



## **Lunch Address**

**Michael Leitman**

Strategic Analyst

National Rural Electric Cooperative Association

# The Renewable Landscape of America's Electric Cooperatives

Michael Leitman  
Strategic Analyst

NRECA Business and Technology  
Strategies

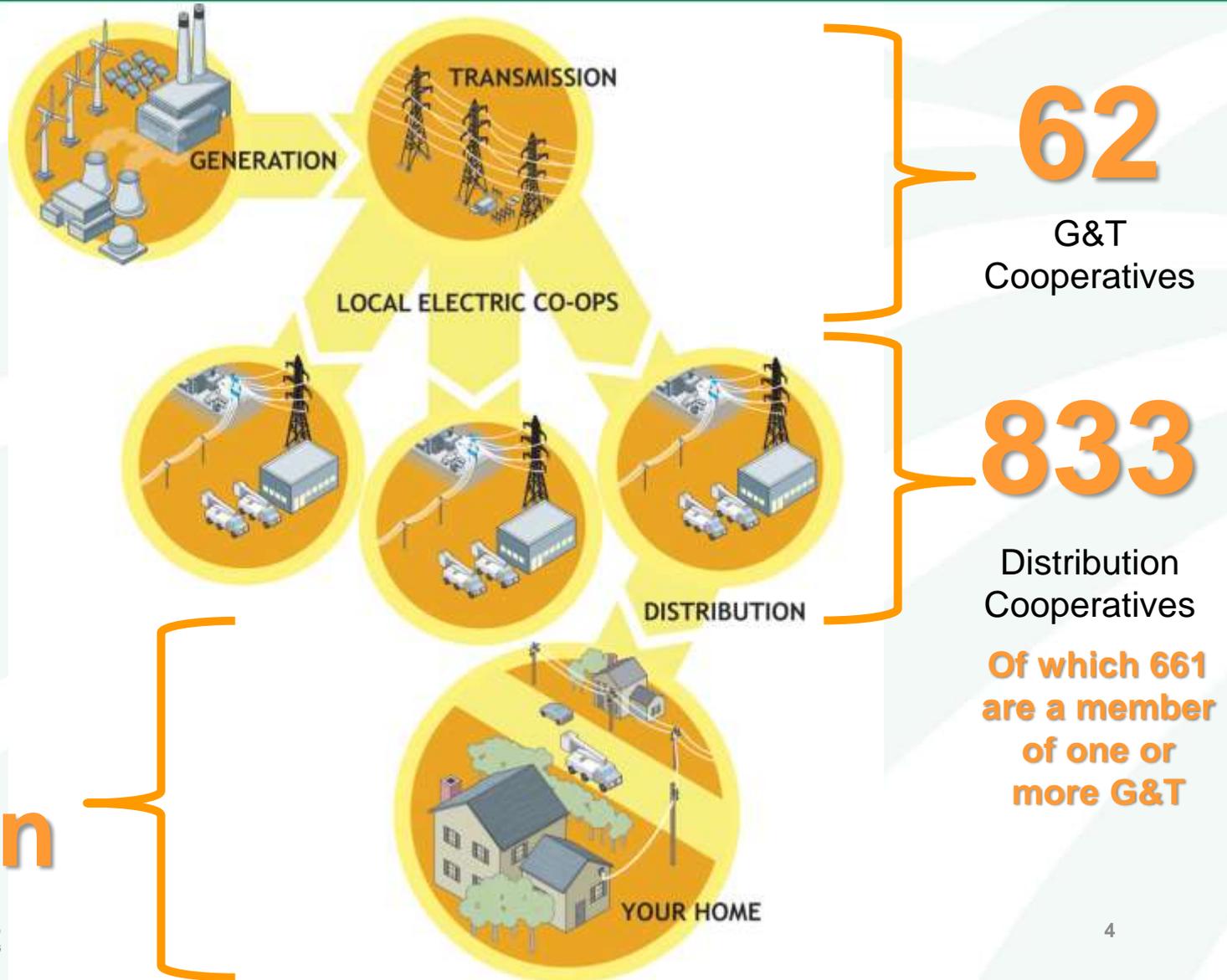
[michael.leitman@nreca.coop](mailto:michael.leitman@nreca.coop)

# America's Electric Cooperatives

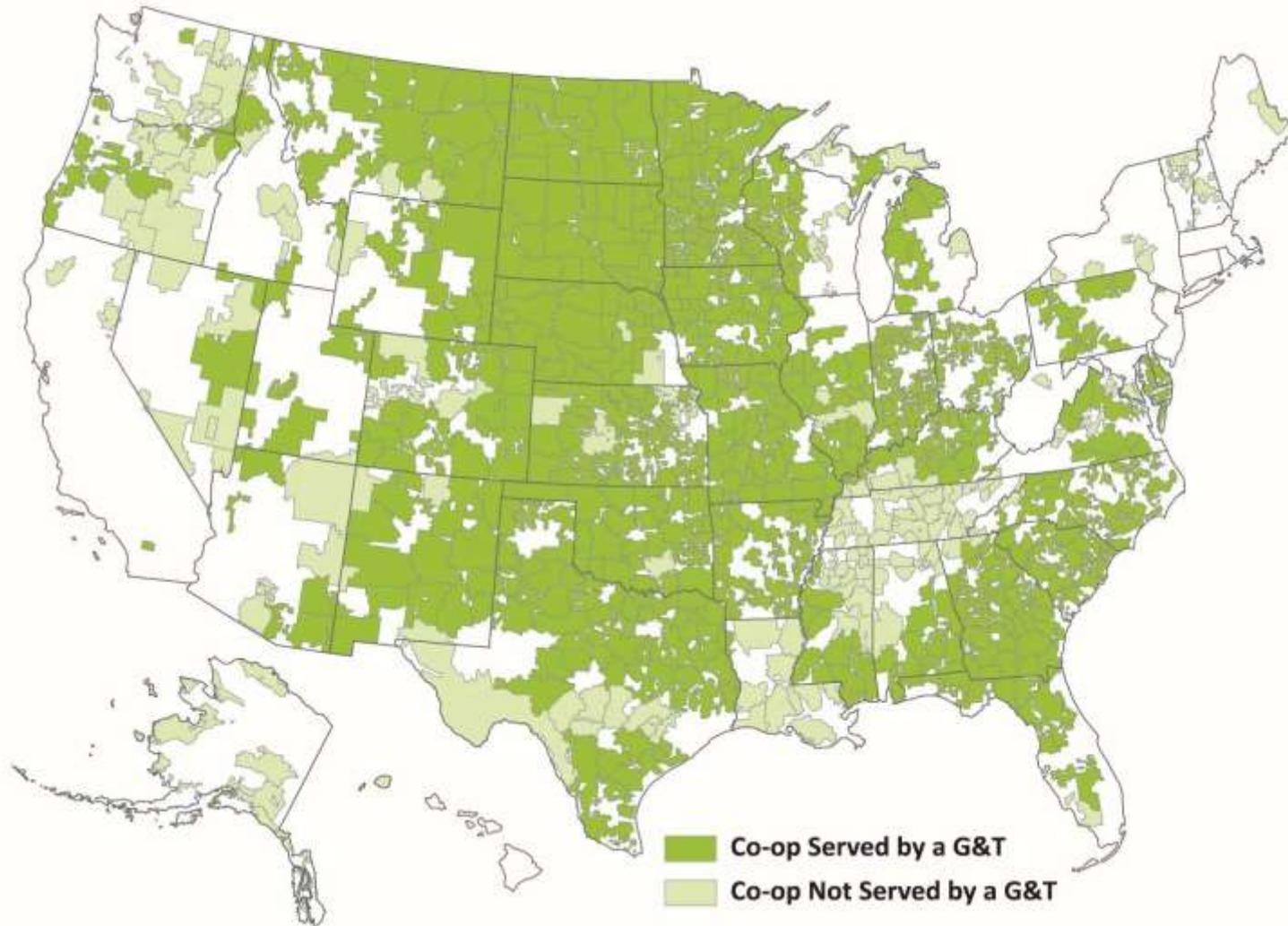
## America's Electric Cooperatives are:

- Cooperatively run businesses
- Not-for-profit, locally governed, and owned by their consumer-members
- Provide power to over 19 million consumer-members, 42 million Americans in total
- Serve in 2,500 of 3,141 U.S. counties in 47 states
- Own assets worth \$183 billion
- Own and maintain 2.6 million miles, or 42%, of the nation's electric distribution lines, averaging 7.4 consumers per mile of line
- Deliver 12 percent of the total kilowatt hours sold in the U.S. each year
- Generate ~5 percent of the total U.S. electricity production
- Employ 71,000 people in the U.S.
- Retire over \$1 billion in capital credits annually

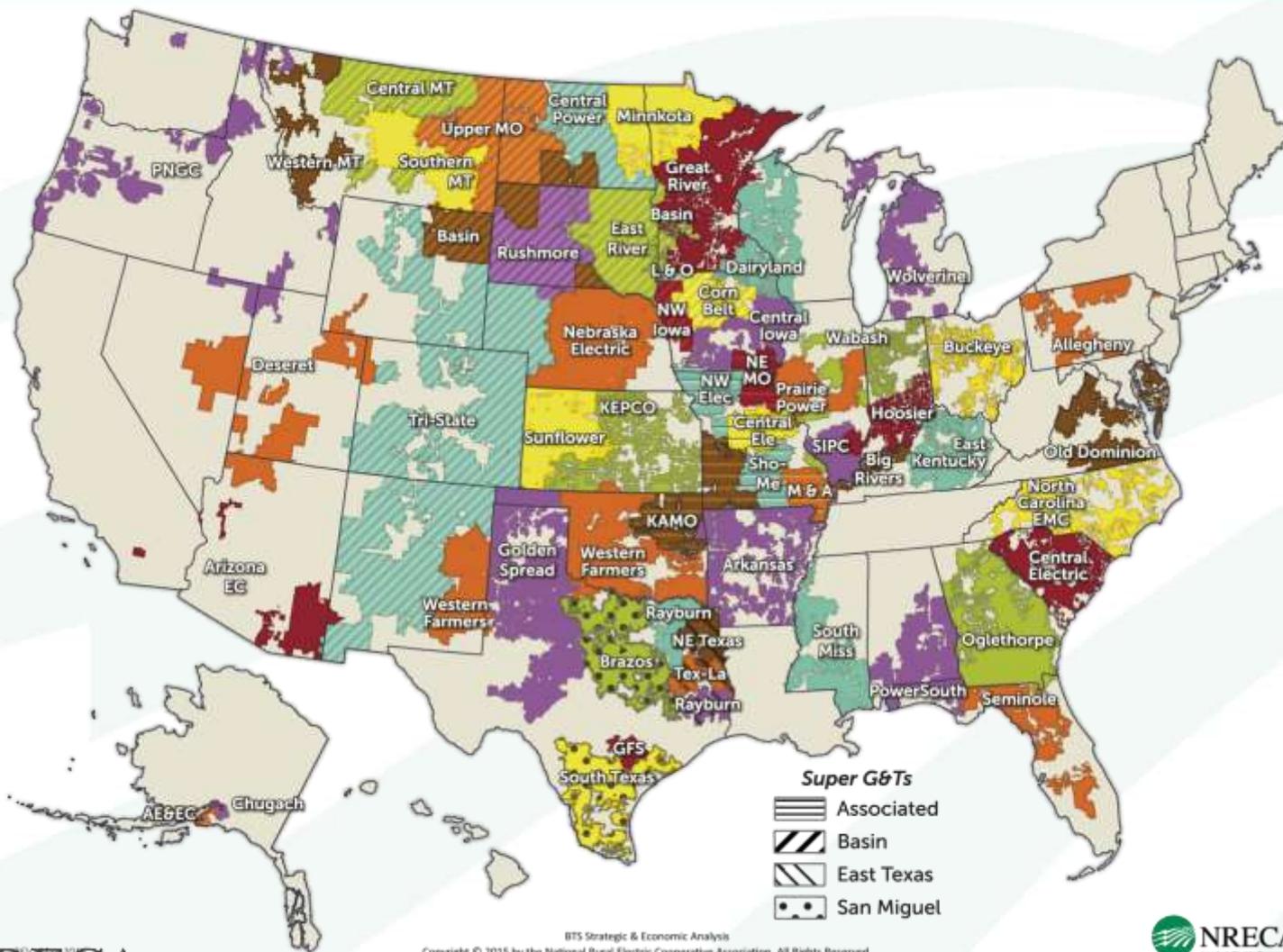
# Co-ops By the Numbers



# Distribution Cooperative Service Areas



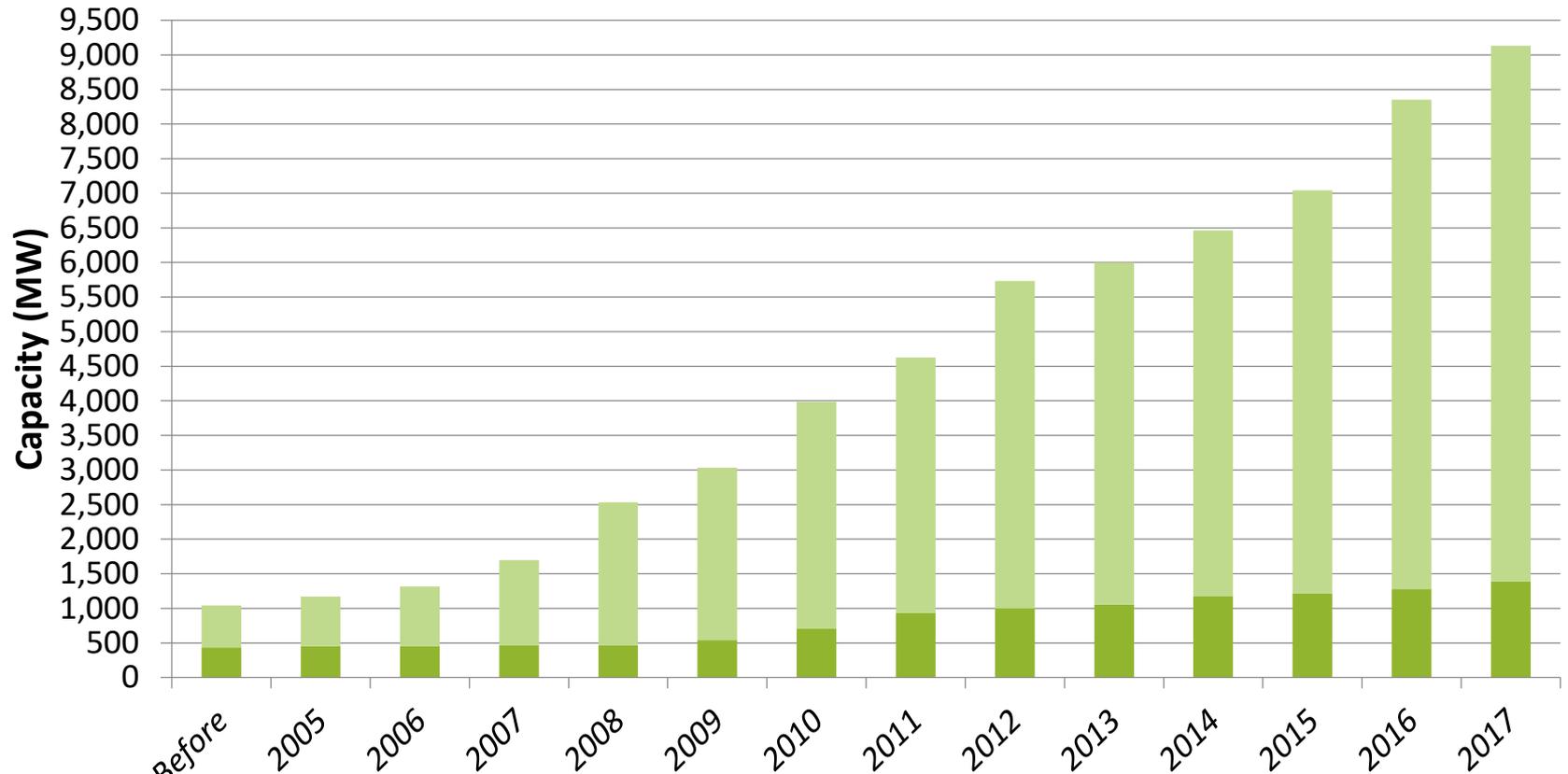
# G&T Cooperative Services Areas



BTS Strategic & Economic Analysis  
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# Cumulative Co-op Renewable Capacity by owned and purchased (PPA) capacity

More than 9,100 MW online, with at least 1,100 MW planned

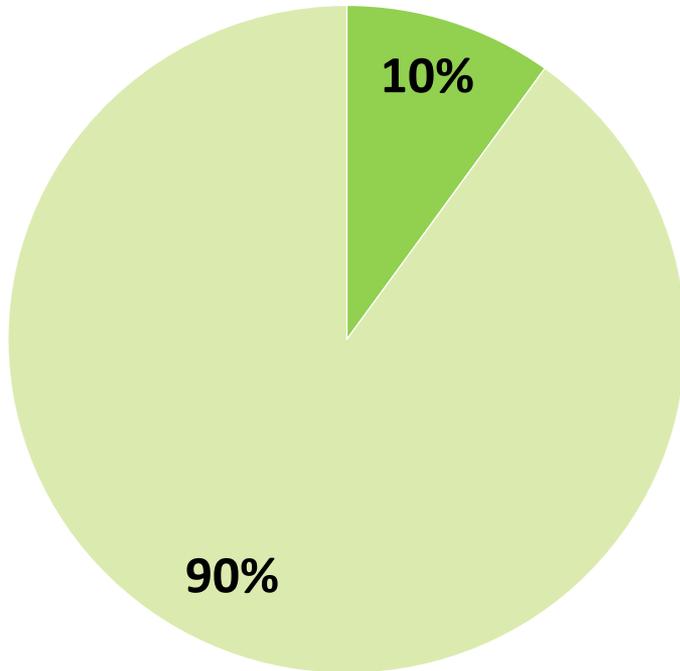


**Notes:**

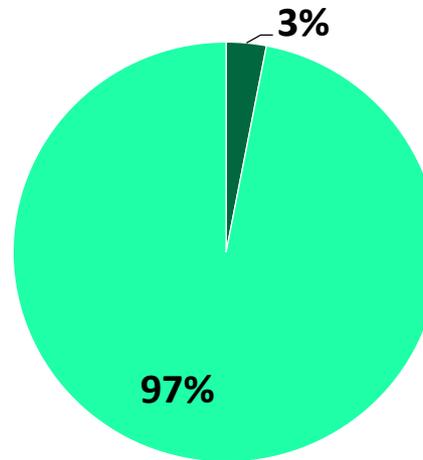
- 1) Some co-ops sell the environmental attributes of power generated using renewable resources
- 2) This figure does not include roughly 10 GW of federal hydropower capacity purchased by co-ops annually

# Electric Co-op Renewable Resources and Distributed (10 MW or less) Share

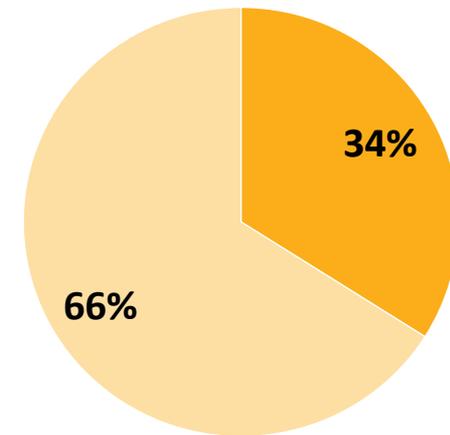
**All Types**  
**9,174 MW**



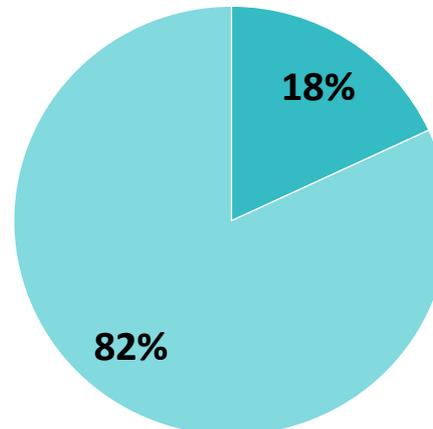
**Wind**  
**6,982 MW**



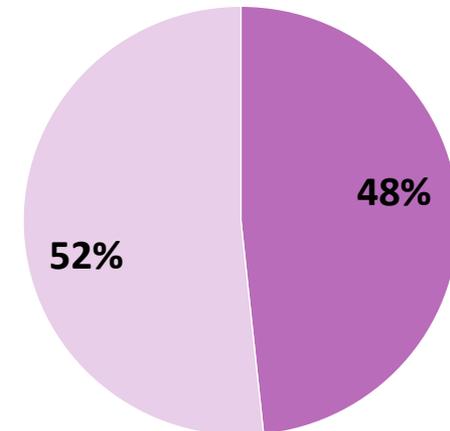
**Solar**  
**874 MW**



**Hydro**  
**692 MW**

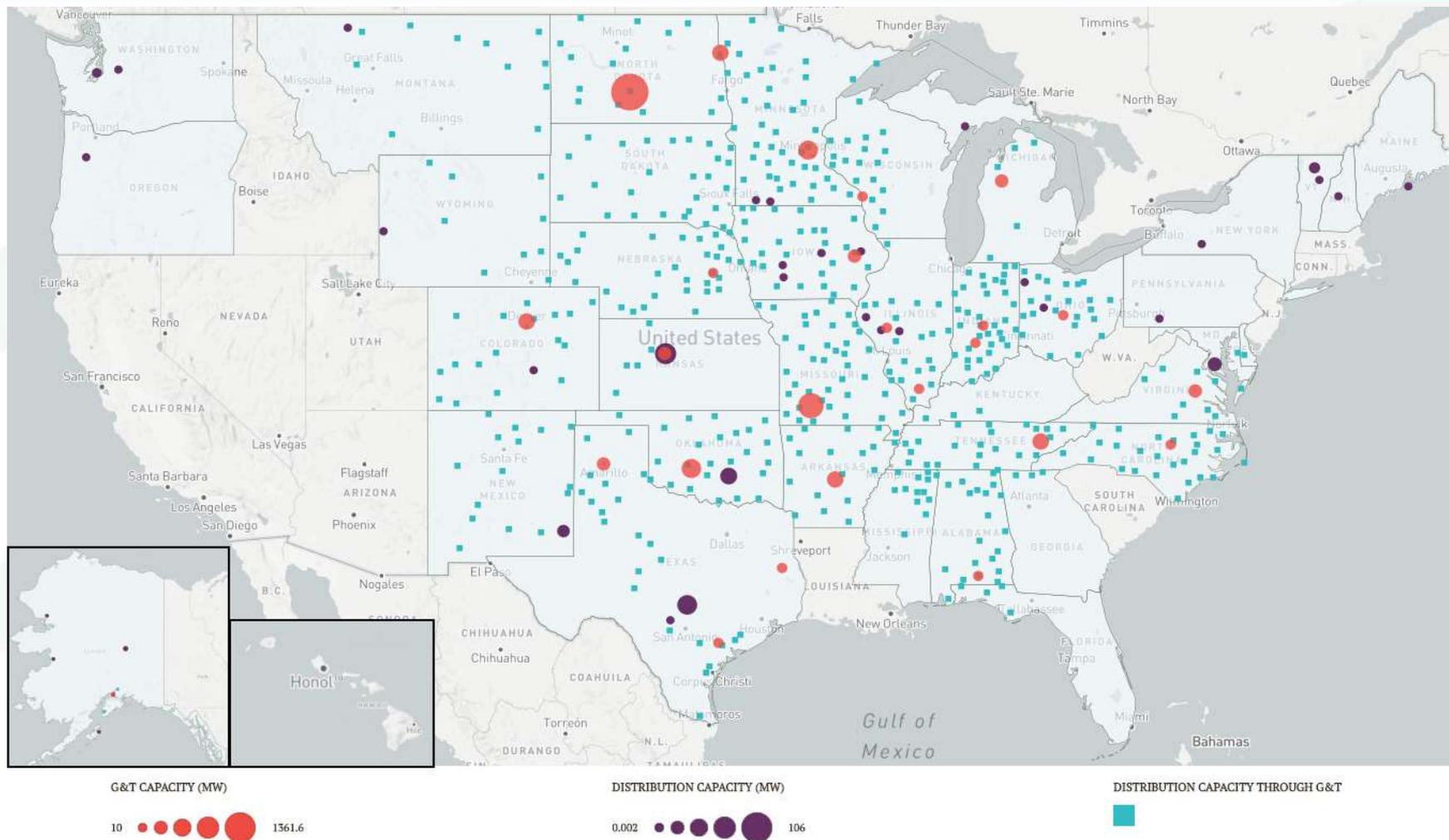


**Other**  
**633 MW**



# Co-ops with Wind Energy

About 7 GW online, and 700+ MW planned (90%+ through PPAs)



Note: Some co-ops sell the environmental attributes of power generated using renewable resources

# San Isabel Electric Cooperative (Colorado)



- San Isabel Electric Association (SIEA) headquarter in Pueblo serves about 24,000 consumer members in central-southeastern area of Colorado down to the New Mexico border
- SIEA developed the 8 MW Huerfano River Wind Project, which came online in 2013 as the region's largest community-owned distributed generation facility
- The project is owned by investors and the co-op has PPA for the output in order to harness the PTC
- The project provides about 5 percent of the co-op's power, with the rest coming from Tri-State G&T Association
- SIEA and Tri-State were jointly recognized by DOE as the 2014 WINDEXchange Wind Cooperatives of the year
- Worked jointly with Tri-State and the Electric Power Research Institute (EPRI) on a pilot project to improve small-wind grid-integration by storing wind energy as hot water for households

# Alaska Village Electric Cooperative



- Serves 58 communities and 11,000 consumer-members in interior, western and southeastern Alaska
- These communities constitute 50 microgrids, not connected to the Railbelt Grid around Anchorage
- Expensive diesel fuel has to be brought in by boat, so wind generation is used to offset costs
- Have erected 11 small wind installations (200 to 400 kW, using mostly 100 kW turbines) totaling 3.4 MW and serving 15 communities (4 are intertied)
- Generation was about 5,500 MWh, over 4% of total and saving over \$1 million in 2016
- At times when wind production exceeds demand, power is shunted to passive loads like water heating and treatment; cogeneration is also used to increase efficient use of fuel
- Several other off-grid co-ops in Alaska also use small wind installations to offset fuel costs

# Fox Islands Wind (Maine)



- Fox Islands Electric Cooperative was formed in 1975 to serve the towns of Vinalhaven and North Haven on the Fox Islands of Maine's Penobscot Bay
- Today about 2,000 consumer-members
- Power was brought in via a submarine cable and power costs were high (3x the national average)
- In 2009, the Coop installed a small wind farm with three full-size (1.5 MW) turbines on Vinalhaven island, providing 60% of the co-ops power
- This has allowed the co-op to take control of their supply and stabilize power costs, with excess Winter generation sold to the mainland and power imported during busier Summer months

# G&T-Distribution Co-op Partnerships in DG

- Several G&Ts have partnered with their distribution member-cooperatives to deploy distributed generation
- Hoosier Energy (IN) has deployed ten 1 MW arrays in its member-cooperatives' territories
- Dairyland Power (WI) deployed 15 PPA solar projects in member-cooperatives' territories, ranging from 500 kW to 2.5 MW for a total of 20 MW, and facilitated direct PPAs with the developer for seven members to add 1.3 MW of additional capacity for community solar programs
- Several G&Ts have also deployed centralized community solar arrays and either offer programs to their member-cooperatives to brand, or offer capacity for their member-cooperatives to offer through their own programs
- Partnerships can help integrate these resources into resource planning and power supply contracts

# Distributed Generation for C&I



Arkansas Electric  
Cooperative Corporation



**AEROJET**  
**ROCKETDYNE**



Ouachita Electric  
Cooperative Corporation

  
**SILICON RANCH**

- Arkansas Electric Cooperative Corp. and its distribution member-cooperative Ouachita Electric Cooperative partnered with Silicon Ranch to develop a 12 MW array at Aerojet Rocketdyne's facility in Camden, Arkansas
- The company had a goal of improving the sustainability score for its facility
- AECC purchases the excess generation, so it also helps the cooperative meet its sustainability goals
- Received federal and state new markets tax credits, as well as the federal ITC to improve financing
- The largest solar array in the state, receiving recognition for its innovation
- This model of partnership could easily be applied to wind for C&I customers seeking renewable energy

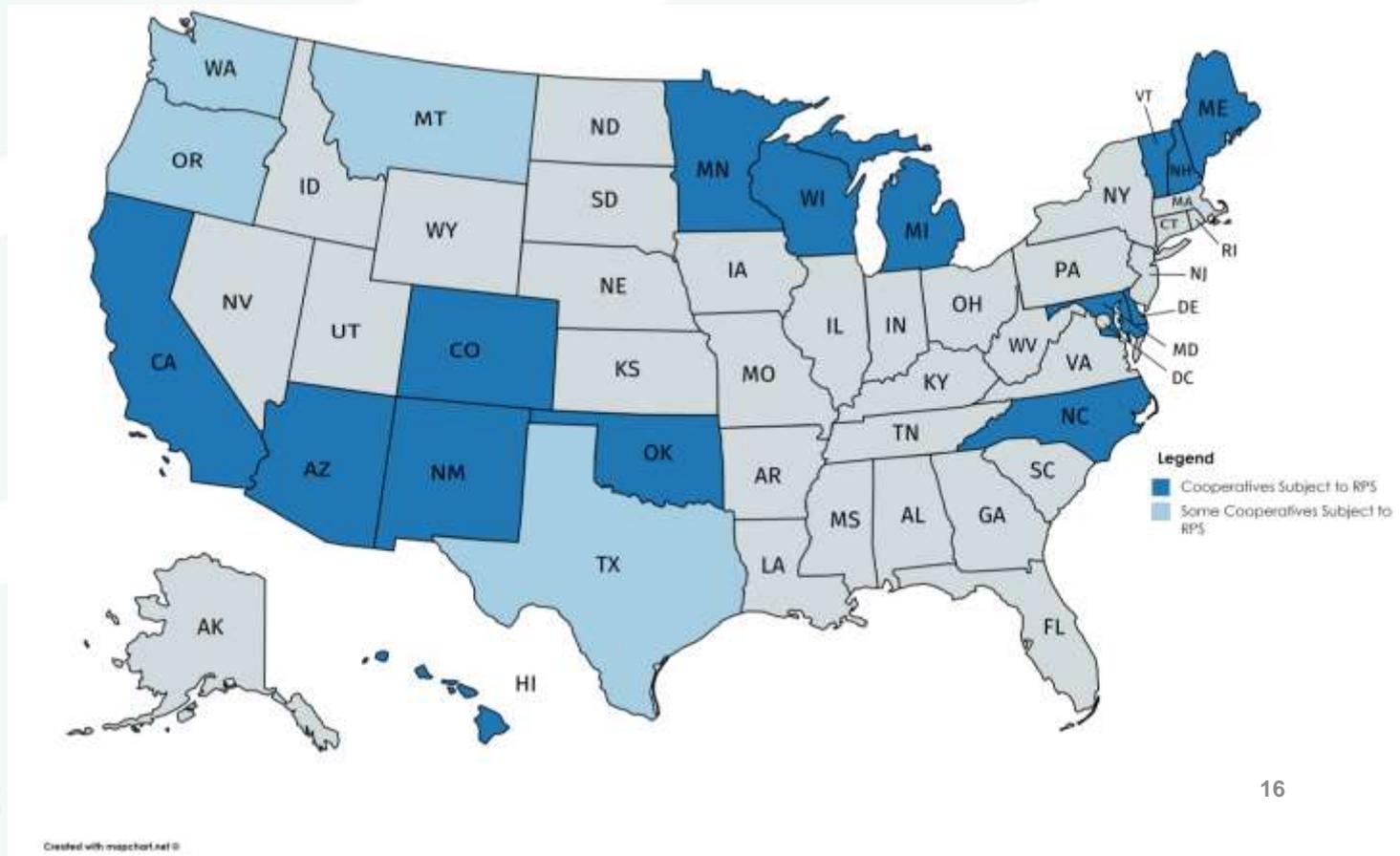
# Microgrid Projects

- Experience has been gained from “natural microgrids” in off-grid locations
- North Carolina EMC is piloting two microgrids with member-cooperatives
  - One on Ocracoke Island, served by Tideland EMC, integrates a small 15-kw solar installation with an existing 3 MW diesel backup and a Tesla Powerback (500 kW/1 MWh), plus wi-fi connected thermostats
  - A second, at Butler Farms in South River EMC’s territory, combines battery storage (200 kW/750 kWh) with a 185 kW swine-waste generator, 20 kW of solar, and 100 kW of diesel
- In Oklahoma, Central Electric Cooperative has deployed a microgrid to serve its headquarters and data center, as well as a business park built around it, including a 504 kW of solar, a 750 kW diesel generator, and a 250 kW/475 kWh battery
- A partnership for a microgrid including distributed wind might be of interest



# What Drives Co-op DG Growth?

- In a recent NRECA survey, distribution cooperatives identified consumer-member demand and satisfaction as their most common drivers for renewable programs in general, and their distributed generation programs in particular
- Declining costs of renewable and DG technologies were also major driver
- Many states include cooperatives in their RPSs, and some have DG and in-state requirements or incentives



# Closing Thoughts 1

- As not-for-profit utilities, cost and affordability are very important; congratulations to DWEA on the small wind ITC extension!
- Improved small-wind technologies that can lower costs and increased performance vis-à-vis other technologies and larger wind projects can capture public attention can help attract new development
- While co-ops have primarily used PPAs to add renewables, the smaller scale of distributed wind can make it an attractive opportunity for ownership
- Local economic development is very important for cooperatives, so distributed projects within a service territory might be more attractive than a share of a larger more distant project
- Distributed projects can provide greater visibility and member-relations value at the distribution cooperative level

# Closing Thoughts 2

- Geography is very important, and additional value streams like fuel savings, transmission cost savings, or peak reduction can add value beyond just kilowatt hours
- Partnerships between G&T and their distribution member-cooperatives can facilitate the deployment of multiple distributed generation projects
- Cooperatives lead the industry in community solar program deployment with about a quarter offering a program; these often favor local distributed generation that participants can see; these started small, and often through partnerships
- Cooperatives cooperate and share information, so successful partnerships can be broadcast across the cooperative network



# **Distributed Wind for America's Heartland**

## Moderator

**Trudy Forsyth**, Wind Advisors Team

## Speakers

**Ciel Caldwell**, Northern Power Systems

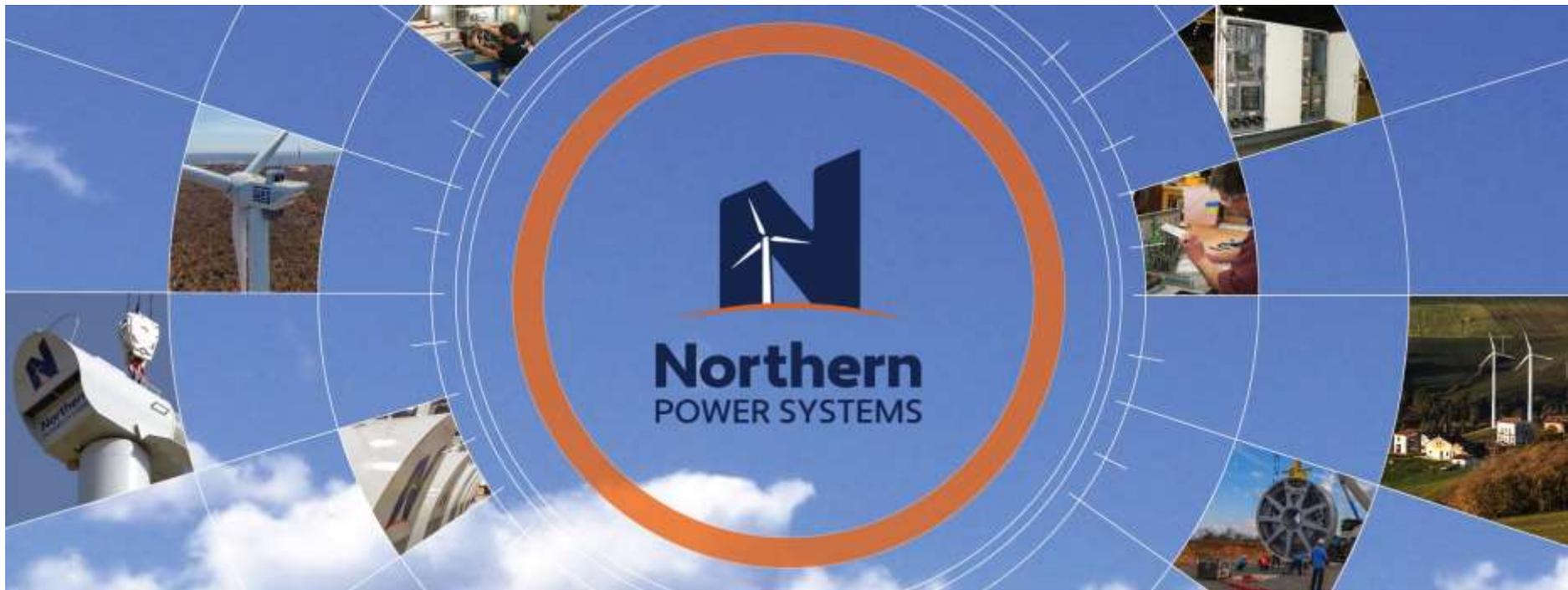
**Rob Hach**, Trusted Energy

**Jack Morgan**, National Association of Counties



# **Distributed Wind for America's Heartland**

**Ciel Caldwell, Northern Power Systems**



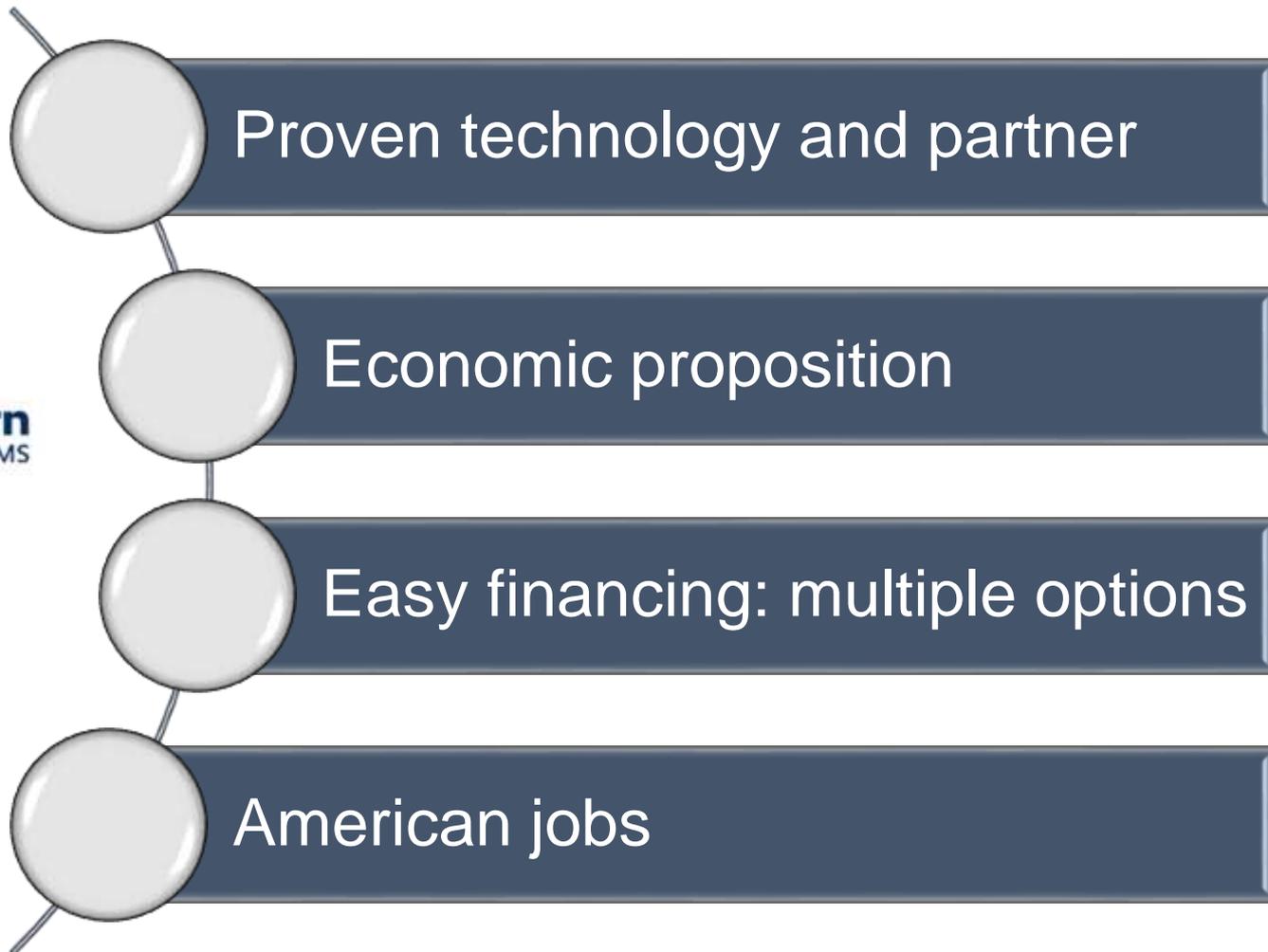
# Boosting Profits with Onsite Generation

*How America and America's Heartland benefit from Distributed Wind*

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# Wind Power Value Proposition

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# Northern Power Systems – Company Overview

Providing distributed energy & renewable solutions globally for over 40 years

Based in Barre, Vermont, USA

Offices in:

Boston ▪ Italy ▪ United Kingdom ▪ Switzerland

## Distributed Wind Turbines



100 kW, 60 kW  
~800 turbines  
with over 20  
million run hours  
98% availability

## MW Scale Wind Technology



Partnered with  
WEG  
Over 100MW  
installed

## Integrated design and controls



For microgrid  
applications  
>25 projects  
globally

## Power Converter Systems



500 kVA – 2.5  
MVA units  
FlexPhase™  
technology

## Turnkey Energy Storage



ESS site  
controller  
BMS integration  
Monitoring &  
data acquisition

Business  
core

Leveraging history into distributed solutions



# NPS Global Footprint

*Over 800 systems worldwide with over 20 million run hours  
98% availability*



# NPS Services

## ❖ Regional support assets for full service across the value stream:

- Application Development & Support
- Permitting and site management
- Project Management and site construction
- Installation & Commissioning Teams
- Warranty & Maintenance Inventory
- 24/7 performance and condition monitoring
- Product and performance upgrades



24/7 monitoring and service support

**95% of customers have rated the Northern Service Team as either “Very Knowledgeable” or “Extremely Knowledgeable”**

*Source: Jan 2017 NPS customer survey*



# Why Wind Power? Why Northern Power?

- ❖ 100kW wind turbine is a right fit for many on-site, “behind the meter” applications
- ❖ Generate 200,000 – 350,000 kWh/year
- ❖ Lower – and more stable – cost of power
- ❖ Tax advantages
- ❖ Small footprint
- ❖ “Green” values made visible
- ❖ Educational value

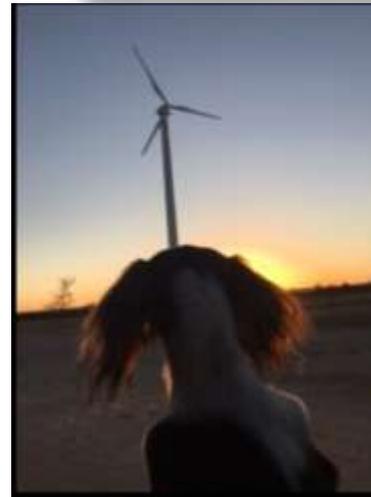
**Energy Independence**

**Financial Benefits**

**Non-Financial Benefits**

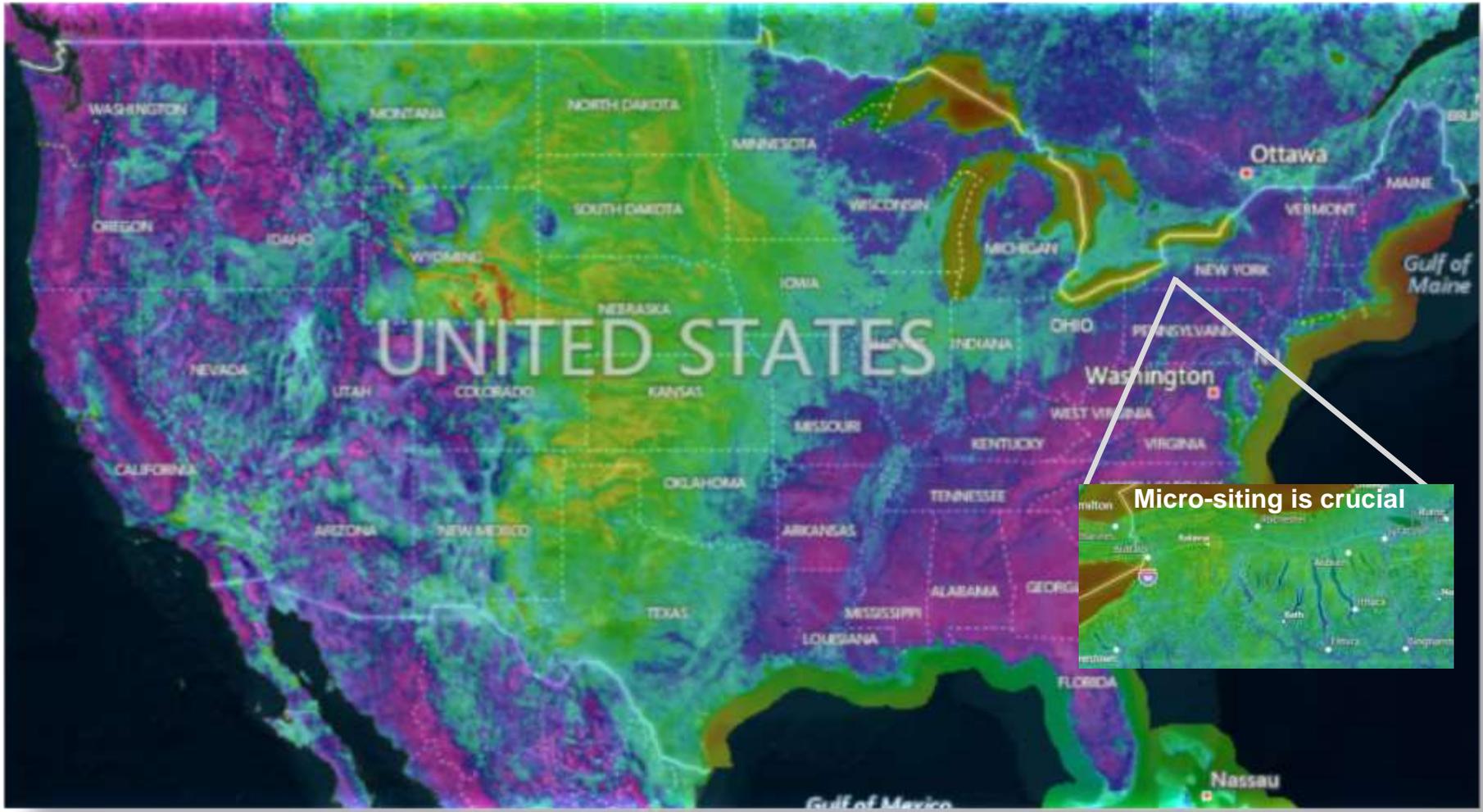
**NPS: Proven track-record of performance and safety**

*NPS100:  
120 ft. high  
10'x10' foundation*



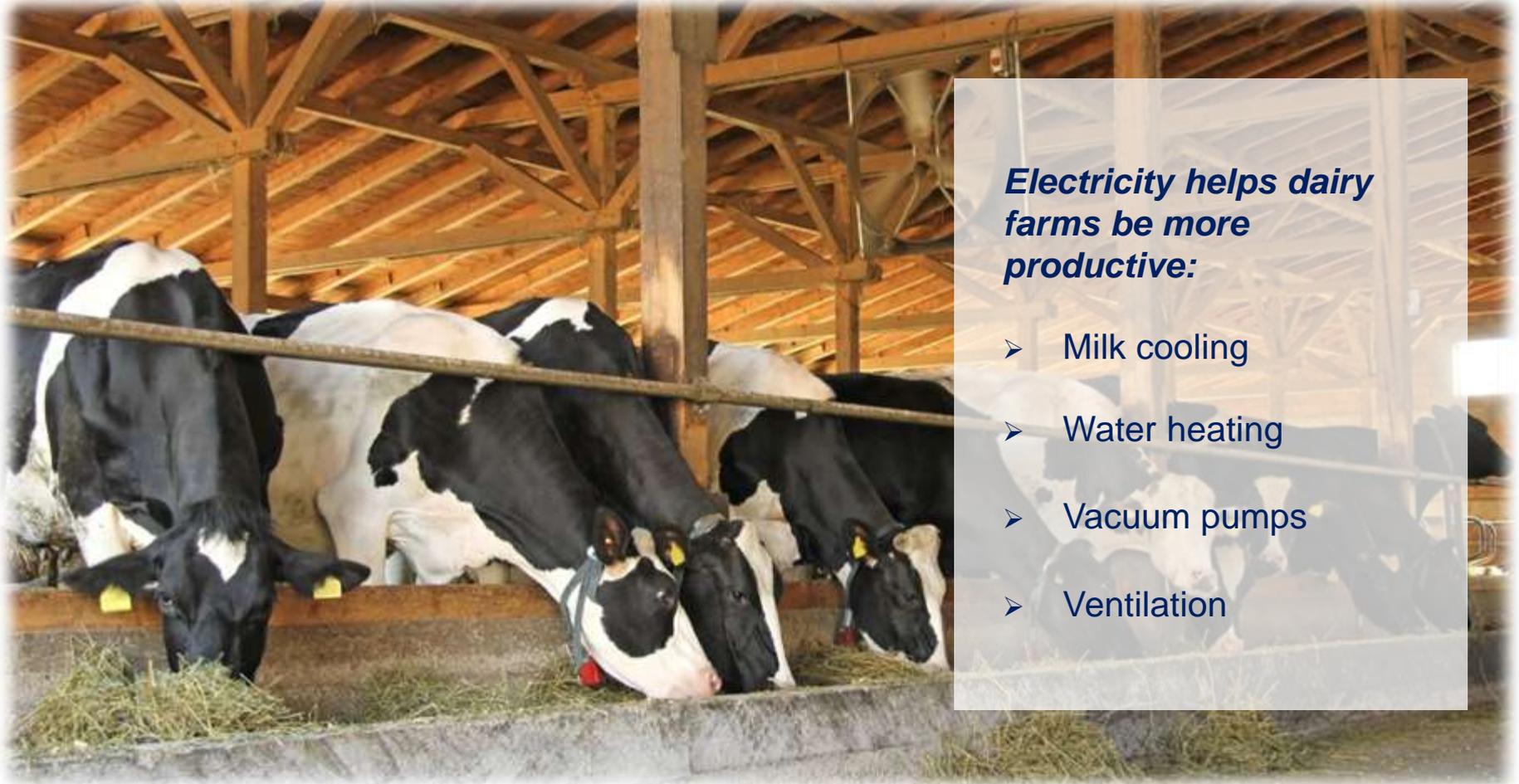
# Wind in the United States

- ❖ Light blue / green / yellow / red are high quality wind regimes



# Energy on a Dairy Farm

*A typical dairy farm consumes between 800 and 1,200 kilowatt hours (kWh) per cow every year.*



***Electricity helps dairy farms be more productive:***

- Milk cooling
- Water heating
- Vacuum pumps
- Ventilation



# Easy / Flexible Financing Options

Northern Power partner provides financing and tax equity appetite

Customer identifies financing and has a tax equity appetite



**Power Purchase Program**

(Immediate 10% discount on current rate)



**Lease to own**

(7 or 9 years)



**Customers corporate bank**

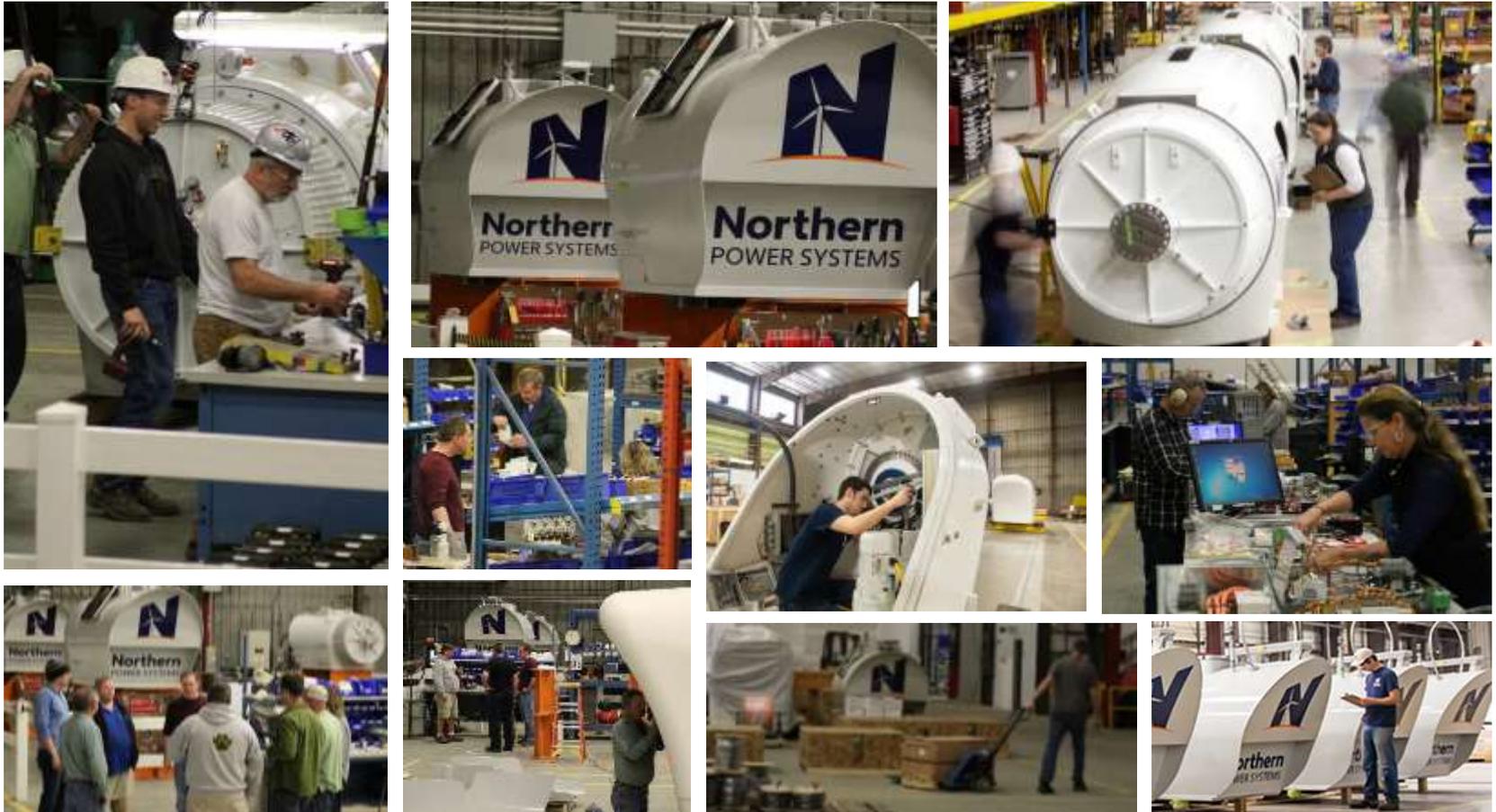


**Cash Investment**

Savings and Commitment Spectrum



# Northern Power Systems



*Proven Track-Record of Performance and Safety*  
*Engineered and assembled in America*





# **Distributed Wind for America's Heartland**

**Rob Hach, Trusted Energy**



# Wind, Solar, Storage Hybrid Solutions

**DWEA – Distributed Wind 2018**  
February 28, 2018

# Presenter

**Rob Hach**

Trusted Energy

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Phone: (712) 291-8012

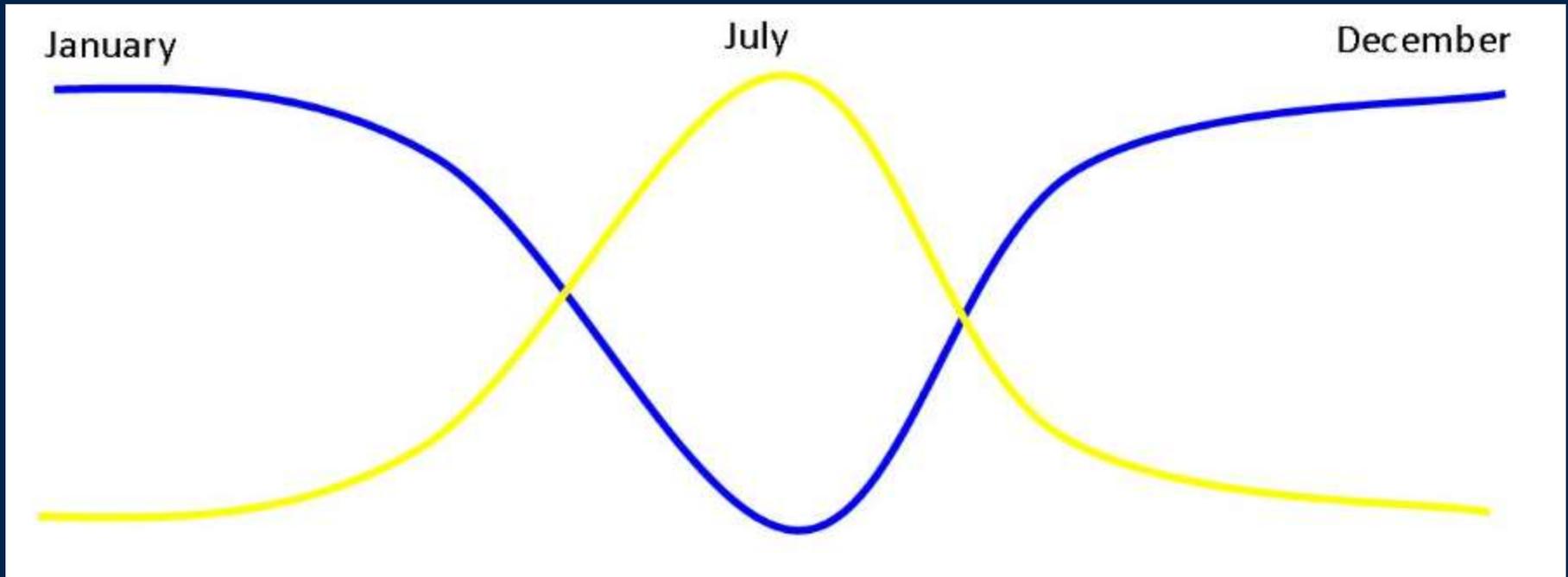
**TRUSTED**  
 energy

# Why choose to build a wind and solar project?



The production curve from wind and the production curve from solar compliment each other.

Blue curve represents the electrical production from a wind turbine



Yellow curve represents the electrical production from a solar array

# A new study by the Reiner Lemoine Institut and Solarpraxis AG has found that solar and wind power generation complement each other better than previously thought.

The study examined the surface area where solar photovoltaic systems and wind turbines were installed together. In that same surface area, twice the amount of electricity was being generated, and the shading produced by the wind turbines accounted for a mere 1 to 2% loss in the photovoltaic system — which is much less than previously thought would be the case.

One of the strong benefits is the construction of these types of power plants do not require grid expansion since the plants generate wind and solar power at different intervals and during complementary seasons. This helps ensure that the level of energy being fed into the grid is more steady than that of wind or photovoltaic power plants alone.

“Until now, it was thought that the shadows cast on solar plants by wind turbines led to high yield losses. The study shows, however, that these shading losses are much lower than expected, provided the hybrid power plant is well designed,” said Alexander Woitas, head of the engineering department at Solarpraxis AG, parent company of pv-magazine.com. In the study, they also calculated what effects combining photovoltaic and wind power plants will have on power grids on both a global and regional level.

The bottom line is: solar power plants generate more solar power in the summer, while wind turbines generally produce a lot more electricity during the colder parts of the year — this balances out the overall supply to the grid and keeps it more stable throughout the year.

To continue the research, a photovoltaic system will be retrofitted with wind turbines in Templin (near Berlin). The pilot plant will be analyzed by Solarpraxis, the Reiner Lemoine Institut, and project partners. The data will be used for feasibility studies of future integration between wind and solar power. This is all part of the German government’s Zwanzig20 research initiative.



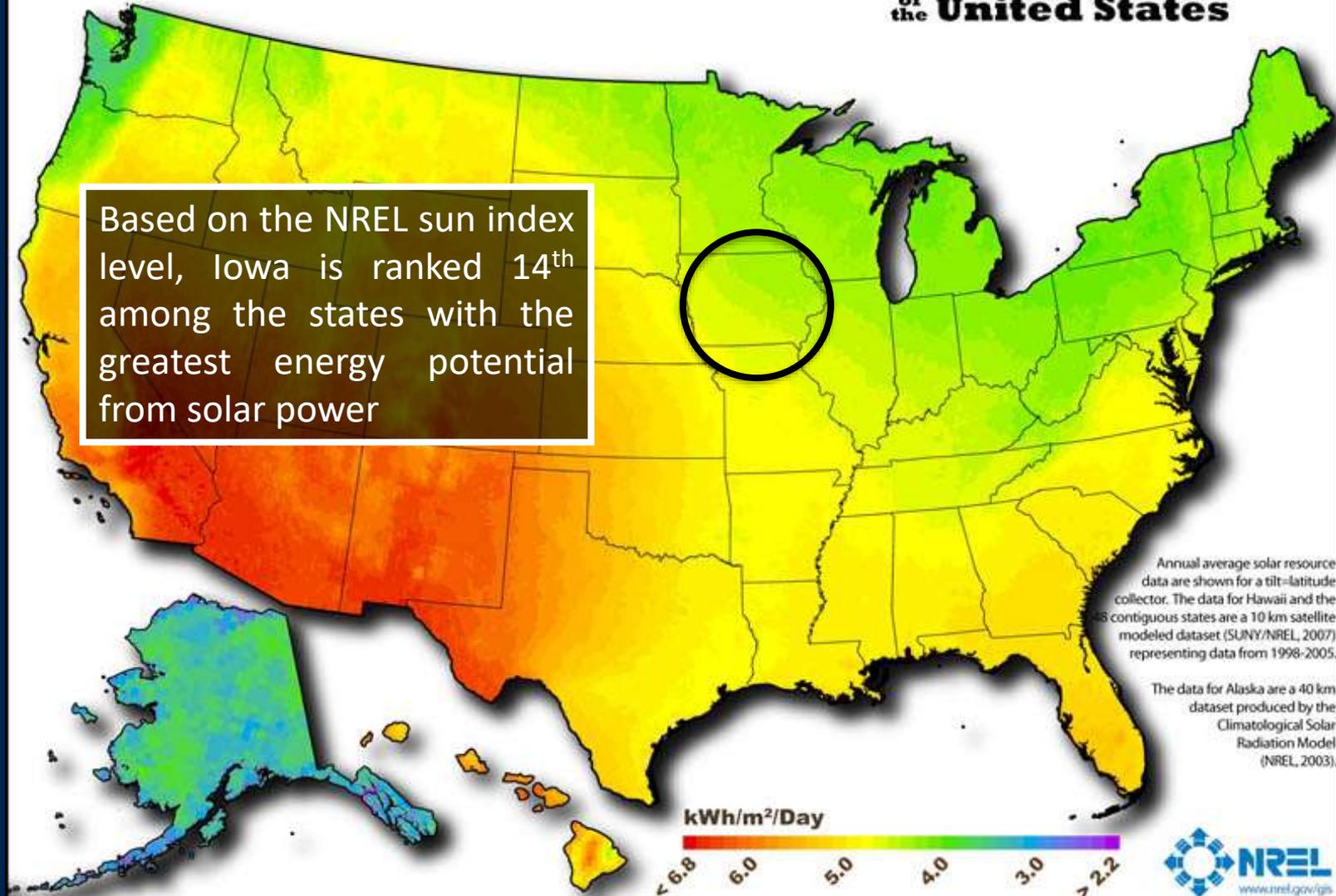
# Solar Basics

- Enough energy from the sun hits the earth every hour to power the planet for an entire year
- Solar PV is a clean, cost-effective way to harness power for homes and businesses - durable, no moving parts
- 285+ watts generated per module (increasing ~ 5 watts per quarter)
- Solar systems like colder temperatures

# Iowa's Solar Resource

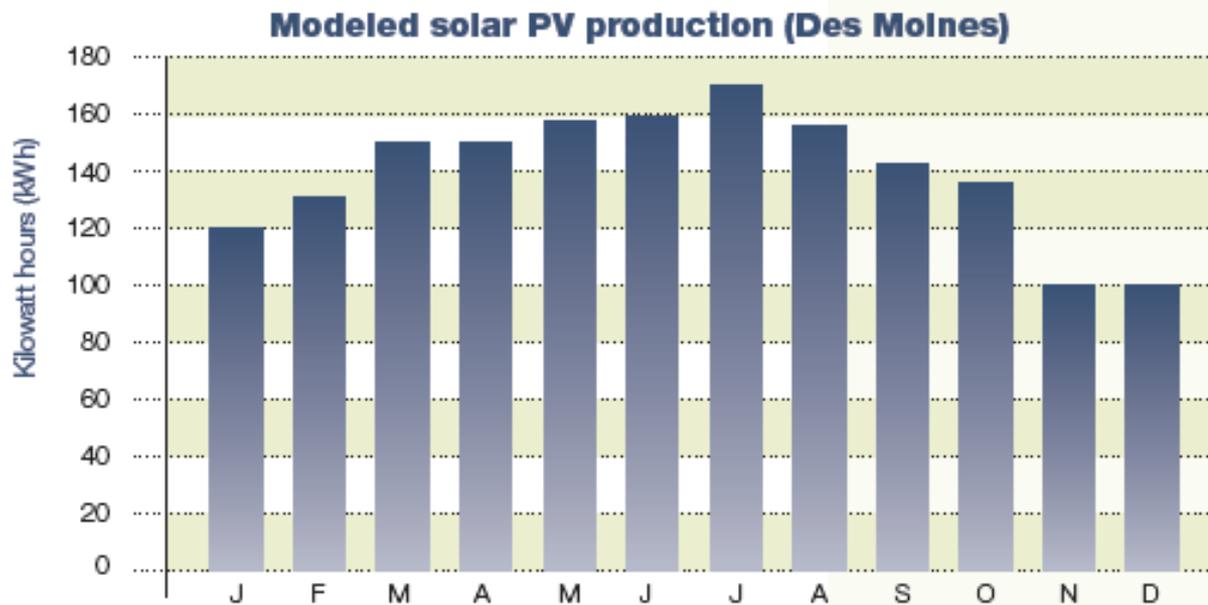
## Photovoltaic Solar Resource of the United States

Based on the NREL sun index level, Iowa is ranked 14<sup>th</sup> among the states with the greatest energy potential from solar power





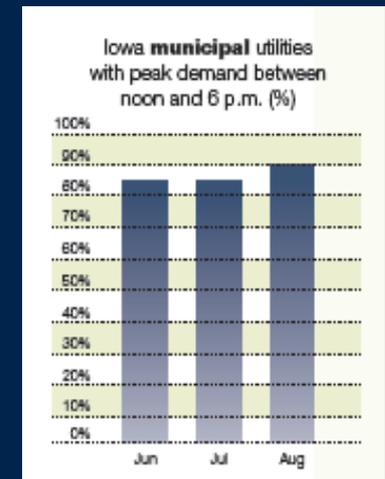
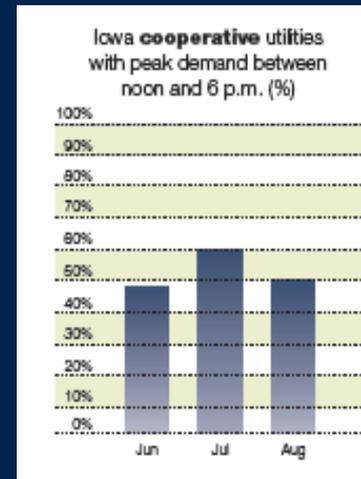
# Modeled Solar Production



**Figure 6.** This chart shows the average monthly production of a solar PV array in Iowa throughout the year.

# Utility Peak Demand in Rural Areas

Figure 7. In the summer, about 50% of Iowa's cooperative utilities and 85% of municipal utilities reach their monthly system coincident peak between noon and 6 p.m., when solar PV is producing energy. These charts include the 36 cooperative utilities and 114 municipal utilities that reported data in 2011.<sup>14</sup>



# Kirk and Carla Christensen Farm



# Project Specifications:

**Project Type:** Grid Tied Wind Turbine and 30kw Fixed Solar

**Project Size:** A combined total of 40 kilowatts (kW) DC power by using 10kW Bergey turbine on a 100' lattice tower and total 30kW solar panels.

**Project Came Online February 18<sup>th</sup>.**

**Estimated Annual Output:** Wind Turbine – 21,288 kilowatt hours (kWh) per year, Solar – 44,715 kWh per year, A total of 66,003

**Number of PV Modules and Size of PV Modules:** A total of 120 modules, 12 modules on each of the 10 solar piers. The modules are 280 Watts

RECs are starting to square up net metering at the end of the month. Economic return changes when over production is paid at avoided cost rather than deferred kwh production.

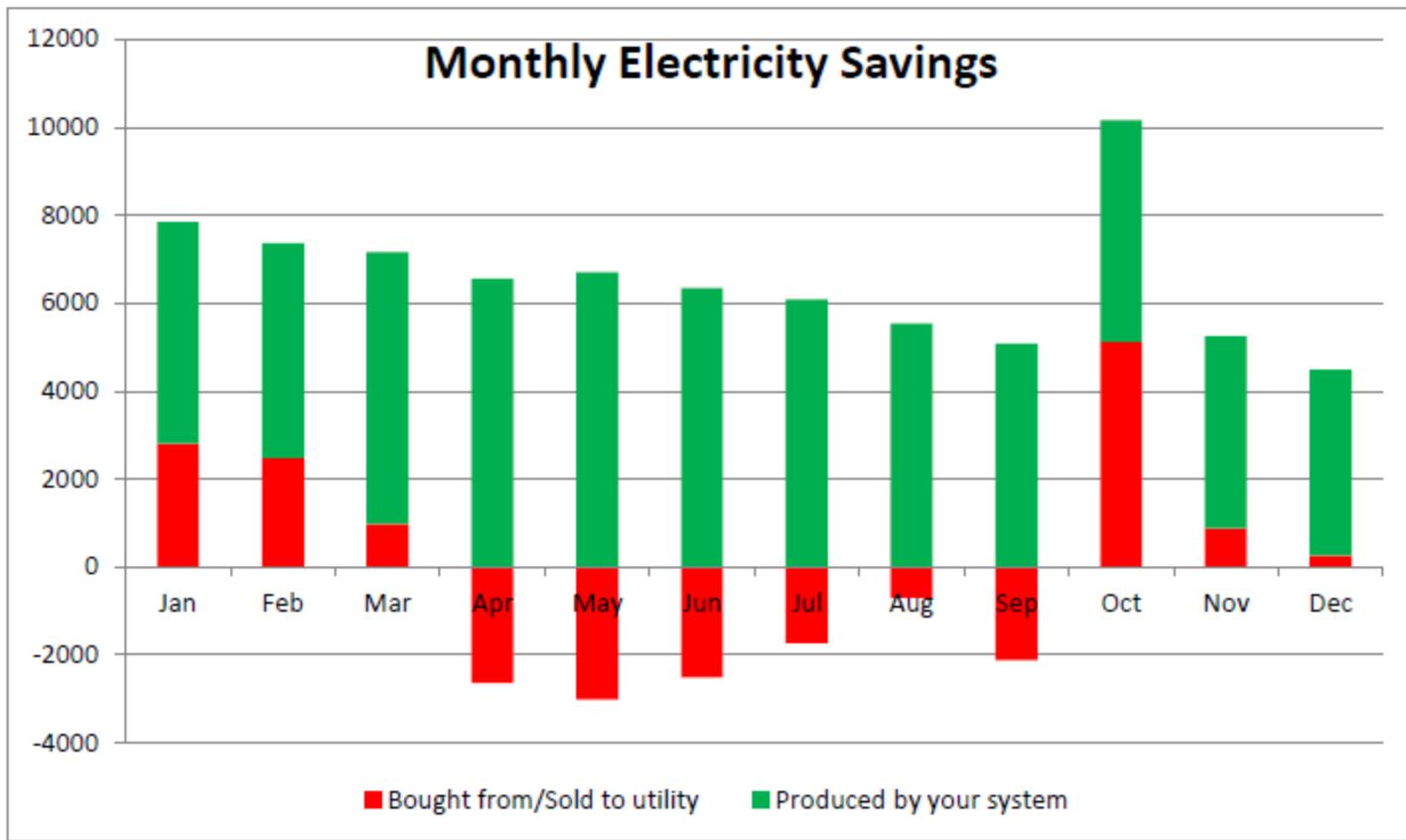
RECs will have a production cap often at 40kW or 50kW.

To offset a customer's generation, the combination of the two resources will offset more than each resource by itself.

Month	Wind Generation	Solar Generation	Total Generation	Old Load	New Load	Bill Savings	Old Bill	New Bill
Jan	2166	2866	5032	7840	2808	\$ 549.45	\$ 901.60	\$ 352.15
Feb	1911	2966	4877	7360	2483	\$ 532.51	\$ 809.60	\$ 277.09
Mar	2256	3924	6180	7160	980	\$ 674.81	\$ 787.60	\$ 112.79
Apr	2223	4332	6555	3920	-2635	\$ 715.73	\$ 443.99	\$ (271.74)
May	1878	4820	6699	3680	-3019	\$ 731.38	\$ 420.15	\$ (311.23)
Jun	1524	4823	6346	3840	-2506	\$ 692.94	\$ 422.40	\$ (270.54)
Jul	1180	4911	6091	4360	-1731	\$ 664.99	\$ 501.40	\$ (163.59)
Aug	1045	4488	5533	4840	-693	\$ 604.13	\$ 556.60	\$ (47.53)
Sep	1326	3760	5085	2960	-2125	\$ 555.25	\$ 340.60	\$ (214.65)
Oct	1731	3299	5030	10160	5130	\$ 549.20	\$1,035.81	\$ 486.61
Nov	1952	2407	4359	5240	881	\$ 475.92	\$ 726.59	\$ 250.67
Dec	2097	2118	4215	4480	265	\$ 460.21	\$ 596.37	\$ 136.16
<b>Total</b>	<b>21288</b>	<b>44715</b>	<b>66003</b>	<b>65840</b>	<b>-163</b>	<b>\$7,206.51</b>	<b>\$7,542.71</b>	<b>\$ 336.20</b>

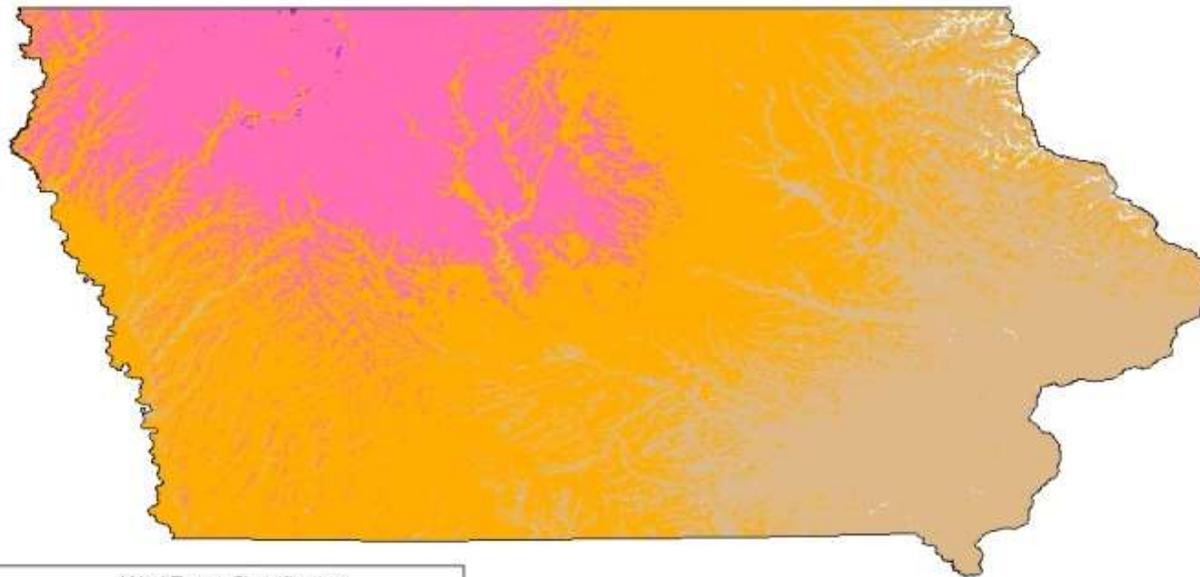
Key Outputs	Solar	Wind	Combined
Simple Payback (yrs)	4.25	10	5.75
Equity IRR (20yr)	19.0%	7.7%	14.5%

You will make 100% of the electricity you need.



# Iowa Wind Resource

Iowa - Annual Wind Power at 50-m Height



Wind Power Class	Resource Potential	Wind Power Density at 50m W/m <sup>2</sup>	Wind Speed <sup>a</sup> at 50 m m/s	Wind Speed <sup>a</sup> at 50 m mph
1	Poor	0 - 200	0.0 - 5.6	0.0 - 12.5
2	Marginal	200 - 300	5.6 - 6.4	12.5 - 14.3
3	Fair	300 - 400	6.4 - 7.0	14.3 - 15.7
4	Good	400 - 500	7.0 - 7.5	15.7 - 16.8
5	Excellent	500 - 600	7.5 - 8.0	16.8 - 17.9
6	Outstanding	600 - 800	8.0 - 8.8	17.9 - 19.7
7	Superb	> 800	> 8.8	> 19.7

<sup>a</sup>Wind speeds are based on a Weibull k value of 2.0

# Ag Installations



# Van Meter Muscatine office



# Ag Installations



Hybrid system with  
a 10kW Wind  
Turbine and 30kw  
of Solar at a cattle  
farm in western  
Iowa

# Storage





FUTURE AHEAD

# Public Policy

- Critical to drive adoption of new energy technologies
- Recommend focus be on ...
  - Eliminating barriers: make it simple, easy, and inexpensive to permit, install, and connect to the grid
  - Creating incentives to invest - fair open market and a fair price for the energy produced
  - Allowing third-party power purchase agreements
  - Standardizing interconnection policies , net-metering, zoning, permitting
  - Encouraging community solar projects
  - Modifying RPS to include a carve out for solar



**Questions?**



**Rob Hach**

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**Contact  
Information**



## **Distributed Wind for America's Heartland**

**Jack Morgan, National Association of Counties**

# Fueling Job Growth by Tapping into the New Energy Economy

**Jack Morgan**  
**Program Manager**  
**Community & Economic Development**  
**National Association of Counties**

DWEA Annual Conference  
2.28.18

**Stronger Counties. Stronger America.**





# #CountiesMatter



- NACo unites America's 3,069 county governments
- Vision: *Healthy, vibrant and safe counties across the United States.*

**Stronger Counties. Stronger America.**



# Resilient Counties

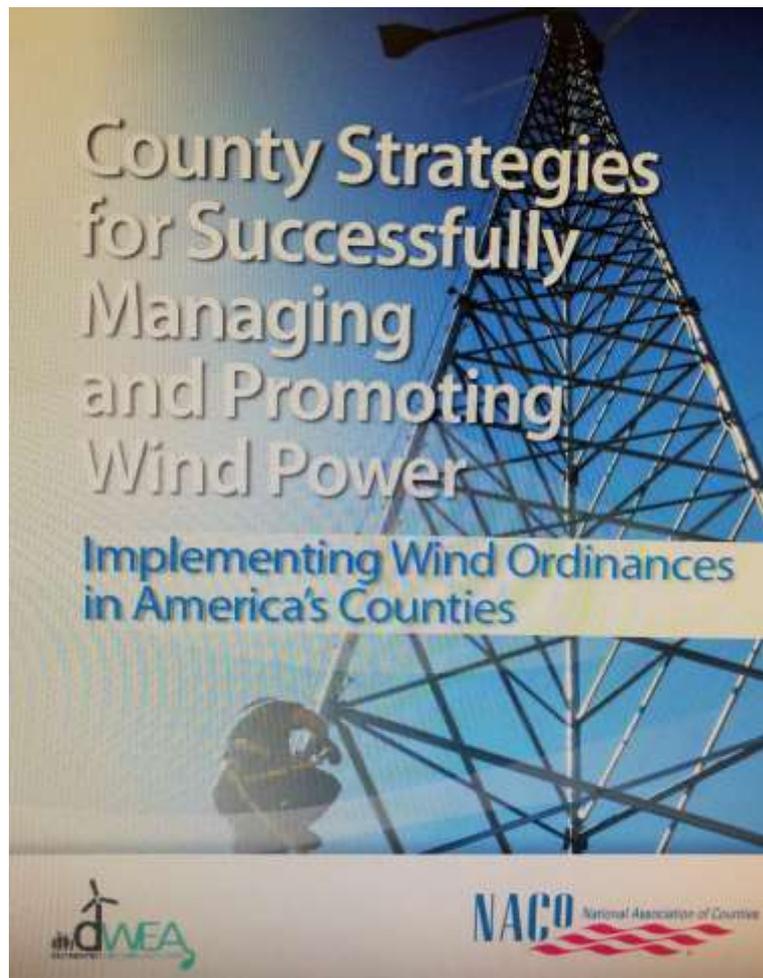


# Why Renewable Energy?

- **Sustainability Plans/Goals**
- **Reduce Energy Use/Cost**
- **Disaster Resilience**
- **Toward American Energy Independence**
- **Revenue**
- **J-O-B-S**
  - **Economic & Workforce Development**



# Distributed Wind Energy



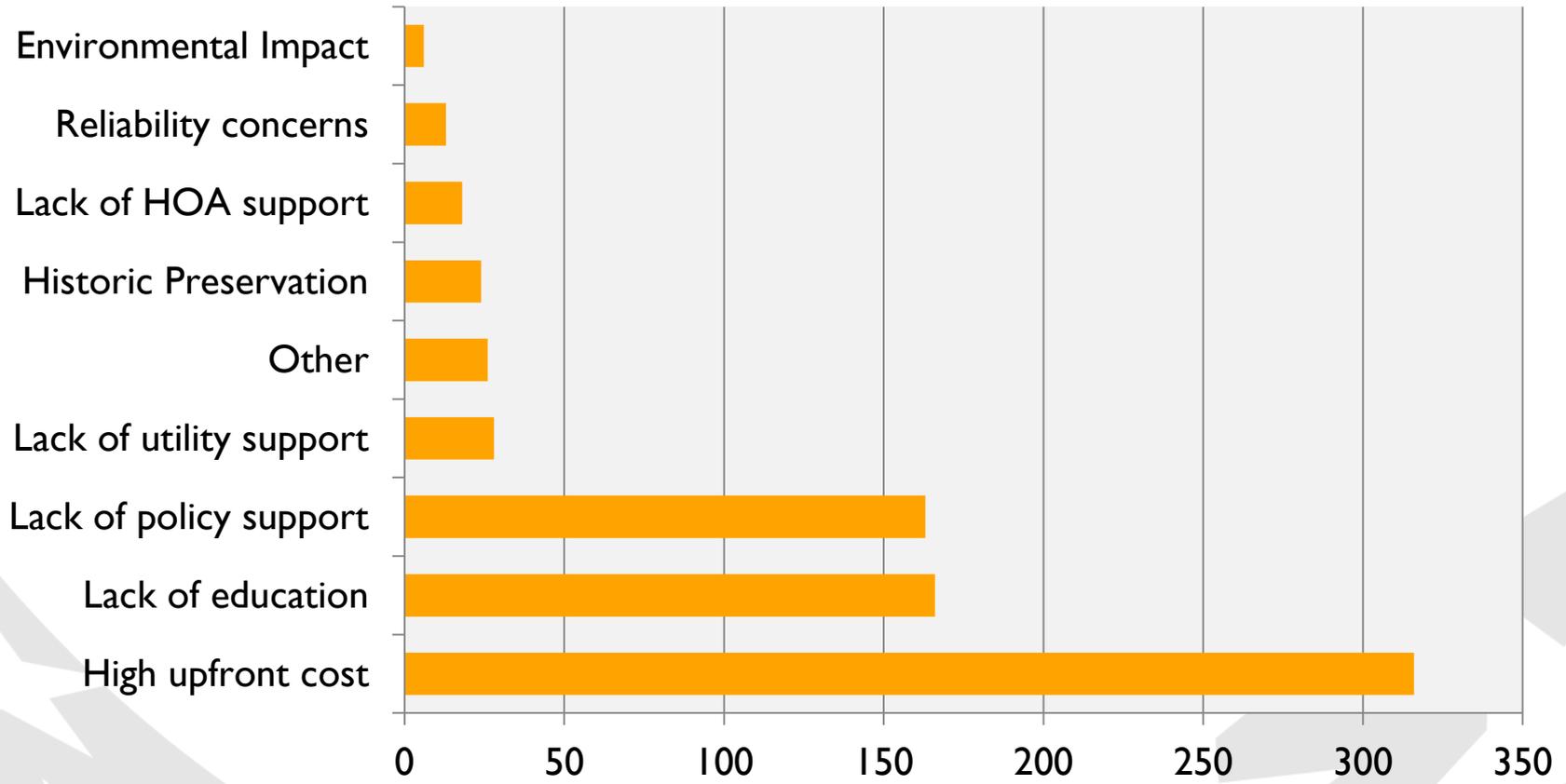


# SOLSMART

NATIONALLY DISTINGUISHED. **LOCALLY POWERED.**



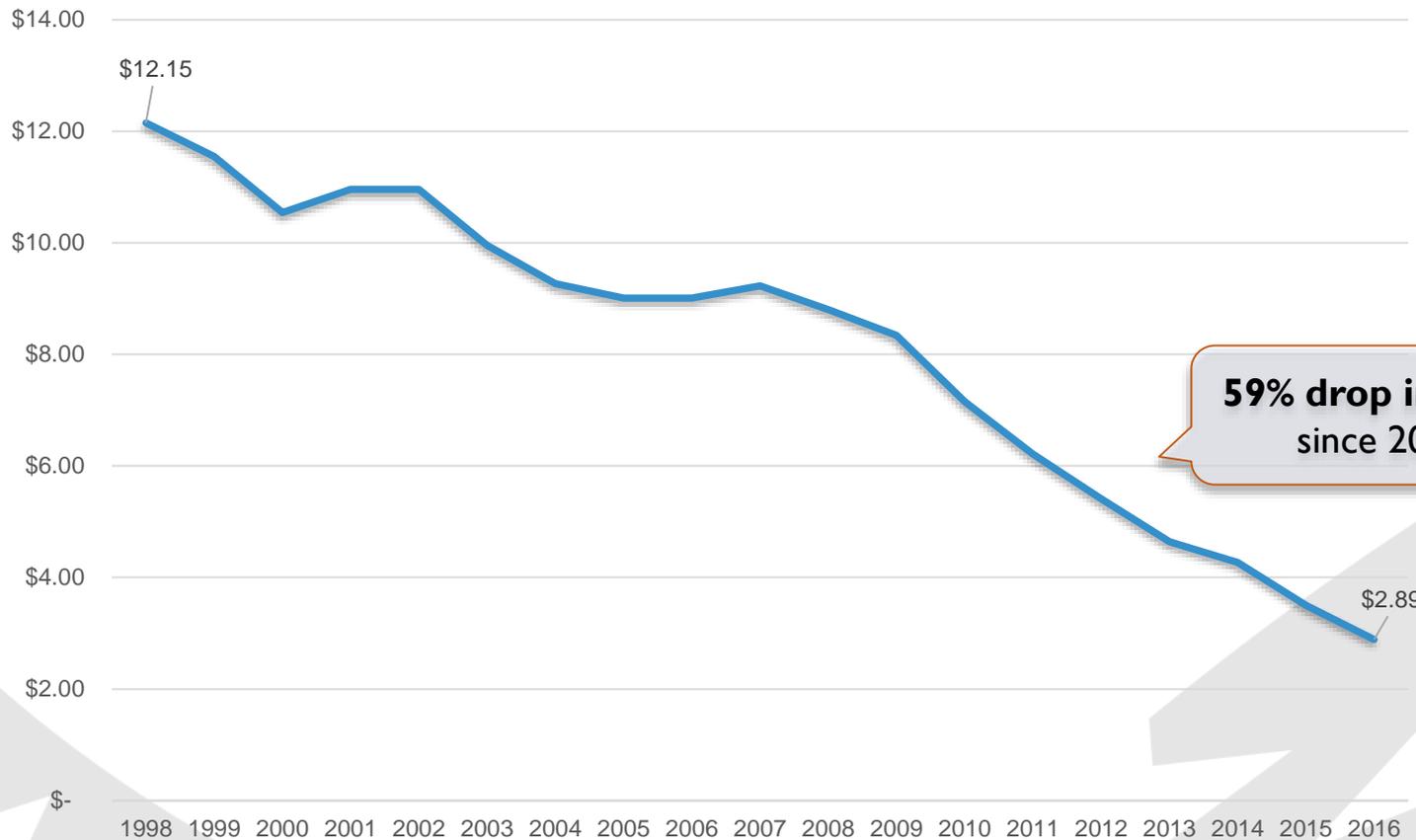
# Common Barriers to Solar



# The Cost of Solar PV



## US Average Installed Cost for Residential PV

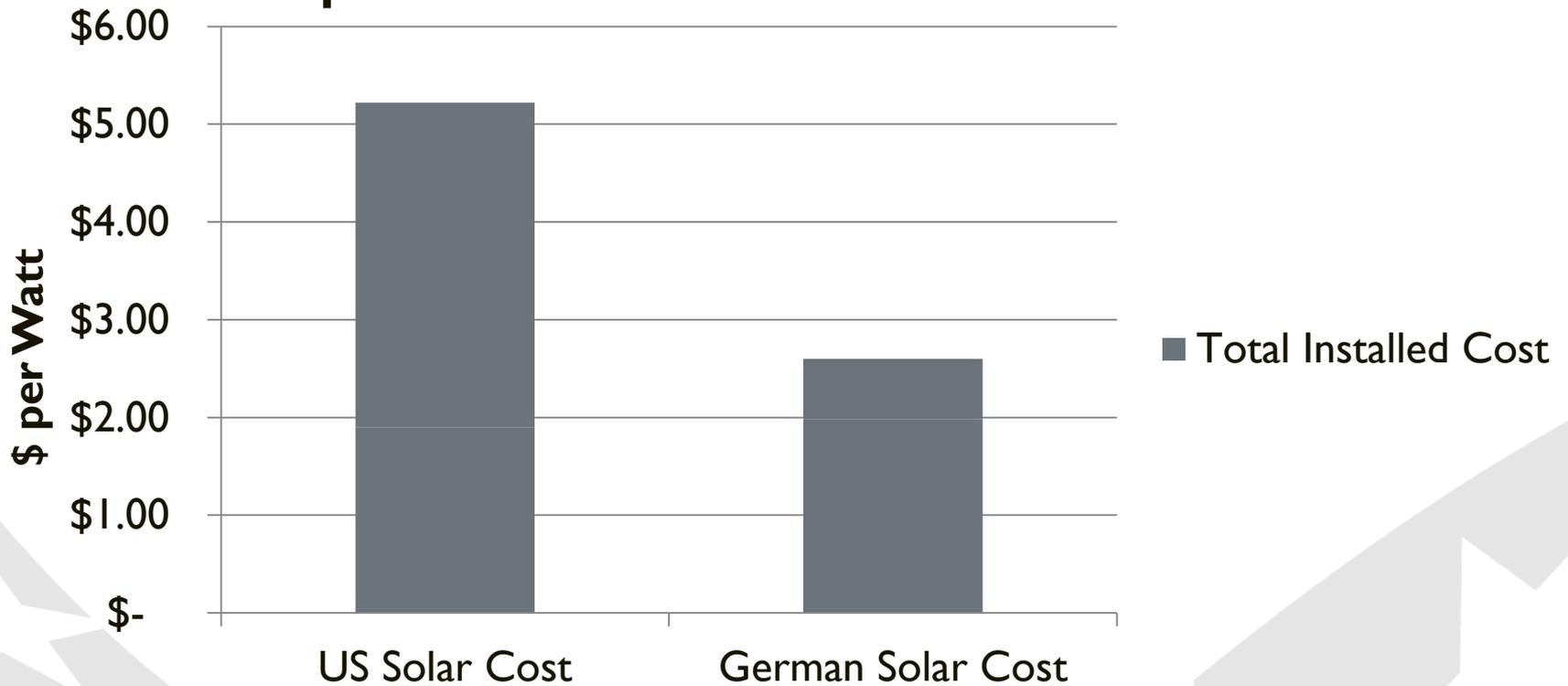


**59% drop in price since 2010**

# The Cost of Solar in the US



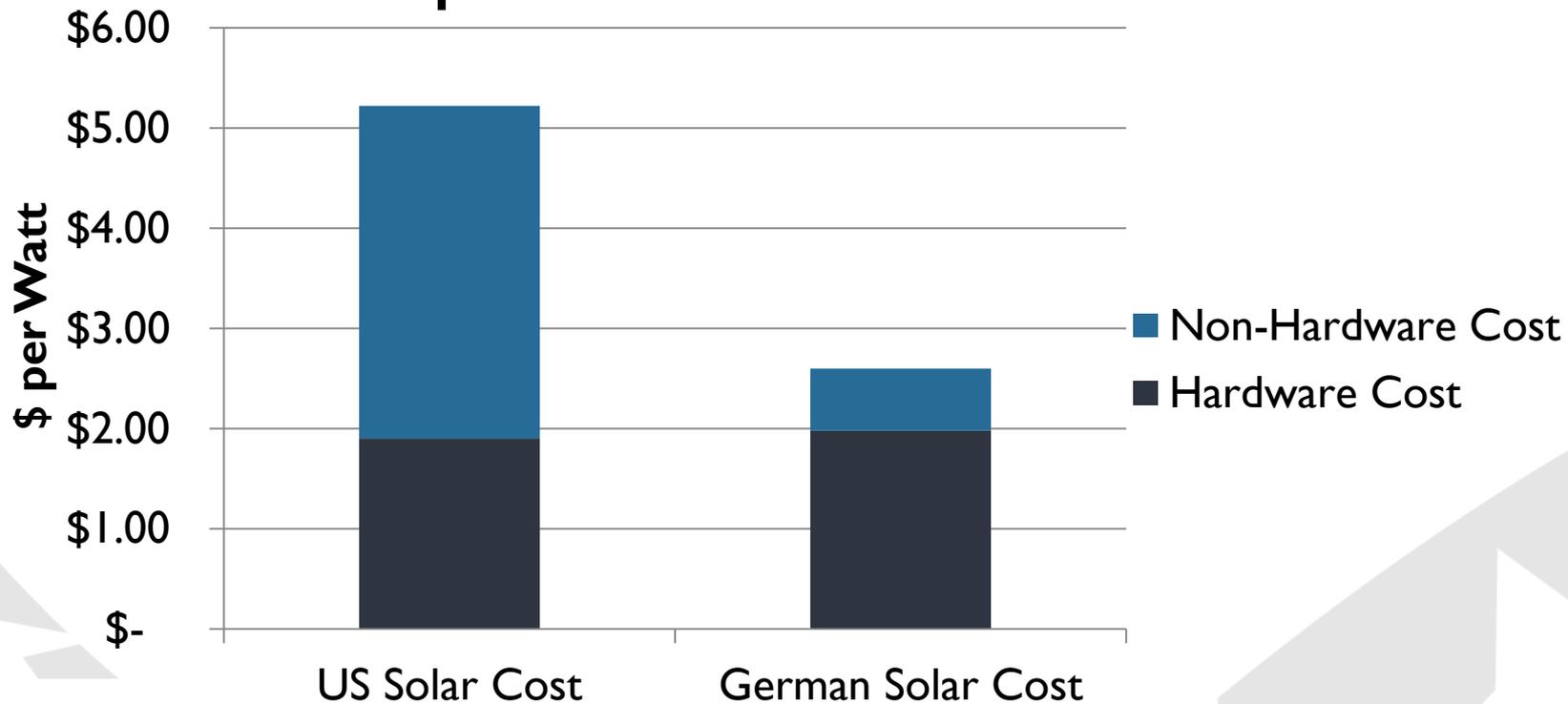
## Comparison of US and German Solar Costs



Source: NREL ( )  
LBNL ( )

# The Cost of Solar in the US

## Comparison of US and German Solar Costs

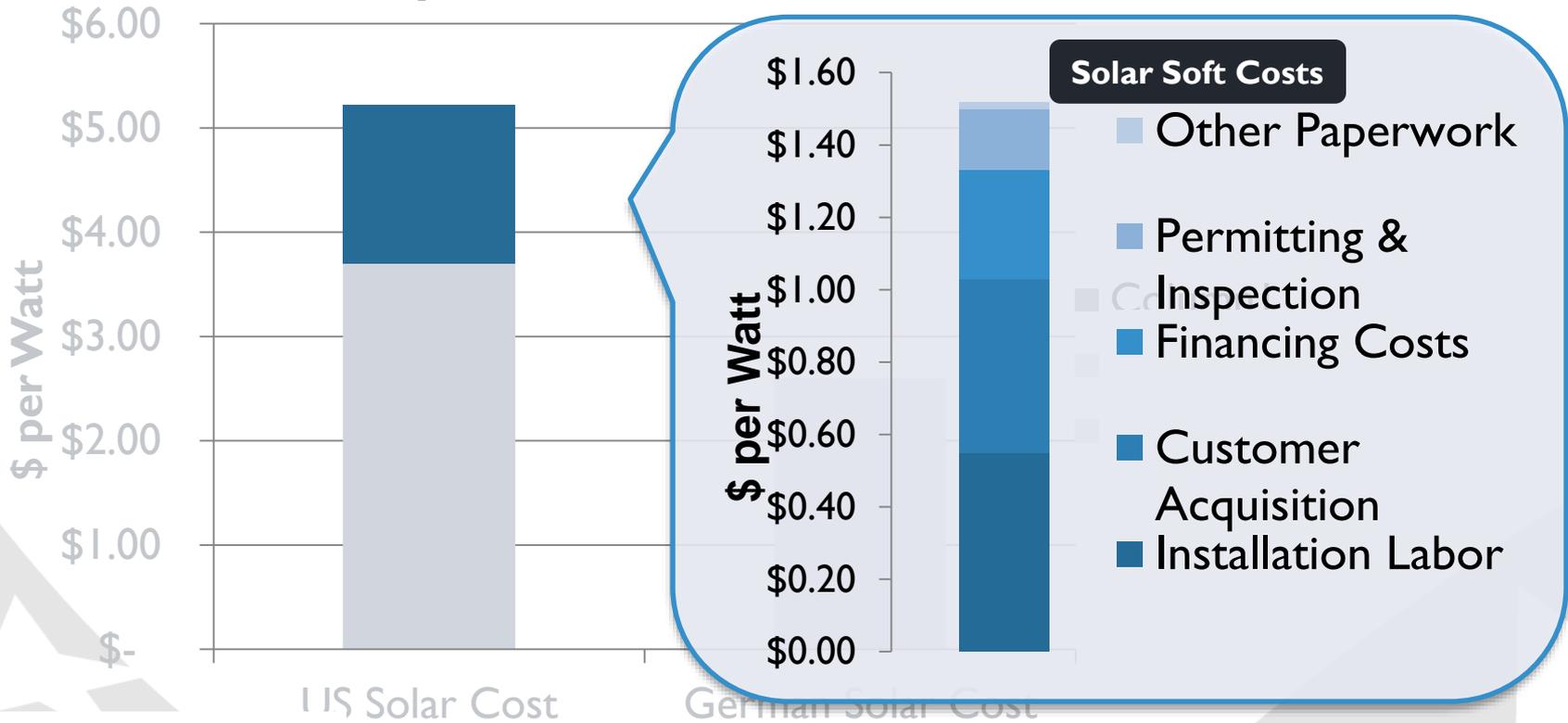


Source: NREL ( )  
LBNL ( )

# The Cost of Solar in the US



## Comparison of US and German Solar Costs

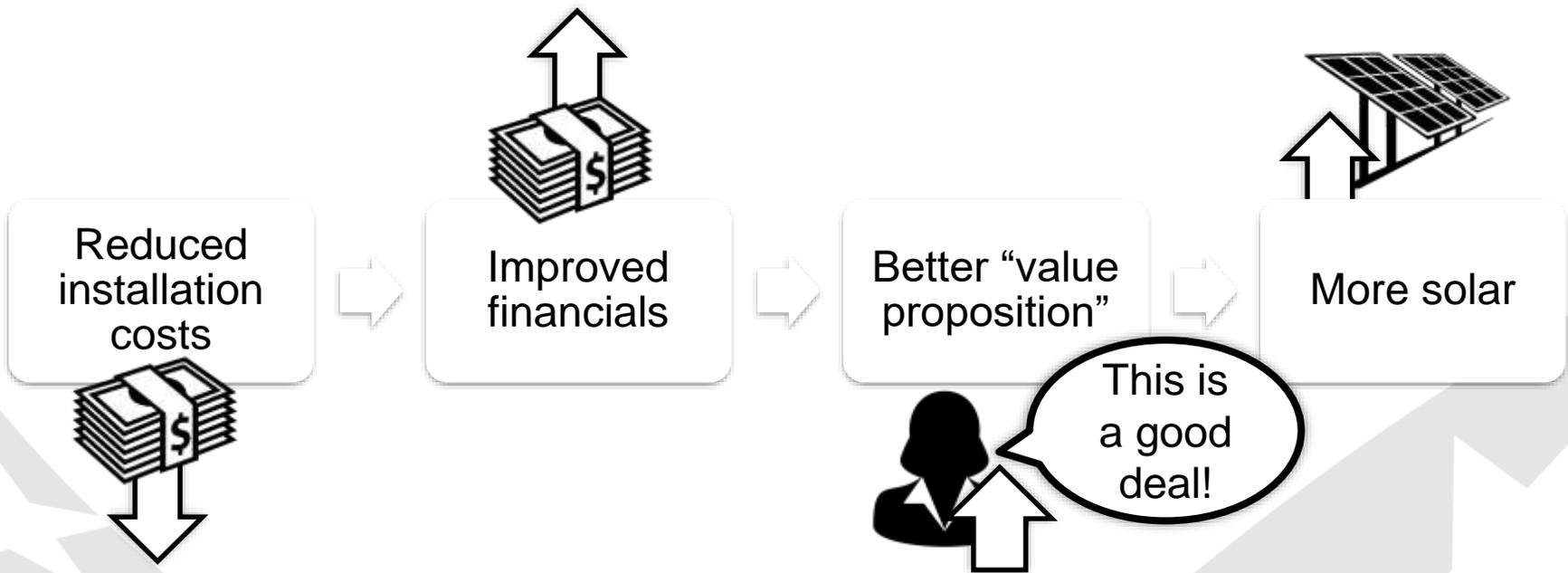


Source: NREL ( )  
LBNL ( )

# Benefits of Reducing Soft Costs

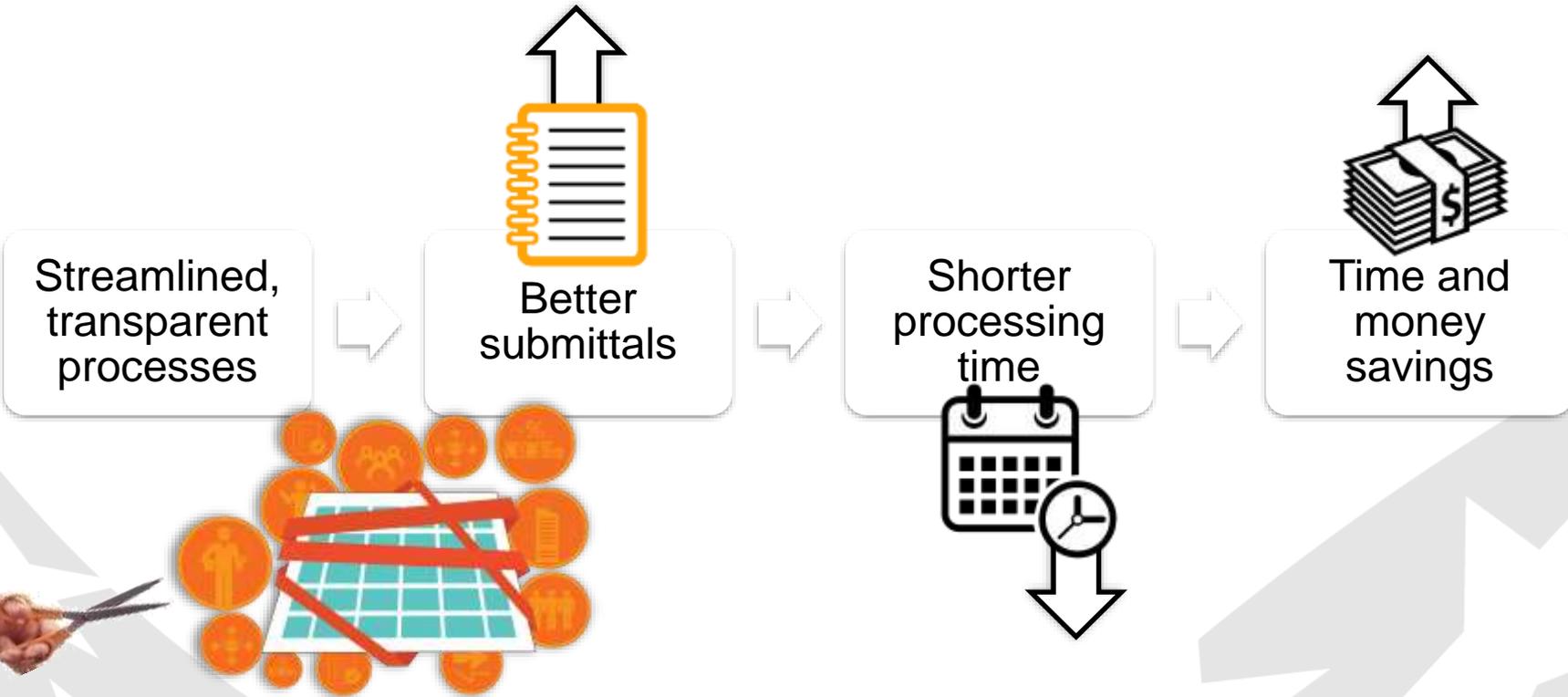


Streamlining local regulatory processes can reduce the cost of a typical system by **\$2,500**. Onerous permitting procedures, for instance, can add **\$700** to the installed cost.



# Benefits of Reducing Soft Costs

Streamlining processes at the local level can free up staff time to address other priorities.



# SolSmart Goals & Initiatives



To make it **faster**, **easier**, and more **affordable** for more Americans to choose solar energy, SolSmart will **recognize at least 300 U.S. local governments** with a nationally prestigious solar designation.

## Technical Assistance

- Communities can receive no-cost technical assistance
- Solar experts will help review local processes, expand solar markets, and earn designation.

## Designation

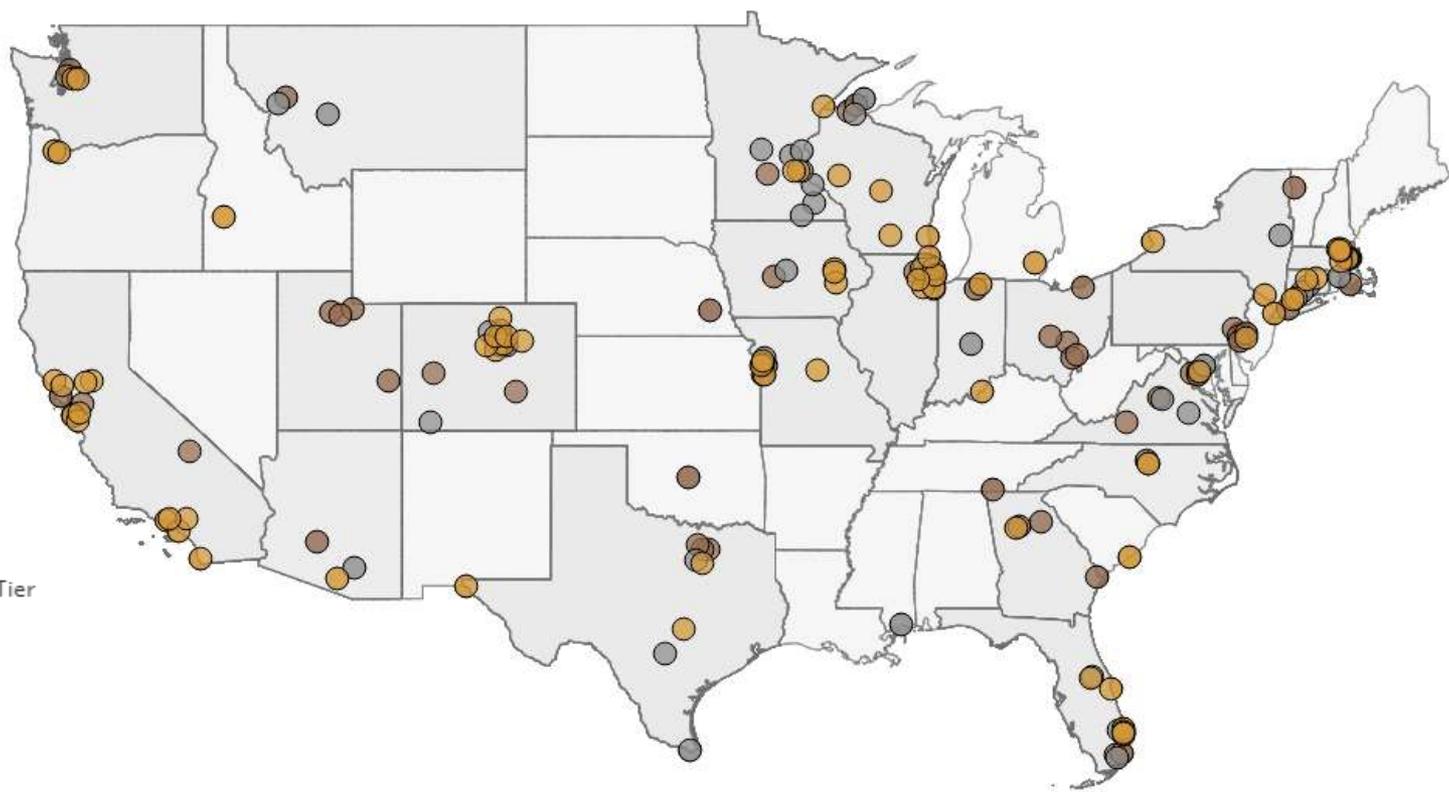
- Earn Bronze, Silver, or Gold based on solar-related actions.
- Demonstrate that a community is **“open for solar business”**.

# SolSmart Designation



- Address Bronze prerequisites
- Earn 20 points in the Permitting category
- Earn 20 points in the Planning, Zoning, & Development Regulations category
- Earn 20 total points across “Special Focus” categories
- Earn SolSmart Bronze
- Address Silver prerequisites
- Earn 100 total points from actions taken across any combination of categories
- Address Gold prerequisites
- Earn 200 total points from actions taken across any combination of categories

# SolSmart Participants



- 200+ participating AHJs
- 187 current designees
- Designees in 34 states (and D.C)
- 52+ million Americans



# Benefits of Reducing Solar Soft Costs



## Support American businesses

- 8,601 U.S. businesses comprise the solar value chain. All but a handful are small businesses.
- Installers avoid multiple jurisdictions in their service areas based on onerous permitting.

## Create American jobs

- There are over **260,077 solar workers** in the U.S.
- **One in fifty jobs created** in 2016 was in the solar industry.
- **For every 1 MW installed:**



Residential  
solar

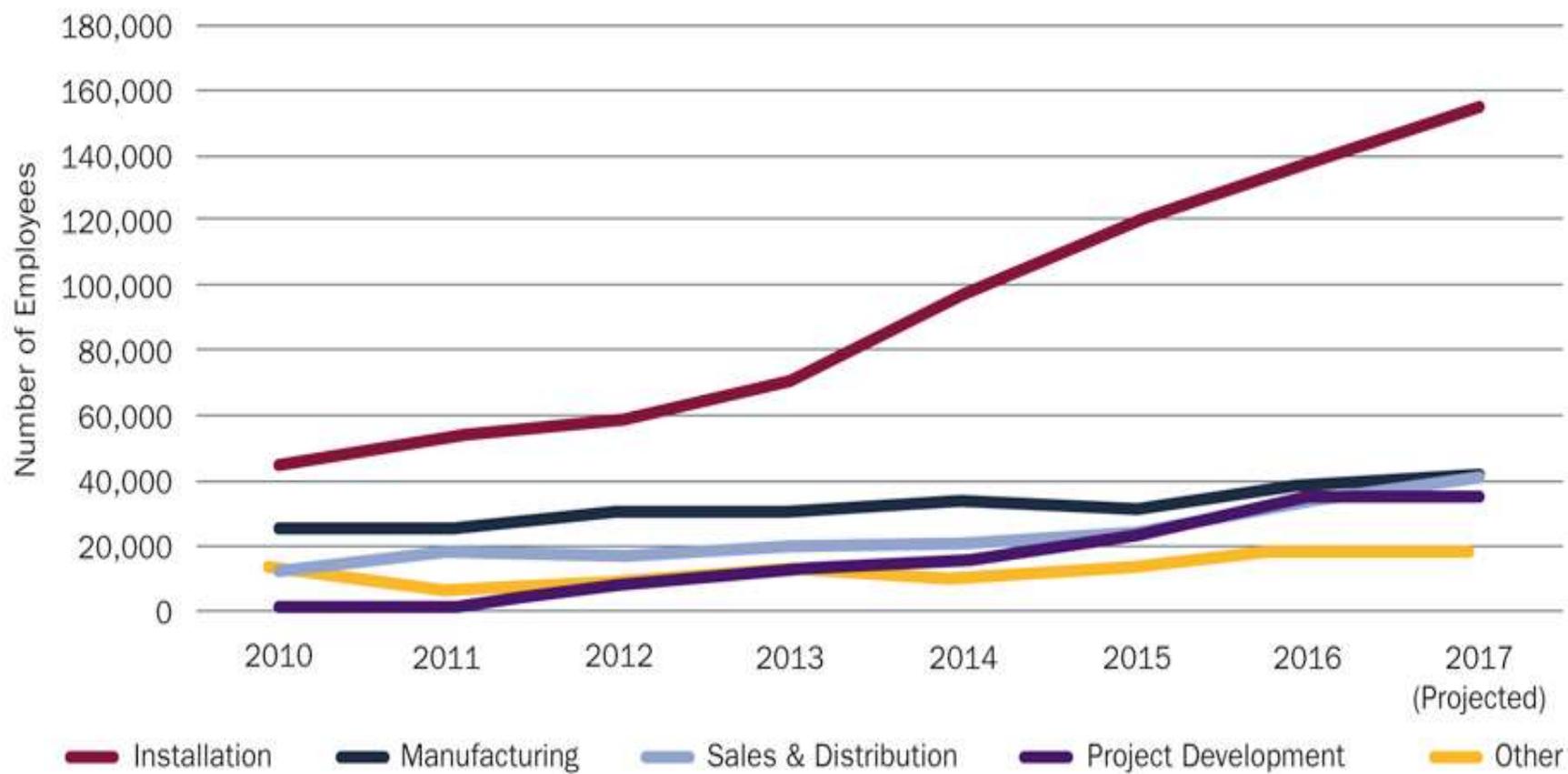


Non-  
residential  
solar



Utility scale  
solar

## Solar Employment Growth by Sector, 2010-2016



MOST SOLAR COMPANIES  
**DO NOT REQUIRE**  
A BACHELOR'S  
DEGREE FOR  
NEW HIRES



**SOLAR**  
FOUNDATION  
FOR THE  
MIDDLE CLASS

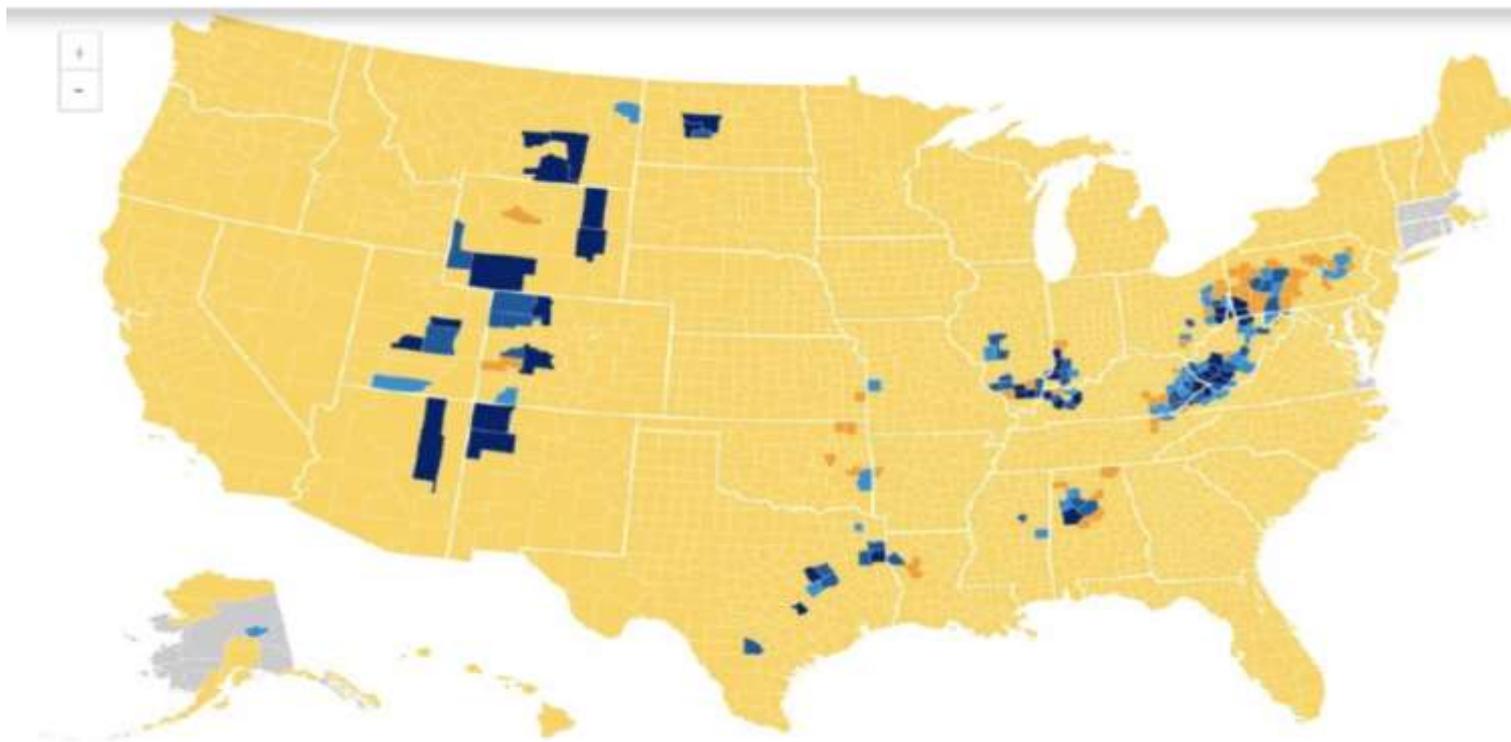


**SOLAR**  
WORKFORCE  
DEMOGRAPHICS  
2017



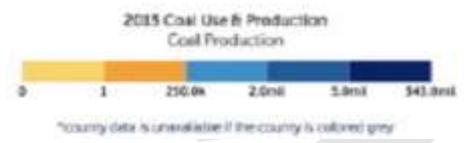
**SOLAR**  
FOUNDATION  
FOR THE  
MIDDLE CLASS

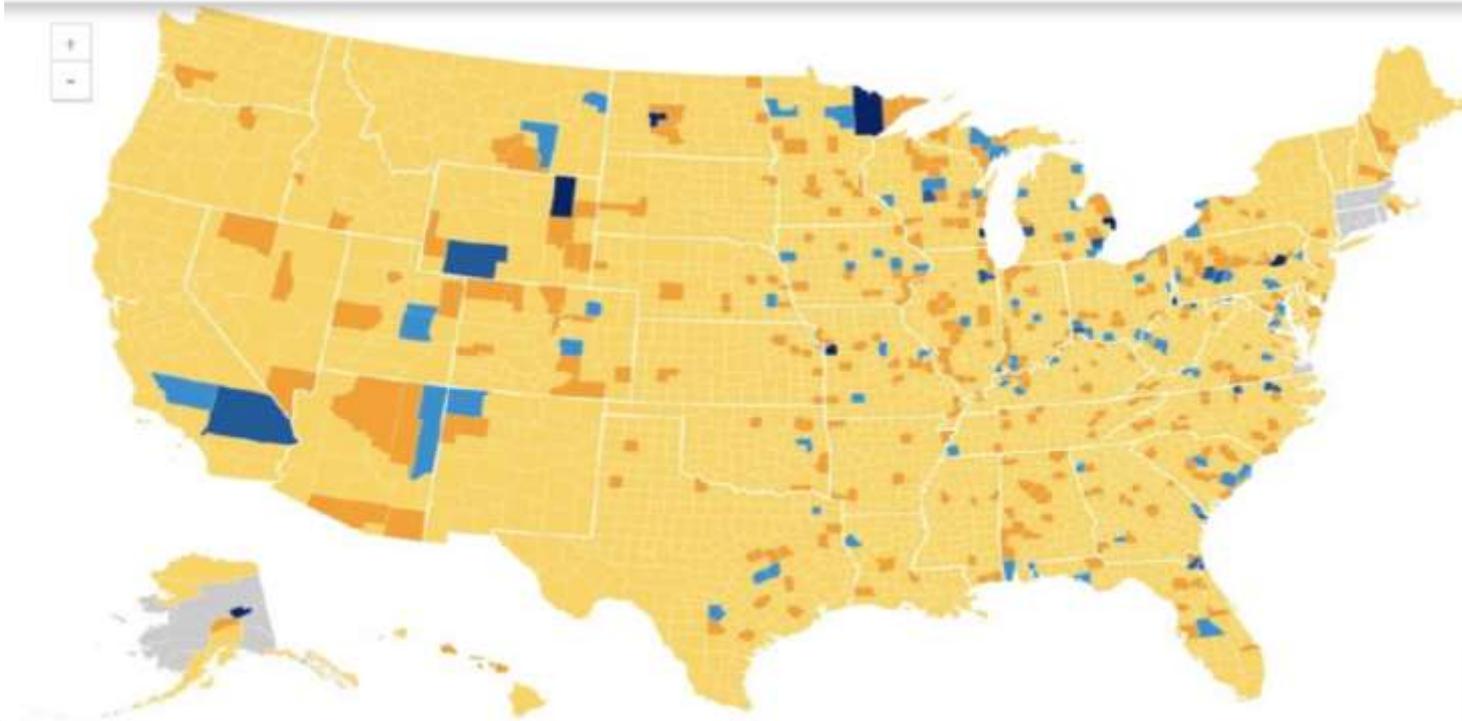




Source: NACo Analysis of U.S. Energy Information Administration Data, 2015

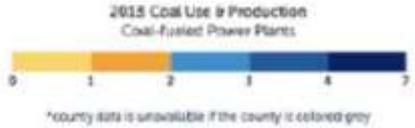
# Coal Producing Counties





Source: NACo Analysis of U.S. Energy Information Administration Data, 2015

# Coal Power Plant Counties





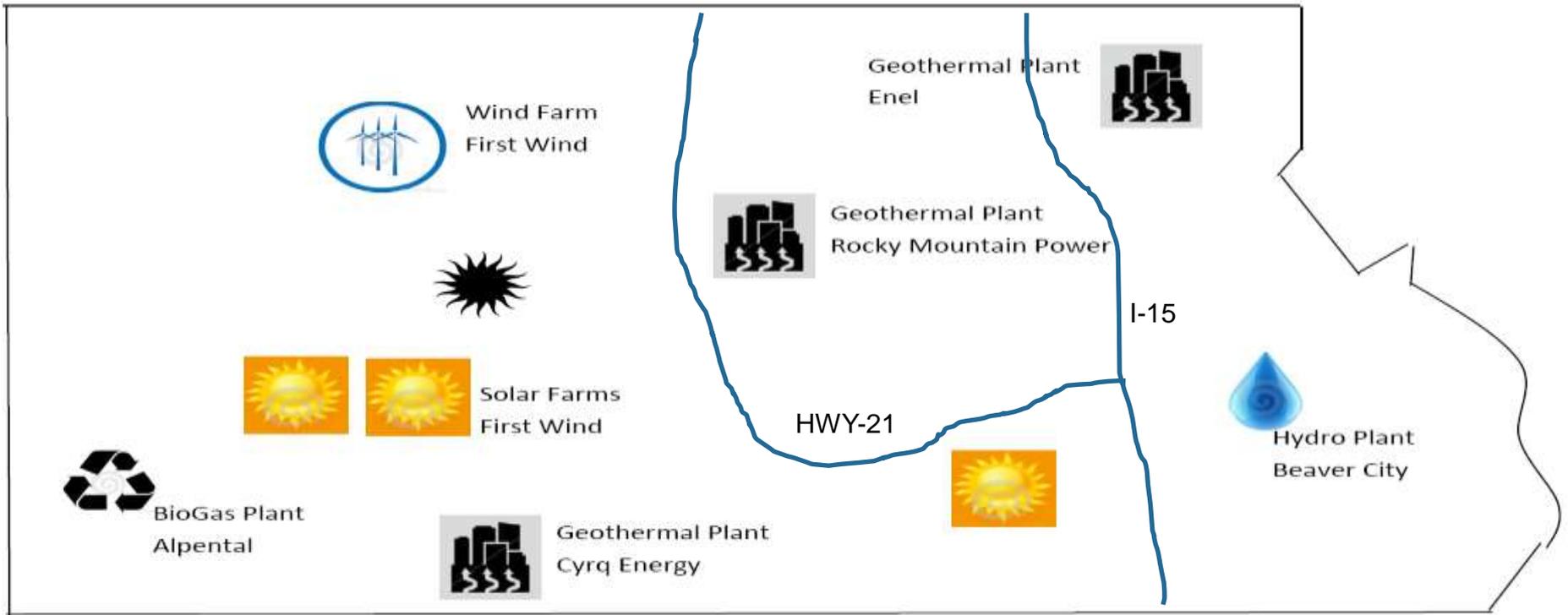
# GROWING STRONGER ECONOMIES IN OUR NATION'S COAL COMMUNITIES





# Diversifying our Economy through Renewable Energy

# 5 WITHIN 50 RENEWABLES



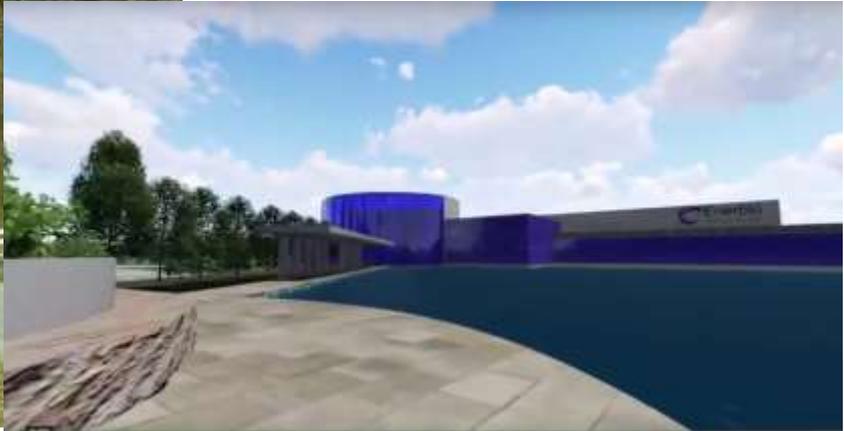
# “Wind Kids” of Beaver Co.

**The study of renewable energy allows students to see how easy it is to create their own power. It allows a teacher to reinforce math, science, and technology. The main question students have while learning in the high school setting is, ‘Where will this pertain to me in my life and where will I ever use this stuff?’ RE helps to incorporate formulas, physics, and even grammar into something exciting and powerful that actually pertains to their life.” Andy Swapp**

<https://www.youtube.com/watch?v=LF586aLTXzk>



<https://www.youtube.com/watch?v=MBBxEr829PU>



**Thank You!**

**Questions?**

**Jack Morgan**  
**[jmorgan@naco.org](mailto:jmorgan@naco.org)**





# Distributed Wind 2018

## All Eyes on the States

### Moderator

**Charles Newcomb**, Universal mCloud Corporation

### Speakers

**Ian Baring-Gould**, National Renewable Energy Laboratory

**Dorothy Barnett**, Climate + Energy Project

**Roger L. Freeman**, Roger Freeman LLC

**Ryan Storke**, Storke, LLC



# **All Eyes on the States**

**Ian Baring-Gould, National Renewable Energy Laboratory**



## State Market Development

Ian Baring-Gould

February 27, 2018

*Distributed Wind 2018*

# National DW Deployment

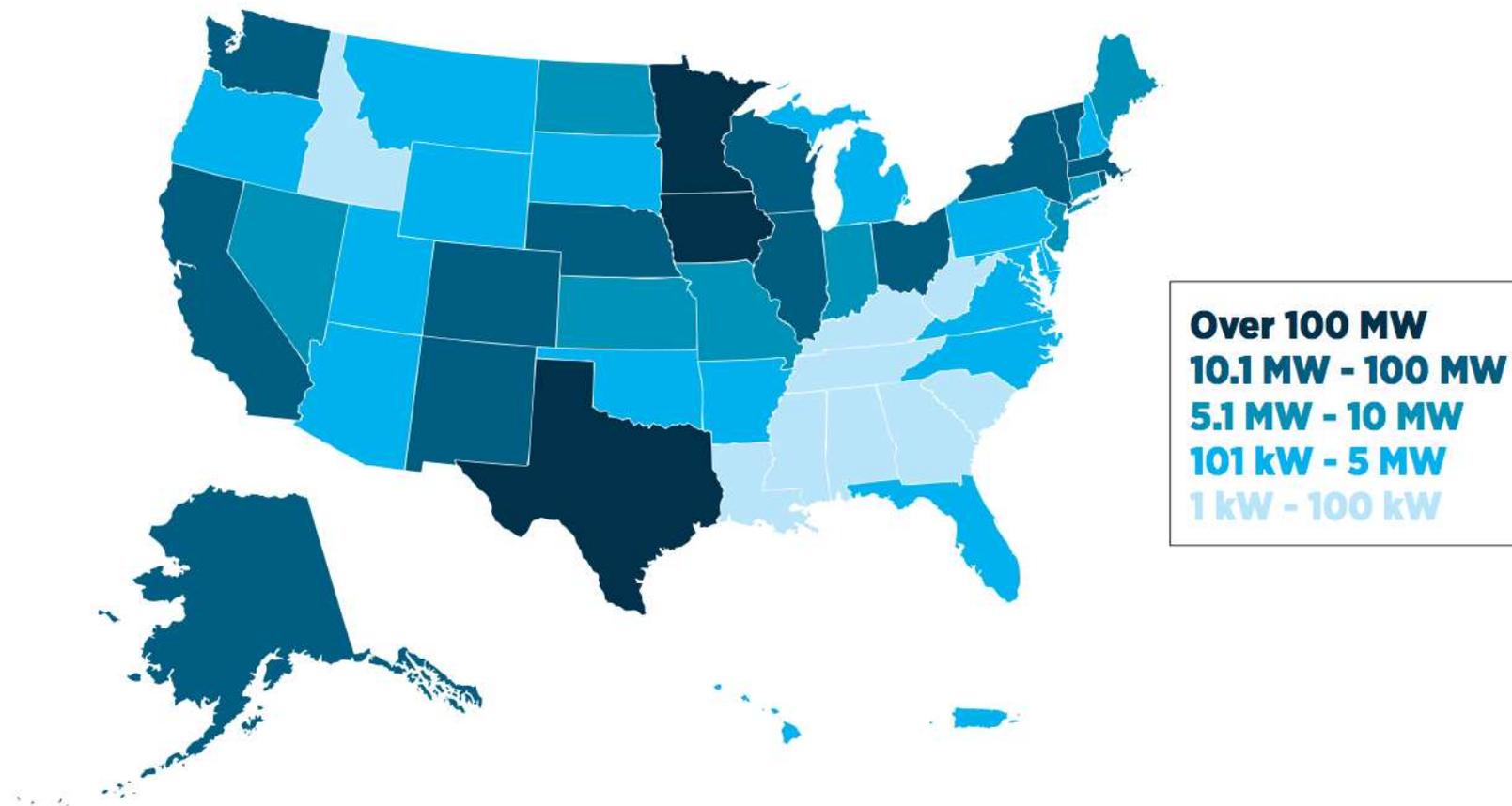
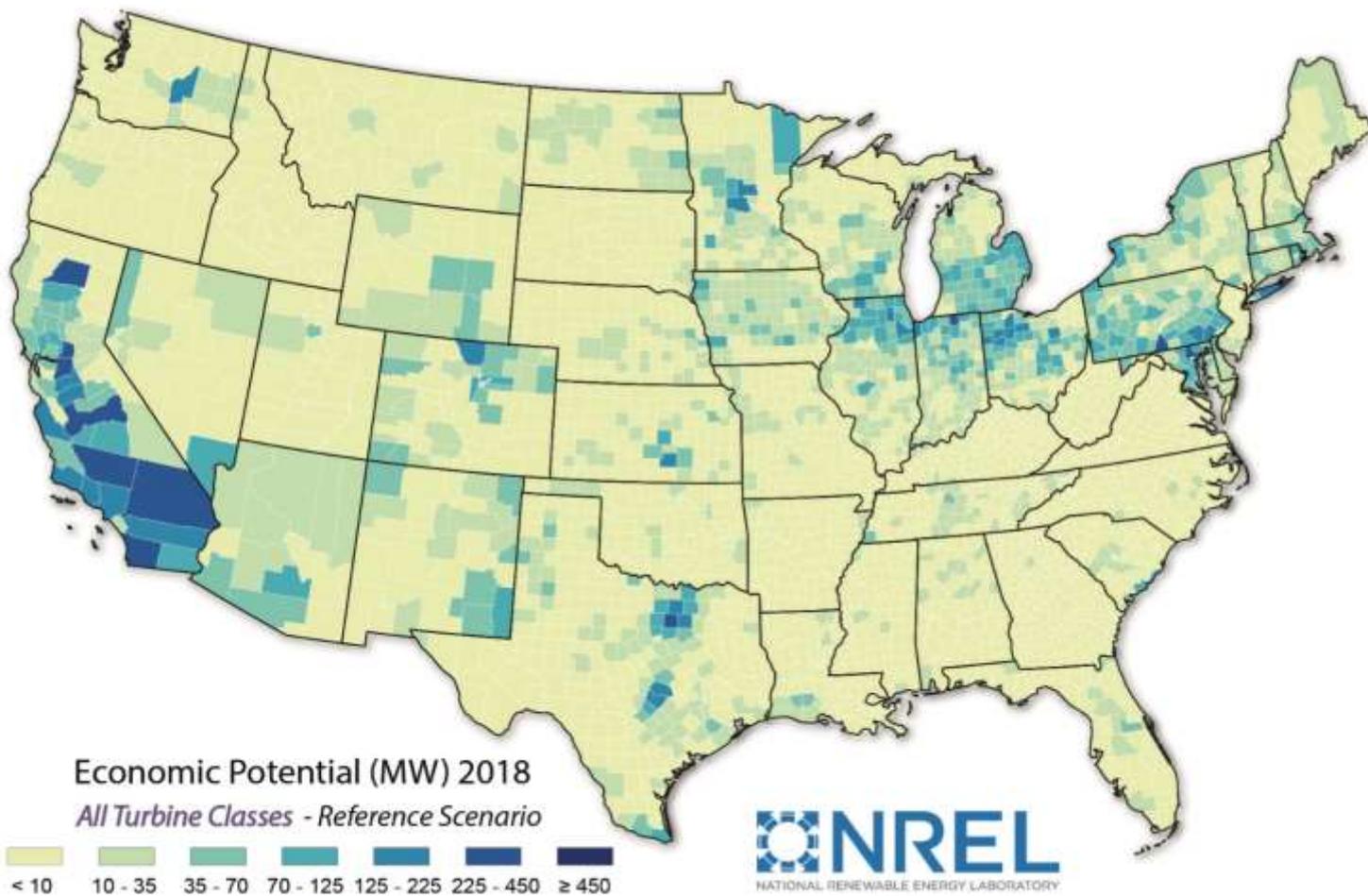


Figure 3. Cumulative U.S. distributed wind capacity by state, 2003–2016

# National Economic Potential by County



# State Report - Key Findings (1 of 2)

Assessment of the Economic Potential of Distributed Wind in Colorado, Minnesota, and New York (<https://www.nrel.gov/docs/fy18osti/70547.pdf>)

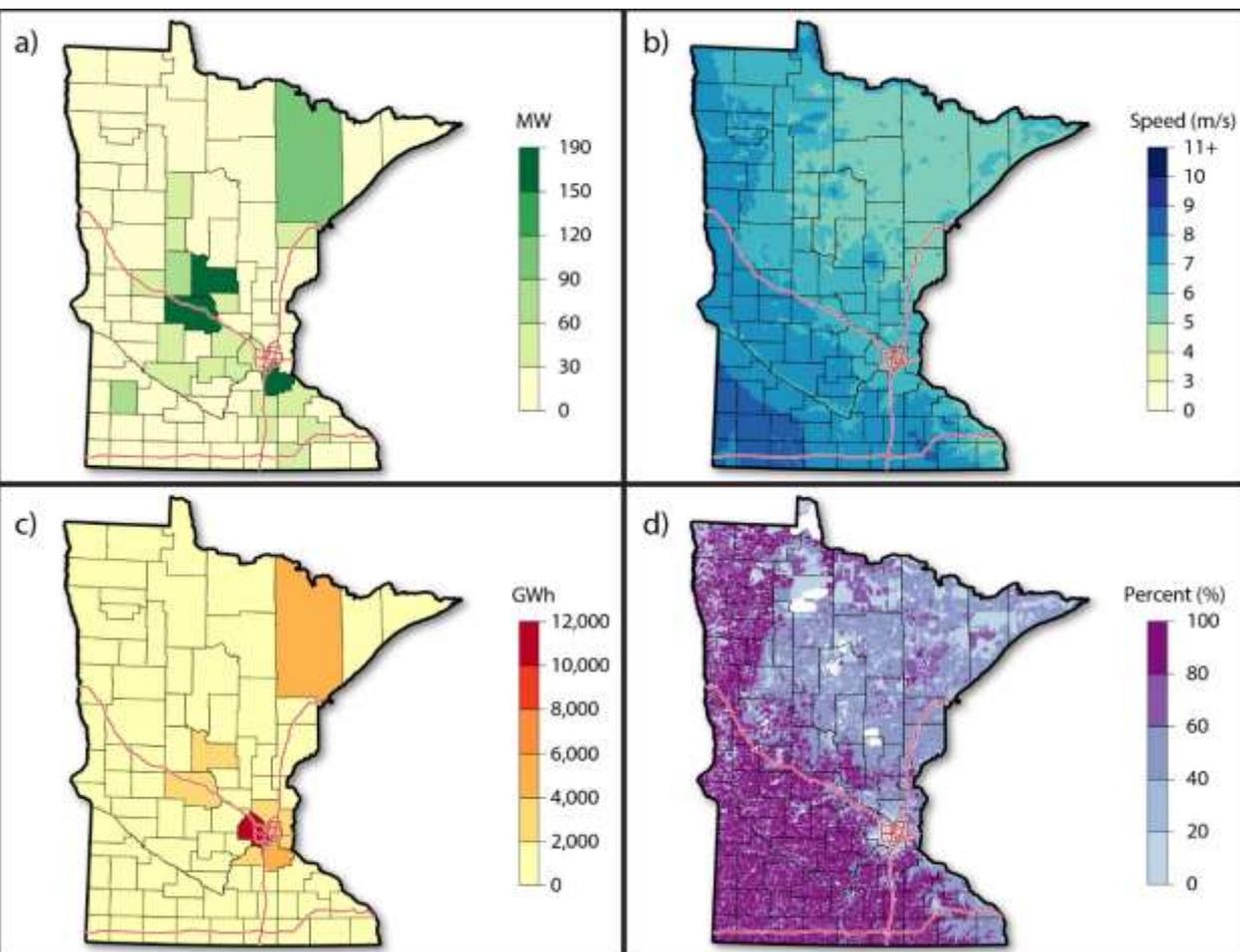
- Key factors include – wind speed, land area, electricity rates and structures, loads (obvious) - understanding the mix is the secret sauce
- The aggregated capacity totals for sites that can generate a positive NPV in 2018 are:
  - 360 MW in Colorado
  - 1,950 MW in Minnesota
  - 920 MW in New York
- The greatest opportunity (in MW – not number of units) is seen in low-density urban centers (e.g., industrial areas) and suburban and rural areas;
- Agricultural, commercial, and industrial end-use customers tend to offer the greatest near-term possibility for market expansion
- Economic potential estimates were shown to be highly sensitive to the nuances of retail rate structure and generation

## Key Findings (2 of 2)

- Access to low-cost financing and reductions in capital costs stand out as levers that can be used to increase economic potential
- Improvements in costs, siting, and other factors are not equally distributed across counties, for example:
  - Improvements to project siting in Colorado affect potential in suburban counties near Denver and the Eastern Plain
  - Improvements to project siting in New York and Minnesota have a more profound effect on the Residential turbine class and broader impacts throughout the state

# Distribution of Economic Potential: Minnesota

**High levels of potential for Minnesota are observed for areas around St. Cloud, Duluth, and the suburbs of the Twin Cities**



- a) Total, all sectors and turbine classes Reference scenario
- b) Average wind speed at an 80-meter hub height
- c) Annual electricity consumption at county level, all end-use sectors
- d) Turbine siting availability at the block level.

Ian Baring-Gould  
National Renewable Energy Laboratory  
email: [ian.baring-gould@nrel.gov](mailto:ian.baring-gould@nrel.gov)

This work was supported by the Wind Energy Technologies Office, Office of Energy Efficiency and Renewable Energy of the U.S. Department of Energy under Contract No. DE-AC36-08GO28308.

[www.nrel.gov](http://www.nrel.gov)





## **All Eyes on the States**

**Dorothy Barnett, Climate + Energy Project**



## **All Eyes on the States**

**Roger L. Freeman, Roger Freeman LLC**

# Roger Freeman

## Roger Freeman LLC, Renewable Energy Law

- Colorado landscape – Plenty of Wind, Sun.... and New Arrivals!
- Colorado Renewable Energy Standard – Genesis, Evolution, Current Application to IOUs and Co-ops
- DW in Colorado – Yuma Project
- Utility Scale Wind in Colorado – Status
- Possible Pressure Points - Helping Colorado DW Ramp Up:
  - RES expansion/modification
  - Teaming with Distributed Solar Community
  - Current PUC rulemaking– (IOUs only) – Storage, Interconnection many other rules at issue
  - Use of the RESA – Pending Coal retirements
  - TriState and Rural Co-ops – possible ripple effects of a changing tide
  - Climate Costs and Realities – Walking the Walk AND Talking the Talk
  - Political Races



# **All Eyes on the States**

**Ryan Storke, Storke, LLC**



# Distributed Wind 2018

## Powering America with On-Site Power

### Moderator

**Russell Tencer**, United Wind

### Speaker

**Padma Kasthurirangan**, Buffalo Renewables

**Robert Magyar**, Navitus Strategies

**Scott Sklar**, The Stella Group Ltd.



# Distributed Wind 2018

## **Powering America with On-Site Power**

**Padma Kasthurirangan, Buffalo Renewables**



**BUFFALO**  
**RENEWABLES INC.**

# Distributed Wind On Site @ Triad Recycling

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PADMA KASTHURIRANGAN, MSEE

# Triad Recycling & Energy Video

[https://www.youtube.com/watch?v=pE9-9\\_0fKNg](https://www.youtube.com/watch?v=pE9-9_0fKNg)



# Triad Recycling & Energy

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WT1

- ❖ Drywall Recycling
- ❖ Mattress Recycling

WT2

- ❖ Wood Grinding
- ❖ Plastics Grinding



# Permitting – Town of Tonawanda

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- ❖ 10 year old wind ordinance – allowed up to 150' / 250 kW as non commercial wind turbines in industrial area
- ❖ Variances – Height + Distance from dwelling
- ❖ Modified Ordinance to increase height limit to 165'



# The Installation

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## Foundation

- ❖ 24' diameter grout less gravity foundation
- ❖ constructed on 14' deep recycled concrete fill

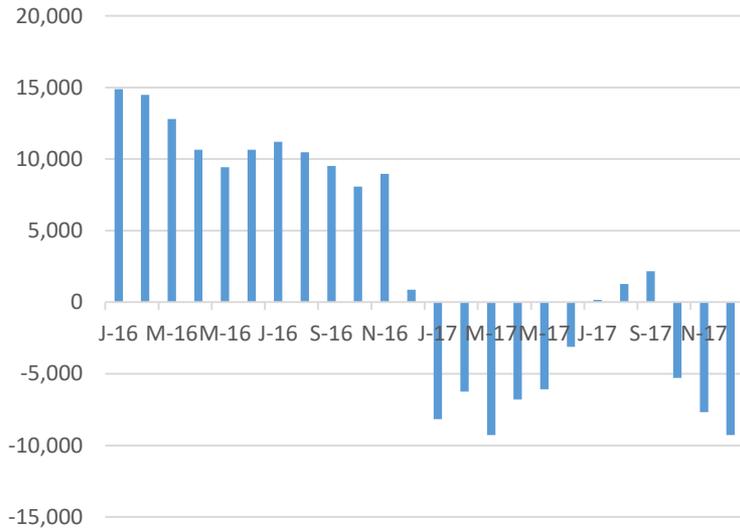
## Interconnection

- ❖ Behind the meter
- ❖ Pointless delays

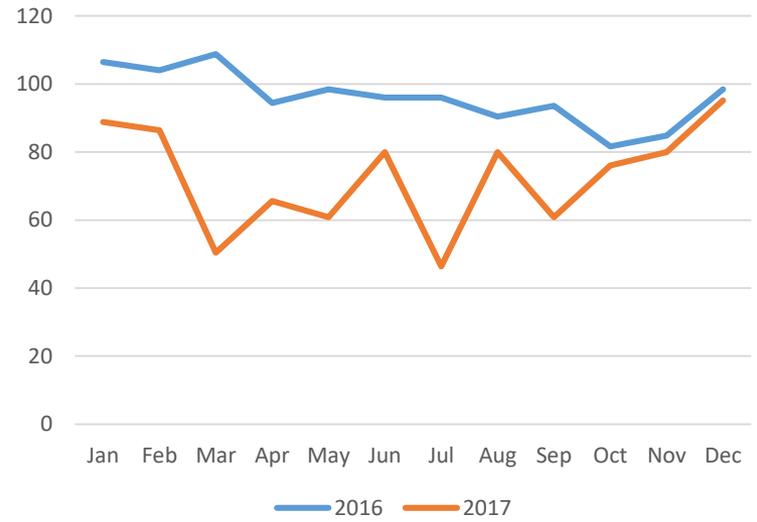


# After Year 1

Triad 1 kWh Usage



Triad 1 kW Demand



QUESTIONS???

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# **Powering America with On-Site Power**

**Robert Magyar, Navitus Strategies**

Distributed Wind Energy Association

*“Investing in America’s Future with On  
Site Power”*

The U.S. Battery storage market  
In 2018

NAVITUS  STRATEGIES



Navitus is a private industry consultant.

We focus on solid state power electronics inverters, advanced battery chemistry and battery storage system operating software.

We work with manufacturers seeking to understand and provide solutions which work to their highest value proposition.

Focus on the PJM and NY ISO market regions.

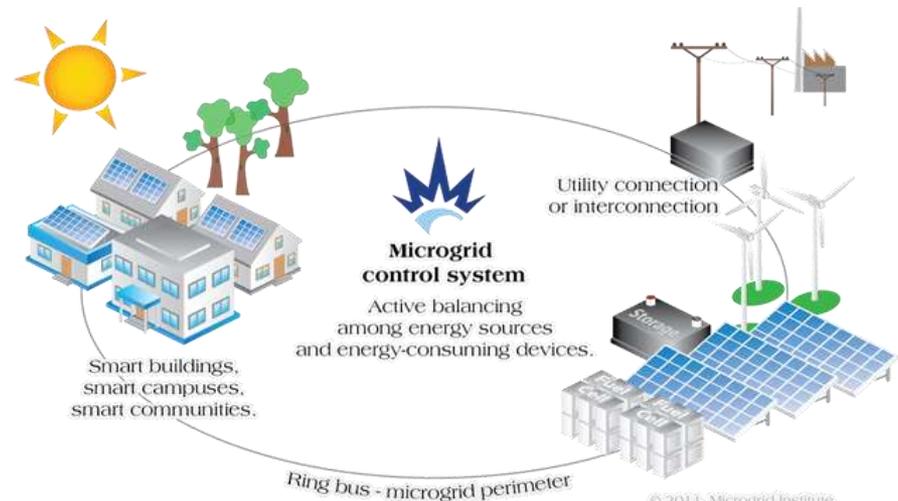
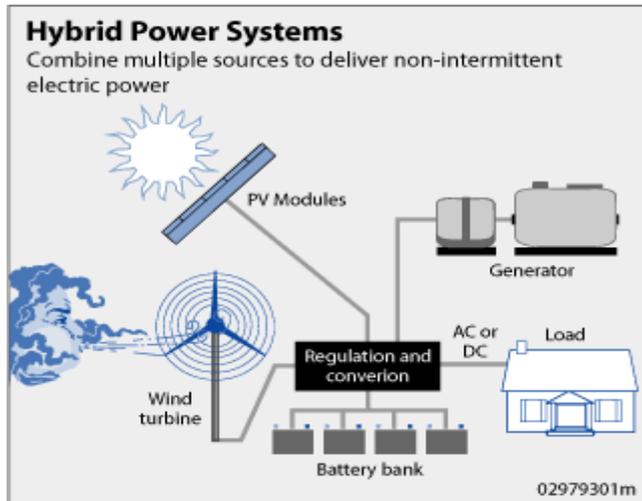
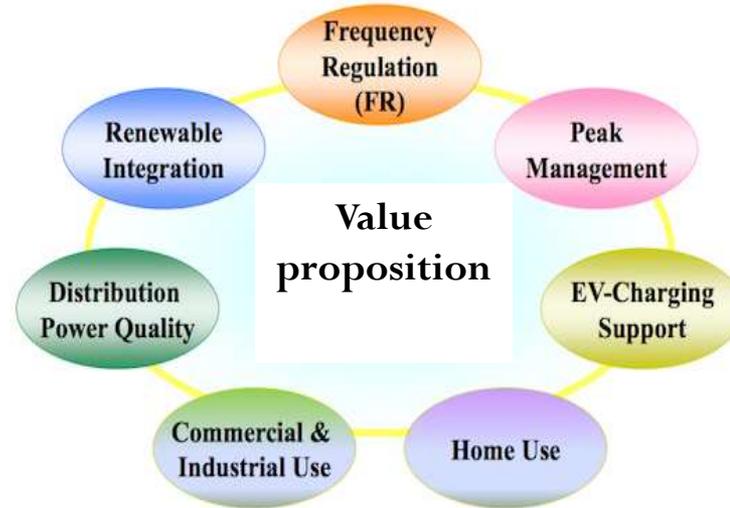
Located in Bucks County, PA outside of Philadelphia

BP Solar, Green Mountain Energy, Princeton Power Systems, Intergrid LLC, VARTA Storage and Darfon Electronics.



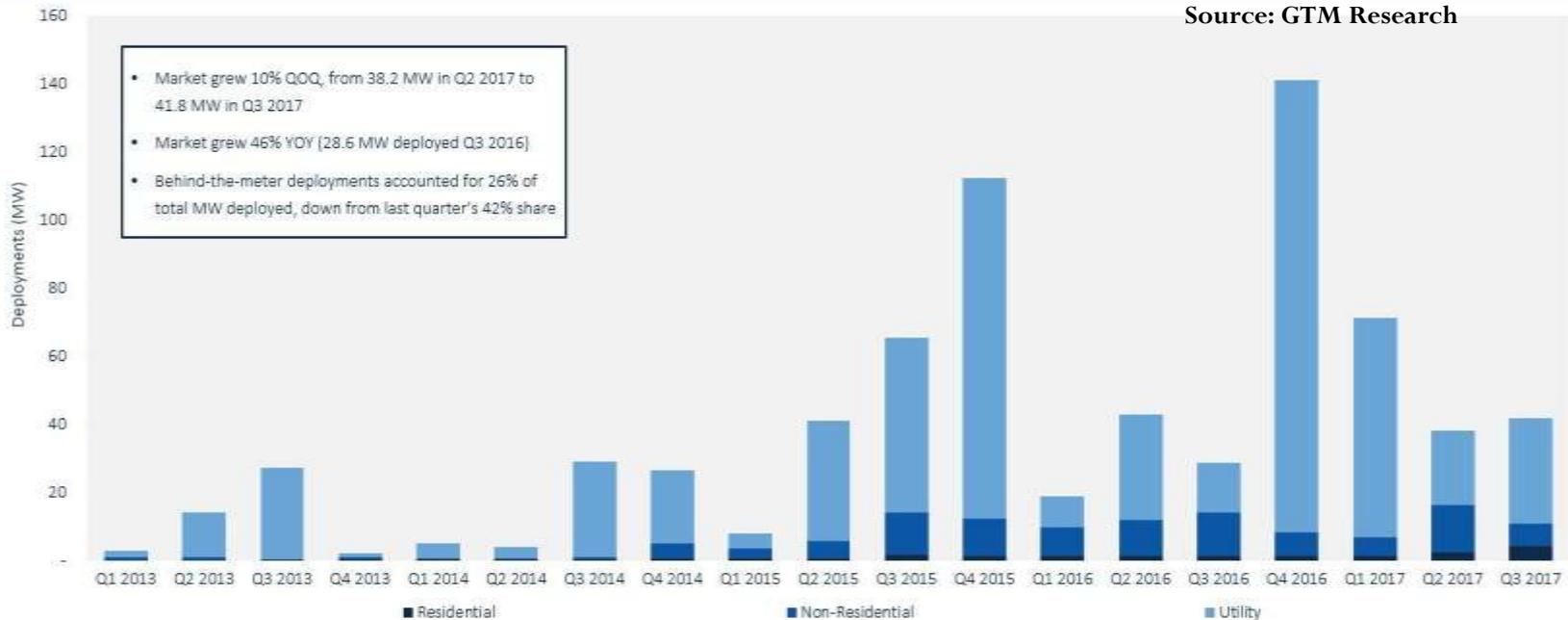
# Batteries are like Swiss Army knives

## Battery Energy Storage Applications



# U.S. battery storage market continues emerge

U.S. Quarterly Energy Storage Deployments by Segment (MW)



U.S. battery storage segments residential and commercial estimated at \$315M to \$436M by 2020.

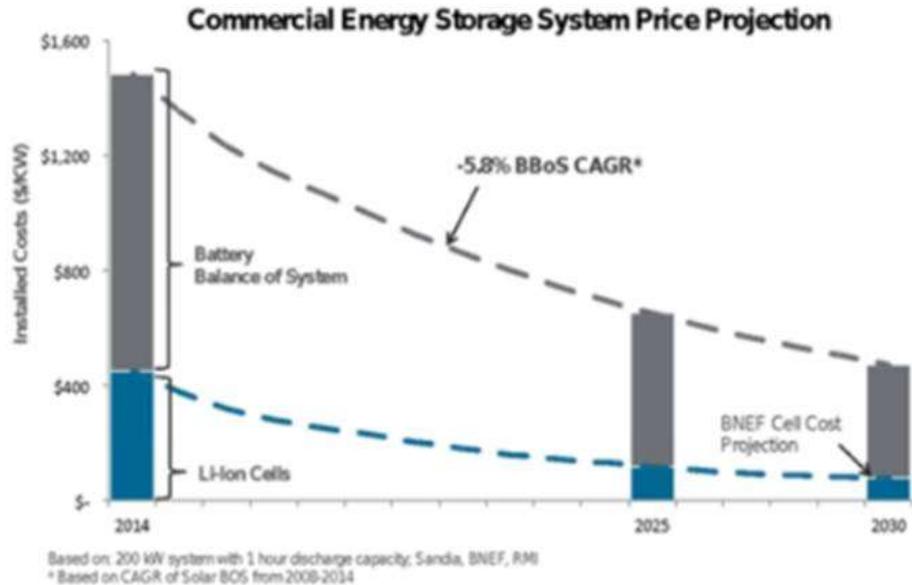
80% of this is estimated to be On Grid.

U.S. electric utility segment forecast \$670M by 2023.

Source: Markets & Markets Energy Storage report 2017

# Tesla putting pressure on the battery industry

## Costs expected to continue falling



Navigent: 4-hr battery  
install cost as low as  
\$700/kWh by 2020

Oncor: \$350/kWh  
install cost by 2020

Morgan Stanley:  
battery-only costs as  
low as \$125/kWh to  
come

Tesla: Li-ion battery-only  
cost \$110/kWh  
already



*Battery price decreases drive costs down for other system components*

## Bi-directional battery storage inverter industry very active

PV & Battery Market Segment	Residential	Commercial	Utility
Typical System Power	<25kW	25kW to 2MW	>2MW
Grid Intertie AC Volts	120/240V single phase	208 or 480V 3 phase	medium voltage 3 phase
Electricity Value (US Average)	residential retail (\$0.12/kWh)	commercial retail (\$0.10/kWh)	utility wholesale (\$0.05/kWh)



# Inverter industry active performance



Intergrid LLC Temple, NJ developing a cost effective “single box” solution for turbine power conditioning and control. They are integrating their 25 kW inverter with turbine control, a front-end rectifier and diversion load control.

Moving away from transformer based designs which is allowing:

“Solar Storage” inverters

“Wind Storage” inverters

Rule 21 electric utility ride through capable

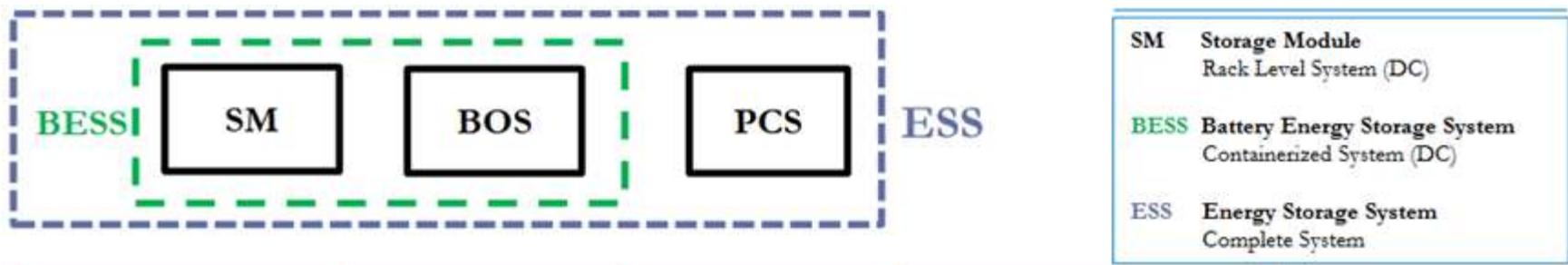
50 or 60 Hz self sensing

3 phase to single phase conversion capable

120 volt, 208 volt, 240 volt capacities

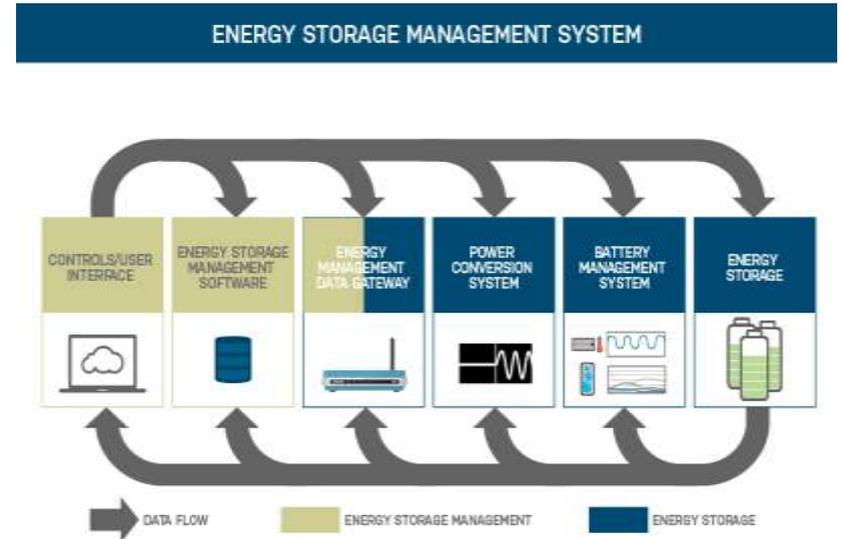
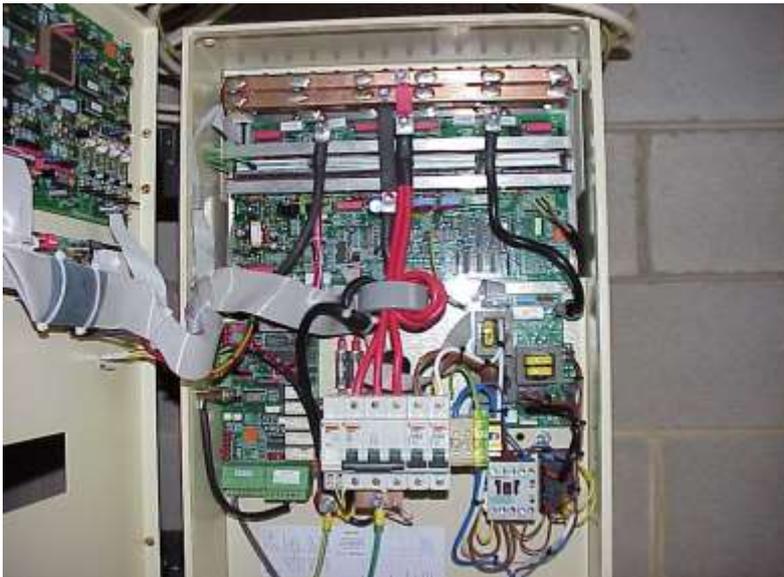
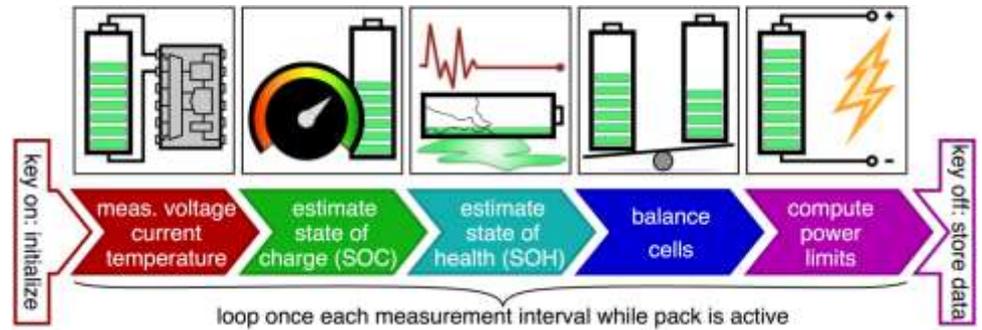
Handle lead acid, advanced lead acid, lithium ion and nickel metal hydride battery chemistry

# Education, engineering and equipment metrics gate the business



Storage Module ("SM")	Balance of System ("BOS")	Power Conversion System ("PCS")	Engineering Procurement & Construction ("EPC")	Other (Not Included in Analysis)
Racking Frame/Cabinet	Container	Inverter	Project Management	SCADA Software
Local Protection (i.e., Breakers)	Electrical Distribution & Control	Electrical Protection	Engineering Studies/Permitting	Shipping
Rack Management System	Communication	Energy Management System ("EMS")	Site Preparation/Construction	Grid Integration Equipment
Battery Management System	HVAC/Thermal Management		Foundation/Mounting	Metering
Battery Module	Fire Suppression		Commissioning	Land

# Integrated software solutions will be the driving force



# Making data simple, systems bankable



Thank you!

Available to answer your questions



# Distributed Wind 2018

## **Powering America with On-Site Power**

**Scott Sklar, The Stella Group Ltd.**



# The Stella Group, Ltd.

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The Stella Group, Ltd.. is a strategic technology optimization and policy firm for clean distributed energy users and companies which include advanced batteries and controls, energy efficiency, fuel cells, geexchange, heat engines, microhydropower (including tidal and wave), modular biomass, photovoltaics, small wind, and solar thermal (including CSP, daylighting, water heating, industrial preheat, building air-conditioning, and electric power generation). Scott Sklar serves as Steering Committee Chair of the Sustainable Energy Coalition, composed of the renewable and energy efficiency associations, national environmental groups, and analytical groups, and sits on the national Boards of Directors of the non-profit Business Council for Sustainable Energy and The Solar Foundation, teaches two unique interdisciplinary sustainable energy course at The George Washington University, Scott Sklar was awarded the prestigious The Charles Greely Abbot Award by the American Solar Energy Society (ASES) and on April 26, 2014 was awarded the Green Patriot Award by George Mason University in Virginia, and serves on the Executive Committee of the US Department of Commerce Renewable Energy & Energy Efficiency Advisory Committee, term ending 2018.

The Stella Group, Ltd. 706 North Ivy Street Arlington, VA 22201  
202-347-2214 (f-2215) [www.TheStellaGroupLtd.com](http://www.TheStellaGroupLtd.com) solarsklar@aol.com

## Enhancing the Resilience of the Nation's Electricity System

<https://www.nap.edu/download/24836>

“Laboratory Valuation Analysis Team” that provides for consistency and information sharing among the six other projects, with the aim of synthesizing them into a more holistic plan for the modern grid.

*Image: Map of research locations for \$32 million grid resiliency funding round via US DOE.*

SOURCE:

<http://www.triplepundit.com/2017/09/energy-dept-pledges-32-million-grid-resiliency-renewables/>

Transportation Secretary Elaine Chao about the emerging plan to repair U.S. roads, bridges and airports, a key campaign promise for Trump. Chao has said the legislation could include money for energy, water, broadband and veterans hospitals, while Housing and Urban Development Secretary Ben Carson has maintained that it could include funding for housing, according to The Washington Post.

<http://thehill.com/policy/transportation/327521-republicans-rush-to-help-shape-trumps-infrastructure-plan>

## Democratic Senate Proposal: **A Blueprint to Rebuild America's Infrastructure** **Creating Over 15 Million New Jobs**

**Overview of investments that will create 15 million new jobs over the next 10 years:**

<b>Reconstruct Roads &amp; Bridges</b>	<b>\$100B</b>	<b>Improve Airports</b>	<b>\$30B</b>
Revitalize Main Street	\$100B	Address Ports & Waterways	\$10B
Expand TIGER	\$10B	Build Resilient Communities	\$25B
Rehab Water & Sewer	\$110B	21st Century Energy Infrastr	\$100B
Modernize Rail Infr	\$50B	Expand Broadband	\$20B
Repair & Expand Transit	\$130B	Invest Pub Lands & Tribal Infr	\$20B
Vital Infrastructure Prog	\$200B	Modernize VA Hospitals	\$10B
Rebuild Public Schools	\$75B	Innovative Financing Tools	\$10B

For an industrial country such as ours, loss of energy, especially electricity, has much more profound impact on our economy, health, and comfort than ever before. The internet and e-commerce is a major driver of our economic health. Our water, sewage, and fuels are carried hundreds of miles as well as their delivery locally, tied to electricity. Our transportation systems from signal lights to railway crossings and seaports are extremely grid reliant. And our buildings -- from safety systems, WIFI, elevators and HVAC systems in many cases must operate to be operational - for a safe and healthy work and living environment.

On-site distributed renewable energy generation dedicated to these specialized critical loads, discussed below, remove these critical functions off the grid, forever. They cannot be controlled, so they are cyber-secure. There is no fuel delivery, so a compromised supply chain no longer becomes a problem. These generators can be hybrids with other renewables and battery storage, even small propane generators or fuel cells - that make these systems completely operational at all times and under all conditions. Removing these loads off the grid, can be quite cost effective, reduce distribution line congestion, and significantly add to the resiliency of ur grid and the critical functions our communities need during unplanned events.

## Basic Infrastructure:

- \* communications - from cellular towers, government communications,
  - area cameras.
  - first responders - police, fire, and emergency health support
- pipeline pumps for water, sewage and fuels
- core functions at water & sewage treatment plants.
- transportation lighting and signage especially
  - at major intersections to prevent gridlock
- river port, and airport lighting and communications have the same requirements.
- data centers have layered back-up, many went down because diesel fuel suppliers could not get to fill generator tanks

In buildings -

- WIFI and phone, security
- operating rooms in hospitals
- data centers within buildings
- sump pumps to prevent flooding
- at least one elevator shaft
- in certain climates - the HVAC systems to insure minimally-acceptable comfort is essential.

In communities –

- powering selected strip malls that are geographically dispersed that have
  - ATM machines
  - refrigeration for food
  - health care (eye, health, dental) to keep only the most critical care at to hospitals and non-critical away from hospitals
  - gasoline pump islands
  - schools as convergence points from displaced people of for first responders.

Note: For schools, we only powered the office, computer lab, kitchen and gymnasium (about a third of the overall energy) to make the facility usable

## FINANCING –

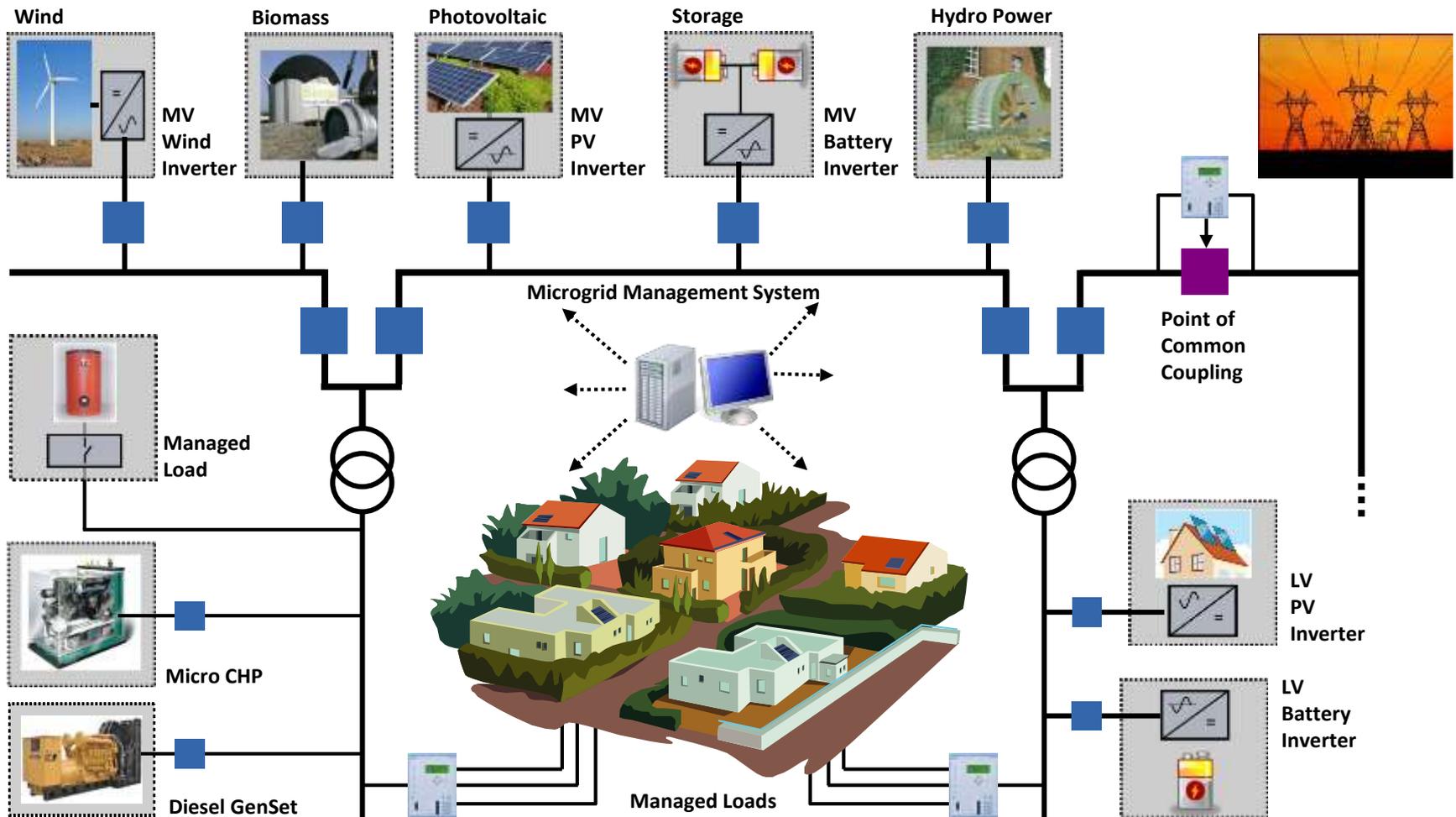
Federal government infrastructure share (maybe for interconnection)

Federal, state and local bonds

Private sector –

- leasing
- power purchase agreements
- shared-savings
- long-term amortized loans
- pay-as-you-go
- PACE

# Microgrids for Mission Critical Installations

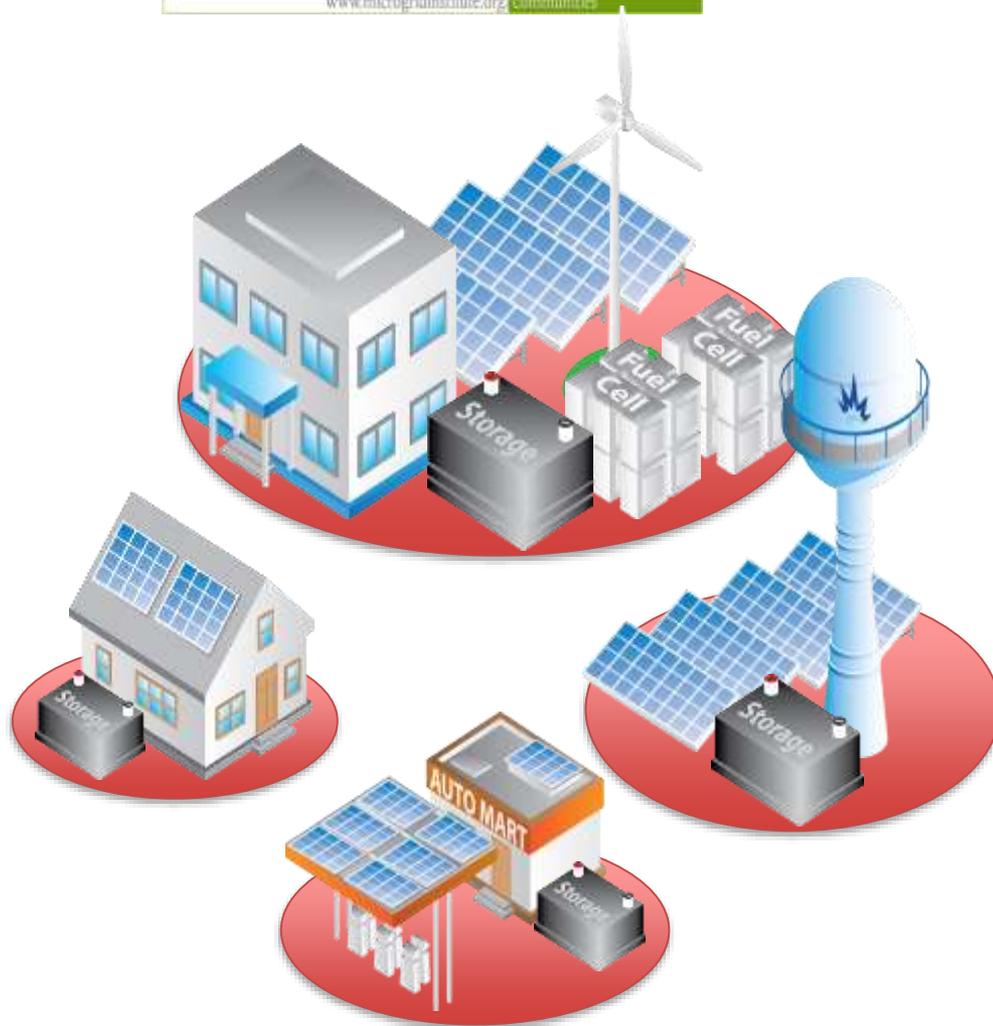


# A note on nanogrids and solar storage systems

A **nanogrid** is the smallest type of microgrid, typically designed for a single building or asset.

A **solar storage system** is a PV array with connected batteries. If it can operate in isolation, it's a type of nanogrid.

Such systems allow individual customers (businesses, institutions, homeowners, etc.) to capture the benefits of microgrid control technologies and achieve sustainable **hyper-local resilience**.

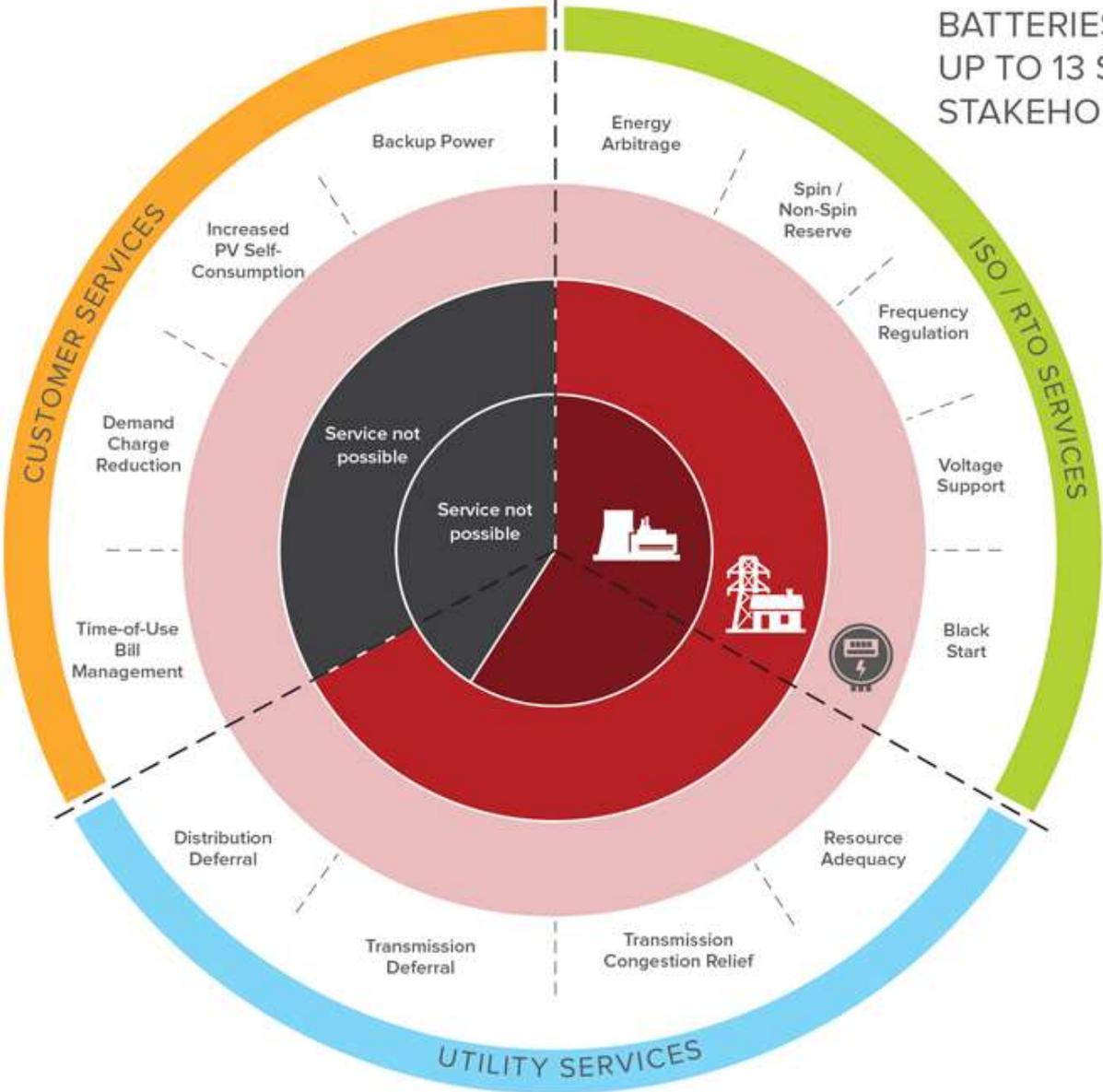


Distributed Energy Storage System L1000 In-Building  
Manage energy use, cut costs and provide backup power for a building, campus or enterprise with the L1000 In-Building Distributed Energy Storage System from Johnson Controls. JCI combines world-class battery technology, in-depth buildings expertise and intelligent controls to deliver the solution that performs best with specific building systems. Controls go beyond the battery to optimize whole-building performance and simplify participation in energy markets. Adaptive algorithms and premium battery composition to realize the lowest total lifecycle cost.

First battery bank with no wires – batteries just snap in and out !!



# BATTERIES CAN PROVIDE UP TO 13 SERVICES TO THREE STAKEHOLDER GROUPS



CENTRALIZED



TRANSMISSION

DISTRIBUTION

BEHIND THE METER



DISTRIBUTED



**Sacred Power Systems on Flatbread (5/2011)**

Coming Soon



 **Folderz**<sup>TM</sup> Deployable Micro-Grid

<http://www.sustencorp.com/folderz/>



<http://www.sactecsolar.com/2011/11/22/sunmacro-isocont/>



<https://oksolar.com/lion/Item/359597/solar---wind-powered-shipping-containers>



These energy-harvesting wind turbines in Kotzebue, Alaska, are part of the Energy Assurance at Remote Radar Sites project, a one-year effort managed by the AFRL Advanced Power Technology Office to demonstrate rapidly-deployable, off-grid energy technologies for increased mission energy resiliency in remote locations. (U.S. Air Force photo by Capt. Jason Goins)

<http://science.dodlive.mil/2017/08/03/air-force-works-to-bring-power-to-remote-military-sites/>



A mobile phone base station from Alcatel Lucent could reduce the carbon footprint of networks by combining renewable energy sources. Alcatel Lucent is offering developing countries a mobile phone base station that combines solar cells and a wind turbine to reduce its cost and environmental impact. In some countries, the majority of cell towers have to be powered by continuously operating diesel generators or "gensets" because the electric grid is too unreliable. Alcatel Lucent is already supplying the base stations to Vodafone in Qatar, reducing its energy need and contributing to Alcatel Lucent's "Green Touch" initiative, which aims to reduce the emissions produced by networks a thousand fold.

[http://www.solaripedia.com/13/249/cell\\_towers\\_combine\\_solar\\_&\\_wind\\_power.html](http://www.solaripedia.com/13/249/cell_towers_combine_solar_&_wind_power.html)

# On-Site Generation Utilization List

**HYBRID CELLULAR TOWERS WITH  
MARINE, PHOTOVOLTAICS, AND AN  
AGM BATTERY BANK..**



**ELEVATED SECURITY**

# PV Street Lights

- Sturdy – able to withstand hurricane winds and provide needed lighting when the electricity grid is down.

Dade County  
Florida USA



After Hurricane Andrew, Picture facing N.W.



**street lights powered by solar and wind energy are an emerging trend in china**

<https://www.designboom.com/design/street-lights-powered-by-solar-and-wind-energy-are-an-emerging-trend-in-china-04-01-2014/>



<http://www.bomsolar.com/en/solar-led-street-lights.html>

<http://www.eco-smart.org/productdocs/1-LED-Solar-Wind--Hybrid-Street-Light-Specs-Overview.pdf>



*The ZeroBase ReGenerator is:*

**Portable**

*Environmentally-sealed, marine-grade housing*

**Hybrid**

*Manages up to 10kW of production & storage*

**Power Generation**

*Distributed power generation from solar, wind & fossil-fuels*

**Storage**

*Stores up to 43kWh in sealed AGM batteries*

**Appliance**

*Easy set-up, simple to operate and maintain  
COTS since 2007 – In-theater since 2008  
Mounts to standard TQG trailers*



# Puerto Rico needs microgrids and private buy-in for reliable energy

BY SCOTT SKLAR, OPINION CONTRIBUTOR — 10/04/17 04:40 PM EDT

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<http://thehill.com/opinion/energy-environment/353869-puerto-rico-needs-microgrids-and-private-buy-in-for-reliable>

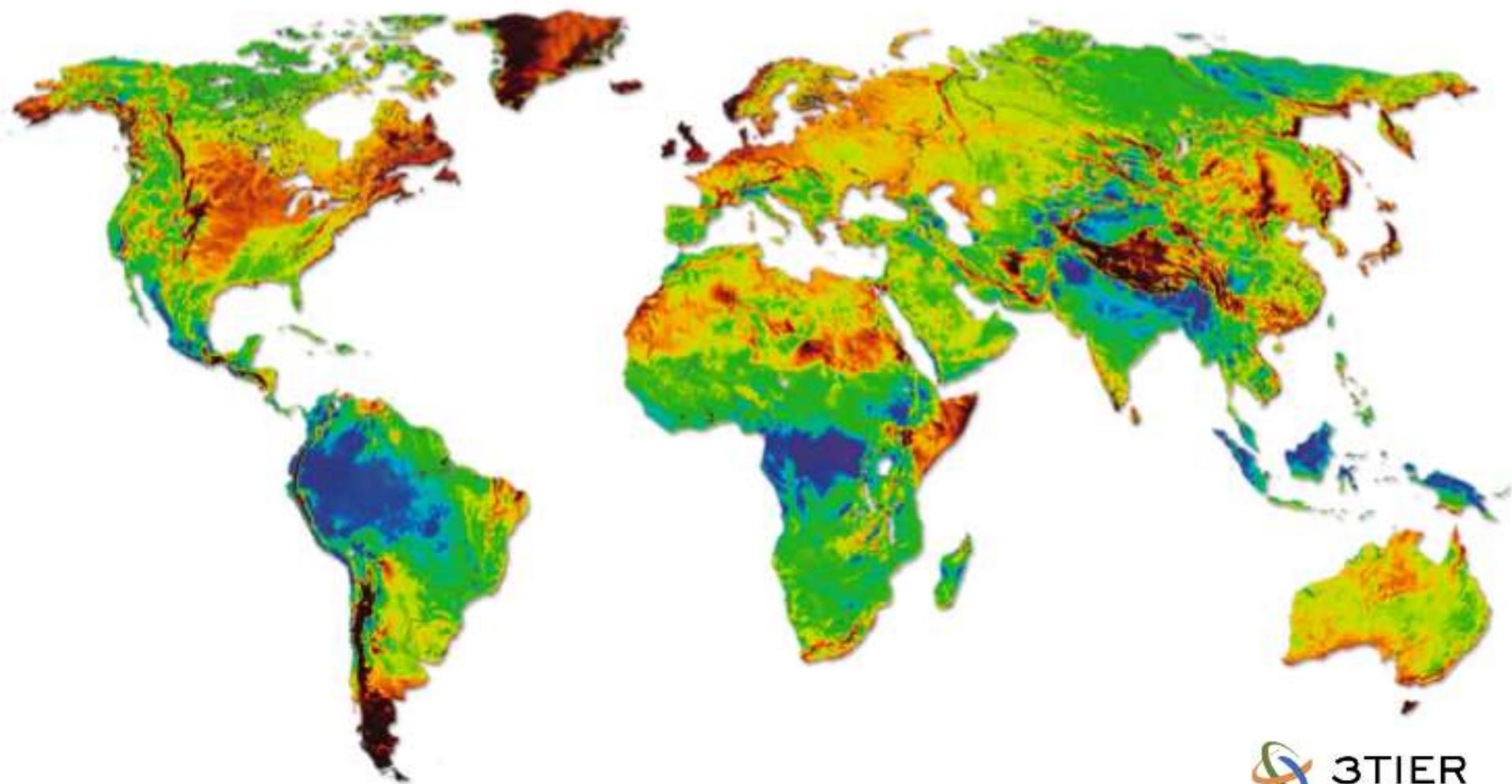


The Stella Group, Ltd. zero energy office (Arlington, VA)

Segmenting Puerto Rico's electric grid may be a much faster and more reliable rebuilding approach. The average number of minutes of power outages experienced by the average customer each year in a utility service territory is why electric utilities in Europe and Japan are integrating microgrids within their older electric grid systems.

Providing dedicated, on-site generation to power critical infrastructure may be a parallel approach for speed of deployment and resiliency of the electric grid as well as the next Puerto Rican grid and water and sewage system. During a horrific, unplanned event, what do we want operating at all times?

One of the first functions needed is communications — from cellular towers, government communications, cameras, and of course overall functionality of first responders — police, fire and emergency health support. Another is pipeline pumps for water, sewage and fuels and core functions at water and sewage treatment plants.





Good planets are hard to find.

Any questions ???

Need reports, contacts ???

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