Solar Site Visit Report

Prepared for:
Madison Central Library
201 W. Mifflin St.
Madison, WI

Prepared by:
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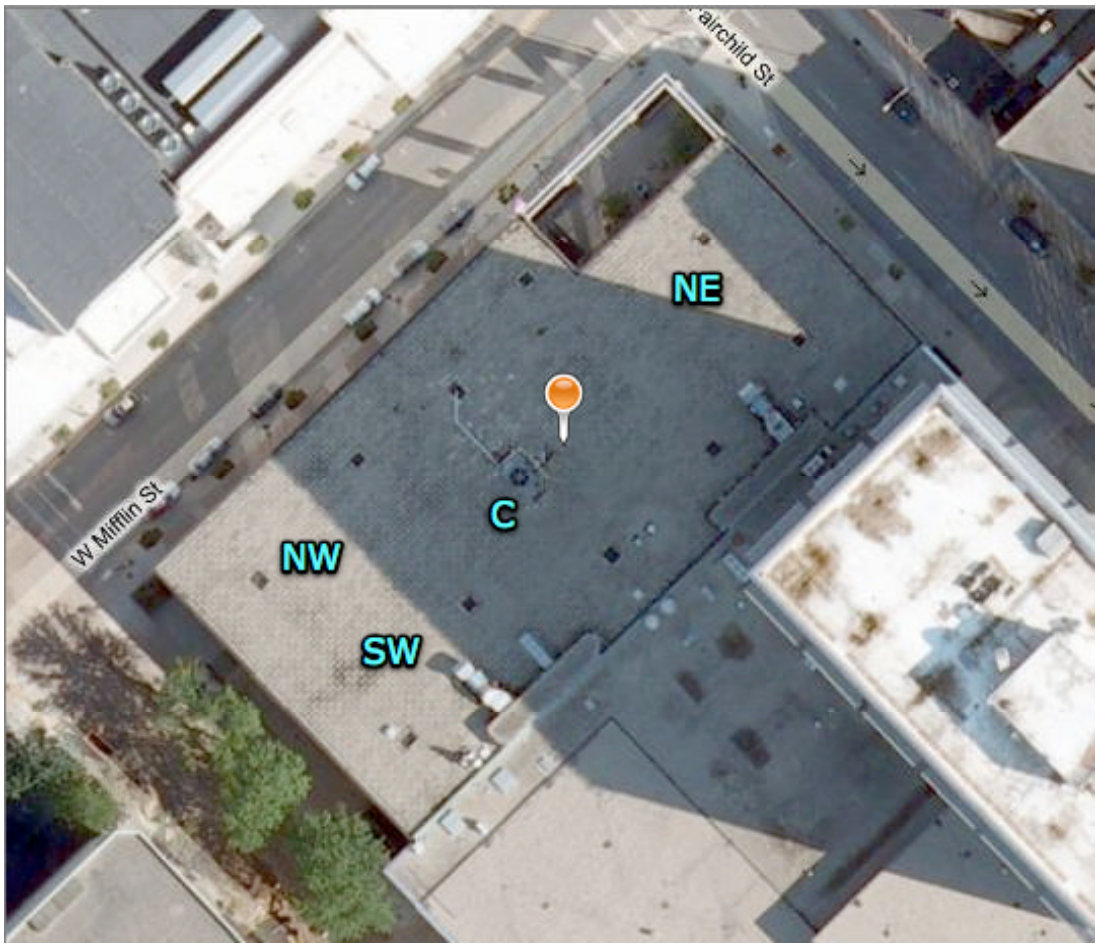
Walker Energy Systems LLC
Solar Buyer's Agent

Performed:
June 24, 2010

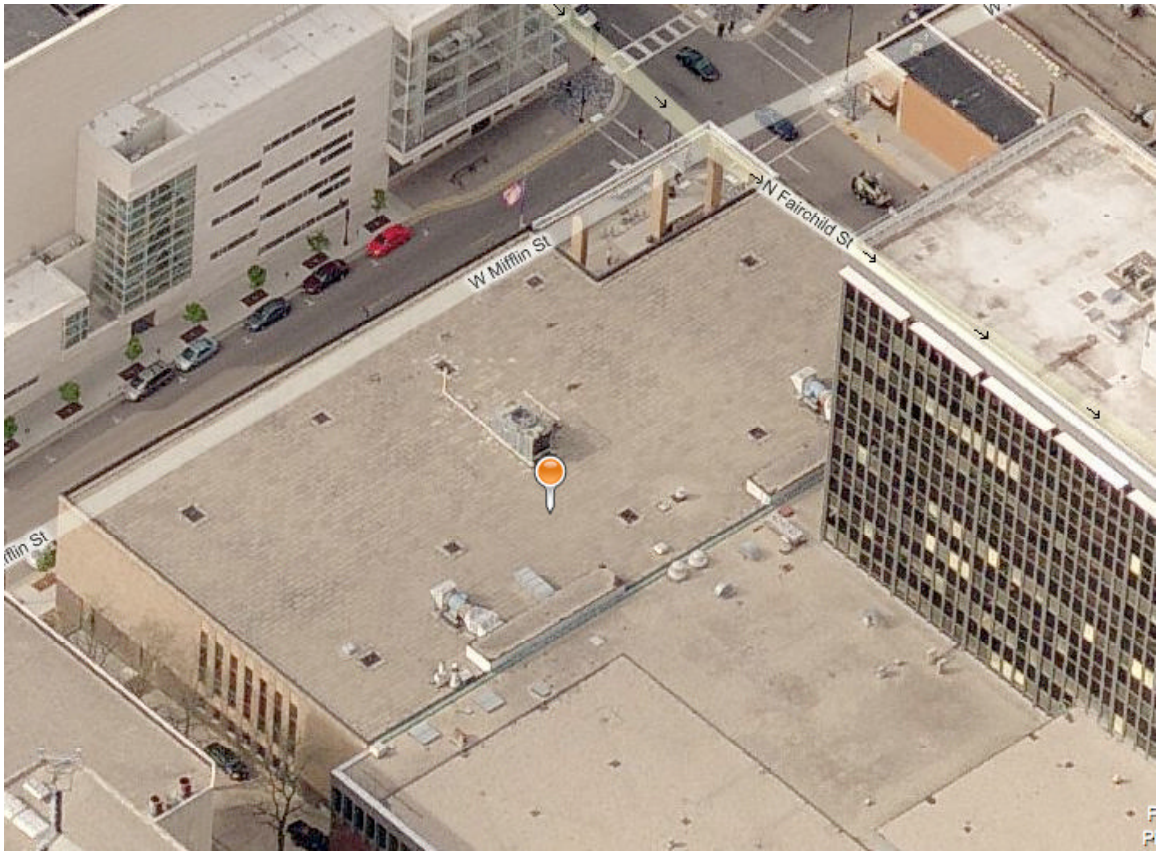
Site Characteristics:

Aerial view:



(aerial view, with solar window locations noted)

Site views:



Site Description:

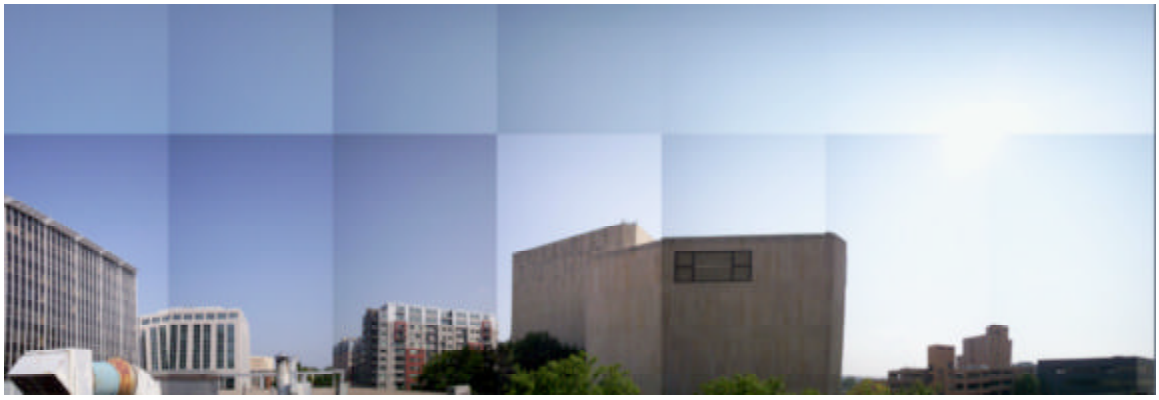
This building is located in downtown Madison. The building is oriented at a good angle for solar, with a flat roof. An adjacent tall building to the southeast will create some serious shading issues.

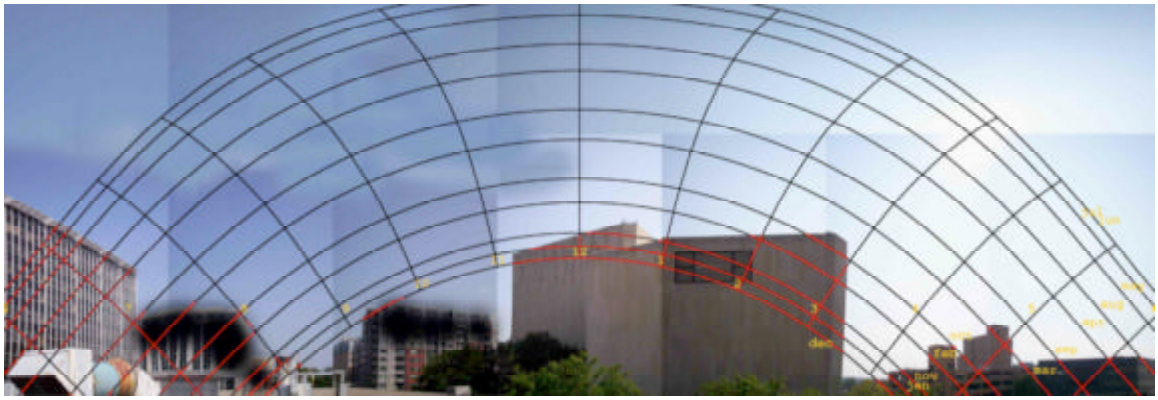
Zoning Status: ____C4____ Zoning Issues? ____N_____

Gas Utility: __MG&E__
Electric Utility: __MG&E__

Solar Window

Location 1: Southwest Roof ("SW" on aerial photo)





This solar window was acquired in the southwest corner of the roof.

% cumulative annual sunlight shaded: 13%

Available area: 28,000 sq ft Pitch: 0º Orientation: n/aº

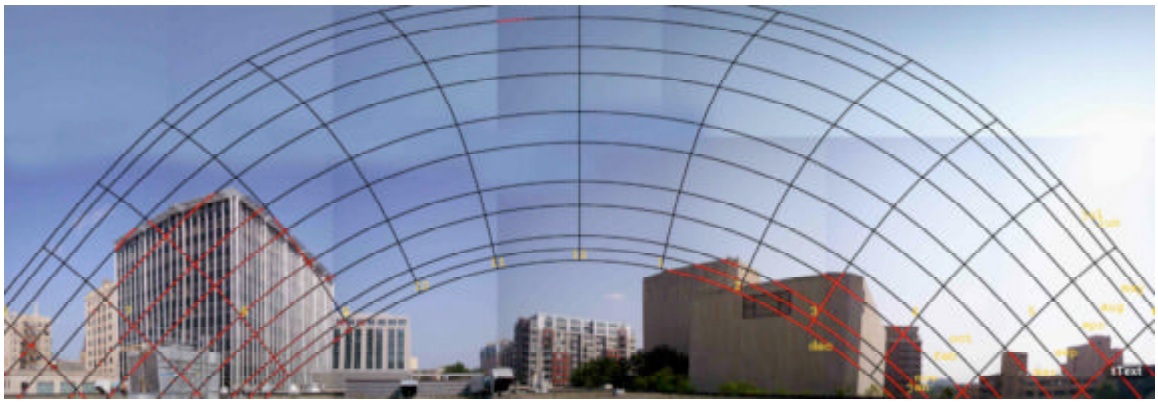
Solar Capacity: ~10 kW

The 28,000 square feet is the approximate size of the total roof. The 10 kW capacity figure is based on the assumption that it is not economical to exceed the maximum size allowed in the MG&E buy-back program….

This location receives a moderate amount of shading from the adjacent building, though not so much as to rule out solar electric in this portion of the roof, since it mainly occurs in the winter (weak sun months) and the early morning (weak sun hours).

Solar Window

Location 2: Northwest Roof ("NW" on aerial photo)



This solar window was acquired in the northwest corner of the roof.

% cumulative annual sunlight shaded: 8%

Available area: 28,000 sq ft Pitch: 0º Orientation: n/aº

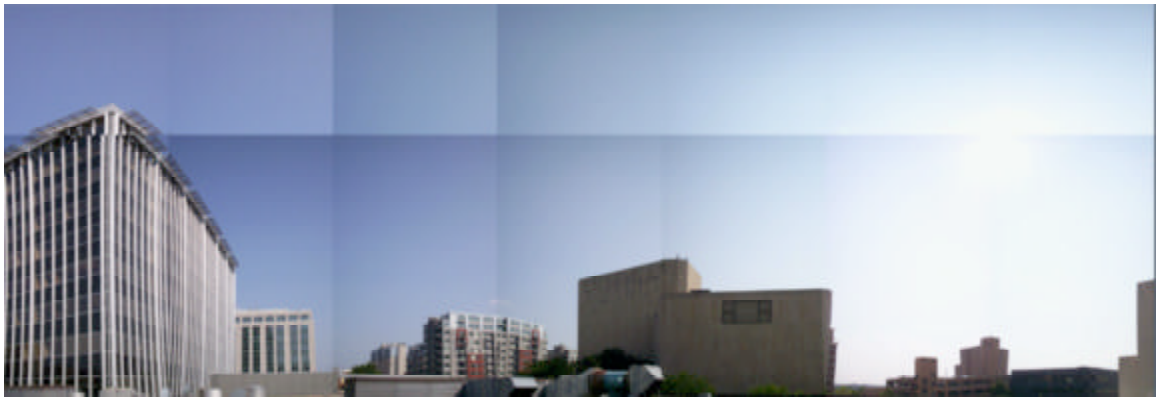
Solar Capacity: ~10 kW

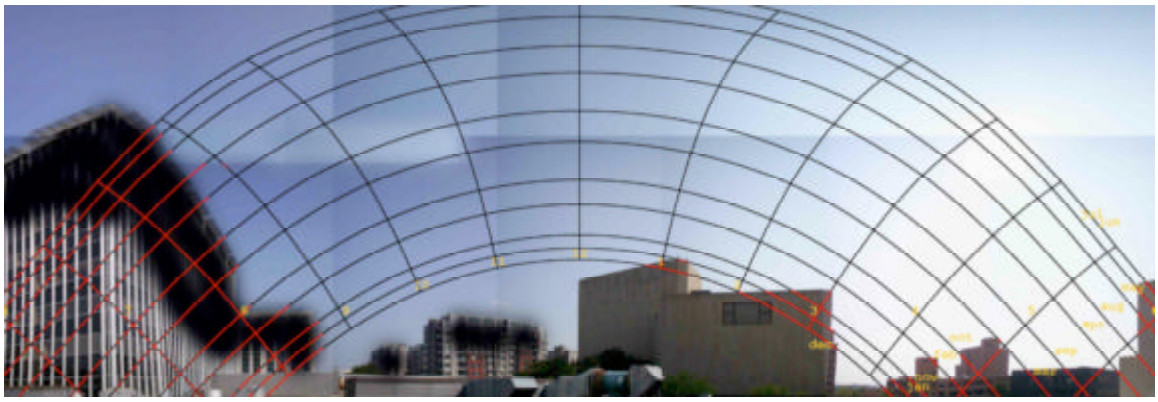
The 28,000 square feet is the approximate size of the total roof. The 10 kW capacity figure is based on the assumption that it is not economical to exceed the maximum size allowed in the MG&E buy-back program….

This location receives only a modest amount of shading from the adjacent building.

Solar Window

Location 3: Center Roof ("C" on aerial photo)





This solar window was acquired in center of the roof.

% cumulative annual sunlight shaded: 12%

Available area: 28,000 sq ft Pitch: 0º Orientation: n/aº

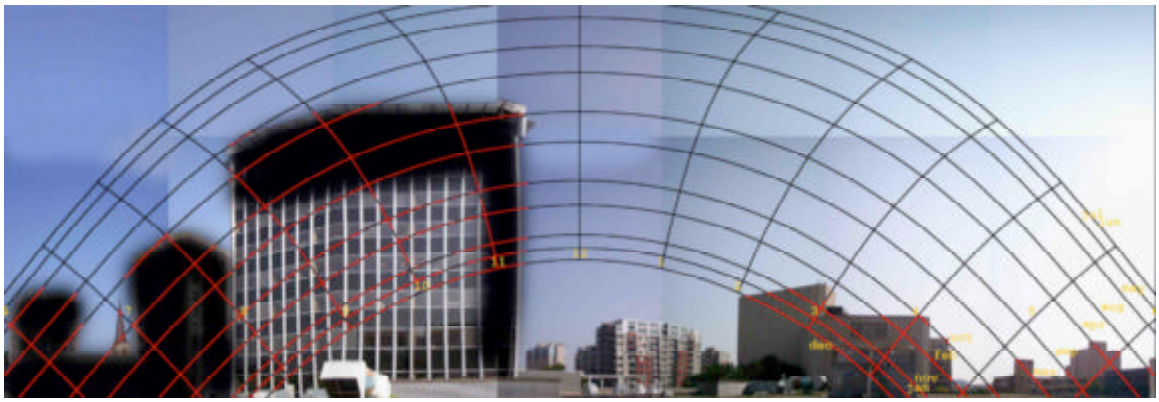
Solar Capacity: ~10 kW

The 28,000 square feet is the approximate size of the total roof. The 10 kW capacity figure is based on the assumption that it is not economical to exceed the maximum size allowed in the MG&E buy-back program….

This location receives a moderate amount of shading from the adjacent building, though not so much as to rule out solar electric in this portion of the roof, since it mainly occurs in the early morning (weak sun hours).

Solar Window

Location 4: Northeast Roof ("NE" on aerial photo)



This solar window was acquired from the NE corner of the roof.

% cumulative annual sunlight shaded: 22%

Available area: 28,000 sq ft Pitch: 0º Orientation: n/aº

Solar Capacity: ~10 kW

The 28,000 square feet is the approximate size of the total roof. The 10 kW capacity figure is based on the assumption that it is not economical to exceed the maximum size allowed in the MG&E buy-back program….

This location receives a fairly large amount of shading from the adjacent building, making it unsuitable for solar electric

Solar Electric Findings

Location 1: Southwest Roof

Predicted annual solar production, per kW installed

Total annual sunlight (historical)	1240 kWh/yr	
Available sunlight (allow for orientation & tilt)	1238 kWh/yr	
Useable sunlight (allow for shading)	1077 kWh/yr	$269/yr

Annual dollar value based on MG&E buyback at $0.25 kWh.

Solar Electric Load Analysis

Proposed Solar Electric Size (kW)	Predicted Annual Production (kWh/yr)	Current Consumption (kWh/yr)	Solar Percentage of Consumption
10	10,779	1,200,00	1%

Location 2: Northwest Roof

Predicted annual solar production, per kW installed

Total annual sunlight (historical)	1240 kWh/yr	
Available sunlight (allow for orientation & tilt)	1238 kWh/yr	
Useable sunlight (allow for shading & snow)	1138 kWh/yr	$285/yr

Annual dollar value based on MG&E buyback at $0.25 kWh.

Solar Electric Load Analysis

Proposed Solar Electric Size (kW)	Predicted Annual Production (kWh/yr)	Current Consumption (kWh/yr)	Solar Percentage of Consumption
10	11,380	1,200,000	1%

Location 3: Center Roof

Predicted annual solar production, per kW installed

Total annual sunlight (historical)	1240 kWh/yr	
Available sunlight (allow for orientation & tilt)	1238 kWh/yr	
Useable sunlight (allow for shading & snow)	1105 kWh/yr	$276/yr

Annual dollar value based on MG&E buyback at $0.25 kWh.

Solar Electric Load Analysis

Proposed Solar Electric Size (kW)	Predicted Annual Production (kWh/yr)	Current Consumption (kWh/yr)	Solar Percentage of Consumption
10	11,050	1,200,000	1%

Location 4: Northeast Roof

Predicted annual solar production, per kW installed

Total annual sunlight (historical)	1240 kWh/yr	
Available sunlight (allow for orientation & tilt)	1238 kWh/yr	
Useable sunlight (allow for shading & snow)	968 kWh/yr	$242/yr

Annual dollar value based on MG&E buyback at $0.25 kWh.

Solar Electric Load Analysis

Proposed Solar Electric Size (kW)	Predicted Annual Production (kWh/yr)	Current Consumption (kWh/yr)	Solar Percentage of Consumption
2	9,680	1,200,000	0.8%

Solar Thermal Findings

10am-2pm window open?	N
If No, % 10am-2pm shaded	3%

Solar Thermal Load Analysis

Proposed Solar Thermal Size (sq ft)	Predicted Annual Production (therms/yr)	Est. Current Natural Gas Consumption (therms/yr)	Delivered hot-water therms (80% efficiency)	Solar Percentage of Delivered therms
192 (6-panel)	407	792	633	66%

Solar hot water only requires an open solar window from 10am-2pm to perform properly. The northwest section of this roof has an almost completely open window in this period (only 3% shaded).

The library has a rather high apparent hot water consumption, averaging 66 therms per month during the summer (non-heating season). Building staff says that no boilers operate in summer months and that the air conditioning system no longer utilizes terminal-reheat. This means that summer gas consumption should be 100% hot water.

Using the 66 therms/month value, the building is estimated to consume about 792 therms/year for hot water. Correcting for hot water heater efficiency, which amounts to about 633 therms available to be replaced by solar hot water.

Based on the rule of thumb that solar hot water systems in this climate can meet roughly two-thirds to three-quarters of annual hot water consumption, a 6-panel solar hot water system would be an appropriate size.

Solar Window Interpretation:

Solar windows are interpreted differently for solar electric vs. solar hot water:

Solar Electric:

Solar electric panels are affected very strongly by any kind of shading. Even the branches of bare trees in winter can cause significant degradation in output, so the solar window must be evaluated to "worst case" standards. To be most cost-effective, solar electric panels should be shaded by no more than about 10%.

In this case, the central and western portions of the roof would be suitable locations for a solar electric system. The eastern portion of the roof receives excessive shading from the adjacent building.

Solar Hot Water:

Solar hot water collectors are much less sensitive to shading. Partial shading from bare branches has very little effect. Additionally, only about 4 hours per day of unshaded sunlight (preferably between 10am and 2pm) are required.

In this case, the 10am-2pm window is very nearly wide open on the entire western end of the roof, especially the northwest corner. This portion of the roof would make a very good location for solar hot water.

Summary of Potential Location(s):

The western portions of the roof of this building would be a good candidate for a solar electric and a very good candidate for a solar hot water system.

Financial Analysis:

A detailed financial analysis will also be provided for a representative 10 kW solar electric system and for a 6-panel solar hot water system, using a spreadsheet prepared by Focus on Energy.

Note: This information is for reference only; you should always consult a qualified tax professional for definitive information on applying solar energy tax credits in your own financial situation.

Note: As a government building, there is no federal income tax credit or depreciation deduction available for this building, which will make the financial returns less attractive than a commercial or residential building would enjoy

Central_Library_Thermal-Nonprof_Focus_financial_model_V6.xls
Central_library_PV-Nonprof_Focus_financial_model_V9.xls

The summary of the financial analysis for the PV system is shown here:

Energy Production, Cost, Economics and Environment	
Production	
Solar electric systems rated module capacity (kW dc)	10.00
Estimated output year one (kWh/yr)	11,088
Cost	
Estimated installed cost	$75,000
Focus Incentive	$19,404
Federal Tax Credit	$0
Other first cost incentives	$0
System cost after all incentives	$55,596
Value of year 1 to year 10 power production	$26,020
Economics	
Years to cost recovery, "0" Means > 30 years	24.0
10 year discounted NPV	-$40,116
25 Year discounted NPV	-$17,449
10 Year IRR	-15.0%
25 Year IRR	0.6%
If IRR has #NUM! or "#DIV/0!"error, then xcel is unable to determine the IRR	
Environment	
CO2 emission reduction per year (tons/year)	12.3

Key Assumptions	
Cost of System Per kW (dc)	$7,500
Electricity rate year one ($/kWh)	$0.13
Solar electric buyback rate	$ 0.240
Estimated electricity price inflation rate (%/yr)	6.00%
Expected output degradation (%/year)	0.50%

These results reflect several factors that effect the payback period and the return-on-investment:

1) The lack of federal tax credits for non-profit/governmental entities.

2) Recent price decreases, from an average of $8700 per kW last year to $7500 per kW late this year.

3) Recent decrease in Focus on Energy Cash-Back Rewards, from about 30% to about 25% of installed cost for non-profit/governmental entities.

4) The approximately 10% shading on this roof.

5) Participation in MG&E's 10-year buy-back program, at $0.25/kWh.

6) The assumption that electrical rates will increase at 6% per year over the life of the system. This is based on the last 5 years rate increases, but many believe rates are likely to increase much faster in the future. Changing that assumption to 10% reduces the payback period to 19 years and increases the return-on-investment to 4.4%.

The summary of payback for the hot water system is shown here:

System Cash Flows		Year ->
		1
	System Initial Investment	$ (26,880)
	Commercial Loan Proceeds	$ -
	Special Loans	$ -
	Fed Tax Credit	$ -
	Focus Incentives	$ 7,631
	WE or Alliant incentive	$ -
	Income Tax on Focus Incentive	-
	Income Tax on We Energies Incentive	-
	Income Tax on USDA Grant	-
	Fed and State Depreciation Value	$ -
	Special Loans Payment	$ -
	Bank Loan Payment	$ -
	Tax Savings - Int. Exp. (**Commercial systems only**)	$0
	O&M	$ (134)
	Energy Cost Savings	$ 509
	Total Annual Cash Flow	$ (18,874)
	Cumulative Cash Flow	$ (18,874)
	Positive cumulative cashflow flag	NA
Years to cost payback (non discounted)		25
Internal Rate of Return		
	10 Year IRR	#DIV/0!
	20 Year IRR	-3%
	25 Year IRR	0%

These results reflect a mid-range assumption for system pricing ($140/sqft of collector). Actual values will depend on current market conditions and actual quotes from installers

Next Steps:

Examine the financial analysis information (at least the summary info above) and understand the costs and paybacks. Use this information as part of your decision on adding a solar energy system. A decision to invest in a solar energy system should examine costs, paybacks, carbon impacts and personal preferences for how your energy is generated.

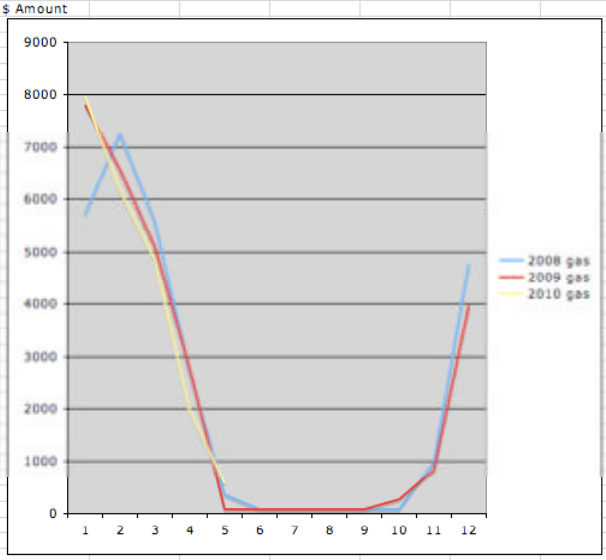
If you decide that you would like to add a solar energy system, then you will need to get quotes from one or more licensed installers. You can do this yourself, using Focus on Energy's list of Full-Service Installers (http://focusonenergy.com/Renewable/Full-Service/) or you can receive assistance in getting quotes from the MadiSUN program.

For additional assistance, please contact:

Larry Walker
Solar Buyer's Agent
MadiSUN Program
608.345.9533
larry@walkerenergysystems.com

Utility History:

Read Date	# Days	Therms	Heating Degr	Therms/Degr	$ Amount
1/16/12	33	5708	1322	4.318	
2/15/12	30	7259	1538	4.72	
3/15/12	29	5567	1320	4.217	
4/15/12	31	2685	856	3.137	
5/15/12	30	348	358	NA	
6/14/12	30	67	181	NA	
7/16/12	32	72	11	NA	
8/15/12	30	63	3	NA	
9/16/12	32	68	52	NA	
10/15/12	29	63	183	0.344	
11/13/12	29	972	564	1.723	
12/13/12	30	4754	1144	4.156	
1/16/13	34	7792	1692	4.605	
2/14/13	29	6549	1425	4.596	
3/14/13	28	5087	1129	4.506	
4/16/13	33	2764	823	3.358	
5/15/13	29	67	326	NA	
6/13/13	29	60	160	NA	
7/15/13	32	68	24	NA	
8/15/13	31	64	20	NA	
9/16/13	32	66	68	NA	
10/15/13	29	263	324	0.812	
11/13/13	29	797	560	1.423	
12/15/13	32	3948	985	4.008	
1/16/14	32	7956	1530	5.2	
2/13/14	28	6158	1227	5.019	
3/13/14	28	4843	1051	4.608	
4/16/14	34	1957	612	3.198	
5/15/14	29	552	365	NA	



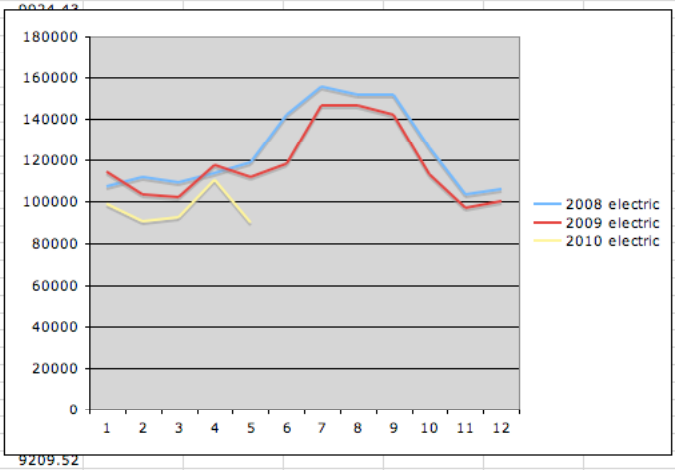
2008 therms	27626
2009 therms	27525
2010 ytd	21466

"heating MPG" (BTU/hdd/sqft): #DIV/0!

house-size= sqft

summer hot water usage 66.0

Read Date	# Days	kWh	kWh/Day	$ Amount
1/15/08	33	107433	3255.5	
2/14/08	30	111916	3730.5	
3/14/08	29	109531	3776.9	
4/14/08	31	113585	3664	
5/14/08	30	119019	3967.3	
6/13/08	30	142123	4737.4	
7/15/08	32	155487	4859	
8/14/08	30	151490	5049.7	
9/15/08	32	151851	4745.3	
10/14/08	29	126264	4353.9	
11/12/08	29	103271	3561.1	
12/12/08	30	105888	3529.6	
1/15/09	34	114249	3360.3	
2/13/09	29	103682	3575.2	
3/13/09	28	102066	3645.2	
4/15/09	33	117571	3562.8	
5/14/09	29	112052	3863.9	
6/12/09	29	117967	4067.8	
7/14/09	32	146329	4572.8	
8/14/09	31	146698	4732.2	
9/15/09	32	141854	4432.9	
10/14/09	29	112878	3892.3	
11/12/09	29	97304	3355.3	
12/14/09	32	100284	3133.9	
1/15/10	32	99055	3095.5	
2/12/10	28	90554	3234.1	
3/12/10	28	92689	3310.3	9209.52
4/15/10	34	110414	3247.5	11039.95
5/14/10	29	89871	3099	9936.6



2008 kWh	1497858
2009 kWh	1412934
2010 ytd	482583