DANE COUNTY DEPARTMENT of PUBLIC WORKS, HIGHWAY and TRANSPORTATION

County Executive
Kathleen M. Falk

1919 Alliant Energy Center Way • Madison, Wisconsin 53713
Phone: (608) 266-4018 • Fax: (608) 267-1533

Commissioner / Director
Gerald J. Mandli

December 6, 2010

ATTENTION ALL REQUEST FOR BID (RFB) HOLDERS

RFB NO. 310034 - ADDENDUM NO. 1

SOLAR PHOTOVOLTAIC FACILITIES

BIDS DUE: THURSDAY, DECEMBER 9, 2010, 2:00 PM. DUE DATE AND TIME ARE NOT CHANGED BY THIS ADDENDUM.

This Addendum is issued to modify, explain or clarify the original Request for Bid (RFB) and is hereby made a part of the RFB. Please attach this Addendum to the RFB.

PLEASE MAKE THE FOLLOWING CHANGES:

1. **Pre-Bid Meeting Minutes**
   The Pre-Bid Meeting Minutes are attached. All Bidders need to be aware of items discussed.

2. **Bid Form**
   Page BF-3 - Alternate Bid F and G:
   Add these alternate bids for the Springfield Corners Highway Garage: 10kW Roof Mounted installation in lieu of 10kW Ground Mount (Alternate F), and for 5kW Roof Mounted installation in lieu of 5kW Ground Mount(Alternate G)

3. **PV Solar Site Assessment**
   The 10/11/10 Solar Site Assessment is provided for all bidders.

4. **Section 48-14-00(3)(i)**
   DELETE "An internal data meter must be installed to measure the AC output of the inverter…The inverter shall have a TC/IP and MODBUS interface for remote access via network computer."

6. **Section 48-14-00(5)**
   ADD Sub-Item (f) "Structural drawings and calculations required by the City of Madison for Roof Mounted Solar Arrays shall be provided by the design engineer (A/E) and is not the responsibility of the photovoltaic contractor.

10. **Sheet E1.0**
    1. Detail 3: Change feeder from combiner box to #1 in lieu of #2. See feeder schedule sheet EL.

2. Detail 4: Change feeder from combiner box to #2 in lieu of #1. See feeder schedule sheet EL.

11. Sheet E2.0

1. The solar array shall be located on flat roof Area D of the Highway Garage.
2. Detail 1, Note 1: ADD "The owner shall clear the present area to mount the PV equipment. E.C. shall provide a painted ¾" plywood mounting board minimum 4'h x 6'w mounted to the existing wall to support the PV equipment."

12. Sheet E4.0

New Alternate Bids F and G – see bid form for Roof Mounted Solar Array at this site for 10kW and 5kW systems.

1. 10kW Roof Mount System shall consist of (39) panels wired in (3) strings of (13) panels, a combiner box, and #1 feeder from combiner box to disconnect at the 10kW inverter. The PV system wiring diagram 10kW shall apply. Include weatherproof GFI 110V receptacle on roof. Details EL/1, EL/2 and EL/3 shall apply. General notes, plan notes and racking system notes for roof mounting shall apply. Array shall be directed to face south.
2. 5kW Roof Mount System shall consist of (20) panels wired in (2) strings of (10) panels, a combiner box, and #2 feeder from combiner box to disconnect at the 5kW inverter. The PV system wiring diagram 5kW shall apply. . Include weatherproof GFI 110V receptacle on roof. Details EL/1, EL/2 and EL/3 shall apply. General notes, plan notes and racking system notes for roof mounting shall apply. Array shall be directed to face south.

13. Sheet E5.0

1. Detail 3: Provide (2) strings of (8) panels, (16) total in lieu of (20) shown.
2. Detail 1, Note 3: ADD "110V circuits shall be MC Cable type wherin the jacket and conductors are listed for the application."

If any additional information about this Addendum is needed, please call John Schraufnagel at 608/266-4798, schraufnagel@co.dane.wi.us.

Sincerely,

John Schraufnagel P.E.

John Schraufnagel
Project Manager

Enclosures:
Pre-Bid Meeting Minutes
Bid Form
Solar Site Assessment

HARWOOD ENGINEERING CONSULTANTS, LTD

7420 West State Street
Milwaukee, WI 53213
Phone: (414) 475-5554
Fax: (414) 475-5698
www.hecl.com

civil . structural . plumbing / fire protection . mechanical . electrical

MEETING MINUTES

Project	**Dane County Solar Photovoltaic Facilities**	**Date**	**12/1/2010**
Project No	010-1142.01	**Time**	8:30 am
Author	Holly Blomquist (Harwood Engineering Consultants)	**At**	Dane County DPW Office

DISTRIBUTION

Name	Company	Email	Attended
John Schraufnagel	Dane County DPW	schraufnagel@co.dane.wi.us	☒
Caleb Barth	Dane County DPW	barth.caleb@co.dane.wi.us	☒
Richard Sujecki	Harwood Engineering Consultants, Ltd.	richard.sujecki@hecl.com	☒
Holly Blomquist	Harwood Engineering Consultants, Ltd.	holly.blomquist@hecl.com	☒
Todd Roethel	H&H Solar	troethel@hhsolar.org	☒
Mike Joyce	Full Spectrum Solar	info@fullspectrumsolar.com	☒
Ben Hommen	The Morse Group	bhomman@ampelectric.com	☒
Bob Belick	Sustainable Strategies	bbelick@sustainablestrategiesnow.com	☒
Chris Manny	Sustainable Strategies	cmanny@sustainablestrategiesnow.com	☒
Tony Dubanowich	American Power, Inc	info@americanpowerinc.net	☒
Matt Giovanelli	SolaRain, LLC	solarain@wi.rr.com	☒
Steve Tweed	Forward Electric	steve@forwardelectric.com	☒
Ben Collins	Pieper Electric	collins@pieperpower.com	☒
Al Dittmar	Carroll Electric	ald@metropower.com	☒
Chris Kneeland	Venture Electric	gogreen@venture-electric.com	☒
Sue Worthington	Midwest General and Mechanical Contractors	sworthit51@hotmail.com	☒

These meeting minutes represent our understanding of the above proceedings. Please review the contents carefully and notify the author immediately in writing of any inaccurate statements. If no response is received within (7) seven days of issue, it shall be deemed that all parties are in agreement with the contents.

1. Overview EECBG
    a. February 3, 2011 is deadline for signed contract
    b. Project for Public Works, Highway, and Transportation Department
2. Bid Registration

7420 West State Street
Milwaukee, WI 53213
Phone: (414) 475-5554
Fax: (414) 475-5698
www.hecl.com

MEETING MINUTES

Dane County Solar Photovoltaic Facilities
010-1142.01

December 1, 2010 at 8:30am Central

   a. Online registration
   b. $20 fee
   c. Contract Documents, Addenda available to contractor on website
3. Bids Due
   a. December 9, 2010 by 2pm
   b. Hard copies, no faxes
4. Project Schedule
   a. Notice to Proceed and Purchase Order will be issued prior to start (pending approvals, etc)
5. Bonds and Insurance
   a. 100% performance payment bond required
   b. Insurance is spelled out in Front End documents
6. Meet Qualification Requirements
   a. Contractor shall review requirements to ensure eligibility prior to bidding
   b. Contractor needs to submit alternate qualifications for review prior to awarding bid
7. Fair Labor Practices
   a. Part of bid checklist on bid form
   b. Must be signed and included with bid.
8. Plans and Specifications
   a. Extra copies of plans and specs available at DPW office.
9. Routing of Questions, Submittals, Change Orders, Shop Drawings, and Pay Requests
   a. Route to Harwood Engineering Consultants for review.
10. Permits
   a. Permits by contractor.
   b. City of Madison Permits for Job Center, Dane County Highway Garage, Landfill, and Badger Salt Shed. Springfield Corner will be permitted through local township.
   c. County/DPW may be of some assistance with City permits
   d. Question was asked as to schedule allowing for permit processing time. John indicated that County/DPW will help to expedite permit process as much as possible
11. Parking on Sites
   a. Parking may be limited at sites, needs to be coordinated per site
   b. Job Center may be difficult for staging and security
   c. Other facilities are occupied and used daily
   d. Locked gate at Springfield Corners, but other sites may require additional security measures, by contractor.
12. Utilities
   a. No electricity for heating is provided by County. Contractor shall furnish their own heat as required.
   b. No toilet at Badger Salt Shed.
   c. Toilet facilities and other electricity is available at no cost for contractor.
13. Base Bid and Alternate Bids
   a. Springfield Corners is Ground/Slab Mount, but Addendum will include alternate bids for Roof mount in lieu of slab
   b. Job Center, Dane County Highway Garage are Roof Mount
   c. Alternate at Badger Salt shed is Pole Mount
   d. Alternate at Landfill is Roof Mount
   e. Some flexibility in the budget ($2.3 million in overall stimulus money for several energy efficiency projects)
14. Recycling
   a. Goal is 100% recycling
   b. Cardboard, pallets, plastics, freight packing
   c. Dane County form is in specification book (Required)
15. Davis Bacon/Prevailing Wage Rates
   a. Higher of the two needs to be paid, outlined in Front End document
16. ARRA Reporting
   a. Monthly and Quarterly reporting required
   b. County DPW and/or Harwood Engineering can assist as needed
   c. Final reporting will be the end of the quarter when project is completed
17. Focus on Energy Applications
   a. All FOE applications are by contractor, outlined in specifications
   b. Approximately 30 day timeline for Pre-Application makes the schedule tighter
18. “Buy American” provisions
   a. Contractor shall review requirements and exemptions
   b. Get manufacturer’s “Buy American” documentation (or assurance of documentation) prior to purchasing equipment which needs to meet this qualification

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MEETING MINUTES

Dane County Solar Photovoltaic Facilities
010-1142.01

December 1, 2010 at 8:30am Central

19. D-U-N-S Number and CCR Number
    a. Contractor required to get both numbers
20. Work Times
    a. Standard County schedule is M-F 7:45 – 4:30.
    b. This time may vary by site so contractor shall verify proposed schedule with owner
21. Progress Meetings
    a. Every 2 weeks or more as required by Owner
    b. Decision maker must attend the meetings
    c. Include pre-construction, progress, post-construction
22. Noise Control
    a. Only an issue at the Job Center as the work takes place above an active office
23. Work by Owner
    a. Concrete slab at Springfield Corners by owner but that project may change to a roof mount.
24. Q&A
    a. Pole mounted array is dual-axis tracker.
    b. No monitoring for IT at sites but the inverter needs provisions to be IT capable (interface cards)
    c. No external inverter (this will be removed from the spec in addendum)
    d. Salt shed is unconditioned. Inverter needs to be able to operate to -40 F or be provided with a heater (as specified)
    e. Design intent shall be followed but HEC is willing to review equivalent product options. Any proposed system shall be installed in the specified way (mounting angles, ballasted roof mounting with minimal roof penetration) and perform to the specified capacity
    f. Roof structures shall be capable of wind load, snow load. City of Madison requires calculations and PE stamp. HEC will provide engineering calculations and PE stamp, not the contractor. The dead load estimate is complete and structure has been reviewed already by HEC.
    g. Badger Salt Shed bid shall include the protective barrier (parts and labor)
    h. Solar tracker size is called out as 5kW.
    i. 20 year warranty for all components, including inverters, is required
    j. A post construction “call-back” provision by the contractor is included in the specification and shall be included for each site.
    k. #6 ground to each module per plan note #10.
    l. 110V weatherproof outlet required by dedicated circuit. There is a 110V panel at each site, most within a reasonable distance. 110V dedicated circuit required for solar tracker.
    m. MG&E buy back shall be engaged for all PV systems. Interface/connection to MG&E is required at all sites. MG&E has a copy of the plans as of 11/16/2010.

Document Prepared By: Holly Blomquist, Harwood Engineering Consultants, Ltd.

BID FORM

BID NO. 310034
PROJECT: SOLAR PHOTOVOLTAIC FACILITIES
MULIPLE LOCATIONS
DANE COUNTY, WISCONSIN

TO: DANE COUNTY DEPARTMENT OF PUBLIC WORKS, HIGHWAY & TRANSPORTATION PROJECT ENGINEER
1919 ALLIANT ENERGY CENTER WAY
MADISON, WISCONSIN 53713

BASE BID:
Construction services to install several solar photovoltaic facilities throughout Dane County. The locations included in the base bid are the Dane County Highway Garage, Dane County Job Center, and Springfield Corners Highway Garage. The undersigned, having examined the sites where the Work is to be executed and having become familiar with local conditions affecting the cost of the Work and having carefully examined the Drawings and Specifications, all other Construction Documents and Addenda thereto prepared by Dane County Department of Public Works, Highway & Transportation hereby agrees to provide all labor, materials, equipment and services necessary for the complete and satisfactory execution of the entire Work, as specified in the Construction Documents, for the Base Bid stipulated sum of:

- Dane County Highway Garage
  2302 Fish Hatchery Road, Madison, WI 53713,
  Roof Mount Option, 10 kW system: _____

- Dane County Job Center
  1819 Aberg Avenue, Madison, WI 53704,
  Roof Mount Option, 10 kW system: _____

- Springfield Corners Highway Garage
  6159 USH 12, Dane, WI 53529,
  Ground Mount Option, Concrete Slab By Owner,
  10 kW system: _____

Total: $_____
Numeric Price

_____ and _____ /100 Dollars
Written Price

The undersigned further agrees to add the alternate(s) portion of the Work as described, for the following addition(s) to or subtraction(s) from the Base Bid stipulated below. They further agree to honor the alternate(s) bid for 60 days from date of Award of Contract.

ALTERNATE BID A - LUMP SUM:
Deduct price for installing a roof mounted 5 kW solar photovoltaic facility (in lieu of 10 kW) at the Dane County Highway Garage.

_____ and _____ /100 Dollars
Written Price

$_____
Numeric Price (circle: Add or Deduct)

ALTERNATE BID B - LUMP SUM:
Deduct for installing a roof mounted 5 kW solar photovoltaic facility (in lieu of 10 kW) at the Dane County Job Center.

_____ and _____ /100 Dollars
Written Price

$_____
Numeric Price (circle: Add or Deduct)

ALTERNATE BID C - LUMP SUM:
Deduct for installing a ground mounted 5 kW solar photovoltaic facility (in lieu of 10 kW) at the Springfield Corners Highway Garage.

_____ and _____ /100 Dollars
Written Price

$_____
Numeric Price (circle: Add or Deduct)

ALTERNATE BID D - LUMP SUM:
Add price for installing a pole mounted 5 kW solar photovoltaic facility with tracker at the Badger Salt Shed, 3650 CTH T, Madison, WI 53718.

_____ and _____ /100 Dollars
Written Price

$_____
Numeric Price (circle: Add or Deduct)

ALTERNATE BID E - LUMP SUM:
Add price for installing a roof mounted 5 kW solar photovoltaic facility at the Landfill Main Garage, 7102 USH 12 & 18, Madison, WI 53718.

_____ and _____ /100 Dollars
Written Price

$_____
Numeric Price (circle: Add or Deduct)

ALTERNATE BID F - LUMP SUM:
Add price for installing a roof mounted 10 kW solar photovoltaic facility at the Springfield Corners Highway Garage in lieu of ground mounted system.

_____ and _____ /100 Dollars
Written Price

$_____
Numeric Price (circle: Add or Deduct)

ALTERNATE BID G - LUMP SUM:
Deduct for installing a roof mounted 5 kW solar photovoltaic facility (in lieu of 10 kW Roof Mount) at the Springfield Corners Highway Garage.

_____ and _____ /100 Dollars
Written Price

$_____
Numeric Price (circle: Add or Deduct)

Receipt of the following addenda and inclusion of their provisions in this Bid is hereby acknowledged:

Addendum No(s). _____ through _____

Dated _____

Dane County must have this project completed by April 29, 2011. Assuming this Work can be started by February 14, 2011, what dates can you commence and complete this job?

Commencement Date: _____ Completion Date: _____
(final, not substantial)

I hereby certify that all statements herein are made on behalf of:

_____
(Name of Corporation, Partnership or Person submitting Bid)

Select one of the following:
1. A corporation organized and existing under the laws of the State of _____, or

2. A partnership consisting of _____, or

3. A person conducting business as _____;

Of the City, Village, or Town of _____ of the State of _____.

I have examined and carefully prepared this Bid from the associated Construction Documents and have checked the same in detail before submitting this Bid; that I have full authority to make such statements and submit this Bid in (its) (their) (my) behalf; and that the said statements are true and correct. In signing this Bid, we also certify that we have not, either directly or indirectly, entered into any agreement or participated in any collusion or otherwise taken any action in restraint of free competition; that no attempt has been made to induce any other person or firm to submit or not to submit a Bid; that this Bid has been independently arrived at without collusion with any other bidder, competitor, or potential competitor; that this Bid has not been knowingly disclosed prior to the opening of Bids to another bidder or competitor; that the above statement is accurate under penalty of perjury.

SIGNATURE: _____
(Bid is invalid without signature)

Print Name: _____ Date: _____

Title: _____

Address: _____

Telephone No.: _____ Fax No.: _____

Email Address: _____

Contact Person: _____

BID CHECK LIST:
These items **must** be included with Bid:
☐ Bid Form ☐ Bid Bond ☐ Fair Labor Practices Certification

THE FOLLOWING IS FOR BIDDERS' REFERENCE AND ARE REQUIRED BUT NEED NOT BE SUBMITTED WITH BID FORM:

DANE COUNTY VENDOR REGISTRATION PROGRAM

Any person bidding on any County contract must be registered with the Dane County Purchasing Division & pay an annual registration fee. A contract will not be awarded to an unregistered vendor. Obtain a *Vendor Registration Form* by calling 608/266-4131 or complete a new form or renewal one online at:
www.danepurchasing.com/registration

DANE COUNTY BEST VALUE CONTRACTING PRE-QUALIFICATION

Contractors must be pre-qualified as a Best Value Contractor with the Dane County Public Works Engineering Division before the award of contract. Obtain a *Best Value Contracting Application* by calling 608/266-4018 or complete one online at:
www.co.dane.wi.us/pwht/BVC_Application.aspx

EQUAL BENEFITS REQUIREMENT

By submitting a Bid, the contractor acknowledges that a condition of this contract is to provide equal benefits as required by Dane County Code of Ordinances Chapter 25.016. Contractor shall provide equal benefits as required by that Ordinance to all required employees during the term of the contract. For more information:
www.danepurchasing.com/partner_benefit.aspx

OBTAIN D-U-N-S NUMBER, CCR NUMBER AND REVIEW ALL ARRA REPORTING

In order to be selected as successful bidder, the contractor must obtain a free D-U-N-S number. A D-U-N-S number is a unique nine-digit sequence recognized as the universal standard for identifying and keeping track of a business. The D-U-N-S number may be obtained by the following link: http://www.dnb.com/us/duns_update/index.html.

Central Contractor Registration (CCR) is the primary registrant database for the U.S. Federal Government. CCR collects, validates, stores and disseminates data in support of agency acquisition missions. The CCR number may be obtained by the following link: https://www.bpn.gov/CCR/default.aspx.

The American Recovery and Reinvestment Act (ARRA) requires the contractor to provide information for monthly and quarterly reporting throughout the life of the project. Please review the attached ARRA reporting requirements before bidding.

DAVIS-BACON, EECBG, F.O.E., AND BUY AMERICAN PROVISIONS

All wages for all trades participating in this project are subject to the State of Wisconsin Prevailing Wage Rates or Federal Davis-Bacon Wage Rates, whichever is larger. The Davis-Bacon wage rates are provided in the Supplementary Conditions and may be modified prior to bid opening. (Except if modified within ten days of Bid Opening.)

This project is funded by the Energy Efficiency Conservation Block Grant (EECBG). Information about the EECBG can be found at: http://www.eecbg.energy.gov/.

Focus On Energy rebates will be applied for during this project. Information about F.O.E. can be found at: http://www.focusonenergy.com/.

All products used in this project will be required to meet Buy American Provisions. Guidance for meeting Buy American Provisions can be found at: http://www1.eere.energy.gov/recovery/buy_american_provision.html.

SOLAR ELECTRIC SITE ASSESSMENT REPORT

Dane County Highway Garage

c/o

Richard Sujecki, P.E.
Harwood Engineering Consultants, LTD.
7420 W. State Street
Milwaukee, WI 53213

Site Assessor

Matthew Giovanelli
7133 W. Wells Street
Wauwatosa, WI 53213
414-861-4572
solarain@wi.rr.com
www.solarain.net

Date of Site Visit:
October 11, 2010

Date Final Report completed:
October 28, 2010

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

Executive Summary

The results of the photovoltaic (PV) solar site assessment indicate that the Dane County Department of Public Works Highway Garage site is an excellent site for the installation of a solar PV system. The best location to install PV modules for the anticipated array size is a roof mounted array located on the southern most flat roof section of the building complex. There are shading issues at this location related to vent stacks and adjacent trees, but space is available for the anticipate array sizes. The following table summarizes the results of the site assessment using 22 solar panels (230 watts each) and 40 roof mounted solar panels:

Energy Production, Cost, Economics and Environment Dane County Highway Garage– Roof Mount		
Production	*Roof Mount*	
Solar electric systems rated module capacity (kW dc)	5.06 kW-DC	9.2 kW-DC
Estimated output year one (kWh/yr)	6,257	11,376
Cost		
Estimated installed cost	$37,950	$64,400
Focus On Energy Incentive*	$ 9,385	$17,064
System Cost after all incentives	**$28,565**	**$47,336**
Value of year 1 to year 10 power production	$15,295	$27,808
Economics		
10 Year discounted NPV	-$19,539	-$30,657
25 Year discounted NPV	-$ 8,864	-$10,873
10 Year IRR	-12.8%	-11.3%
25 Year IRR	1.4%	2.2%
Simple Payback Period	23 years	21 Years
Environment		
CO2 emission reduction per year (tons/year)	6.9	12.6
Key Assumptions		
Cost of System Per kW (dc)	$ 7,500	$ 7,000
Meets Focus on Energy Tier II Efficiency Level	$1.50/kWh	$1.50/kWh
Electricity Rate Year One ($/kWh)	$ 0.12	$ 0.12
MG&E Solar Electric Buyback Rate**	$0.25	$0.25
Estimated electricity price inflation rate (%/yr)	6.0%	6.0%
Expected output degradation (%/year)	0.50%	0.50%
Discount rate (used only in NPV)	3.0%	3.0%

***Installer must be certified by the North American Board of Certified Energy Practitioners (NABCEP) or those working towards certification.**

****Does not include cost to enter Green Power Tomorrow Program**

An area of approximately 60 feet by 55 feet is reasonably available for the installation of a roof mounted array on the northern half of the southern most flat roof section of the building complex. In order to install a 10 kW array, the PV modules will need to be installed in either landscape orientation in four rows or in portrait orientation in three rows. Landscape orientation would result in less wind loading. Four rows of 10 modules each could be installed in the given space available. Using 230-watt modules, the 40 modules would compose a 9.2 kW array. Dane County is considering using a pan and ballast mounting system. Because this could place the bottom of the modules close to the roof surface, significant snow events could result in the modules being covered for an extended period. A smaller area is available on the white roof section of the complex adjacent to the north, but shading issues and a sloping roof pose some challenges.

Next Steps

a) Evaluate the options presented in this report, and make a decision on system size, location and mounting methods.

b) Engineering reviews maybe needed.

- For roof mounted systems, confirm with the building designer and/or qualified structural engineer as to the building roof structure's ability to support the additional weight and wind loading of a solar electric system. Also, review the impact on roofing warrantee of siting panels over roofing.
- With an electrical professional, ensure space is available for balance of system components (e.g., inverter(s) disconnects, etc.) in the utility room, and at that space is available at electric panel/substation, with good access to the solar modules.

c) Determine the project's economics with your financial professionals. Incentive programs are subject to change, so ensure you information is up to date. For information regarding:

- Focus on Energy incentives, contact: www.focusonenergy.com or 800 762.7077.
- Federal tax incentives, contact: the IRS.
- U.S. Department of Agriculture rural business incentives, contact: www.farmenergy.org or in Wisconsin, Mark Brodziski at 715.345.7615, or mark.brodziski@wi.usda.gov

d) Contact at least three qualified installers to get price quotes (see Focus on Energy's full service solar electric installers attached to this report for a directory of Wisconsin's solar electric installers).

- It is recommended that the installer completes interconnection applications, obtains permits and fills out Focus on Energy incentive paperwork.

- Ensure that price quotes are comparable (e.g., all include any work that may be needed on the AC side of the inverter to be eligible for We Energies or Madison Gas and Electric buy back rates incentives).

e) Contact your insurance agent and advise them of your intent to install the renewable energy system, and ask for written confirmation of the liability coverage currently provided (as needed to meet utility requirements). Confirm that current insurance provides the needed coverage, and resolve any issues with the agent.

f) Define any permitting requirements for the installation of the system.
g) Based on the quote received, and consultation with financial professionals, make the final decisions on the project's size, location, mounting options and price with your preferred installer.

h) Apply and receive approval for incentives as appropriate. Commonly your preferred installer will assist with the applications.

i) Sign the installation contract with your selected installation firm.
- Insure that all zoning, utility agreements, financial incentive and any other required approvals are in hand prior to making any commitment to purchase.

j) It is usually much more cost effective to make energy efficiency improvements than install a solar electric system. For information about the Focus on Energy business energy efficiency program contact: Focusonenergy.com or 800.762.7077

Insure that all utility agreements, financial incentives, and any other required approvals/permits are in hand prior to making any commitment to purchase.

Disclaimers:

- All costs, power production, economic and other values in this report are estimates.
- The economic analysis presented in this report should be considered one method of evaluating this project.
- The estimated installed system cost(s) are/is not a formal estimate or bid.
- The information provided in this report should NOT be considered legal, financial, or tax advice.

October 28, 2010

Matthew R Giovanelli

Date

REPORT CONTENTS

1. Purpose of Site Assessment

The purpose of this assessment is to provide site-specific information on how a solar electric (also referred to as a photovoltaic, or PV) system would perform at your location, including information on estimated physical size, rated output, energy production, costs, financial incentives and mounting options. Site assessors are required to present unbiased information and may not recommend contractors or products.

Dane County Department of Public Works is interested in:

- Clean energy/environmental concerns
- Reducing energy bills: maximizing system production and minimizing cost
- Possible Educational/Demonstration project
- Public relations: system should be publicized as a green investment

Dane County's solar electric system size expectations for the Highway Garage are between 5 and 10 kW.[1]

2. Site's Electric Data

Electrical Service**:** The building complex has 120/208 volt 3 phase 4 wire service. The electrical service is located on the east wall of the main garage building. See Figures 1 through 3.

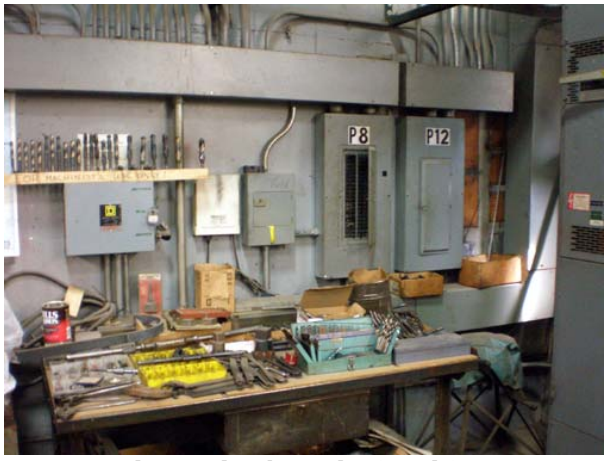

Figure 1 Electrical Subpanels (inside)

Figure 2 Electrical Subpanels (inside)

[1] In Southeastern Wisconsin, a one kilowatt (kW) solar electric system, that is unshaded and fix mounted, will generate about 1230 kilowatt hours (kWh) per year. A one kW unshaded dual axis tracking system will generate about 1640 kWh/year.

Figure 3 Electrical Service (outside)

Dane County provided energy usage for the Highway Garage site over the past 21 months. The information provided was for 4 MG&E meters, and did not specify which meter was for which part of the complex. Therefore, the meter with the highest usage was used to obtain a rate of $0.12 kWh.

3. Siting Options

The Dane County Highway Garage Building site is located at 2302 Fish Hatchery Road in the City of Madison, Wisconsin 53713. Dane County prefers that the PV array be installed as a roof mount system. Because of the large amount of paved parking and storage areas, the active nature of the site, and the closeness of the property line along the east side of the building, roof mounting is the only reasonable option. See Figure 4 for an aerial view of the southern end of the building complex.

Figure 4 Aerial View Looking South

3.1 Shading Estimates

The location of the roof mounted PV modules on the southern portions of the building complex will need to take into consideration potential shading of the panels. Since PV modules can last from 30 to 40 years, system placement should consider shading by tree growth, adjacent buildings, and roof mounted HVAC units and vent stacks.

A device called the Solar Pathfinder is used to determine if there are any shading issues that would block the PV modules from receiving sun light. The Pathfinder shows the solar window for a given PV array system, for all months of the year, by transferring the shading of the surrounding obstructions (usually trees or buildings) onto an easy-to-read flat display. From this display, the percentage of shading for each month of the year can be computed; and from that, the reduction in energy output from the PV system due to this shading can be calculated.

Roof Mount – Black Roof Section

The Pathfinder was placed at four locations on the roof and solar window readings collected. Figure 5 shows the locations at which Pathfinder readings were collected.

Figure 5 Pathfinder Placement.

Figures 6 through 13 were taken of the proposed location of the roof mounted array.

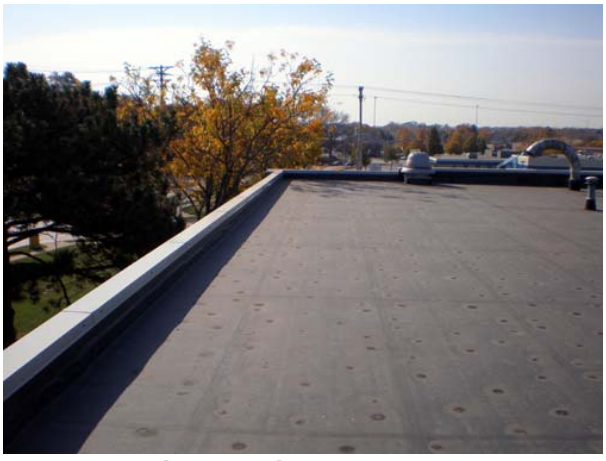
Figure 6 Looking South From NE Corner.


Figure 7 Looking Southwest From NE Corner.

Figure 8 Looking West From NE Corner.

Figure 9 Looking East From SW Corner.

Figure 10 Looking Northeast From SW Corner.

Figure 11 Looking North From SW Corner.

Figures 12 & 13 depict the Pathfinder image and shading trace for the Pathfinder location numbers 1 and 4, respectively, (as depicted on Figure 5). Taken together the four locations identified on Figure 5 are shaded less than 1% of the time on average for the entire year.

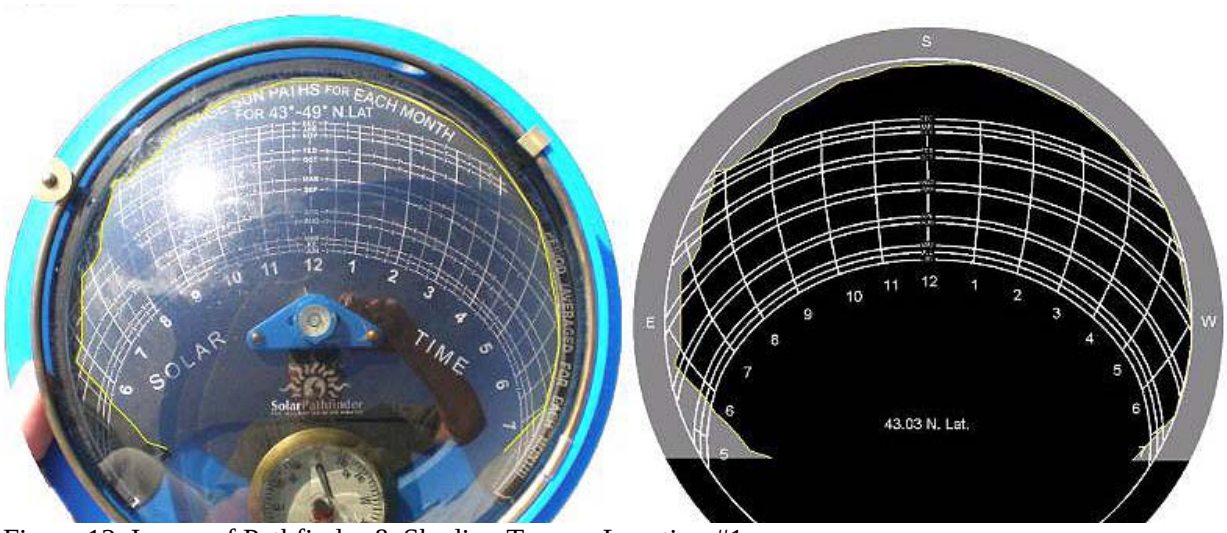

Figure 12 Image of Pathfinder & Shading Trace – Location #1.

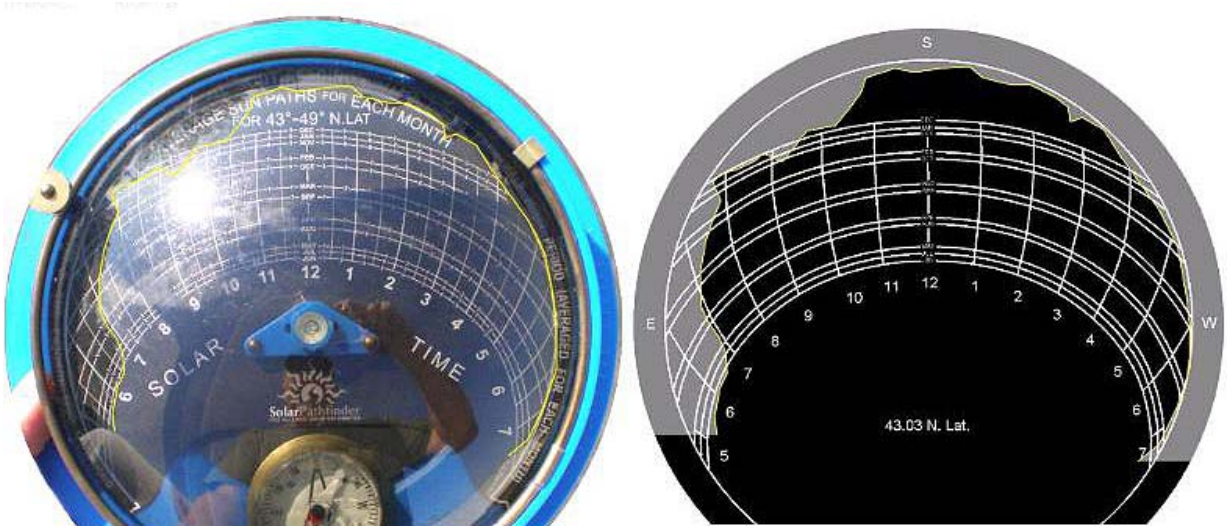

Figure 13 Image of Pathfinder & Shading Trace – Location #4.

Figure 14 presents the shading analysis by averaging the results from the four Pathfinder readings locations. The shading analysis indicates that a 9.2 kW-DC roof mount system on the southeast corner of the building would generate approximately 11,495 kWh a year.

Solar Obstruction Data

Month	Ideal Unshaded Solar Radiation Azimuth=180.0 Tilt=43.03 KWH/m ^{2} /day	Actual Shaded Solar Radiation Azimuth=177.7 Tilt=35.0 KWH/m ^{2} /day	Actual Shaded AC Energy (KWH) Azimuth=177.70 Tilt=35.00	Actual Unshaded AC Energy (KWH) Azimuth=177.7 Tilt=35.00	PVWatts Unshaded % Actual Site Azimuth=177.7 Tilt=35.00
January	3.28	3.03	758.60	777.00	97.00 %
February	3.96	3.81	832.81	834.00	99.72 %
March	4.36	4.34	999.05	1,002.00	99.34 %
April	4.96	5.03	1,072.69	1,075.00	99.27 %
May	5.57	5.74	1,217.26	1,223.00	98.93 %
June	5.84	6.10	1,224.91	1,229.00	99.14 %
July	5.74	5.94	1,227.84	1,233.00	99.17 %
August	5.52	5.64	1,167.71	1,171.00	99.29 %
September	4.93	4.87	989.39	996.00	98.75 %
October	3.91	3.73	825.50	835.00	98.81 %
November	2.88	2.64	585.54	604.00	96.46 %
December	2.72	2.40	593.79	627.00	94.54 %
Totals	**53.66**	**53.21**	**11,495.06**	**11,606.00**	**98.37 %**
	Effect: 100.00%	**Effect: 99.24%**			**Unweighted**
	Sun Hrs: 4.47	**Sun Hrs: 4.44**			**Yearly Avg**

Notes: 40 - 230 watt panels

Figure 14 Solar Obstruction Data for Roof Mount (Black Roof Section) – 9.2 kW-DC.

The shading analysis also indicates that a 5.06 kW-DC roof mount system at the same location would generate approximately 6,325 kWh a year (see Figure 15).

Solar Obstruction Data

Month	Ideal Unshaded Solar Radiation Azimuth=180.0 Tilt=43.0 KWH/m^2 /day	Actual Shaded Solar Radiation Azimuth=177.7 Tilt=35.0 KWH/m^2 /day	Actual Shaded AC Energy (KWH) Azimuth=177.70 Tilt=35.00	Actual Unshaded AC Energy (KWH) Azimuth=177.7 Tilt=35.00	PVWatts Unshaded % Actual Site Azimuth=177.7 Tilt=35.00
January	3.28	3.03	415.46	425.00	97.00 %
February	3.96	3.81	459.35	460.00	99.72 %
March	4.36	4.34	549.23	551.00	99.34 %
April	4.96	5.03	590.84	592.00	99.27 %
May	5.57	5.74	669.91	673.00	98.93 %
June	5.84	6.10	673.96	676.00	99.14 %
July	5.74	5.94	674.32	677.00	99.17 %
August	5.52	5.64	641.36	643.00	99.29 %
September	4.93	4.87	544.34	548.00	98.75 %
October	3.91	3.73	455.90	461.00	98.81 %
November	2.88	2.64	322.53	333.00	96.46 %
December	2.72	2.40	327.94	346.00	94.54 %
Totals	**53.66**	**53.21**	**6,325.12**	**6,385.00**	**98.37 %**
	Effect: 100.00%	**Effect: 99.24%**			**Unweighted**
	Sun Hrs: 4.47	**Sun Hrs: 4.44**			**Yearly Avg**

Notes: 22 - 230 watt panels

Figure 15 Solar Obstruction Data for Roof Mount (Black Roof Section) – 5.06 kW-DC.

Roof Mount – White Roof Section

The Pathfinder was placed at four locations on the white roof section and solar window readings collected. It should be noted that the roof has a 7 degree slope to the east and west from its center line (which runs north to south). Figure 16 shows the locations at which Pathfinder readings were collected.

Figure 16 Pathfinder Placement.

Figures 17 and 18 were taken of the proposed location of the roof mounted array.


Figure 17 Looking North.


Figure 18 Looking South.

Figures 19 & 20 depict the Pathfinder image and shading trace for the Pathfinder location numbers 2 and 3, respectively, (as depicted on Figure 16). Taken together the four locations identified on Figure 16 are shaded less than 1% of the time on average for the entire year.

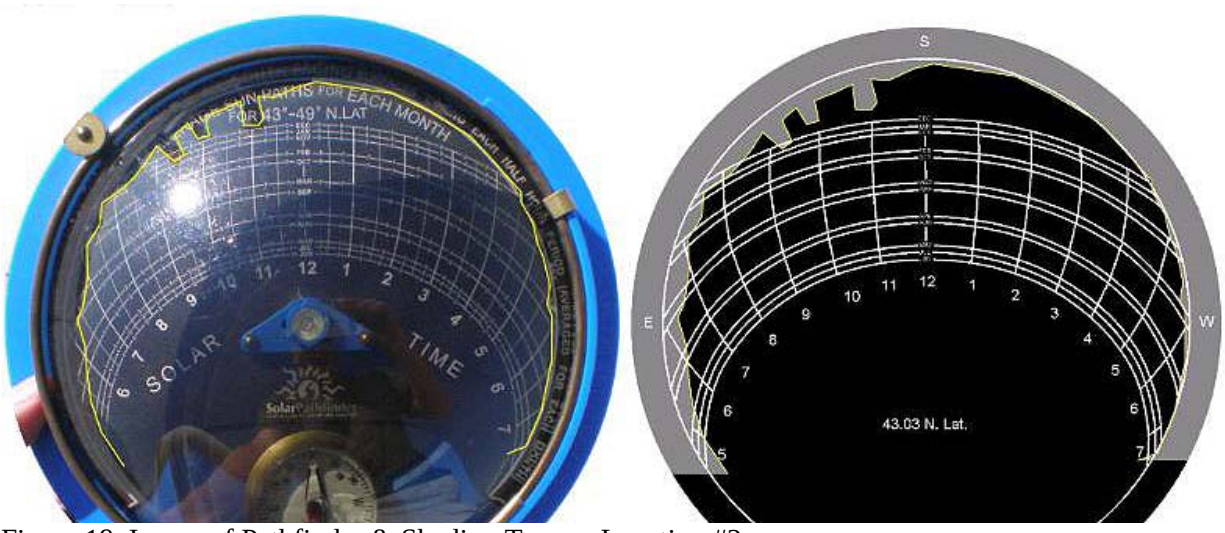

Figure 19 Image of Pathfinder & Shading Trace – Location #2.

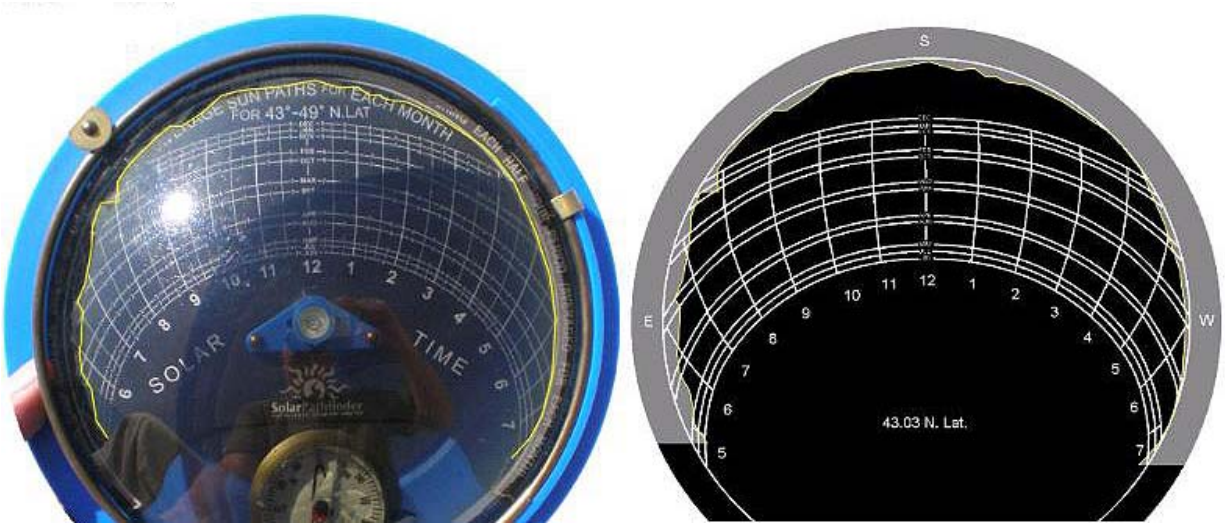

Figure 20 Image of Pathfinder & Shading Trace – Location #3.

Figure 21 presents the shading analysis by averaging the results from the four Pathfinder readings locations. The shading analysis indicates that a 7.36 kW-DC roof mount system on the southeast corner of the building would generate approximately 9,268 kWh a year.

Solar Obstruction Data

Month	Ideal Unshaded Solar Radiation Azimuth=180.0 Tilt=43.03 KWH/m^2 /day	Actual Shaded Solar Radiation Azimuth=177.7 Tilt=35.0 KWH/m^2 /day	Actual Shaded AC Energy (KWH) Azimuth=177.70 Tilt=35.00	Actual Unshaded AC Energy (KWH) Azimuth=177.7 Tilt=35.00	PVWatts Unshaded % Actual Site Azimuth=177.7 Tilt=35.00
January	3.28	3.09	618.96	622.00	99.16 %
February	3.96	3.82	669.27	670.00	99.77 %
March	4.36	4.36	800.50	801.00	99.71 %
April	4.96	5.05	861.67	862.00	99.62 %
May	5.57	5.79	978.00	978.00	99.76 %
June	5.84	6.14	985.00	985.00	99.85 %
July	5.74	5.99	986.00	986.00	99.96 %
August	5.52	5.67	936.89	937.00	99.74 %
September	4.93	4.90	794.71	797.00	99.30 %
October	3.91	3.76	666.75	669.00	99.65 %
November	2.88	2.72	480.58	483.00	99.36 %
December	2.72	2.49	490.57	501.00	97.80 %
Totals	**53.66**	**53.84**	**9,268.88**	**9,291.00**	**99.47 %**
	Effect: 100.00%	**Effect: 99.97%**			**Unweighted**
	Sun Hrs: 4.47	**Sun Hrs: 4.48**			**Yearly Avg**

Notes: 32 - 230 watt panels

Figure 21 Solar Obstruction Data for Roof Mount (White Roof Section) – 7.36 kW-DC.

The above Solar Obstruction Data tables are the output of a computer program developed by the makers of the Solar Pathfinder. It was used to calculate the estimated annual output in kWh/yr that will be produced by a solar PV system at this site. The table incorporates a software tool called PVWatts. PVWatts was developed by the National Renewable Energy Laboratory (NREL) to estimate the energy output of solar systems taking into account such factors as the daily solar radiation (kWh/m^2/day) in the geographic area, the type of mount (fixed or dual axis mounted), the azimuth angle between the direction of the array and due south, the tilt angle of the array, and a de-rating factor which takes into account any electrical losses in the inverter, transformer, AC and DC wiring, PV module mismatch, etc., as well as a small percentage de-rating for soiling, shading, and age of the panels. For this case a de-rate factor of 80% was used to account for the system losses. The Pathfinder computer program also incorporated TMY3 weather data for the United States.

4. System Mounting Recommendations

Roof Mount

There are two main ways to install a roof mount system. One way is to use a racking system that is attached to the structural members of the roof, which would require roof penetrations (see Figure 22 for an example). Many of these racking systems have flashing boots that help eliminate water from leaking through the roof. Advantages of this system include excellent support for wind loading and a bigger area for snow to slide of the modules to kelp them from being covered by snow.

Figure 22 Direct To Roof Mounting System.

The easiest and usually cheapest mounting option is to place the solar panels directly on the roof using a pan and ballast racking system that eliminates the need for roof penetrations (see Figure 23 for example). One possible disadvantage is the lack of room for snow to slide off the modules.

Figure 23 Example Fixed Mounted Pan and Ballast System.

The white roof section has a slope of 7 degrees. This may pose a problem for a pan and ballast mounting system. The pans may creep down slope of the roof via repeated freeze thaw cycles. The racking manufacture should be consulted with regard to this concern.

For all roof-mounted systems, the roof loading from the modules, racks, balance of system, etc., as well as wind and snow loading, must be evaluated to determine if the roof is structurally able to support the additional loads. This is the responsibility of the customer and their structural engineer.

When unshaded and positioned directly south with the proper pitch (30 to 35 degrees), this type of system would be expected to generate about 1230 kWh/year per kilowatt (kW) of modules. The output from the modules would be slightly less then this value if it is determined that the pitch of the PV modules would need to be less than 30-degrees to reduce wind loading. Fix mounted systems have no moving parts and are therefore expected to require very little maintenance

Some of the benefits of a roof-mounted array are:

- Utilizes an out of the way space
- Is generally considered to be less costly to install than a ground-mounted array

- Lowered concern about vandalism for some locations

5. Recommended Solar Electric Layout and Sizing

The layout of the PV modules will be dictated by the size expectations of the array, space availability, inter-row spacing (shading a PV module casts on the module behind it), and shadows cast by HVAC units and vent stacks.

Black Roof Section

The flat black roof section (southern end of building complex) is the best location for the PV arrays. Because of the shadows cast by the vent stacks on the southern third of the roof, and the shadows cast by the trees located on the east side if the building, the largest unobstructed array that can be installed is 9.2 kW. This assumes that the modules are installed in landscape orientation to reduce wind loading and therefore reducing the amount of ballast for pan and ballast systems. A larger array could be installed if the modules are installed in portrait orientation. The array would consist of four rows of 10 modules each located on the northern half of the roof section.

White Roof Section

The white roof section poses some challenges. Because the roof slopes at 7 degrees to the east and west, it would not be possible to have a continuous racking system running the entire width of the roof. It would need to be installed in two sections, reducing available roof space. The shadows cast by the vent stacks on the south end of the roof and shadow cast by the radio antenna located neat the northeast section of the roof further reduces the available roof area. As a result, the largest unobstructed array that could be installed on the roof is 7.36 kW. The array would consist of four rows of four modules on each roof half (east and west) located on the center section of the roof. As noted earlier in this report, the slope of the roof could be a problem for a pan and ballast system. The pans may creep down slope of the roof via repeated freeze thaw cycles. The racking manufacture should be consulted with regard to this concern.

Assuming the PV modules are 68-inches by 40-inches in size and installed in landscape orientation (long axis parallel to roof surface) and at a pitch of 35 degrees, each successive row of modules will need to be at least 9-feet apart (measured from the front of the module in the first row to the front of the module in the second and third row). This assumes the worst case sun angle on December 21st at 9:00 AM and 3:00 PM.

The distance from the electrical service in the building to the northeast end of the proposed array on the black roof is approximately 100 feet, and 40 feet from the northeast end of the proposed array on the white roof section.

6. Solar Electric Systems Costs and Incentives

The typical installed price of a grid-tied solar system is $7.00 to $9.00 per watt. Larger systems will tend to be toward the lower end of the range; smaller systems usually cost more $/watt because the cost of additional modules is not as big a factor compared with the labor and materials that go into the initial installation of the PV system. In addition, longer distances for electrical cable to reach the inverters will also increase the cost. A cost of $7,500 per kW was assumed for the 5.06 kW-DC and $8,000 per kW for the 9.2 kW roof mounted system, with the total cost of your system, before incentives, estimated to be $37,950 and $64,400, respectively.

6.1 Incentives

a. Focus on Energy Renewable Program

Focus on Energy provides a performance-based buy-down incentive program for solar photovoltaic systems based on there size and energy efficiency of the building on which they are installed. Beginning in February 2010 Focus on Energy introduced a two tiered incentive structure designed to encourage customers to achieve a level of energy efficiency in their home or business before installing PV renewable energy systems.

Cash Back Rewards for DC rated module capacity between 0.5 kW-DC and 50 kW-DC

Tier I incentives will be available to all customers; Tier II incentives will be available to those customers who met a prescribed level of efficiency first (this will be achieved either through past participation in specified Focus on Energy program or by achieving an energy usage benchmark set by the program).

Tier I non-profit and local government customer incentives will be $1.50 per kWh generated over an average year for systems of 0.5 kW to 50 kW. Customers who do energy efficiency first (Tier II), as defined by Focus on Energy, will be eligible for an incentive level of $1.75 per kWh. The incentive caps at $75,000, not to exceed 35% of installed cost. The actual amount of the incentive is determined by Focus on Energy when the application for a Cash Back Reward is submitted. Upon approval, you will have one year to install the system and receive the installation incentive. The system must be installed by a NABCEP certified PV installer, or an installer listed as pursuing NABCEP certification, to qualify for a Focus on Energy Reward.

To receive the Tier II incentive, the job site of the renewable energy system must fully satisfy the requirements of one of the efficiency tracks listed on page 4 of the *Solar Electric (Photovoltaic) System Pre-Approval Incentive Application for Business* which is attached to this site assessment report.

For additional details about these programs go to the Focus on Energy web site www.focusonenergy.com and follow the links for renewable energy incentives.

b. Madison Gas & Electric (MG&E)

Customer-generators enrolled in the Madison Gas & Electric (MGE) green power purchase program -- Green Power Tomorrow -- are eligible to receive a special rate for the power produced from solar photovoltaic (PV) systems. Under this program, the electricity produced from 1 to 10 kilowatt (kW-DC) PV systems will be purchased by MGE at a rate of $0.25/kilowatt-hour (kWh). This rate will apply to all electricity produced by the system. As the program is limited to Green Power Tomorrow participants, customers will purchase electricity from the utility at the normal retail rate plus the green power premium (currently $0.0125/kWh).

Annual green energy purchases must be at least as large as the AC output of the PV system. This arrangement requires that the customer have two electricity meters; one to measure electricity production and one to measure electricity consumption. MGE will provide the additional meter but the customer must pay for an electrician to supply and install a two-meter socket and any other modifications necessary for system function.

Participants must sign a 10-year contract with MGE but may opt-out with 30 days notice. Systems must be designed and installed to comply with Wisconsin interconnection standards. Any renewable energy credits (RECs), emission allowances, or other environmental attributes generated by the system while the contract is in force will accrue to MGE rather than the customer-generator. The overall enrollment for this program is capped at 1,000 kW. More information can be found at http://www.mge.com/home/rates/cleanpower.htm

c. State Taxes

Wisconsin's depreciation is based on the Federal depreciation formula. So the Federal five-year accelerated depreciation applies to Wisconsin business income taxes as well. Consult a qualified tax adviser to determine your individual eligibility.

d. Net Metering

Wisconsin municipal and investor-owned utilities are required to allow customers to net-meter solar electric systems with rated output of 20kW or less. What this means is that the utility will provide full retail credit for any extra energy that is sent out by the customer's solar electric system onto the utility grid. Net metering can be done using any electric rate provided for which the customer is eligible (including time of day rates).

e. Property Tax Exemption

Solar electric systems are exempt from Wisconsin property tax assessments making solar an investment you can make on your property without increasing the assessed value and tax liability.

f. Renewable Energy Credits (RECS)
In some states markets are buying and selling Renewable Energy Credits (RECs) also known as green tags. The RECs represent the clean energy attributes of renewable electric systems (not the kilowatt hours). It is likely that during the life of a large commercial solar electric system the owner will be able to sell RECs in Wisconsin for additional income. MG&E will own the RECs for ten years.

6.2 Demand Benefits

Reduced demand loads and charges can occur if the site's peak demand occurs during periods of solar electric system output.

- For sites with a peak electrical demand between 10 am and 2 pm on sunny business days: Demand reduction benefits could equal up to 60% of the solar electric system's rated dc capacity
- For sites with a peak electrical demand that occurs before 8 am or after 4 pm: Demand reductions would be expected to be minimal
- While a PV system will likely reduce Demand Charges, the method MG&E uses for determining demand charges may not factor for this reduction. Additional investigation may be required.

6.3 System Cost after Incentives

The following table shows the cost of the roof mounted 5.06 kW-DC and 9.66 kW-DC solar PV systems after all of the incentives[2]. It is assumed that the building would **not** qualify for Focus on Energy's Tier II cash back program. The Tier I level of $1.50 per kWh was used. Focus on Energy also requires that the estimated production be reduced by 1% for snow cover for modules tilted at 35 degrees, which is reflected in the tables.

Energy Production, Cost, Economics and Environment Dane County Highway Garage– Roof Mount		
Production	*Roof Mount*	
Solar electric systems rated module capacity (kW dc)	5.06 kW-DC	9.2 kW-DC
Estimated output year one (kWh/yr)	6,257	11,376
Cost		
Estimated installed cost	$37,950	$64,400
Focus On Energy Incentive*	$ 9,385	$17,064
System Cost after all incentives	**$28,565**	**$47,336**
Value of year 1 to year 10 power production	$15,295	$27,808

[2] The incentives in the table do not include any adjustments that may be made by Focus on Energy.

Economics		
10 Year discounted NPV	-$19,539	-$30,657
25 Year discounted NPV	-$ 8,864	-$10,873
10 Year IRR	-12.8%	-11.3%
25 Year IRR	1.4%	2.2%
Simple Payback Period	23 years	21 Years
Environment		
CO2 emission reduction per year (tons/year)	6.9	12.6
Key Assumptions		
Cost of System Per kW (dc)	$ 7,500	$ 7,000
Meets Focus on Energy Tier II Efficiency Level	$1.50/kWh	$1.50/kWh
Electricity Rate Year One ($/kWh)	$ 0.12	$ 0.12
MG&E Solar Electric Buyback Rate**	$0.25	$0.25
Estimated electricity price inflation rate (%/yr)	6.0%	6.0%
Expected output degradation (%/year)	0.50%	0.50%
Discount rate (used only in NPV)	3.0%	3.0%

***Installer must be certified by the North American Board of Certified Energy Practitioners (NABCEP) or those working towards certification.**

****Does not include cost to enter Green Power Tomorrow Program**

Based on these calculations, the payback time for the roof mounted system is 23 years for the 5.06 kW-DC and 21 years for the 9.2 kW-DC system. The payback times are based on a 6% per year fuel escalation rate. This means if the electricity rates increase by greater then 6% per year over the next 20 years, the payback time will be less. Most people believe that the utility's electricity rates will most likely be on the rise. However, predicting future energy costs is not within the scope of this report. Once the payback period is reached, the owner will be producing free electricity for the remaining 15 to 20 or so years left in the life of the PV system.

7. Operation and Maintenance

Operation and maintenance needs will be minimal with a fixed mounted systems. Expect to pay approximately 0.25% of the total cost of the system per year for maintenance and approximately 0.4% for insurance. Operation and maintenance costs of 0.25% were used in the payback calculations while insurance costs were not.

8. Summary

Under present site conditions, the Highway Garage building site is an excellent site for a solar PV system. A roof mount system can accommodate a 9.2 kW-DC kW system that is estimated to generate 11,376 kWh/year. The estimate cost to install the systems after Focus on Energy Cash Back Rewards is taken into consideration is $47,336, with a pay back time of 21 years. A smaller 5.06 kW-DC system would generate an estimated 6,257 kWh/yr at an installed price of $28,565 after incentives, with a payback time of 23 years.

The electrical rate used was $0.12 kWh, MG&E solar electric buyback rate of $0.25 kWh, and the Focus on Energy incentive efficiency level was $1.50/kWh.

9. Education Resources

- Focus on Energy web site (www.focusonenergy.org) for information on Renewable Energy.
- For more information on state incentives for renewable energy - www.dsireusa.org
- Home Power Magazine/Website (www.homepower.com) – Case studies and stories of renewable energy installations around the country.
- Midwest Renewable Energy Association (www.the-mrea.org) – Hands-on workshops in Wind, PV, Solar Hot water, and more.
- Consumer Guide to Buying a Solar Electric System www.nrel.gov/docs/fy04osti/35297.pdf http://www.homepower.com/files/beginner/SolarElectricBasics.pdf
- The We Energies renewable energy programs, contact: We Energies Customer Contact Center at 800-714-7777, ext. 7700 or www.we-energies.com/re
- Energy Star for information on appliance energy ratings (http://www.energystar.gov)

10. Other Information

Attachment	Description
1	Solar Electric System Terminology Definitions.
2	Full service solar electric installer list.
3	Solar Electric System Pre-Approval Incentive Application for Business

Attachment 1
Solar Electric System Terminology Definitions

Solar Electric System Definitions

Based largely on the Solar Electric Glossary from Sandia National Labs

Alternating Current (ac) An electric current that reverses direction periodically.

Direct Current (dc) Electric current flowing in only one direction.

Fixed Tilt Array A solar electric array set in at a fixed angle with respect to horizontal.

Grid Term used to describe an electrical utility distribution network.

Inverter In a solar electric system, an inverter converts dc power from the solar electric array to ac power compatible with the utility and ac loads.

Kilowatt (kw) One thousand watts. A unit of power.

Kilowatt Hour (kwh) One thousand watt-hours. A unit of energy. Power multiplied by time equals energy.

Module The smallest replaceable unit in a solar electric array. An integral, encapsulated unit containing a number of PV cells.

Net Energy Billing a billing and metering practice under which a customer is billed on the basis of net energy over the billing period taking into account accumulated unused kilowatt-hour credits from the previous billing period.

Orientation Placement with respect to the cardinal directions, N, S, E, W; azimuth is the measure of orientation from north.

Panel A designation for a number of solar electric modules assembled in a single mechanical frame.

Peak Load The maximum load demand on a system.

Photovoltaic Cell The treated semiconductor material that converts solar irradiance to electricity.

Photovoltaic System (or Solar Electric System) An installation of solar electric modules and other components designed to produce power from sunlight and meet the power demand for a designated load.

Power (Watts) A basic unit of electricity equal (in dc circuits) to the product of current and voltage.

Tilt Angle The angle of inclination of a solar collector measured from the horizontal.

Tracking Array A solar electric array that follows the path of the sun. This can mean one-axis, east to west daily tracking, or two-axis tracking where the array follows the sun in azimuth and elevation.

Watt (W) The unit of electrical power. The power developed when a current of one ampere flows through a potential difference of one volt; 1/746 of a horsepower.

Watt Hour (Wh) A unit of energy equal to one watt of power connected

SOLAR ELECTRIC SITE ASSESSMENT REPORT

Dane County Job Center

c/o

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Date of Site Visit:
October 11, 2010

Date Final Report completed:
October 28, 2010

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

Executive Summary

The results of the photovoltaic (PV) solar site assessment indicate that the Dane County Department of Public Works Job Center site is an excellent site for the installation of a solar PV system. The best location to install PV modules for the anticipated array size is a roof mounted array located near the southeast corner of the building. There are shading issues at this location related to HVAC units and vent stacks, but space is available for the anticipate array sizes. The following table summarizes the results of the site assessment using 22 solar panels (230 watts each) and 42 roof mounted solar panels:

Energy Production, Cost, Economics and Environment Dane County Job Center– Roof Mount		
Production	*Ground Mount*	
Solar electric systems rated module capacity (kW dc)	5.06 kW-DC	9.66 kW-DC
Estimated output year one (kWh/yr)	6,262	11,954
Cost		
Estimated installed cost	$37,950	$67,620
Focus On Energy Incentive*	$ 9,393	$17,917
System Cost after all incentives	**$28,557**	**$49,703**
Value of year 1 to year 10 power production	$15,307	$29,199
Economics		
10 Year discounted NPV	-$17,624	-$28,734
25 Year discounted NPV	-$5,272	-$4,996
10 Year IRR	-10.9%	-9.9%
25 Year IRR	1.7%	2.5%
Simple Payback Period	22 years	20 Years
Environment		
CO2 emission reduction per year (tons/year)	6.9	13.2
Key Assumptions		
Cost of System Per kW (dc)	$ 7,500	$ 7,000
Focus on Energy Tier I Efficiency Level	$1.50/kWh	$1.50/kWh
Electricity Rate Year One ($/kWh)	$ 0.10	$ 0.10
MG&E Solar Electric Buyback Rate**	$0.25	$0.25
Estimated electricity price inflation rate (%/yr)	6.0%	6.0%
Expected output degradation (%/year)	0.50%	0.50%
Discount rate (used only in NPV)	3.0%	3.0%

***Installer must be certified by the North American Board of Certified Energy Practitioners (NABCEP) or those working towards certification.**

****Does not include cost to enter Green Power Tomorrow Program**

An area of approximately 120 feet by 25 feet is reasonably available for the installation of a roof mounted array near the southeast corner of the building. Other portions of the roof are also large enough for the installation of the anticipated array size, but the southeast corner is nearest to the electrical service. In order to install a 10 kW array, the PV modules will need to be installed in either landscape orientation in three rows or in portrait orientation in two rows. Landscape orientation would result in less wind loading. Three rows of 14 modules each could be installed in the given space available. Using 230-watt modules, the 42 modules would compose a 9.66 kW array. Dane County is considering using a pan and ballast mounting system. Because this could place the bottom of the modules close to the roof surface, significant snow events could result in the modules being covered for an extended period, especially since the white roof will slow down the melting of the snow.

Next Steps

a) Evaluate the options presented in this report, and make a decision on system size, location and mounting methods.

b) Engineering reviews maybe needed.

- For roof mounted systems, confirm with the building designer and/or qualified structural engineer as to the building roof structure's ability to support the additional weight and wind loading of a solar electric system. Also, review the impact on roofing warrantee of siting panels over roofing.
- With an electrical professional, ensure space is available for balance of system components (e.g., inverter(s) disconnects, etc.) in the utility room, and at that space is available at electric panel/substation, with good access to the solar modules.

c) Determine the project's economics with your financial professionals. Incentive programs are subject to change, so ensure you information is up to date. For information regarding:

- Focus on Energy incentives, contact: www.focusonenergy.com or 800 762.7077.
- Federal tax incentives, contact: the IRS.
- U.S. Department of Agriculture rural business incentives, contact: www.farmenergy.org or in Wisconsin, Mark Brodziski at 715.345.7615, or mark.brodziski@wi.usda.gov

d) Contact at least three qualified installers to get price quotes (see Focus on Energy's full service solar electric installers attached to this report for a directory of Wisconsin's solar electric installers).

- It is recommended that the installer completes interconnection applications, obtains permits and fills out Focus on Energy incentive paperwork.

- Ensure that price quotes are comparable (e.g., all include any work that may be needed on the AC side of the inverter to be eligible for We Energies or Madison Gas and Electric buy back rates incentives).

e) Contact your insurance agent and advise them of your intent to install the renewable energy system, and ask for written confirmation of the liability coverage currently provided (as needed to meet utility requirements). Confirm that current insurance provides the needed coverage, and resolve any issues with the agent.

f) Define any permitting requirements for the installation of the system.
g) Based on the quote received, and consultation with financial professionals, make the final decisions on the project's size, location, mounting options and price with your preferred installer.

h) Apply and receive approval for incentives as appropriate. Commonly your preferred installer will assist with the applications.

i) Sign the installation contract with your selected installation firm.
- Insure that all zoning, utility agreements, financial incentive and any other required approvals are in hand prior to making any commitment to purchase.

j) It is usually much more cost effective to make energy efficiency improvements than install a solar electric system. For information about the Focus on Energy business energy efficiency program contact: Focusonenergy.com or 800.762.7077

Insure that all utility agreements, financial incentives, and any other required approvals/permits are in hand prior to making any commitment to purchase.

Disclaimers:

- All costs, power production, economic and other values in this report are estimates.
- The economic analysis presented in this report should be considered one method of evaluating this project.
- The estimated installed system cost(s) are/is not a formal estimate or bid.
- The information provided in this report should NOT be considered legal, financial, or tax advice.

October 28, 2010

Matthew R Giovanelli

Date

REPORT CONTENTS

1. Purpose of Site Assessment

The purpose of this assessment is to provide site-specific information on how a solar electric (also referred to as a photovoltaic, or PV) system would perform at your location, including information on estimated physical size, rated output, energy production, costs, financial incentives and mounting options. Site assessors are required to present unbiased information and may not recommend contractors or products.

Dane County Department of Public Works is interested in:

- Clean energy/environmental concerns
- Reducing energy bills: maximizing system production and minimizing cost
- Possible Educational/Demonstration project
- Public relations: system should be publicized as a green investment

Dane County's solar electric system size expectations for the Job Center are between 5 and 10 kW.[1]

2. Site's Electric Data

Electrical Service**:** The building complex has 120/208 volt 3 phase 4 wire service. The electrical service is located on the south wall of the building near the southeast corner of the building. See Figures 1 through 3.

Figure 1 Electrical Subpanels (inside)


Figure 2 Electrical Subpanels (inside)

[1] In Southeastern Wisconsin, a one kilowatt (kW) solar electric system, that is unshaded and fix mounted, will generate about 1230 kilowatt hours (kWh) per year. A one kW unshaded dual axis tracking system will generate about 1640 kWh/year.

Figure 3 Electrical Service (outside)

Dane County provided energy usage for the Jobs Center building over the past 22 months:

Average Annual:	992,463 kWh
On Peak:	407,363 kWh
Average per month:	82,705 kWh
Site's Electric Utility:	MG&E
Annual Electricity Bill:	**$99,950**
Average Rate ($/kWh)	
blended on and off peak:	**$0.10 kWh**

3. Siting Options

The Dane County Job Center Building site is located at 1819 Aberg Avenue in the City of Madison, Wisconsin 53704. Dane County prefers that the PV array be installed as a roof mount system. Because of the large amount of paved parking and property lines near the building, roof mounting is the only reasonable option. See Figure 4 for an aerial view of the site.

Figure 4 Aerial View Looking North (Photo Does Not Show Recent Changes in HVAC Locations and the Addition of a White Roof Membrane)

3.1 Shading Estimates

The location of the roof mounted PV modules on the southeast corner of the site will need to take into consideration potential shading of the panels. Since PV modules can last from 30 to 40 years, system placement should consider shading by tree growth, adjacent buildings, and roof mounted HVAC units and vent stacks.

A device called the Solar Pathfinder is used to determine if there are any shading issues that would block the PV modules from receiving sun light. The Pathfinder shows the solar window for a given PV array system, for all months of the year, by transferring the shading of the surrounding obstructions (usually trees or buildings) onto an easy-to-read flat display. From this display, the percentage of shading for each month of the year can be computed; and from that, the reduction in energy output from the PV system due to this shading can be calculated.

Roof Mount - Southeastern Section of Roof

The Pathfinder was placed at three locations on the roof and solar window readings collected. Figure 5 shows the locations at which Pathfinder readings were collected.

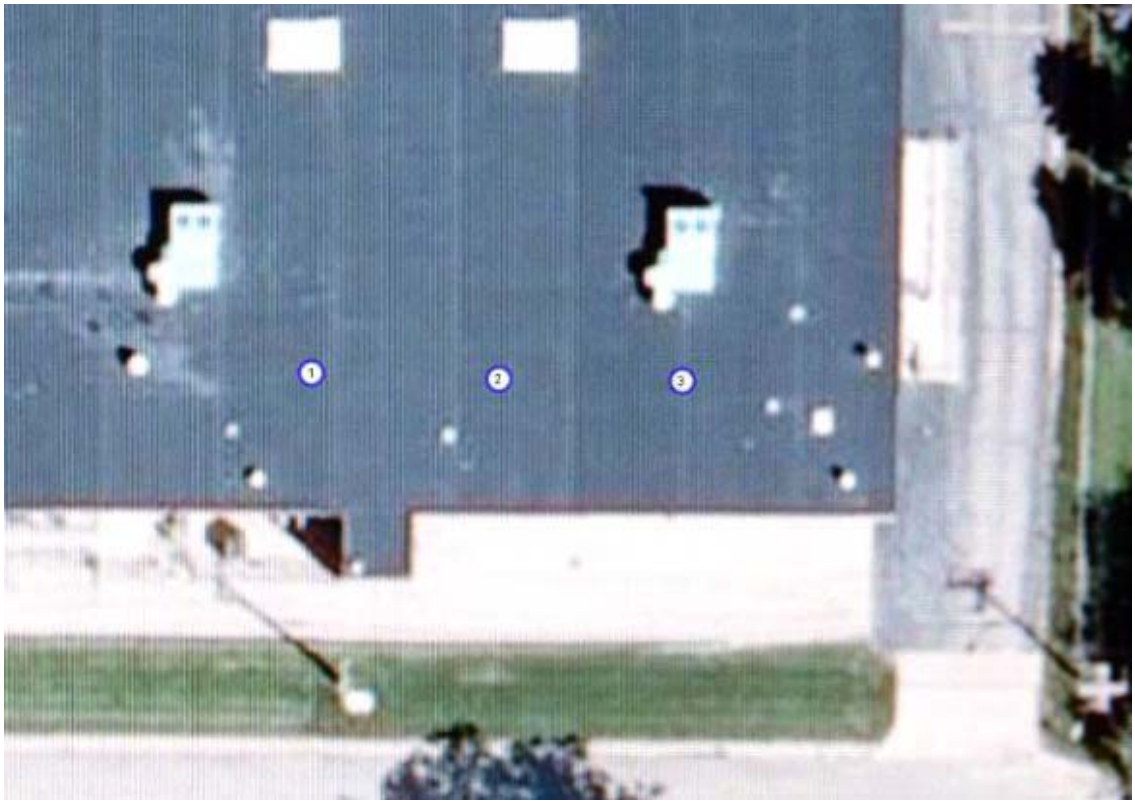

Figure 5 Pathfinder Placement.

Figures 6 through 13 were taken of the proposed location of the roof mounted array.


Figure 6 Looking West From SE Corner.


Figure 7 Looking Northwest From SE Corner.

Figure 8 Looking North From SE Corner.

Figure 9 Looking West From NE Corner.

Figure 10 Looking Southwest From NE Corner.

Figure 11 Looking South From NE Corner.

Figure 12 Looking East From SW Corner.

Figure 13 Looking Northeast From SW Corner.

Figures 14 & 15 depict the Pathfinder image and shading trace for the Pathfinder location numbers 1 and 3, respectively, (as depicted on Figure 5). Taken together the three locations identified on Figure 5 are shaded less than 1% of the time on average for the entire year.

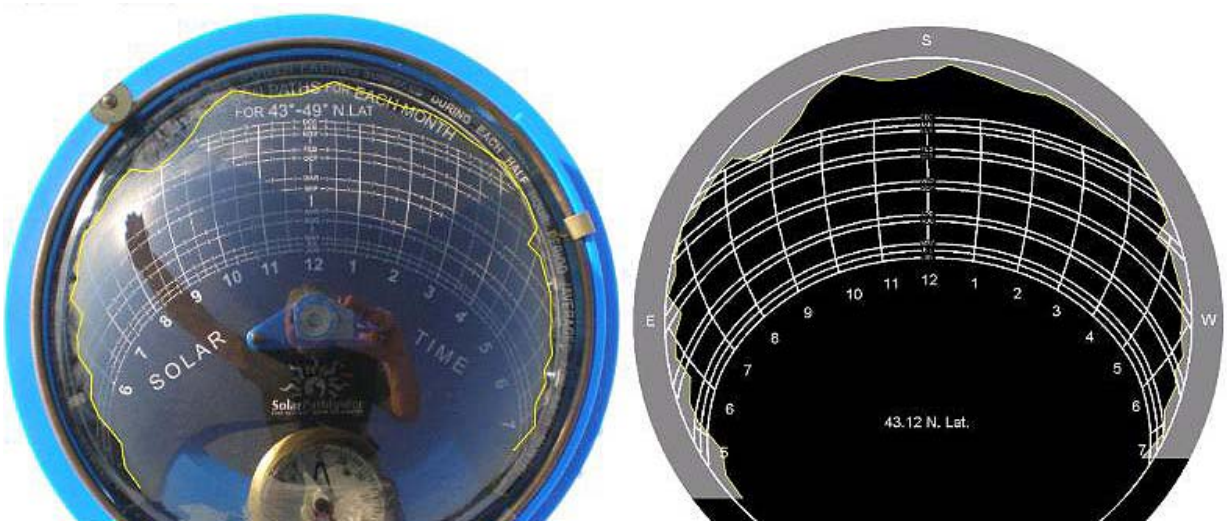

Figure 14 Image of Pathfinder & Shading Trace – Location #1.

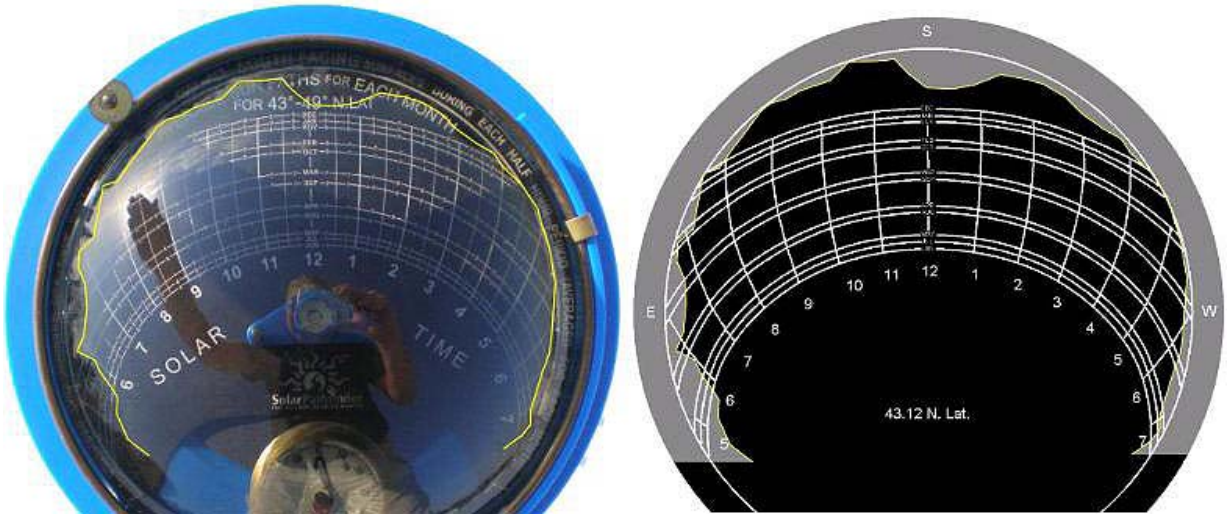

Figure 15 Image of Pathfinder & Shading Trace – Location #3.

Figure 16 presents the shading analysis by averaging the results from the three Pathfinder readings locations. The shading analysis indicates that a 5.06 kW-DC roof mount system on the southeast corner of the building would generate approximately 6,373 kWh a year.

Solar Obstruction Data

Month	Ideal Unshaded Solar Radiation Azimuth=180.0 Tilt=43.12 KWH/m^2 /day	Actual Shaded Solar Radiation Azimuth=177.7 Tilt=35.0 KWH/m^2 /day	Actual Shaded AC Energy (KWH) Azimuth=177.70 Tilt=35.00	Actual Unshaded AC Energy (KWH) Azimuth=177.7 Tilt=35.00	PVWatts Unshaded % Actual Site Azimuth=177.7 Tilt=35.00
January	3.28	3.11	425.00	425.00	99.64 %
February	3.96	3.80	458.66	460.00	99.55 %
March	4.36	4.36	550.73	551.00	99.82 %
April	4.96	5.05	592.00	592.00	99.67 %
May	5.57	5.77	673.00	673.00	99.49 %
June	5.83	6.12	676.00	676.00	99.51 %
July	5.74	5.98	677.00	677.00	99.76 %
August	5.51	5.66	643.00	643.00	99.67 %
September	4.93	4.89	545.98	548.00	99.12 %
October	3.91	3.76	460.61	461.00	99.83 %
November	2.88	2.73	332.00	333.00	99.58 %
December	2.73	2.49	339.73	346.00	98.13 %
Totals	**53.65**	**53.74**	**6,373.72**	**6,385.00**	**99.48 %**
	Effect: 100.00%	**Effect: 100.00%**			**Unweighted**
	Sun Hrs: 4.47	**Sun Hrs: 4.48**			**Yearly Avg**

Notes: 22 - 230 watt Modules

Figure 16 Solar Obstruction Data for Roof Mount (Southeast Corner of Building) – 5.06 kW-DC.

The shading analysis also indicates that a 9.66 kW-DC roof mount system at the same location (encompassing three rows of modules) on the southeast corner of the building would generate approximately 12,171 kWh a year (see Figure 17).

Solar Obstruction Data

Month	Ideal Unshaded Solar Radiation Azimuth=180.0 Tilt=43.12 KWH/m^2 /day	Actual Shaded Solar Radiation Azimuth=177.7 Tilt=35.0 KWH/m^2 /day	Actual Shaded AC Energy (KWH) Azimuth=177.70 Tilt=35.00	Actual Unshaded AC Energy (KWH) Azimuth=177.7 Tilt=35.00	PVWatts Unshaded % Actual Site Azimuth=177.7 Tilt=35.00
January	3.28	3.11	815.57	816.00	99.64 %
February	3.96	3.80	876.43	879.00	99.55 %
March	4.36	4.36	1,052.60	1,053.00	99.82 %
April	4.96	5.05	1,130.00	1,130.00	99.67 %
May	5.57	5.77	1,286.00	1,286.00	99.49 %
June	5.83	6.12	1,289.67	1,290.00	99.51 %
July	5.74	5.98	1,294.00	1,294.00	99.76 %
August	5.51	5.66	1,230.00	1,230.00	99.67 %
September	4.93	4.89	1,041.37	1,045.00	99.12 %
October	3.91	3.76	876.31	877.00	99.83 %
November	2.88	2.73	633.17	635.00	99.58 %
December	2.73	2.49	646.73	659.00	98.13 %
Totals	**53.65**	**53.74**	**12,171.84**	**12,194.00**	**99.48 %**
	Effect: 100.00%	**Effect: 100.00%**			**Unweighted**
	Sun Hrs: 4.47	**Sun Hrs: 4.48**			**Yearly Avg**

Notes: 42 - 230 watt Modules

Figure 17 Solar Obstruction Data for Roof Mount (Southeast Corner of Building) – 9.66 kW-DC.

The above Solar Obstruction Data tables are the output of a computer program developed by the makers of the Solar Pathfinder. It was used to calculate the estimated annual output in kWh/yr that will be produced by a solar PV system at this site. The table incorporates a software tool called PVWatts. PVWatts was developed by the National Renewable Energy Laboratory (NREL) to estimate the energy output of solar systems taking into account such factors as the daily solar radiation (kWh/m^2/day) in the geographic area, the type of mount (fixed or dual axis mounted), the azimuth angle between the direction of the array and due south, the tilt angle of the array, and a de-rating factor which takes into account any electrical losses in the inverter, transformer, AC and DC wiring, PV module mismatch, etc., as well as a small percentage de-rating for soiling, shading, and age of the panels. For this case a de-rate factor of 80% was used to account for the system losses. The Pathfinder computer program also incorporated TMY3 weather data for the United States.

4. System Mounting Recommendations

Roof Mount

There are two main ways to install a roof mount system. One way is to use a racking system that is attached to the structural members of the roof, which would require roof penetrations (see Figure 18 for an example). Many of these racking systems have flashing boots that help eliminate water from leaking through the roof. Advantages of this system include excellent support for wind loading and a bigger area for snow to slide of the modules to kelp them from being covered by snow.

Figure 18 Direct To Roof Mounting System.

The easiest and usually cheapest mounting option is to place the solar panels directly on the roof using a pan and ballast racking system that eliminates the need for roof penetrations (see Figure 19 for example). One disadvantage with some of these systems is the lack of room for snow to slide off the modules.

Figure 19 Example Fixed Mounted Pan and Ballast System.

For all roof-mounted systems, the roof loading from the modules, racks, balance of system, etc., as well as wind and snow loading, must be evaluated to determine if the roof is structurally able to support the additional loads. This is the responsibility of the customer and their structural engineer.

When unshaded and positioned directly south with the proper pitch (30 to 35 degrees), this type of system would be expected to generate about 1230 kWh/year per kilowatt (kW) of modules. The output from the modules would be slightly less then this value if it is determined that the pitch of the PV modules would need to be less than 30-degrees to reduce wind loading. Fix mounted systems have no moving parts and are therefore expected to require very little maintenance

Some of the benefits of a roof-mounted array are:

- Utilizes an out of the way space
- Is generally considered to be less costly to install than a ground-mounted array
- Lowered concern about vandalism for some locations

5. Recommended Solar Electric Layout and Sizing

The layout of the PV modules will be dictated by the size expectations of the array, space availability, inter-row spacing (shading a PV module casts on the module behind it), and shadows cast by HVAC units and vent stacks. In order to achieve an array close to the desired 10 kW size, the PV modules can either be installed in two rows in portrait orientation or in three rows in landscape orientation. The second and third rows of modules (north of the first row) will need to be placed far enough away so the first row does not shade the succeeding rows. Modules mounted in landscape orientation generate less wind loading.

Assuming the PV modules are 68-inches by 40-inches in size and installed in landscape orientation (long axis parallel to roof surface) and at a pitch of 35 degrees, each successive row of modules will need to be at least 9-feet apart (measured from the front of the module in the first row to the front of the module in the second and third row). This assumes the worst case sun angle on December 21st at 9:00 AM and 3:00 PM. Given the location of the HVAC units and vent stacks, there is room to install three rows of modules in landscape orientation. Only two rows of modules would be possible in portrait orientation.

The distance from the electrical service in the building to the west end of the proposed array location is approximately 30 feet.

6. Solar Electric Systems Costs and Incentives

The typical installed price of a grid-tied solar system is $7.00 to $8.00 per watt. Larger systems will tend to be toward the lower end of the range; smaller systems usually cost more $/watt because the cost of additional modules is not as big a factor compared with the labor and materials that go into the initial installation of the PV system. In addition, longer distances for electrical cable to reach the inverters will also increase the cost. A cost of $7,500 per kW was assumed for the 5.06 kW-DC and $7,000 per kW for the 9.66 kW ground mounted system, with the total cost of your system, before incentives, estimated to be $37,950 and $67,620, respectively.

6.1 Incentives

a. Focus on Energy Renewable Program

Focus on Energy provides a performance-based buy-down incentive program for solar photovoltaic systems based on there size and energy efficiency of the building on which they are installed. Beginning in February 2010 Focus on Energy introduced a two tiered incentive structure designed to encourage customers to achieve a level of energy efficiency in their home or business before installing PV renewable energy systems.

Cash Back Rewards for DC rated module capacity between 0.5 kW-DC and 50 kW-DC

Tier I incentives will be available to all customers; Tier II incentives will be available to those customers who met a prescribed level of efficiency first (this will be achieved either through past participation in specified Focus on Energy program or by achieving an energy usage benchmark set by the program).

Tier I non-profit and local government customer incentives will be $1.50 per kWh generated over an average year for systems of 0.5 kW to 50 kW. Customers who do energy efficiency first (Tier II), as defined by Focus on Energy, will be eligible for an incentive level of $1.75 per kWh. The incentive caps at $75,000, not to exceed 35% of installed cost. The actual amount of the incentive is determined by Focus on Energy when the application for a Cash Back Reward is submitted. Upon approval, you will have one year to install the system and receive the installation incentive. The system must be installed by a NABCEP certified PV installer, or an installer listed as pursuing NABCEP certification, to qualify for a Focus on Energy Reward.

To receive the Tier II incentive, the job site of the renewable energy system must fully satisfy the requirements of one of the efficiency tracks listed on page 4 of the *Solar Electric (Photovoltaic) System Pre-Approval Incentive Application for Business* which is attached to this site assessment report.

For additional details about these programs go to the Focus on Energy web site www.focusonenergy.com and follow the links for renewable energy incentives.

b. Madison Gas & Electric (MG&E)

Customer-generators enrolled in the Madison Gas & Electric (MGE) green power purchase program -- Green Power Tomorrow -- are eligible to receive a special rate for the power produced from solar photovoltaic (PV) systems. Under this program, the electricity produced from 1 to 10 kilowatt (kW-DC) PV systems will be purchased by MGE at a rate of $0.25/kilowatt-hour (kWh). This rate will apply to all electricity produced by the system. As the program is limited to Green Power Tomorrow participants, customers will purchase electricity from the utility at the normal retail rate plus the green power premium (currently $0.0125/kWh).

Annual green energy purchases must be at least as large as the AC output of the PV system. This arrangement requires that the customer have two electricity meters; one to measure electricity production and one to measure electricity consumption. MGE will provide the additional meter but the customer must pay for an electrician to supply and install a two-meter socket and any other modifications necessary for system function.

Participants must sign a 10-year contract with MGE but may opt-out with 30 days notice. Systems must be designed and installed to comply with Wisconsin

interconnection standards. Any renewable energy credits (RECs), emission allowances, or other environmental attributes generated by the system while the contract is in force will accrue to MGE rather than the customer-generator. The overall enrollment for this program is capped at 1,000 kW. More information can be found at http://www.mge.com/home/rates/cleanpower.htm

c. State Taxes
Wisconsin's depreciation is based on the Federal depreciation formula. So the Federal five-year accelerated depreciation applies to Wisconsin business income taxes as well. Consult a qualified tax adviser to determine your individual eligibility.

d. Net Metering
Wisconsin municipal and investor-owned utilities are required to allow customers to net-meter solar electric systems with rated output of 20kW or less. What this means is that the utility will provide full retail credit for any extra energy that is sent out by the customer's solar electric system onto the utility grid. Net metering can be done using any electric rate provided for which the customer is eligible (including time of day rates).

e. Property Tax Exemption
Solar electric systems are exempt from Wisconsin property tax assessments making solar an investment you can make on your property without increasing the assessed value and tax liability.

f. Renewable Energy Credits (RECS)
In some states markets are buying and selling Renewable Energy Credits (RECs) also known as green tags. The RECs represent the clean energy attributes of renewable electric systems (not the kilowatt hours). It is likely that during the life of a large commercial solar electric system the owner will be able to sell RECs in Wisconsin for additional income. MG&E will own the RECs for ten years.

6.2 Demand Benefits

Reduced demand loads and charges can occur if the site's peak demand occurs during periods of solar electric system output.

- For sites with a peak electrical demand between 10 am and 2 pm on sunny business days: Demand reduction benefits could equal up to 60% of the solar electric system's rated dc capacity
- For sites with a peak electrical demand that occurs before 8 am or after 4 pm: Demand reductions would be expected to be minimal
- While a PV system will likely reduce Demand Charges, the method MG&E uses for determining demand charges may not factor for this reduction. Additional investigation may be required.

6.3 System Cost after Incentives

The following table shows the cost of the roof mounted 5.06 kW-DC and 9.66 kW-DC solar PV systems after all of the incentives[2]. It is assumed that the building would **not** qualify for Focus on Energy's Tier II cash back program. The Tier I level of $1.50 per kWh was used. Focus on Energy also requires that the estimated production be reduced by 1% for snow cover for modules tilted at 35 degrees, which is reflected in the tables.

Energy Production, Cost, Economics and Environment Dane County Job Center– Roof Mount		
Production	*Ground Mount*	
Solar electric systems rated module capacity (kW dc)	5.06 kW-DC	9.66 kW-DC
Estimated output year one (kWh/yr)	6,262	11,954
Cost		
Estimated installed cost	$37,950	$67,620
Focus On Energy Incentive	$ 9,393	$17,917
System Cost after all incentives	**$28,557**	**$49,703**
Value of year 1 to year 10 power production	$15,307	$29,199
Economics		
10 Year discounted NPV	-$17,624	-$28,734
25 Year discounted NPV	-$5,272	-$4,996
10 Year IRR	-10.9%	-9.9%
25 Year IRR	1.7%	2.5%
Simple Payback Period	22 years	20 Years
Environment		
CO2 emission reduction per year (tons/year)	6.9	13.2
Key Assumptions		
Cost of System Per kW (dc)	$ 7,500	$ 7,000
Focus on Energy Tier I Efficiency Level	$1.50/kWh	$1.50/kWh
Electricity Rate Year One ($/kWh)	$ 0.10	$ 0.10
MG&E Solar Electric Buyback Rate	$0.25	$0.25
Estimated electricity price inflation rate (%/yr)	6.0%	6.0%
Expected output degradation (%/year)	0.50%	0.50%
Discount rate (used only in NPV)	3.0%	3.0%

***Installer must be certified by the North American Board of Certified Energy Practitioners (NABCEP) or those working towards certification.**
****Does not include cost to enter Green Power Tomorrow Program**

Based on these calculations, the payback time for the roof mounted system is 22 years for the 5.06 kW-DC and 20 years for the 9.66 kW-DC system. The payback times are based on a 6% per year fuel escalation rate. This means if the electricity

[2] The incentives in the table do not include any adjustments that may be made by Focus on Energy.

rates increase by greater then 6% per year over the next 20 years, the payback time will be less. Most people believe that the utility's electricity rates will most likely be on the rise. However, predicting future energy costs is not within the scope of this report. Once the payback period is reached, the owner will be producing free electricity for the remaining 15 to 20 or so years left in the life of the PV system.

7. Operation and Maintenance

Operation and maintenance needs will be minimal with a fixed mounted systems. Expect to pay approximately 0.25% of the total cost of the system per year for maintenance and approximately 0.4% for insurance. Operation and maintenance costs of 0.25% were used in the payback calculations while insurance costs were not.

8. Summary

Under present site conditions, the Job Center building site is an excellent site for a solar PV system. A roof mount system can accommodate an 9.66 kW-DC kW system that is estimated to generate 11,954 kWh/year. The estimate cost to install the systems after Focus on Energy Cash Back Rewards is taken into consideration is $49,703, with a pay back time of 20 years. A smaller 5.06 kW-DC system would generate an estimated 6,262 kWh/yr at an installed price of $28,557 after incentives, with a payback time of 22 years.

The electrical rate used was $0.10 kWh, MG&E solar electric buyback rate of $0.25 kWh, and the Focus on Energy incentive efficiency level was $1.50/kWh.

9. Education Resources

- Focus on Energy web site (www.focusonenergy.org) for information on Renewable Energy.
- For more information on state incentives for renewable energy - www.dsireusa.org
- Home Power Magazine/Website (www.homepower.com) – Case studies and stories of renewable energy installations around the country.
- Midwest Renewable Energy Association (www.the-mrea.org) – Hands-on workshops in Wind, PV, Solar Hot water, and more.
- Consumer Guide to Buying a Solar Electric System www.nrel.gov/docs/fy04osti/35297.pdf http://www.homepower.com/files/beginner/SolarElectricBasics.pdf
- The We Energies renewable energy programs, contact: We Energies Customer Contact Center at 800-714-7777, ext. 7700 or www.we-energies.com/re
- Energy Star for information on appliance energy ratings (http://www.energystar.gov)

10. Other Information

Attachment	Description
1	Solar Electric System Terminology Definitions.
2	Full service solar electric installer list.
3	Solar Electric System Pre-Approval Incentive Application for Business

Attachment 1
Solar Electric System Terminology Definitions

Solar Electric System Definitions

Based largely on the Solar Electric Glossary from Sandia National Labs

Alternating Current (ac) An electric current that reverses direction periodically.

Direct Current (dc) Electric current flowing in only one direction.

Fixed Tilt Array A solar electric array set in at a fixed angle with respect to horizontal.

Grid Term used to describe an electrical utility distribution network.

Inverter In a solar electric system, an inverter converts dc power from the solar electric array to ac power compatible with the utility and ac loads.

Kilowatt (kw) One thousand watts. A unit of power.

Kilowatt Hour (kwh) One thousand watt-hours. A unit of energy. Power multiplied by time equals energy.

Module The smallest replaceable unit in a solar electric array. An integral, encapsulated unit containing a number of PV cells.

Net Energy Billing a billing and metering practice under which a customer is billed on the basis of net energy over the billing period taking into account accumulated unused kilowatt-hour credits from the previous billing period.

Orientation Placement with respect to the cardinal directions, N, S, E, W; azimuth is the measure of orientation from north.

Panel A designation for a number of solar electric modules assembled in a single mechanical frame.

Peak Load The maximum load demand on a system.

Photovoltaic Cell The treated semiconductor material that converts solar irradiance to electricity.

Photovoltaic System (or Solar Electric System) An installation of solar electric modules and other components designed to produce power from sunlight and meet the power demand for a designated load.

Power (Watts) A basic unit of electricity equal (in dc circuits) to the product of current and voltage.

Tilt Angle The angle of inclination of a solar collector measured from the horizontal.

Tracking Array A solar electric array that follows the path of the sun. This can mean one-axis, east to west daily tracking, or two-axis tracking where the array follows the sun in azimuth and elevation.

Watt (W) The unit of electrical power. The power developed when a current of one ampere flows through a potential difference of one volt; 1/746 of a horsepower.

Watt Hour (Wh) A unit of energy equal to one watt of power connected

SOLAR ELECTRIC SITE ASSESSMENT REPORT

Springfield Corners Highway Garage

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Date of Site Visit:
October 11, 2010

Date Final Report completed:
October 28, 2010

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

Executive Summary

The results of the photovoltaic (PV) solar site assessment indicate that the Dane County Springfield Corners Highway Garage (SCHG) site is an excellent site for the installation of a solar PV system. The best location to install PV modules for the anticipated array size is a ground mounted array located just east of the parking lot located on the east side of the garage building. There are no shading issues at this location but space is limited and the ground surface is not uniformly flat. The following table summarizes the results of the site assessment using 18 solar panels (230 watts each) and 36 ground mounted solar panels:

Energy Production, Cost, Economics and Environment Springfield Corners Highway Garage – Ground Mount		
Production	*Ground Mount*	
Solar electric systems rated module capacity (kW dc)	4.14 kW-DC	8.28 kW-DC
Estimated output year one (kWh/yr)	5,115	10,230
Cost		
Estimated installed cost	$33,120	$62,100
Focus On Energy Incentive*	$ 7,673	$15,345
System Cost after all incentives	**$25,447**	**$46,755**
Value of year 1 to year 10 power production	$12,504	$25,007
Economics		
10 Year discounted NPV	-$16,566	-$28,894
25 Year discounted NPV	-$ 4,489	-$ 4,587
10 Year IRR	-12.1%	-10.9%
25 Year IRR	1.8%	2.5%
Simple Payback Period	22 years	20 Years
Environment		
CO2 emission reduction per year (tons/year)	5.7	11.3
Key Assumptions		
Cost of System Per kW (dc)	$ 8,000	$ 7,500
Meets Focus on Energy Tier II Efficiency Level	$1.50/kWh	$1.50/kWh
Electricity Rate Year One ($/kWh)	$ 0.12	$ 0.12
MG&E Solar Electric Buyback Rate**	$0.25	$0.25
Estimated electricity price inflation rate (%/yr)	6.0%	6.0%
Expected output degradation (%/year)	0.50%	0.50%
Discount rate (used only in NPV)	3.0%	3.0%

***Installer must be certified by the North American Board of Certified Energy Practitioners (NABCEP) or those working towards certification.**

****Does not include cost to enter Green Power Tomorrow Program**

An area of approximately 60 feet by 30 feet is reasonably available for the installation of a ground mounted array. In order to install an array close to 10 kW in size, the PV modules will need to be installed in portrait orientation and in two rows. Two rows of 18 modules each could be installed in the given space available. Using 230-watt modules, two rows of modules would compose an 8.28 kW array. Dane County is considering using concrete slabs to mount the array racking. The second row of modules (north row) may be on ground that slopes down toward the north. This will need to be taken in to account.

Next Steps

a) Evaluate the options presented in this report, and make a decision on system size, location and mounting methods.

b) Engineering reviews maybe needed.

- For roof mounted systems, confirm with the building designer and/or qualified structural engineer as to the building roof structure's ability to support the additional weight and wind loading of a solar electric system. Also, review the impact on roofing warrantee of siting panels over roofing.
- With an electrical professional, ensure space is available for balance of system components (e.g., inverter(s) disconnects, etc.) in the utility room, and at that space is available at electric panel/substation, with good access to the solar modules.

c) Determine the project's economics with your financial professionals. Incentive programs are subject to change, so ensure you information is up to date. For information regarding:

- Focus on Energy incentives, contact: www.focusonenergy.com or 800 762.7077.
- Federal tax incentives, contact: the IRS.
- U.S. Department of Agriculture rural business incentives, contact: www.farmenergy.org or in Wisconsin, Mark Brodziski at 715.345.7615, or mark.brodziski@wi.usda.gov

d) Contact at least three qualified installers to get price quotes (see Focus on Energy's full service solar electric installers attached to this report for a directory of Wisconsin's solar electric installers).

- It is recommended that the installer completes interconnection applications, obtains permits and fills out Focus on Energy incentive paperwork.
- Ensure that price quotes are comparable (e.g., all include any work that may be needed on the AC side of the inverter to be eligible for We Energies or Madison Gas and Electric buy back rates incentives).

e) Contact your insurance agent and advise them of your intent to install the renewable energy system, and ask for written confirmation of the liability coverage

currently provided (as needed to meet utility requirements). Confirm that current insurance provides the needed coverage, and resolve any issues with the agent.

f) Define any permitting requirements for the installation of the system.
g) Based on the quote received, and consultation with financial professionals, make the final decisions on the project's size, location, mounting options and price with your preferred installer.

h) Apply and receive approval for incentives as appropriate. Commonly your preferred installer will assist with the applications.

i) Sign the installation contract with your selected installation firm.
- Insure that all zoning, utility agreements, financial incentive and any other required approvals are in hand prior to making any commitment to purchase.

j) It is usually much more cost effective to make energy efficiency improvements than install a solar electric system. For information about the Focus on Energy business energy efficiency program contact: Focusonenergy.com or 800.762.7077

Insure that all utility agreements, financial incentives, and any other required approvals/permits are in hand prior to making any commitment to purchase.

Disclaimers:

- All costs, power production, economic and other values in this report are estimates.
- The economic analysis presented in this report should be considered one method of evaluating this project.
- The estimated installed system cost(s) are/is not a formal estimate or bid.
- The information provided in this report should NOT be considered legal, financial, or tax advice.

October 28, 2010

Matthew R Giovanelli

Date

REPORT CONTENTS

1. Purpose of Site Assessment

The purpose of this assessment is to provide site-specific information on how a solar electric (also referred to as a photovoltaic, or PV) system would perform at your location, including information on estimated physical size, rated output, energy production, costs, financial incentives and mounting options. Site assessors are required to present unbiased information and may not recommend contractors or products.

Dane County Department of Public Works is interested in:

- Clean energy/environmental concerns
- Reducing energy bills: maximizing system production and minimizing cost
- Possible Educational/Demonstration project
- Public relations: system should be publicized as a green investment

Dane County's solar electric system size expectations for the Springfield Corners Highway Garage (SCHG) are between 5 and 10 kW.[1]

2. Site's Electric Data

Electrical Service**:** The building complex has 277/480 volt service with 120/208 step down transformer. The electrical service is located on the north wall of the building near the northeast corner of the building. See Figures 1 through 4.

Figure 1 Electrical Subpanels (inside)

Figure 2 Electrical Subpanels (inside)

[1] In Southeastern Wisconsin, a one kilowatt (kW) solar electric system, that is unshaded and fix mounted, will generate about 1230 kilowatt hours (kWh) per year. A one kW unshaded dual axis tracking system will generate about 1640 kWh/year.

Figure 3 Electrical Service (outside)

Figure 4 Electrical Service (outside)

Dane County provided energy usage for the SCHG site over the past 22 months:

Average Annual:	88,930 kWh
Average per month:	7,411 kWh
Site's Electric Utility:	MG&E
Annual Electricity Bill:	**$10,996**
Average Rate ($/kWh):	**$0.12 kWh**

3. Siting Options

The Dane County SCHG Building site is located at 6159 U.S. Highway 12 Springfield Corners, Wisconsin 53529. Dane County prefers that the PV array be installed as a ground mount system. Installing the array on the garage building is an option, however, the PV modules would not be visible to the general public, and the shallow slope of the building roof would require a somewhat more involved racking system. Because of the large amount of paved parking and storage areas, shading caused by the two buildings on site, the steep terrain on the south portion of the site, as well as trees along the south and west site boundaries, area available for a ground mounted system is limited to the northeast portion of the site. See Figure 5 for an aerial view of the site.

Figure 5 Aerial View Looking South

3.1 Shading Estimates

The location of the ground mounted PV modules on the northeast corner of the site will need to take into consideration potential shading of the panels. Since PV modules can last from 30 to 40 years, system placement should consider shading by tree growth, adjacent buildings, and near by equipment.

A device called the Solar Pathfinder is used to determine if there are any shading issues that would block the PV modules from receiving sun light. The Pathfinder shows the solar window for a given PV array system, for all months of the year, by transferring the shading of the surrounding obstructions (usually trees or buildings) onto an easy-to-read flat display. From this display, the percentage of shading for each month of the year can be computed; and from that, the reduction in energy output from the PV system due to this shading can be calculated.

Dane County is only interested in placing grounded mounted arrays. Figure 6 depicts the proposed location of the PV array (blue rectangle).

Figure 6 Proposed Array Layout

Ground Mount - Northeastern Section of Site

The Pathfinder was placed at two locations within the blue shaded area as depicted in Figure 6 and solar window readings collected. Figure 7 shows the locations at which Pathfinder readings were collected.

Figure 7 Pathfinder Placement.

Figures 8 through 11 were taken of the proposed ground mounted array. Figure 9 was taken from near the northeast corner of the roof looking

Figure 8 Looking North.

Figure 9 Looking Northwest.

Figure 10 Looking West.

Figure 11 Looking Southeast

Figures 12 & 13 depict the Pathfinder image and shading trace for the Pathfinder location numbers 1 and 2, respectively, (as depicted on Figure 7). Taken together the two locations identified on Figure 7 are shaded less than 1% of the time on average for the entire year.

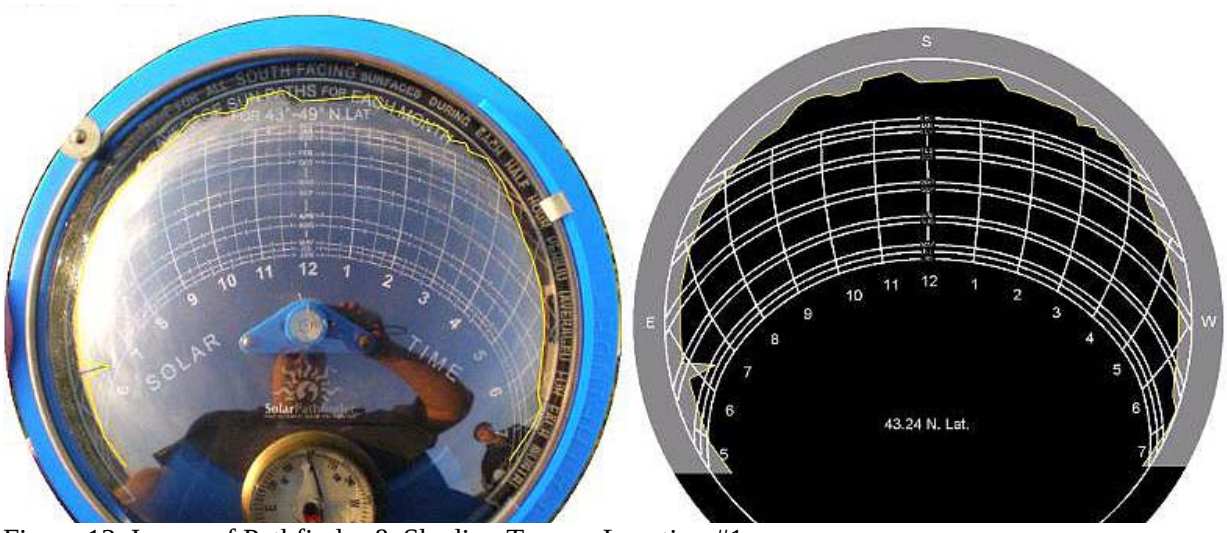

Figure 12 Image of Pathfinder & Shading Trace – Location #1.

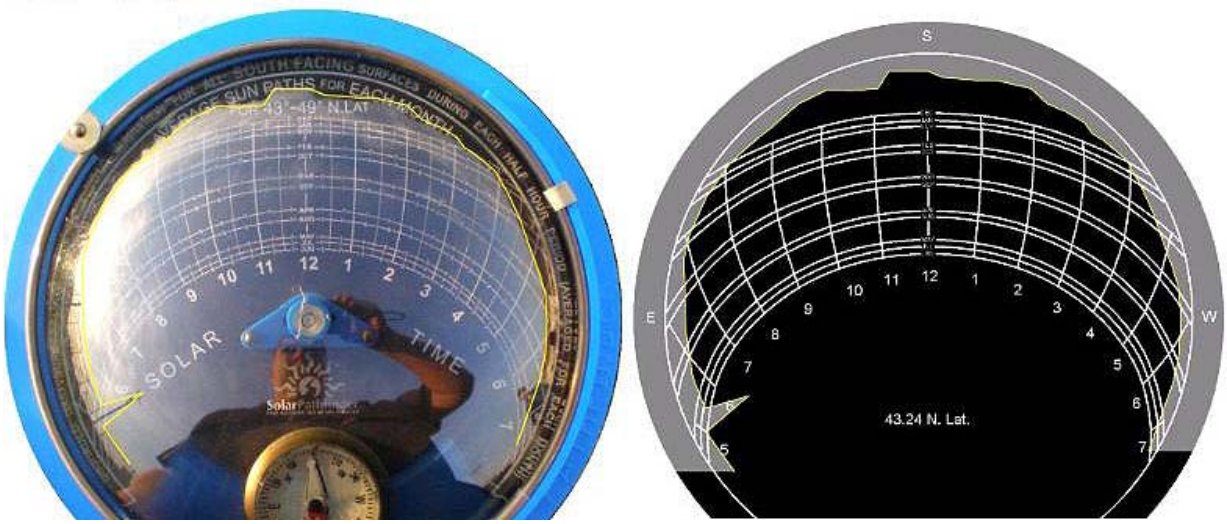

Figure 13 Image of Pathfinder & Shading Trace – Location #2.

Figure 14 presents the shading analysis by averaging the results from the Pathfinder readings taken at locations 1 and 2 as shown on Figure 7. The shading analysis indicates that a 4.14 kW-DC ground mount system on the northeast corner of the site would generate approximately 5,167 kWh a year.

Solar Obstruction Data

Month	Ideal Unshaded Solar Radiation Azimuth=180.0 Tilt=43.24 KWH/m^2 /day	Actual Shaded Solar Radiation Azimuth=192.8 Tilt=35.0 KWH/m^2 /day	Actual Shaded AC Energy (KWH) Azimuth=192.80 Tilt=35.00	Actual Unshaded AC Energy (KWH) Azimuth=192.8 Tilt=35.00	PVWatts Unshaded % Actual Site Azimuth=192.8 Tilt=35.00
January	3.28	3.02	341.99	343.00	98.60 %
February	3.96	3.78	373.40	379.00	98.38 %
March	4.36	4.25	440.00	440.00	99.79 %
April	4.96	5.04	483.93	484.00	99.59 %
May	5.57	5.75	546.78	547.00	99.63 %
June	5.83	6.10	548.00	548.00	99.54 %
July	5.73	5.98	550.00	550.00	99.77 %
August	5.51	5.62	523.98	524.00	99.51 %
September	4.93	4.84	442.46	443.00	99.00 %
October	3.92	3.71	370.46	373.00	99.20 %
November	2.88	2.71	269.35	271.00	99.06 %
December	2.73	2.49	276.92	280.00	98.69 %
Totals	**53.64**	**53.27**	**5,167.25**	**5,182.00**	**99.23 %**
	Effect: 100.00%	**Effect: 99.32%**			**Unweighted**
	Sun Hrs: 4.47	**Sun Hrs: 4.44**			**Yearly Avg**

Notes: 18 modules at 230-watts

Figure 14 Solar Obstruction Data for Ground Mount (Northeast Corner of Site) – 4.14 kW-DC.

The shading analysis also indicates that a 8.28 kW-DC ground mount system at the same location (encompassing two rows of modules) on the northeast corner of the site would generate approximately 10,346 kWh a year (see Figure 15).

Solar Obstruction Data

Month	Ideal Unshaded Solar Radiation Azimuth=180.0 Tilt=43.24 KWH/m^2 /day	Actual Shaded Solar Radiation Azimuth=192.8 Tilt=35.0 KWH/m^2 /day	Actual Shaded AC Energy (KWH) Azimuth=192.80 Tilt=35.00	Actual Unshaded AC Energy (KWH) Azimuth=192.8 Tilt=35.00	PVWatts Unshaded % Actual Site Azimuth=192.8 Tilt=35.00
January	3.28	3.02	682.97	685.00	98.60 %
February	3.96	3.78	747.17	758.00	98.38 %
March	4.36	4.25	879.00	879.00	99.79 %
April	4.96	5.04	971.86	972.00	99.59 %
May	5.57	5.75	1,096.55	1,097.00	99.63 %
June	5.83	6.10	1,097.00	1,097.00	99.54 %
July	5.73	5.98	1,105.00	1,105.00	99.77 %
August	5.51	5.62	1,047.93	1,048.00	99.51 %
September	4.93	4.84	887.11	889.00	99.00 %
October	3.92	3.71	741.84	747.00	99.20 %
November	2.88	2.71	538.70	542.00	99.06 %
December	2.73	2.49	551.07	557.00	98.69 %
Totals	**53.64**	**53.27**	**10,346.18**	**10,376.00**	**99.23 %**
	Effect: 100.00%	**Effect: 99.32%**			**Unweighted**
	Sun Hrs: 4.47	**Sun Hrs: 4.44**			**Yearly Avg**

Notes: 36 modules at 230-watts

Figure 15 Solar Obstruction Data for Ground Mount (Northeast Corner of Site) – 8.28 kW-DC.

The above Solar Obstruction Data tables are the output of a computer program developed by the makers of the Solar Pathfinder. It was used to calculate the estimated annual output in kWh/yr that will be produced by a solar PV system at this site. The table incorporates a software tool called PVWatts. PVWatts was developed by the National Renewable Energy Laboratory (NREL) to estimate the energy output of solar systems taking into account such factors as the daily solar radiation (kWh/m^2/day) in the geographic area, the type of mount (fixed or dual axis mounted), the azimuth angle between the direction of the array and due south, the tilt angle of the array, and a de-rating factor which takes into account any electrical losses in the inverter, transformer, AC and DC wiring, PV module mismatch, etc., as well as a small percentage de-rating for soiling, shading, and age of the panels. For this case a de-rate factor of 80% was used to account for the system losses. The Pathfinder computer program also incorporated TMY3 weather data for the United States.

4. System Mounting Recommendations

Ground Mount

There are several ways to install a ground mount system. One way is to use self drilling support poles that have an auger like fitting welded on to it that is drilled into the ground, assuming there is no bedrock or large rocks in the top four feet of the ground surface. The racking is then attached to the poles. See Figure 16 for an example. Another way is to install concrete footings in the ground and then attach the racking. See Figure 17 for an example.

Figure 16 Self Drilling Support Poles.

Figure 17 Concrete Footing.

Another option is to attach the racking to a concrete slab which does not require any digging or ground penetrations. The recently completed MATC Solar Farm has pole mounted modules in which the pole is attached to a concrete slab that can be moved if needed. Although the MATC system uses a pole mounted system, ground mount racking could be attached to concrete slabs. See Figure 18 for a photograph of the MATC system.

Figure 18 MATC Pole and Slab System. (Photo Courtesy of MATC Web Site)

If the concrete slab option is taken, the sloping nature of the ground surface at the SCHG site will need to be taken in to consideration. Wind and snow loading must be

evaluated to determine if the slab and racking system is structurally able to support the loads. This is the responsibility of the customer and their structural engineer.

When unshaded and positioned directly south with the proper pitch (30 to 35 degrees), this type of system would be expected to generate about 1230 kWh/year per kilowatt (kW) of modules. The output from the modules would be slightly less then this value if it is determined that the pitch of the PV modules would need to be less than 30-degrees to reduce wind loading. Fix mounted systems have no moving parts and are therefore expected to require very little maintenance

Some of the benefits of a ground-mount array are:

- Avoids re-roofing issues inherent in most roof mounts
- Allows for proper array orientation
- Offers seasonal adjustability for better year-round solar gain
- Operates cooler, thereby increasing power output slightly
- Less snow shading than roof mounts
- Easy access

5. Recommended Solar Electric Layout and Sizing

The layout of the PV modules will be dictated by the size expectations of the array given the limited space available, inter-row spacing (shading a PV module casts on the module behind it), and closeness to the access road. In order to achieve an array close to the desired 10 kW size, the PV modules will need to be installed in portrait orientation. A second row of modules (north of the first row) will need to be placed far enough away so the first row does not shade the second row.

Assuming the PV modules are 68-inches by 40-inches in size and installed in portrait orientation (long axis top to bottom) and at a pitch of 35 degrees, each successive row of modules will need to be at least 15.4-feet apart (measured from the front of the module in the first row to the front of the module in the second and succeeding rows). This assumes the worst case sun angle on December 21st at 9:00 AM and 3:00 PM. This will effectively limit the number of row to two. A third row of modules would end up being only 10 feet from the fence line.

Consideration should also be taken on how close the array will be to the road that runs along the south side of the proposed array location. Rocks, debris and dirt kicked up by passing trucks could be a concern as well as snow plowing in the winter.

The distance from the electrical service in the garage building to the west end of the proposed array location is approximately 180 feet. This is a long distance for DC current to travel and will require large diameter wire to reduce voltage drop. Placing the inverter(s) at the array will reduce the size of the wires leading to the electrical service.

6. Solar Electric Systems Costs and Incentives

The typical installed price of a grid-tied solar system is $7.00 to $9.00 per watt. Larger systems will tend to be toward the lower end of the range; smaller systems usually cost more $/watt because the cost of additional modules is not as big a factor compared with the labor and materials that go into the initial installation of the PV system. Systems with non-standard mounting systems such as concrete slabs will also cost more then panels mounted with “off the self” components. In addition, longer distances for electrical cable to reach the inverters will also increase the cost. A cost of $8,000 per kW was assumed for the 4.14 kW-DC and $7,500 per kW for the 8.28 kW ground mounted system, with the total cost of your system, before incentives, estimated to be $33,120 and $62,100, respectively.

6.1 Incentives

a. Focus on Energy Renewable Program

Focus on Energy provides a performance-based buy-down incentive program for solar photovoltaic systems based on there size and energy efficiency of the building on which they are installed. Beginning in February 2010 Focus on Energy introduced a two tiered incentive structure designed to encourage customers to achieve a level of energy efficiency in their home or business before installing PV renewable energy systems.

Cash Back Rewards for DC rated module capacity between 0.5 kW-DC and 50 kW-DC

Tier I incentives will be available to all customers; Tier II incentives will be available to those customers who met a prescribed level of efficiency first (this will be achieved either through past participation in specified Focus on Energy program or by achieving an energy usage benchmark set by the program).

Tier I non-profit and local government customer incentives will be $1.50 per kWh generated over an average year for systems of 0.5 kW to 50 kW. Customers who do energy efficiency first (Tier II), as defined by Focus on Energy, will be eligible for an incentive level of $1.75 per kWh. The incentive caps at $75,000, not to exceed 35% of installed cost. The actual amount of the incentive is determined by Focus on Energy when the application for a Cash Back Reward is submitted. Upon approval, you will have one year to install the system and receive the installation incentive. The system must be installed by a NABCEP certified PV installer, or an installer listed as pursuing NABCEP certification, to qualify for a Focus on Energy Reward.

To receive the Tier II incentive, the job site of the renewable energy system must fully satisfy the requirements of one of the efficiency tracks listed on page 4 of the *Solar Electric (Photovoltaic) System Pre-Approval Incentive Application for Business* which is attached to this site assessment report.

For additional details about these programs go to the Focus on Energy web site www.focusonenergy.com and follow the links for renewable energy incentives.

b. Madison Gas & Electric (MG&E)
Customer-generators enrolled in the Madison Gas & Electric (MGE) green power purchase program -- Green Power Tomorrow -- are eligible to receive a special rate for the power produced from solar photovoltaic (PV) systems. Under this program, the electricity produced from 1 to 10 kilowatt (kW-DC) PV systems will be purchased by MGE at a rate of $0.25/kilowatt-hour (kWh). This rate will apply to all electricity produced by the system. As the program is limited to Green Power Tomorrow participants, customers will purchase electricity from the utility at the normal retail rate plus the green power premium (currently $0.0125/kWh).

Annual green energy purchases must be at least as large as the AC output of the PV system. This arrangement requires that the customer have two electricity meters; one to measure electricity production and one to measure electricity consumption. MGE will provide the additional meter but the customer must pay for an electrician to supply and install a two-meter socket and any other modifications necessary for system function.

Participants must sign a 10-year contract with MGE but may opt-out with 30 days notice. Systems must be designed and installed to comply with Wisconsin interconnection standards. Any renewable energy credits (RECs), emission allowances, or other environmental attributes generated by the system while the contract is in force will accrue to MGE rather than the customer-generator. The overall enrollment for this program is capped at 1,000 kW. More information can be found at http://www.mge.com/home/rates/cleanpower.htm

c. State Taxes
Wisconsin's depreciation is based on the Federal depreciation formula. So the Federal five-year accelerated depreciation applies to Wisconsin business income taxes as well. Consult a qualified tax adviser to determine your individual eligibility.

d. Net Metering
Wisconsin municipal and investor-owned utilities are required to allow customers to net-meter solar electric systems with rated output of 20kW or less. What this means is that the utility will provide full retail credit for any extra energy that is sent out by the customer's solar electric system onto the utility grid. Net metering can be done using any electric rate provided for which the customer is eligible (including time of day rates).

e. Property Tax Exemption
Solar electric systems are exempt from Wisconsin property tax assessments making solar an investment you can make on your property without increasing the assessed value and tax liability.

f. Renewable Energy Credits (RECS)
In some states markets are buying and selling Renewable Energy Credits (RECs) also known as green tags. The RECs represent the clean energy attributes of renewable electric systems (not the kilowatt hours). It is likely that during the life of a large commercial solar electric system the owner will be able to sell RECs in Wisconsin for additional income. MG&E will own the RECs for ten years.

6.2 Demand Benefits

Reduced demand loads and charges can occur if the site's peak demand occurs during periods of solar electric system output.

- For sites with a peak electrical demand between 10 am and 2 pm on sunny business days: Demand reduction benefits could equal up to 60% of the solar electric system's rated dc capacity
- For sites with a peak electrical demand that occurs before 8 am or after 4 pm: Demand reductions would be expected to be minimal
- While a PV system will likely reduce Demand Charges, the method MG&E uses for determining demand charges may not factor for this reduction. Additional investigation may be required.

6.3 System Cost after Incentives

The following table shows the cost of the roof mounted 4.14 kW-DC and 8.28 kW-DC solar PV systems after all of the incentives[2]. It is assumed that the building would **not** qualify for Focus on Energy's Tier II cash back program. The Tier I level of $1.50 per kWh was used. Focus on Energy also requires that the estimated production be reduced by 1% for snow cover for modules tilted at 35 degrees, which is reflected in the tables.

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[2] The incentives in the table do not include any adjustments that may be made by Focus on Energy.

Economics		
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10 Year IRR	-12.1%	-10.9%
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Environment		
CO2 emission reduction per year (tons/year)	5.7	11.3
Key Assumptions		
Cost of System Per kW (dc)	$ 8,000	$ 7,500
Meets Focus on Energy Tier II Efficiency Level	$1.50/kWh	$1.50/kWh
Electricity Rate Year One ($/kWh)	$ 0.12	$ 0.12
MG&E Solar Electric Buyback Rate**	$0.25	$0.25
Estimated electricity price inflation rate (%/yr)	6.0%	6.0%
Expected output degradation (%/year)	0.50%	0.50%
Discount rate (used only in NPV)	3.0%	3.0%

***Installer must be certified by the North American Board of Certified Energy Practitioners (NABCEP) or those working towards certification.**

****Does not include cost to enter Green Power Tomorrow Program**

Based on these calculations, the payback time for the ground mounted system is 22 years for the 4.14 kW-DC and 20 years for the 8.28 kW-DC system. The payback times are based on a 6% per year fuel escalation rate. This means if the electricity rates increase by greater then 6% per year over the next 20 years, the payback time will be less. Most people believe that the utility's electricity rates will most likely be on the rise. However, predicting future energy costs is not within the scope of this report. Once the payback period is reached, the owner will be producing free electricity for the remaining 15 to 20 or so years left in the life of the PV system.

7. Operation and Maintenance

Operation and maintenance needs will be minimal with a fixed mounted systems. Expect to pay approximately 0.25% of the total cost of the system per year for maintenance and approximately 0.4% for insurance. Operation and maintenance costs of 0.25% were used in the payback calculations while insurance costs were not.

8. Summary

Under present site conditions, the SCHG building site is an excellent site for a solar PV system. A ground mount system can accommodate an 8.28 kW-DC kW system that is estimated to generate 10,230 kWh/year. The estimate cost to install the systems after Focus on Energy Cash Back Rewards is taken into consideration is $46,755, with a pay back time of 20 years. A smaller 4.14 kW-DC system would generate an estimated 5,115 kWh/yr at an installed price of $25,447 after incentives, with a payback time of 22 years.

The electrical rate used was $0.12 kWh, MG&E solar electric buyback rate of $0.25 kWh, and the Focus on Energy incentive efficiency level was $1.50/kWh.

9. Education Resources

- Focus on Energy web site (www.focusonenergy.org) for information on Renewable Energy.
- For more information on state incentives for renewable energy - www.dsireusa.org
- Home Power Magazine/Website (www.homepower.com) – Case studies and stories of renewable energy installations around the country.
- Midwest Renewable Energy Association (www.the-mrea.org) – Hands-on workshops in Wind, PV, Solar Hot water, and more.
- Consumer Guide to Buying a Solar Electric System www.nrel.gov/docs/fy04osti/35297.pdf http://www.homepower.com/files/beginner/SolarElectricBasics.pdf
- The We Energies renewable energy programs, contact: We Energies Customer Contact Center at 800-714-7777, ext. 7700 or www.we-energies.com/re
- Energy Star for information on appliance energy ratings (http://www.energystar.gov)

10. Other Information

Attachment	Description
1	Solar Electric System Terminology Definitions.
2	Full service solar electric installer list.
3	Solar Electric System Pre-Approval Incentive Application for Business

Attachment 1
Solar Electric System Terminology Definitions

Solar Electric System Definitions

Based largely on the Solar Electric Glossary from Sandia National Labs

Alternating Current (ac) An electric current that reverses direction periodically.

Direct Current (dc) Electric current flowing in only one direction.

Fixed Tilt Array A solar electric array set in at a fixed angle with respect to horizontal.

Grid Term used to describe an electrical utility distribution network.

Inverter In a solar electric system, an inverter converts dc power from the solar electric array to ac power compatible with the utility and ac loads.

Kilowatt (kw) One thousand watts. A unit of power.

Kilowatt Hour (kwh) One thousand watt-hours. A unit of energy. Power multiplied by time equals energy.

Module The smallest replaceable unit in a solar electric array. An integral, encapsulated unit containing a number of PV cells.

Net Energy Billing a billing and metering practice under which a customer is billed on the basis of net energy over the billing period taking into account accumulated unused kilowatt-hour credits from the previous billing period.

Orientation Placement with respect to the cardinal directions, N, S, E, W; azimuth is the measure of orientation from north.

Panel A designation for a number of solar electric modules assembled in a single mechanical frame.

Peak Load The maximum load demand on a system.

Photovoltaic Cell The treated semiconductor material that converts solar irradiance to electricity.

Photovoltaic System (or Solar Electric System) An installation of solar electric modules and other components designed to produce power from sunlight and meet the power demand for a designated load.

Power (Watts) A basic unit of electricity equal (in dc circuits) to the product of current and voltage.

Tilt Angle The angle of inclination of a solar collector measured from the horizontal.

Tracking Array A solar electric array that follows the path of the sun. This can mean one-axis, east to west daily tracking, or two-axis tracking where the array follows the sun in azimuth and elevation.

Watt (W) The unit of electrical power. The power developed when a current of one ampere flows through a potential difference of one volt; 1/746 of a horsepower.

Watt Hour (Wh) A unit of energy equal to one watt of power connected

SOLAR ELECTRIC SITE ASSESSMENT REPORT

Dane County Badger Salt Shed

c/o

Richard Sujecki, P.E.
Harwood Engineering Consultants, LTD.
7420 W. State Street
Milwaukee, WI 53213

Site Assessor

Matthew Giovanelli
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Date of Site Visit:
October 11, 2010

Date Final Report completed:
October 28, 2010

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

Executive Summary

The results of the photovoltaic (PV) solar site assessment indicate that the Dane County Department of Public Works Badger Salt Shed site is an excellent site for the installation of a solar PV system. The best location to install PV modules for the anticipated array size is a pole mounted array with duel axis tracking located to the southwest of the salt shed building. There are no shading issues at this location. There is ample room for the anticipate array size. The following table summarizes the results of the site assessment using 16 solar panels (210 watts each) on a pole mount system with duel axis tracking:

Energy Production, Cost, Economics and Environment Dane County Badger Salt Shed Site– Pole Mount (Duel Axis Tracking)	
Production	*Roof Mount*
Solar electric systems rated module capacity (kW dc)	3.36 kW-DC
Estimated output year one (kWh/yr)	5,389
Cost	
Estimated installed cost	$30,240
Focus On Energy Incentive*	$ 8,083
System Cost after all incentives	**$22,157**
Value of year 1 to year 10 power production	$13,173
Economics	
10 Year discounted NPV	-$14,241
25 Year discounted NPV	$ 9,808
10 Year IRR	-11.1%
25 Year IRR	7.1%
Simple Payback Period	15 years
Environment	
CO2 emission reduction per year (tons/year)	6.0
Key Assumptions	
Cost of System Per kW (dc)	$ 9,000
Focus on Energy Tier I Efficiency Level	$1.50/kWh
Electricity Rate Year One ($/kWh)	$ 0.28
MG&E Solar Electric Buyback Rate**	$0.25
Estimated electricity price inflation rate (%/yr)	6.0%
Expected output degradation (%/year)	0.50%
Discount rate (used only in NPV)	3.0%

***Installer must be certified by the North American Board of Certified Energy Practitioners (NABCEP) or those working towards certification.**

****Does not include cost to enter Green Power Tomorrow Program**

An area of approximately 50 feet by 100 feet is reasonably available for the installation of a pole mounted array near the pad mounted electrical transformer located approximately 100 feet southwest of the southwest corner of the salt shed building. Using 210-watt modules, the pole mounting system could hold 16 modules which would result in a 3.36 array.

Next Steps

a) Evaluate the options presented in this report, and make a decision on system size, location and mounting methods.

b) Engineering reviews maybe needed.

- For roof mounted systems, confirm with the building designer and/or qualified structural engineer as to the building roof structure's ability to support the additional weight and wind loading of a solar electric system. Also, review the impact on roofing warrantee of siting panels over roofing.
- With an electrical professional, ensure space is available for balance of system components (e.g., inverter(s) disconnects, etc.) in the utility room, and at that space is available at electric panel/substation, with good access to the solar modules.

c) Determine the project's economics with your financial professionals. Incentive programs are subject to change, so ensure you information is up to date. For information regarding:

- Focus on Energy incentives, contact: www.focusonenergy.com or 800 762.7077.
- Federal tax incentives, contact: the IRS.
- U.S. Department of Agriculture rural business incentives, contact: www.farmenergy.org or in Wisconsin, Mark Brodziski at 715.345.7615, or mark.brodziski@wi.usda.gov

d) Contact at least three qualified installers to get price quotes (see Focus on Energy's full service solar electric installers attached to this report for a directory of Wisconsin's solar electric installers).

- It is recommended that the installer completes interconnection applications, obtains permits and fills out Focus on Energy incentive paperwork.
- Ensure that price quotes are comparable (e.g., all include any work that may be needed on the AC side of the inverter to be eligible for We Energies or Madison Gas and Electric buy back rates incentives).

e) Contact your insurance agent and advise them of your intent to install the renewable energy system, and ask for written confirmation of the liability coverage currently provided (as needed to meet utility requirements). Confirm that current insurance provides the needed coverage, and resolve any issues with the agent.

f) Define any permitting requirements for the installation of the system.
g) Based on the quote received, and consultation with financial professionals, make the final decisions on the project's size, location, mounting options and price with your preferred installer.

h) Apply and receive approval for incentives as appropriate. Commonly your preferred installer will assist with the applications.

i) Sign the installation contract with your selected installation firm.
- Insure that all zoning, utility agreements, financial incentive and any other required approvals are in hand prior to making any commitment to purchase.

j) It is usually much more cost effective to make energy efficiency improvements than install a solar electric system. For information about the Focus on Energy business energy efficiency program contact: Focusonenergy.com or 800.762.7077

Insure that all utility agreements, financial incentives, and any other required approvals/permits are in hand prior to making any commitment to purchase.

Disclaimers:

- All costs, power production, economic and other values in this report are estimates.
- The economic analysis presented in this report should be considered one method of evaluating this project.
- The estimated installed system cost(s) are/is not a formal estimate or bid.
- The information provided in this report should NOT be considered legal, financial, or tax advice.

October 28, 2010

Matthew R Giovanelli

Date

REPORT CONTENTS

1. Purpose of Site Assessment

The purpose of this assessment is to provide site-specific information on how a solar electric (also referred to as a photovoltaic, or PV) system would perform at your location, including information on estimated physical size, rated output, energy production, costs, financial incentives and mounting options. Site assessors are required to present unbiased information and may not recommend contractors or products.

Dane County Department of Public Works is interested in:

- Clean energy/environmental concerns
- Reducing energy bills: maximizing system production and minimizing cost
- Possible Educational/Demonstration project
- Public relations: system should be publicized as a green investment

Dane County's solar electric system size expectations for the Badger Salt Shed site between 3 and 4 kW.[1]

2. Site's Electric Data

Electrical Service**:** The building complex has 200 amp 277/480 volt service with step down transformer to 120/208 volt single phase. The electrical service is located inside on the east wall of the small west wing of the building. See Figures 1 and 2.

Figure 1 Electrical Subpanels (inside)

Figure 2 Electrical Subpanels (inside)

Dane County provided energy usage for the Badger Salt Shed site over the past 21 months.

Average Annual:	13,840 kWh
Average per month:	1,153 kWh

[1] In Southeastern Wisconsin, a one kilowatt (kW) solar electric system, that is unshaded and fix mounted, will generate about 1230 kilowatt hours (kWh) per year. A one kW unshaded dual axis tracking system will generate about 1640 kWh/year.

Site's Electric Utility: MG&E
Annual Electricity Bill: $**3,874**
Average Rate ($/kWh): **$0.28**

The cost provided for the number of kWh consumed seems high and should be verified.

3. Siting Options

The Dane County badger Salt Shed site is located at 3650 County Trunk Highway T outside the City of Madison, Wisconsin 53718. Dane County prefers that the PV array be installed as a pole mount system. See Figure 3 for an aerial view of the site.

Figure 3 Aerial View Looking North

3.1 Shading Estimates

The location of the pole mounted PV modules to the southwest of the site building will need to take into consideration potential shading of the panels. Since PV modules can last from 30 to 40 years, system placement should consider shading by tree growth and adjacent buildings.

A device called the Solar Pathfinder is used to determine if there are any shading issues that would block the PV modules from receiving sun light. The Pathfinder shows the solar window for a given PV array system, for all months of the year, by transferring the shading of the surrounding obstructions (usually trees or buildings) onto an easy-to-read flat display. From this display, the percentage of shading for each month of the year can be computed; and from that, the reduction in energy output from the PV system due to this shading can be calculated.

Pole Mount (Duel-Axis Tracking)

The Pathfinder was placed at one location on top of a 10 foot tall step ladder, approximately 40 feet south of the pad mounted transformer, and a solar window reading collected. The Pathfinder reading collected at this proposed pole mounted array location represents what the bottom row of modules of the array would encounter. Figure 4 shows the location at which the Pathfinder reading was collected.

Figure 4 Pathfinder Placement (Looking East).

Figures 5 through 10 were taken either from the proposed pole location or areas around the pole location.

Figure 5 Ladder Shows Proposed Location (SE).

Figure 6 Ladder Shows Proposed Location (SW).

Figure 7 Looking North From Near Pole Location.

Figure 8 Looking South From Near Pole Location.

Figure 9 Looking E-SE At Pole Location.

Figure 10 Looking Southeast Highway Embankment.

Figure 11 depict the Pathfinder image and shading trace for the Pathfinder location number 1, (as depicted on Figure 4). The location identified on Figure 4 is shaded 1% of the time on average for the entire year.

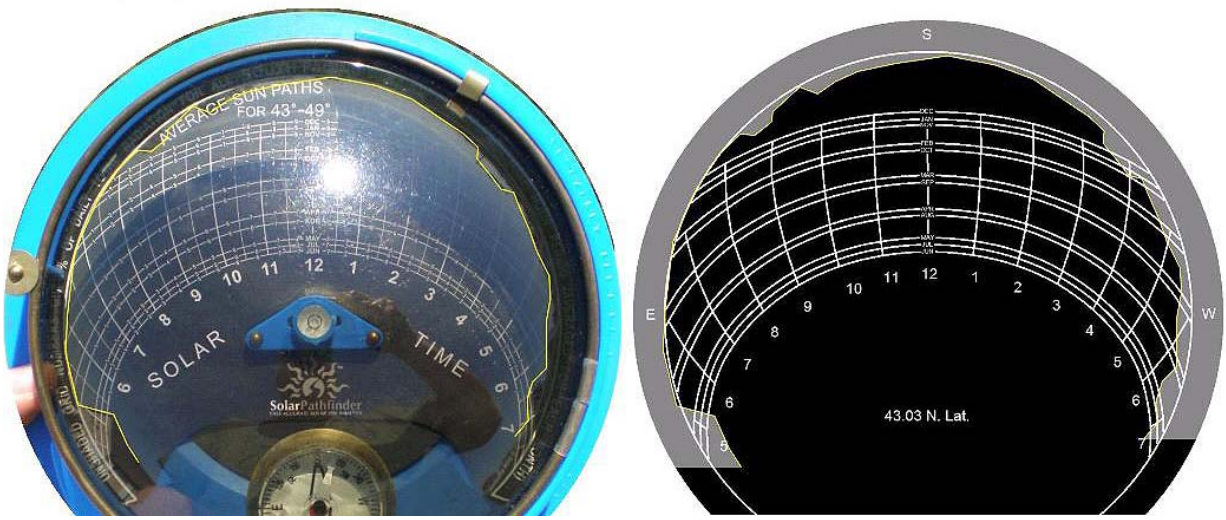

Figure 11 Image of Pathfinder & Shading Trace – Location #1.

Figure 12 presents the shading analysis by averaging the results from the four Pathfinder readings locations. The shading analysis indicates that a 3.36 kW-DC roof mount system on the southeast corner of the building would generate approximately 5,446 kWh a year.

Solar Obstruction Data

Month	Ideal Unshaded Solar Radiation Azimuth=180.0 Tilt=43.03 KWH/m ^{2} /day	Actual Shaded Solar Radiation Azimuth=177.8 Tilt=0.0 KWH/m ^{2} /day	Actual Shaded AC Energy (KWH) Azimuth=177.80 Tilt=0.00	Actual Unshaded AC Energy (KWH) Azimuth=177.8 Tilt=0.00	PVWatts Unshaded % Actual Site Azimuth=177.8 Tilt=0.00
January	3.80	3.72	337.95	343.00	98.02 %
February	4.58	4.46	356.90	365.00	98.32 %
March	5.21	5.20	439.00	439.00	100.00 %
April	6.43	6.41	502.00	503.00	99.65 %
May	7.70	7.58	594.46	602.00	98.60 %
June	8.70	8.54	638.29	649.00	98.12 %
July	8.24	8.14	624.33	629.00	99.19 %
August	7.16	7.15	544.40	545.00	99.86 %
September	6.48	6.40	477.91	483.00	99.10 %
October	4.85	4.72	384.11	393.00	99.43 %
November	3.43	3.43	275.60	276.00	99.96 %
December	3.19	3.00	271.76	286.00	96.65 %
Totals	**69.78**	**68.76**	**5,446.71**	**5,513.00**	**98.91 %**
	Effect: 100.00%	**Effect: 98.55%**			**Unweighted**
	Sun Hrs: 5.81	**Sun Hrs: 5.73**			**Yearly Avg**

Notes: 16 - 210 watt modules

Figure 12 Solar Obstruction Data for Roof Mount (Black Roof Section) – 3.36 kW-DC.

The above Solar Obstruction Data tables are the output of a computer program developed by the makers of the Solar Pathfinder. It was used to calculate the estimated annual output in kWh/yr that will be produced by a solar PV system at this site. The table incorporates a software tool called PVWatts. PVWatts was developed by the National Renewable Energy Laboratory (NREL) to estimate the energy output of solar systems taking into account such factors as the daily solar radiation ($kWh/m^2/day$) in the geographic area, the type of mount (fixed or dual axis mounted), the azimuth angle between the direction of the array and due south, the tilt angle of the array, and a de-rating factor which takes into account any electrical losses in the inverter, transformer, AC and DC wiring, PV module mismatch, etc., as well as a small percentage de-rating for soiling, shading, and age of the panels. For this case a de-rate factor of 80% was used to account for the system losses. The Pathfinder computer program also incorporated TMY3 weather data for the United States.

4. System Mounting Recommendations

Pole Mount (Duel-Axis Tracking)

Pole mounted arrays are seasonally adjustable with a twice yearly adjustment keeping the elevation angle better suited to the sun's seasonally changing altitudinal position in the sky. This will result in a gain of about 5% and offer less snow shading as well (typically 1 - 2% less snow shading).

Figure 13 Example of a 3.2 kW pole mounted, fixed array that is seasonally adjustable.

Pole mounts can also be fitted with a tracker, a rack that moves to follow the sun's position in the sky. Single axis trackers follow this movement east to west, and dual-axis trackers also follow the seasonal elevation movements up and down. Trackers can increase the output of the array by 20 – 30%, but to do so they need a wide open 'solar window', with little or no shading to the east and west. Tracking arrays cost more to install and also add mechanical complexity to the system design, which can translate into increased maintenance costs as well as the possibility of repair expenses.


Figures 14 & 15 Back and front side of a duel-axis tracker, which follows the sun's apparent movement east to west and up and down daily.

5. Recommended Solar Electric Layout and Sizing

The layout and number of the PV modules will be dictated by the pole manufacturer. The location of the pole mounted system will be dictated by the presence of trees and buildings.

Pole Mount (Duel-Axis Tracking)

A pole mounted 3.36 kW array (composed of sixteen 210-watt modules) could be installed near and to the south of the pad mounted electrical transformer approximately 120 from the southwest corner of the salt shed building. To order to maximize electrical production from the array, a dual-axis tracking system is recommended be added to the pole mounting. The proposed location has a nearly wide open solar window from 7:00 AM to 5:00 PM. Placing the array any farther north would result in the building casting shadows during the early morning. Any significant distance farther to the south would encounter shadowing from the trees located south of the paved parking area.

The distance from the electrical service in the building to the proposed pole mounted array location is approximately 140 feet.

6. Solar Electric Systems Costs and Incentives

The typical installed price of a grid-tied solar system using a duel axis tracking pole mounted system is $8.00 to $10.00 per watt. Larger systems will tend to be toward the lower end of the range; smaller systems usually cost more $/watt because the cost of additional modules is not as big a factor compared with the labor and materials that go into the initial installation of the PV system. In addition, longer distances for electrical cable to reach the inverters will also increase the cost. A cost of $9,000 per kW was assumed for the 3.36 kW-DC pole mounted system, with the total cost of your system, before incentives, estimated to be $30,240.

6.1 Incentives

a. Focus on Energy Renewable Program

Focus on Energy provides a performance-based buy-down incentive program for solar photovoltaic systems based on there size and energy efficiency of the building on which they are installed. Beginning in February 2010 Focus on Energy introduced a two tiered incentive structure designed to encourage customers to achieve a level of energy efficiency in their home or business before installing PV renewable energy systems.

Cash Back Rewards for DC rated module capacity between 0.5 kW-DC and 50 kW-DC

Tier I incentives will be available to all customers; Tier II incentives will be available to those customers who met a prescribed level of efficiency first (this will be achieved either through past participation in specified Focus on Energy program or by achieving an energy usage benchmark set by the program).

Tier I non-profit and local government customer incentives will be $1.50 per kWh generated over an average year for systems of 0.5 kW to 50 kW. Customers who do energy efficiency first (Tier II), as defined by Focus on Energy, will be eligible for an incentive level of $1.75 per kWh. The incentive caps at $75,000, not to exceed 35% of installed cost. The actual amount of the incentive is determined by Focus on Energy when the application for a Cash Back Reward is submitted. Upon approval, you will have one year to install the system and receive the installation incentive. The system must be installed by a NABCEP certified PV installer, or an installer listed as pursuing NABCEP certification, to qualify for a Focus on Energy Reward.

To receive the Tier II incentive, the job site of the renewable energy system must fully satisfy the requirements of one of the efficiency tracks listed on page 4 of the *Solar Electric (Photovoltaic) System Pre-Approval Incentive Application for Business* which is attached to this site assessment report.

For additional details about these programs go to the Focus on Energy web site www.focusonenergy.com and follow the links for renewable energy incentives.

b. Madison Gas & Electric (MG&E)

Customer-generators enrolled in the Madison Gas & Electric (MGE) green power purchase program -- Green Power Tomorrow -- are eligible to receive a special rate for the power produced from solar photovoltaic (PV) systems. Under this program, the electricity produced from 1 to 10 kilowatt (kW-DC) PV systems will be purchased by MGE at a rate of $0.25/kilowatt-hour (kWh). This rate will apply to all electricity produced by the system. As the program is limited to Green Power Tomorrow participants, customers will purchase electricity from the utility at the normal retail rate plus the green power premium (currently $0.0125/kWh).

Annual green energy purchases must be at least as large as the AC output of the PV system. This arrangement requires that the customer have two electricity meters; one to measure electricity production and one to measure electricity consumption. MGE will provide the additional meter but the customer must pay for an electrician to supply and install a two-meter socket and any other modifications necessary for system function.

Participants must sign a 10-year contract with MGE but may opt-out with 30 days notice. Systems must be designed and installed to comply with Wisconsin interconnection standards. Any renewable energy credits (RECs), emission allowances, or other environmental attributes generated by the system while the contract is in force will accrue to MGE rather than the customer-generator. The overall enrollment for this program is capped at 1,000 kW. More information can be found at http://www.mge.com/home/rates/cleanpower.htm

c. State Taxes

Wisconsin's depreciation is based on the Federal depreciation formula. So the Federal five-year accelerated depreciation applies to Wisconsin business income taxes as well. Consult a qualified tax adviser to determine your individual eligibility.

d. Net Metering

Wisconsin municipal and investor-owned utilities are required to allow customers to net-meter solar electric systems with rated output of 20kW or less. What this means is that the utility will provide full retail credit for any extra energy that is sent out by the customer's solar electric system onto the utility grid. Net metering can be done using any electric rate provided for which the customer is eligible (including time of day rates).

e. Property Tax Exemption

Solar electric systems are exempt from Wisconsin property tax assessments making solar an investment you can make on your property without increasing the assessed value and tax liability.

f. Renewable Energy Credits (RECS)
In some states markets are buying and selling Renewable Energy Credits (RECs) also known as green tags. The RECs represent the clean energy attributes of renewable electric systems (not the kilowatt hours). It is likely that during the life of a large commercial solar electric system the owner will be able to sell RECs in Wisconsin for additional income. MG&E will own the RECs for ten years.

6.2 Demand Benefits

Reduced demand loads and charges can occur if the site's peak demand occurs during periods of solar electric system output.

- For sites with a peak electrical demand between 10 am and 2 pm on sunny business days: Demand reduction benefits could equal up to 60% of the solar electric system's rated dc capacity
- For sites with a peak electrical demand that occurs before 8 am or after 4 pm: Demand reductions would be expected to be minimal
- While a PV system will likely reduce Demand Charges, the method MG&E uses for determining demand charges may not factor for this reduction. Additional investigation may be required.

6.3 System Cost after Incentives

The following table shows the cost of the pole mounted 3.36 kW-DC solar PV system after all of the incentives[2]. It is assumed that the building would **not** qualify for Focus on Energy's Tier II cash back program. The Tier I level of $1.50 per kWh was used. Focus on Energy also requires that the estimated production be reduced by 1% for snow cover for modules tilted at 35 degrees or more, which is reflected in the tables.

Energy Production, Cost, Economics and Environment Dane County Badger Salt Shed Site– Pole Mount (Duel Axis Tracking)	
Production	*Roof Mount*
Solar electric systems rated module capacity (kW dc)	3.36 kW-DC
Estimated output year one (kWh/yr)	5,389
Cost	
Estimated installed cost	$30,240
Focus On Energy Incentive*	$ 8,083
System Cost after all incentives	**$22,157**
Value of year 1 to year 10 power production	$13,173

[2] The incentives in the table do not include any adjustments that may be made by Focus on Energy.

Economics	
10 Year discounted NPV	-$14,241
25 Year discounted NPV	$ 9,808
10 Year IRR	-11.1%
25 Year IRR	7.1%
Simple Payback Period	15 years
Environment	
CO2 emission reduction per year (tons/year)	6.0
Key Assumptions	
Cost of System Per kW (dc)	$ 9,000
Focus on Energy Tier I Efficiency Level	$1.50/kWh
Electricity Rate Year One ($/kWh)	$ 0.28
MG&E Solar Electric Buyback Rate**	$0.25
Estimated electricity price inflation rate (%/yr)	6.0%
Expected output degradation (%/year)	0.50%
Discount rate (used only in NPV)	3.0%

***Installer must be certified by the North American Board of Certified Energy Practitioners (NABCEP) or those working towards certification.**

****Does not include cost to enter Green Power Tomorrow Program**

Based on these calculations, the payback time for the 3.36-kW-DC pole mounted system is 15 years. The payback times are based on a 6% per year fuel escalation rate. This means if the electricity rates increase by greater then 6% per year over the next 15 years, the payback time will be less. Most people believe that the utility's electricity rates will most likely be on the rise. However, predicting future energy costs is not within the scope of this report. Once the payback period is reached, the owner will be producing free electricity for the remaining 20 to 25 or so years left in the life of the PV system.

7. Operation and Maintenance

Operation and maintenance needs will be minimal with a fixed mounted systems. Expect to pay approximately 0.25% of the total cost of the system per year for maintenance and approximately 0.4% for insurance. Operation and maintenance costs of 0.25% were used in the payback calculations while insurance costs were not.

8. Summary

Under present site conditions, the Badger Salt Shed site is an excellent site for a solar PV system. A duel-axis tracking pole mount system can accommodate a 3.36 kW-DC kW system that is estimated to generate 5,389 kWh/year. The estimate cost to install the systems after Focus on Energy Cash Back Rewards is taken into consideration is $22,157, with a pay back time of 15 years.

The electrical rate used was $0.28 kWh, MG&E solar electric buyback rate of $0.25 kWh, and the Focus on Energy incentive efficiency level was $1.50/kWh.

9. Education Resources

- Focus on Energy web site (www.focusonenergy.org) for information on Renewable Energy.
- For more information on state incentives for renewable energy - www.dsireusa.org
- Home Power Magazine/Website (www.homepower.com) – Case studies and stories of renewable energy installations around the country.
- Midwest Renewable Energy Association (www.the-mrea.org) – Hands-on workshops in Wind, PV, Solar Hot water, and more.
- Consumer Guide to Buying a Solar Electric System www.nrel.gov/docs/fy04osti/35297.pdf http://www.homepower.com/files/beginner/SolarElectricBasics.pdf
- The We Energies renewable energy programs, contact: We Energies Customer Contact Center at 800-714-7777, ext. 7700 or www.we-energies.com/re
- Energy Star for information on appliance energy ratings (http://www.energystar.gov)

10. Other Information

Attachment	Description
1	Solar Electric System Terminology Definitions.
2	Full service solar electric installer list.
3	Solar Electric System Pre-Approval Incentive Application for Business

Attachment 1
Solar Electric System Terminology Definitions

Solar Electric System Definitions

Based largely on the Solar Electric Glossary from Sandia National Labs

Alternating Current (ac) An electric current that reverses direction periodically.

Direct Current (dc) Electric current flowing in only one direction.

Fixed Tilt Array A solar electric array set in at a fixed angle with respect to horizontal.

Grid Term used to describe an electrical utility distribution network.

Inverter In a solar electric system, an inverter converts dc power from the solar electric array to ac power compatible with the utility and ac loads.

Kilowatt (kw) One thousand watts. A unit of power.

Kilowatt Hour (kwh) One thousand watt-hours. A unit of energy. Power multiplied by time equals energy.

Module The smallest replaceable unit in a solar electric array. An integral, encapsulated unit containing a number of PV cells.

Net Energy Billing a billing and metering practice under which a customer is billed on the basis of net energy over the billing period taking into account accumulated unused kilowatt-hour credits from the previous billing period.

Orientation Placement with respect to the cardinal directions, N, S, E, W; azimuth is the measure of orientation from north.

Panel A designation for a number of solar electric modules assembled in a single mechanical frame.

Peak Load The maximum load demand on a system.

Photovoltaic Cell The treated semiconductor material that converts solar irradiance to electricity.

Photovoltaic System (or Solar Electric System) An installation of solar electric modules and other components designed to produce power from sunlight and meet the power demand for a designated load.

Power (Watts) A basic unit of electricity equal (in dc circuits) to the product of current and voltage.

Tilt Angle The angle of inclination of a solar collector measured from the horizontal.

Tracking Array A solar electric array that follows the path of the sun. This can mean one-axis, east to west daily tracking, or two-axis tracking where the array follows the sun in azimuth and elevation.

Watt (W) The unit of electrical power. The power developed when a current of one ampere flows through a potential difference of one volt; 1/746 of a horsepower.

Watt Hour (Wh) A unit of energy equal to one watt of power connected

SOLAR ELECTRIC SITE ASSESSMENT REPORT

Dane County Landfill Main Garage

c/o

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Executive Summary

The results of the photovoltaic (PV) solar site assessment indicate that the Dane County Department of Public Works Landfill Main Garage site is an excellent site for the installation of a solar PV system. The best location to install PV modules for the anticipated array size is a roof mounted array located on the south facing portion the main garage building. There are no shading issues at this location other than one vent stack on the roof. There is ample room for the anticipate array sizes. The following table summarizes the results of the site assessment using 22 solar panels (230 watts each) and 42 roof mounted solar panels:

Energy Production, Cost, Economics and Environment Dane County Landfill Main Garage– Roof Mount		
Production	*Roof Mount*	
Solar electric systems rated module capacity (kW dc)	5.06 kW-DC	9.66 kW-DC
Estimated output year one (kWh/yr)	6,262	11,954
Cost		
Estimated installed cost	$37,950	$67,620
Focus On Energy Incentive*	$ 9,393	$17,931
System Cost after all incentives	**$28,557**	**$49,689**
Value of year 1 to year 10 power production	$15,307	$29,222
Economics		
10 Year discounted NPV	-$17,624	-$28,702
25 Year discounted NPV	-$5,272	-$4,942
10 Year IRR	-10.9%	-9.5%
25 Year IRR	1.7%	2.5%
Simple Payback Period	22 years	20 Years
Environment		
CO2 emission reduction per year (tons/year)	6.9	13.2
Key Assumptions		
Cost of System Per kW (dc)	$ 7,500	$ 7,000
Meets Focus on Energy Tier II Efficiency Level	$1.50/kWh	$1.50/kWh
Electricity Rate Year One ($/kWh)	$ 0.10	$ 0.10
MG&E Solar Electric Buyback Rate**	$0.25	$0.25
Estimated electricity price inflation rate (%/yr)	6.0%	6.0%
Expected output degradation (%/year)	0.50%	0.50%
Discount rate (used only in NPV)	3.0%	3.0%

***Installer must be certified by the North American Board of Certified Energy Practitioners (NABCEP) or those working towards certification.**

****Does not include cost to enter Green Power Tomorrow Program**

An area of approximately 45 feet by 90 feet is reasonably available for the installation of a roof mounted array on the sloping southern facing half of the main garage building. Installing PV modules on the garage roof may prove challenging. The roof only slopes 6 degrees and the ribbed sheet metal roof panels do not have raised ridges that most metal roof racking systems use to attach the racking. A pan and ballast racking system may work, but racking providers should be contacted to verify there use. Using 230-watt modules, the 22 modules compose a 5.06 array and 42 modules would compose a 9.66 kW array. Using a pan and ballast mounting system could place the bottom of the modules close to the roof surface. Significant snow events could result in the modules being covered for an extended period.

Next Steps

a) Evaluate the options presented in this report, and make a decision on system size, location and mounting methods.

b) Engineering reviews maybe needed.

- For roof mounted systems, confirm with the building designer and/or qualified structural engineer as to the building roof structure's ability to support the additional weight and wind loading of a solar electric system. Also, review the impact on roofing warrantee of siting panels over roofing.
- With an electrical professional, ensure space is available for balance of system components (e.g., inverter(s) disconnects, etc.) in the utility room, and at that space is available at electric panel/substation, with good access to the solar modules.

c) Determine the project's economics with your financial professionals. Incentive programs are subject to change, so ensure you information is up to date. For information regarding:

- Focus on Energy incentives, contact: www.focusonenergy.com or 800 762.7077.
- Federal tax incentives, contact: the IRS.
- U.S. Department of Agriculture rural business incentives, contact: www.farmenergy.org or in Wisconsin, Mark Brodziski at 715.345.7615, or mark.brodziski@wi.usda.gov

d) Contact at least three qualified installers to get price quotes (see Focus on Energy's full service solar electric installers attached to this report for a directory of Wisconsin's solar electric installers).

- It is recommended that the installer completes interconnection applications, obtains permits and fills out Focus on Energy incentive paperwork.
- Ensure that price quotes are comparable (e.g., all include any work that may be needed on the AC side of the inverter to be eligible for We Energies or Madison Gas and Electric buy back rates incentives).

e) Contact your insurance agent and advise them of your intent to install the renewable energy system, and ask for written confirmation of the liability coverage currently provided (as needed to meet utility requirements). Confirm that current insurance provides the needed coverage, and resolve any issues with the agent.

f) Define any permitting requirements for the installation of the system.
g) Based on the quote received, and consultation with financial professionals, make the final decisions on the project's size, location, mounting options and price with your preferred installer.

h) Apply and receive approval for incentives as appropriate. Commonly your preferred installer will assist with the applications.

i) Sign the installation contract with your selected installation firm.
- Insure that all zoning, utility agreements, financial incentive and any other required approvals are in hand prior to making any commitment to purchase.

j) It is usually much more cost effective to make energy efficiency improvements than install a solar electric system. For information about the Focus on Energy business energy efficiency program contact: Focusonenergy.com or 800.762.7077

Insure that all utility agreements, financial incentives, and any other required approvals/permits are in hand prior to making any commitment to purchase.

Disclaimers:

- All costs, power production, economic and other values in this report are estimates.
- The economic analysis presented in this report should be considered one method of evaluating this project.
- The estimated installed system cost(s) are/is not a formal estimate or bid.
- The information provided in this report should NOT be considered legal, financial, or tax advice.

October 28, 2010

Matthew R Giovanelli

Date

REPORT CONTENTS

1. Purpose of Site Assessment

The purpose of this assessment is to provide site-specific information on how a solar electric (also referred to as a photovoltaic, or PV) system would perform at your location, including information on estimated physical size, rated output, energy production, costs, financial incentives and mounting options. Site assessors are required to present unbiased information and may not recommend contractors or products.

Dane County is interested in:

- Clean energy/environmental concerns
- Reducing energy bills: maximizing system production and minimizing cost
- Possible Educational/Demonstration project
- Public relations: system should be publicized as a green investment

Dane County's solar electric system size expectations for the Landfill Main Garage are between 5 and 10 kW.[1]

2. Site's Electric Data

Electrical Service**:** The building complex has 400 amp 120/208 volt 3 phase 4 wire service. The electrical service is located on the south wall of the main garage building. See Figures 1 through 4.

Figure 1 Electrical Subpanels (inside)

Figure 2 Electrical Subpanels (inside)

[1] In Southeastern Wisconsin, a one kilowatt (kW) solar electric system, that is unshaded and fix mounted, will generate about 1230 kilowatt hours (kWh) per year. A one kW unshaded dual axis tracking system will generate about 1640 kWh/year.

Figure 3 Electrical Service (outside)

Figure 4 Electrical Service (outside)

Dane County provided energy usage for the Landfill site over the past 21 months. The information provided was for 4 MG&E meters, and did not specify which meter was for the main garage building. Therefore, the two meters with the highest usage was averaged together to obtain an average rate of $0.10 kWh.

3. Siting Options

The Dane County Landfill Main Garage Building site is located at 7102 US Highway 12 & 18 outside the City of Madison, Wisconsin 53718. Because of the active nature of the site, Dane County prefers that the PV array be installed as a roof mount system. See Figure 4 for an aerial view of the southern end of the building complex.

Figure 5 Aerial View Looking North

3.1 Shading Estimates

The location of the roof mounted PV modules on the southern portions of the building complex will need to take into consideration potential shading of the panels. Since PV modules can last from 30 to 40 years, system placement should consider shading by tree growth, adjacent buildings, and roof mounted HVAC units and vent stacks.

A device called the Solar Pathfinder is used to determine if there are any shading issues that would block the PV modules from receiving sun light. The Pathfinder shows the solar window for a given PV array system, for all months of the year, by transferring the shading of the surrounding obstructions (usually trees or buildings) onto an easy-to-read flat display. From this display, the percentage of shading for each month of the year can be computed; and from that, the reduction in energy output from the PV system due to this shading can be calculated.

Roof Mount

The Pathfinder was placed at two locations on the roof and solar window readings collected. Figure 6 shows the locations at which Pathfinder readings were collected.

Figure 6 Pathfinder Placement.

Figures 7 through 10 were taken of the proposed location of the roof mounted array.


Figure 7 Looking Southwest.


Figure 8 Looking West.

Figure 9 Looking Northwest.

Figure 10 Looking East.

Figures 11 & 12 depict the Pathfinder image and shading trace for the Pathfinder location numbers 1 and 2, respectively, (as depicted on Figure 6). Taken together the two locations identified on Figure 6 are shaded less than 1% of the time on average for the entire year.

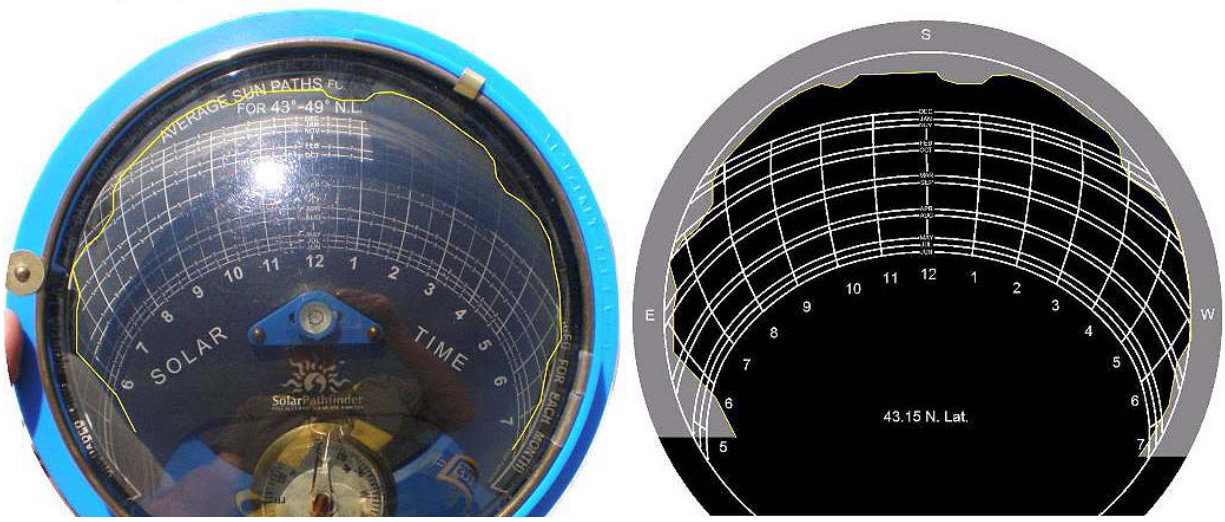

Figure 11 Image of Pathfinder & Shading Trace – Location #1.

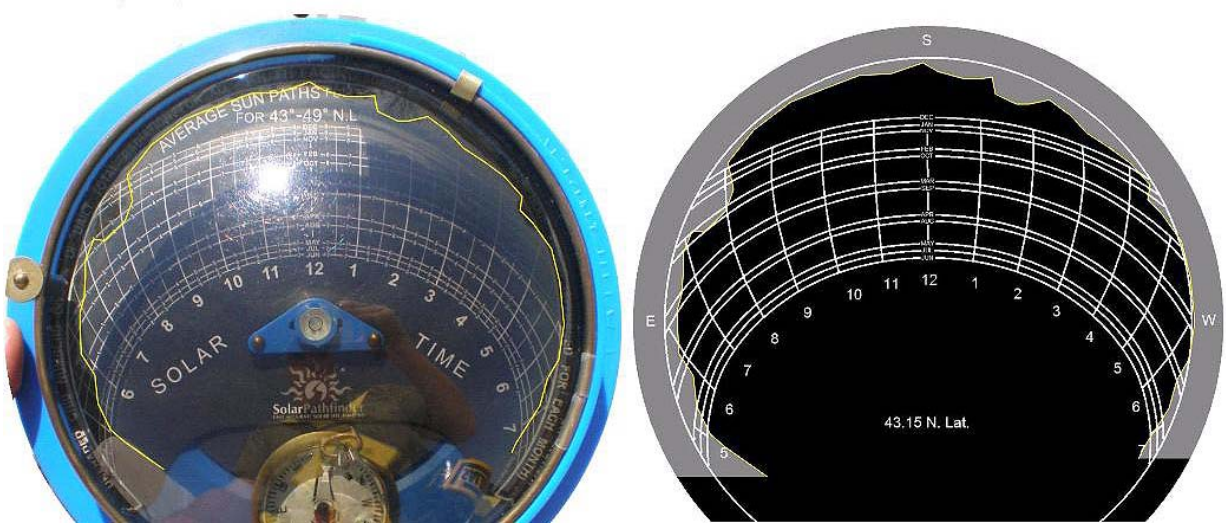

Figure 12 Image of Pathfinder & Shading Trace – Location #4.

Figure 13 presents the shading analysis by averaging the results from the four Pathfinder readings locations. The shading analysis indicates that a 9.66 kW-DC roof mount system on the southeast corner of the building would generate approximately 12,164 kWh a year.

Solar Obstruction Data

Month	Ideal Unshaded Solar Radiation Azimuth=180.0 Tilt=43.1 KWH/m^2 /day	Actual Shaded Solar Radiation Azimuth=177.8 Tilt=35.0 KWH/m^2 /day	Actual Shaded AC Energy (KWH) Azimuth=177.80 Tilt=35.00	Actual Unshaded AC Energy (KWH) Azimuth=177.8 Tilt=35.00	PVWatts Unshaded % Actual Site Azimuth=177.8 Tilt=35.00
January	3.28	3.07	809.44	816.00	98.20 %
February	3.96	3.82	878.16	879.00	99.77 %
March	4.36	4.36	1,051.55	1,052.00	99.80 %
April	4.96	5.05	1,131.00	1,131.00	99.67 %
May	5.57	5.78	1,286.00	1,286.00	99.52 %
June	5.83	6.12	1,287.53	1,288.00	99.45 %
July	5.74	5.97	1,295.00	1,295.00	99.65 %
August	5.52	5.66	1,230.00	1,230.00	99.70 %
September	4.93	4.91	1,042.95	1,045.00	99.54 %
October	3.91	3.77	877.00	877.00	100.00 %
November	2.88	2.68	623.18	635.00	97.62 %
December	2.73	2.52	652.60	659.00	99.09 %
Totals	**53.66**	**53.70**	**12,164.39**	**12,193.00**	**99.33 %**
	Effect: 100.00%	**Effect: 100.00%**			**Unweighted**
	Sun Hrs: 4.47	**Sun Hrs: 4.47**			**Yearly Avg**

Notes: 42 - 230 watt modules

Figure 13 Solar Obstruction Data for Roof Mount (Black Roof Section) – 9.66 kW-DC.

The shading analysis also indicates that a 5.06 kW-DC roof mount system at the same location would generate approximately 6,368 kWh a year (see Figure 14).

Solar Obstruction Data

Month	Ideal Unshaded Solar Radiation Azimuth=180.0 Tilt=43.1 KWH/m^2 /day	Actual Shaded Solar Radiation Azimuth=177.8 Tilt=35.0 KWH/m^2 /day	Actual Shaded AC Energy (KWH) Azimuth=177.80 Tilt=35.00	Actual Unshaded AC Energy (KWH) Azimuth=177.8 Tilt=35.00	PVWatts Unshaded % Actual Site Azimuth=177.8 Tilt=35.00
January	3.28	3.07	422.28	425.00	98.20 %
February	3.96	3.82	459.57	460.00	99.77 %
March	4.36	4.36	549.85	550.00	99.80 %
April	4.96	5.05	592.00	592.00	99.67 %
May	5.57	5.78	673.00	673.00	99.52 %
June	5.83	6.12	676.00	676.00	99.45 %
July	5.74	5.97	677.00	677.00	99.65 %
August	5.52	5.66	643.00	643.00	99.70 %
September	4.93	4.91	547.86	549.00	99.54 %
October	3.91	3.77	460.00	460.00	100.00 %
November	2.88	2.68	326.64	333.00	97.62 %
December	2.73	2.52	341.70	345.00	99.09 %
Totals	**53.66**	**53.70**	**6,368.89**	**6,383.00**	**99.33 %**
	Effect: 100.00%	**Effect: 100.00%**			**Unweighted**
	Sun Hrs: 4.47	**Sun Hrs: 4.47**			**Yearly Avg**

Notes: 22 - 230 watt modules

Figure 14 Solar Obstruction Data for Roof Mount (Black Roof Section) – 5.06 kW-DC.

The above Solar Obstruction Data tables are the output of a computer program developed by the makers of the Solar Pathfinder. It was used to calculate the estimated annual output in kWh/yr that will be produced by a solar PV system at this site. The table incorporates a software tool called PVWatts. PVWatts was developed by the National Renewable Energy Laboratory (NREL) to estimate the energy output of solar systems taking into account such factors as the daily solar radiation (kWh/m^2/day) in the geographic area, the type of mount (fixed or dual axis mounted), the azimuth angle between the direction of the array and due south, the tilt angle of the array, and a de-rating factor which takes into account any electrical losses in the inverter, transformer, AC and DC wiring, PV module mismatch, etc., as well as a small percentage de-rating for soiling, shading, and age of the panels. For this case a de-rate factor of 80% was used to account for the system losses. The Pathfinder computer program also incorporated TMY3 weather data for the United States.

4. System Mounting Recommendations

Roof Mount

There are two main ways to install a roof mount system. One way is to use a racking system that is attached to the structural members of the roof, which would require roof penetrations (see Figure 15 for an example). Many of these racking systems have flashing boots that help reduce or eliminate water from leaking through the roof.

Advantages of this system include excellent support for wind loading and a bigger area for snow to slide of the modules to kelp them from being covered by snow.

Figure 15 Direct To Roof Mounting System.

The easiest and usually cheapest mounting option is to place the solar panels directly on the roof using a pan and ballast racking system that eliminates the need for roof penetrations (see Figure 16 for example). One possible disadvantage is the lack of room for snow to slide off the modules.

Figure 16 Example Fixed Mounted Pan and Ballast System.

However, the roof has a slope of 6 degrees and is composed of ribbed sheet metal attached to a steel beam structure. This may pose a problem for a pan and ballast mounting system. The pans may creep down slope of the roof via repeated freeze thaw cycles. The racking manufacture should be consulted with regard to this concern.

The ribbed sheet metal roof panels are also not typical of metal roofing that PV modules can attach to easily. The rounded ribs of the roof panels do not have raised squared off ridges that most metal roof racking systems use to attach the racking. The racking manufacture should be consulted with regard to this concern. It may be necessary to use roof penetrations and attach the racking to the steel beam structure. In any case, the PV modules will need to be tilted to between 30 and 35 degrees.

For all roof-mounted systems, the roof loading from the modules, racks, balance of system, etc., as well as wind and snow loading, must be evaluated to determine if the roof is structurally able to support the additional loads. This is the responsibility of the customer and their structural engineer.

When unshaded and positioned directly south with the proper pitch (30 to 35 degrees), this type of system would be expected to generate about 1230 kWh/year per kilowatt (kW) of modules. The output from the modules would be slightly less then this value if

it is determined that the pitch of the PV modules would need to be less than 30-degrees to reduce wind loading. Fix mounted systems have no moving parts and are therefore expected to require very little maintenance

Some of the benefits of a roof-mounted array are:

- Utilizes an out of the way space
- Is generally considered to be less costly to install than a ground-mounted array
- Lowered concern about vandalism for some locations

5. Recommended Solar Electric Layout and Sizing

The layout of the PV modules will be dictated by the size expectations of the array, space availability, inter-row spacing (shading a PV module casts on the module behind it), module orientation, and shadows cast by HVAC units and vent stacks.

Roof Mount

The south facing roof section poses some challenges. Because the roof only slopes 6 degrees to the south, the PV modules will need to be tilted an additional 24 to 29 degrees to the south. In order to reduce wind loading, the modules should be installed in landscape orientation. The shadow cast by the vent stack near the east end of the roof will slightly reduce the available roof area.

Assuming the PV modules are 68-inches by 40-inches in size and installed in landscape orientation (long axis parallel to roof surface) and at a relative pitch of 35 degrees (6 degree slope of the roof plus a module tilt of 29 degrees), each successive row of modules will need to be at least 6.8-feet apart (measured from the front of the module in the first row to the front of the module in the second and third row). This assumes the worst case sun angle on December 21st at 9:00 AM and 3:00 PM. Modules should also be installed no closure than 3.3 feet from the sides and back of the 16 inch tall vent stack located near the east end of the roof.

As a result, the roof can easily accommodate a 10 kW solar array. As noted earlier in this report, the slope of the roof could be a problem for a pan and ballast system. The pans may creep down slope of the roof via repeated freeze thaw cycles. The racking manufacture should be consulted with regard to this concern.

The distance from the electrical service in the building to the southwest end of the proposed array on the roof is approximately 35 feet.

6. Solar Electric Systems Costs and Incentives

The typical installed price of a grid-tied solar system is $7.00 to $9.00 per watt. Larger systems will tend to be toward the lower end of the range; smaller systems usually cost more $/watt because the cost of additional modules is not as big a factor compared with the labor and materials that go into the initial installation of the PV

system. In addition, longer distances for electrical cable to reach the inverters will also increase the cost. A cost of $7,500 per kW was assumed for the 5.06 kW-DC and $7,000 per kW for the 9.66 kW roof mounted system, with the total cost of your system, before incentives, estimated to be $37,950 and $67,620, respectively. These costs may increase if a more complicated racking system is needed.

6.1 Incentives

a. Focus on Energy Renewable Program

Focus on Energy provides a performance-based buy-down incentive program for solar photovoltaic systems based on there size and energy efficiency of the building on which they are installed. Beginning in February 2010 Focus on Energy introduced a two tiered incentive structure designed to encourage customers to achieve a level of energy efficiency in their home or business before installing PV renewable energy systems.

Cash Back Rewards for DC rated module capacity between 0.5 kW-DC and 50 kW-DC

Tier I incentives will be available to all customers; Tier II incentives will be available to those customers who met a prescribed level of efficiency first (this will be achieved either through past participation in specified Focus on Energy program or by achieving an energy usage benchmark set by the program).

Tier I non-profit and local government customer incentives will be $1.50 per kWh generated over an average year for systems of 0.5 kW to 50 kW. Customers who do energy efficiency first (Tier II), as defined by Focus on Energy, will be eligible for an incentive level of $1.75 per kWh. The incentive caps at $75,000, not to exceed 35% of installed cost. The actual amount of the incentive is determined by Focus on Energy when the application for a Cash Back Reward is submitted. Upon approval, you will have one year to install the system and receive the installation incentive. The system must be installed by a NABCEP certified PV installer, or an installer listed as pursuing NABCEP certification, to qualify for a Focus on Energy Reward.

To receive the Tier II incentive, the job site of the renewable energy system must fully satisfy the requirements of one of the efficiency tracks listed on page 4 of the *Solar Electric (Photovoltaic) System Pre-Approval Incentive Application for Business* which is attached to this site assessment report.

For additional details about these programs go to the Focus on Energy web site www.focusonenergy.com and follow the links for renewable energy incentives.

b. Madison Gas & Electric (MG&E)

Customer-generators enrolled in the Madison Gas & Electric (MGE) green power purchase program -- Green Power Tomorrow -- are eligible to receive a special

rate for the power produced from solar photovoltaic (PV) systems. Under this program, the electricity produced from 1 to 10 kilowatt (kW-DC) PV systems will be purchased by MGE at a rate of $0.25/kilowatt-hour (kWh). This rate will apply to all electricity produced by the system. As the program is limited to Green Power Tomorrow participants, customers will purchase electricity from the utility at the normal retail rate plus the green power premium (currently $0.0125/kWh).

Annual green energy purchases must be at least as large as the AC output of the PV system. This arrangement requires that the customer have two electricity meters; one to measure electricity production and one to measure electricity consumption. MGE will provide the additional meter but the customer must pay for an electrician to supply and install a two-meter socket and any other modifications necessary for system function.

Participants must sign a 10-year contract with MGE but may opt-out with 30 days notice. Systems must be designed and installed to comply with Wisconsin interconnection standards. Any renewable energy credits (RECs), emission allowances, or other environmental attributes generated by the system while the contract is in force will accrue to MGE rather than the customer-generator. The overall enrollment for this program is capped at 1,000 kW. More information can be found at http://www.mge.com/home/rates/cleanpower.htm

c. State Taxes
Wisconsin's depreciation is based on the Federal depreciation formula. So the Federal five-year accelerated depreciation applies to Wisconsin business income taxes as well. Consult a qualified tax adviser to determine your individual eligibility.

d. Net Metering
Wisconsin municipal and investor-owned utilities are required to allow customers to net-meter solar electric systems with rated output of 20kW or less. What this means is that the utility will provide full retail credit for any extra energy that is sent out by the customer's solar electric system onto the utility grid. Net metering can be done using any electric rate provided for which the customer is eligible (including time of day rates).

e. Property Tax Exemption
Solar electric systems are exempt from Wisconsin property tax assessments making solar an investment you can make on your property without increasing the assessed value and tax liability.

f. Renewable Energy Credits (RECS)
In some states markets are buying and selling Renewable Energy Credits (RECs) also known as green tags. The RECs represent the clean energy attributes of renewable electric systems (not the kilowatt hours). It is likely that during the life of a large commercial solar electric system the owner will be able to sell RECs in Wisconsin for additional income. MG&E will own the RECs for ten years.

6.2 Demand Benefits

Reduced demand loads and charges can occur if the site's peak demand occurs during periods of solar electric system output.

- For sites with a peak electrical demand between 10 am and 2 pm on sunny business days: Demand reduction benefits could equal up to 60% of the solar electric system's rated dc capacity
- For sites with a peak electrical demand that occurs before 8 am or after 4 pm: Demand reductions would be expected to be minimal
- While a PV system will likely reduce Demand Charges, the method MG&E uses for determining demand charges may not factor for this reduction. Additional investigation may be required.

6.3 System Cost after Incentives

The following table shows the cost of the roof mounted 5.06 kW-DC and 9.66 kW-DC solar PV systems after all of the incentives[2]. It is assumed that the building would **not** qualify for Focus on Energy's Tier II cash back program. The Tier I level of $1.50 per kWh was used. Focus on Energy also requires that the estimated production be reduced by 1% for snow cover for modules tilted at 35 degrees, which is reflected in the tables.

Energy Production, Cost, Economics and Environment Dane County Landfill Main Garage– Roof Mount		
Production	*Roof Mount*	
Solar electric systems rated module capacity (kW dc)	5.06 kW-DC	9.66 kW-DC
Estimated output year one (kWh/yr)	6,262	11,954
Cost		
Estimated installed cost	$37,950	$67,620
Focus On Energy Incentive*	$ 9,393	$17,931
System Cost after all incentives	**$28,557**	**$49,689**
Value of year 1 to year 10 power production	$15,307	$29,222
Economics		
10 Year discounted NPV	-$17,624	-$28,702
25 Year discounted NPV	-$5,272	-$4,942
10 Year IRR	-10.9%	-9.5%
25 Year IRR	1.7%	2.5%
Simple Payback Period	22 years	20 Years

[2] The incentives in the table do not include any adjustments that may be made by Focus on Energy.

Environment		
CO2 emission reduction per year (tons/year)	6.9	13.2
Key Assumptions		
Cost of System Per kW (dc)	$ 7,500	$ 7,000
Meets Focus on Energy Tier II Efficiency Level	$1.50/kWh	$1.50/kWh
Electricity Rate Year One ($/kWh)	$ 0.10	$ 0.10
MG&E Solar Electric Buyback Rate**	$0.25	$0.25
Estimated electricity price inflation rate (%/yr)	6.0%	6.0%
Expected output degradation (%/year)	0.50%	0.50%
Discount rate (used only in NPV)	3.0%	3.0%

***Installer must be certified by the North American Board of Certified Energy Practitioners (NABCEP) or those working towards certification.**

****Does not include cost to enter Green Power Tomorrow Program**

Based on these calculations, the payback time for the roof mounted system is 22 years for the 5.06 kW-DC and 20 years for the 9.66 kW-DC system. The payback times are based on a 6% per year fuel escalation rate. This means if the electricity rates increase by greater then 6% per year over the next 20 years, the payback time will be less. Most people believe that the utility's electricity rates will most likely be on the rise. However, predicting future energy costs is not within the scope of this report. Once the payback period is reached, the owner will be producing free electricity for the remaining 10 to 15 or so years left in the life of the PV system.

7. Operation and Maintenance

Operation and maintenance needs will be minimal with a fixed mounted systems. Expect to pay approximately 0.25% of the total cost of the system per year for maintenance and approximately 0.4% for insurance. Operation and maintenance costs of 0.25% were used in the payback calculations while insurance costs were not.

8. Summary

Under present site conditions, the Landfill Main Garage building site is an excellent site for a solar PV system. A roof mount system can accommodate a 9.66 kW-DC kW system that is estimated to generate 11,954 kWh/year. The estimate cost to install the systems after Focus on Energy Cash Back Rewards is taken into consideration is $49,689, with a pay back time of 20 years. A smaller 5.06 kW-DC system would generate an estimated 6,262 kWh/yr at an installed price of $28,557 after incentives, with a payback time of 22 years.

The electrical rate used was $0.10 kWh, MG&E solar electric buyback rate of $0.25 kWh, and the Focus on Energy incentive efficiency level was $1.50/kWh.

9. Education Resources

- Focus on Energy web site (www.focusonenergy.org) for information on Renewable Energy.
- For more information on state incentives for renewable energy - www.dsireusa.org
- Home Power Magazine/Website (www.homepower.com) – Case studies and stories of renewable energy installations around the country.
- Midwest Renewable Energy Association (www.the-mrea.org) – Hands-on workshops in Wind, PV, Solar Hot water, and more.
- Consumer Guide to Buying a Solar Electric System www.nrel.gov/docs/fy04osti/35297.pdf http://www.homepower.com/files/beginner/SolarElectricBasics.pdf
- The We Energies renewable energy programs, contact: We Energies Customer Contact Center at 800-714-7777, ext. 7700 or www.we-energies.com/re
- Energy Star for information on appliance energy ratings (http://www.energystar.gov)

10. Other Information

Attachment	Description
1	Solar Electric System Terminology Definitions.
2	Full service solar electric installer list.
3	Solar Electric System Pre-Approval Incentive Application for Business

Attachment 1
Solar Electric System Terminology Definitions

Solar Electric System Definitions

Based largely on the Solar Electric Glossary from Sandia National Labs

Alternating Current (ac) An electric current that reverses direction periodically.

Direct Current (dc) Electric current flowing in only one direction.

Fixed Tilt Array A solar electric array set in at a fixed angle with respect to horizontal.

Grid Term used to describe an electrical utility distribution network.

Inverter In a solar electric system, an inverter converts dc power from the solar electric array to ac power compatible with the utility and ac loads.

Kilowatt (kw) One thousand watts. A unit of power.

Kilowatt Hour (kwh) One thousand watt-hours. A unit of energy. Power multiplied by time equals energy.

Module The smallest replaceable unit in a solar electric array. An integral, encapsulated unit containing a number of PV cells.

Net Energy Billing a billing and metering practice under which a customer is billed on the basis of net energy over the billing period taking into account accumulated unused kilowatt-hour credits from the previous billing period.

Orientation Placement with respect to the cardinal directions, N, S, E, W; azimuth is the measure of orientation from north.

Panel A designation for a number of solar electric modules assembled in a single mechanical frame.

Peak Load The maximum load demand on a system.

Photovoltaic Cell The treated semiconductor material that converts solar irradiance to electricity.

Photovoltaic System (or Solar Electric System) An installation of solar electric modules and other components designed to produce power from sunlight and meet the power demand for a designated load.

Power (Watts) A basic unit of electricity equal (in dc circuits) to the product of current and voltage.

Tilt Angle The angle of inclination of a solar collector measured from the horizontal.

Tracking Array A solar electric array that follows the path of the sun. This can mean one-axis, east to west daily tracking, or two-axis tracking where the array follows the sun in azimuth and elevation.

Watt (W) The unit of electrical power. The power developed when a current of one ampere flows through a potential difference of one volt; 1/746 of a horsepower.

Watt Hour (Wh) A unit of energy equal to one watt of power connected