Leading the Charge: Creating a Solar Roadmap for Your School

Starts at 11:45 AM

Kenneth A. Walz

Presentation for WI State Education Convention 01/18/24

Acknowledgements:

CREATE Energy Center

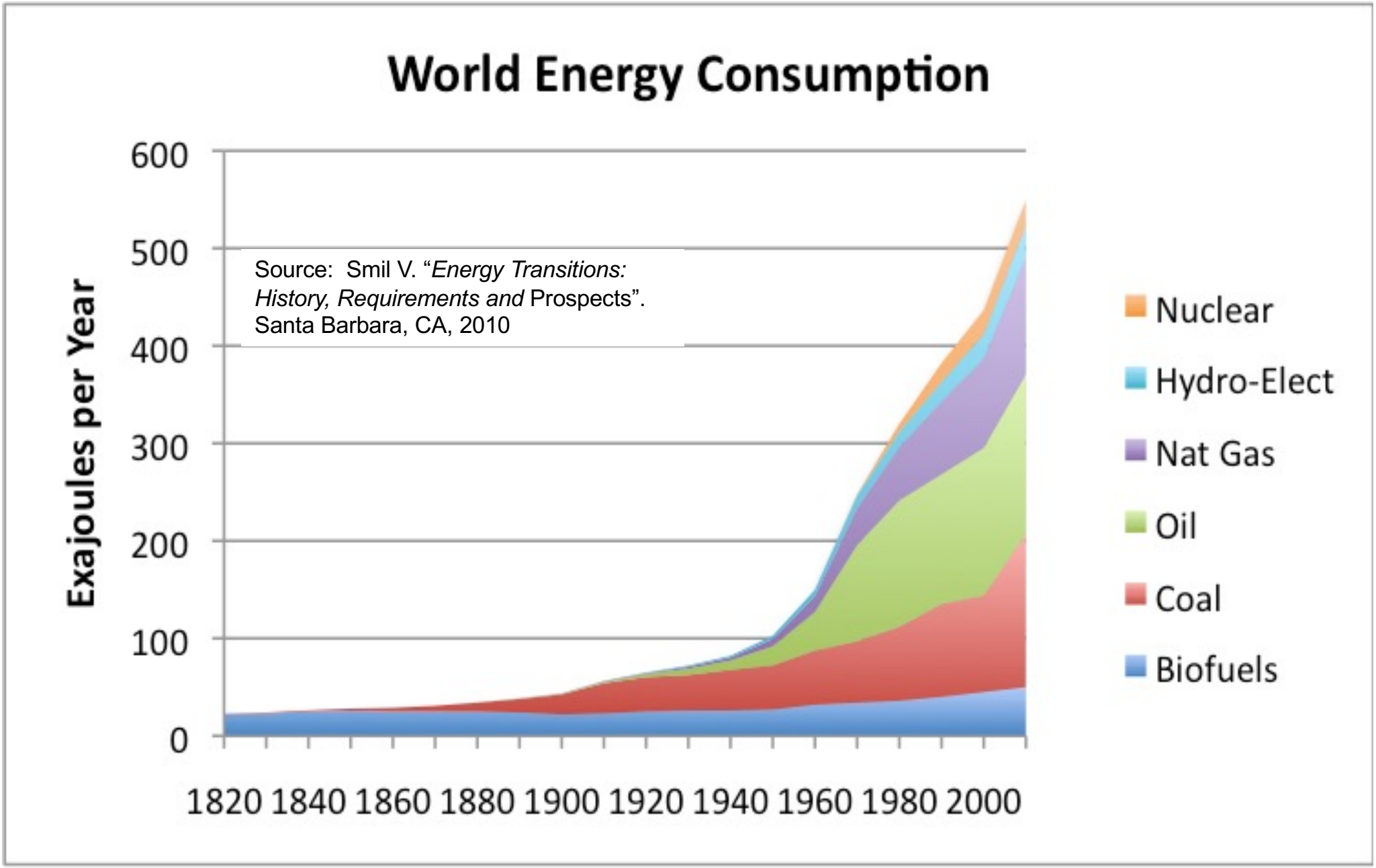
Award #s 2000714 & 2201631

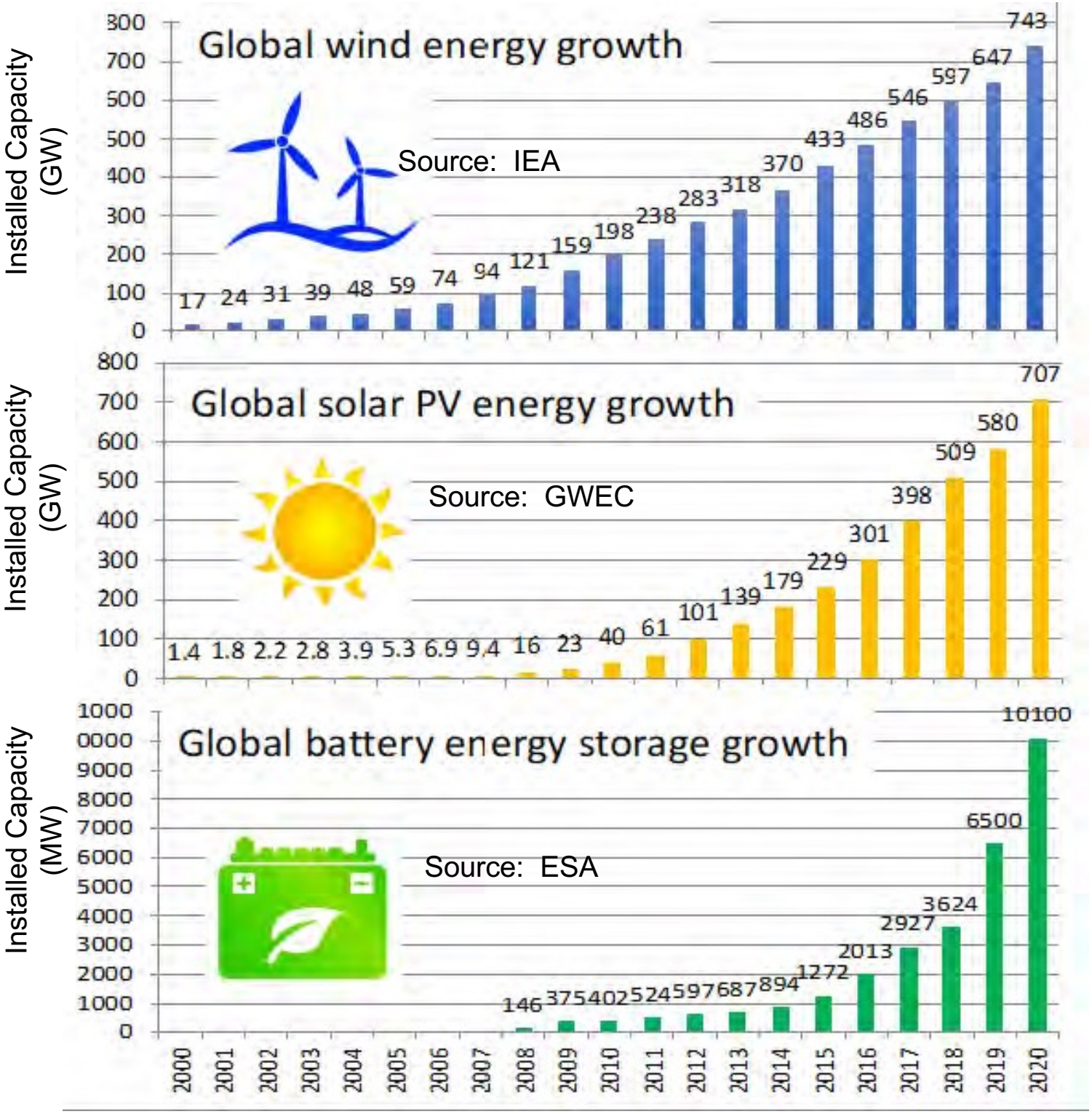
midwest renewable energy association

Disclaimer: this work was supported by the the 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.

Let's Examine Some Global Trends in Energy Consumption

We live at a historic time…




Global wind energy growth
Installed Capacity (GW)
Source: IEA
300
700
500
500
400
300
200
100
0
17 24 31 39 48 59 74 94 121 159 198 238 283 318 370 433 486 546 597 647 743
Global solar PV energy growth
Installed Capacity (GW)
Source: GWEC
800
700
600
500
400
300
200
100
0
1.4 1.8 2.2 2.8 3.9 5.3 6.9 9.4 16 23 40 61 101 139 179 229 301 398 509 580 707
Global battery energy storage growth
Installed Capacity (MW)
Source: ESA
1000
0000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
146 375 402 524 597 687 894 1272 2013 2927 3624 6500 10100
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020

Renewable energy costs hit new lows, now cheapest new power option for most of the world

Phil Dzikiy - May. 29th 2019 2:54 pm ET @phildzikiy

How can solar benefit schools?

1. Reduces the cost of electricity ($/kWh) by 30-50%
2. Moves utility costs from the annual operational budget to the long term capital budget.
3. Frees up operational dollars for other costs directly related to student instruction
4. "Locks in" a portion of the utility budget, providing cost certainty for budgeting
5. Solar construction costs paid with bonds at 2-3% interest. Solar Internal Rate of Return of 8-15% depending on site
6. Provides a learning opportunity for students and a path to energy careers

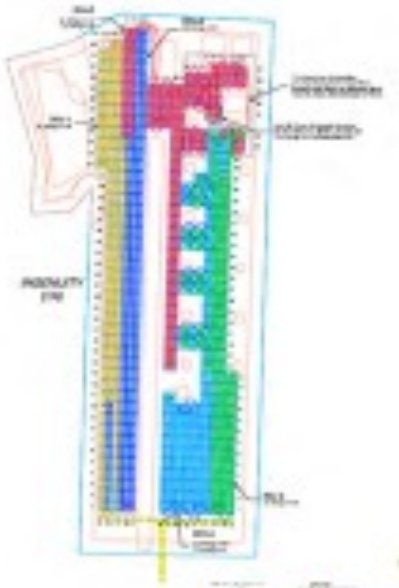
Madison College – A Solar on Schools Case Study…


Truax PV Systems (2002)
2.1 and 1.2 kW

Truax PV System Commissioned Jan 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
- Ecolibrium and Unirac Racking
  - Ballasted, non-penetrating
  - E-W and South Facing arrays

Madison College 1.85 MW Solar System



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

ADA Accessible Student Lab

Ecolibrium Ballasted South Facing Racking

Unirac East-West Ballasted Racking

EcoX Standing Seam Metal Clips

While remarkable in its size, the Madison System has also garnered attention for its educational design elements

Madison College Solar Instructional Sub- Array

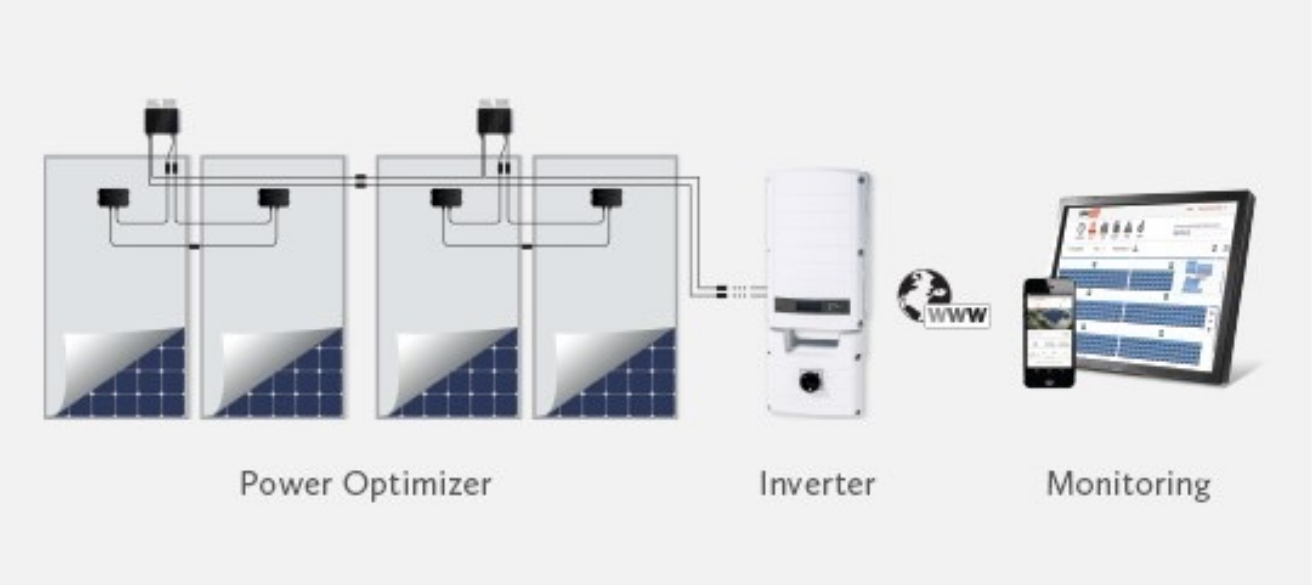
- Lower Roof Elevation Ample Spacing
- Guard Rails
- Walkway Traction Pads
- Ready Disconnect/Lock-Out Point
- ADA Accessible Roof Access
- Easy access to Tools and Equipment

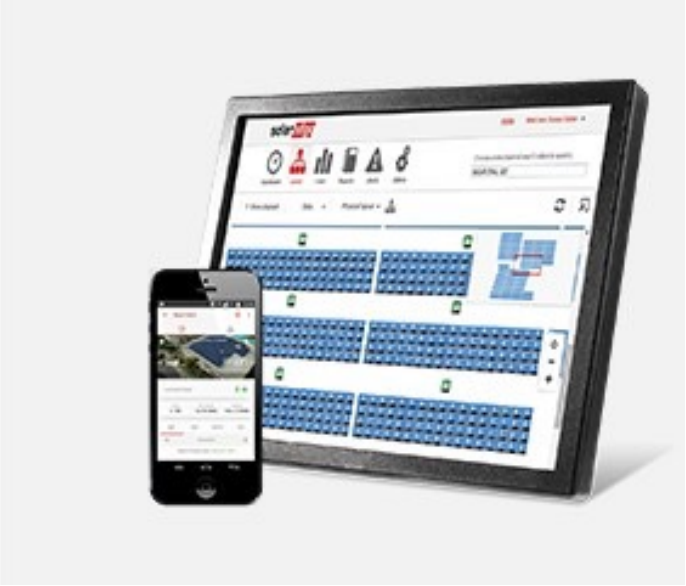
Space Designed to accommodate large groups

Walkway tread pads to access workspace traffic areas

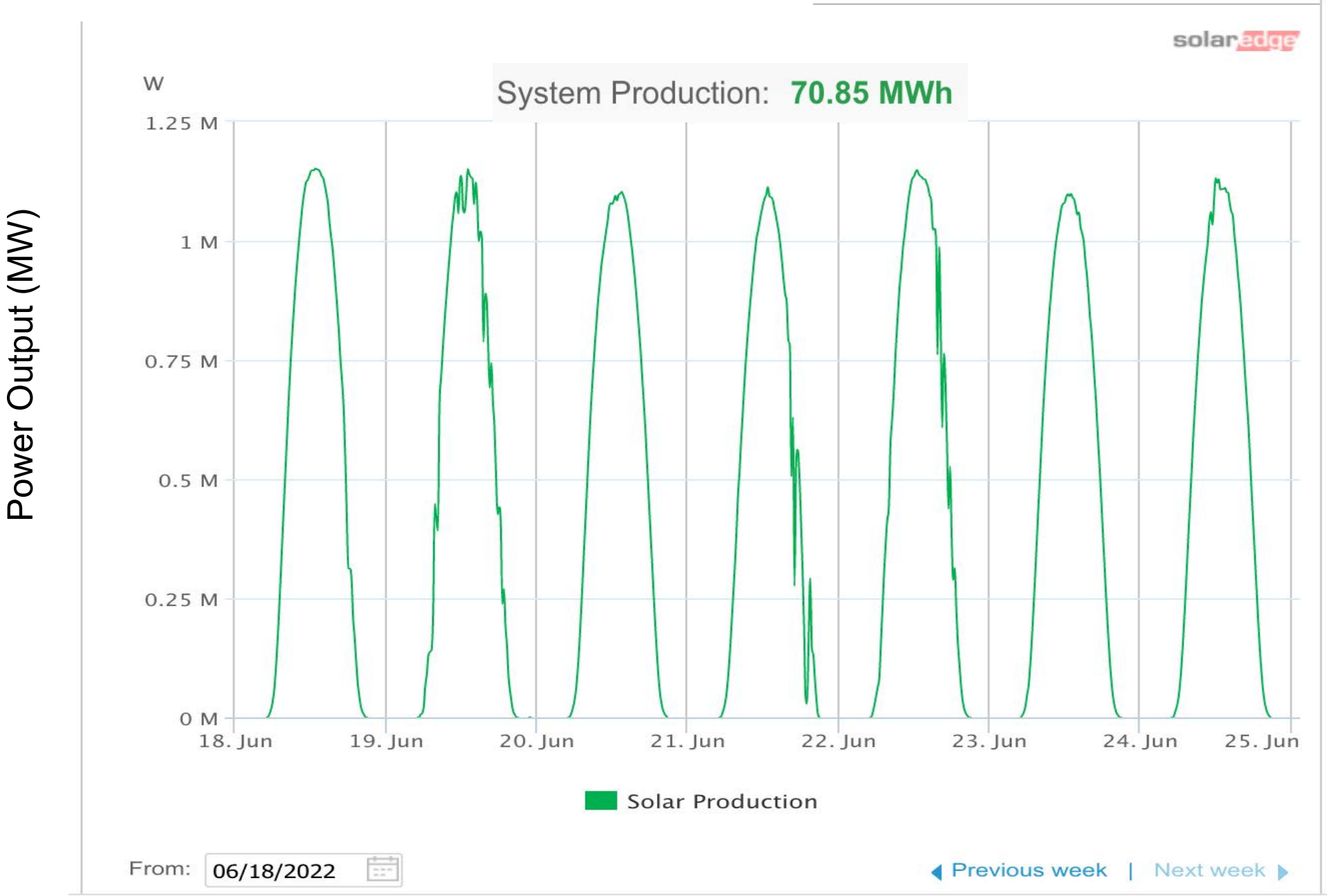
SolarEdge Synergy Inverters

- SE10KUS, SE66.6K, & SE100KUS inverters with integrated monitoring, 10 year warranty extendable to 12 years
- P730 optimizers – two modules per optimizer
  - Maximize power production using DC to DC conversion for MPPT
  - Monitoring to the optimizer level using powerline communication
- Israeli company founded in 2006; 2,500 MW shipped in 2017



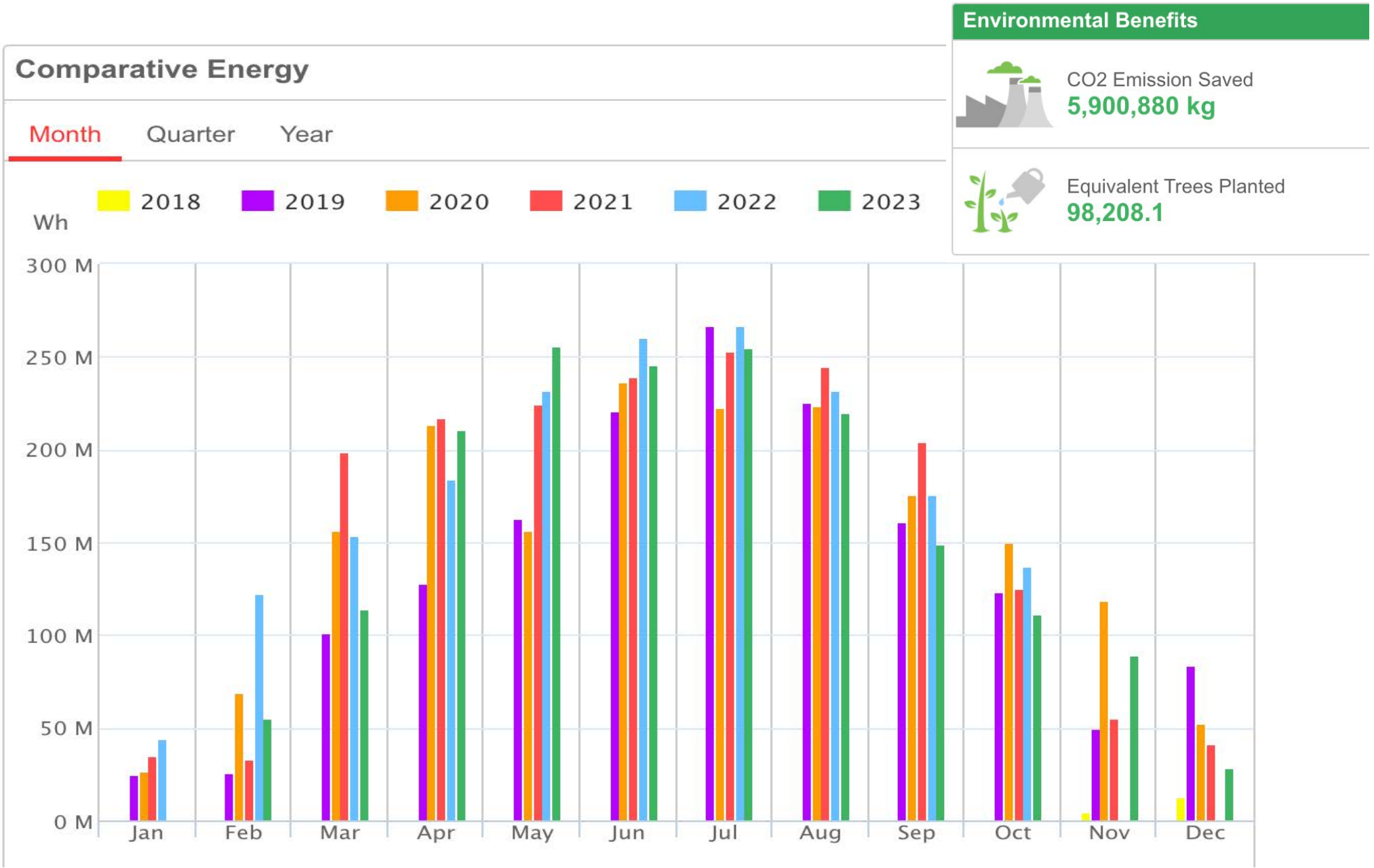


When skies are clear, the system powers the whole campus from ~ 10am-2pm



Power Output (MW)

Lifetime Energy Production 8,390,000 kWh



How Might Madison College's Experience Help Promote Solar at my School?

(Please steal our playbook!)

Solar Photovoltaic Roadmap

Produced in 2017, as the cost of solar PV technology was falling rapidly

Goal of integrating Solar Energy into all campus facilities

Table of Contents

Why create a Solar Roadmap?

Smart Allocation of Resources

- Schools have many places to invest $, solar is just one of them
- Like most districts, Madison College operates many buildings (cannot do 20 construction projects all at the same time)
- Spend $ where it has the greatest benefit

10 Step Guide to Create a Solar Roadmap

Honors student:
Steven Ansorge

Mentor: Ken Walz

Download available at: www.CreateEnergy.org

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

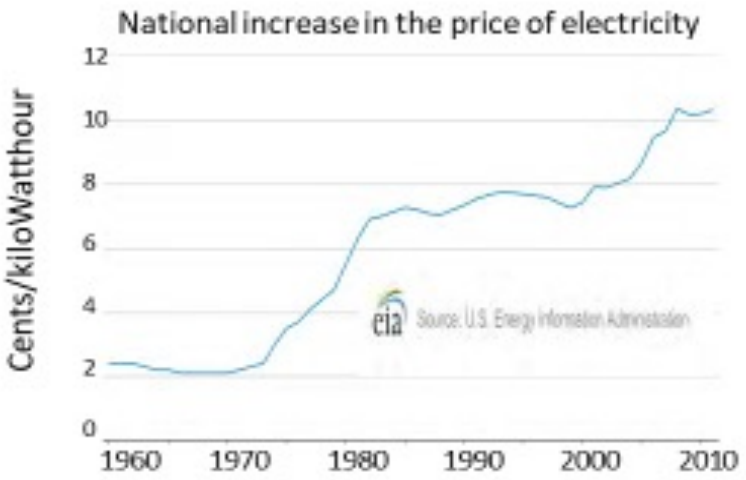
Step 3: Identify Stakeholders

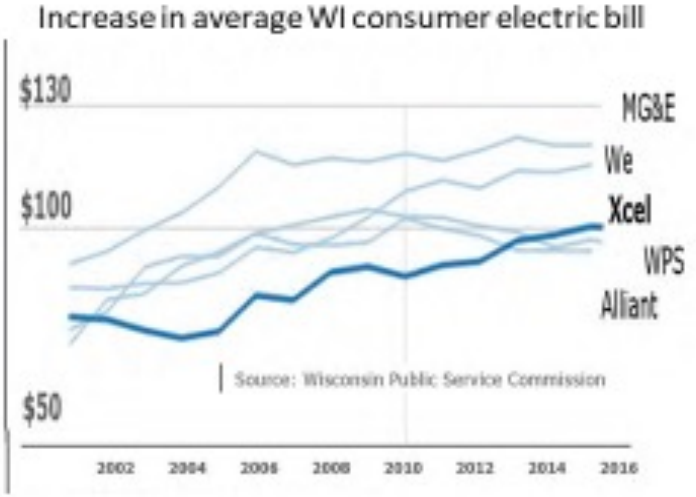
START <----------Phases of Development ----------> FINISH

	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	Finanical 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



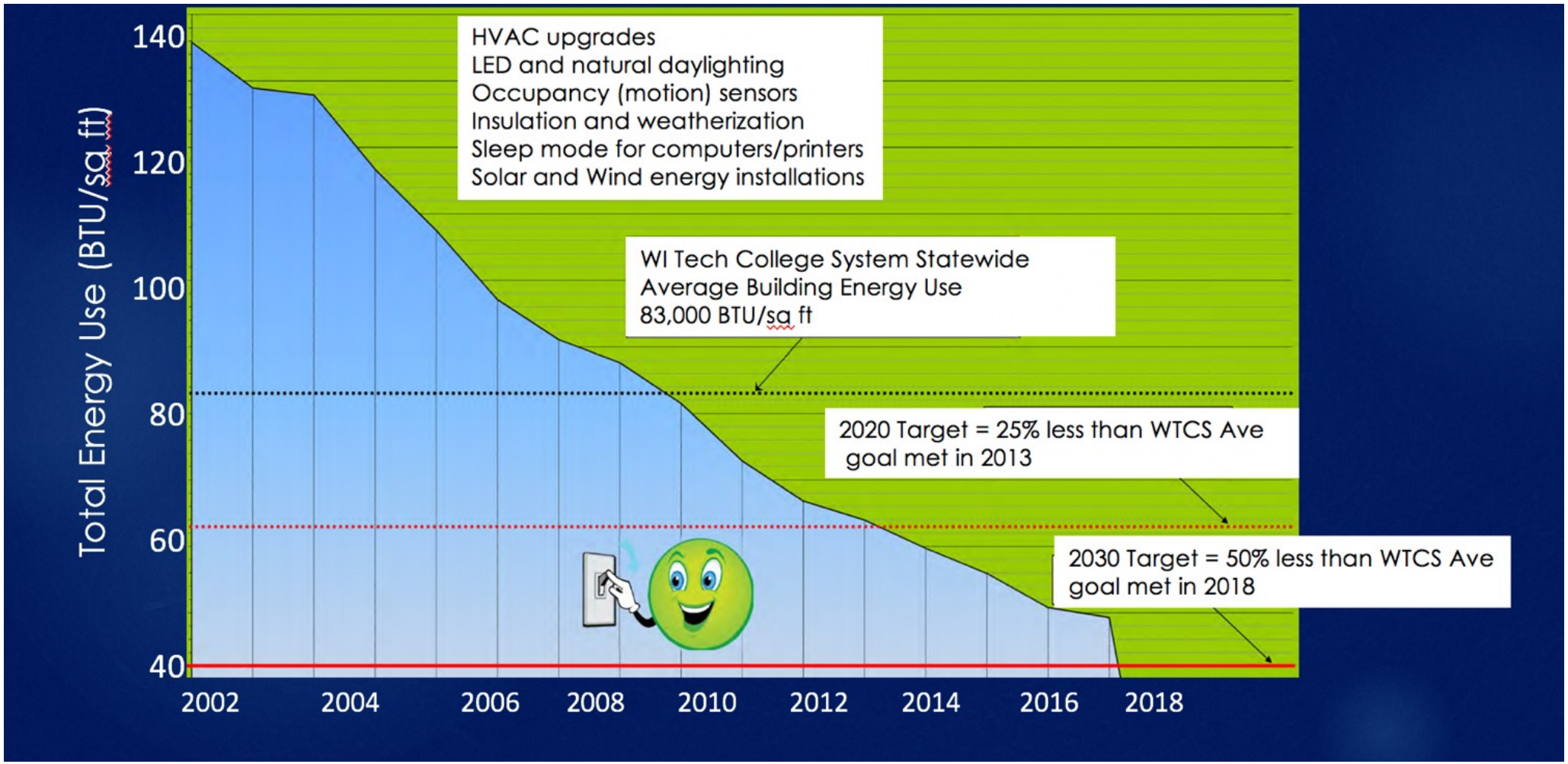


Madison Gas and Electric Rates per kWh	Summer	Winter
Off-Peak (nights and weekends)	$0.049	$0.037
On-Peak (days)	$0.099	$0.086

Madison College operates twenty some buildings, at twelve campus locations, with five different electric utilities having a wide variety of rate structures. These all must be analyzed and understood.

Step 5: Document Energy Management Practices

Ideally, solar will be one component of a larger comprehensive energy plan



Step 6: Assess Sites for Solar

Health Education Building

1705 Hoffman St., Madison, WI 53704

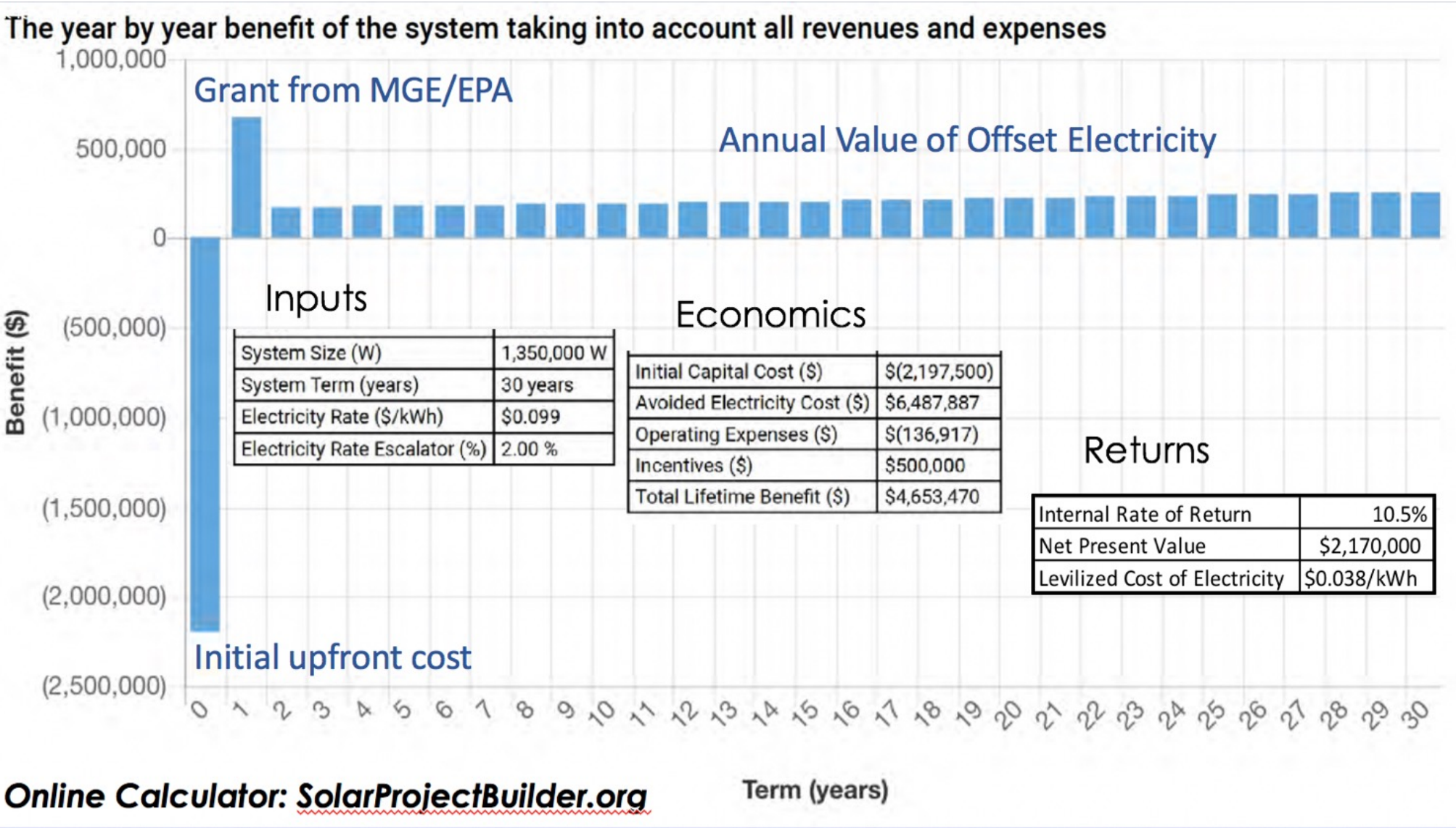
Electric Provider = MGE, CG-2 Rate
Energy Use Index (Btu/ft^2) = 33,178
Peak Electric Load = 545 kW

No shade

Modest roof penetrations &
a handful of Mechanical units

Age of Roof = 10 years
Rooftop solar system size estimate = 250 kWdc
Some structural reinforcements may be needed*

Step 7: Economic Modeling



Inputs

System Size (W)	1,350,000 W
System Term (years)	30 years
Electricity Rate ($/kWh)	$0.099
Electricity Rate Escalator (%)	2.00 %

Economics

Initial Capital Cost ($)	$(2,197,500)
Avoided Electricity Cost ($)	$6,487,887
Operating Expenses ($)	$(136,917)
Incentives ($)	$500,000
Total Lifetime Benefit ($)	$4,653,470

Returns

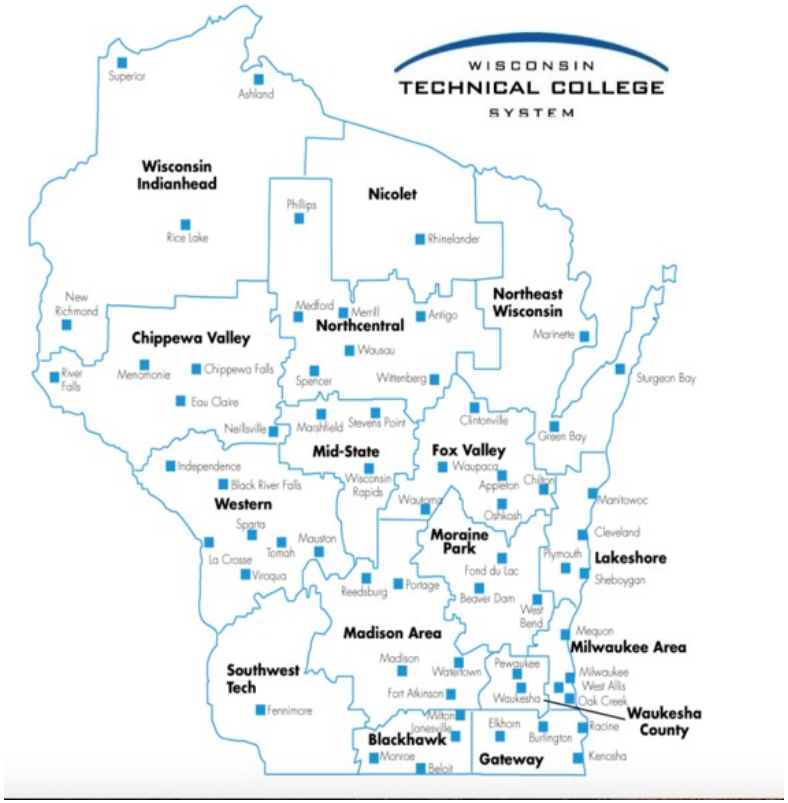
Internal Rate of Return	10.5%
Net Present Value	$2,170,000
Levilized Cost of Electricity	$0.038/kWh

Online Calculator: SolarProjectBuilder.org

Step 8: Prioritize Projects

Priorities Identified	Status?
1. Truax Main Building	Complete 2018
2. Goodman South Campus	Complete 2019
3. Fort Atkinson Campus	Complete 2020
4. Reedsburg Campus	Complete 2020
5. Truax Early Childhood Bldg	Complete 2021
6. Watertown Campus	Complete 2022
7. Fitness Center Addition	Complete 2023
8. Commercial Avenue Campus Repowering (PV + Energy Storage +Electric Vehicle Charging)	In Progress
9. Truax North Building	RFP in Development
10. Truax Protective Services Bldg	RFP in Development
11. Goodman South Expansion	Feasibility Study
12. Truax Health Science Bldg	
13. Portage Campus	
14. Columbus Campus	

Step 9: Share the Plan



Facilities Plan

Academic Plan

Grants Office

Community

AMERICAN ASSOCIATION OF COMMUNITY COLLEGES

Step 10: Implement Projects

This may be an opportunity to engage students through apprenticeships or internships

A few other Solar on Schools examples

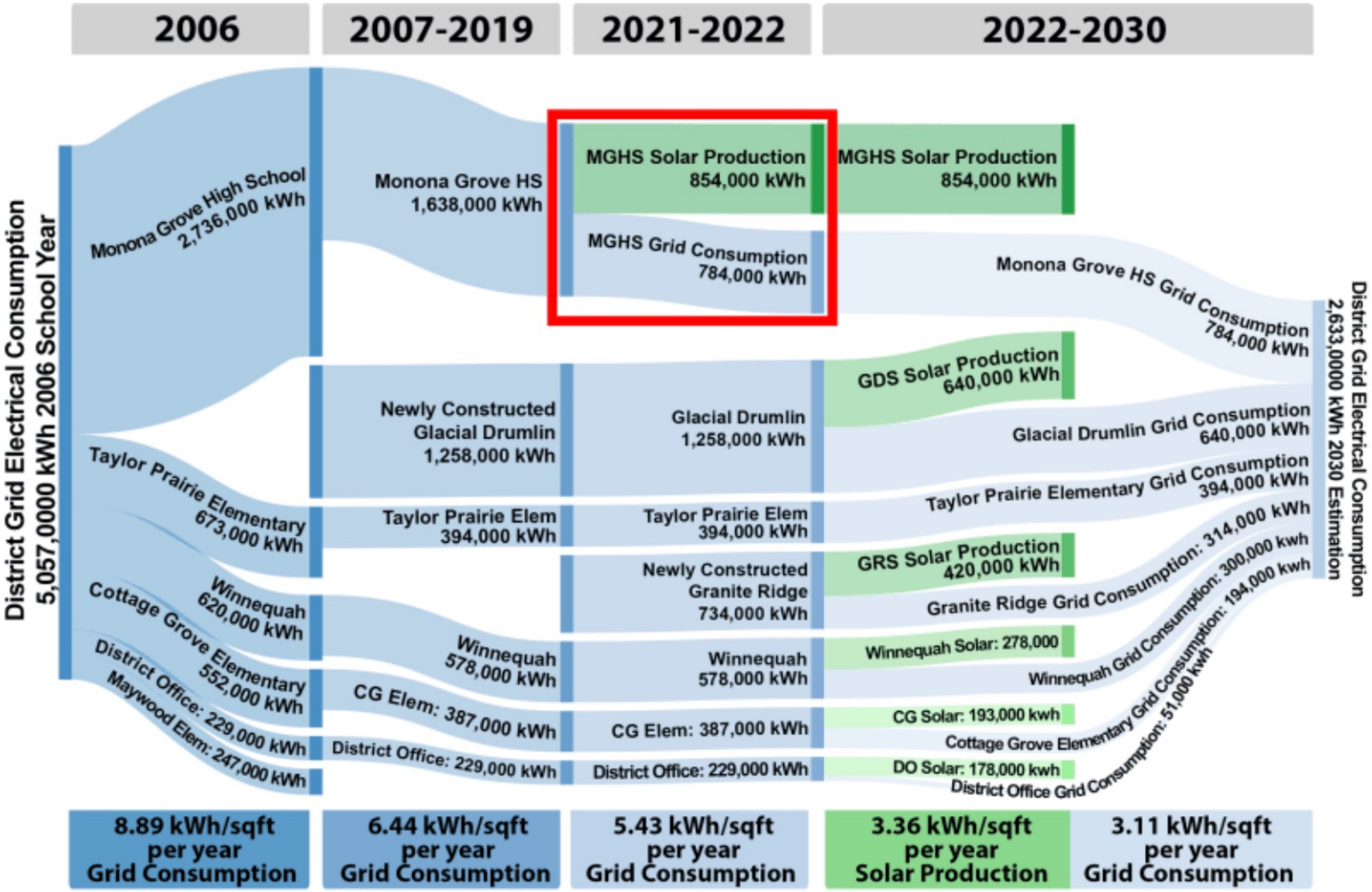
The Herald-Independent and McFarland Thistle
No One Delivers Local Like We Do

Monona Grove School District

Monona Grove should have solar for every building, school district committee says

By Lauren Henning lhenning@hngnews.com Sep 7, 2022 Updated Oct 13, 2023 1 min to read

Monona Grove's Solar Energy Roadmap



The red box shows the contribution of this project to the district's past and proposed energy saving projects. Click the image to enlarge.

MERTON
COMMUNITY SCHOOLS
THINKING AHEAD

Case Study: Solar on Merton Community School District

PROJECT SUMMARY:

Until the state of WI changed the minimum per pupil revenue limit, Merton Community School District was the lowest per-pupil spending district in Waukesha County. With declining enrollment, we saw that our revenue limit (what we can spend) continued to decline. At this point, we began seeking other ways to continue saving money, especially in energy as this was continuing to be a "fixed cost" regardless of enrollment.

Then, in the Spring of 2018, a School Board member was pursuing their own solar energy for their home and brought the idea of solar PV to the district as a means to save on operating expenses. The School Board and Village Hall met several times to run numbers and build capacity through the Winter of 2018 and we received some early calculations from SunVest which showed great potential. The district formally went to bid for the solar project in March 2019 and by December, our 389 kW DC solar array was installed, commissioned, and online.

The Merton Community School District invested in solar energy as a way to continue to save energy which means we are contributing to a cleaner environment as well as saving money.

Both Merton Primary and Merton Intermediate have solar arrays on the roof tops. The anticipated sizing of the solar energy is projected to produce almost two-thirds of our energy needs, which results in an average electricity savings of $70,000 per year for the expected 30-year life of the system. To help fund this project, we received a donation of a portion of the modules needed for each system through MREA's Solar for Schools program and a $68,000 RECIP Grant through the Focus on Energy program, together totaling over $100,000 in incentives. The remaining balance was paid through district dollars as well as a low-interest, ten-year loan. It is anticipated that the simple payback period will be no more than eight years.

"The district found this project to be very successful as a way to continue focusing our fiscal resources into education instead of just "keeping the lights on."
— Ronald Russ, Superintendent

https://couillardsolarfoundation.org/solar-on-schools

SOLAR ON SCHOOLS

CASE STUDY: *Solar on Forest Edge Elementary School*

PROJECT SUMMARY:

The Oregon School District built a 126,000 square foot new construction elementary school, Forest Edge Elementary School in 2020. The key sustainability requirement of the new elementary school was to be a zero-energy building. This is defined as "an energy-efficient building where, on a source energy basis, the actual annual delivered energy is less than or equal to the on-site renewable exported energy" as defined by the U.S. Department of Energy. It will be the first net zero energy school in the state of Wisconsin, offsetting 100% of all on-site energy needs.

The 646kW DC/500kW AC rooftop solar PV system and geothermal heating and cooling system will be leveraged as educational tools for the school and the larger community. The school includes a viewing area to see the roof mounted system and will also include an energy dashboard that can be viewed through an internet connection by anyone interested in learning about the school's sustainability features and ongoing energy performance compared to the net zero energy target.

"This solar PV system enables our school district to reduce operational expenses on energy and divert more of the available budget to resources that directly impact student success!"

— Statement from Oregon School District

https://www.midwestrenew.org/solar-on-schools/#case-studies

Some Resources to get you started for solar at *YOUR SCHOOL*

Please steal our playbook!

CreateEnergy.org

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Schedule:

Saturday, April 13, 11:00 am – 1:00 pm CST

Wednesday, April 17, 6:00-7:00 pm CST

Saturday, April 20, 11:00 am – 12:30 pm CST

Wednesday, April 24, 6:00-7:00 pm CST

Saturday, April 27, 11:00 am – 12:30 pm CST

Registration is open NOW!

Participants receive tools and equipment shipped to their home!

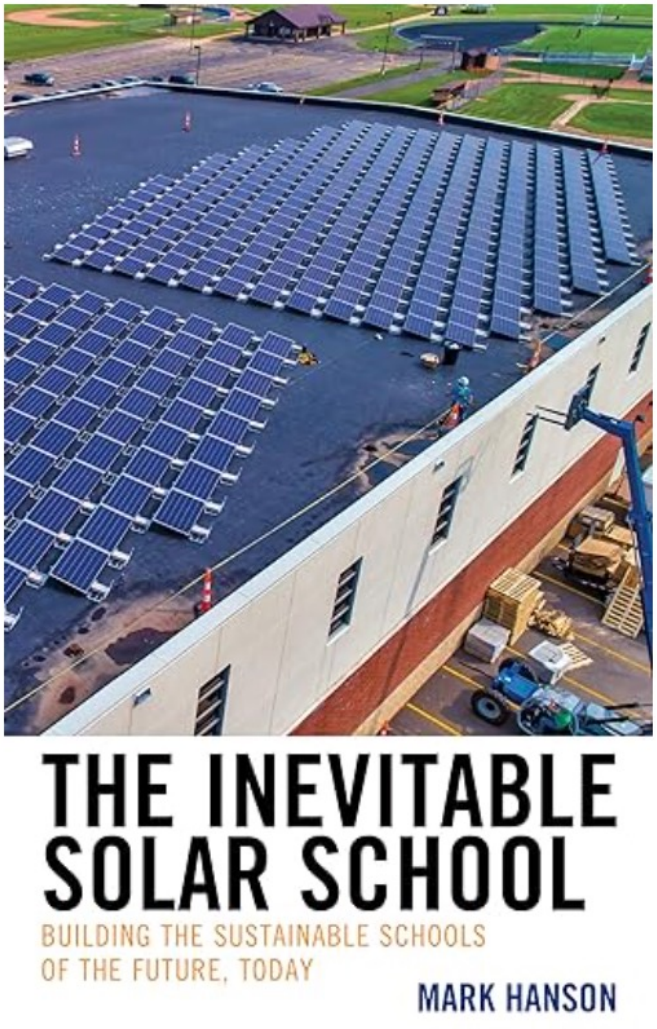
Face to Face STEM Educator Institutes
Solar PV, July 9-11, 2024
Solar + Storage, July 23-25, 2024

CREATE

MADISON AREA | TECHNICAL COLLEGE

www.CreateEnergy.org

Some additional resources



Rowman & Littlefield Publishers
August 28, 2019
ISBN: 978-1475844207

Sustainable Universities and Colleges

Sustainability Advances in Institutions of Higher Education

New Horizons in Sustainability and Business series

Edited by Mark Starik, Senior Lecturer, Sustainability Management Program, University of Wisconsin Extended Campus, Madison, Wisconsin and Paul Shrivastava, Professor, Department of Management and Organization, The Pennsylvania State University, University Park, Pennsylvania, US

Publication Date: June 2024 | **ISBN:** 978 1 03531 472 0 | **Extent:** c 304 pp

This book provides a set of decision and organizational models for the advancement of sustainability in higher education. International authors present how universities and colleges have attempted to advance sustainability both within and outside of their institutions, and how institutions of higher education can continue to upgrade those efforts to help lead societies toward greater sustainability in the future.

Take Home Points

- Solar electricity offers a tremendous opportunity for schools to employ new energy technology to save money for their districts
- Solar Roadmaps are invaluable for planning solar projects with your school team
- Schools can help prep students for the workforce by teaching solar concepts in their classrooms and by embracing solar energy in their buildings


Thank you for your attention!
Questions?
For more info, please see:
CreateEnergy.org
kwalz@madisoncollege.edu