

# Project End of Life: Repowering and Decommissioning

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12TH ANNUAL  
Nebraska  
Wind & Solar  
CONFERENCE & EXHIBITION

Submit Questions at [Slido.com](https://www.slido.com) - Code #R870

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# Kimball Wind Farm Replacement

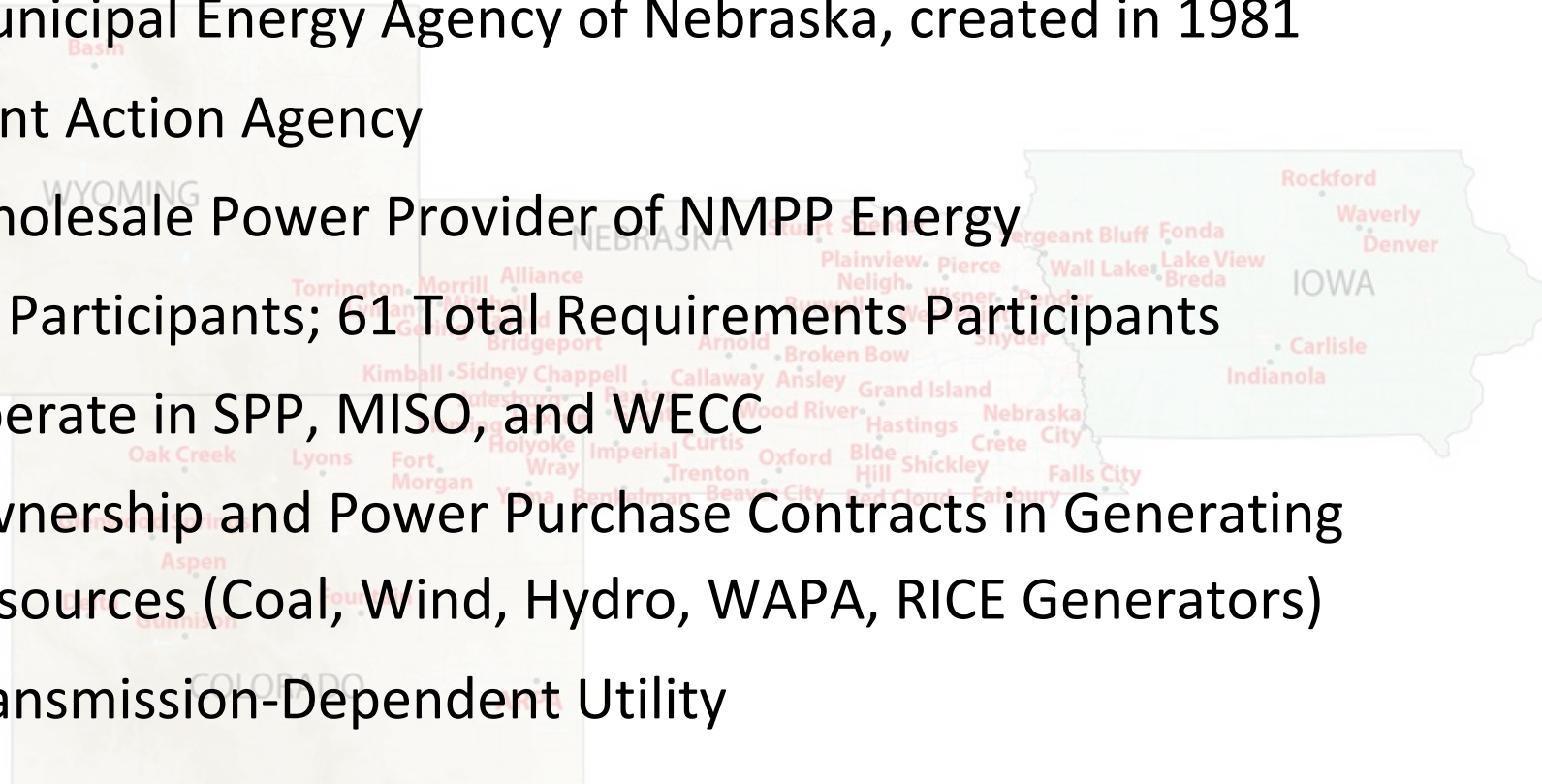
Shannon Coleman, PE  
Supervisor of Resource Planning and Analysis



NMPP | MEAN | NPGA | ACE

# About MEAN

- Municipal Energy Agency of Nebraska, created in 1981
- Joint Action Agency
- Wholesale Power Provider of NMPP Energy
- 69 Participants; 61 Total Requirements Participants
- Operate in SPP, MISO, and WECC
- Ownership and Power Purchase Contracts in Generating Resources (Coal, Wind, Hydro, WAPA, RICE Generators)
- Transmission-Dependent Utility



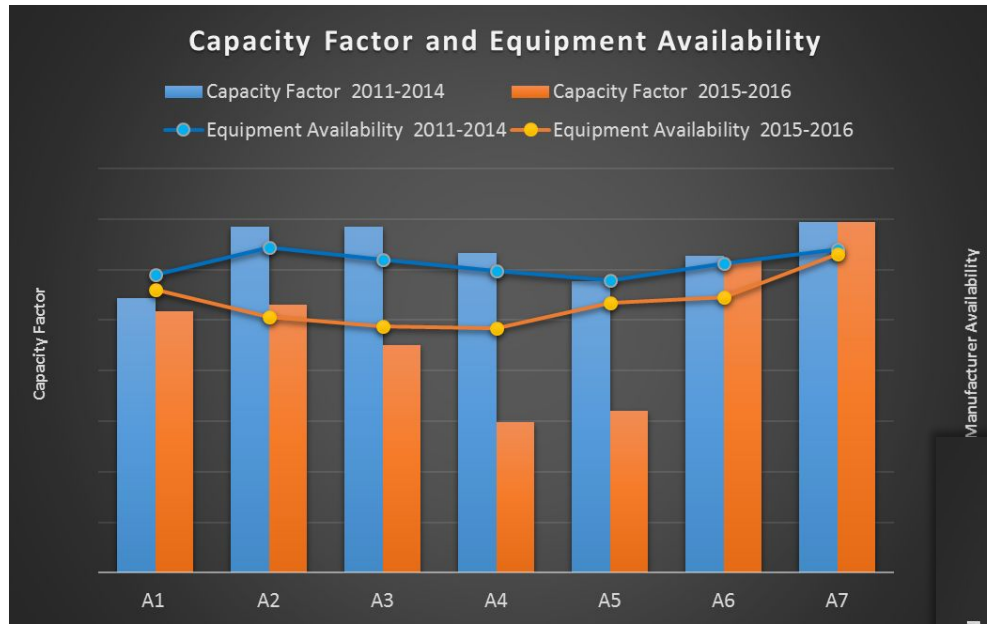
# Original Kimball Wind Farm Construction

- First “wind farm” built in Nebraska
- 3 miles NW of Kimball, NE
- Owned and Operated by MEAN  
(3rd Party Operating and Maintenance Contract)
- Commercial Operation Date =  
October 2002
- Seven (7) 1.5 MW Vestas Turbines
- One Landowner
- Interconnect to Kimball substation,  
city-owned line to WAPA substation



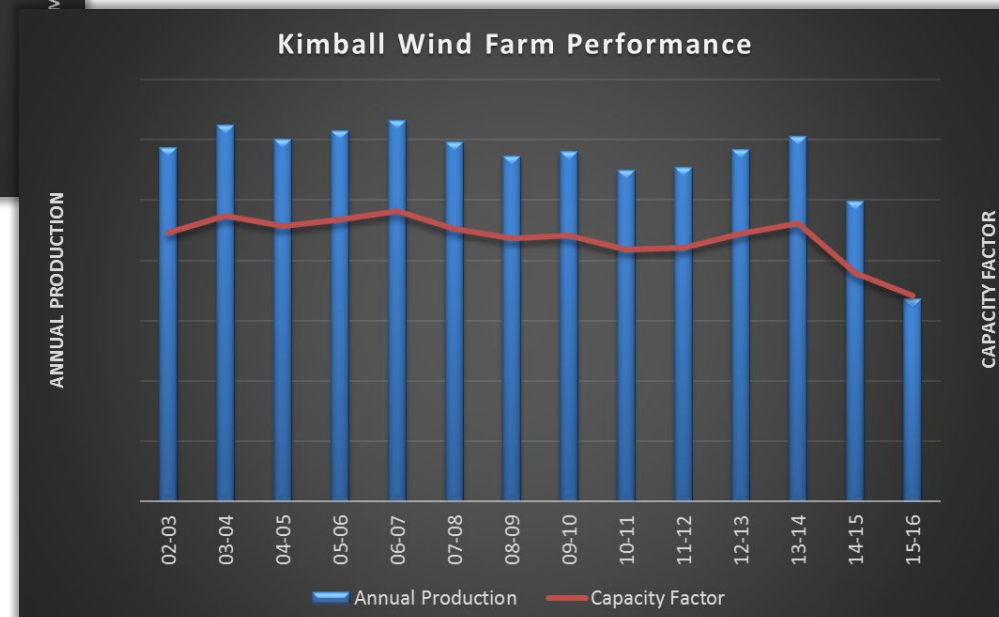
★ Designed by TownMapsUSA.com

# Kimball Wind Farm Operation



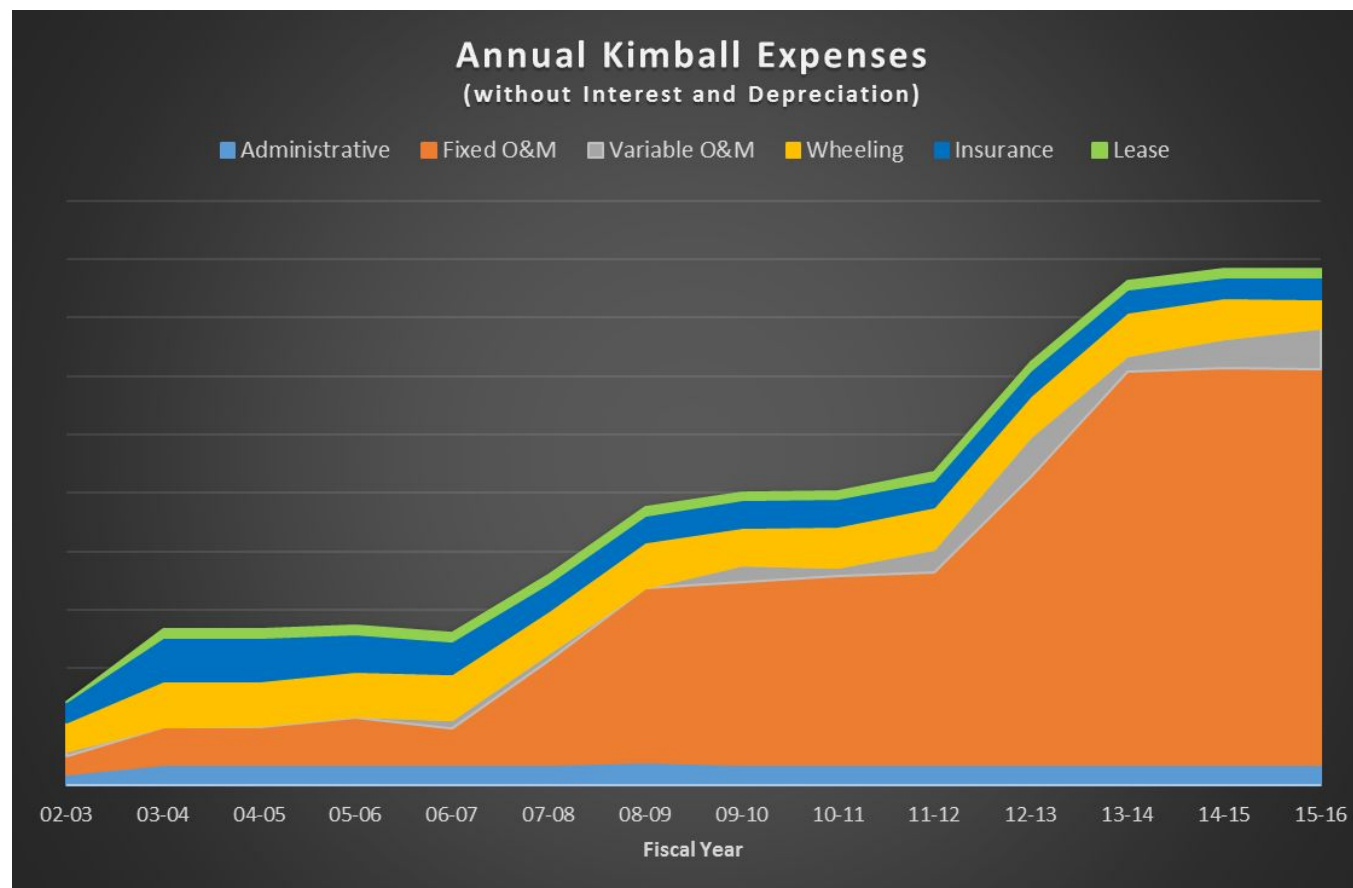
- Major Repairs
  - 17 Generator Replacements
  - 4 Gearbox Replacements

- Latest Failures
  - A3 - August 2016
  - A4 - January 2016
  - A5 - December 2015





# Kimball Wind Farm Costs



- Increase in Variable O&M

## MEAN's Legal Limitations

- No PTCs for Public Power
- Nebraska Power Review Board Opinion
  - ▶ MEAN cannot directly sell operating generation assets to a private for-profit entity operating in the electric industry





# Request for Proposals

- 20-Year Power Purchase Agreement
- Renewable Energy + Environmental Attributes
- Minimum 20 MW
  - ▶ First Right of Refusal for Additional
- Preference for Kimball Location
  - ▶ Minimum of 10.5 MW
  - ▶ Any Location for Additional
- Repower Considered
- Decommissioning Included
- Transmission Options (Reuse or Build New)
  - ▶ Bidder Responsible for Transmission Upgrades



MUNICIPAL ENERGY AGENCY OF NEBRASKA

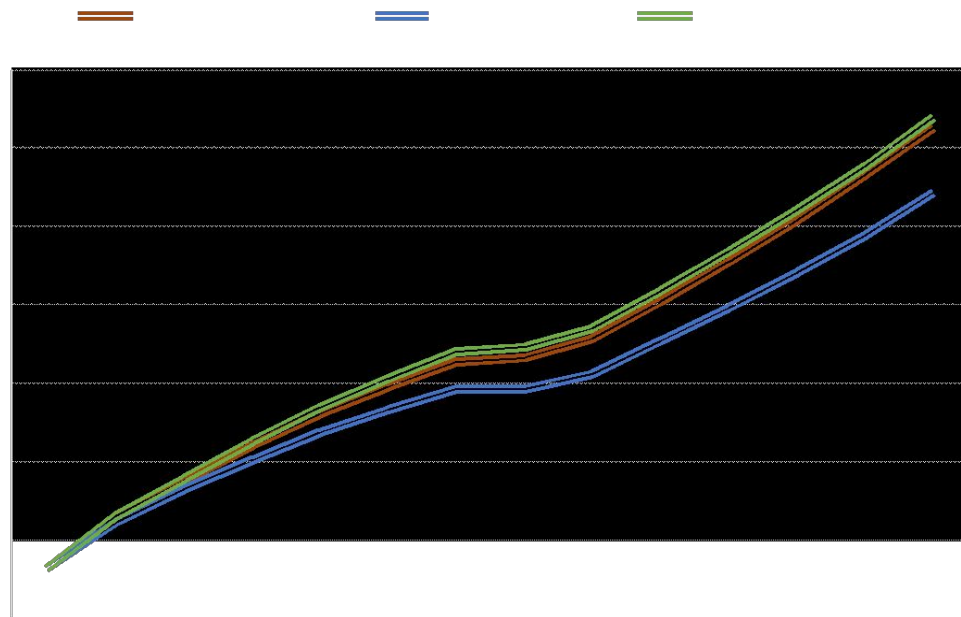
Lincoln, Nebraska

KIMBALL WIND FARM  
REQUEST FOR PROPOSALS (RFP)

NOVEMBER 2016

# Proposal Selection

- Received 4 Proposals
  - ▶ Wind and Solar
  - ▶ NE and CO
- Evaluation
  - ▶ Location
  - ▶ Life Cycle Cost
- Participant Goals
  - ▶ Renewable Energy
  - ▶ Local Benefit
  - ▶ Low Cost



# Decommissioning Contract

- NGC Group, Inc. Contract
- Included Salvage of All Materials
- Removal of All Above-Ground Structures
  - ▶ Turbines, Transformers, Transmission Lines, Met Tower
- Removal of Below-Ground Structures to Ground Level
  - ▶ Foundations, Distribution Conduit, Drainage Structures
- Restoration of Topsoil (18-inches)
- Re-Vegetation and Seeding
  - ▶ Grazing Land



## Awarded PPA

- 30 MW
  - ▶ 12 Turbines @ 2.5 MW Each
  - ▶ GE
  - ▶ 80 m Hub Height
  - ▶ 116 m Rotor Diameter
- 20 Years
- PTC Included in Energy-Only Price
  - ▶ MEAN Ineligible for PTC
- Expanded Area and Number of Landowners
- WAPA Transmission System
- Guarantees for Availability and Annual Generation



## Kimball Wind LLC Operation

- Official Decommissioning Date  
October 30, 2017
- Substantial Completion Date  
March 23, 2018
- Commercial Operation Date  
June 29, 2018
- 43.5% Annual Capacity Factor  
in First Year of Operation







# Nebraska Solar & Wind Decommissioning

## Policy Overview & What to Expect





# Questions??

(But not answers....yet)

- Who requires decommissioning in Nebraska?
- What are the requirements?
- What is the decommissioning process?
- Who has to pay for it?
- Where can solar and wind equipment be recycled?



# Overview

**01**

Q & Not A (???)

**02**

The Rise of Solar + Wind

**03**

Decommissioning Policy in Nebraska

**04**

Wind Decommissioning in Nebraska

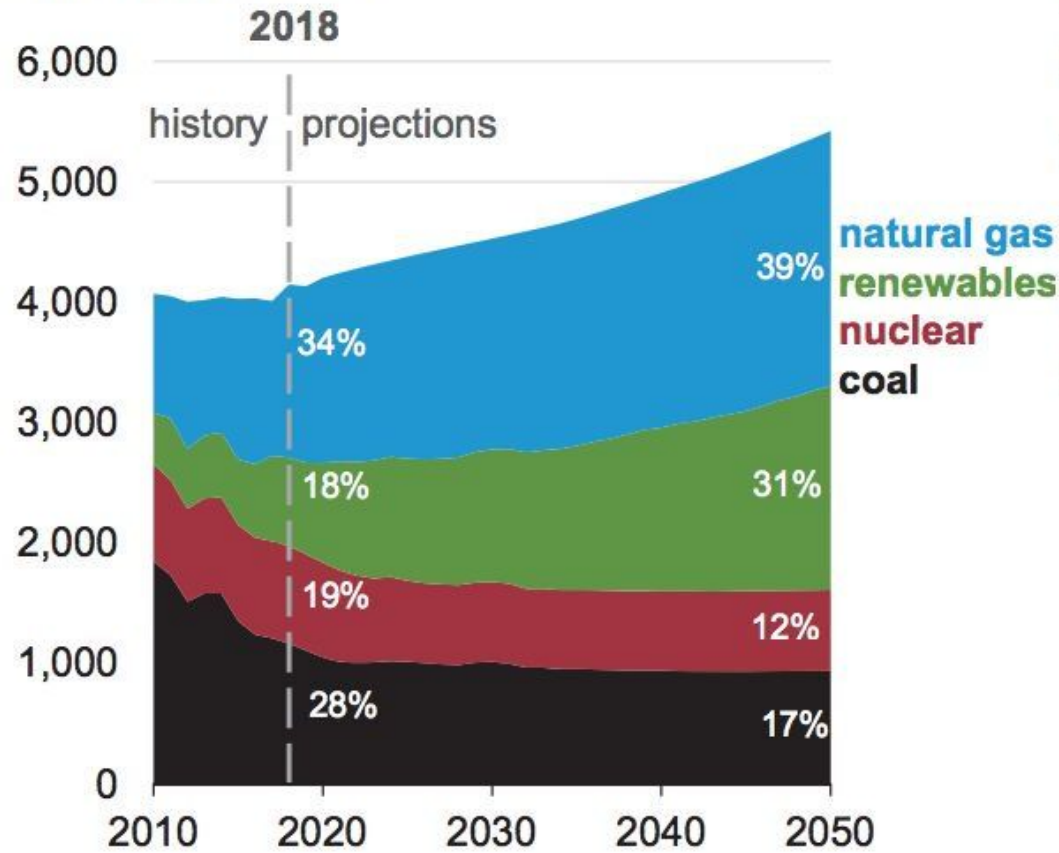
**05**

Decommissioning Considerations and Takeaways

# Electricity generation from natural gas and renewables increases, and the shares of nuclear and coal generation decrease—

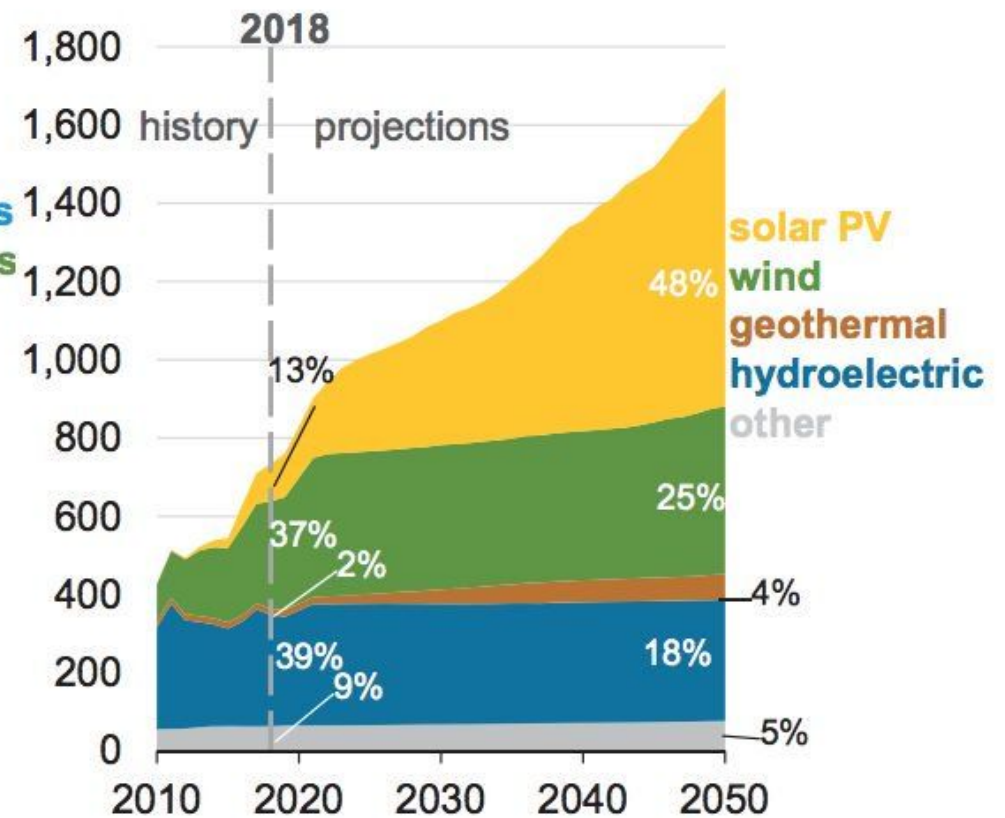
**Electricity generation from selected fuels (Reference case)**

billion kilowatthours



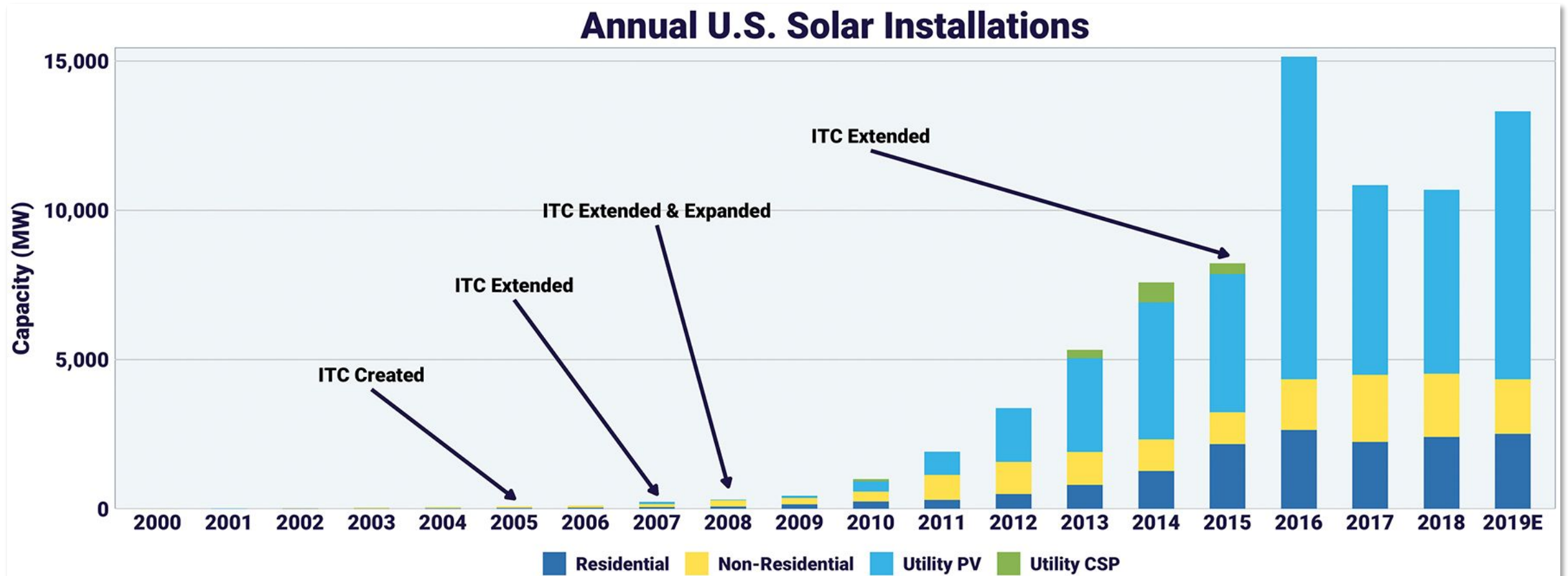
**Renewable electricity generation, including end-use (Reference case)**

billion kilowatthours



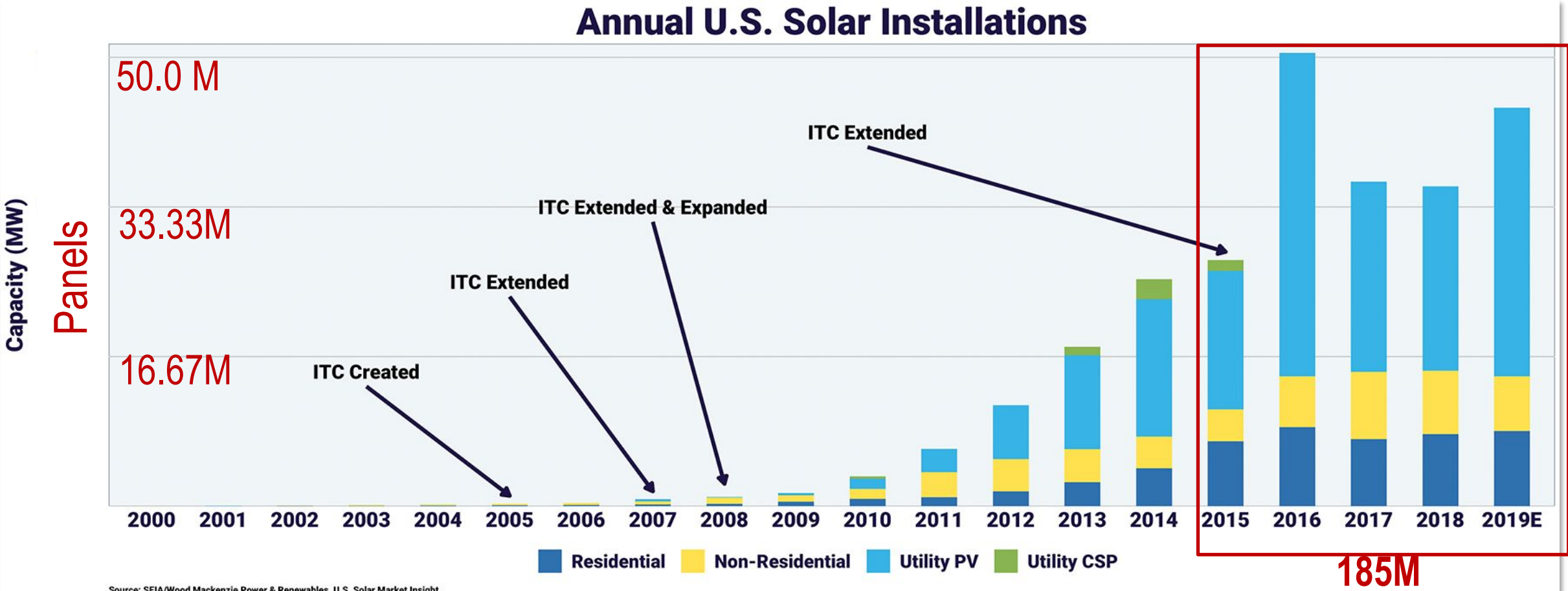


# Solar Has Seen Unprecedented Growth in the Past Decade



Source: SEIA/Wood Mackenzie Power & Renewables, U.S. Solar Market Insight

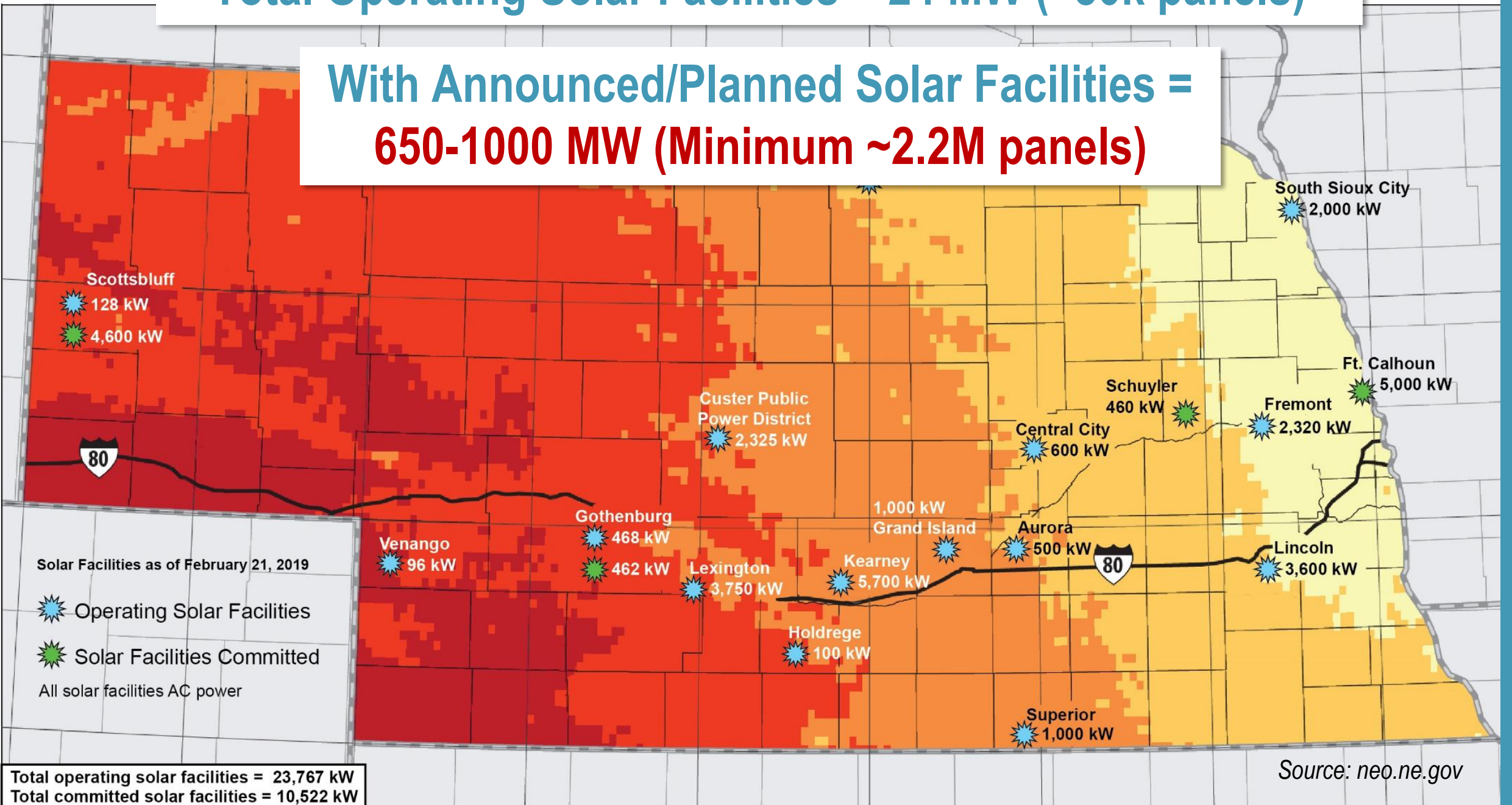
# With Solar Growth Comes A LOT of Panels



**From 2040 – 2045 we will have 185M solar panels to retire or repurpose**

Total Operating Solar Facilities = 24 MW (~80k panels)

With Announced/Planned Solar Facilities =  
650-1000 MW (Minimum ~2.2M panels)

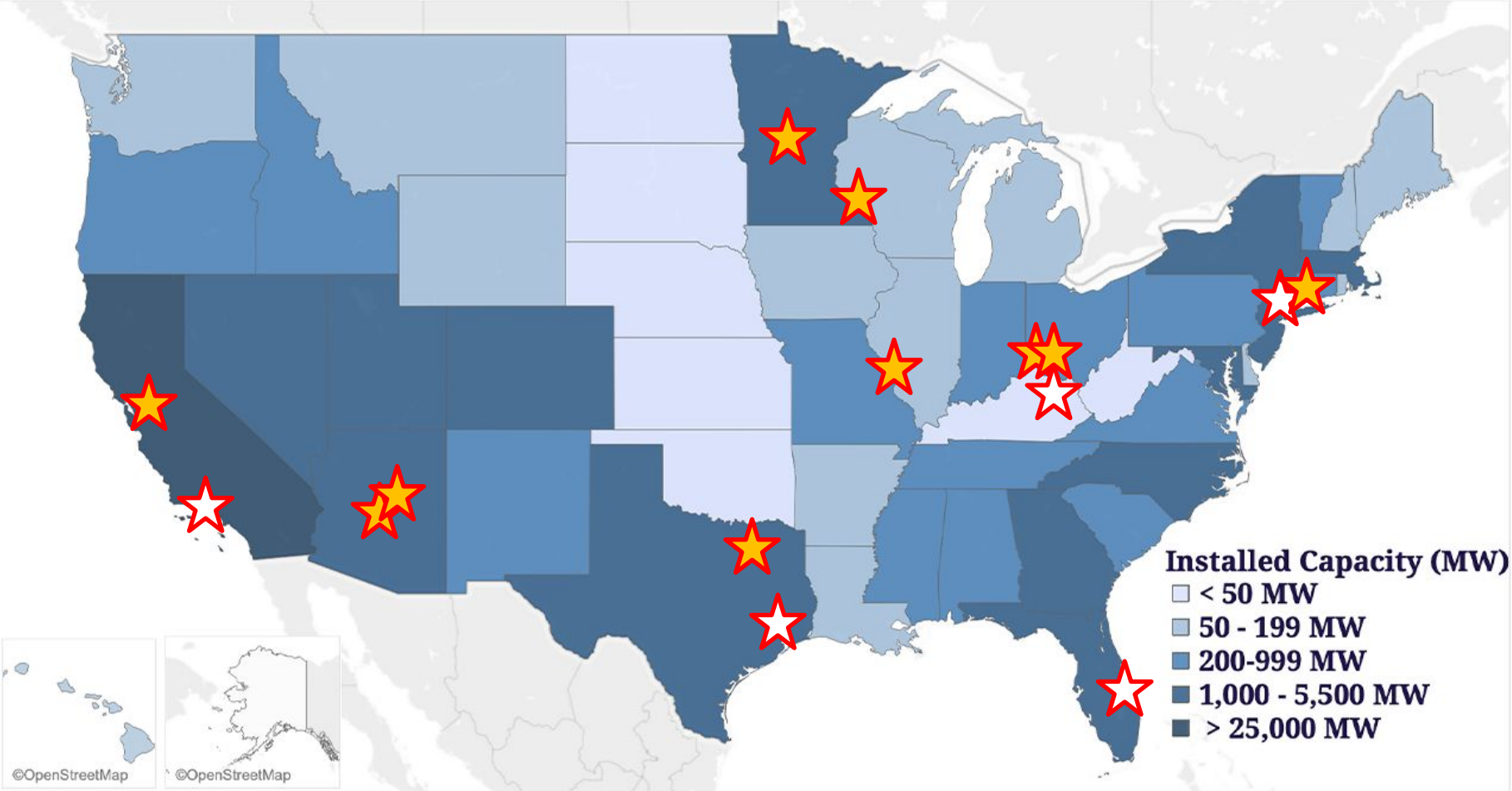




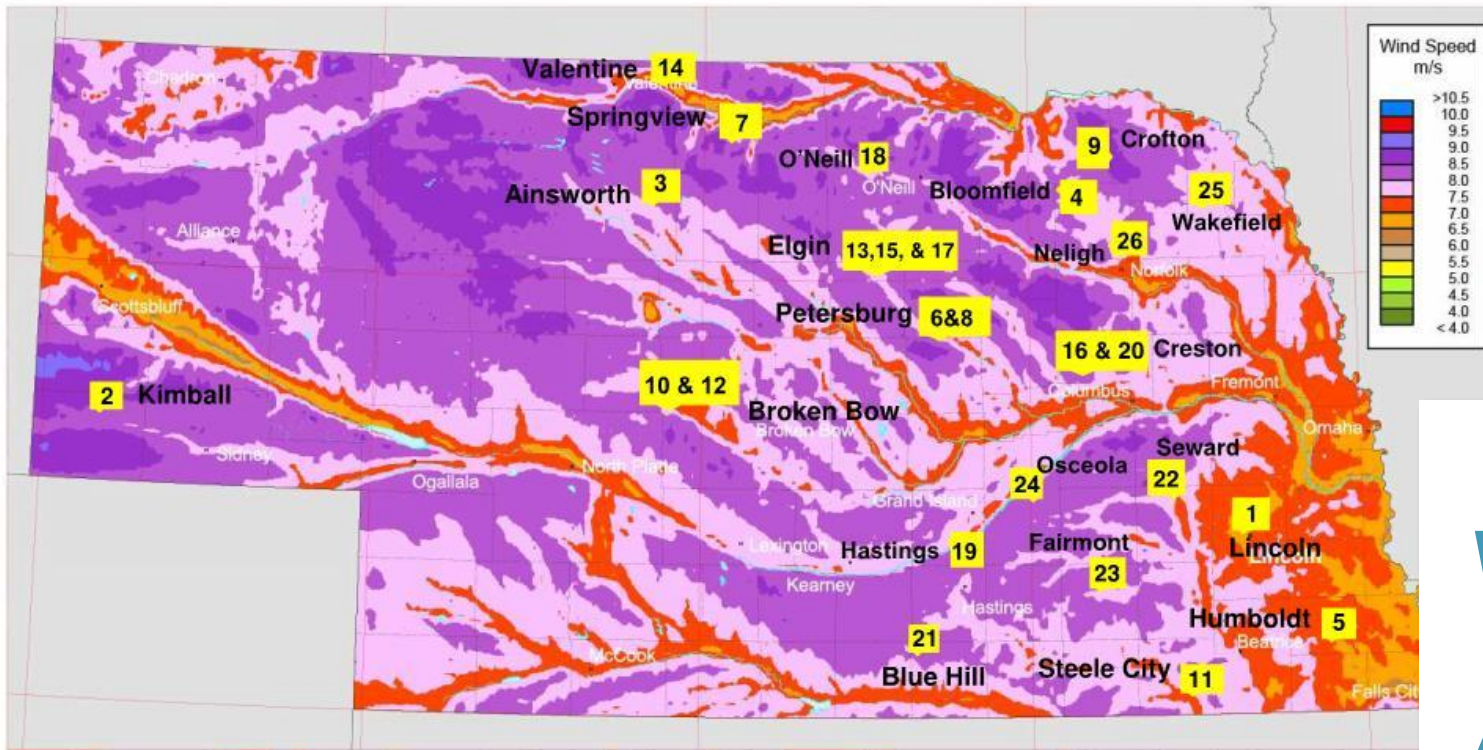
# Where is solar being installed? Where are current recycling centers?

## Top 10 States

California	25,016 MW
North Carolina	5,467 MW
Arizona	3,788 MW
Nevada	3,452 MW
Florida	3,156 MW
Texas	2,957 MW
New Jersey	2,829 MW
Massachusetts	2,535 MW
New York	1,718 MW
Utah	1,661 MW
Georgia	1,572 MW



★ - Full Panel    ★ - Specific Components



**Total Operating  
Wind Facilities =  
1.98 GW  
(~1,300 turbines)**

## WIND DEVELOPMENT IN NEBRASKA 80 Meter Wind Overlay

REVISION: March 2019



PROJECT	YEAR	MW	OWNER	PARTICIPANTS
1 Salt Valley	1998-99	1.32	LES	LES
2 Kimball	2018	30	Aspenall Energies, LLC	MEAN
3 Ainsworth Wind Energy	2005	59.4	NPPD	NPPD, OPPD, MEAN, GI, JEA* *Financial Participant for RECs
4 Elkhorn Ridge Wind, LLC	2009	80	NRG Energy	NPPD, OPPD, MEAN, LES, GI
5 Flat Water Wind Farm, LLC	2010	60	Gestamp Wind N.A.	OPPD
6 Laredo Ridge Wind Farm	2011	80	NRG Energy	NPPD, LES, MEAN, GI
7 Springview II/Bluestem, LLC	2011	3	Bluestem, LLC	NPPD, OPPD**, LES**, Grand Island**, ** will receive RECs
8 TPW Petersburg, LLC	2011	40.5	Gestamp Wind N.A.	OPPD
9 Crofton Bluffs Wind Farm	2012	42	NRG Energy	NPPD, OPPD, LES, MEAN
10 Broken Bow Wind, LLC	2012	80	NRG Energy	NPPD, OPPD, LES, GI
11 Steele Flats Wind	2013	74.8	NextEra	NPPD
12 Broken Bow II	2014	75	Sempra	NPPD, OPPD
13 Prairie Breeze I	2014	200.6	Invenergy	OPPD
14 Valentine Wind LLC	2014	1.85	Bluestem Sandhills	City of Valentine, NE
15 Prairie Breeze II	2015	73.39	Invenergy	LES
16 Creston Ridge LLC	2015	6.8	Bluestem Energy Solutions	Loup Public Power District

PROJECT	YEAR	MW	OWNER	PARTICIPANTS
17 Prairie Breeze III	2016	35.8	Invenergy	City of Grand Island, sharing with Nebraska City and Neligh
18 Grand Prairie	2016	400	Berkshire Hathaway Renewables	OPPD
19 Central Comm. College-Hastings	2016	1.7	Central Community College-Hastings	Central Community College-Hastings
20 Creston Ridge II	2017	6.9	Bluestem Energy Solutions	Loup Public Power District
21 Cottonwood I	2017	89.96	NextEra	Beatrice, Fremont, South Sioux City, Northeast Public Power District
22 City of Seward	2017	1.7	Bluestem Energy Solutions	City of Seward
23 Fillmore County Wind Farm	2018	6.9	Bluestem Energy Solutions	Perennial Public Power District
24 Prairie Wind	2018	2.5	Bluestem Energy Solutions	Polk County Rural Public Power District
25 Rattlesnake Creek Wind Farm	2018	318.15	Enel Green Power North America	Facebook
26 Upstream Wind Energy Center	2019	202.5	Invenergy & WEC Energy Group	WEC Energy Group
		<b>~1,974.677</b>	<b>Total MW</b>	

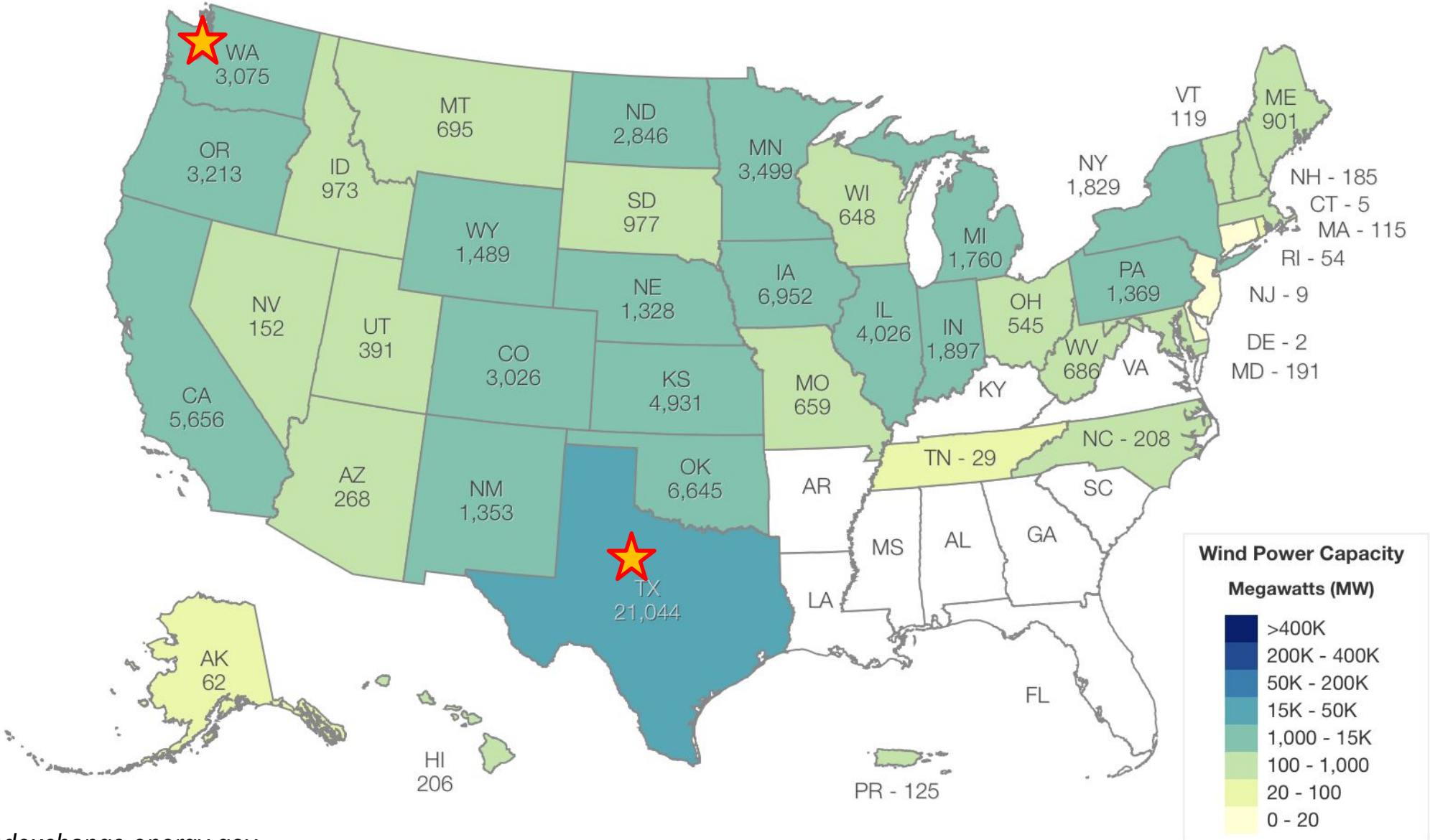
Note: 1998 Springview Wind Energy 1.5 MW and 2001 Valley .66 MW retired.

6312b592-Rev. 3-4-19

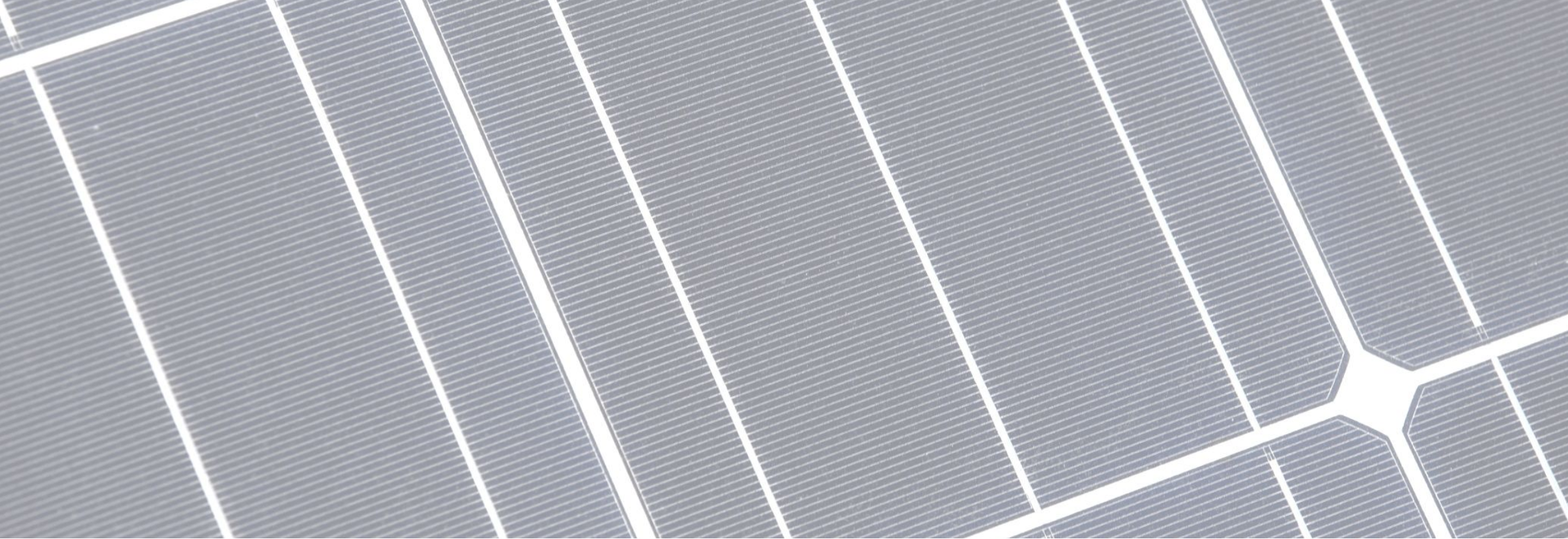
Source: neo.ne.gov



# Where can wind turbines be recycled? Turbine blades?



Source: [windexchange.energy.gov](http://windexchange.energy.gov)



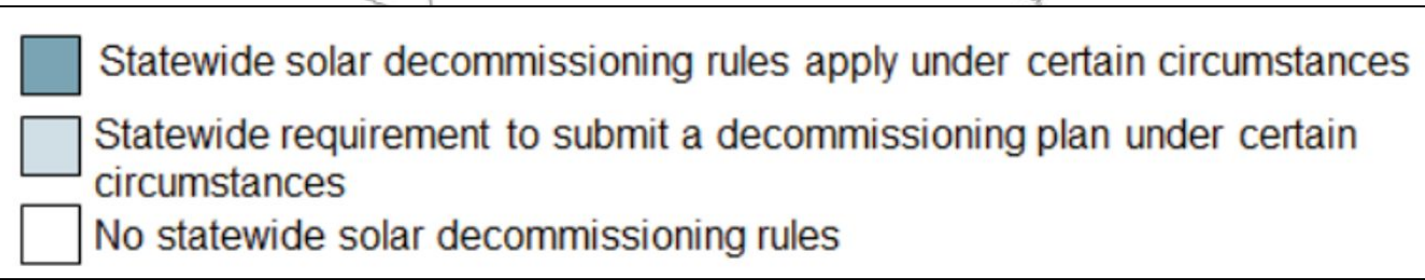
# **Decommissioning Policy and Drivers**

Who Requires Decommissioning?



# State Solar Decommissioning Policies

February 2016



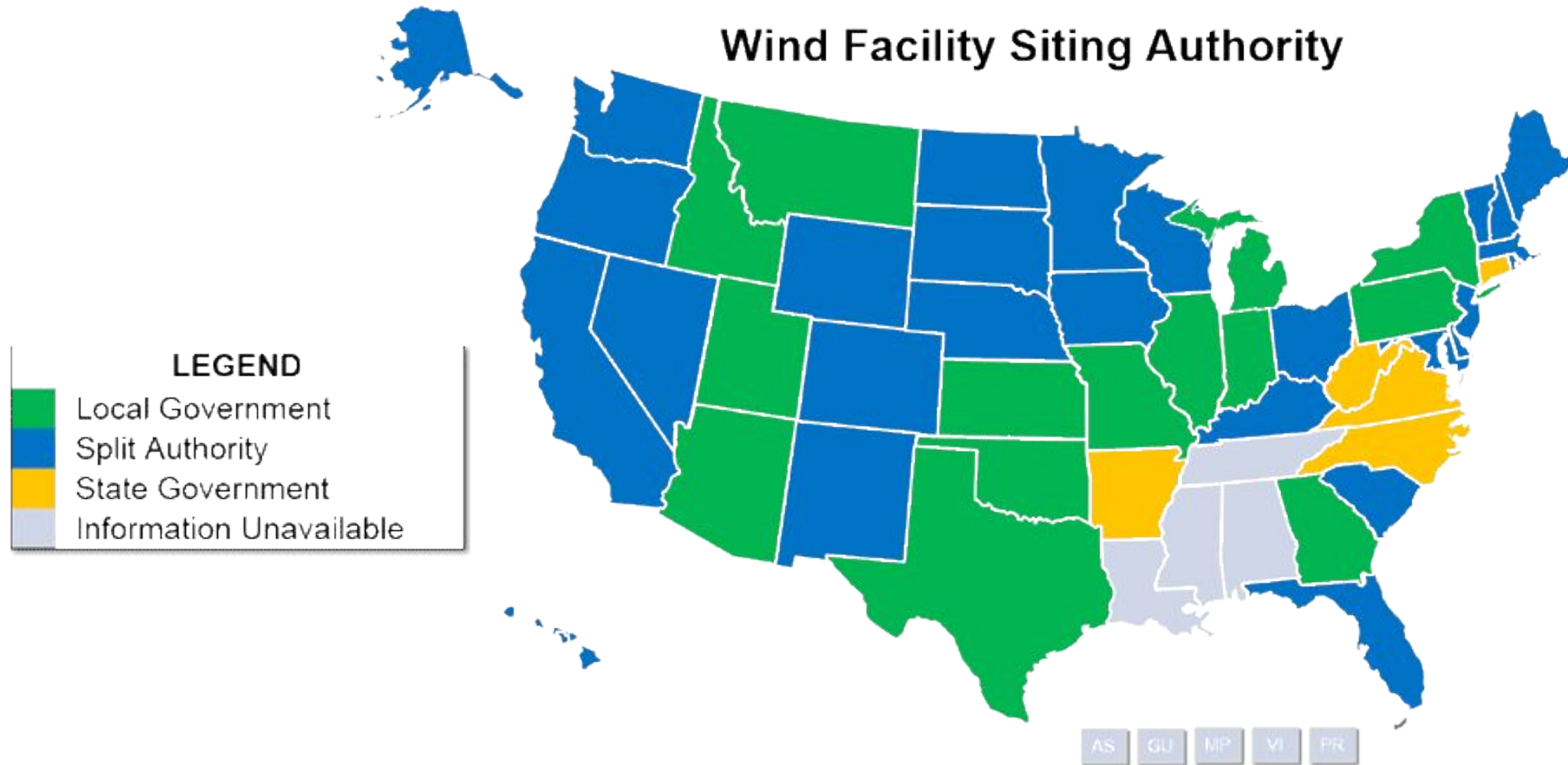
# Nebraska Is One of the Few States with a State Level Solar Decommissioning Requirement

Nebraska State Policy (LB 1048)

**The applicant shall submit a decommissioning plan. The applicant or owner of the facility shall establish decommissioning security** by posting an instrument, a copy of which is given to the board, **no later than the tenth year** following final approval of the facility to ensure sufficient funding is available **for removal of the facility and reclamation at the end of the useful life** of such facility pursuant to the decommissioning plan. **The owner** of the certified renewable export facility **shall be solely responsible for decommissioning**. If the applicant or any subsequent owner of the facility intends to transfer ownership of the facility, the proposed new owner shall provide the board with adequate evidence demonstrating that substitute decommissioning security has been posted or given prior to transfer of ownership. **The requirements of this subdivision shall be waived if a local governmental entity with authority to create requirements for decommissioning has enacted decommissioning requirements for the applicable jurisdiction;**



# Wind Decommissioning at State Levels is More Common but Still Primarily Local



# Nebraska State Wind Decommissioning Policy

## Nebraska State Policy (LB 155)

(iii) Certifies to the board that the **private electric supplier will (A) comply with any decommissioning requirements adopted by the local governmental entities** having jurisdiction over the privately developed renewable energy generation facility and (B) except as otherwise provided in subdivision (b) of this subsection, **submit a decommissioning plan to the board obligating the private electric supplier to bear all costs of decommissioning** the privately developed renewable energy generation facility and requiring that the **private electric supplier post a security bond or other instrument, no later than the tenth year** following commercial operation, **securing the costs of decommissioning** the facility and provide a copy of the bond or instrument to the board;

(b) **The board may bring an action in the name of the State of Nebraska for failure to comply with subdivision (a)(iii)(B) of this subsection.** Subdivision (a)(iii)(B) of this subsection **does not apply if a local government entity with the authority to create requirements for decommissioning has enacted decommissioning requirements** for the applicable jurisdiction.



# When It Comes to Decommissioning

## Think Local

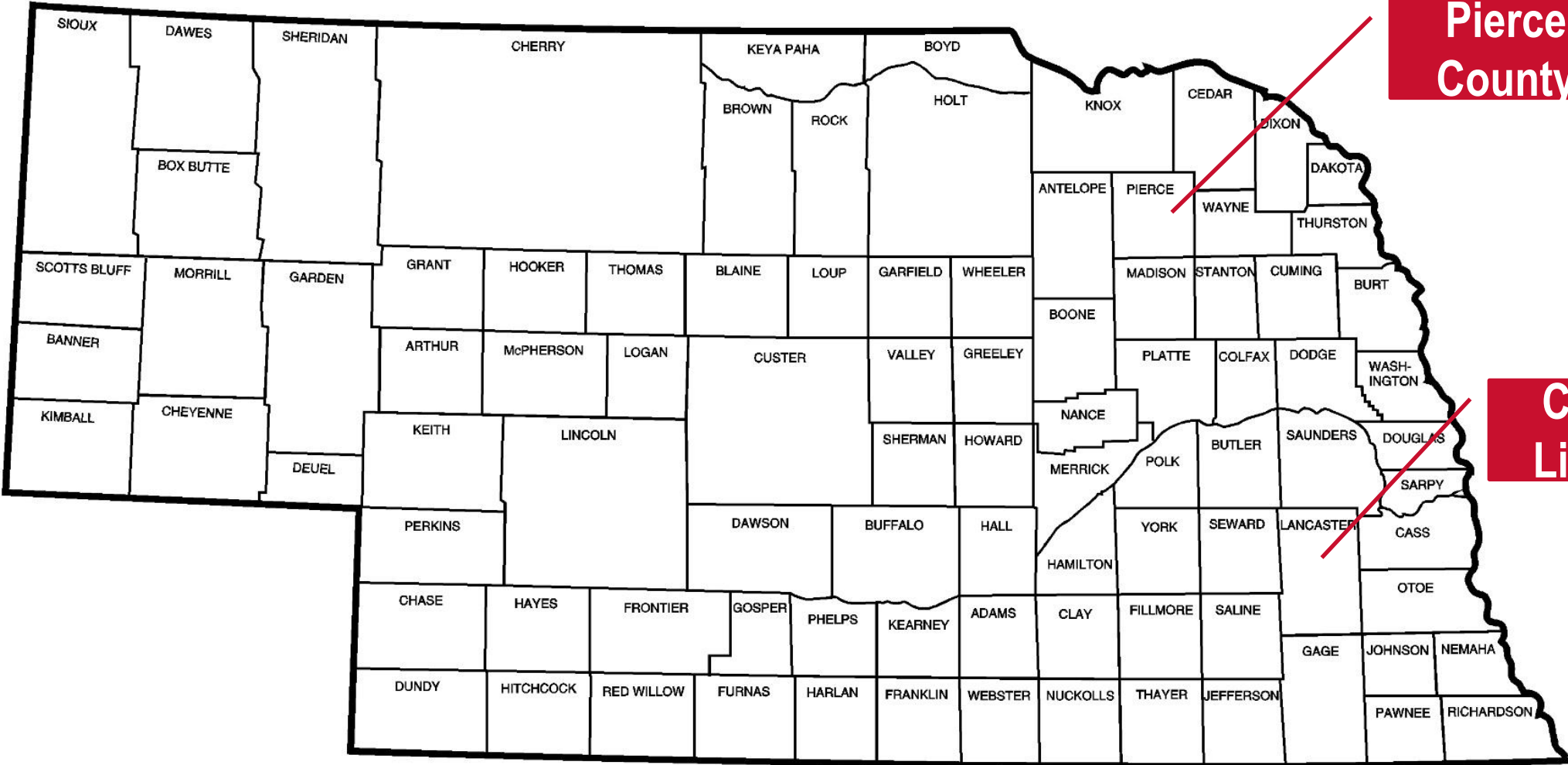
Permits & Regulations

- Schedule
- Cost Assurances
- Waste & Recycling
- Environmental Protections



Source: [adamscounty.us](http://adamscounty.us)

# Local Solar Decommissioning Requirement Examples



Pierce County

City of Lincoln



# Pierce County Solar Decommissioning Regulations

- **6.04.04 Submittal Requirements:** (9) A decommissioning plan shall be required to ensure that facilities are properly removed after their useful life. Decommissioning of solar panels must occur in the event they are not in use for 12 consecutive months. The plan shall include provisions for removal of all structures and foundations, restoration of soil and vegetation and a plan ensuring financial resources will be available to decommission the site. The Board may require the posting of a bond, letter of credit or the establishment of an escrow account to ensure proper decommissioning.
- **6.04.06 Discontinuation.** A solar farm shall be considered abandoned after one year without energy production. The property owner shall remove all solar farm equipment and appurtenances within 90 days of abandonment.

# City of Lincoln Solar Decommissioning Regulations:

## 27.63.830 Solar Energy Conversion System

a.iv) Each Solar Energy Conversion System facility shall have a decommissioning plan outlining the means, procedure, and costs of removing the machines and all related supporting infrastructure and a bond or equivalent enforcement resource to guarantee removal and restoration upon discontinuance, decommissioning, or abandonment.





# Hamilton County Wind Energy Decommissioning Regulations (and Antelope, Knox, Cherry....)

## 08.07 Special Safety and Design Standards and Additional Requirements

**10) Discontinuation and Decommissioning - A WECS shall be considered a discontinued use after one year without energy production**, unless a plan is developed and submitted to the Zoning Administrator outlining the steps and schedule for returning the WECS to service. **All WECS and accessory facilities shall be removed to four feet below ground level within 180 days of the discontinuation of use.** This period may be extended by the Zoning Administrator following a written request by an agent of the owner of the WECS.

**Each WECS project under this section shall have a Decommissioning Plan outlining the anticipated means and cost of removing WECS** at the end of their serviceable life or upon being discontinued use. **The cost estimates shall be made by a competent party; such as a Professional Engineer, a contractor capable of decommissioning or a person with suitable expertise or experience with decommissioning. The plan shall also identify the financial resources** that will be available to pay for decommissioning and removal of the WECS and accessory facilities.

# Additional Hamilton County Wind Energy Decommissioning Regulations

**9) Waste Disposal** - Solid and Hazardous wastes, including but not limited to crates, packaging materials, damaged or worn parts, as well as used oils and lubricants, shall be removed from the site promptly and disposed of in accordance with all applicable local, state and federal rules and regulations.

**13) County Roads** -In regard to roads applicants shall:

B) Conduct a pre-construction survey, in coordination with the appropriate jurisdictions to determine existing road conditions. The survey shall include photographs and a written agreement to document the condition of the public facility.

C) Be responsible for restoring the road(s) and bridges to preconstruction conditions.

# Holt County Decommissioning Regulations – Always

## Read the Fine Print

### F.7) Discontinuation and Decommissioning

a. A WECS shall be considered a discontinued use after one year without energy production, unless a plan is developed and submitted to the Zoning Administrator outlining the steps and schedule for returning the WECS to service. **All WECS and accessory facilities shall be removed to 5 feet below ground level, or as negotiated between landowner and developer, within 90 days, weather permitting, of the discontinuation of use.**

b. Each commercial/utility WECS shall have a decommissioning plan outlining the anticipated means and cost of removing WECS at the end of their serviceable life or upon being discontinued in use. The cost estimates shall be made by a competent party; such as a professional engineer, a contractor capable of decommissioning, or a person with suitable expertise or experience with decommissioning. The plan shall also identify the financial resources that will be available to pay for decommissioning and removal of the WECS and accessory facilities.



# Recent Policy Trends and Stakeholder Concerns

- Financial Assurance Requirements
- Cost Estimate Updates
- Land Restoration
- Erosion and Environmental Impacts
- Local Landowner Safety
- Noise/Construction Impacts





# Sample Decommissioning Checklist

- Defined conditions or timeframe upon which decommissioning will be initiated
- The timeframe for completion of decommissioning activities
- Plans for updating the decommissioning plan
- The party responsible for decommissioning
- Financial assurance for decommissioning costs
- Description of any agreement (e.g., lease) with landowner regarding decommissioning
- Final electrical and/or environmental inspection (County)
- Removal of all non-utility owned equipment (e.g., conduit, structures, roads, and foundations)
- Restoration of property to condition prior to solar development

# Solar Decommissioning 101 → Install in Reverse

- Pre-Decommissioning Activities
- Secure and De-energize the Site
- Environmental Protections
- Equipment Dismantling and Removal
  - Panels/Racks/Piles
  - Inverter/Equipment Skids
  - Project Substation
  - Underground Cable
- Fences and Gates
- Grading and Land Restoration





# Wind Decommissioning 101 → Equipment Driven

- Pre-Decommissioning Activities
- Crane Pads & Roads
- Turbine Dismantling and Removal
  - Blades/Nacelle
  - Tower
  - Foundation
- Padmount Transformers & Collection System Cable
- Road and Land Restoration



# How Much It Costs for **Solar** Depends on Who You Ask

Max: \$179k / MW

Avg: \$57k / MW

Min: (-\$89k / MW)

## ▪ Significant Costs

- Equipment Dismantling/ Removal
- Disposal & Recycling
- Site Restoration



## ▪ Salvage Values

- Steel Piles
- Racking
- Electrical Equipment
- Panels....

Source: [ourenergypolicy.org](http://ourenergypolicy.org)



# Wind Decommissioning Costs Can Also Vary Greatly

Max: \$222k / MW

Avg: \$51k / MW

Min: (\$2k / MW)

(Avg: \$76k / 1.5 MW Turbine)

- Significant Costs

- Turbine Dismantling/ Removal
- Disposal & Recycling
- Land Restoration



- Salvage Values

- Steel Towers
- Equipment (Gearboxes, Transformer)
- Cabling

Source: [ourenergypolicy.org](http://ourenergypolicy.org)



# **Why Decommissioning Financial Assurance?**

Because the road to hell is paved with good intentions



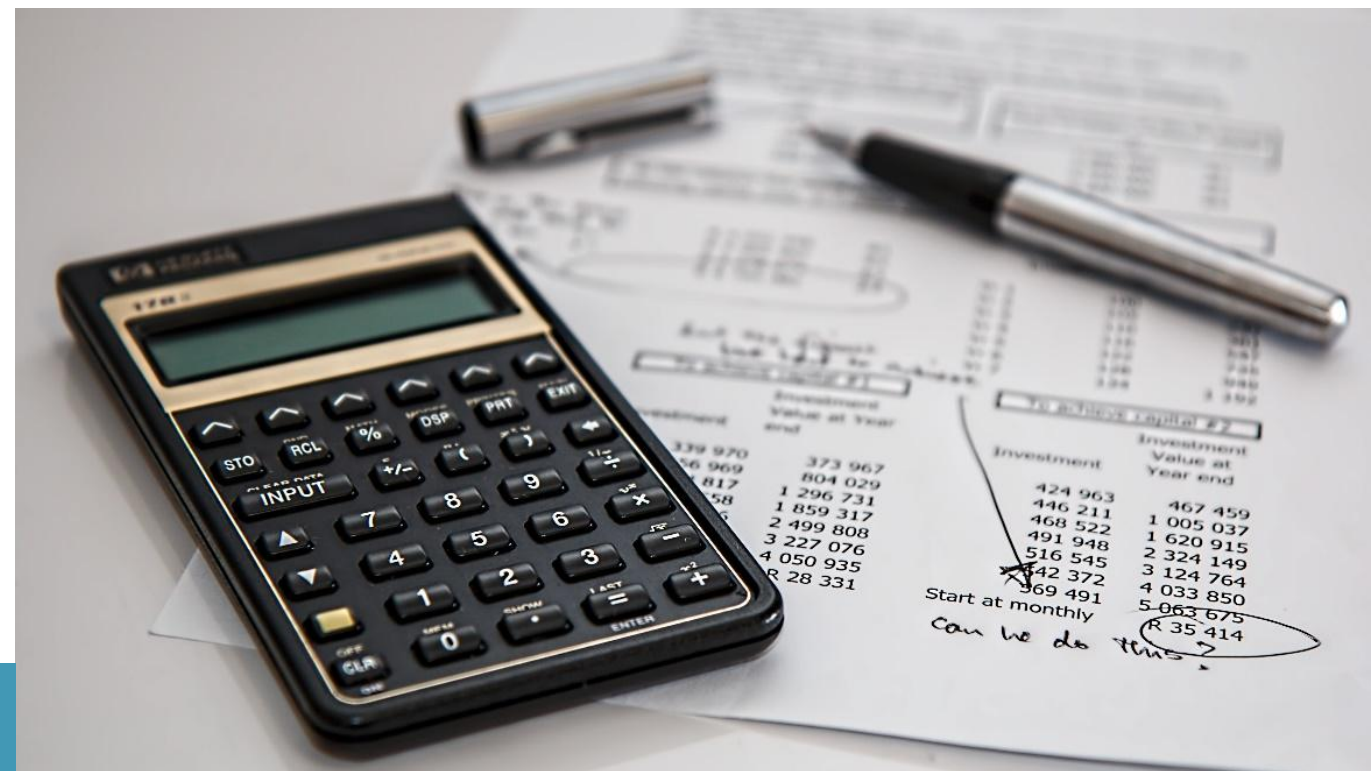
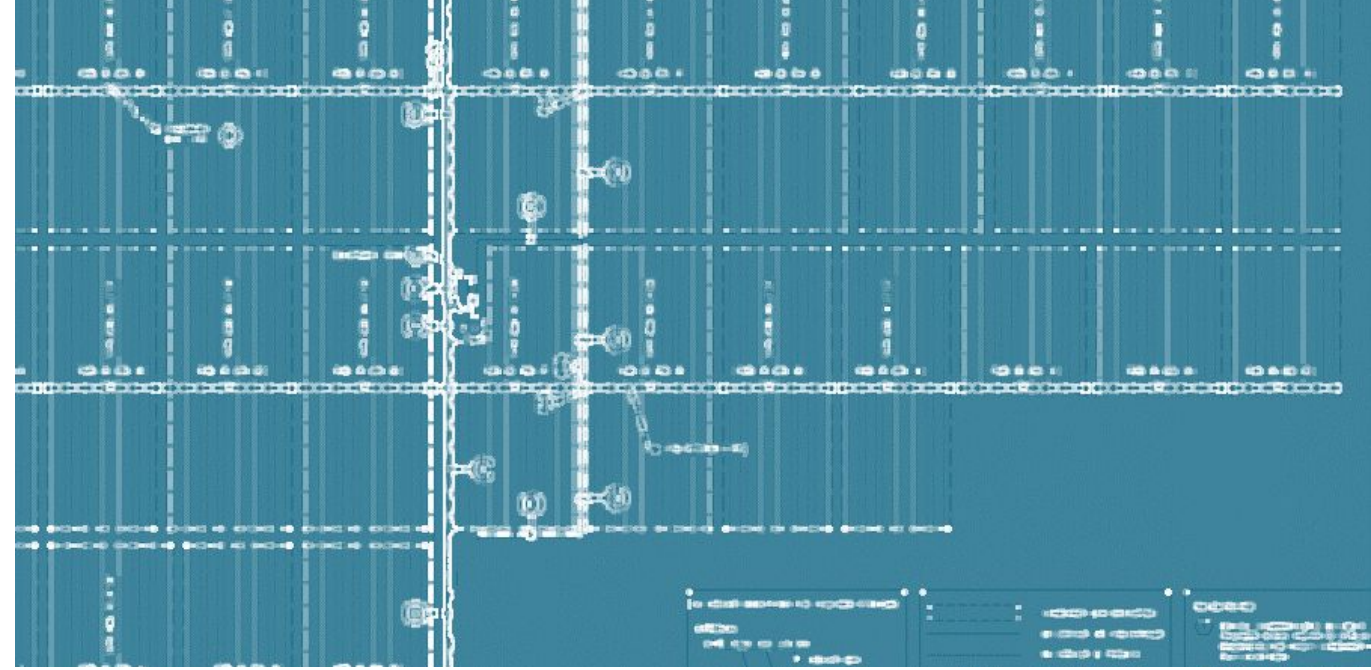
# Financial Assurance Mechanisms

- **Bonds:** Security/Surety/Performance Bonds for the decommissioning cost amount
- **Letter of Credit:** promise issued by a bank to ensure funds
- **Guarantee:** similar financial institution assurance to mitigate risk
- **Other:** traditional means or other agreements



# Decommissioning Financing Best Practices

- Know what you're paying for
- Update costs/values periodically
- Discuss assurance early and determine the what, when and how
- Seek clarity for all stakeholders





# Takeaways from Today

- Renewables aren't slowing...
  - But we need to be ready to address end of life issues as well!
- Decommissioning is a Relatively Straightforward Process...
  - But it's not one size fits all (i.e. THINK LOCAL)!
- Renewables are Getting Cheaper...
  - But end of life costs and how/who pays for it are still important factors!





# Questions? (AND Answers)

Will Kirby, PE, ENV SP  
*Renewables Project Manager*  
HDR | [will.kirby@hdrinc.com](mailto:will.kirby@hdrinc.com)

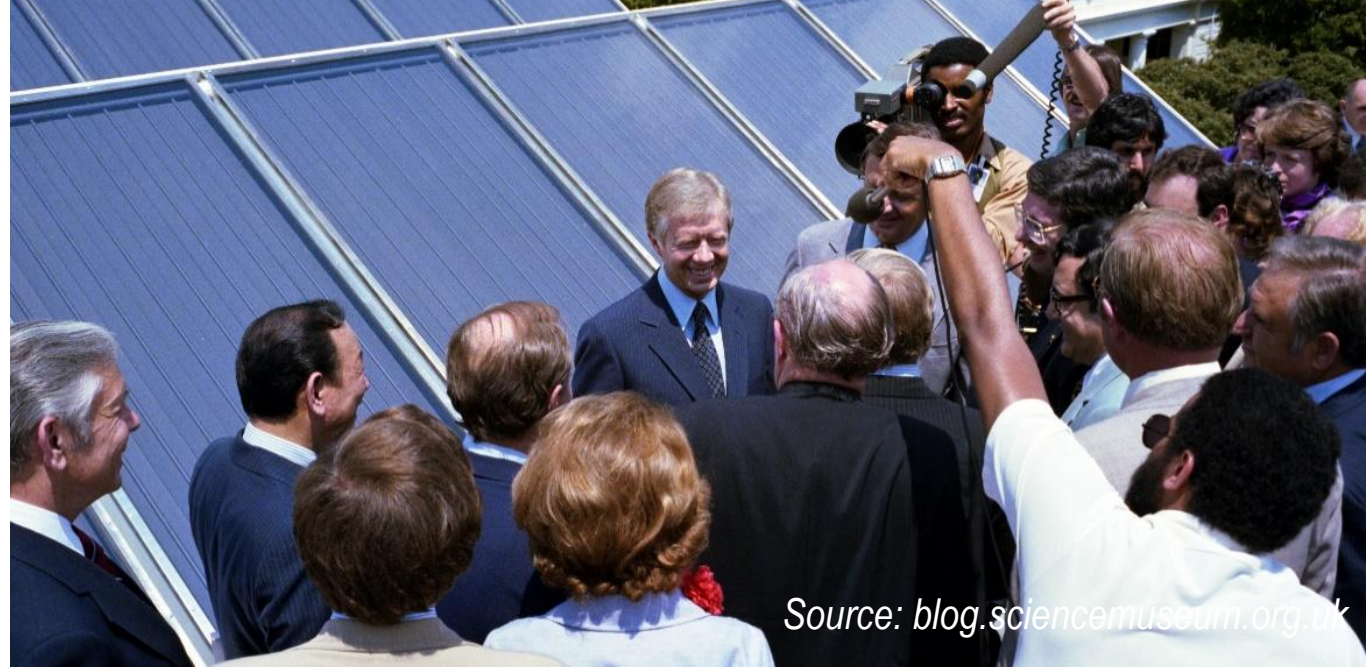




# A (Brief) Modern History of Solar + Policy

- 1977 – DOE created
- 1978 – First solar tax incentives
- 1992 – Commercial ITC Energy Policy Act of 1992
- 2005 – ITC expands and increases
- 2008 – ITC cap removed and extended through 2016
- 2011 – DOE Sunshot Initiative
- 2015 – ITC step-down extended to 2021
- 20XX – What's Next....???

Source: [instituteeforenergyresearch.org](http://instituteeforenergyresearch.org)



Source: [blog.sciencemuseum.org.uk](http://blog.sciencemuseum.org.uk)



Source: [latimes.com](http://latimes.com)



# California State Policies

- Decommissioning for solar easements, including:
  - Financial Securities
  - Restoration of Land
  - Mitigation Measures
    - Environmental Impact Report
    - Monitoring and Reporting

Source: [leginfo.legislature.ca.gov](http://leginfo.legislature.ca.gov)

