



MADISON
AREA | TECHNICAL
COLLEGE

Creating a Solar Roadmap for your School

Ken Walz

MREA Energy Fair, Fri July 21, 2019

4pm – Orange Tent



Acknowledgements:



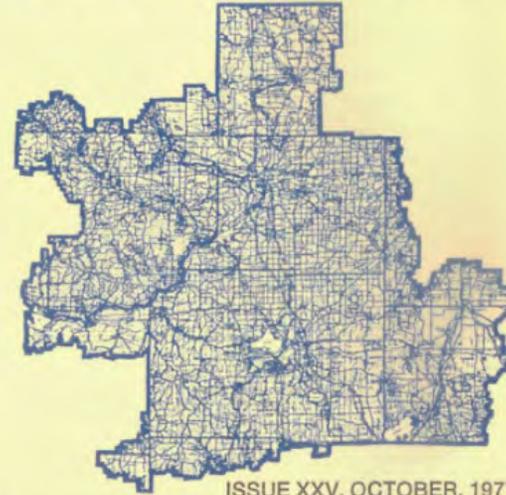
Award #s 1600934 and 1800893

Disclaimer: this work was supported by the US Dept of Energy Solar Energy Technology Office and the National Science Foundation Advanced Technological Education program. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the Department of Energy or the National Science Foundation.

**A quick historical
snapshot of pioneering
clean energy efforts at
Madison College..**

THE SHUTTLE NEWSLETTER

for
"better communications between
high school and MATC personnel"



ISSUE XXV, OCTOBER, 1977

AREA VOCATIONAL, TECHNICAL & ADULT EDUCATION DISTRICT NO. 4

MATC STUDENT HONORED **Solar Heat In Portage**



The Greater Madison Board of Realtors, Inc. honored Lem Eaton, a MATC student, at the April, 1977 GMBR Board Luncheon. Pictured is President Mike Franzen presenting the \$150.00 GMBR Scholarship to Mr. Eaton.

Mr. Eaton, the son of Mr. and Mrs. Nathaniel Eaton of Milwaukee, resides in Madison, Wisconsin.

The energy of the sun will provide an estimated 42 per cent of the annual heating needs of a new vocational education facility at Portage.

The Area Board of Vocational, Technical and Adult Education District No. 4, reviewed the results of an energy study and instructed architect Kenton Peters to include solar heating in the design of the new building.

Bert Johnson, vice-president of Mechanical Design, Inc., said the cost of the solar heating system would be \$62,000.

Johnson recommended electric heat be used to supplement the solar heat and said that arrangement would save about \$41,000 over 20 years.

"Most heating will be served electrically 20 years from now," Johnson predicted.

The electric heating system would be capable of carrying the entire heating load, he said, but is expected to be used only as a supplement to the solar system.

The structure will be one of the first educational buildings in the state to employ solar heating.

"I feel strongly we need to go this way even if we consider ourselves experimental," John Misfeldt, a board member from Fort Atkinson, said.

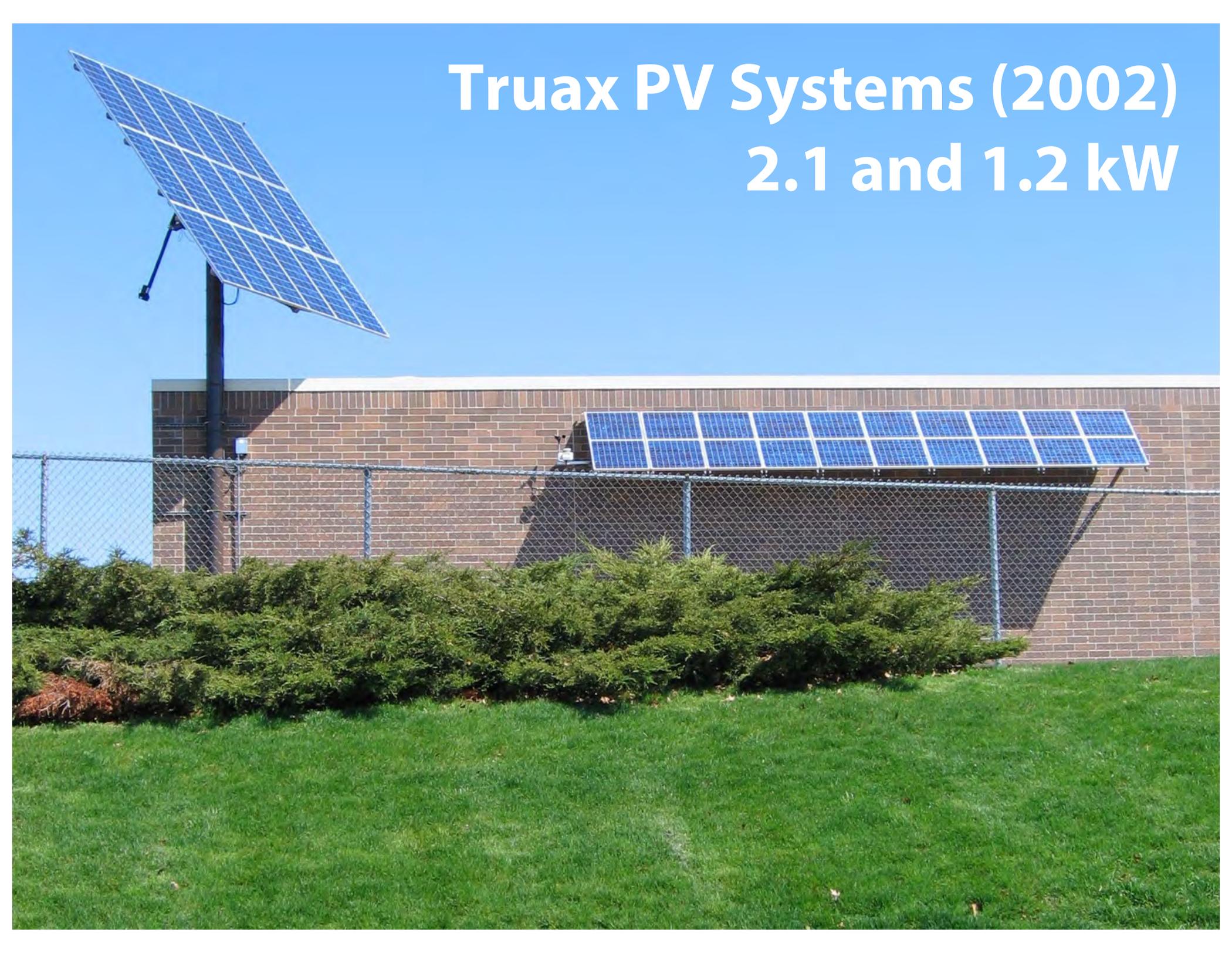
MATC – Portage Solar Thermal System



2,200 sq.ft. of collector surface area, producing an estimated 5,000 therms of energy annually

Truax PV Systems (2002)

2.1 and 1.2 kW





Building Integrated Photovoltaic Bus Shelter – 1.0 kW (2007)

Commercial Ave PV Training Lab. 9 kW total (2010)





Solar Photovoltaic Roadmap

The Madison College Solar Roadmap was created through the College's participation in the Solar University Network funded by the U.S. Department of Energy SunShot Initiative. Over the course of several months in spring 2018, a team from Madison College participated in a course organized by the Midwest Renewable Energy Association to develop a campus solar roadmap. The course included teams from 14 colleges and universities across the country that worked together to explore and share best practices in solar planning and development. The course included subject matter expert instructors from the education, industry, and financial sectors. Numerous solar informational resources, research analyses, online tools, and case studies provided by government agencies, national laboratories, and other colleges were examined. The Madison College Solar Roadmap is a 60 page document that was produced as an outcome of that process, with the intention that it would be incorporated in the Madison College Facilities Master Plan, to guide solar projects to be completed over the next decade.

The Roadmap was authored by:

Steven Ansonge, Madison College Student Senate President
Tom Helbig, Madison College Electrician and Electrical Instructor
Wes Marquardt, Madison College Facilities Manager
Mark Thomas, Madison College Vice President and CFO
Ken Walz, Madison College STEM Instructor & Director of the CREATE Energy Center

Table of Contents

Overview and Executive Summary
Section 1: Solar PV Stakeholders at Madison College
Section 2: Solar PV Development Considerations
Section 3: Campus Energy Analysis
Section 4: Solar PV Site Prioritization
Section 5: Solar PV Project Financial Modeling
Section 6: Solar PV Contracting - Bid-Ready Solar Projects
Section 7: Solar PV RFPs - Creation and Execution
Section 8: Solar PV Forecast and Future Outlook
Section 9: Solar PV Instruction at Madison College
Section 10: Solar Grant Related Activities at Madison College
Attachments and Figures

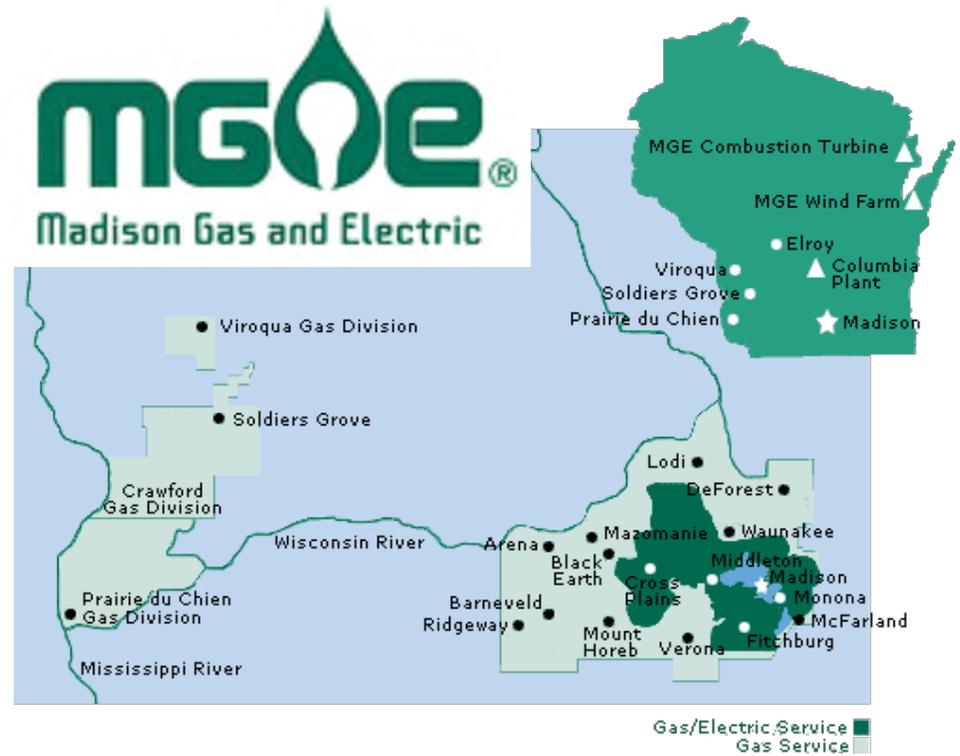
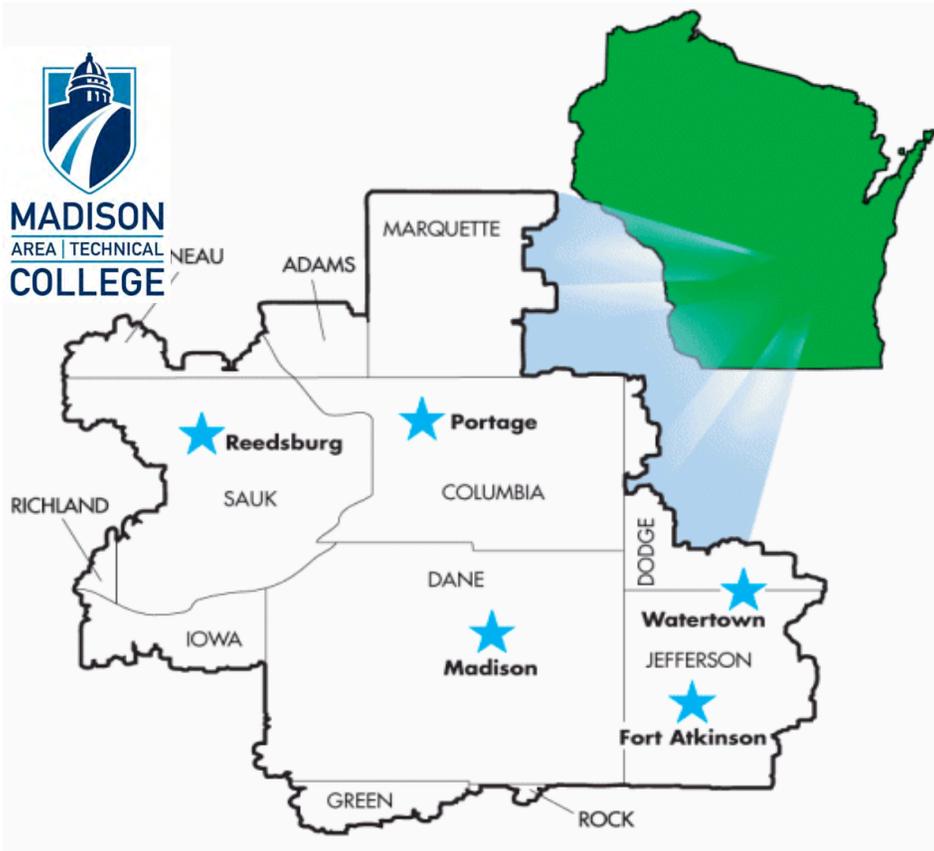
Roadmap Completed in 2017-2018

Priorities Identified

1. Truax Main Campus
2. New South Campus
3. Health and Protective Services
4. Commercial Avenue (update instructional systems to include a ground mount array, energy storage and EV charging capacity)
5. Regional Campuses

Madison College Announces 1.85 MW Rooftop Solar Project (2018)

Maps Illustrating the Madison College District and MGE Service Territory



Ariel View of the Truax Main Building (taken before new construction)

1701 Wright St.

© 2016 Google

Anderson St
Google Earth





View of SE corner of 3rd floor roof. Looking East

View of NE corner of roof looking Northeast



View from roof facing south – note 100% open solar window



Decrease in solar costs since 2010

(this allowed the college to increase the system size)

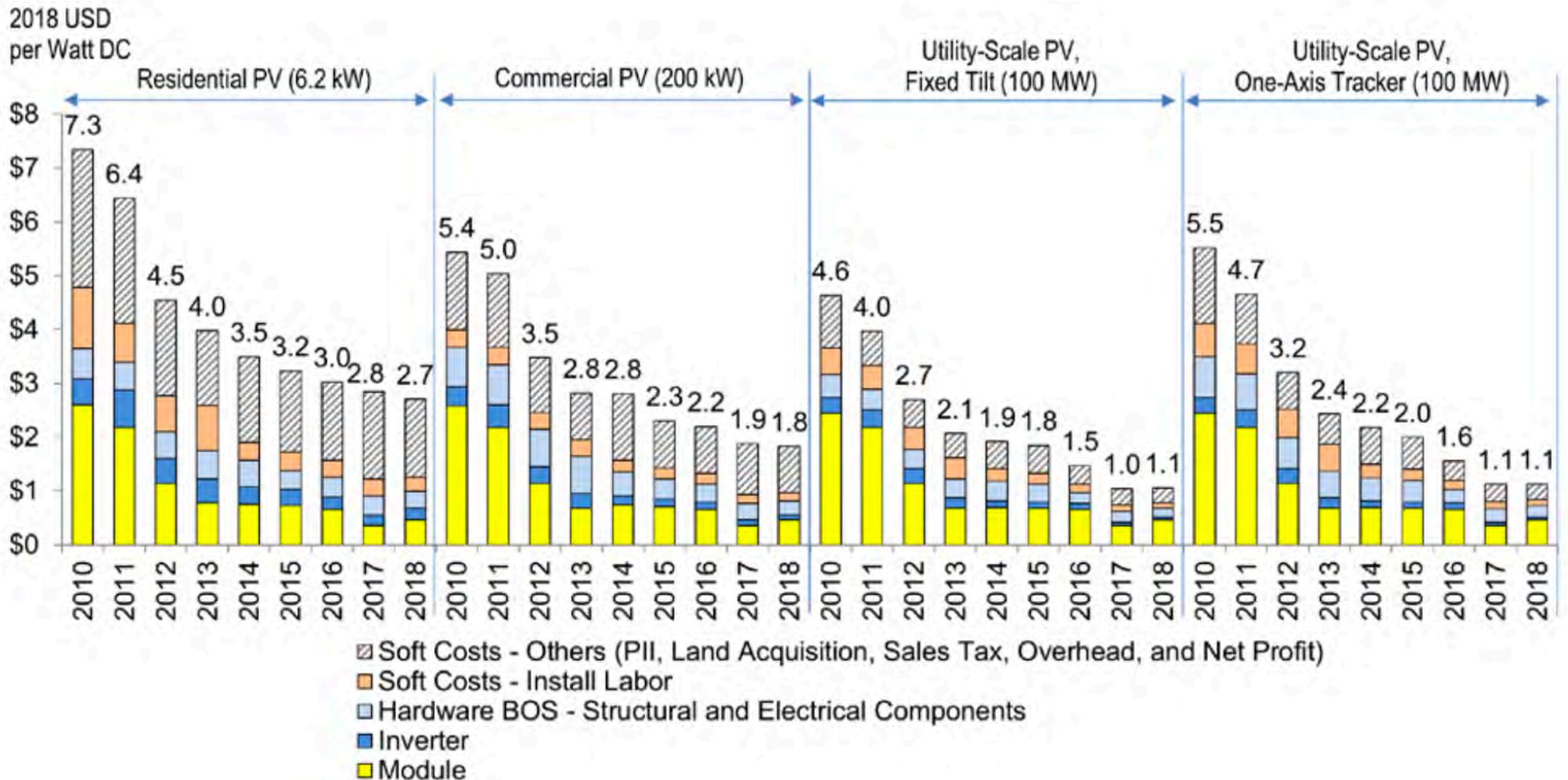
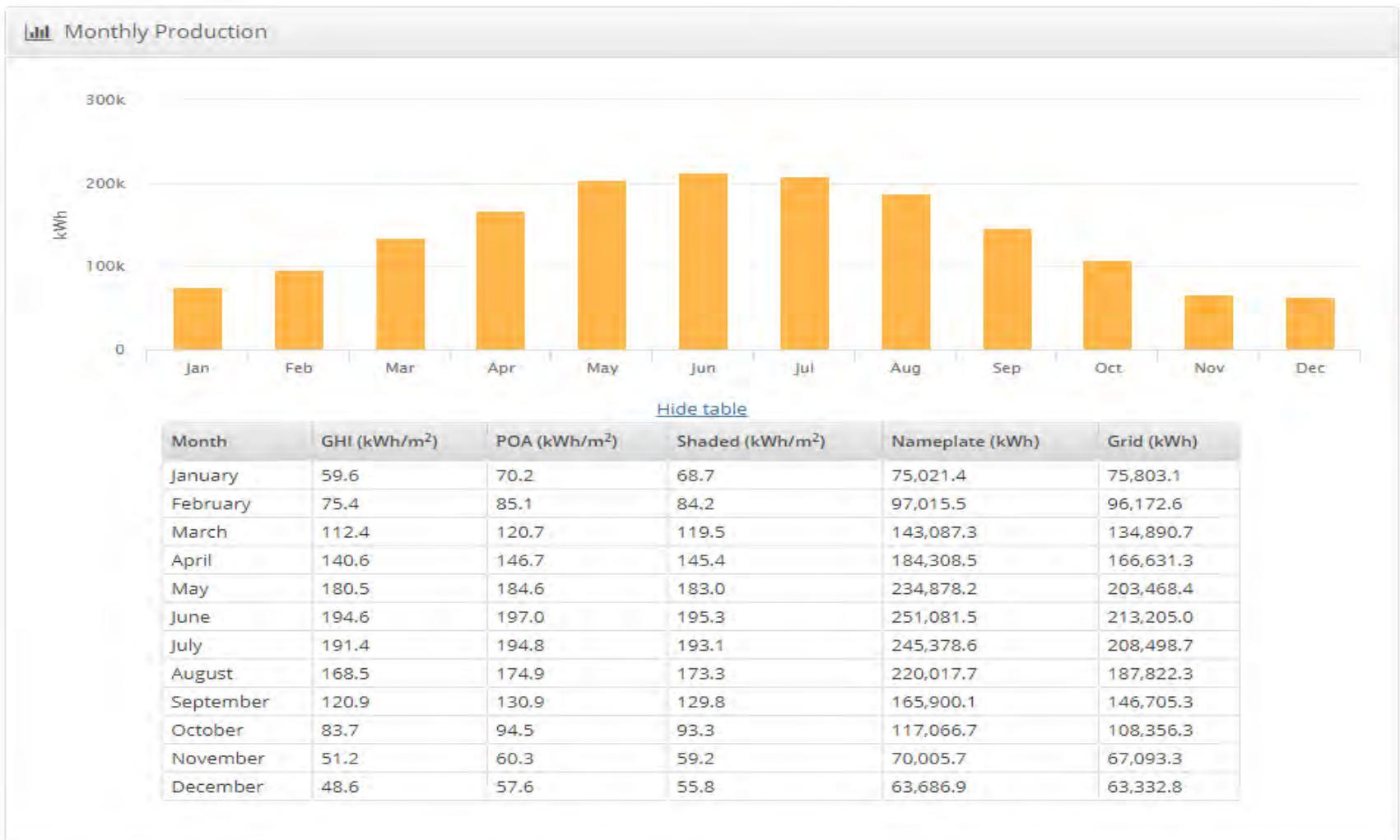


Figure 33. NREL PV system cost benchmark summary (inflation adjusted), 2010–2018

Estimated System Production

2,300,000 kWh average annual PV system production



Energy Impact for MC

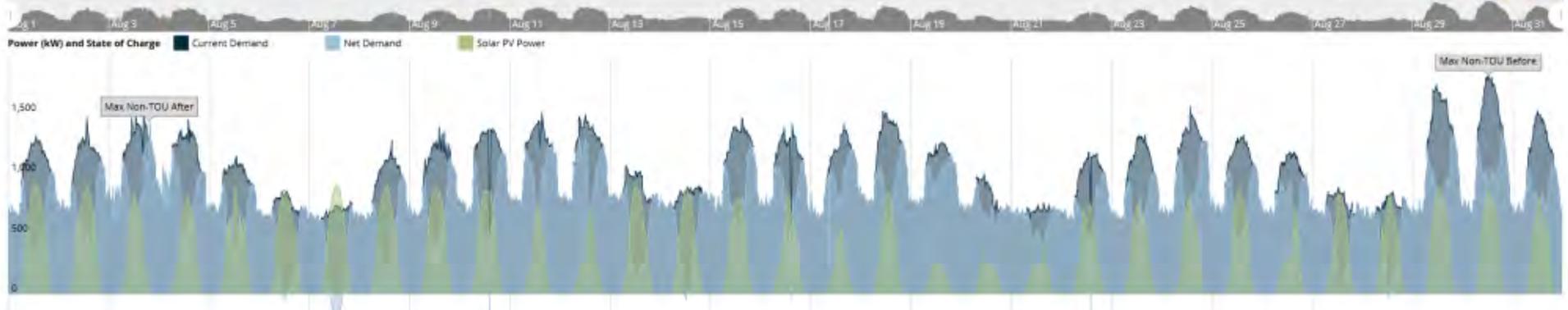
- On a good day: offset roughly 75-100% of Truax campus electric load
- Over a year: offset roughly 20-25% of consumption

Date Range for Chart

Select Date Range

Demand Profile And Costs Data

Zoom: 1 day 2 days 3 days 1 week **Full Range**

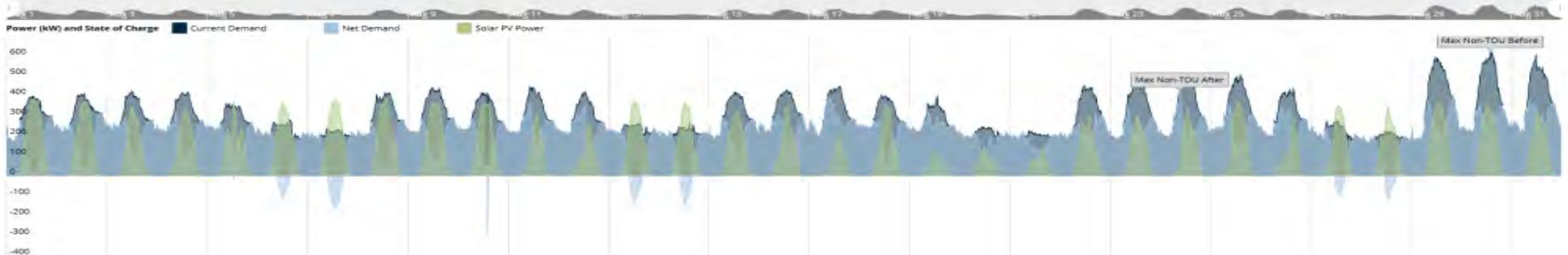


Date Range for Chart

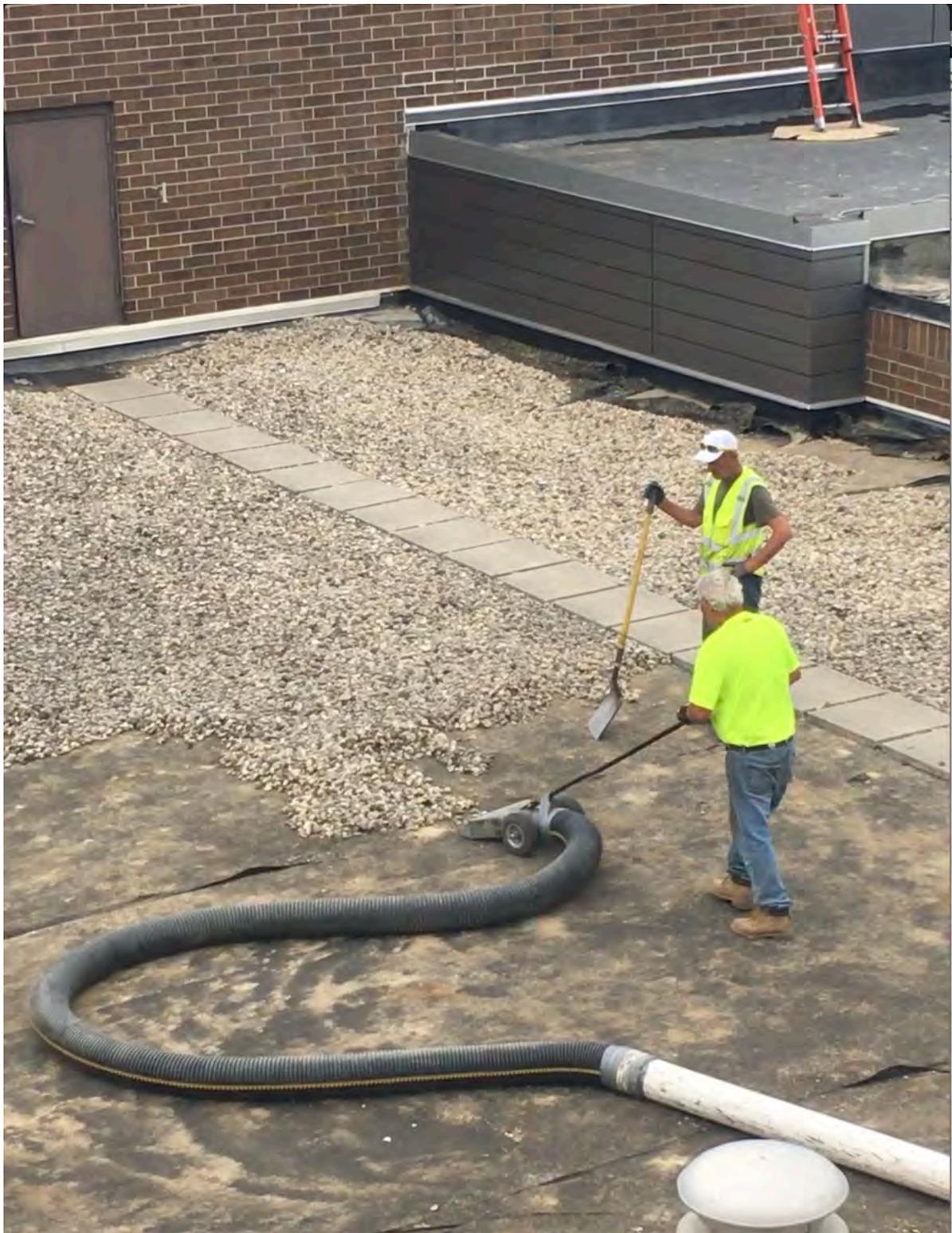
Select Date Range

Demand Profile And Costs Data

Zoom: 1 day 2 days 3 days 1 week **Full Range**



Let's Look At the Roof
Replacement and Soar Installation
Process...













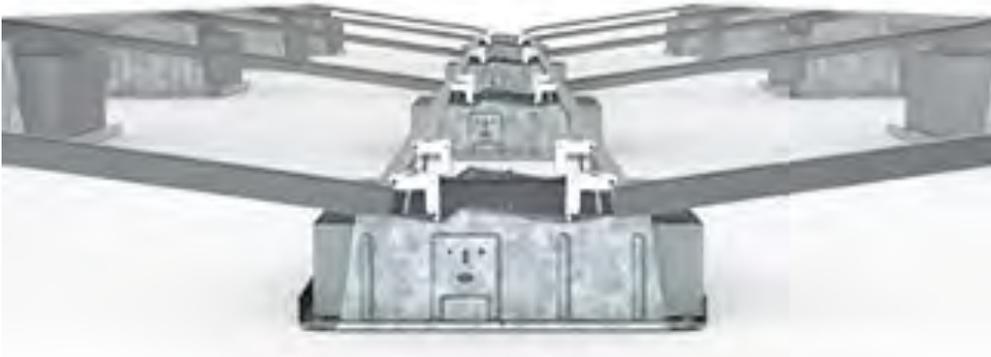
Madison College Alumni were part of the crew!



Ecolibrium ballasted rack



Unirac RMDT



- 8° tilt dual tilt (E-W) design to maximize power density due to existing roof penetrations and skylights



Ecolibrium Eco X Metal – Standing Seam Racking



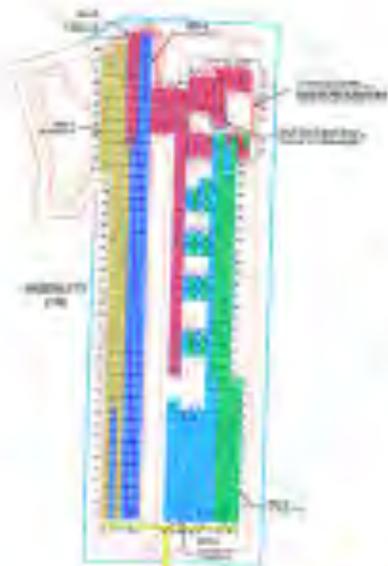
SolarEdge New Synergy Inverters

- SE10KUS, SE66.6K, & SE100KUS inverters with integrated monitoring, 10 year warranty
- P730 DC power optimizers – two modules per optimizer
 - Max Power Point Tracking
 - Monitoring to the optimizer level using powerline communication
 - NEC 2017 rapid shutdown compliant
- Israeli company founded in 2006; 2,500 MW shipped in 2017





Madison College 1.85 MW Solar System



5700 panels
119,300 sq ft
Roughly two
football fields
worth of panels

ADA Accessible Student Lab

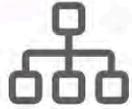


SUNVEST
SOLAR INC.

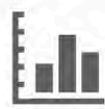




Dashboard



Layout



Charts



Reports



Alerts



Admin

Choose a site (insert at least 3 letters to search):

Madison College Truax

Overview

Current Power 94.1 kW	Energy today 1.65 MWh	Energy this month 119.97 MWh	Lifetime energy 621.14 MWh
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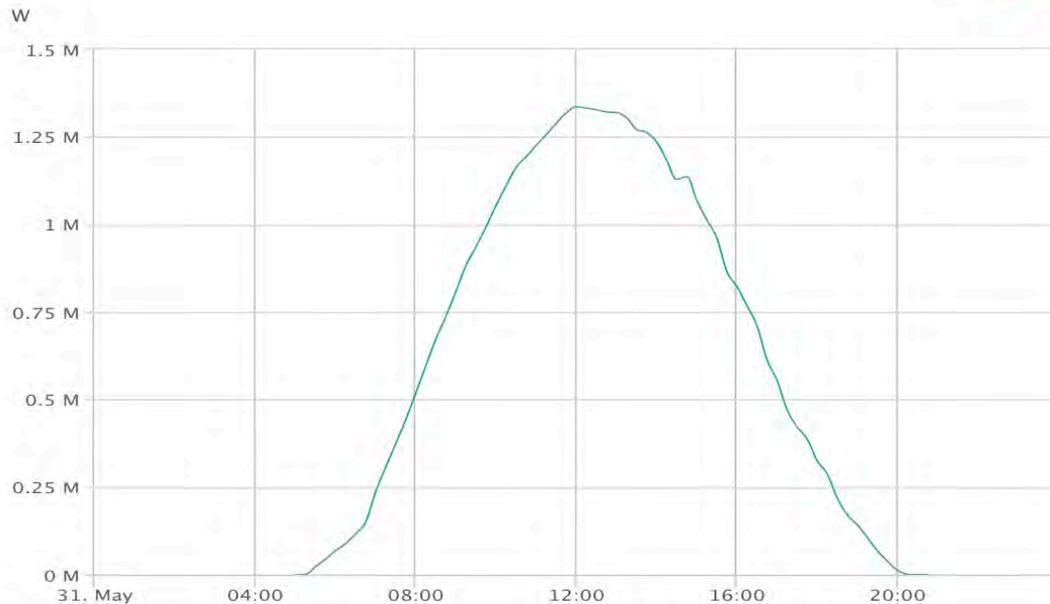
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Power and Energy

Day Week Month Billing Cycle Year

05/31/2019

System Production: **11 MWh**



■ Solar Production

Site Details

Name	Madison College
Country	United States
Installed	06/01/2018
Last Updated	06/17/2019 11:58
Peak Power	1.851 kWp

Weather

Cloudy
65 °F
Feels like 65 °F
Wind , 3 MPH
Humidity 68 %
Sunrise at 05:17
Sunset at 20:39

Monday



73 - 59 °F
Cloudy

Tuesday



75 - 61 °F
Partly Cloudy

Wednesday



68 - 55 °F
Cloudy

Environmental Benefits



CO2 Emission Saved
961,815.5 lb



Equivalent Trees Planted
24,224.62

Madison College Truax PV System Commissioned 2019



- 1.85 MW_{DC} - (5,700) Yingli YL325P-35b modules
- 1.65 MW_{AC} - SolarEdge 33kW kW Inverters
- 277/480 VAC output for three phase interconnection
- Fully UL listed, NEC 2017 Rapid shutdown compliant
- 730 W DC optimizer per pair of modules
- **Conception, Mar 2017 – Completion, June 2019**

**How can Madison College's
Experience help other schools?**

10 Steps to a Solar Roadmap for Educational Institutions

Honors student:
Steven Ansorge
Honors Mentor:
Ken Walz



MADISON COLLEGE
HONORS PROGRAM



Download available at: www.CreateEnergy.org

Why Solar Roadmaps?

Smart of Allocation of Resources

- Schools have many places to invest \$, solar is just one of them
- Spend \$ where it has the greatest benefit

Step 1: Assemble Roadmap Team

- Steven Ansorge, Student Senate President
- Tom Helbig, Electrician and Electrical Instructor
- Wes Marquardt, Facilities Manager
- Mark Thomas, Vice President and CFO
- Kenneth Walz, Renewable Energy Instructor



Step 2: Motivating Objectives

What do you feel are the most important reasons/goals for Madison College to "go solar"	Rank	Rank	Rank	Rank	Rank	Average Rank
cost savings	1	1	2	4	4	2.4
learning opportunities for students	2	4	3	2	3	2.8
energy budget certainty (cost hedging)	3	2	5	1	5	3.2
social and environmental goals	4	5	1	7	1	3.6
energy resilience for critical electrical loads	7	6	7	3	2	5
"green" visibility	5	3	6	6	6	5.2
off balance sheet treatment (e.g. capital or operating leases)	6	7	4	5	7	5.8

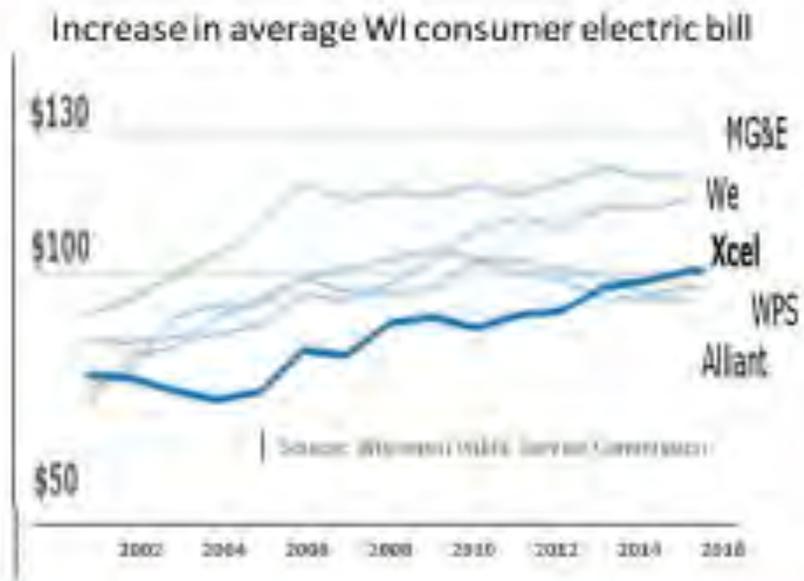
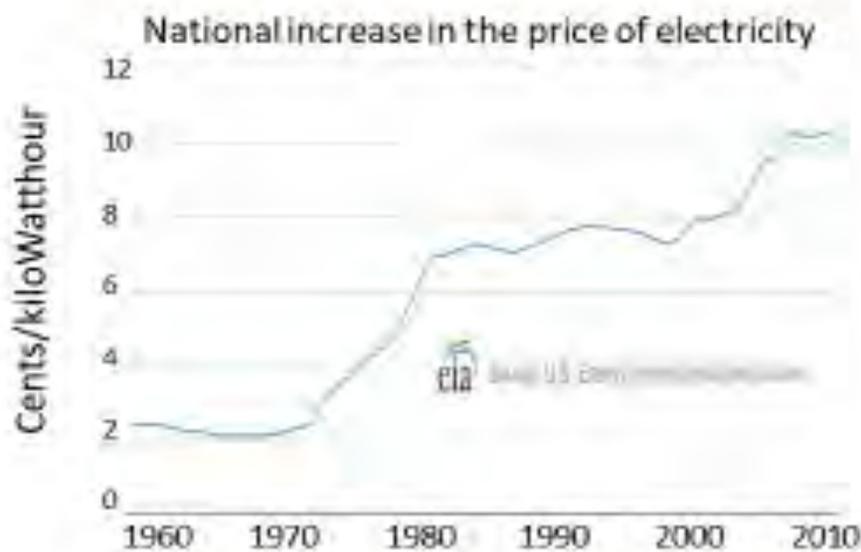
Step 3: Identify Stakeholders

START <-----Phases of Development -----> FINISH

	Development of Solar Roadmap	Prioritization of Solar Sites	Exploration of Funding Vehicles	Proposal and Approval of Projects	Legal/ Contractual	Project Design	Project Execution	Operations and Maintenance
Internal Stakeholders	PV Roadmap team	PV RoadMap Team	PV RoadMap Team	PV RoadMap Team	Facilities Team	Facilities Team	Facilities Team	Facilities Team
		Campus Managers	Financial Team	Presidents Office	Legal Office	Program Faculty	Faculty?	Faculty?
		PV Students?	MATC Foundation	College Board	Procurement Office	Students?	Students?	Students?
			Grants Office		Grants Office			
External Stakeholders		Solar Contractors	Electric Providers	WTCS	Solar Developers	Solar Developers	Solar Developers	Solar Contractors
		Roofing Contractors	NSF, DOE, etc.	Electric Providers	Electric Providers	RE Industry Adv Board	Solar Contractors	
			Focus on Energy	City Permitting		Electric Providers	Electric Providers	
			PV Developers	FAA Permitting		NREL	Permitting Bodies	

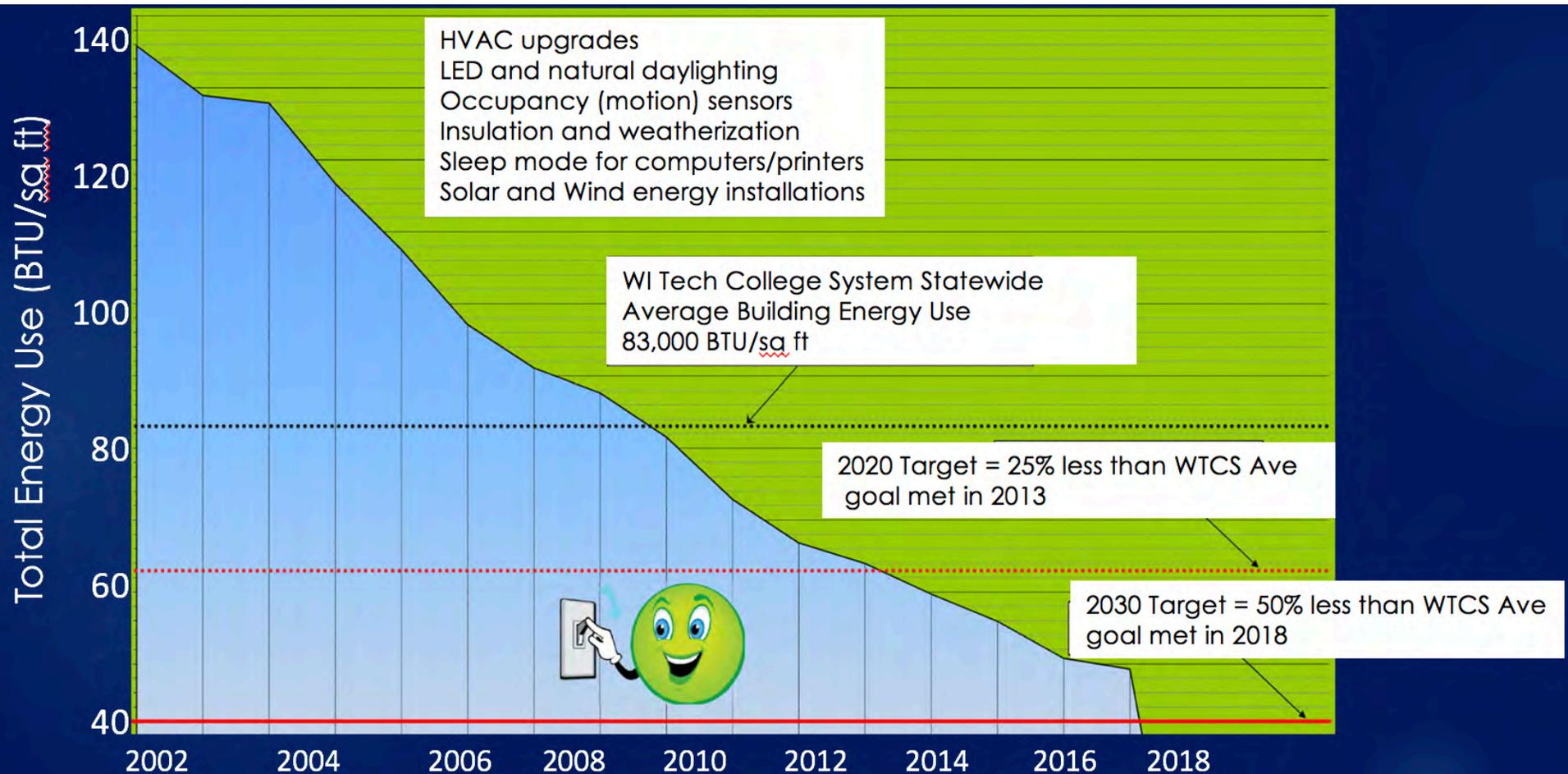
Step 4: Energy Usage and Costs

Electric bills represent an ongoing operational cost for colleges and universities



Madison Gas and Electric Rates per kWh	Summer	Winter
Off-Peak (nights and weekends)	\$0.049	\$0.037
On-Peak (days)	\$0.099	\$0.086

Step 5: Document Energy Management Practices



Step 6: Assess Sites for Solar

Health Education Building

Electric Provider = MGE, CG-2 Rate
Energy Use Index (Btu/ft²) = 33,178
Peak Electric Load = 545 kW

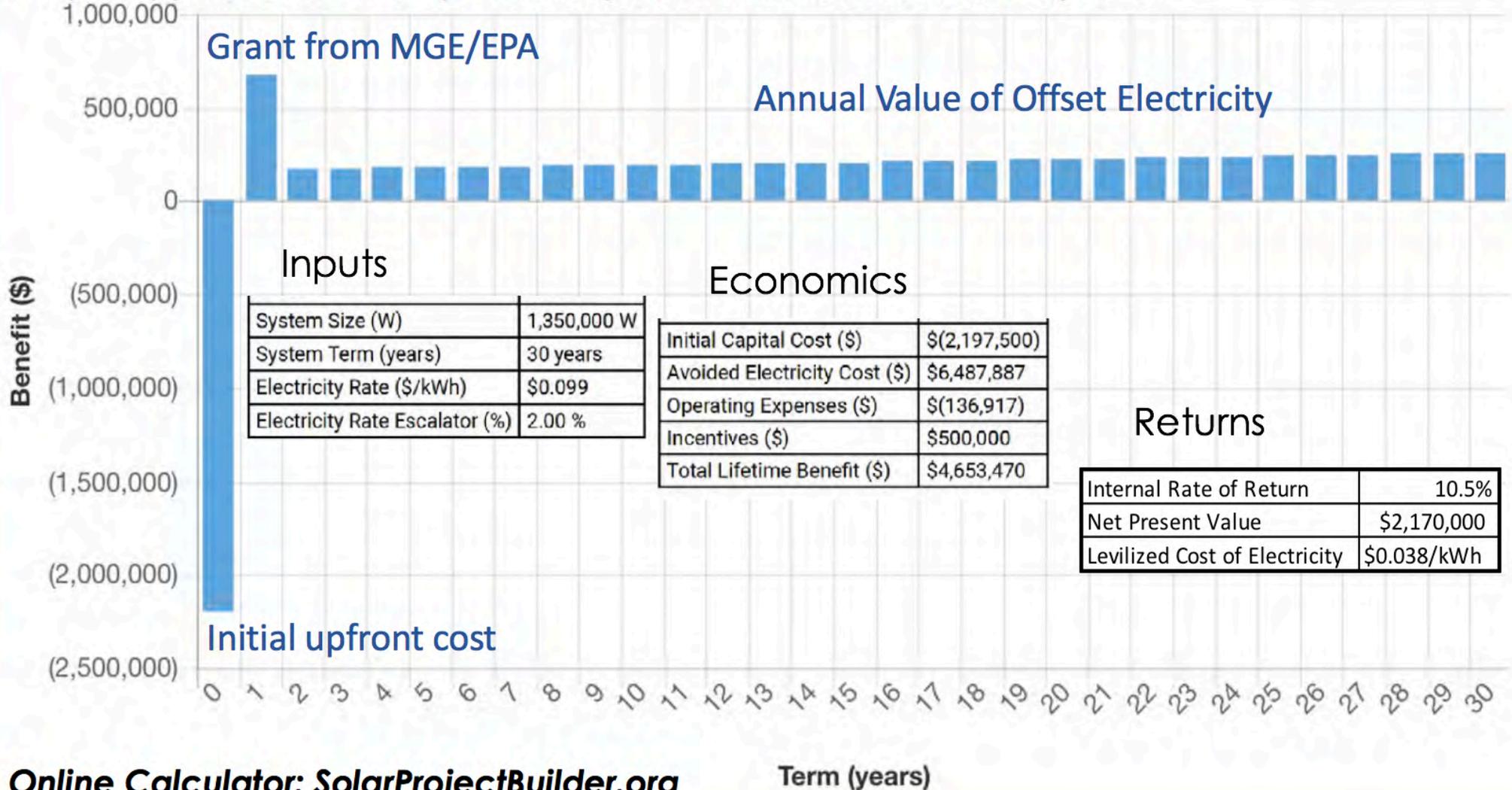
Age of Roof = 3 years
Rooftop solar system size estimate =
250 kWdc

1705 Hoffman St., Madison, WI 53704



Step 7: Economic Modeling

The year by year benefit of the system taking into account all revenues and expenses



Step 8: Prioritize Projects

System and Status	Target Completion Date
1.85 MW Truax Rooftop solar system	Dec 2018
New Madison South Campus	Summer 2019
Highest Priority Future System for Energy Generation Health Science and Protective Services	Dec 2019 (to take adv of 30% ITC tax credits)
Highest Priority Future System for Instructional Use Commercial Avenue PV Training lab redesign to incorporate energy storage and electric vehicle charging	2020
Lower Priority Systems Regional Campuses	Dec 2021 (to take adv of 22% ITC tax credits)
Energy Storage (lithium-ion battery) system for Truax Feasibility Study to be completed in 2018-2019	?

Step 9: Disseminate the Plan



Facilities Plan
Academic Plan
Grants Office
Community



Step 10: Implement Projects





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Questions?

kwalz@madisoncollege.edu