NON-RESIDENTIAL SOLAR WATER HEATING SITE ASSESSMENT

Client Information

Client Name **American Baptists – Plymouth Apartments (Part 1 - Three west apartment buildings)**		*Date of Site Visit* **6/3/09**	*Date of Report* **6/26/09**
Site Address **812 through 828 W. Galena St.**	*City* **Milwaukee**	*State* **WI**	*Zip* **53205**
County **Milwaukee**	*Municipality* **Milwaukee**		
Email	*Phone* **414-263-1020**	*Cell* **414-737-9400**	
Electric Utility **We Energies**	*Gas Utility* **We Energies**		
Water Heating Fuel Type **Natural Gas**		*Focus Territory (yes/no)* **Yes**	

View of courtyard & main apartment buildings, looking North-northwest. Vehicle entrance is from South.

Site Assessor Information

Name **Barb Basaj**			
Company **SunSpec, LLC**			
Mailing Address **3359 S. Pennsylvania Ave.**	*City* **Milwaukee**	*State* **WI**	*Zip* **53207**
Email **sunspec@earthlink.net**	*Phone* **(414) 489-0826**	*Cell* **(414) 491-3383**	

THIS SITE ASSESSMENT WAS CO FUNDED BY FOCUS ON ENERGY
(WWW.FOCUSONENERGY.COM OR 800 762.7077)

focus on energy
The power is within you.

TABLE OF CONTENTS

1 – CLIENT PROFILE
- **1.1 – Client Information**
- **1.2 – Load Analysis**
- **1.3 – Energy Efficiency and Load Reduction Recommendations**

2 – SITE PROFILE
- **2.1 – Exterior of Buildings**
- **2.2 – Solar Access**
- **2.3 – Interior of Buildings**

3 – COLLECTOR AND SYSTEM DESCRIPTION
- **3.1 – Solar Hot Water Basics**
- **3.2 – System Recommendations**

4 – FINANCIAL ANALYSIS
- **4.1 – Estimated System Cost**
- **4.2 – Financial Analysis**

5 – ADDITIONAL INFORMATION
- **5.1 – Attachments**

1 – CLIENT PROFILE

1. Why is the client interested in renewable Energy?
The client has received funding for renewable energy projects.

2. What types of systems is the client interested in?
Solar hot water and solar electric. This report will only cover solar hot water.

3. Is the system being installed as a part of new construction or as a retrofit?
Retrofit.

4. What is the client's timeline for installation? Will it be installed all at once or incrementally?
Most likely 2010, all at once.

5. How involved is the customer willing to be with the system?
Wants an outside contractor to perform installation and maintenance.

1.1 – Load Analysis

Number of Occupants **80**	*Estimated Daily Hot Water Consumption* **2,900 gallons / day**
Current Electricity Rates **$0.12**	*Current Gas Rates* **$1.06**
Additional Load Considerations **There are 80 apartments, each unit having one occupant. The occupants are older adults.** **The summertime natural gas usage averaged out to 615 therms/month, or 7,385 therms/year.** **The estimated gallons per day was calculated using the RETScreen analysis tool based on the natural gas usage. It averaged out to 36 gallons/day per person.**	

1.2 – Energy Efficiency and Load Reduction Recommendations

Consider the following improvements to help reduce hot water use. **For every $1 you spend on energy efficiency, you save $3-$5 on the cost of a solar system.**

Proper maintenance can promote efficiency:

- High efficiency conventional water heaters use 30- 50 percent less energy than standard models of the same size. Make sure it's properly sized and installed.
- Fix leaky faucets promptly. A faucet that leaks 30 drops of water per minute leaks around 84 gallons per month.
- Install low-flow showerheads or use a flow restrictor.
- Lower the thermostat to between 120-130 degrees Fahrenheit. Most hot water uses don't need water hotter than that.
- Wrap the back-up water heater in insulation if it is in an unheated area.
- Insulate all hot water pipes.
- Upgrade appliances: Energy efficient and low water use dishwashers and front loading washing machines save a lot of hot water.

Educate occupants on efficient use of hot water:

- Take quick showers instead of baths.
- Use cold water with the garbage disposal. Cold water solidifies grease so the disposal can get rid of it more effectively.
- When washing dishes in the sink by hand, don't let the water run while rinsing. Fill one sink with wash water and the other with rinse water.
- Soak pots and pans instead of letting the water run while scraping them clean.
- Whenever possible, wash only full loads. If your washer has a water selector, use the lowest practical level.
- Turn off the water while shaving.

2 – SITE PROFILE

General Site Description:
The Plymouth Apartments campus consists of 3 central apartment buildings arranged in courtyard fashion, 2 more apartment buildings to the east along Galena St., and a newer building with office and common use areas at the southwest corner of the courtyard.

2.1 – Exterior of Buildings

Addresses 812 through 828 to the west (80 apartment units), plus office and common area under hip roof @ SW

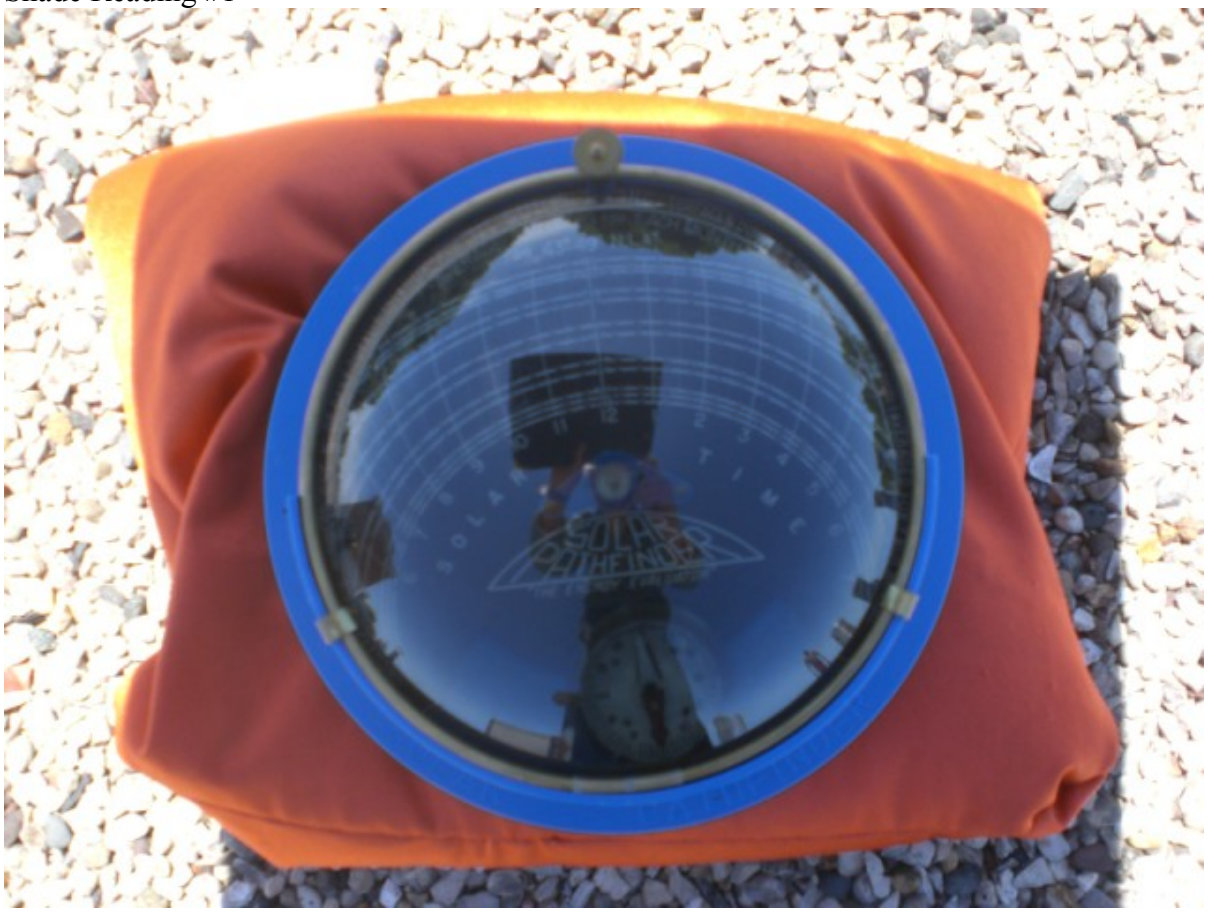
Addresses 712 through 792A to the east (32 apartment units)

South facing roof? (yes/no) **N/A (flat)**	*Azimuth from south:* **N/A (flat)**	
Slope/Pitch of the roof: **0° - 4°** **Ground locations are flat, no hills**	*Square footage of available roof space:* **Size of north building roof = 5,600 sq. ft.** **1,800 sq. ft. is clear of roof penetrations** **Also two ground mount locations 4,600 sq. ft. and 400 sq. ft.**	
Roof Type: **Ballasted membrane**	*Estimated remaining lifetime of roof:* **5 – 10 years.**	
Ladder Access: **22 ft. ladder or longer**	*Power lines overhead? (yes/no)* **No.**	*Building Height:* **~ 20 ft.**
Roof Structure: **Corrugated metal**	*Attic Access:* **No.**	
Describe any additional mounting considerations: **The client has concerns with roof mounting in general, due to concerns over roof leaks. It should be noted that solar installations are as likely to leak as any roof penetrations. With quality workmanship and proper roof maintenance, leaks can be avoided.**		

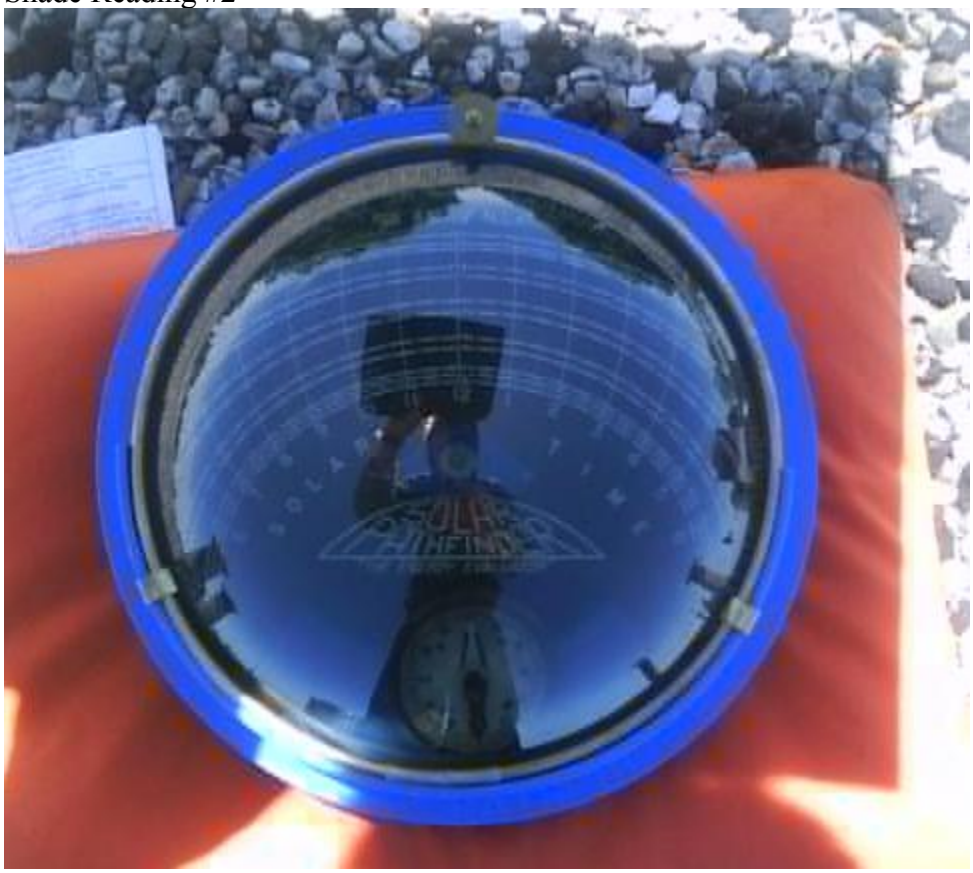
2.2 – Solar Access

Describe any potential obstructions to the solar window:

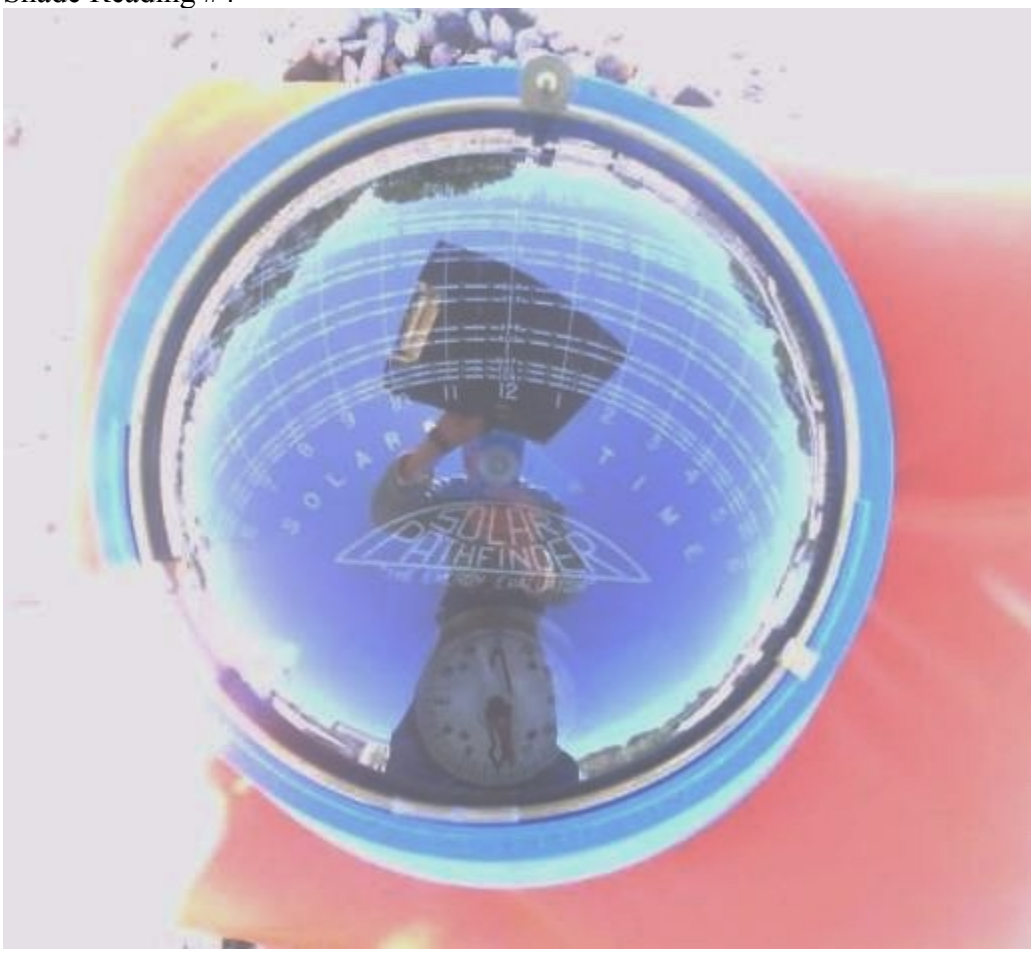
Shade Reading #1



Shade Reading #2

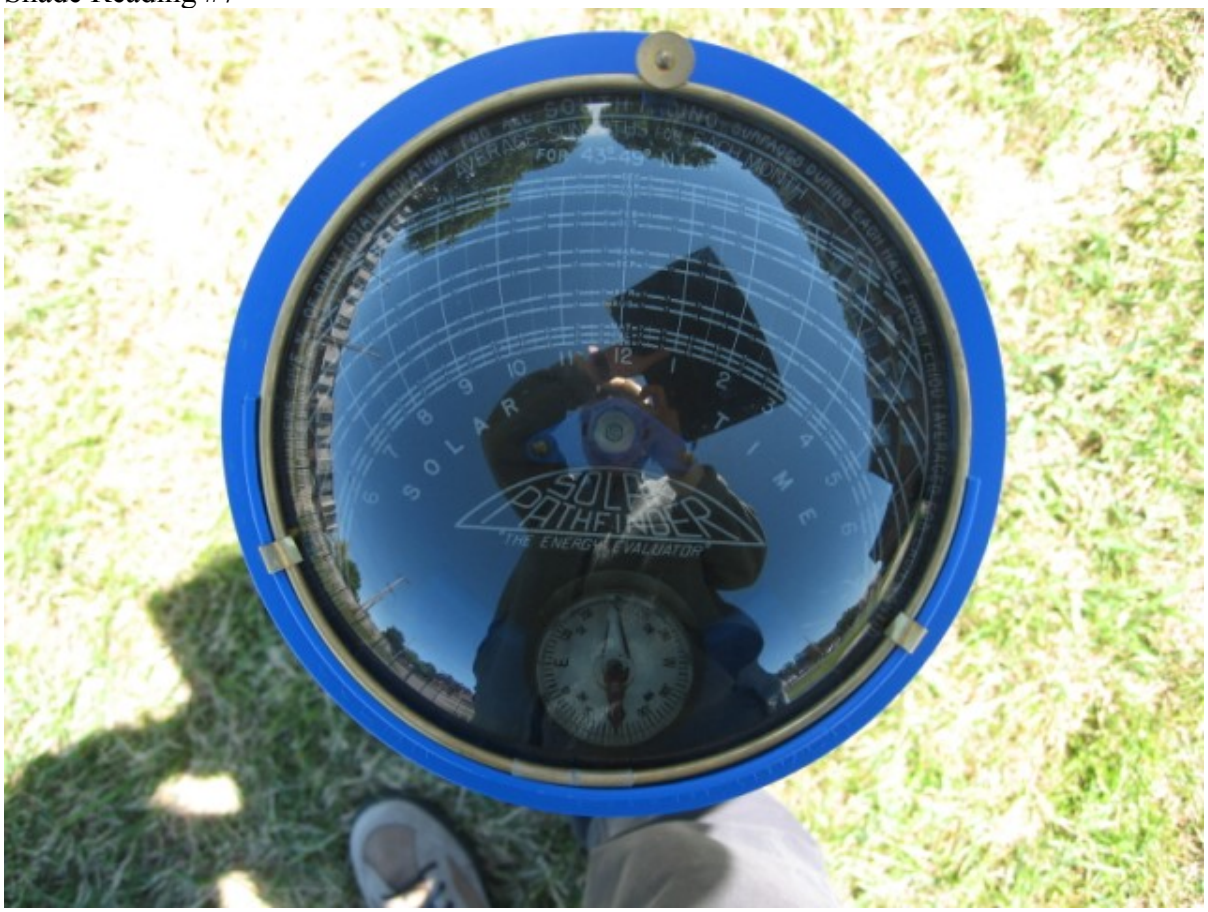


Shade Reading #4

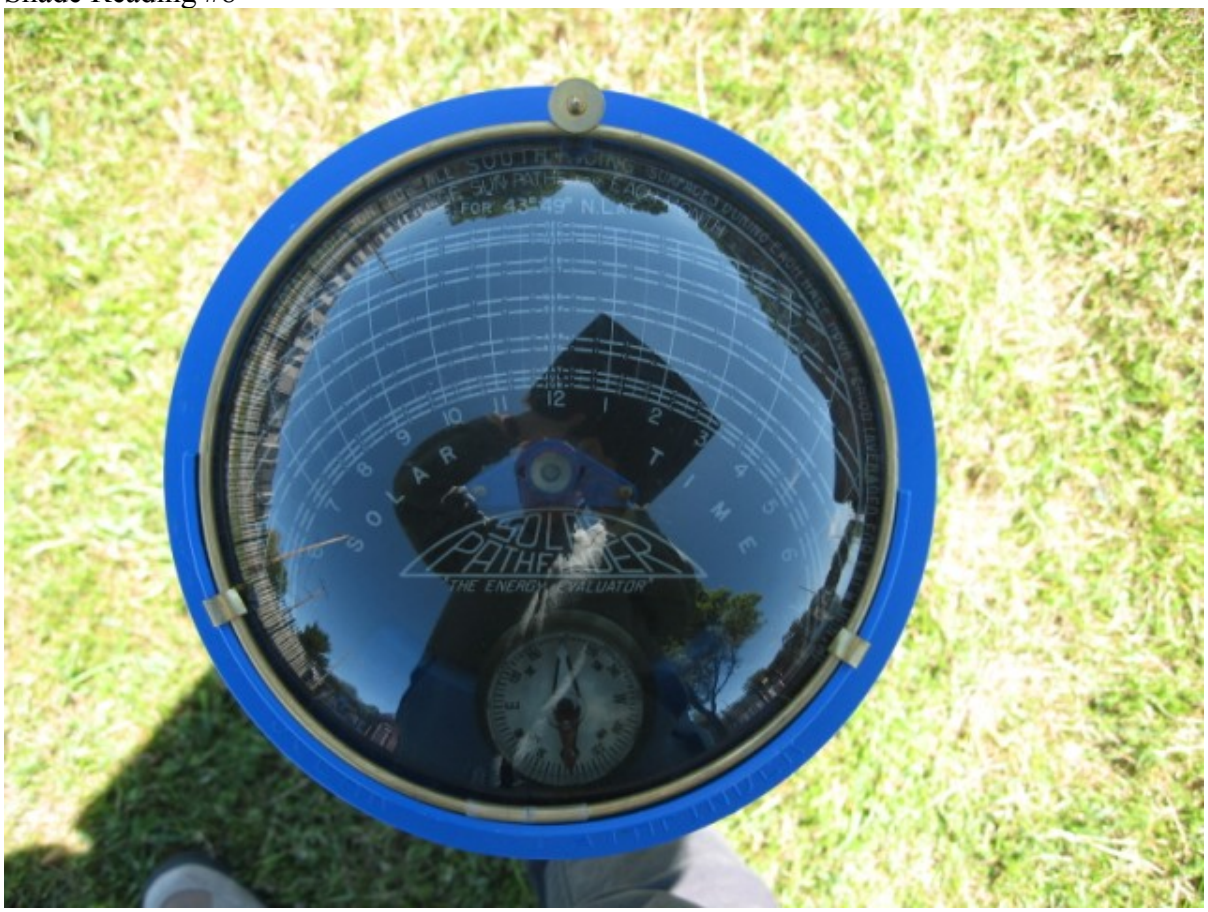


The roof of the north building (addresses 820 and 822, Shade Readings 1, 2, and 4) offers an excellent site for solar hot water collectors. However, the southeast portion (Shade reading #2) does have some minor shading in winter, approx. 15 minutes in November, December, and January during the prime solar production period between 10:00 AM and 2:00 PM.

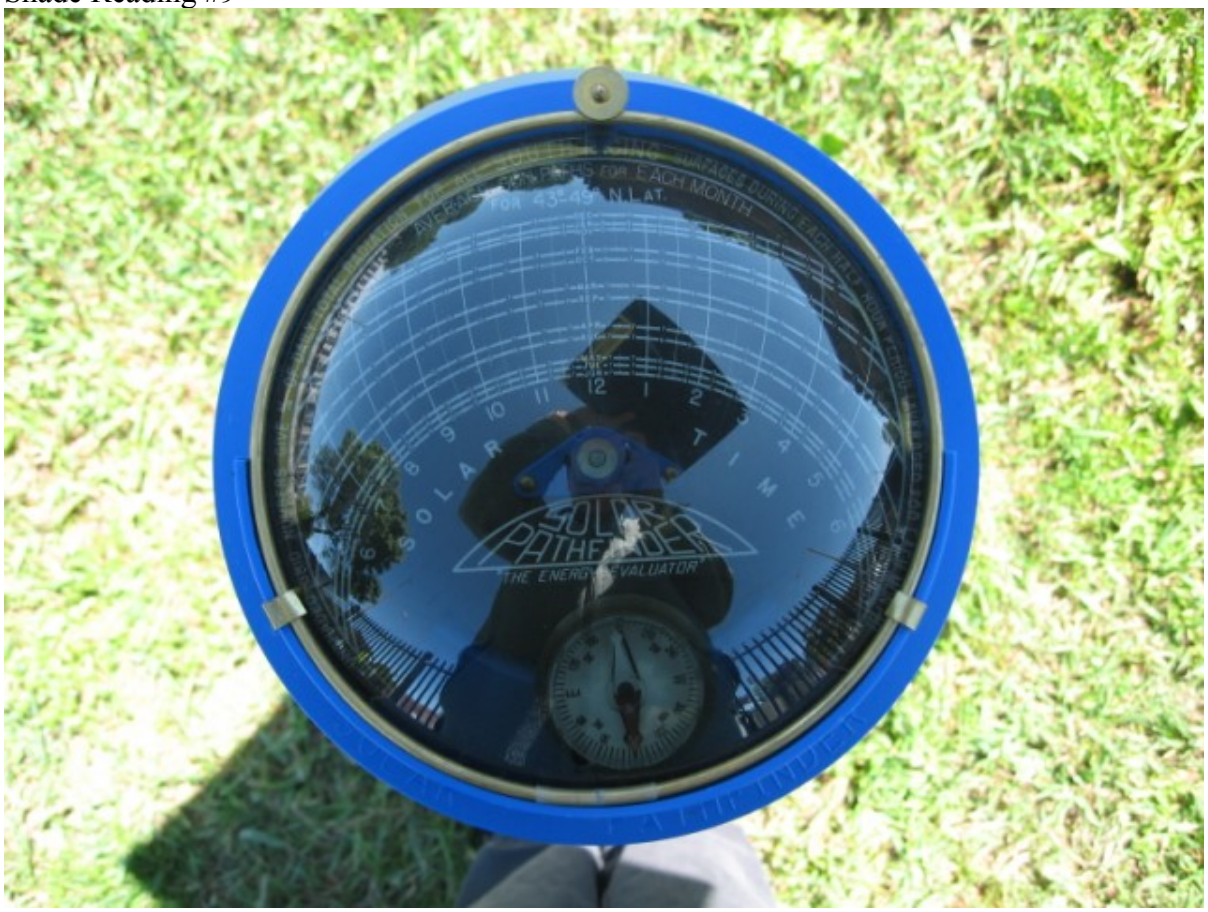
Shade Reading #7



Shade Reading #8



Shade Reading #9



The far northeast corner of the lawn (Shade reading #8) offers an excellent location for ground mounted collectors. Other areas nearby (Shade readings #7 and #9) are also very good, each having just a half hour of shade in November and December occurring during the prime production period between 10:00 AM and 2:00 PM.

2.3 – Interior of Buildings

Existing Water Heating System

Water Heater Type **Natural Gas, natural draft**	*Estimated Water Heater Efficiency* **78%**	
Water Heater Size **2 water heaters, 120 gallons each**	*Estimated Water Heater Age* **Approx. 5 years and 15 years**	
Plumbing Type at Solar Integration **Copper**	*Pipe Diameter* **1.5”**	*Recirculation Loop (yes/no)* **Yes**
Area Available for Solar Storage Tank **Approx. 6’ x 22’ unused area available**	*Minimum Door Size* **35”**	*Ceiling Height* **8 ft.**
Describe the location of the existing water heating and proposed location of the balance of system **Basement Boiler Room. There is plenty of open area for multiple storage tanks.**		

3 – COLLECTOR AND SYSTEM DESCRIPTION

3.1 – Solar Hot Water Basics

Solar hot water systems consist of three major components: the solar collectors (panels), a solar storage tank and a circulation system. Collectors for solar water heating come in two main types – flat plate collectors and evacuated tube collectors. Flat plate collectors are typically composed of an insulated aluminum box with a tempered glass front. Behind the glass is an absorber plate connected to a grid of copper pipes. Evacuated tube collectors use a set of sealed glass tubes, with each tube containing an absorber plate to absorb the solar energy.

Insulated pipes connect the collectors to a liquid-to-liquid heat exchanger which is plumbed to the solar storage tank. This tank, which is usually slightly larger than that of a traditional water heater, stores the solar-heated water and supplies it to your existing water heater.

Most cool-climate solar hot water systems circulate a non-toxic antifreeze mixture to heat the water in the storage tank. When the sun shines on the collectors, the fluid absorbs the solar energy and becomes hot. A pump circulates the fluid through the insulated pipes to the heat exchanger, which transfers the heat from the fluid to the water in the solar storage tank. The fluid is then pumped back to the collectors and the process begins again.

There are two types of system designs commonly used in our climate: drainback and pressurized. Drainback systems only move fluid through the collectors when there is a call for additional heat. Otherwise they allow the fluid to drain into a small additional tank mounted above the pre-heat storage tank. This prevents overheating of the system and minimized pump run time. In pressurized systems, there is always fluid in the collectors, but it is only pumped when there is a higher temperature in the collectors than in the tank. Overheating protection in pressurized systems can be achieved by other means, such as a loop of pipe in the ground or a radiator in the basement. Overheating protection is especially important in systems sized for space heating.

Solar hot water systems are very reliable, with a long and successful track record in Wisconsin. The collectors and insulated piping can last the life of the home. The circulating pump, tank, non-toxic antifreeze mixture and other minor components are subject to wear and may need to be replaced eventually. The system should be checked every five to ten years by a qualified service technician. Expect the average annual maintenance costs to be around $500 for a large system.

Because solar water heaters offset the use of fossil fuels, there are environmental benefits associated with their use. These benefits are calculated in tons of greenhouse gas reduction. The estimated greenhouse gas reduction for the modeled system is listed in the chart in the next section.

3.2 – System Recommendations

Recommended Gross Size of Collector Area **1920 sq. ft.**	*Recommended Gallons of Solar Storage* **2000 - 2200 gallons**
Recommended Mounting Location **A. On the ground at the northeast corner of the property. Minimum 25 ft. separation (N-S) between rows.** **- OR -** **B. In two rows on the roof of the north building, minimum 25 ft. separation (N-S) between rows.**	
Collector Pitch **45°**	*Collector Orientation* **0° (Due South)**
Recommended Routing of Pipe Runs **For ground-mounted collectors, pipes would be buried and insulated, running from the ground location, across mostly grass, crossing one or two concrete sidewalks. The best route is probably westward from the collectors and entering the building basement at the north wall.** **For roof-mounted collectors, pipes would run from the collectors along roof, penetrate roof near boiler vent, and vertically to boiler room and to tank(s).**	

Estimated Total Pipe Run Length (one way) **Ground: 150 ft.** **Roof: 30 ft.**	*Interior Length* **Ground: 25 ft.** **Roof: 25 ft.**	*Exterior Length* **Ground: 125 ft.** **Roof: 5 ft.**

Estimated Production of System **3261 therms / year**	*Estimated Energy Offset by the System* **4076 therms / year**
Estimated Percentage of Solar Contribution to the Load **44%**	*Estimated Greenhouse Gas Reduction* **25.9 tons / year**
Additional Comments	

4 – FINANCIAL ANALYSIS

Disclaimers:

- All numerical values in this report are estimates.
- To determine the installed cost of a system at your site, solicit at least three bids from solar hot water full service installers. The list is enclosed at the end of this report and is updated regularly at focusonenergy.com/fullserviceinstallers
- Proper legal counsel, along with IRS guidance, is required to definitively determine the tax ramification of installing a solar water heating system.
- The information provided here should NOT be considered legal advice.

4.1 – Estimated System Cost

Cost estimates are computed based on an average installed cost in Wisconsin and given in the form a range instead of a point estimate to account for variability in contractors, components and installation costs in Wisconsin. These variables include:

System - size, complexity of usage, quality & efficiency of equipment

Contractor - credentials, reliability, solar experience

Site - proximity to installer network, difficulty of installation (e.g. steep roof pitch, pipe run length & access), permitting & zoning considerations

The range is based on the installed cost per square foot of collector. The current range for large systems is $50-$100 per square foot.

The system would be eligible for financial incentives. There are currently two that are available.

<u>Focus on Energy Solar Water Heating Cash-Back Reward:</u>

The reward is based on energy offset (calculated in therms of energy). The energy offset is calculated by using a modeling program called RETScreen, which calculates the energy produced by a solar water heating system using water heating load estimates, weather data and collector performance data. For systems that offset electric water heaters, the energy offset is the same as the estimated energy produced by the system (from RETScreen). For systems that offset natural gas water heaters, the energy offset is calculated by taking the estimated energy produced by the system (from RETScreen) divided by 0.8 (average combustion efficiency).

For non-profits or government entities, the reward amounts are calculated as follows:

For systems offsetting up to 250 therms is $25.00 per therm offset with a maximum 35% of the total system cost or $75,000.

For systems offsetting 250 to 2,500 therms is $15.00 per therm offset with a maximum 35% of the total system cost or $75,000.

For systems offsetting 2,500 to 5,000 therms is $13.00 per therm offset with a maximum 35% of the total system cost or $75,000.

Please consult the Cash-Back Reward Application (attached) for all reward information and system requirements.

We Energies Solar Thermal Incentive for Non-Profits:
This reward is a dollar-for-dollar match of the Focus on Energy Cash Back Reward.
Eligibility: Applicants must be We Energies retail electric customers located in Wisconsin, and one of the following:

- Not-for-profit organization.
- Not-for-profit educational/academic institution, unit of government, or special district or authority defined as government under Wisconsin law.

Please consult your financial advisor to determine how these rewards will affect your organization's finances.

Square Feet of Collector **1920 sq. ft.**		*Estimated Installed Cost Range* **$96,000 -**	**$192,000**
		Low End of Range	High End of Range
Anticipated Cost of System		$96,000	$192,000
Focus on Energy Cash Back Reward			
Adjusted Energy Offset **4076 therms / year**	*Reward Factor* **$13 / therm**	-$33,600	-$52,988
We Energies Grant for Non-Profits		-$33,600	-$52,988
Estimated End System Cost		**$28,800**	**$86,024**

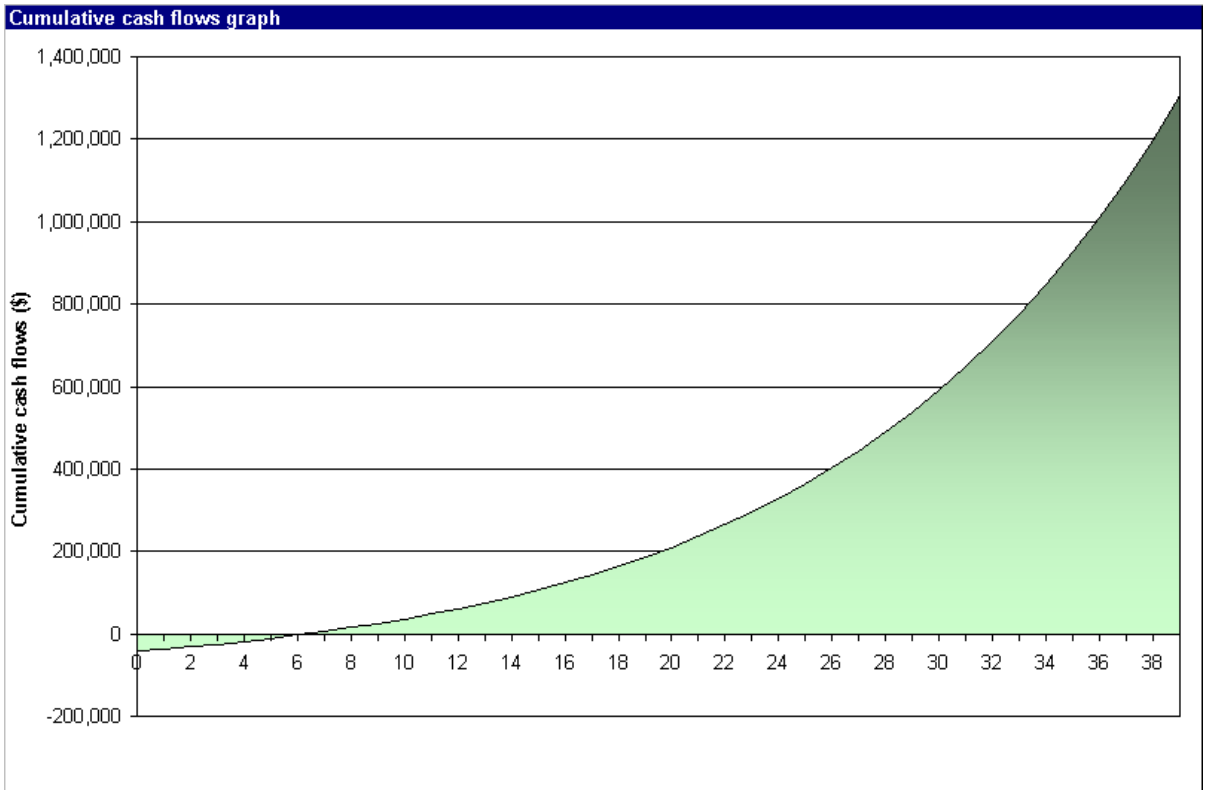
4.2 –Financial Analysis

For example purposes, the following analysis uses the middle of the estimated price range for the modeled system.

Assumptions		
Year One Natural Gas Price ($/therm)	$	1.06
Natural Gas Inflation Rate (%/yr)		7%
Water Heater Combustion Efficiency (%)		80.0%
O&M Cost (% of installed cost/yr)		0.3%
O&M Inflation Rate (%/yr)		3%

Economic Results	
Years to cost payback (non discounted)	9
Years to cost payback (equity)	7

Again, the following chart uses the middle of the estimated price range for the modeled system.



5 – ADDITIONAL INFORMATION

5.1 – Attachments

1. **Focus on Energy Cash Back Reward Form**
2. **Solar Thermal Full Service Installer List**