WHY SOLAR ENERGY IS GROWING ON UTILITIES

THE ENERGY FAIR – CUSTER, WISCONSIN – JUNE 15, 2018

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PROGRAM AND POLICY DIRECTOR

RENEW WISCONSIN

A LITTLE BIT ABOUT MYSELF

- Program and Policy Director, RENEW Wisconsin
- Member, Sustainable Madison Committee

Where I Live

OUTLINE OF PRESENTATION

- Fundamental changes underway on the electric generation scene
  - Coal plant retirements
  - Renewables taking over
- Utility solar energy
    - History/Electric co-ops + Dairyland
    - Badger Hollow/Two Creeks/WPS + MGE acquisitions
- Shared solar
- Utilities still don't like solar self-generation

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When we think of a power plant, this is the kind of image that comes to mind.

This is a power plant, too!

Sisters of St. Agnes
Fond du Lac

And they are sprouting up everywhere!

Bayfield Electric Cooperative

Your Touchstone Energy® Cooperative

Bayfield Solar Garden – 300 kW

Iron River
Energized 10/2016

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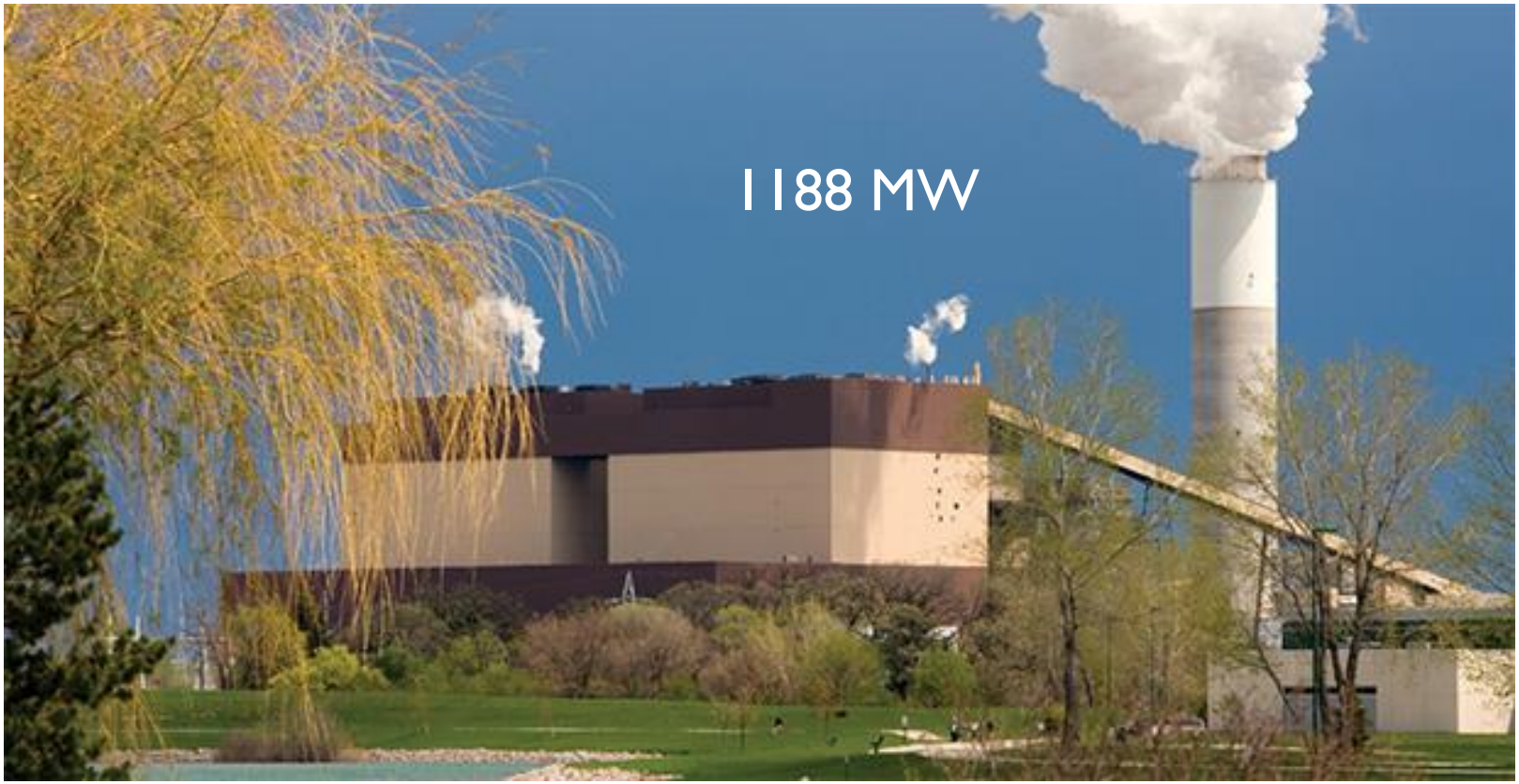
We Energies Retires Massive Coal Plant



Pleasant Prairie Power Plant (near Kenosha)
Unit 1 online 1980, Unit 2 online 1985; retired March 2018
Generated about 10% of Wisconsin's electricity (1985–2016)

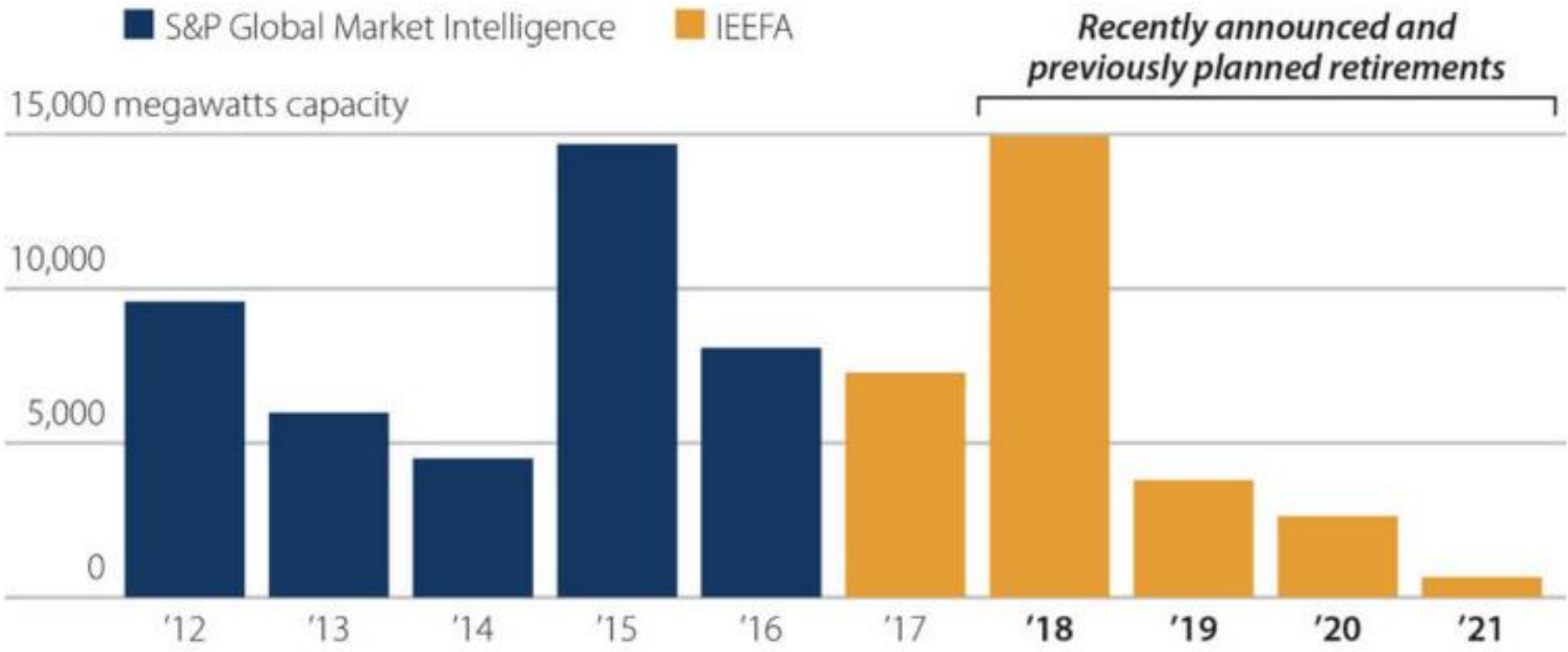
The same plant, from another vantage point

Central Storage & Warehouse
Pleasant Prairie
746 kW

SunPeak
Your Commercial Solar Partner

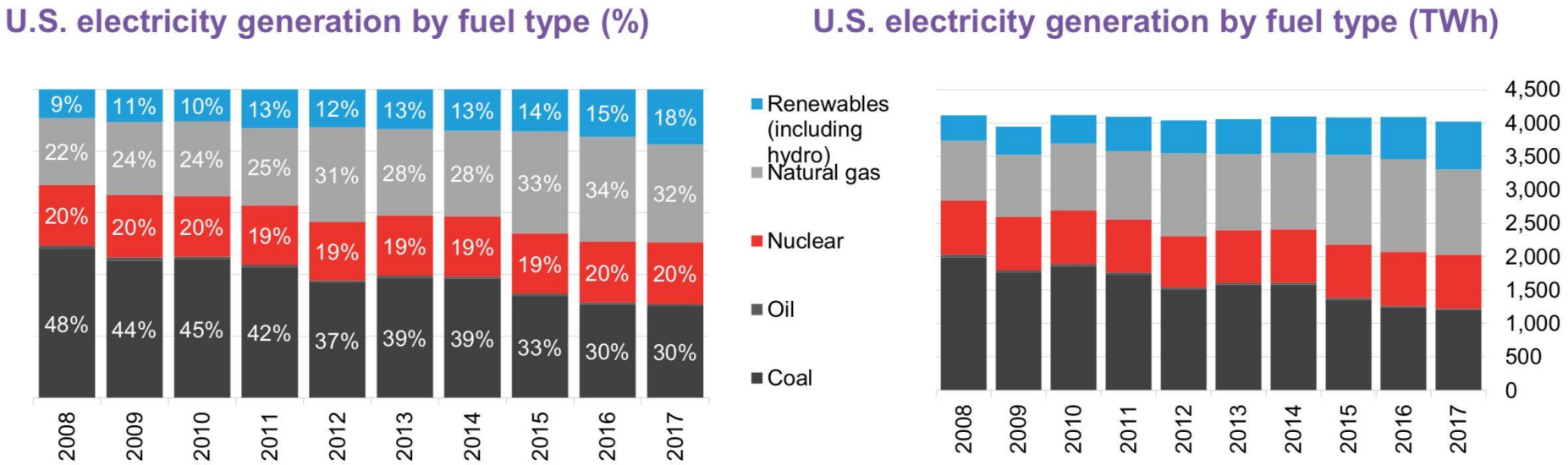
Coal-Fired Electric Generation Retirements

A big new wave of coal-plant retirements is expected this year, driven primarily by economics, that will rival the scale of closures in 2015. Many of these imminent retirements were only announced in 2017.



Sources: S&P Global Market Intelligence; IEEFA research

A shift in electric generation resources is underway



Source: https://www.greentechmedia.com/articles/read/renewable-energy-generation-nuclear-bnef#gs.qzSsU04


Solar accounts for 30% of all new electric generating capacity brought online in 2017
SEIA Solar Energy Industries Association®
seia.org/smi

WIND & SOLAR ARE ON THE HORIZON IN WISCONSIN

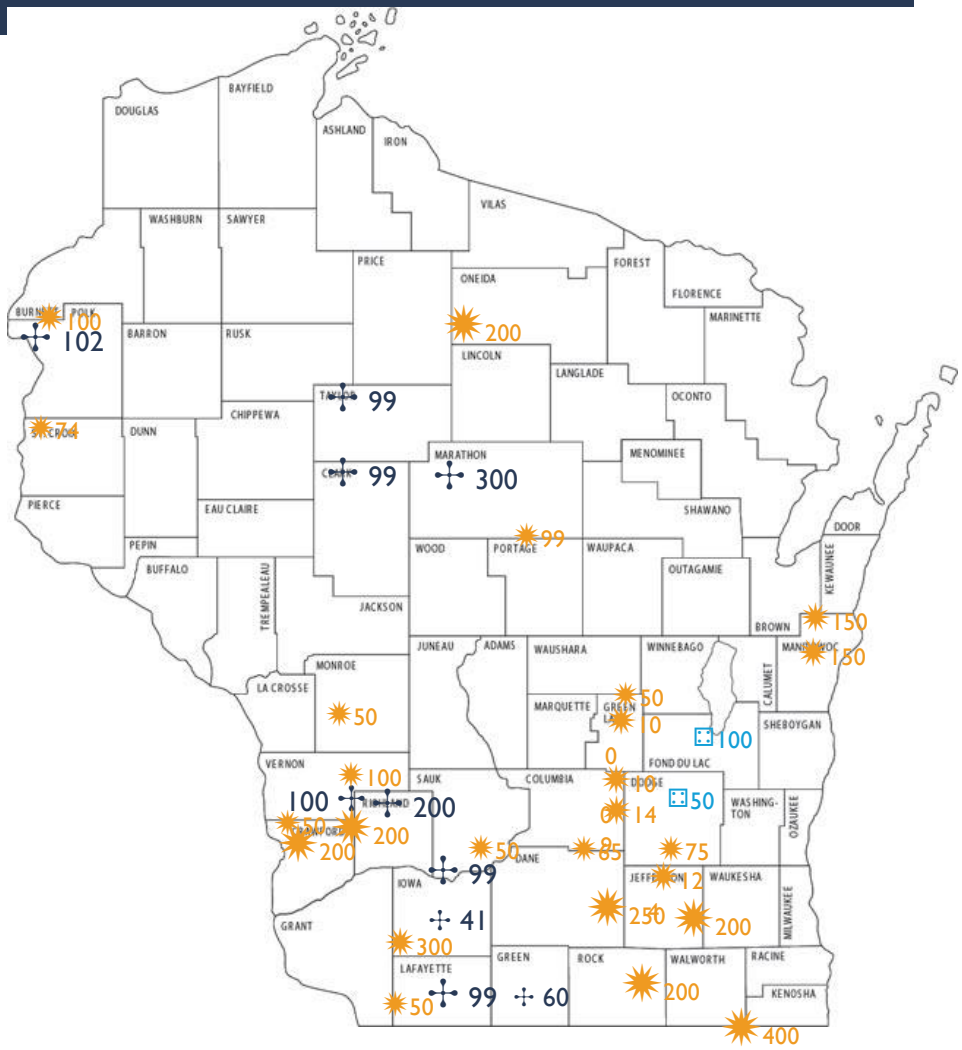
Wisconsin Solar & Wind in April 2018 MISO Queue:

3,460 MW Solar

1,300 MW Wind

170 MW Battery

Numbers in map denote project size in megawatts



If all this were built:

7.6% Solar

+6.7% Wind

23% Total Renewables

$19 million to local governments and ~$25 million to landowners annually

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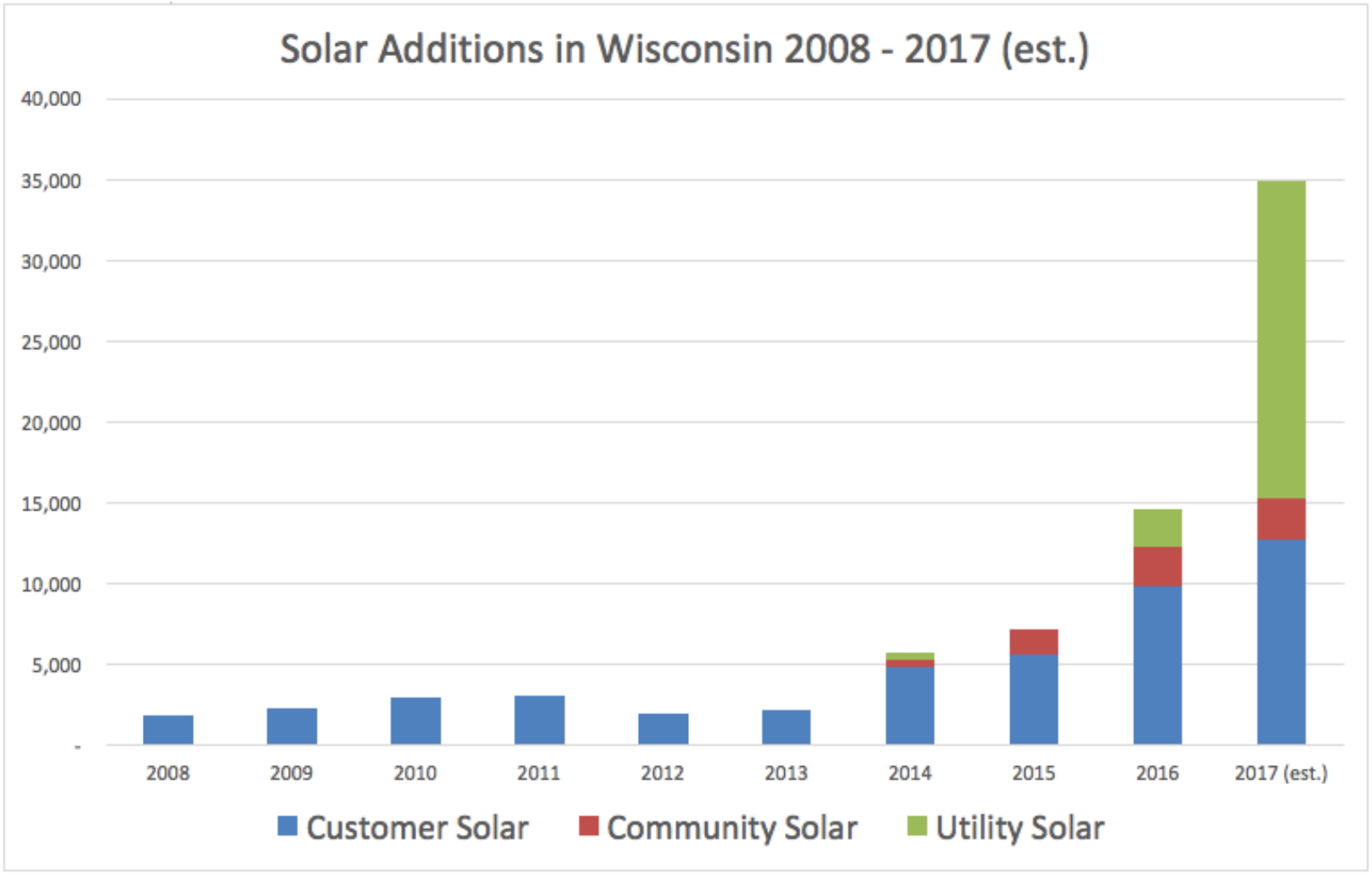
WISONSIN UTILITY SOLAR: A HISTORY



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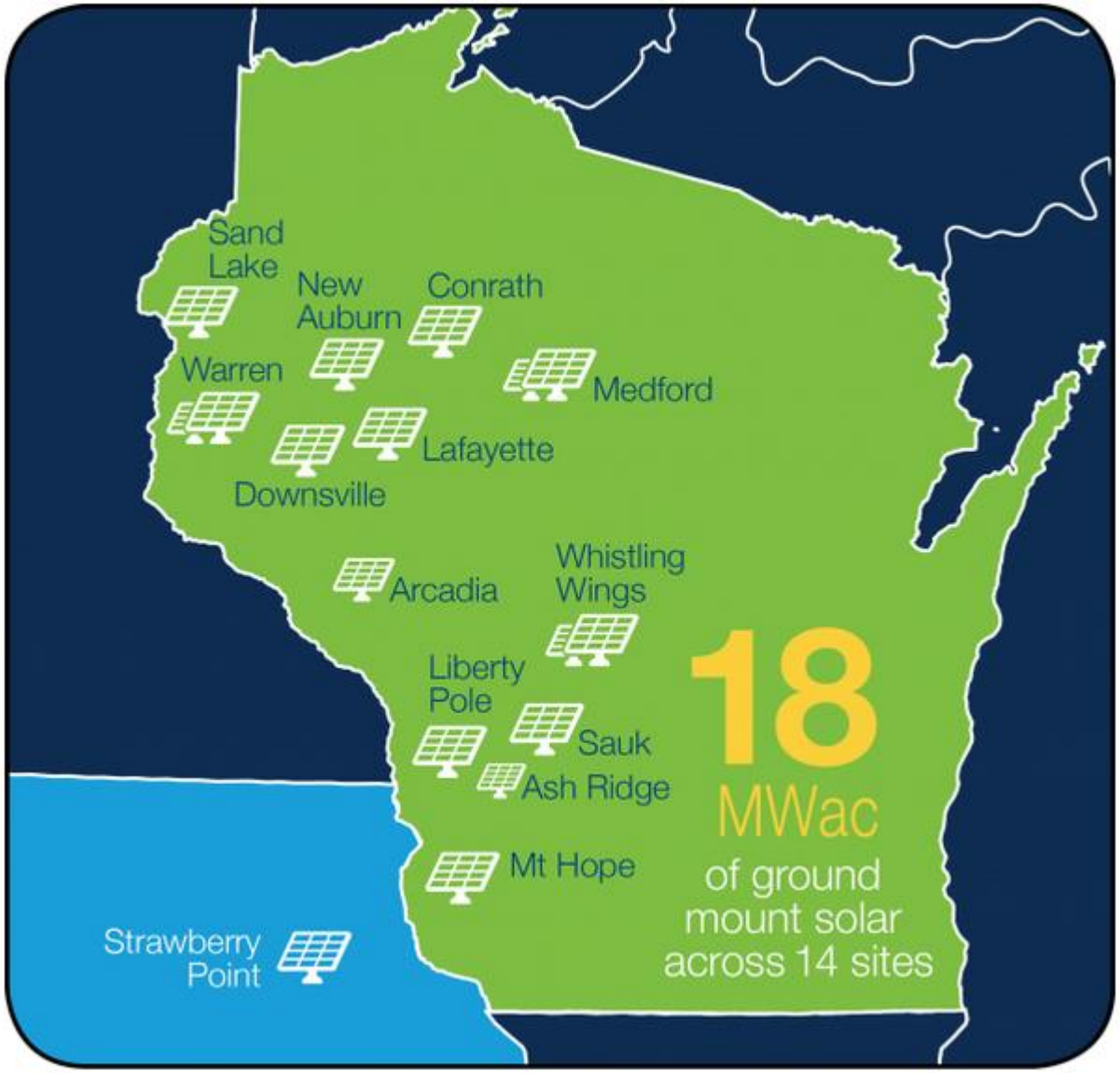
Dedication ceremony,
Vernon Electric Cooperative
community solar array
June 26, 2014

First WI utility foray into solar energy



SoCore Energy solar projects for Dairyland Power Cooperative

SoCore Energy
An ENGIE company

DAIRYLAND POWER COOPERATIVE

SoCore Energy

An EDISON INTERNATIONAL® Company

DAIRYLAND POWER

COOPERATIVE

A Touchstone Energy® Cooperative

Second largest solar array in Wisconsin today

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BADGER HOLLOW/TWO CREEKS

Business

DOW 24,415.84 ▼ 251.94 S&P 500 2,705.27 ▼ 18.74 NASDAQ 7,442.12 ▼ 20.34 10-YEAR T-NOTE 2.86 ▲ 0.01 CRUDE OIL $67.04 ▼ $1.17 GOLD $1,300.10 ▼ $1.40

Utilities to invest in solar power

$390 million project would provide enough electricity for 70,000 customers

Guy Boulton Milwaukee Journal Sentinel
USA TODAY NETWORK – WISCONSIN

Two of the state's largest utilities plan to invest a total of $390 million in two solar power projects that would be the first of their size in the state.

Wisconsin Public Service, a subsidiary of Milwaukee-based WEC Energy Group, and Madison Gas and Electric, as well as the developers of the projects, filed applications for approval with state regulators Thursday.

The two solar projects would generate a total of 300 megawatts — enough electricity for more than 70,000 residential customers — and indicate the changing economics of large-scale solar projects.

As recently as the end of 2015, the state generated a total of 25 megawatts from solar power.

"Alternative energy is not really alternative anymore," said Dan Litchfield, a director of project development for Invenergy, the developer of one of the two projects.

The projects would be built in Iowa County, near the villages of Montfort and Cobb, about 12 miles west of Dodgeville, in southwestern Wisconsin, and in the Town of Two Creeks and the city of Two Rivers, near the Point Beach nuclear power plant in northeastern Wisconsin, WPS and MGE said in a news release.

The project in Iowa County is being developed by Invenergy, a Chicago firm that develops wind and solar projects.

The project in Manitowoc and Kewaunee counties would be developed by NextEra Energy, based in Juno

See SOLAR, Page 11A

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ABOUT THESE TWO SOLAR PROJECTS

Name	County of location	Developer	Total capacity (in MW)	Capacity committed to MGE + WPS
Badger Hollow	Iowa	Invenergy	300	150
Two Creeks	Manitowoc	NextEra Energy	150	150

- **Developer: Invenergy (Chicago)**
- **Anticipated capacity: 300 MWAC**
- **In-service date: 4Q 2020**
- **Location: Towns of Eden, Mifflin & Linden in Iowa County**
- **Project footprint: 3,500 acres**

1.2 million panels

Application filed May 31, 2018
Docket No.: 9697-CE-100

Participating utilities include WPS , MGE

www.badgerhollowsolarfarm.org

IMPACT OF A 300 MW(AC) SOLAR PROJECT

BADGER HOLLOW
SOLAR FARM
Invenergy

Would yield a total of $1.2 million each year to Iowa County and host townships

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WHY ARE MGE AND WPS COMMITTING TO 300 MW OF SOLAR?

From their application (5-BS-228), page 4

- When compared to **alternative** [emphasis added] generation sources, the Solar Facilities will save customers money over the 30-year economic life of the assets
- [A]cquiring the Solar Facilities presents the least cost alternative when compared to securing needed capacity and energy from generating technologies that use other fuel sources.

Clean Energy is Mainstream

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DO GO ON …

From their application (5-BS-228), page 10

- The Solar Facilities will provide a low-cost, zero-emissions source of electricity for WI customers for decades to come.
- The acquisitions will not impair the efficiency of the utilities' service. In fact, the acquisitions will enhance efficiency by providing a highly reliable, high capacity-accredited renewable resource, significantly improving … resource diversity.

WPS AND MGE ARE RETIRING OLDER POWER PLANTS AND NEED REPLACEMENT CAPACITY

- WPS will retire 270 MW of coal generation in 2018 and 2019 (Pulliam units, Edgewater 4)
- MGE is retiring 75 MW of older combustion turbines

J. P. Pulliam Plant, Green Bay

WIND AND SOLAR PROVIDE DIFFERENT VALUE STREAMS

Resource	Cost per kW	Fuel cost	Capacity factor (energy)	Capacity value (capacity at peak)
Solar – Badger Hollow + Two Creeks MGE + WPS Operational 12/2020	$1,300	0	24-25%	70% (combined)
Kossuth Wind (IA) Alliant Operational 12/2020	$1,702	0	47%	10-15%
Saratoga Wind (IA) MGE Operational 12/2019	$1,633	0	49%	10-15%

HOW DO THESE SOLAR PROJECTS COMMAND SUCH A HIGH CAPACITY VALUE?

- **Single-axis trackers**: This technology captures more late-afternoon sunlight, which corresponds closely with utility peaks.

- **Geographic diversity**: Badger Hollow and Two Creeks are on opposite sides of the state, and often subject to different weather conditions.

Wind v. Solar (Part 1)

- If a utility is looking for a source of very inexpensive energy, **wind power** is its best bet

Wind v. Solar (Part 2)

However, if a utility is looking for low-cost replacement capacity, **solar generation** is its best bet

Conclusion: The crossover point has arrived. Solar is now the utilities' default option for replacing generation capacity. The PSC will ratify that milestone later this year.

SHARED SOLAR (COMMUNITY SOLAR)

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MGE Shared Solar Project

Middleton Operations Center

552 kW DC

Shared Solar

mgoe®

Madison Gas and Electric

Middleton Police Dept.

97 kW DC

MIDDLETON

The Good Neighbor City

SOLAR

THE THEORY BEHIND UTILITY SHARED SOLAR

- Large arrays in service territory → lower per kW cost of project.
- Self-selecting customers subscribe to energy from new solar arrays.
- 70%-80% of residential customers cannot access solar where they live (shade trees, roof needs work, rental properties, etc.)
- Customers contribute an up-front payment, then are compensated through on-bill credits over 20 years, modest ROI
- Utility acquires new generating capacity without needing to raise rates.

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MGE MULLS NEXT SHARED SOLAR PROJECT

Next MGE shared solar array likely to go up near Moray Field in Middleton

CUSTOMER-SITED SOLAR

TARGET STORES

West Allis
380 kWDC

Solar PV arrays have been installed on 17 Target stores in Wisconsin including two in 2017. The retailer now hosts 6.5 MWDC of solar capacity in Wisconsin. All but three of the stores are located in WEPCO territory. The other three are in Dane County.

IKEA'S NEW OAK CREEK STORE

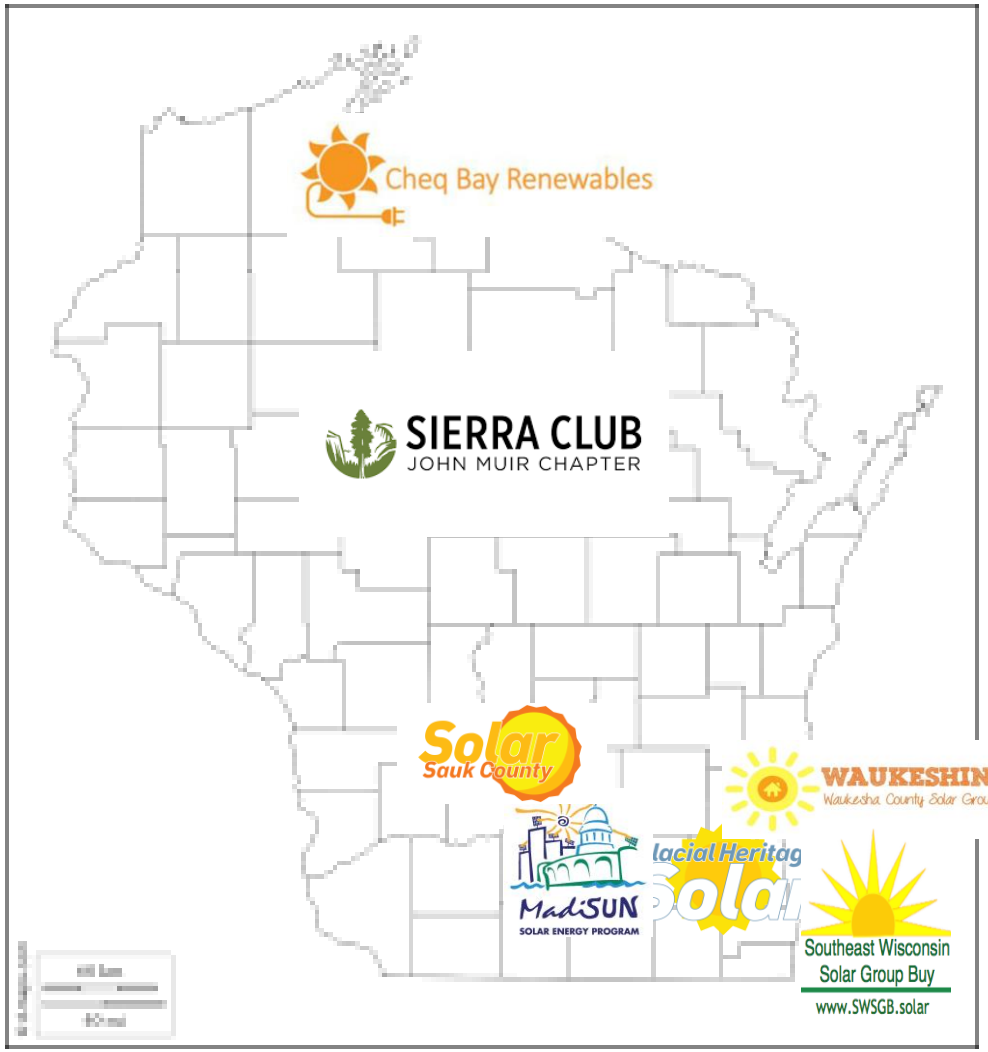
At 1.64 MW, this is the largest rooftop PV array in Wisconsin, though that distinction will not last long.

MADISUN - MADISON'S SOLAR GROUP BUY PROGRAM

WISCONSIN SOLAR GROUP BUYS – 2017

Program	Participants	Signed contracts	Aggregate capacity (in kW)
Solar Milwaukee/ Solar Tosa	Cities of Milwaukee and Wauwatosa/ SunVest Solar/MREA	24	121
MadiSUN	Cities of Madison and Middleton/ Full Spectrum Solar/ Midwest Solar Power/RENEW Wisconsin	38	208
Solar Central Wisconsin	Cities of Stevens Point and Wisconsin Rapids; Mid-State Tech College; North Wind Renewable Energy	46	335
Solar Iowa County	Driftless Area Land Conservancy; Solar Iowa County; UW-Extension; Eagle Point Solar	32	240
Solar Southeastern Wisconsin	Greening Greater Racine; Arch Electric	24	147
Total		**164**	**1,051**

2018 Wisconsin Solar Group Buys



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Electric providers--especially investor-owned utilities--like solar when they own the assets and can integrate them into their generating fleet.

Electric providers are less enamored of solar energy when it is offsetting retail consumption of electricity.

MADISON GAS & ELECTRIC

Except when it's their own panels.
Roof + wall + parking canopy = 160 kW

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mGE®
Madison Gas and Electric

Questions?

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