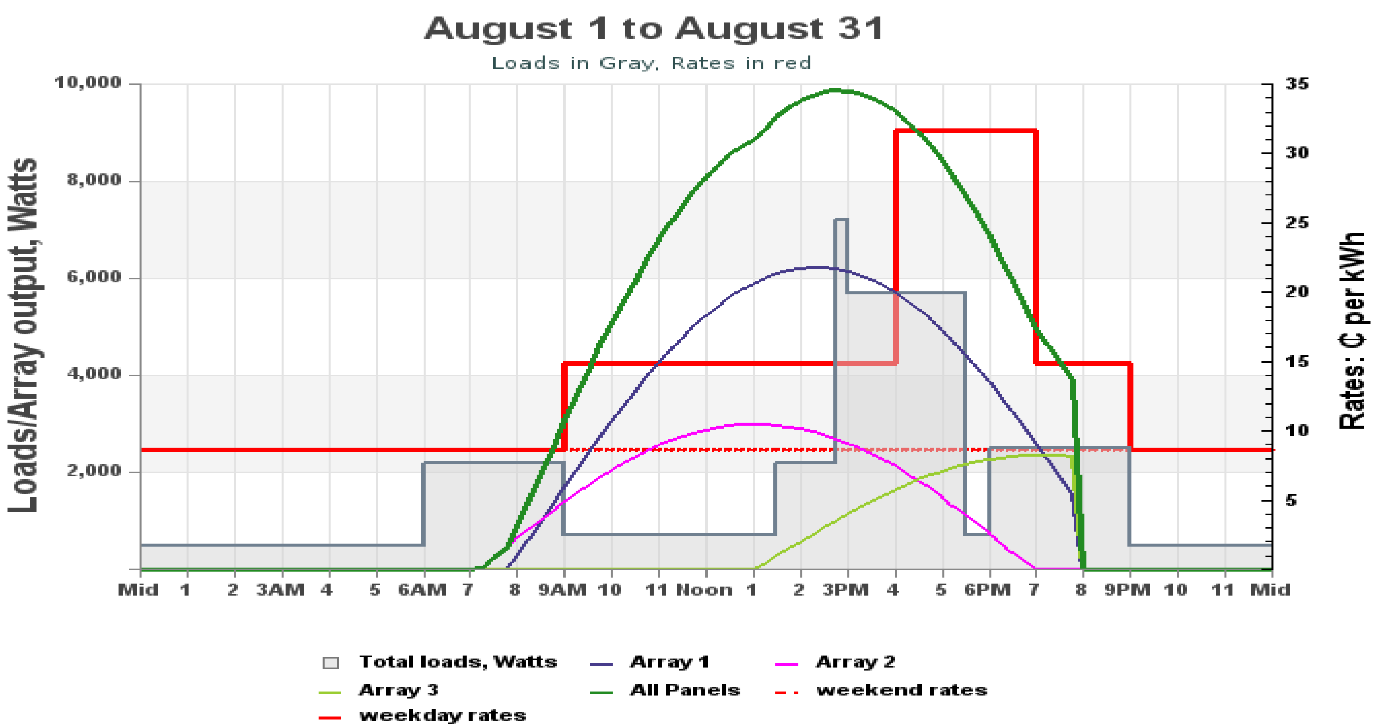
Solar Panel Optimizer

Power, load and rate charts, continued

Solar Panel Optimizer

Sample Site





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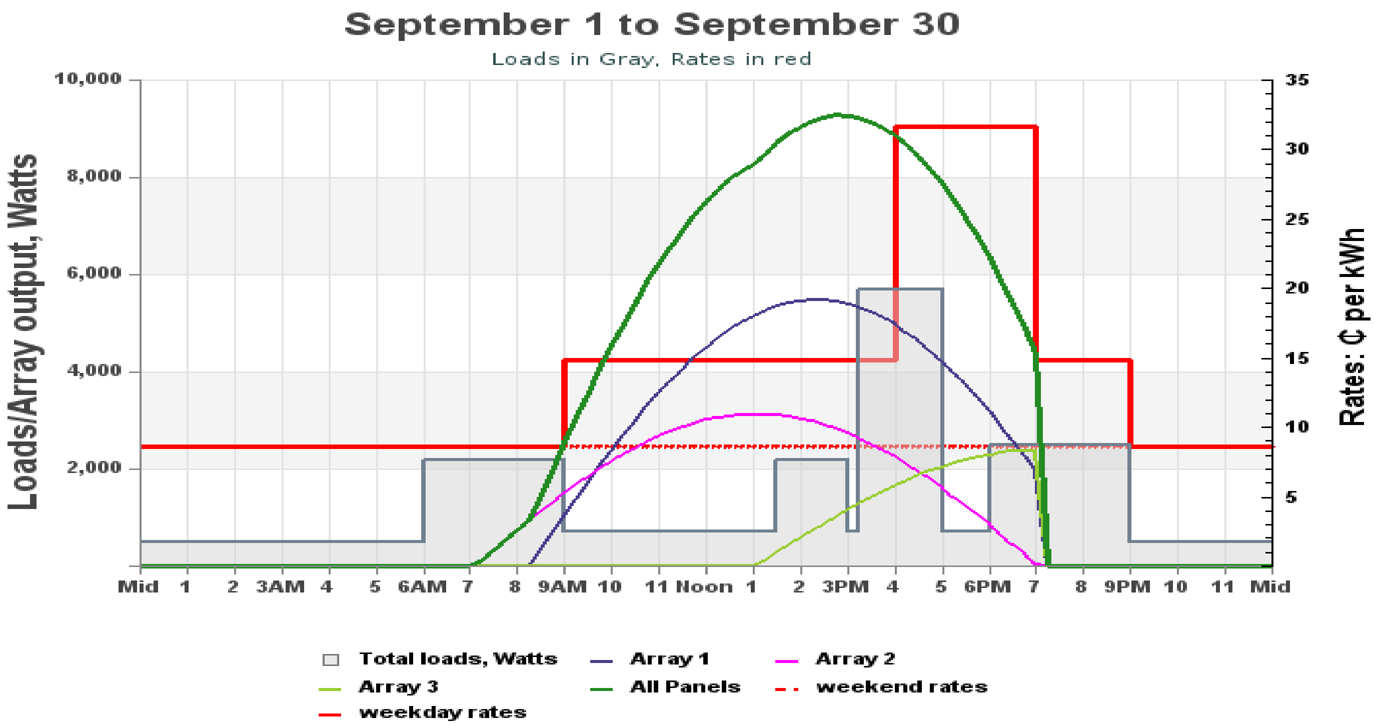
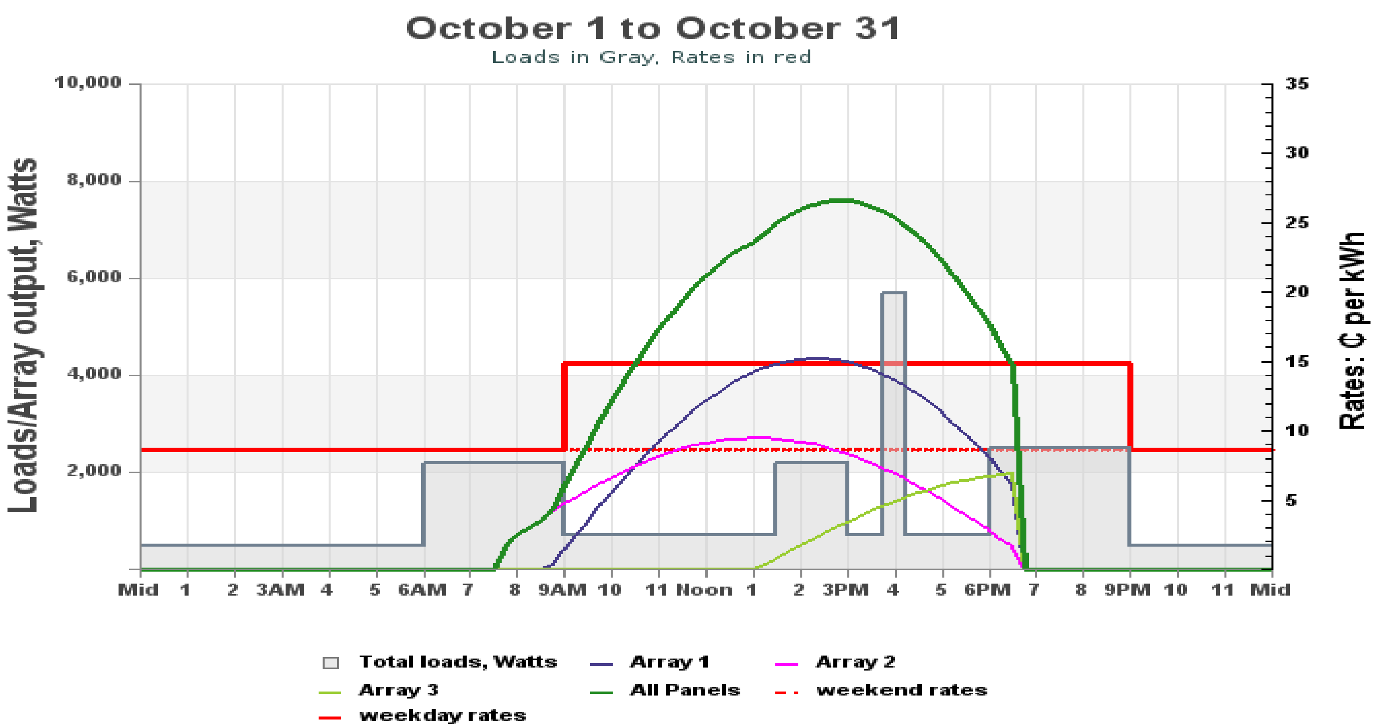
Solar Panel Optimizer

Power, load and rate charts, continued

Solar Panel Optimizer

Sample Site





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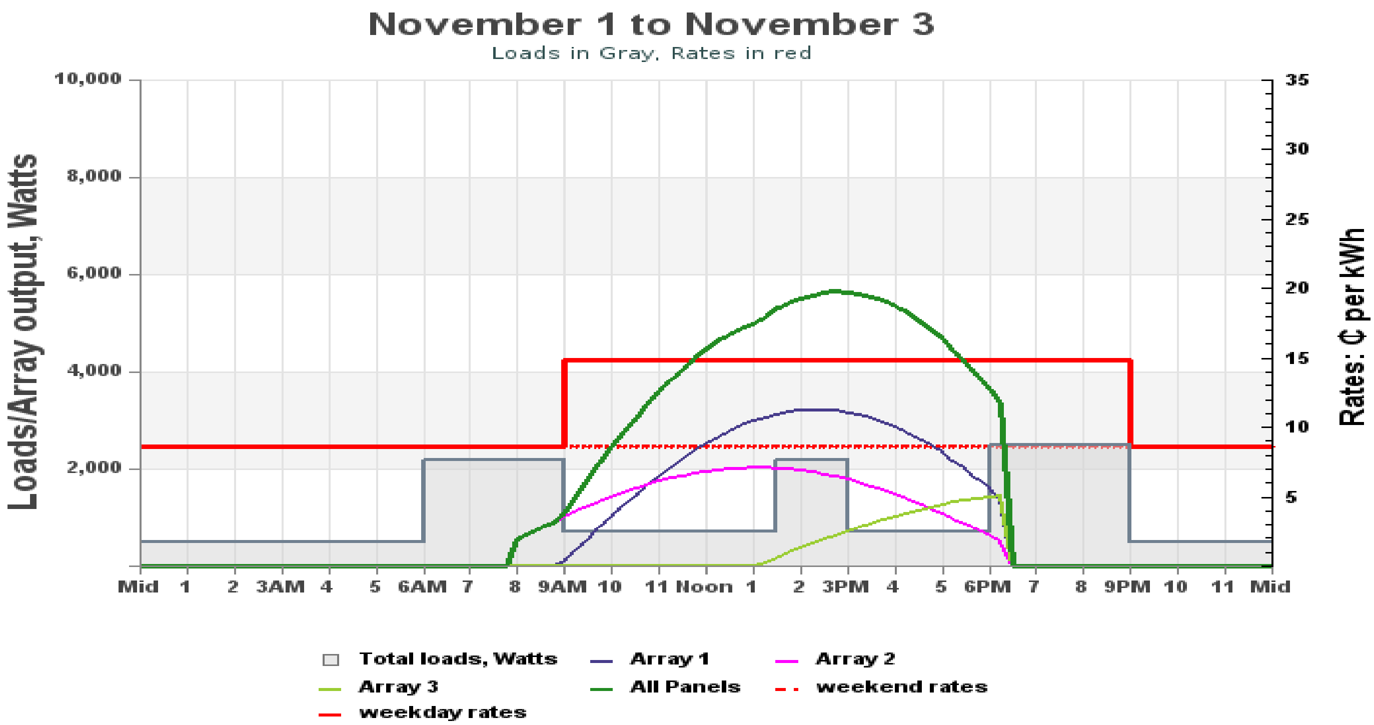
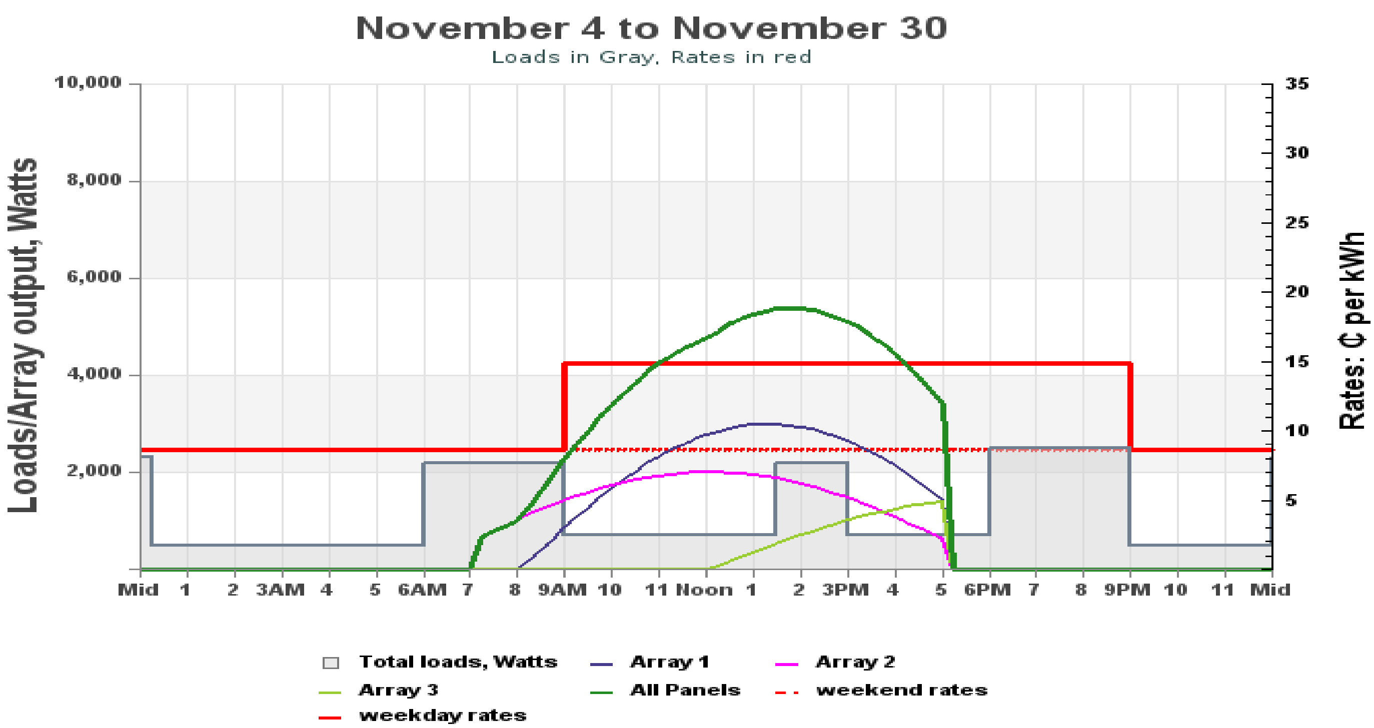
Solar Panel Optimizer

Power, load and rate charts, continued

Solar Panel Optimizer

Sample Site





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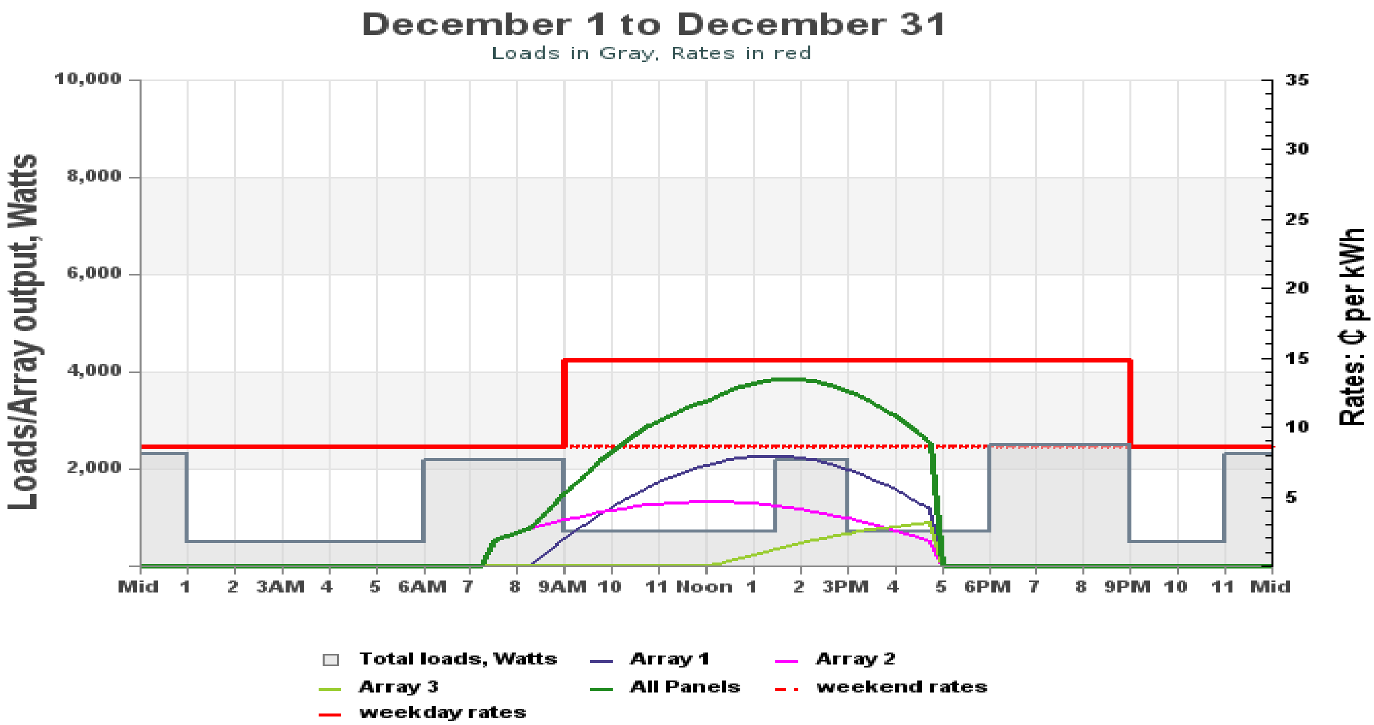
Solar Panel Optimizer

Power, load and rate charts, continued

Solar Panel Optimizer

Sample Site



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Solar Panel Optimizer

Cash Flow

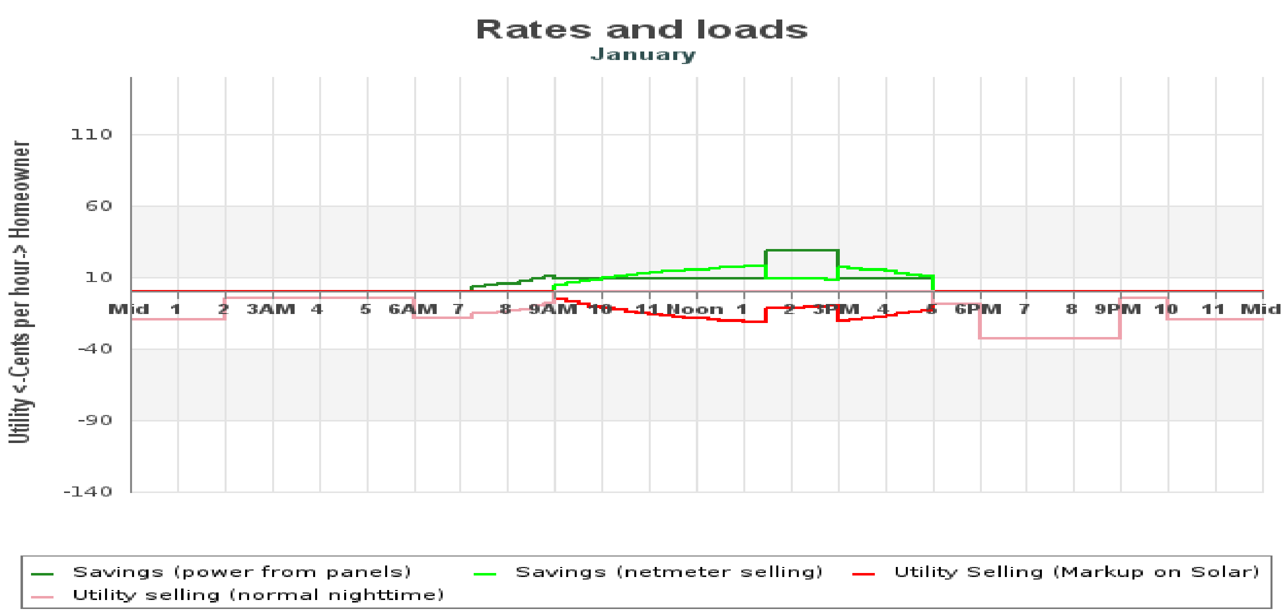
Solar Panel Optimizer

Sample Site

Money is generated in one of four ways. The savings to the homeowner is equal to the power generated by the panels USED BY THE LOADS at the current rate. The second way money is generated is when the meter runs backward and you can "net meter." By selling the electricity back to the utility, the homeowner also makes some money. Both of these savings are used to calculate the return on investment, or ROI. While the utility may try to get you to move loads to the overnight hours, your return on investment may be better if you move those loads to a time when the panels produce excess power, as you may actually make MORE money from your panels as opposed to putting power back on the grid.

The utility also makes money in two ways, first it sells you electricity whenever the panels don't produce enough power, mostly at night when solar panels have no output. It also sells power whenever the panels do not produce enough to exceed the loads. Your electric bill is equal to this amount less any money you may make by selling electricity back to the grid net metering.

Second the utility sells the electricity that the panels put back on the grid at a markup. The markup on solar is equal to the current tariff rate less the net meter rate. in may cases this resale markup is quite good. For example, in the case of the sample site, the net meter rate is 5.96 cents/kWh but the tariff rate is 32 cents/kWh, for a net margin of 81%. This also means that if you do not have the load to use the panel production, you have constructed a high margin power generation facility for your local utility. The numbers here will tell you what this dollar amount is, but in some cases the utility will be making more money than the homeowner. This number means: DO NOT OVERSIZE YOUR SOLAR ARRAYS, as you are spending money (capital) for the benefit of a third party. Second, small solar arrays can provide an excellent return on investment because they reduce the effect of high Time-of-Use rates while minimizing capital investment.



Power produced	**802 kWh**	**Utility Bill**	**$47.99**
Savings from panel power:	$35.37	Money earned net metering:	$30.88
		Net savings:	$66.25
Utility sells power (normal):	$78.86	Utility sells power (marked up) to others:	$36.92

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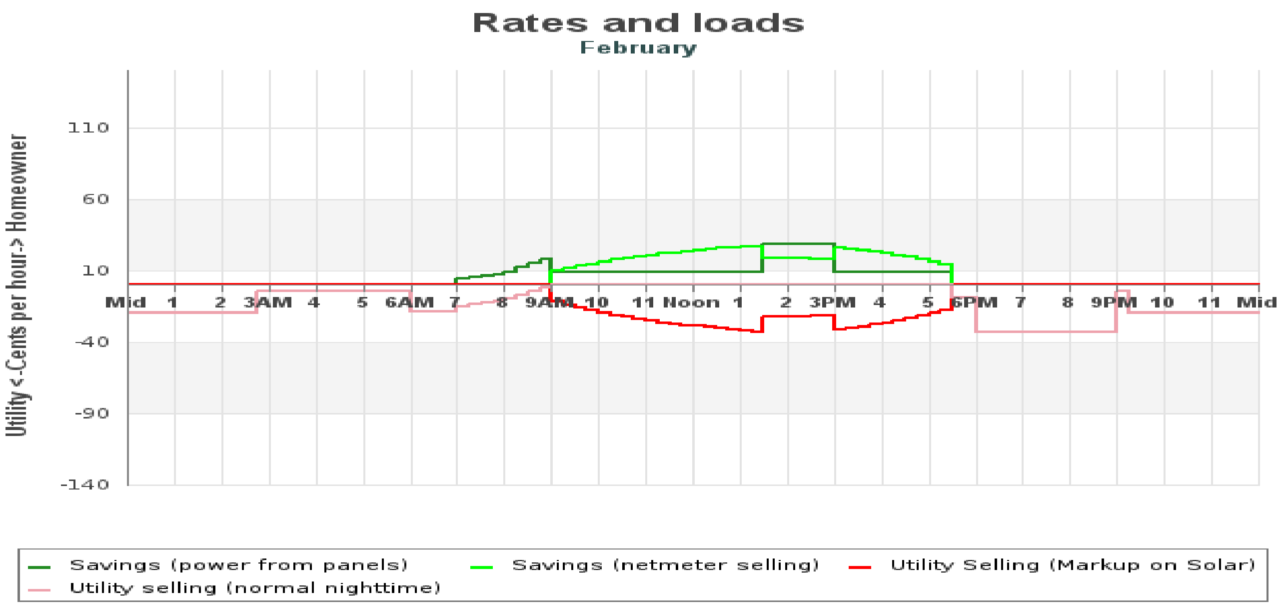
Solar Panel Optimizer

Cash Flows, continued

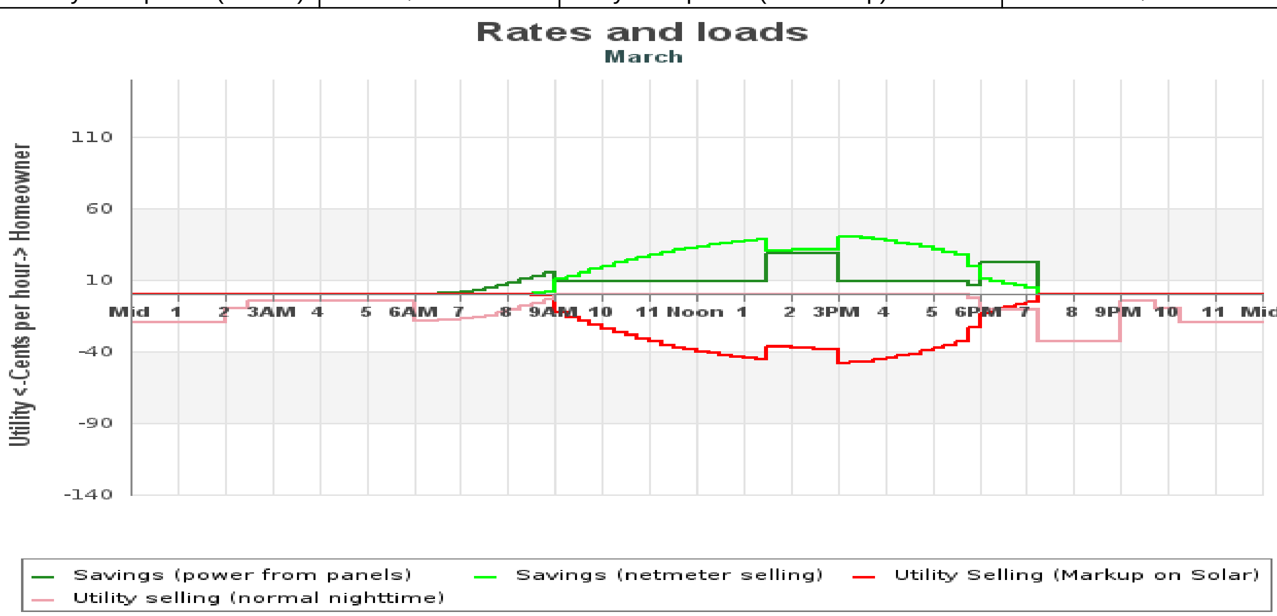
Solar Panel Optimizer

Sample Site



Power produced	**1,099 kWh**	**Utility Bill**	**$26.19**

Savings from panel power:	$35.49	Money earned net metering:	$48.06
		Net savings:	$83.54
Utility sells power (normal):	$74.24	Utility sells power (marked up) to others:	$57.46



Power produced	**1,843 kWh**	**Utility Bill**	**$-20.24**

Savings from panel power:	$48.08	Money earned net metering:	$86.74
		Net savings:	$134.83
Utility sells power (normal):	$66.50	Utility sells power (marked up) to others:	$103.57

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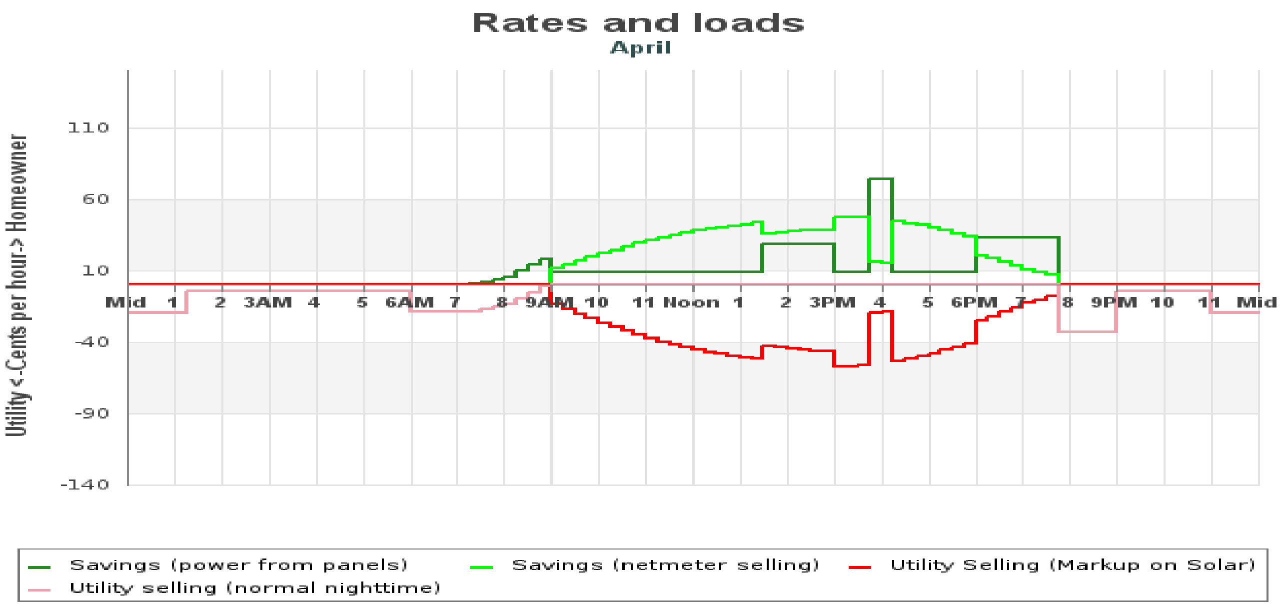
Solar Panel Optimizer

Cash Flows, continued

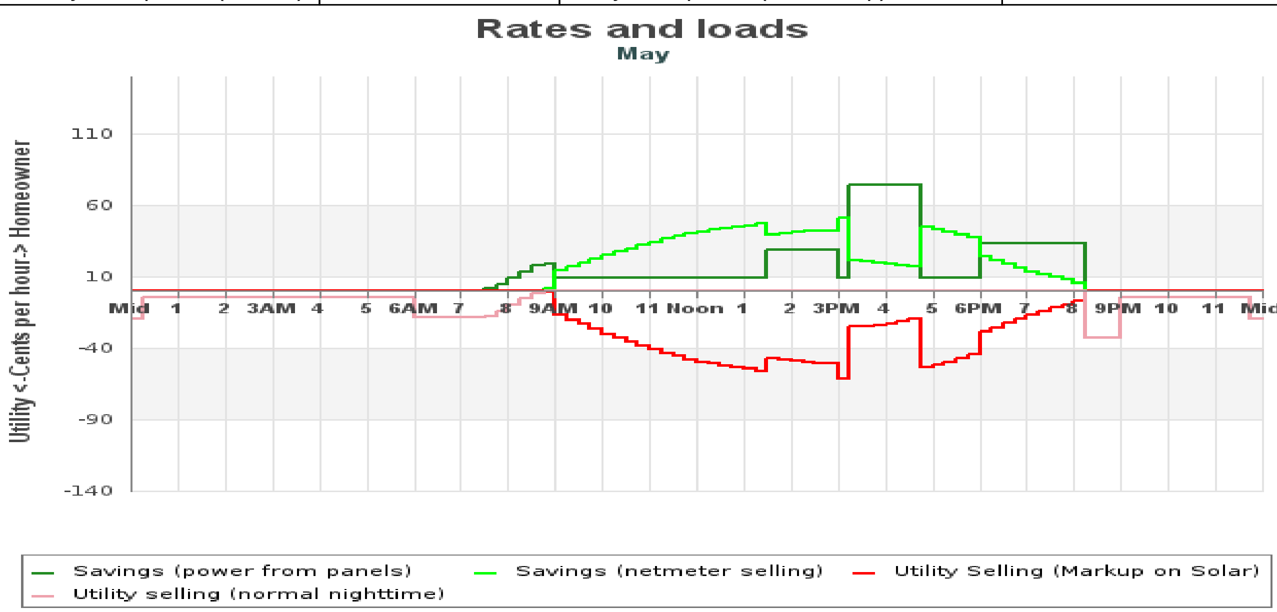
Solar Panel Optimizer

Sample Site



Power produced	**2,169 kWh**	**Utility Bill**	**$-51.32**

Savings from panel power:	$64.62	Money earned net metering:	$98.89
		Net savings:	$163.51
Utility sells power (normal):	$47.56	Utility sells power (marked up) to others:	$118.23



Power produced	**2,492 kWh**	**Utility Bill**	**$-70.24**

Savings from panel power:	$93.00	Money earned net metering:	$104.99
		Net savings:	$197.98
Utility sells power (normal):	$34.75	Utility sells power (marked up) to others:	$125.40

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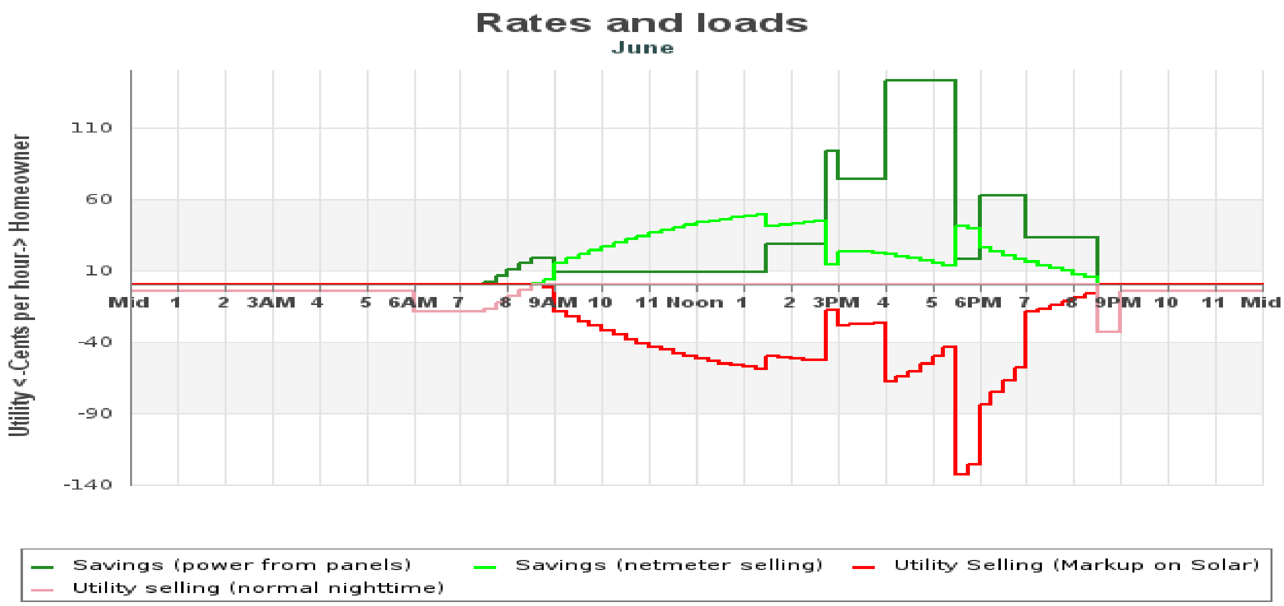
Solar Panel Optimizer

Cash Flows, continued

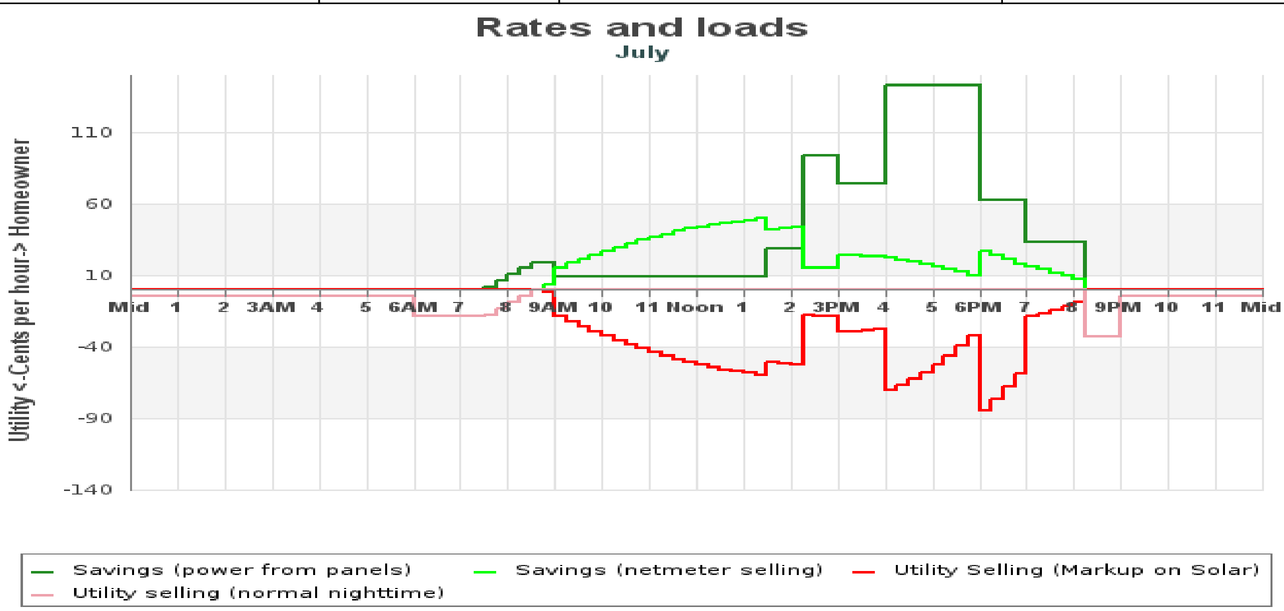
Solar Panel Optimizer

Sample Site



Power produced	**2,559 kWh**	**Utility Bill**	**$-69.41**

Savings from panel power:	$158.55	Money earned net metering:	$97.67
		Net savings:	$256.22
Utility sells power (normal):	$28.26	Utility sells power (marked up) to others:	$158.08



Power produced	**2,646 kWh**	**Utility Bill**	**$-61.18**

Savings from panel power:	$190.71	Money earned net metering:	$93.08
		Net savings:	$283.79
Utility sells power (normal):	$31.90	Utility sells power (marked up) to others:	$145.80

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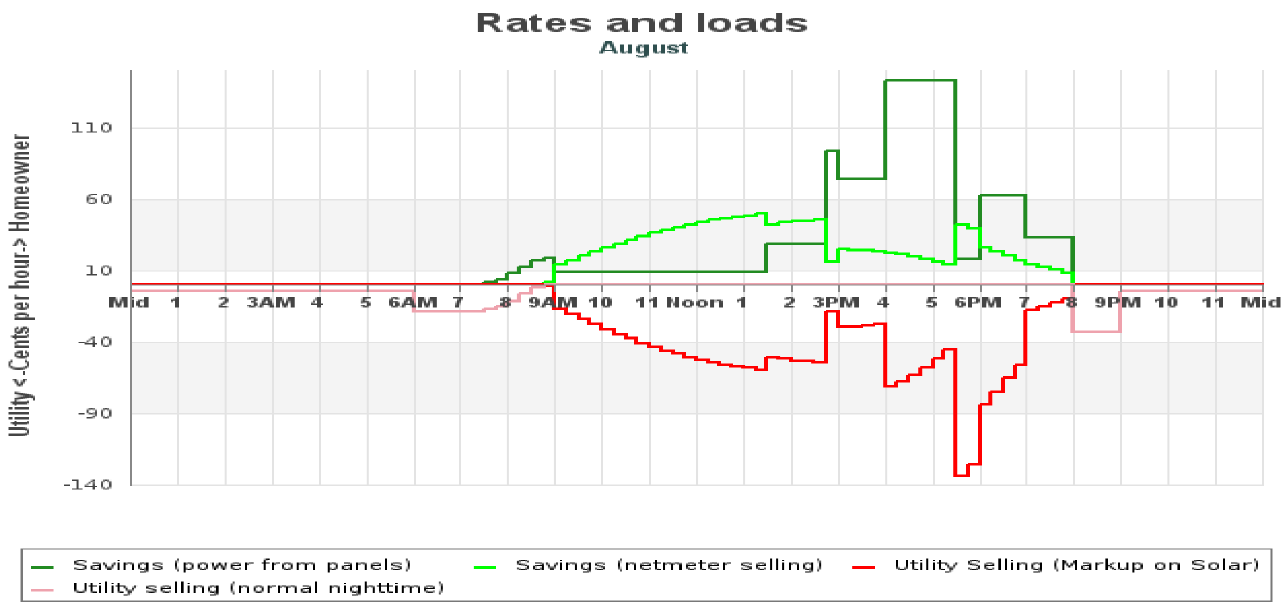
Solar Panel Optimizer

Cash Flows, continued

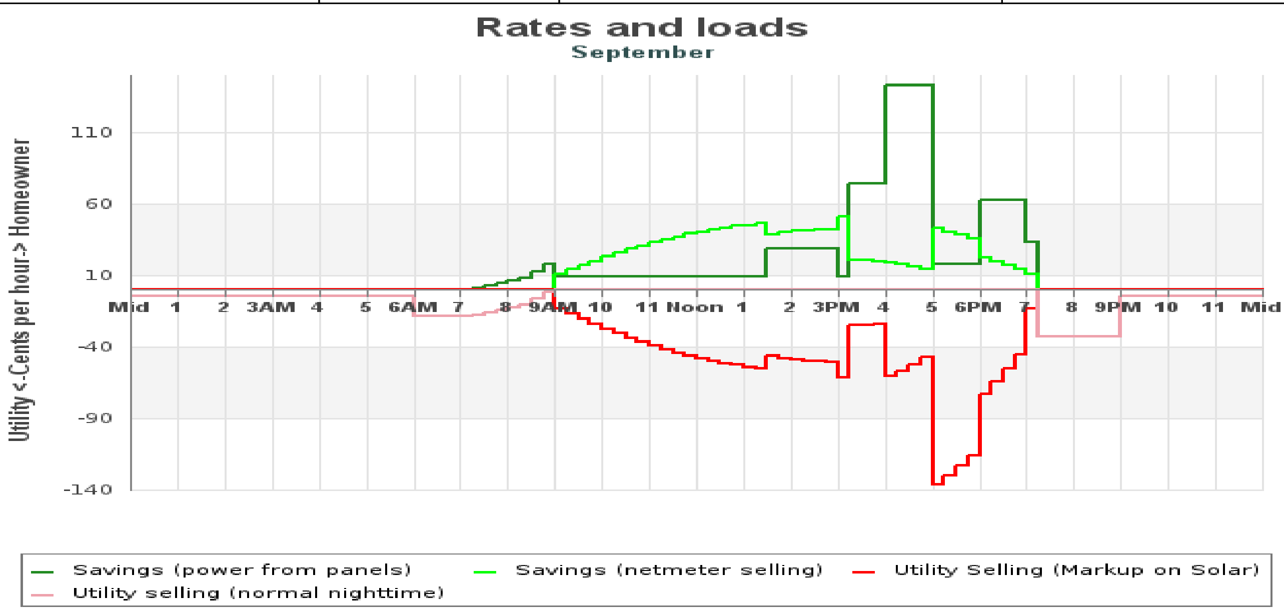
Solar Panel Optimizer

Sample Site



Power produced	**2,588 kWh**	**Utility Bill**	**$-65.38**

Savings from panel power:	$157.95	Money earned net metering:	$100.46
		Net savings:	$258.41
Utility sells power (normal):	$35.08	Utility sells power (marked up) to others:	$163.60



Power produced	**2,226 kWh**	**Utility Bill**	**$-51.37**

Savings from panel power:	$116.20	Money earned net metering:	$93.35
		Net savings:	$209.56
Utility sells power (normal):	$41.99	Utility sells power (marked up) to others:	$156.85

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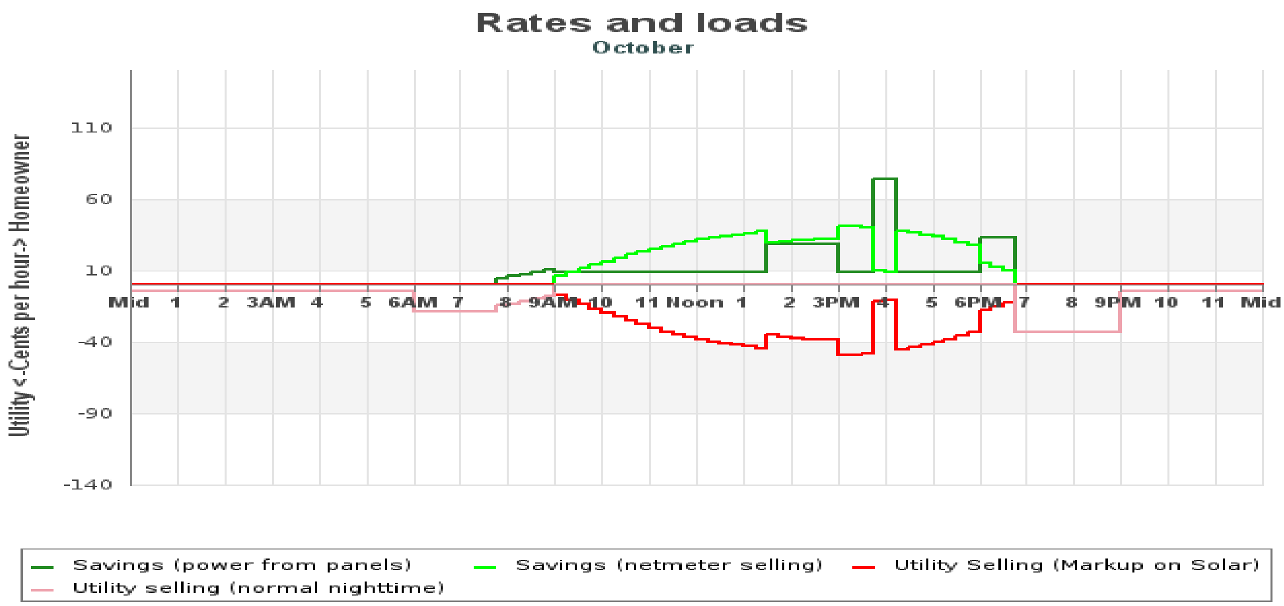
Solar Panel Optimizer

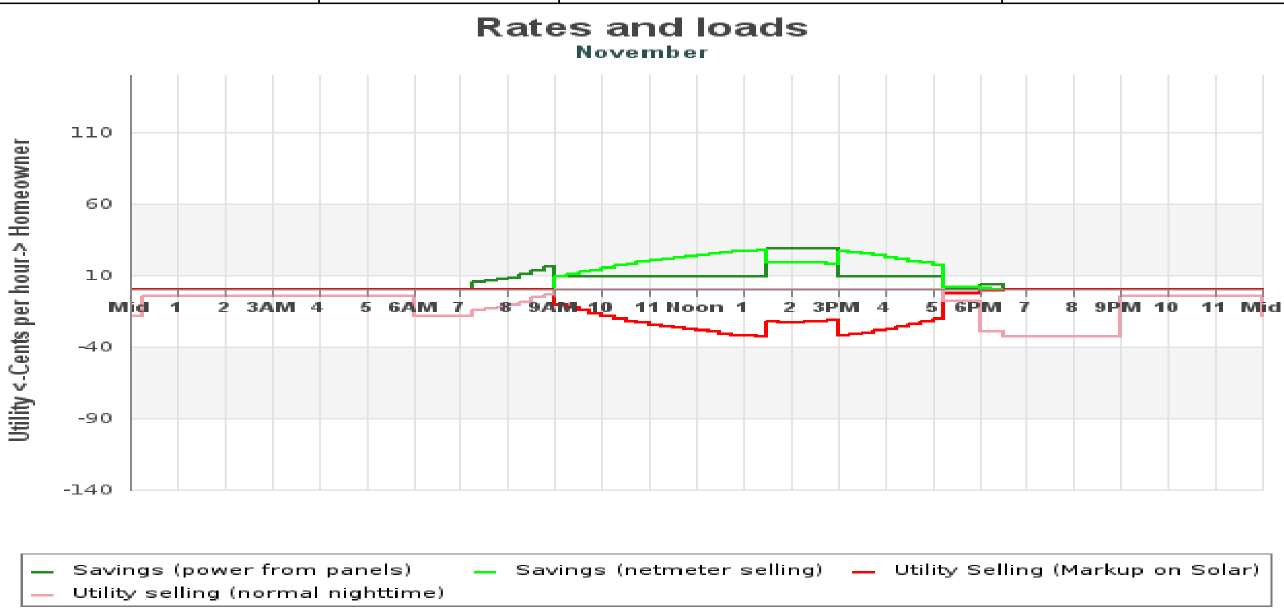
Cash Flows, continued

Solar Panel Optimizer

Sample Site



Power produced	**1,786 kWh**		**Utility Bill**	**$-30.87**
Savings from panel power:	$55.38		Money earned net metering:	$80.54
			Net savings:	$135.92
Utility sells power (normal):	$49.67	Utility sells power (marked up) to others:		$96.29



Power produced	**1,161 kWh**		**Utility Bill**	**$4.61**
Savings from panel power:	$37.22		Money earned net metering:	$51.06
			Net savings:	$88.28
Utility sells power (normal):	$55.68	Utility sells power (marked up) to others:		$61.05

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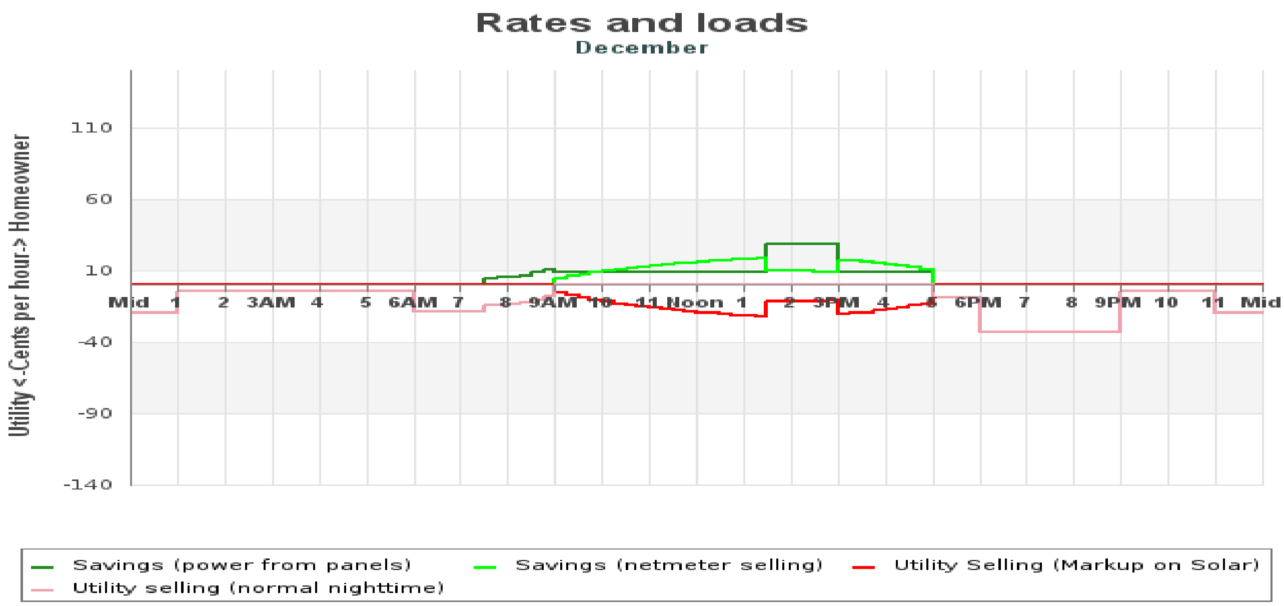
Solar Panel Optimizer

Cash Flows, continued

Solar Panel Optimizer

Sample Site



Power produced	812 kWh	Utility Bill	$37.83

Savings from panel power:	$35.10	Money earned net metering:	$31.65
		Net savings:	$66.74
Utility sells power (normal):	$69.48	Utility sells power (marked up) to others:	$37.84

Annual Returns

Total power production, kWh	**22,181**
Savings due to power from panels	**$1,027.67**
Money earned by net metering	**$917.36**
Utility sells power (normal selling)	**$613.98**
Utility sells power to others that panels produce	**$1,261.08**
Net savings	**$1,945.03**
Net electric bill	**$-303.38**

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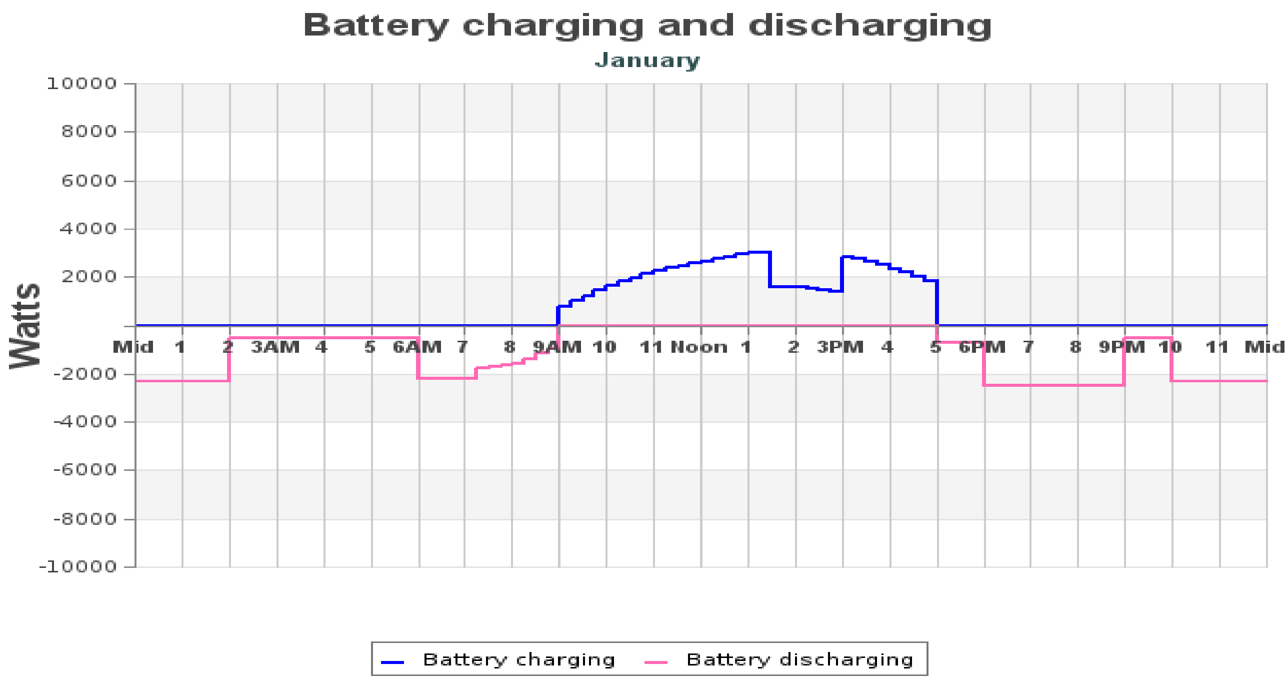
Solar Panel Optimizer

Batteries

Solar Panel Optimizer

Sample Site

Batteries can store electricity that would otherwise go back to the utility through the meter. Because of low rates for "net metering," you are better off storing the power in a battery and then using it when you need it. If fact, the use of a whole house battery may make the return on investment in the solar system increase, as you may use less electricity from the utility. You may find that your best return comes from makiing your arrays smaller, and relying on battery power more. This site does not currently calculate ROI for a system that combines solar array and batteries, but this feature will be added later. These charts will assist you in understanding ow the battery store and use power, and how much is needed, and can be stored, throughout the year.



January

Charging	16.7kWh	Discharging	25.2kWh

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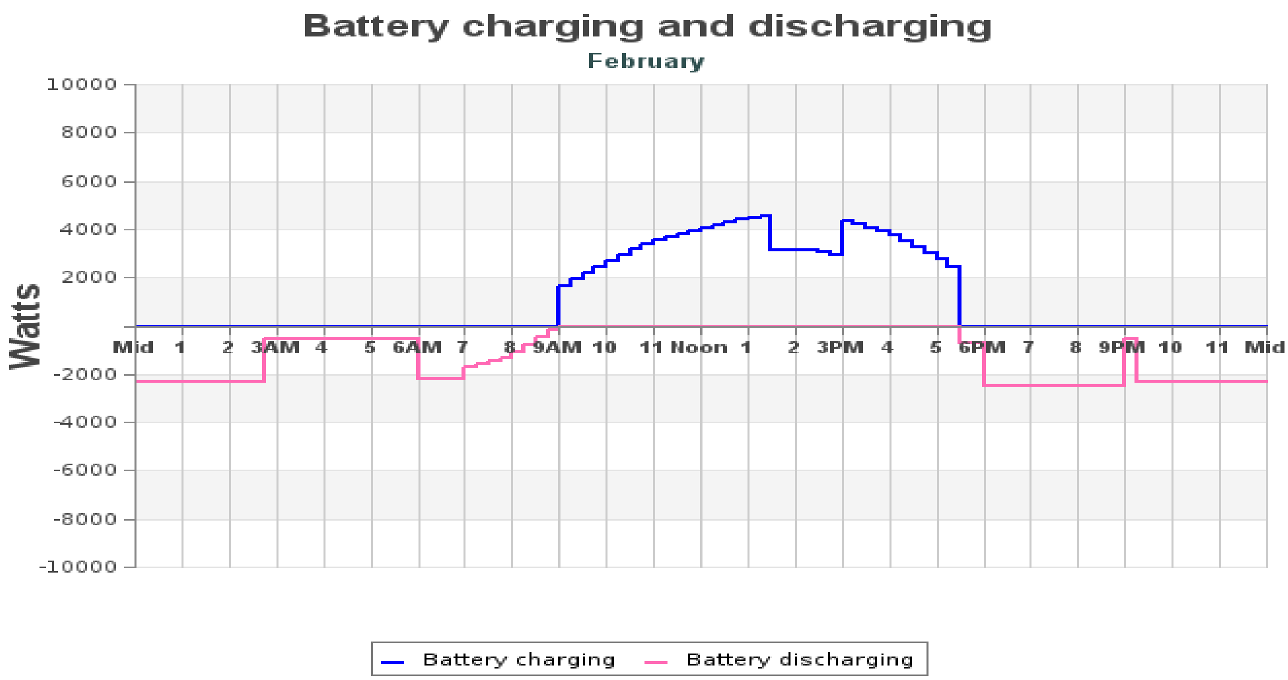
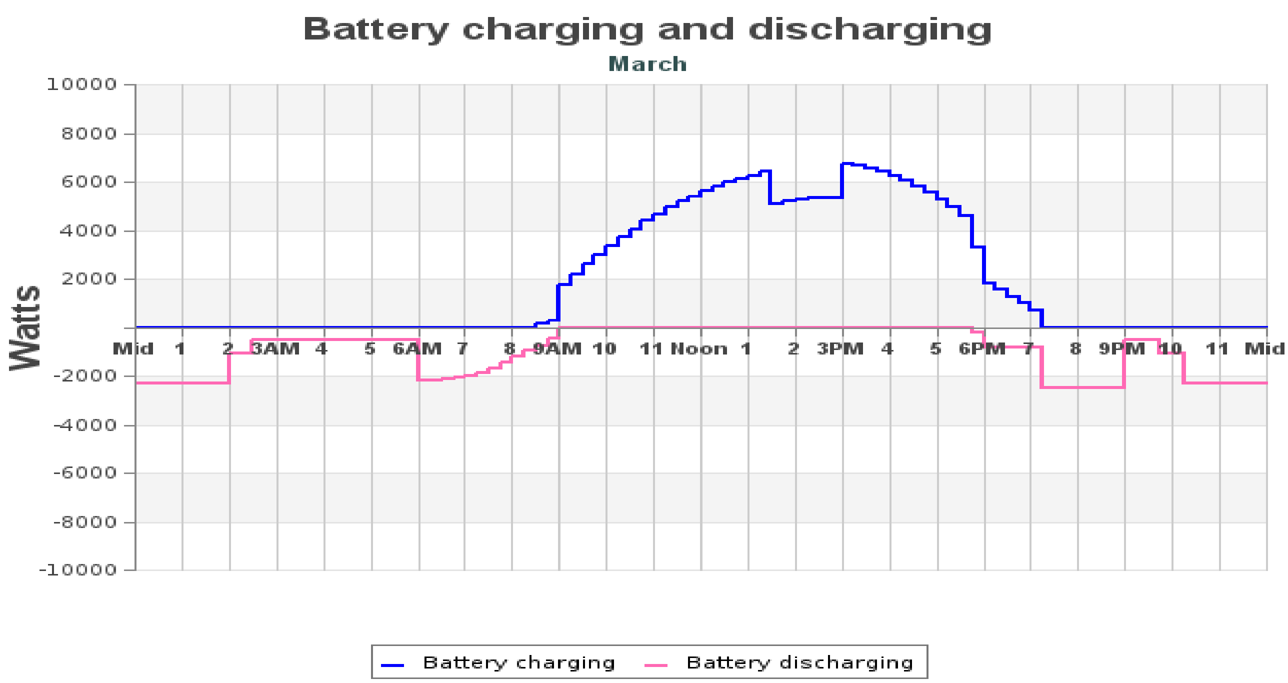


February

Charging	28.8kWh	Discharging	26.6kWh



March

Charging	46.9kWh	Discharging	22.0kWh

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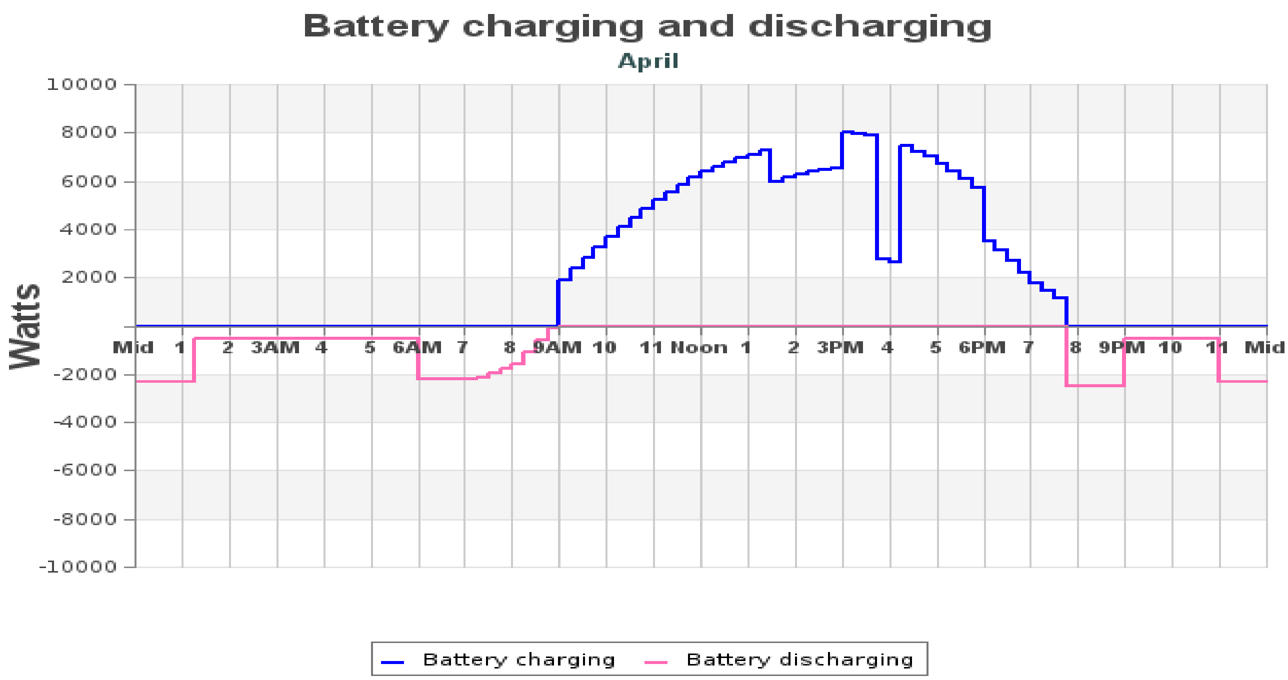
Solar Panel Optimizer

Battery current, continued

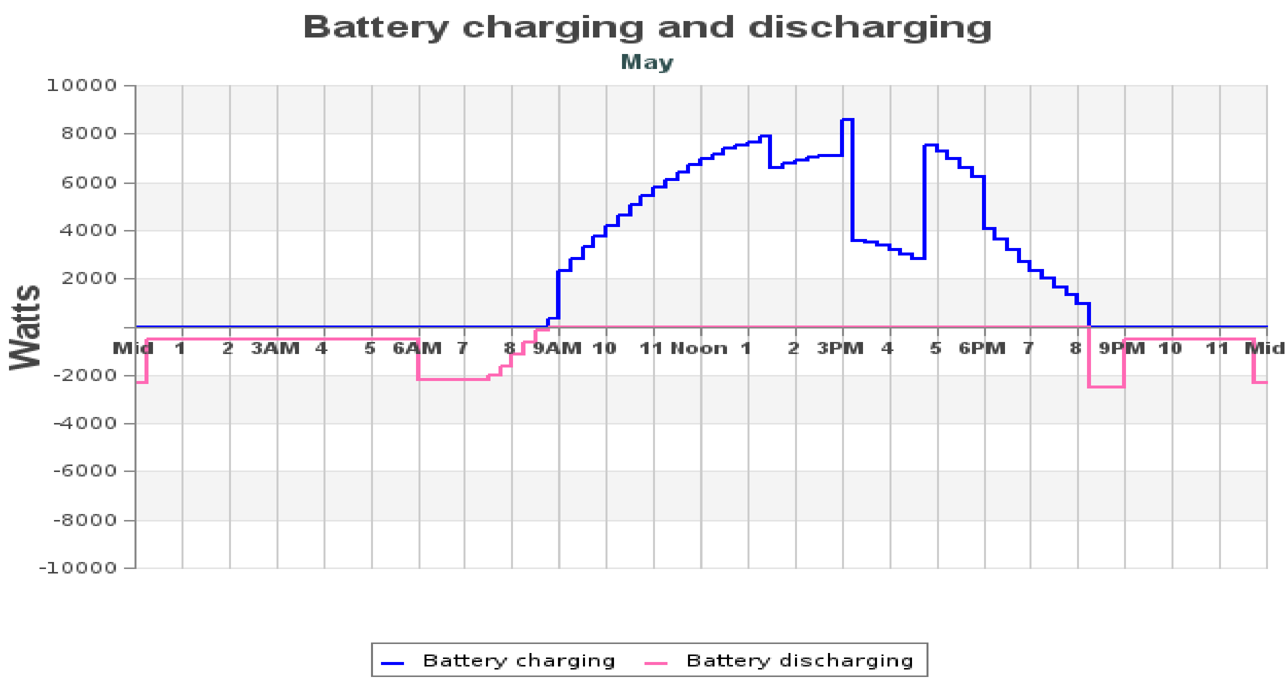
Solar Panel Optimizer

Sample Site



April

Charging	55.3kWh	Discharging	16.7kWh



May

Charging	56.8kWh	Discharging	12.0kWh

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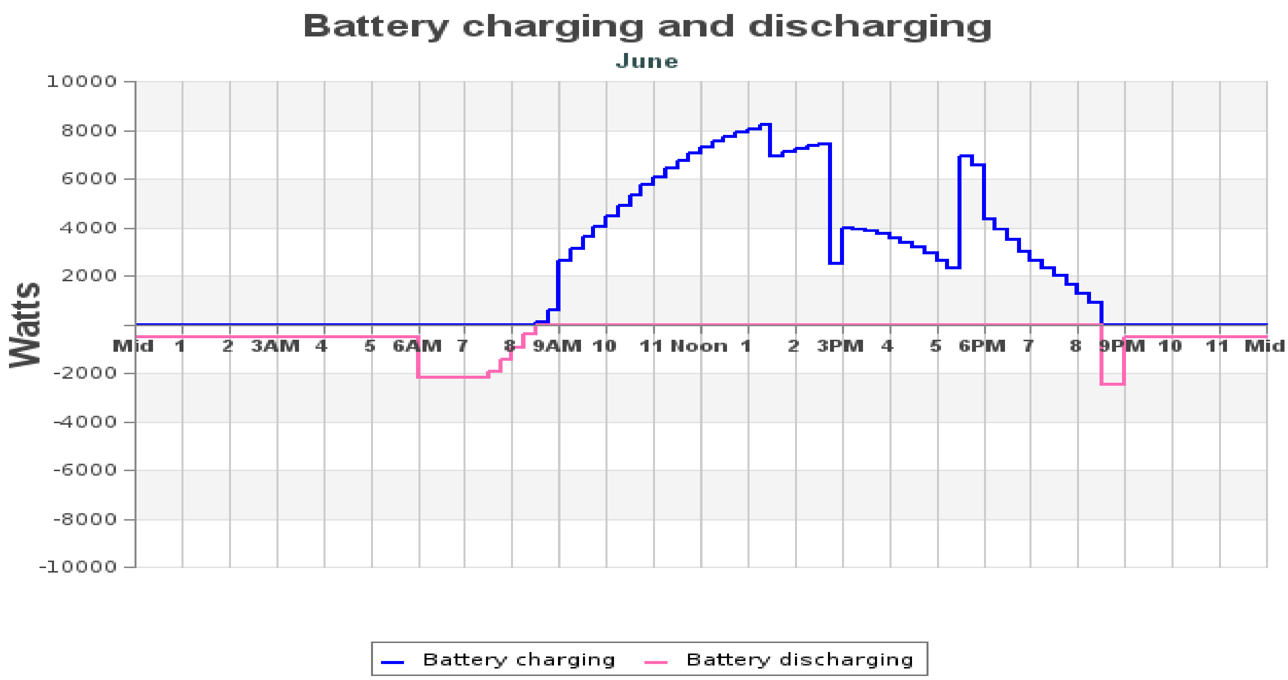
Solar Panel Optimizer

Battery current, continued

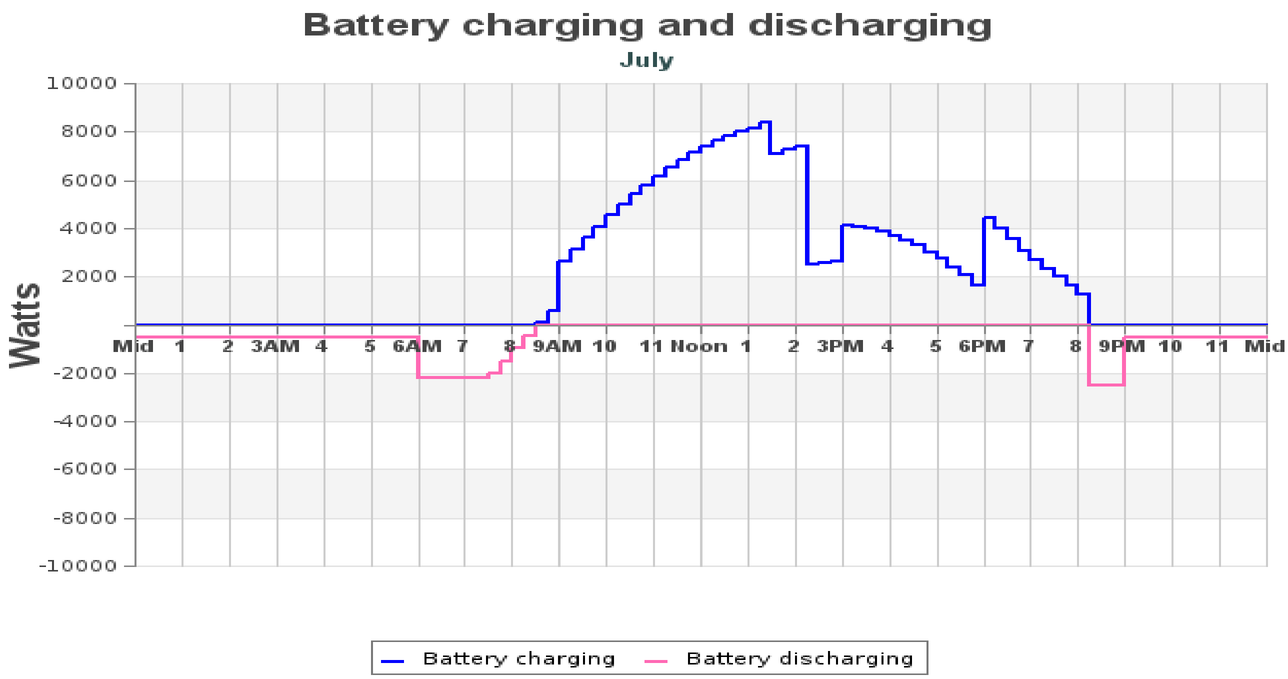
Solar Panel Optimizer

Sample Site



June

Charging	54.6kWh	Discharging	10.2kWh



July

Charging	50.4kWh	Discharging	10.9kWh

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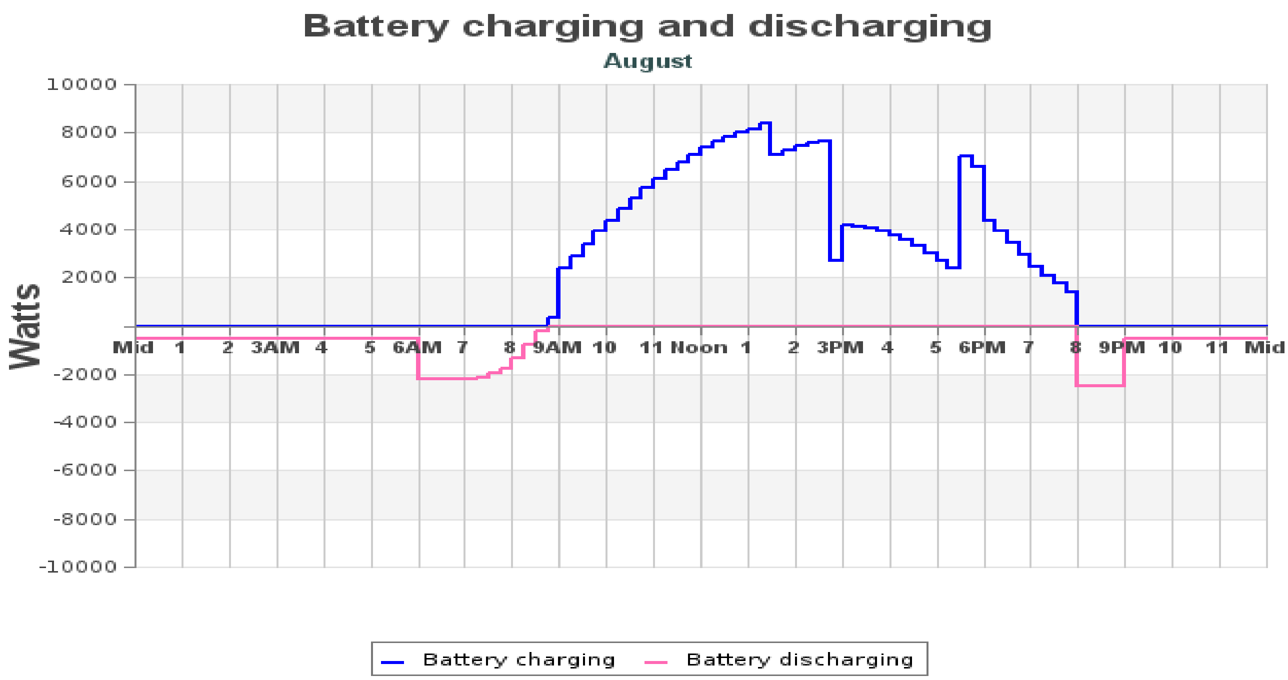
Solar Panel Optimizer

Battery current, continued

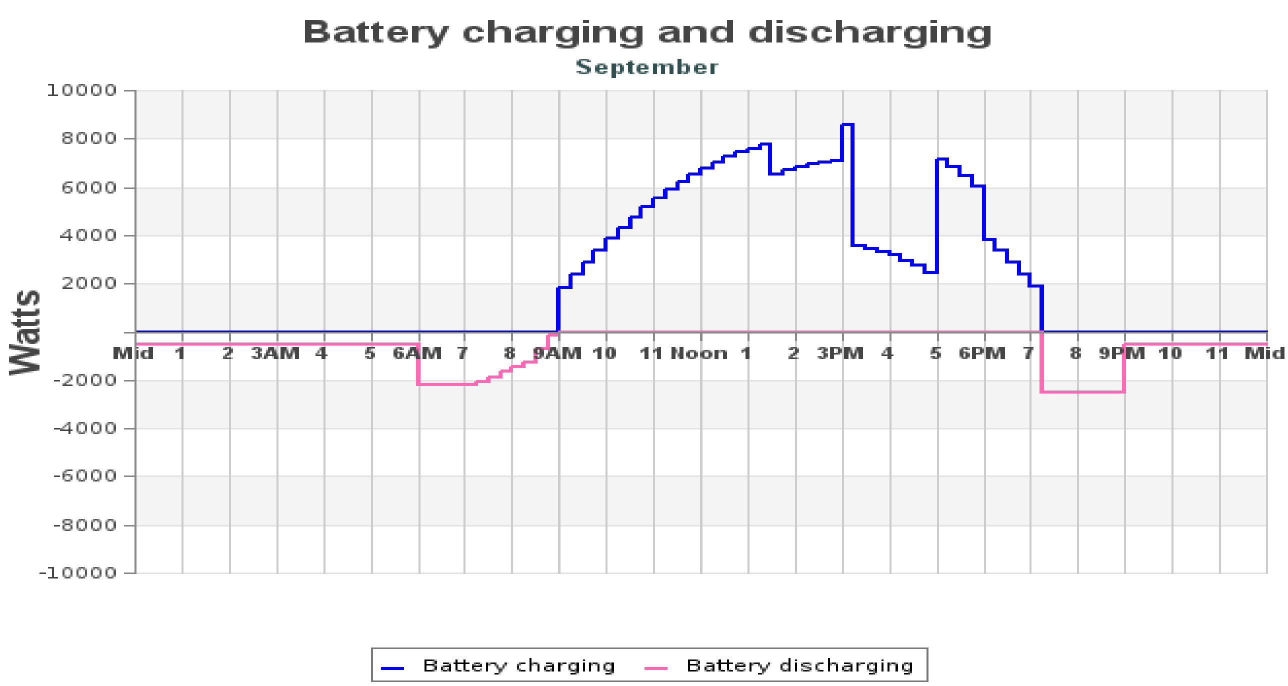
Solar Panel Optimizer

Sample Site



August

Charging	54.4kWh	Discharging	11.8kWh



September

Charging	52.2kWh	Discharging	13.9kWh

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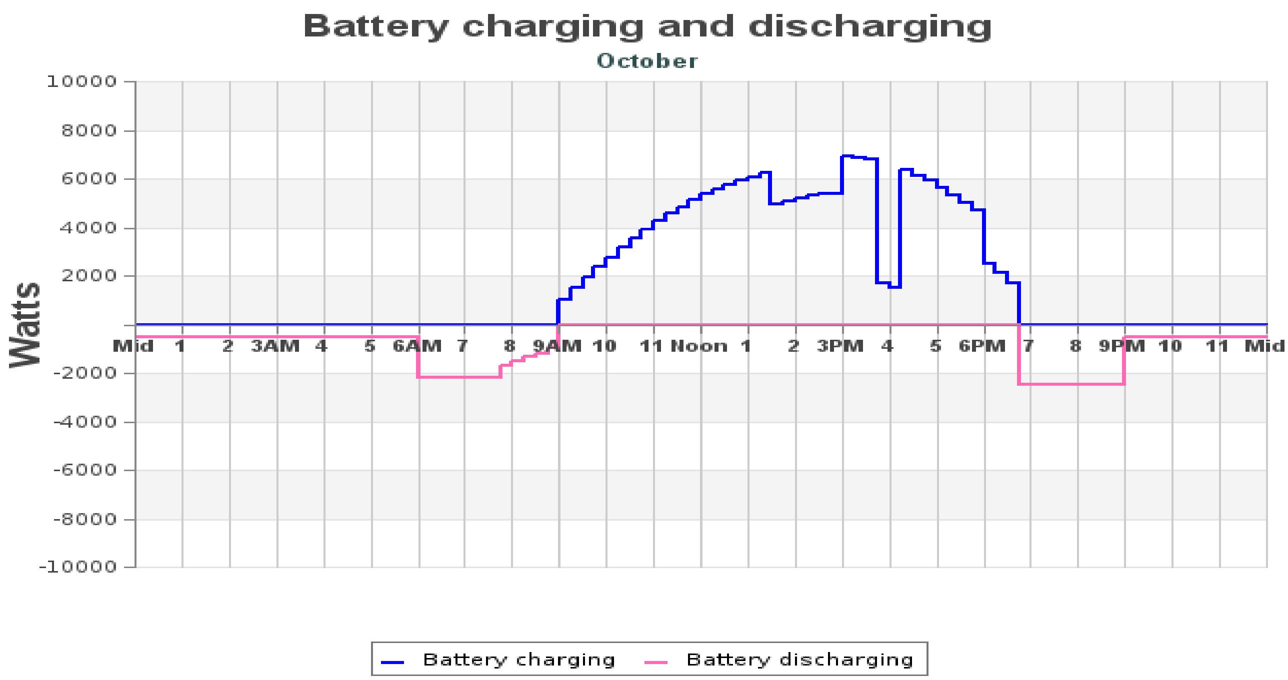
Solar Panel Optimizer

Battery current, continued

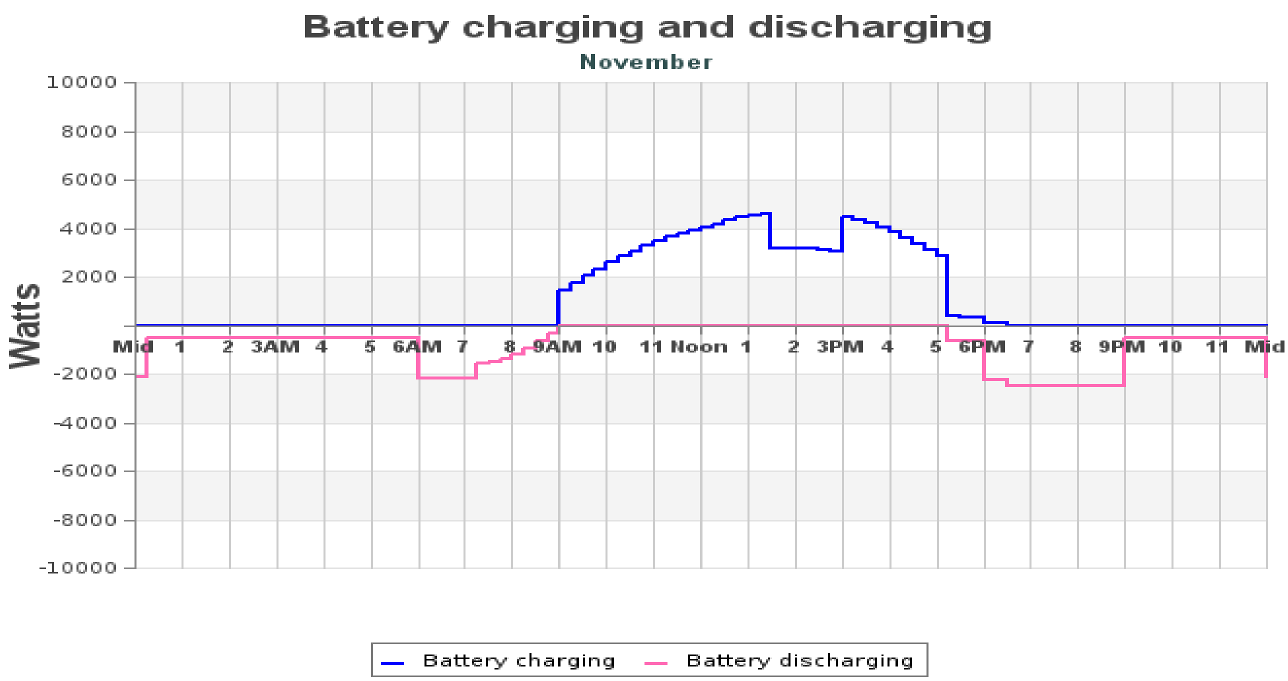
Solar Panel Optimizer

Sample Site



October

Charging	43.6kWh	Discharging	15.6kWh



November

Charging	28.6kWh	Discharging	17.4kWh

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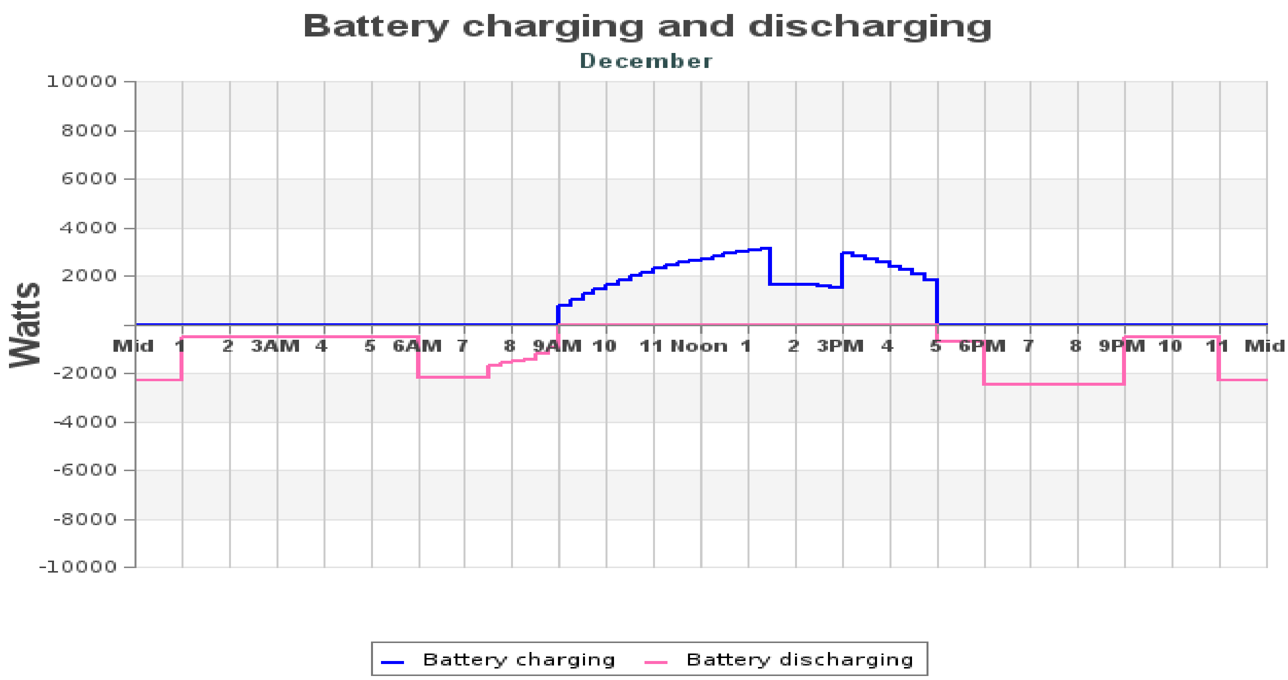
Solar Panel Optimizer

Battery current, continued

Solar Panel Optimizer

Sample Site



December

Charging	17.1kWh	Discharging	21.7kWh

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