Habitat Friendly Solar Summit

Board of Water and Soil Resources Workshop

February 2020

GREAT PLAINS INSTITUTE | Better Energy. Better World.

Agenda

1. Why solar in Minnesota?
2. Minnesota solar resources and markets
3. Solar development as development: How projects happen
4. Benefits, Co-Benefits, Risks


TRANSFORMING THE ENERGY
SYSTEM TO BENEFIT THE
ECONOMY AND ENVIRONMENT.
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If you remember one thing…

Renewable energy development is a significant growth industry that will play an increasingly prominent role in land use and economic development decision making.

Photo credit: NREL InSPIRE, Flickr

Photo credit: NREL InSPIRE, Flickr

If you remember two things…

Renewable energy development is a land use and economic choice, like any other type of development

- ✓ Investment in the community with economic returns; taxes, rents, jobs
- ✓ Part of the bundle of individual property rights
- ✓ Land use creating synergies or conflicts with other land uses and local resources

The community can shape siting and site design to maximize benefits and minimize risks

Why Solar In Minnesota?

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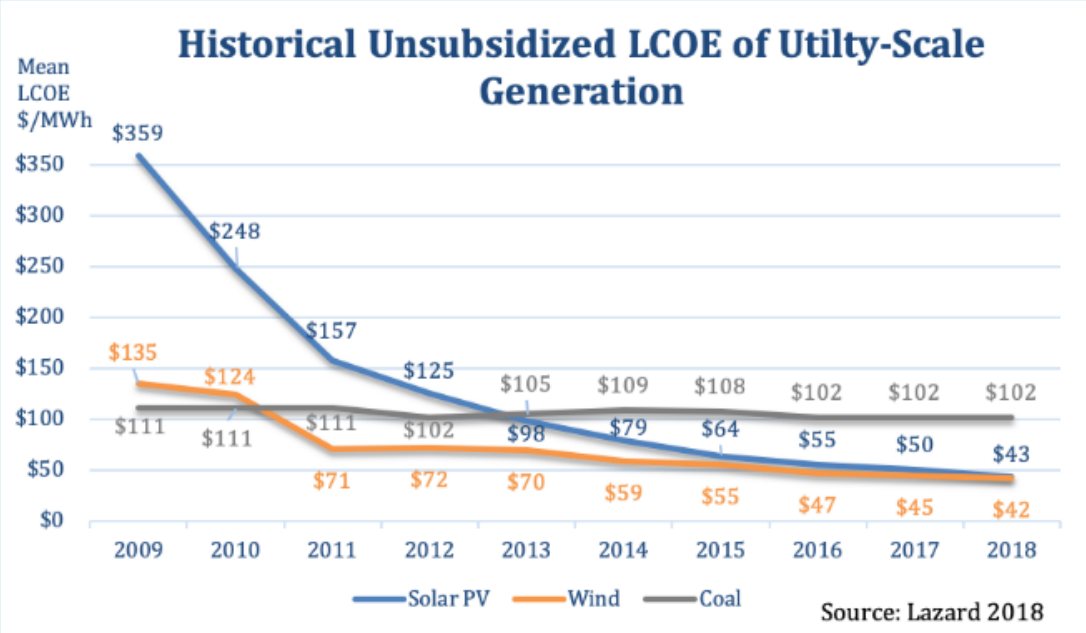
Why Solar Now?

- Renewable energy technologies have an increasingly prominent role in energy systems and production
- Utility-scale **wind** energy is the cheapest form of electric generation in the world, and the cost continues to go down
- Utility-scale **solar** energy is expected to achieve parity with wind in the next couple of years



Source: Advanced Energy Economy, "The numbers are in and Renewable are Winning On Price Alone" https://blog.aee.net/the-numbers-are-in-and-renewables-are-winning-on-price-alone

Different Scales of Solar Development

Utility-Scale Solar

What it is:

- Solar farm, 50MW up to 300 MW
- Operated in the wholesale market, frequently for an electric utility
- Occupies 500 to 3,000 acres per project
- Exempt from local land use controls, permit issued by the PUC

Mid-Scale Solar

What it is:

- Solar farm, 5 MW up to 50 MW
- Operated in the wholesale market, frequently for an electric utility
- Occupies 50 to 500 acres
- Subject to local land use controls

Community-Scale Solar

What it is:

- Community solar garden or combined solar gardens
- Typically 1-5 MW
- Occupies 8-50 acres of land

Small-Scale Solar

What it is:

- Rooftop solar or accessory use
- Usually designed to power an on-site use
- Residential, commercial, industrial

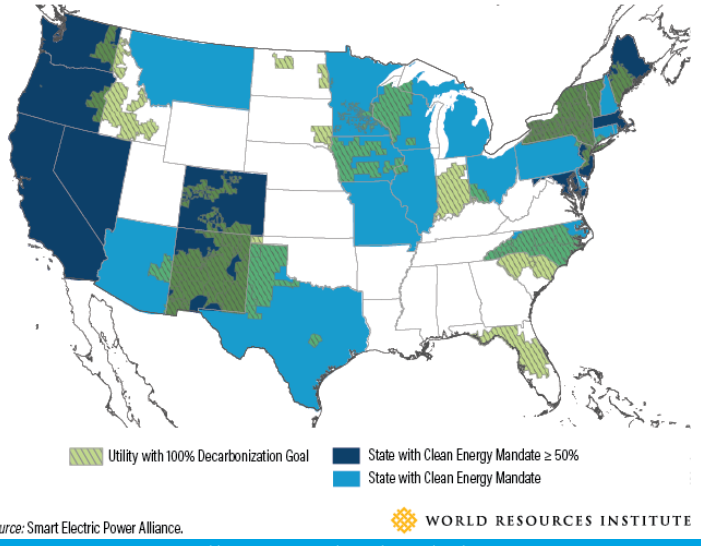
Photo Credit: NREL Image Library, https://images.nrel.gov/bp/#/folder/207405/

Market Demand

- **2018 - Xcel Energy** announces a plan to reduce carbon emissions 80% by 2030, and 100% by 2050
- **2019 – over 20 other utilities** make similar announcements for 80 -100% clean electric generation by 2050
- **Fourteen states** have passed laws or executive orders committing to 100% clean electric generation, including Minnesota, Wisconsin, and Michigan.

Xcel Energy Carbon Reduction Plan

U.S. States with Clean Electricity Mandates & Utilities with Decarbonization Goals, 2019



Source: World Resources Institute, SEPA, https://www.wri.org/blog/2019/12/2019-was-watershed-year-clean-energy-commitments-us-states-and-utilities

Solar Development in Minnesota

2007 - Solar energy advocates celebrated a solar development milestone: Minnesota had finally reach a cumulative solar capacity of one megawatt, or enough solar capacity to power approximately 150 homes.

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Photo credit: Brian Ross

Solar Development in Minnesota

2017 - Solar energy advocates celebrated a solar development milestone: Minnesota had installed one megawatt of solar capacity, on average, every 18 hours for the previous year.

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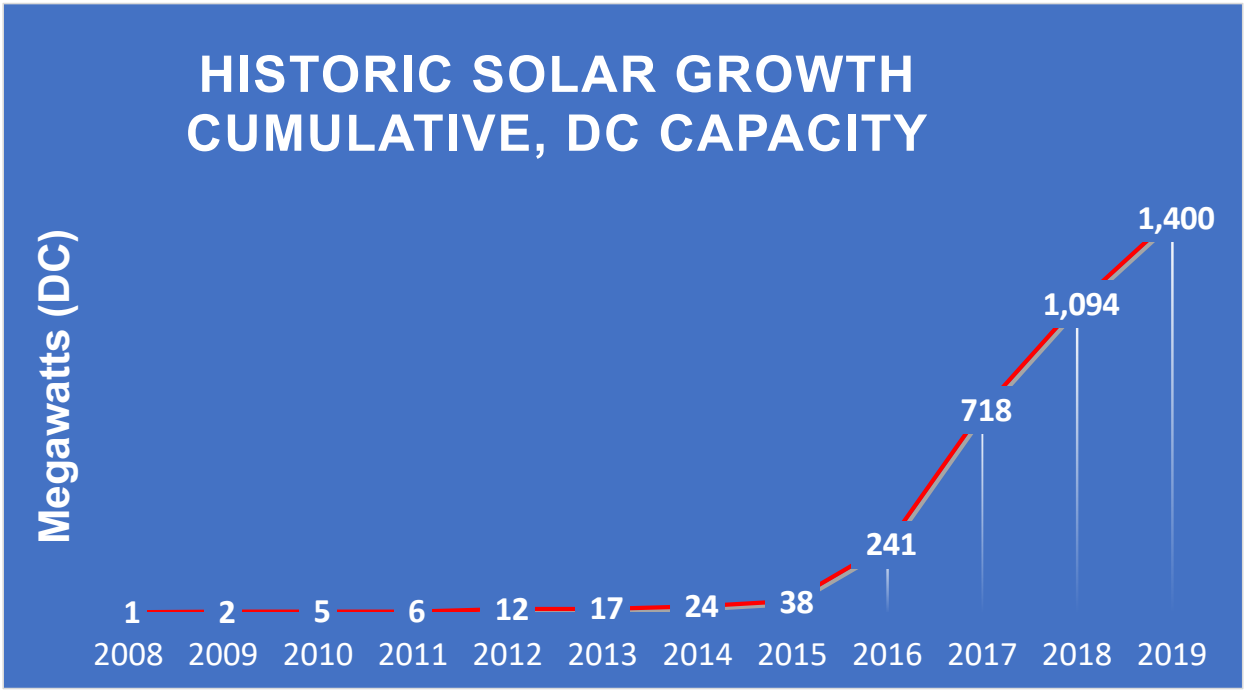
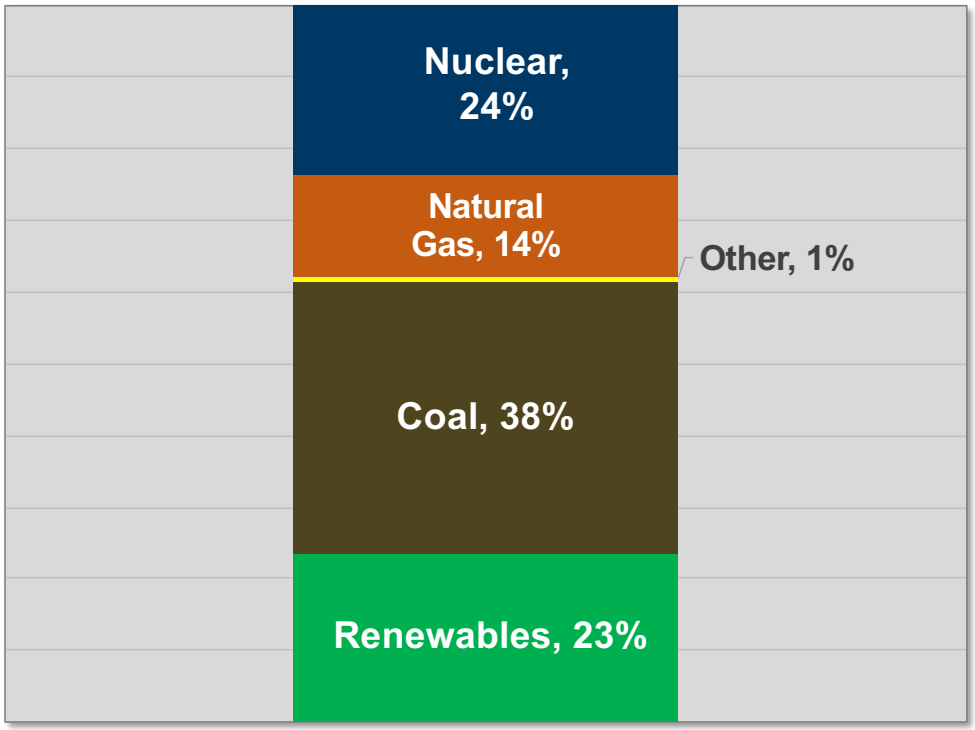
Photo credit: Brian Ross

Solar Energy Annual Growth



Source data: Minnesota Dept of Commerce

Minnesota Net Electricity Generation *(annual 2018)*



The Minnesota Legislature passed renewable energy objectives, requiring 25% of total retail electricity sales to be generated by renewable energy sources by 2025.

As of 2019, we have met the 25% standard goal, but the fuel generation breakdown is yet to be released.

*Other includes non-biogenic municipal solid waste, batteries, chemicals, hydrogen, pitch, purchased steam, sulfur, tire-derived fuels, and miscellaneous technologies, including petroleum.

Source: EIA data on state electricity generation, updated October 2019; available at https://www.eia.gov/electricity/data/state/

Minnesota Solar Resources and Markets

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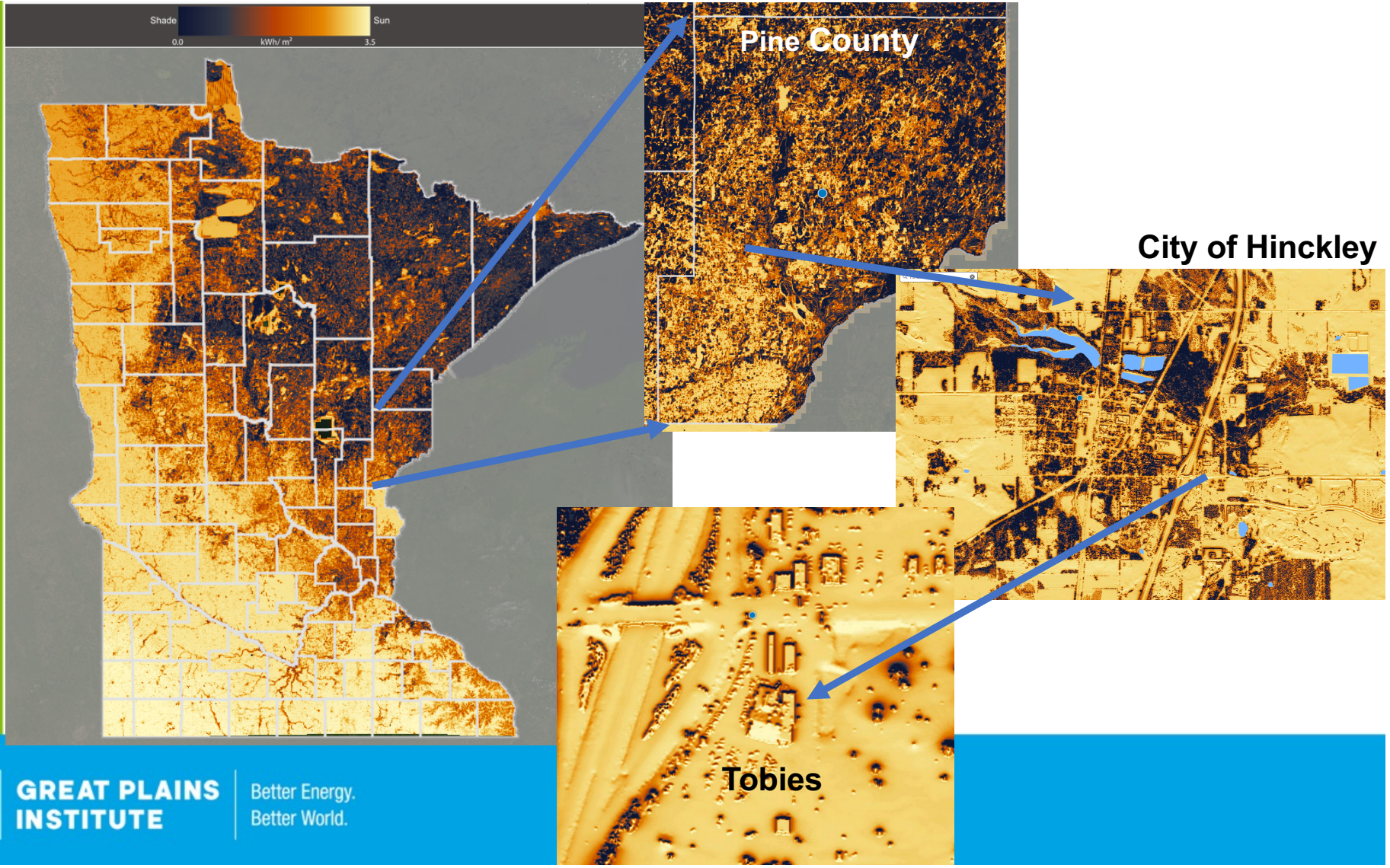
Minnesota Solar Resource



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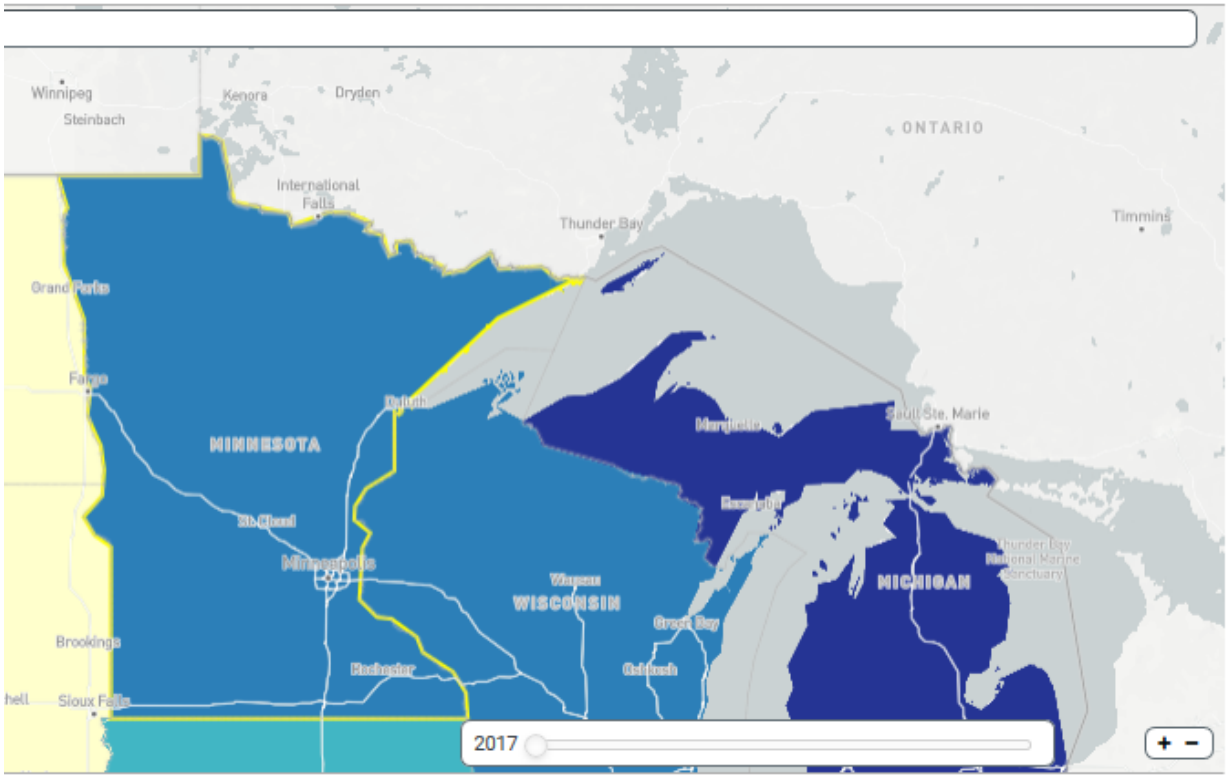
State and Local Planning for Energy (SLOPE)



Energy Consumption
- Net Electricity & Natural Gas Consumption
- Electricity & Natural Gas Dollars Spent

Demographics
- Population

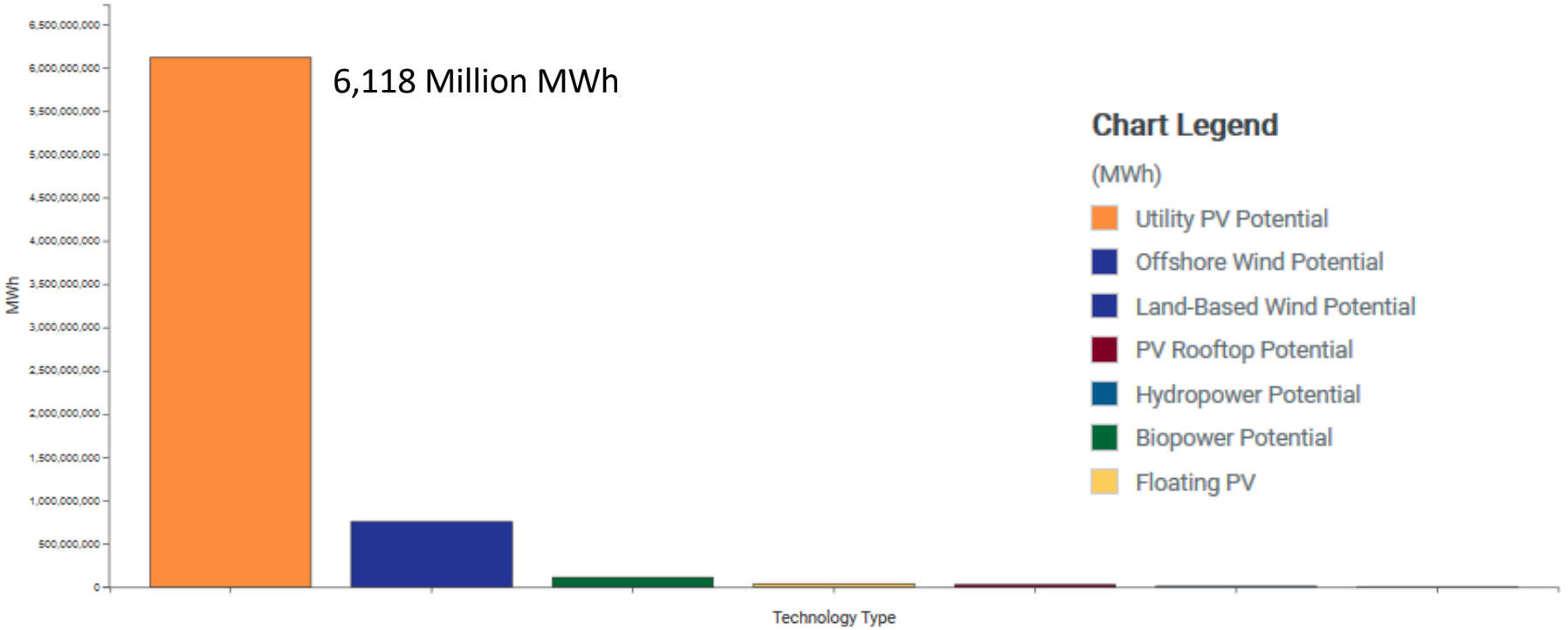
Energy Efficiency
- Economic Potential
- High Achieveable Potential
- Single Family Home Electricity Savings Potential
- Single Family Home Fuel Savings Potential

Commercial Buildings
- Building Count
- Building Square Feet

Renewable Energy Technical Generation Potential
- Utility PV
- Rooftop PV
- Floating PV
- Concentrating Solar Power
- Land-Based Wind
- Offshore Wind
- Biopower
- Geothermal
- Hydropower

Utility Scale Solar

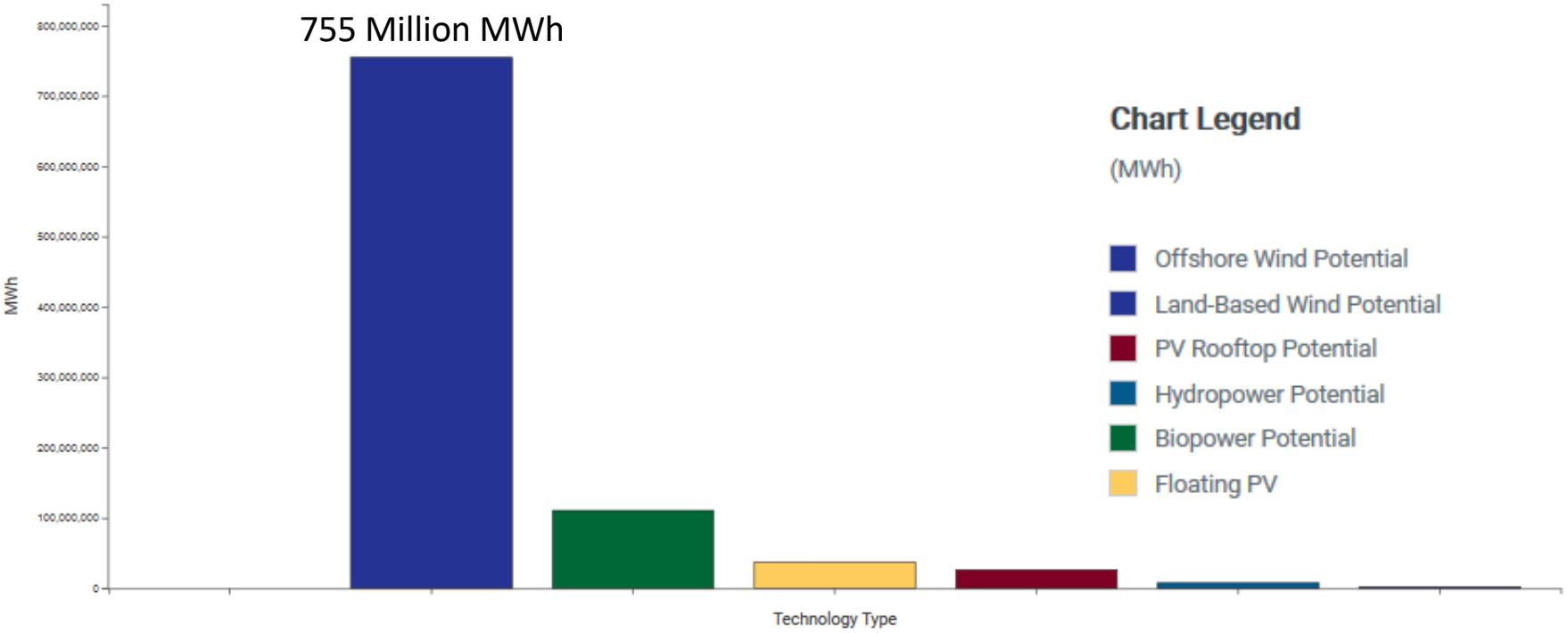
SLOPE shows a total annual energy reserve from utility scale solar approximately 90 times the current total annual electric usage in the state.



State and Local Planning for Energy, NREL, https://gds.nrel.gov/slope

Wind Energy Potential

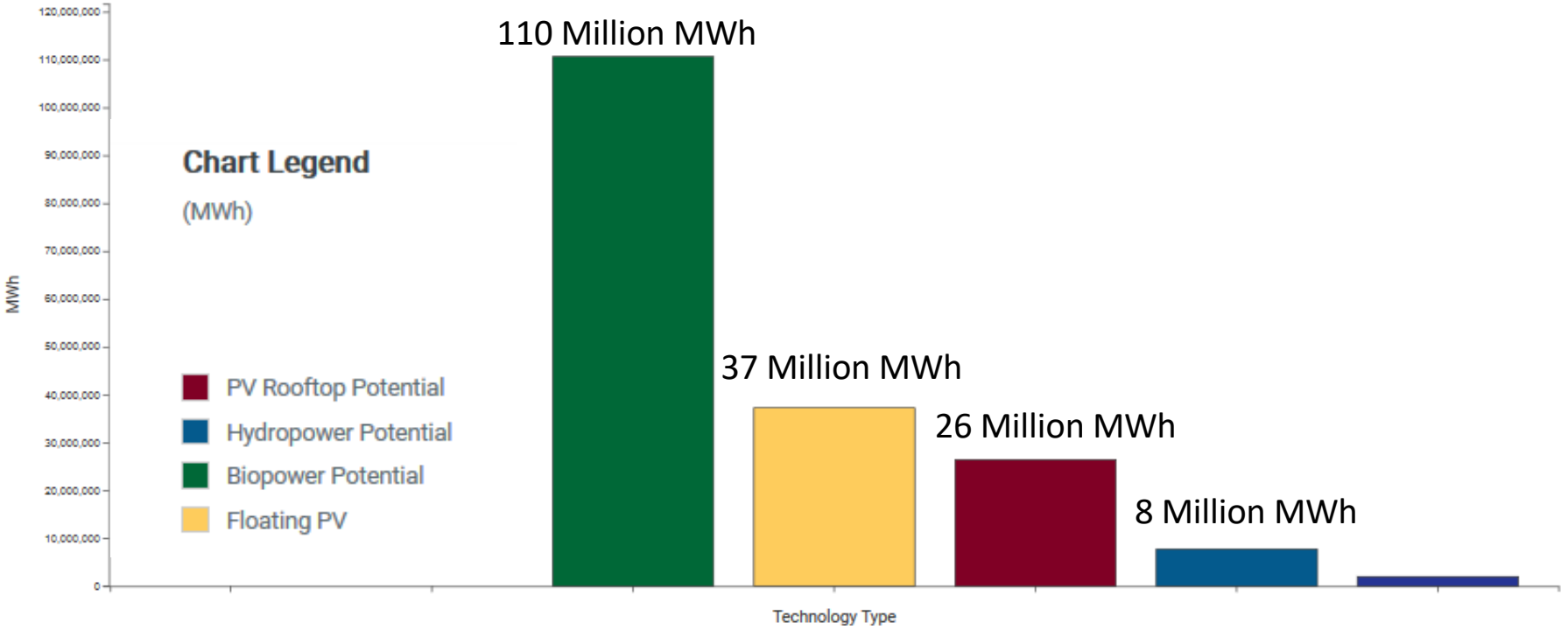
Wind energy has an annual potential production of 755 million MWhs, or approximately 11 times the total annual electric usage in the state.



State and Local Planning for Energy, NREL, https://gds.nrel.gov/slope

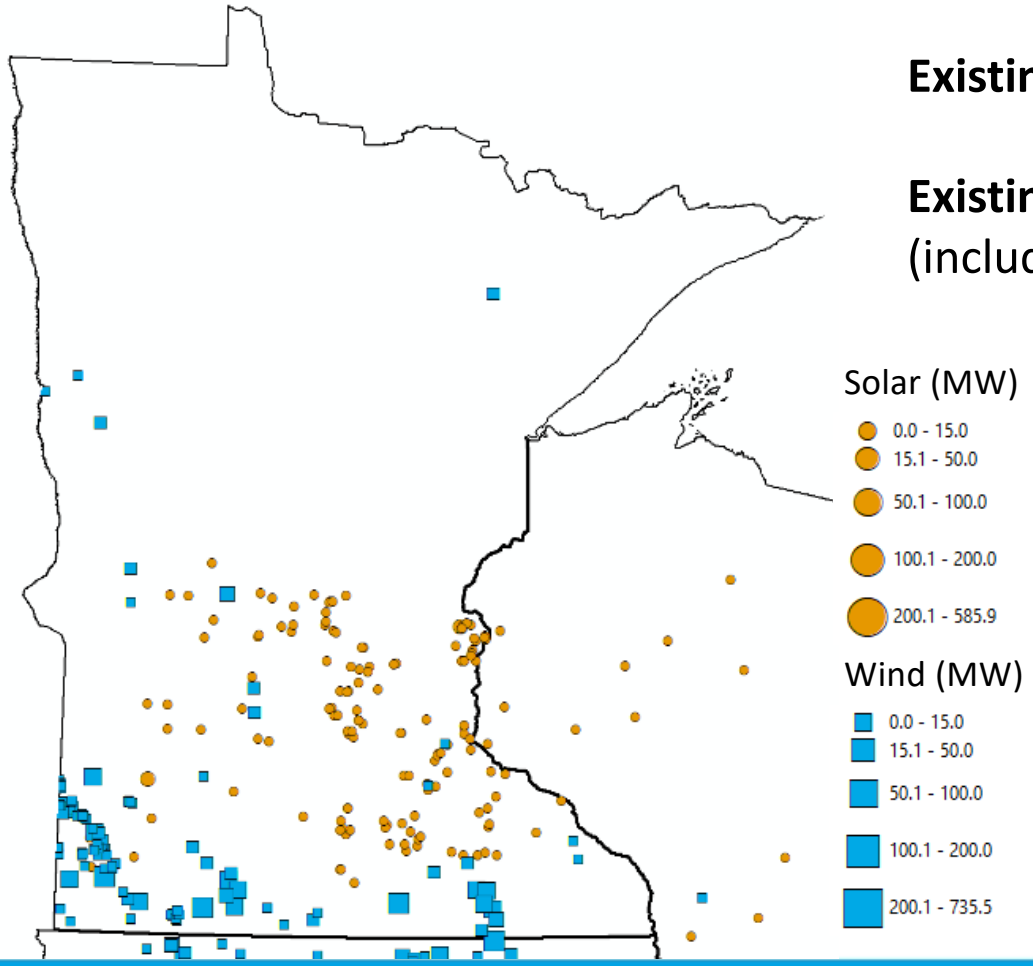
Other Renewable Potential

- ✓ Biomass – approximately 150% of current annual electric use
- ✓ Floating solar – 54%
- ✓ Rooftop solar – 38%
- ✓ Hydropower – 8%



State and Local Planning for Energy, NREL, https://gds.nrel.gov/slope

Existing Wind and Solar

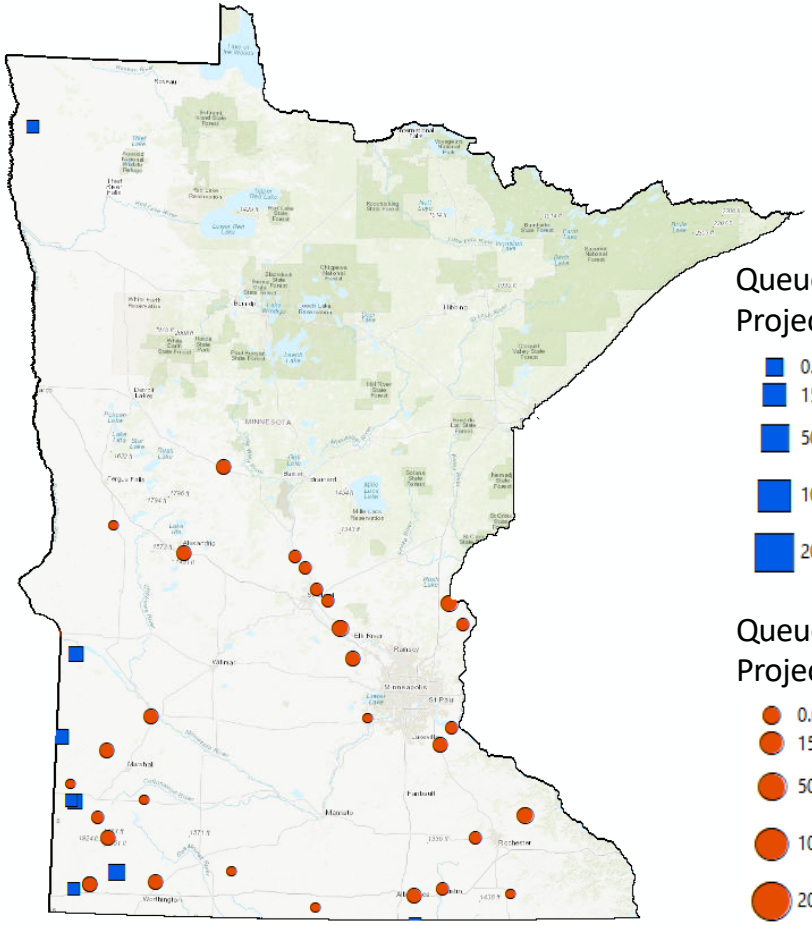


Existing Wind Capacity – 3,845 MW

Existing Solar Capacity – 1,400 MW
(includes distributed solar)

Data source: EIA-860 Form national power dataset, 2018

MISO Queue



Total Solar Capacity in the Queue (MN, Feb, 2020): 4,510 MW

Total Wind Capacity in the Queue (MN, Feb, 2020): 2,979 MW

Data source: MISO Interconnection Queue, January 2020 (for map), February 2020 (for MW)

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The Midwest's solar future will be unlike anything seen before

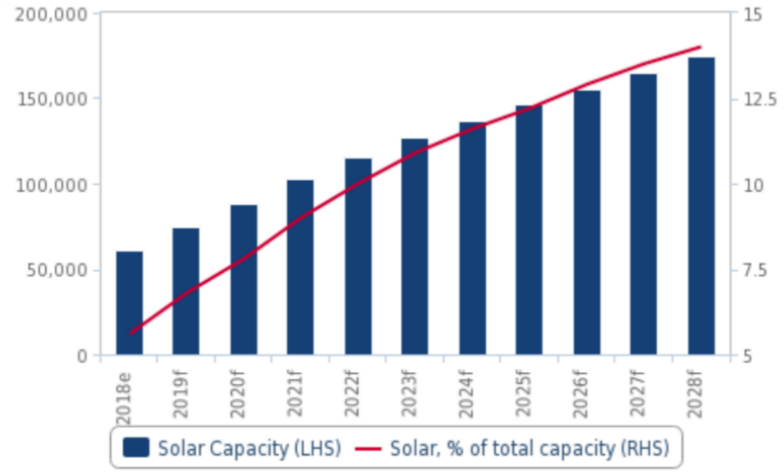
Fitch Solutions Marco Research has boldly predicted the region will be a main driver towards the 100 GW of solar power capacity expected to hit the U.S. over the next 10 years. The procurmeent will be led by city and utility commitments to renewable energy, the falling costs of solar and the continued expansion of popular community solar programs.

OCTOBER 11, 2019 TIM SYLVIA

ACQUISITIONS BUSINESS GRIDS & INTEGRATION INSTALLATIONS MARKETS MARKETS & POLICY PROCUREMENT TECHNOLOGY UTILITY-SCALE PV UNITED STATES

Capacity Growth In Midwest To Boost Overall US Solar Sector Outlook

US - Installed Solar Power Capacity, MW (LHS) & Share Of Solar In Total Installed Capacity (RHS)



e/f = Fitch Solutions estimates/forecasts. Source: EIA, Fitch Solutions


How Projects Happen: Siting Authority and Minnesota Context
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Siting Authority

FEDERAL, STATE & LOCAL ROLES		STATE	LOCAL
Solar	Regulating authority for access to direct sunlight for solar energy systems		X
	Environmental review for solar systems equal to or greater than 50 MW*	X	
	Permitting for solar systems less than 50 MW		X

Counties in Minnesota have land use authority and approval control for all solar energy projects with a total energy capacity of less than 50 MW.

Some exceptions are permitted, such as projects that are divided across multiple sites, and projects where both developer and local government agree handle the siting.

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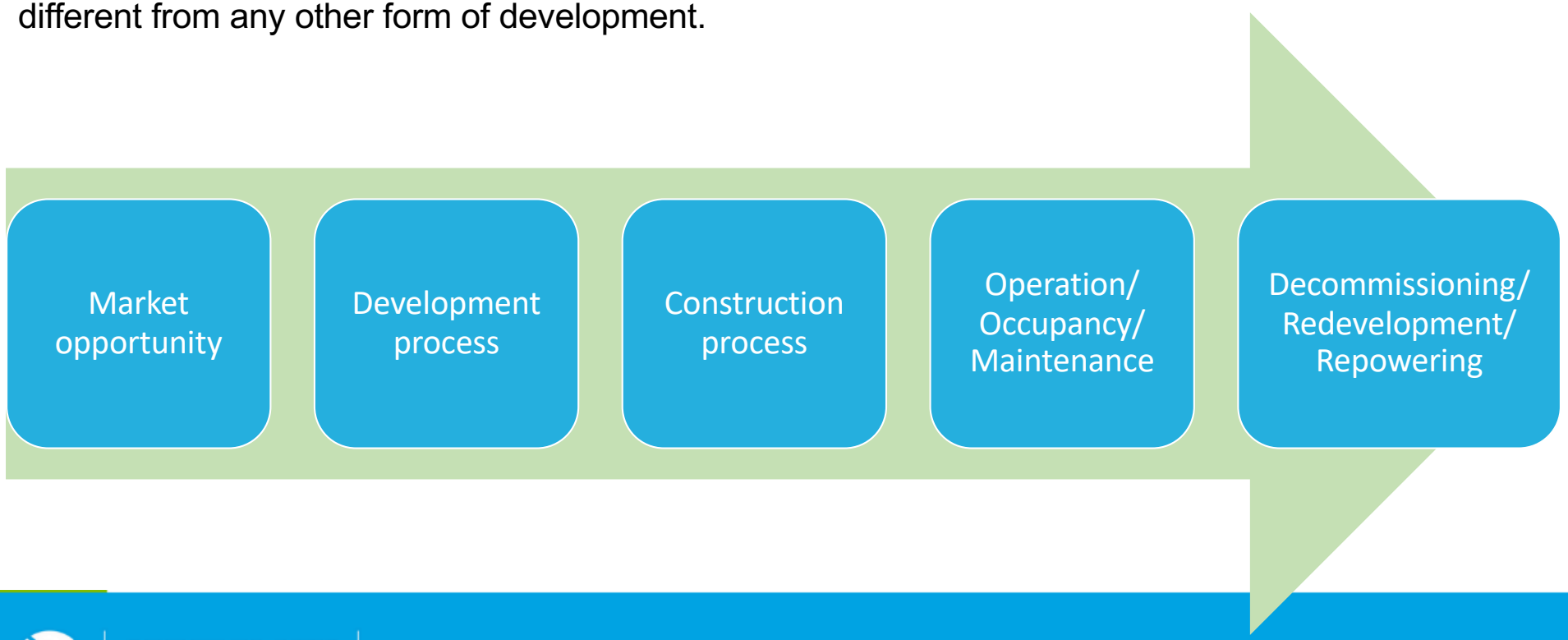
Photo credit: Katharine Chute

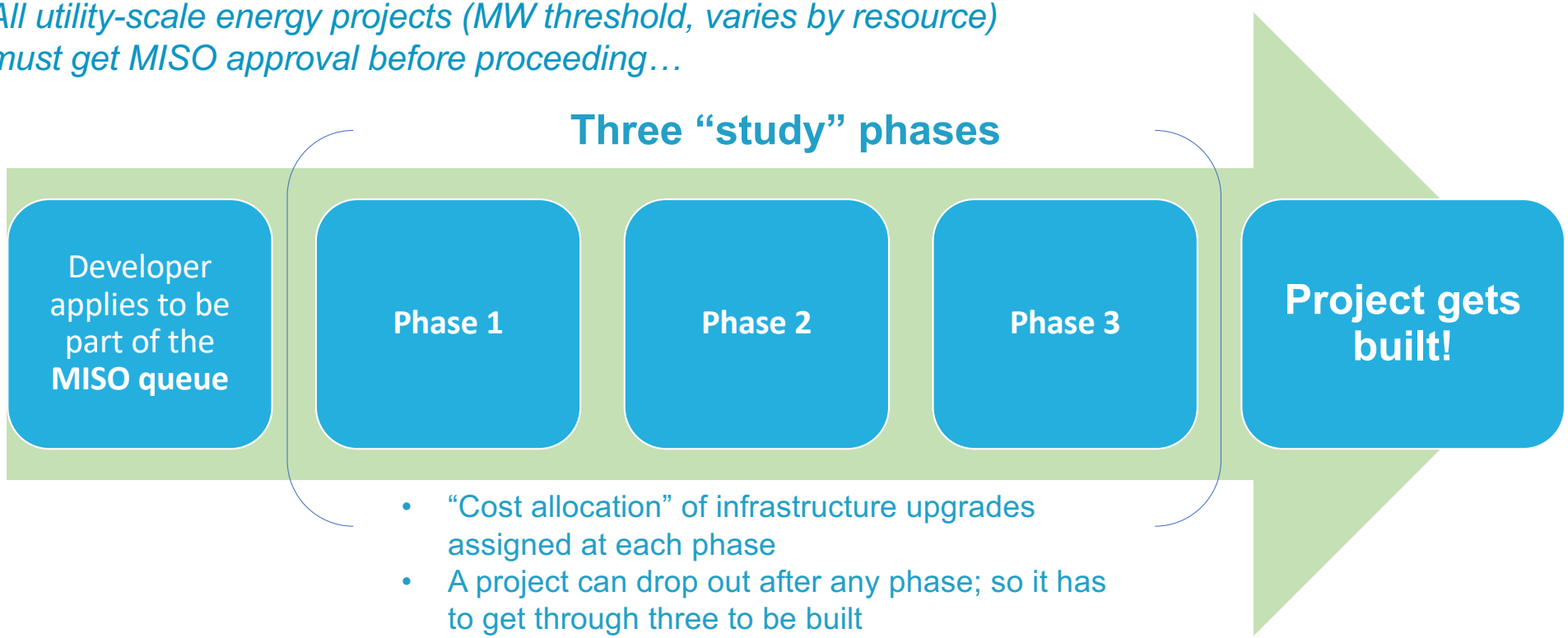
Lifecycle of Development

Renewable energy development is not conceptually different from any other form of development.



Midcontinent Independent System Operator (MISO) General Interconnection Process

All utility-scale energy projects (MW threshold, varies by resource) must get MISO approval before proceeding…



Source: https://www.misoenergy.org/api/documents/getbyname/GI%20Process%20Flow%20Diagram.pdf

Lifecycle of Development

Renewable energy development participants are not conceptually different from any other form of development. . .

1. **Financier**
2. **Developer**
3. **Regulators (state and/or local)**
4. **Contractor (EPC)**
5. **Owner/Manager 1**
6. **Market participants (products/services)**
7. **Owner/Manager 2**
8. **Market participants**
9. **Owner/Manager 3 . . .**

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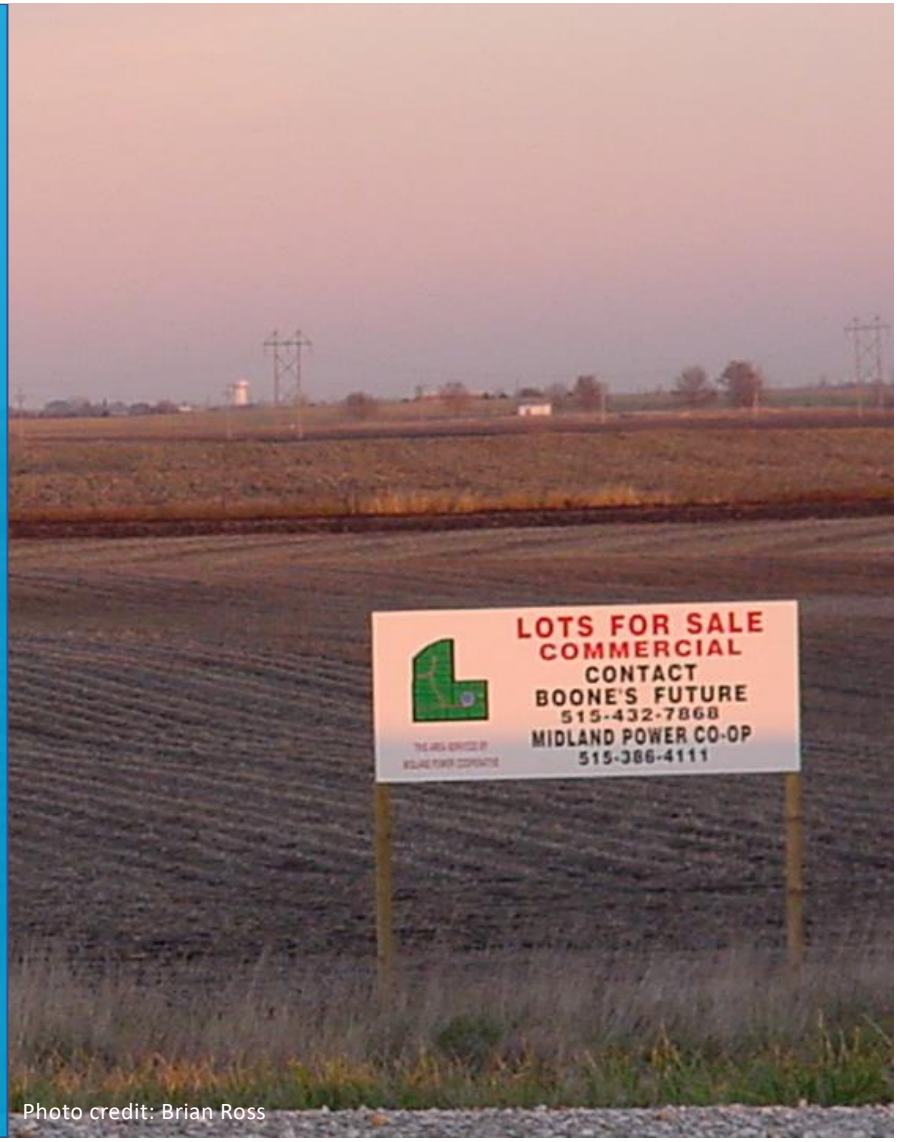

Photo credit: Brian Ross


Benefits, Co-Benefits, Risks
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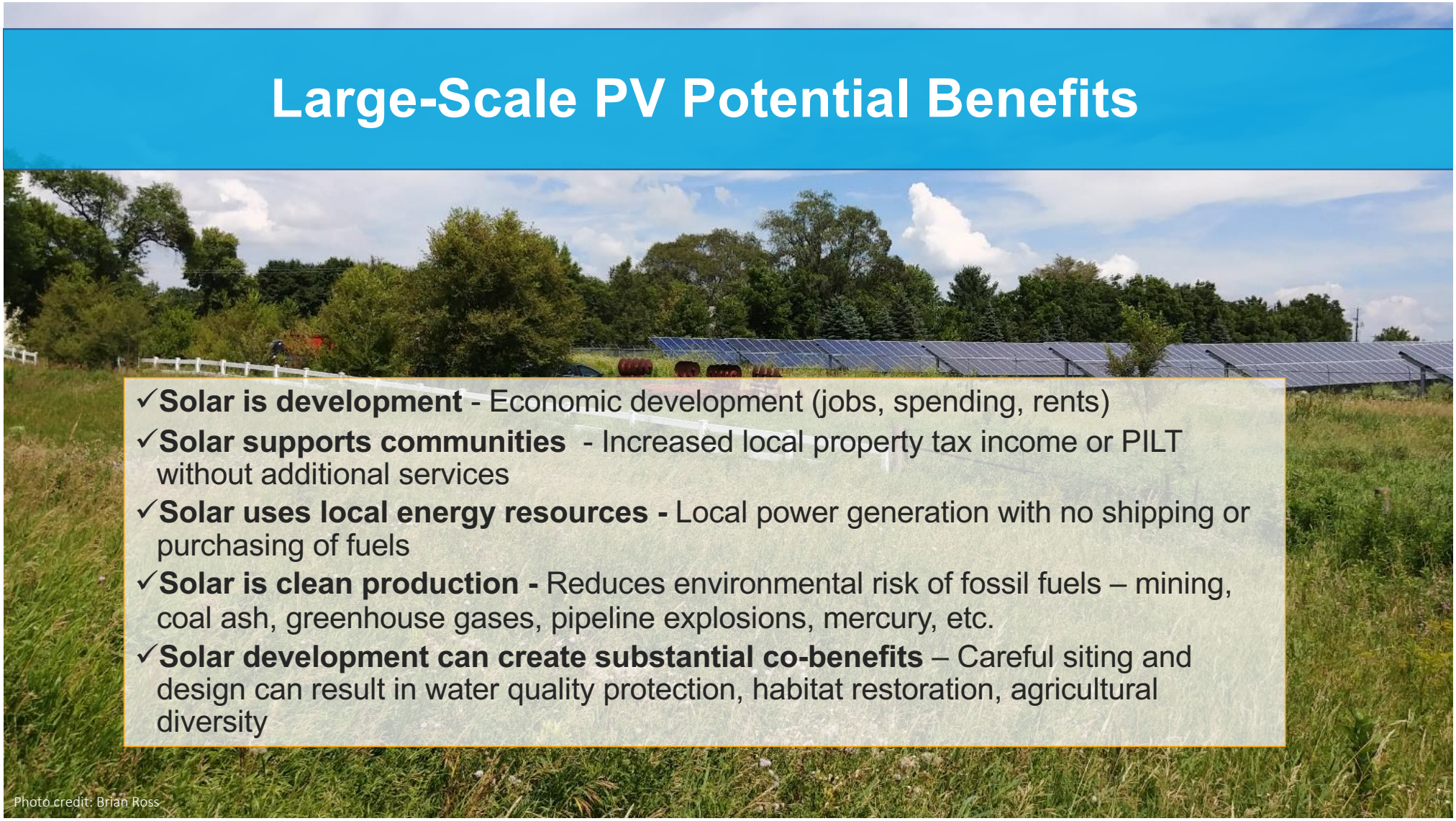
Large-Scale PV Potential Benefits



- ✓**Solar is development** - Economic development (jobs, spending, rents)
- ✓**Solar supports communities** - Increased local property tax income or PILT without additional services
- ✓**Solar uses local energy resources -** Local power generation with no shipping or purchasing of fuels
- ✓**Solar is clean production -** Reduces environmental risk of fossil fuels – mining, coal ash, greenhouse gases, pipeline explosions, mercury, etc.
- ✓**Solar development can create substantial co-benefits** – Careful siting and design can result in water quality protection, habitat restoration, agricultural diversity

Photo credit: Brian Ross

Risks….

Solar Development is Development

Potential conflicts with other resources or development goals:

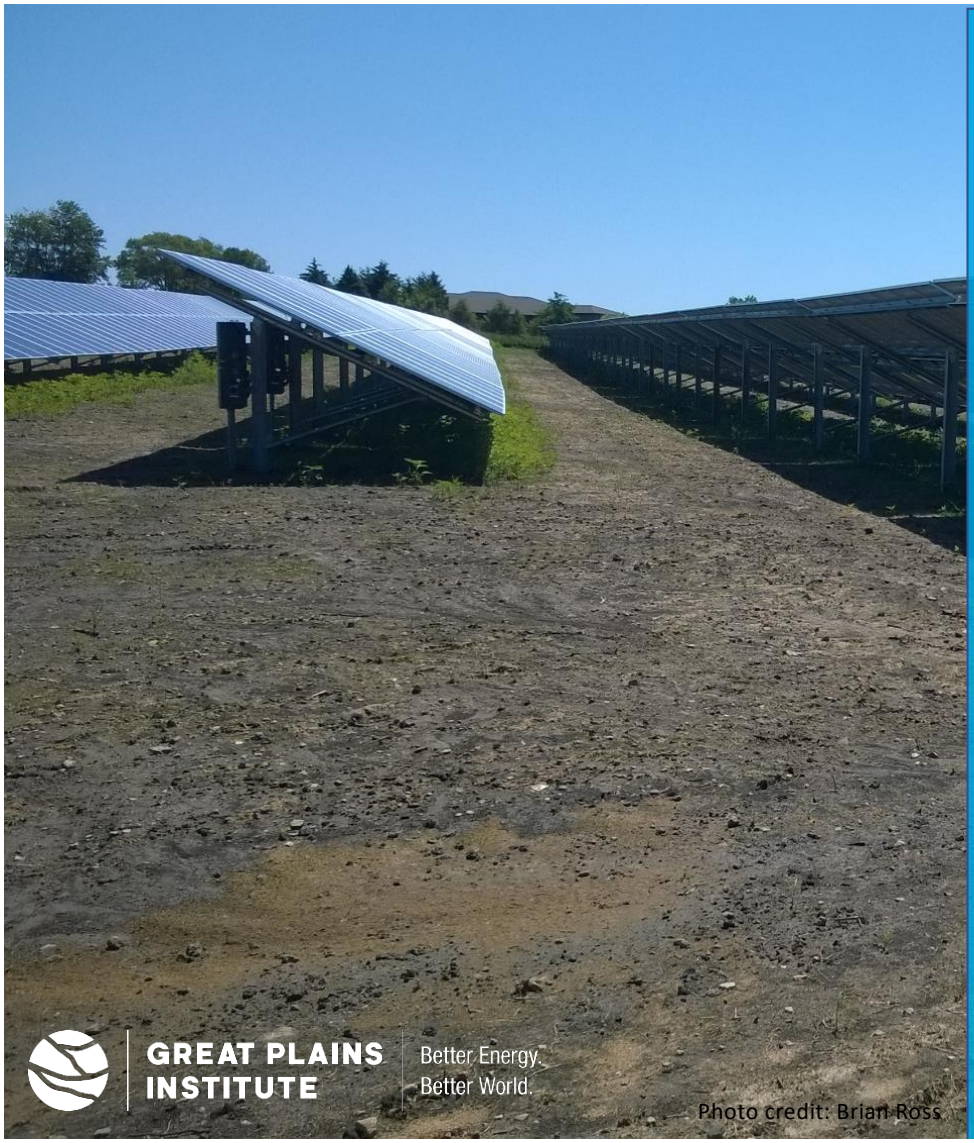
- ✓ Urban forests
- ✓ Historic resources
- ✓ Development, redevelopment, density
- ✓ Natural areas and habitat
- ✓ Aesthetics/character/viewsheds
- ✓ Agricultural practices
  - Loss of prime agricultural soils
  - Loss of local productive capacity
  - Fragmentation of land

Capturing Co-Benefits, Minimizing Risks

With appropriate development guidance, both small and large-scale solar development can provide new opportunities while minimizing nuisances or cross-property impacts.

- Agricultural opportunities – Diversified income stream for agricultural operators, co-located ag production, pollinator benefits for nearby crops
- Water quality protection – Perennial ground cover that reduces runoff, soil conservation, vegetated wetland and waterway buffers
- Habitat value – Pollinators, small mammals, birds, reptiles

Photo credit: Prairie Restorations



Conventional Solar

Conventional Site Preparation:

- ✓Clearing and grubbing of soil and roots
- ✓Topsoil stripping and stockpiling
- ✓Land grading and leveling utilizing heavy machinery
- ✓Soil compaction utilizing heavy machinery
- ✓Land footprint for the foundations of vertical support structures, often including concrete
- ✓Vegetation that supports habitat is discouraged and removed
- ✓O&M activities include herbicide spraying, mowing of weeds and other vegetation

Source: NREL Low Impact Solar Development Basics
https://openei.org/wiki/InSPIRE/Basics

Low Impact Development

Systems and practices that use or mimic natural processes that result in the infiltration, evapotranspiration or use of stormwater in order to protect water quality and associated aquatic habitat.

Source: U.S. EPA, https://www.epa.gov/nps/urban-runoff-low-impact-development

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Low Impact Solar

1. **Existing vegetation is left intact** or is replaced with low-growing native vegetation species or crops
2. **Existing topsoil is left in place** to allow for the successful growth of native vegetation and to promote soil health post-decommissioning of the solar project
3. **Natural contours of land are worked into the** design and configuration of the solar project, with minimal if any land grading required
4. Soil and vegetation are left intact to facilitate the growth of native vegetation, **improved stormwater management through less runoff and erosion**, and soil health
5. **Lower land footprint for foundations** of vertical support structures, often driven piles
6. **Vegetation that supports habitat** (e.g., pollinator species, other native fauna) is encouraged
7. **Minimal O&M activities** due to low-growing native vegetation species, could involve livestock grazing

Source: NREL Low Impact Solar Development Basics https://openei.org/wiki/InSPIRE/Basics

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Photo credit: Brian Ross

Conservation development is a controlled-growth land use development that adopts the principle for allowing limited sustainable development while protecting the area's natural environmental features in perpetuity, including preserving open space landscape and vista, protecting farmland or natural habitats for wildlife, and maintaining the character of rural communities.

Source: Wikipedia, https://en.wikipedia.org/wiki/Conservation_development

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Green Infrastructure "refers to the network of natural lands across the landscape – forests, wetlands, stream corridors, grasslands – that work together as a whole to provide ecological benefits. This broad definition includes both landscape-scale natural features and site-scale practices ranging from reduction of impervious cover to stormwater best management practices (BMPs), such as bioretention and stormwater wetlands, and everything in between…"

Source: **Hye Yeong Kwon, Executive Director,** Center for Watershed Protection

Field tests at the InSPIRE test site in Minnesota, *Photo Credit: NREL Flickr InSPIRE Minnesota Album*

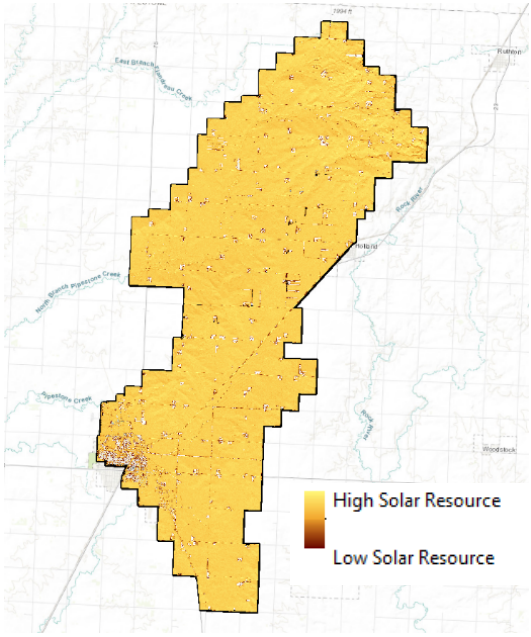
Drinking Water Protection

Lincoln-Pipestone Rural Water Supply

Opportunity: High

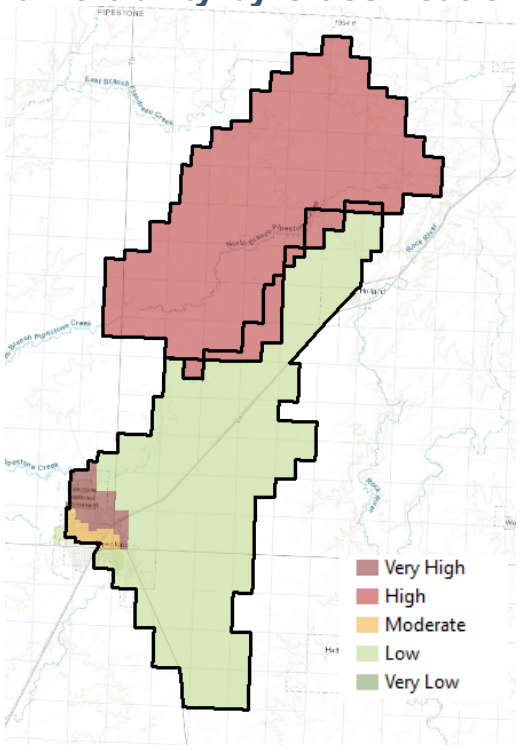
Total Acreage: 49,890.1 acres

Solar Resource



Capacity (MW)	Generation (MWh)
17,019.1	22,124,820

Vulnerability by Classification



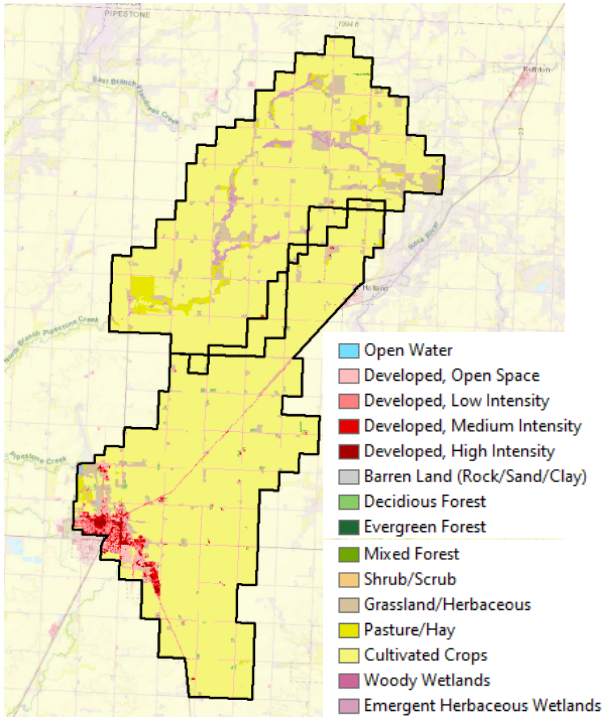
Vulnerability	Total Acreage
Very High	3,245.7 (6.5%)
High	23,473.7 (47.1%)
Moderate	462.4 (0.9%)
Low	24,813.0 (49.7%)
Very Low	0 (0.0%)

Drinking Water Protection

Opportunity: High

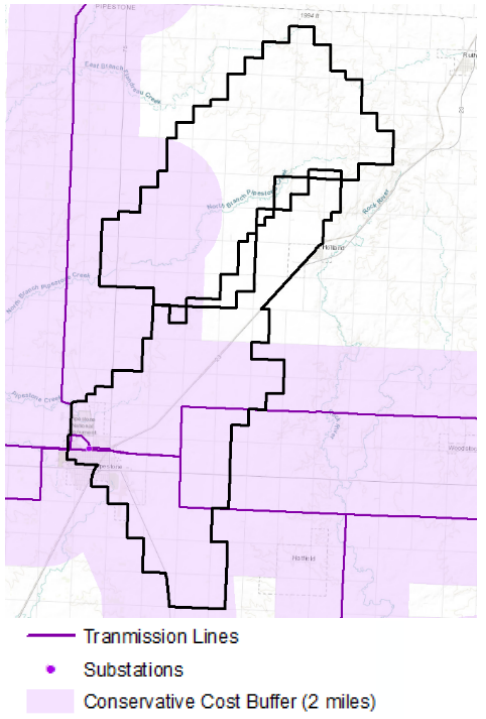
Total Acreage: 59,295.6 acres

Land Cover

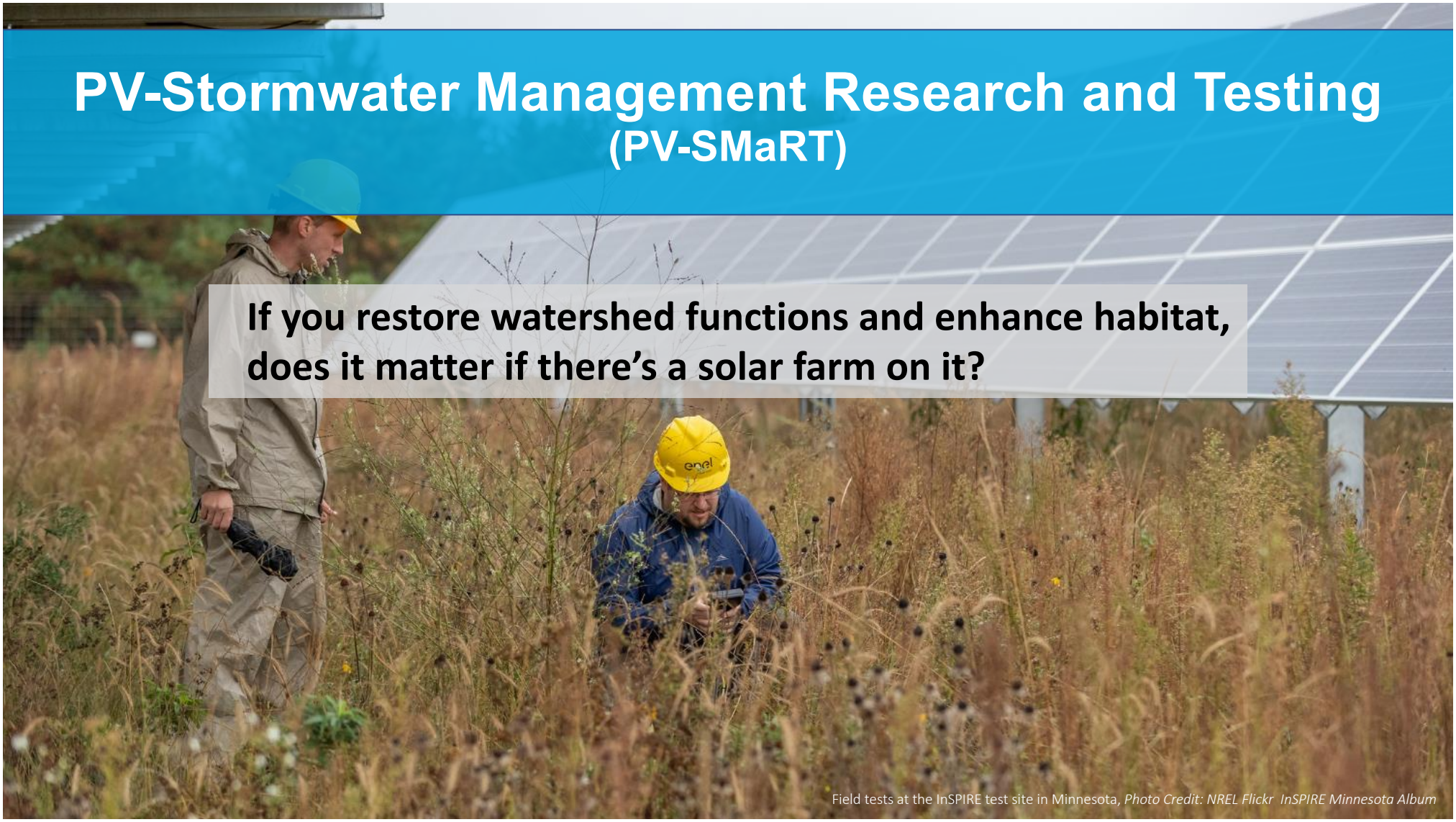


Cover Type	Percent
Developed, Open Space	4.3%
Herbaceous	6.3%
Hay/Pasture	2.1%
Cultivated Crops	83.3%

Transmission Infrastructure



PV-Stormwater Management Research and Testing
(PV-SMaRT)



Field tests at the InSPIRE test site in Minnesota, *Photo Credit: NREL Flickr InSPIRE Minnesota Album*

PV-Stormwater Management Research and Testing

PV-SMaRT, led by the National Renewable Energy Lab (NREL) with GPI, U of MN, Fresh Energy and funded by the U.S. Department of Energy

- ✓ **The PV-SMaRT project is a national study to create solar farm storm water co-efficients and document compliance pathways to water quality regulation that maximizes water quality benefits and minimizes regulatory uncertainty**
- ✓ **Field testing and subsequent modeling of storm water impacts, infiltration, runoff, and other measurement in a variety of soil conditions, PV array designs, hydrologic regimes, and topography**
- ✓ **Five case study states for evaluating state and local water quality opportunities for compliance pathways and maximizing water quality co-benefits of solar development**
- ✓ **Oregon, Colorado, Minnesota, Georgia, and New York**

Field tests at the InSPIRE test site in Minnesota, *Photo Credit: NREL Flickr InSPIRE Minnesota Album*

Brian Ross, AICP LEED Green Associate

Great Plains Institute

bross@gpisd.net |

cell612-501-1531 | 612-767-7296