

Solar Energy Technology: Policy, Programs, and Possibilities

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Agenda

- Overview of Solar Energy Markets in the US
- Overview of Minnesota renewable policy, markets
- Federal Incentives for Solar
- State policies and programs
- Utility Incentives and programs
- How do you get involved
- Technologies pushing solar forward

National Trends

- Large developments in solar
 - Decreasing costs has lead to rapid growth
 - Solar is a fast growing energy resource in the world, the US and Minnesota
 - Lots of growth = opportunity for new business, jobs, economic activity.
 - Some challenges face the adoption of solar
 - Technical integration
 - Cost and value propositions

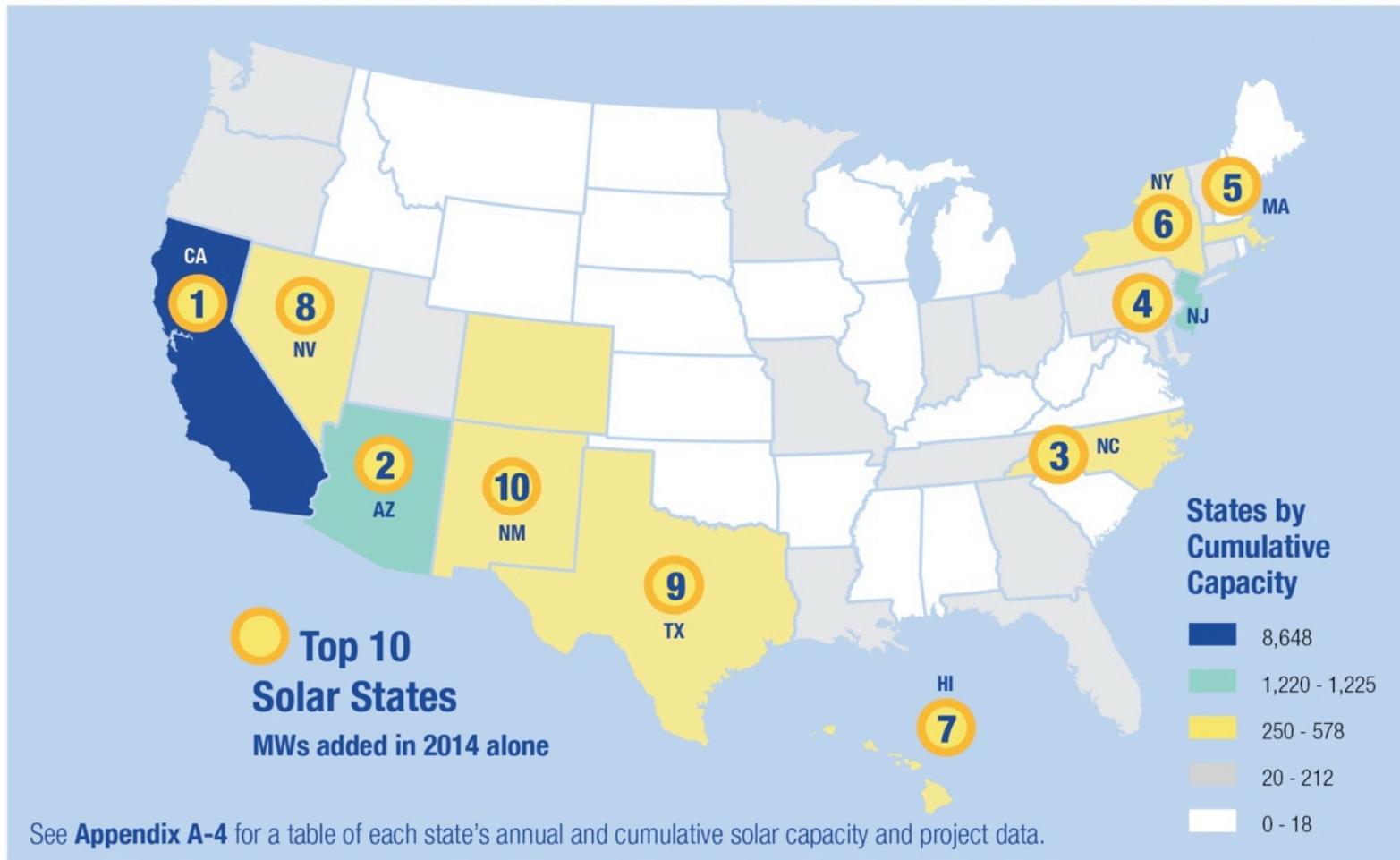
Megawatts



Number of installations



Graphic: SEPA- solar snapshot



Graphic: SEPA solar snapshot

Challenges for Solar

- Cost is still a challenge
- Getting the rate structure right
 - National debates and regulations in flux
 - Net Metering
 - Value of Solar
 - Regulatory proceedings in high penetration states
 - Hawaii, Nevada, California examples
- Advanced inverter technology
 - Enabling high value services to the grid
- Meeting peak demands

Challenges for Solar

- Labor Shortages
- Permitting
- Interconnection issues
- Billing issues

Consumer Affairs Office

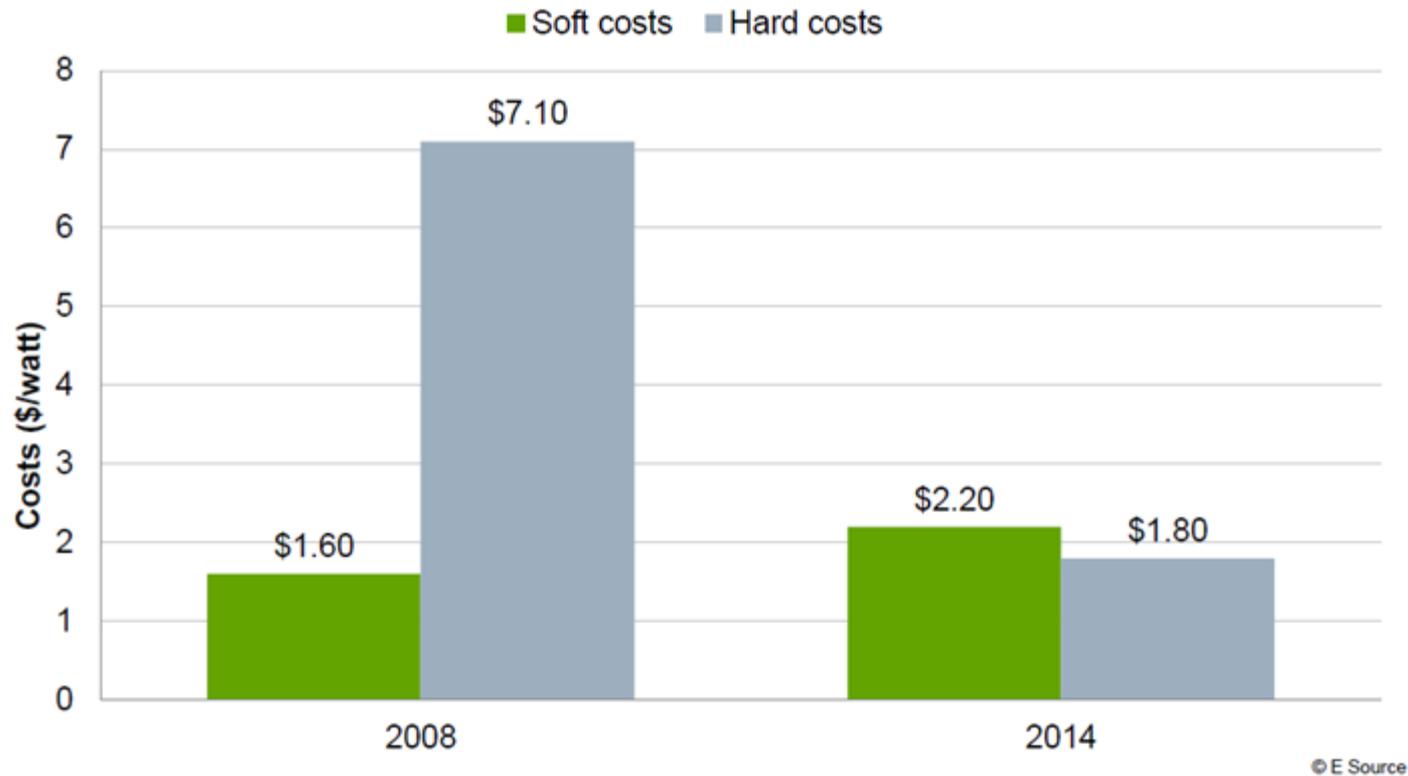
- (651)296-0406 or
1-800-657-3782

consumer.puc@state.mn.us

Department of Labor & Industry

- (651)284-5069 or
1 (800) 342-5354

Challenges for Solar



Federal Investment Tax Credit (ITC)

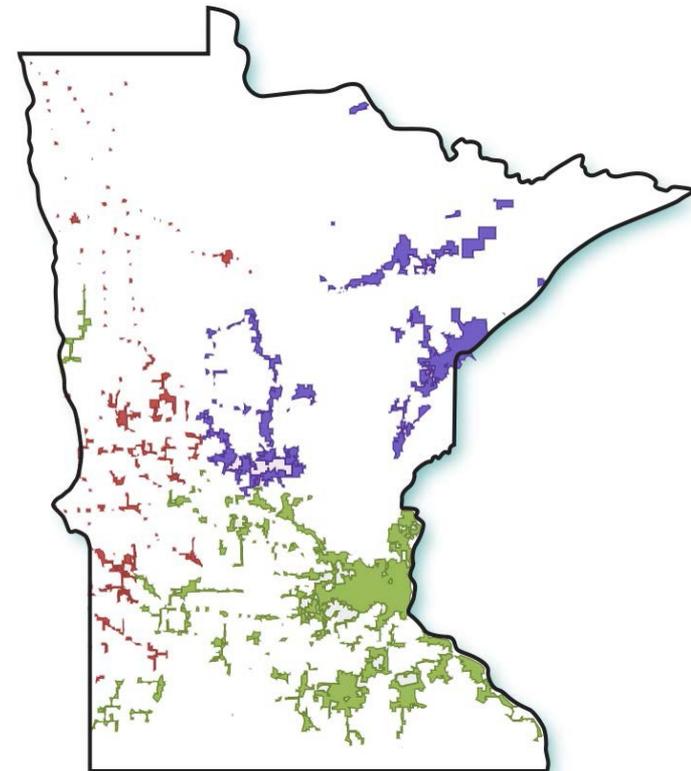
- 30% Federal Tax credit for Commercial and Residential systems in service by 12/31/2019
- Sunset begins in 2020 for commercial systems
 - 2021 – 26%
 - 2022- 22%
 - 2024- 10% (commercial)

Other Federal Programs

- Modified Accelerated Cost Recovery System (MACRS)
 - a depreciation tool to take rapid depreciation of solar assets over a five year window
- REAP Grants- Rural Energy for America Program
 - Up to \$2,500-500,000 grants up to 25% of system cost
 - Up to \$25 million loan up to 75% of system cost
 - Agricultural producers and small businesses in rural areas for energy efficiency and renewable energy projects

Minnesota Renewables

- Minnesota 25% renewable by 2025
- Solar Energy Standard 1.5% x 2020
- New net metering rules
- Community Solar
- Value Of Solar
- Stable Incentives
- **10% x 2030 Goal**



Incentives in Minnesota

- Property Tax Incentive
- Sales Tax Incentive
- Made In Minnesota
- Utility Incentives
 - Minnesota Power
 - Xcel
 - Others

Net Metering

- **Investor owned utilities:**
 - Net metering cap raised to 1 MW in 2013
 - Single-customer meter aggregation on contiguous property
 - No standby charges < 100kW
 - Systems 40 kW - 1,000 kW



Net Metering

- **Cooperative & municipal utilities:** Changes effective July 1, 2015
 - Net metering limit remains 40 kW
 - Net metering fees authorized under certain conditions:

A cooperative ...or municipal utility may charge an additional fee to recover fixed costs not already paid for by the customer through the customer's existing billing. Any additional charge must be reasonable and appropriate based on the most recent cost of service study.

- Customers forfeit excess generation at the end of the year **unless they elect to receive monthly compensation at retail rate**
- Customers interconnected prior to July 1, 2015 unaffected.

Community Solar

- Xcel Energy program is the largest
 - Minimum of 5 subscribers who must be in a contiguous county.
 - A single subscriber may subscribe to 40% of a system
 - Subscribers receive on-bill credit
- 17 co-ops and Moorhead Public Service have community solar programs planned or available now

Community Solar Garden — Coming Summer 2016

Minnesota Power's first community solar garden, planned for 2016, will be a simple way for customers to participate in solar without the need to install a system on their own home or business. It's a safe, flexible, and convenient choice for customers who want to go solar but either rent or don't have a location that is well-suited to generating electricity from the sun.



Customers will have three options for participating*

OPTION 1

Upfront payment. Subscribers pay a onetime fee and receive a monthly energy credit of kilowatt-hours based on their subscription. This option is most comparable to a traditional rooftop solar installation.

OPTION 2

Fixed monthly subscription fee, which is essentially the upfront payment financed over the length of the contract. The customer receives a bill credit for the energy produced from their subscription. This option is comparable to a traditional rooftop installation financed over time.

OPTION 3

Fixed charge for each kilowatt-hour of solar energy produced from a subscription. The customer purchases all the solar energy produced from their subscribed amount of capacity.

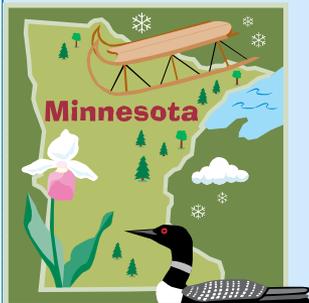
Interested in learning more? Visit mnpower.com/communitysolar, call 218-355-3720, or email solarprogram@mnpower.com

*Subject to approval by the Minnesota Public Utilities Commission (MPUC)

Made in Minnesota Solar

- **Made in Minnesota PV**

- \$15 million/year through 2023
- Xcel Energy, Minnesota Power, Otter Tail Power
- Production Based Incentive (PBI)
- Projects < 40 kW Commercial, < 10 kW Residential
- Applications accepted annually Jan 1 – Feb 28



Solar thermal rebate amounts

Solar Collector

Energy Conservation and Products Solarway
6000

Rural Renewable Energy Alliance (RREAL)* Solar
Powered Furnace (SPF) 26,
SPF 32, SPF 40

Rural Renewable Energy Alliance (RREAL)* Solar
Wall transpired air system

Commercial Properties

The lesser of 25% of the
installed cost of a
complete system or
\$25,000

Multi-family Residential

The lesser of 25% of the
installed cost of a
complete system or
\$5,000

Single Family Residential

The lesser of 25% of the
installed cost of a
complete system or
\$2,500

***RREAL stopped producing the Solar Power Furnace in 2015 but they do have a limited inventory still available. Contact RREAL for more information.**

Made in Minnesota Participation Eligibility

- Cannot receive a utility incentive in addition to a Made in Minnesota incentive
- Must be a customer of an investor-owned utility to participate: Minnesota Power, Xcel Energy, Otter Tail Power

Solar PV

- Commercial systems must have a capacity of less than 40 kW and residential systems may have a capacity of up to 10 kW.

Solar Thermal

- The solar thermal systems may be installed in residential and commercial facilities for, among other purposes, water heating, space heating, and pool heating purposes. Open statewide if there are unused incentives.

Xcel Energy Solar* Rewards

- \$5 million annually 2014-2017
- Production Based Incentive of \$.08/kWh paid annually for 10 years
- 20 kW maximum
- Dakota Electric, Rochester, Minnesota Power, Ottertail Power also have small solar programs



SolarSense

- Available for solar photovoltaic (PV) and solar thermal systems
- Lottery application process
 - Closes February 28th

Solar PV

- Capacity-based, tiered rebate
 - \$750/kW base incentive
 - \$250/kW NABCEP certified installer
 - \$250/kW non-profit or tax-exempt customers

Solar Thermal

- Rebate of up to 25% of project costs, not to exceed
 - \$2,000 for residential
 - \$4,000 for 2-3 family units
 - \$10,000 for 4 or more family units
 - \$25,000 for businesses

Incentives Database



The screenshot shows the DSIRE website interface. At the top, there is a red banner with the DSIRE logo and the text "Database of State Incentives for Renewables & Efficiency". To the right of the banner is the U.S. Department of Energy logo and the IRE logo. Below the banner is a navigation menu with links for Home, Glossary, Links, FAQs, Contact, and About. The main content area features a "DSIRE SOLAR" logo with a play button icon and the text "solar policy information". To the right of this is a map of Minnesota and the heading "MINNESOTA RESIDENTIAL INCENTIVES" with the subtitle "Incentives/Policies for Renewable Energy". Below the heading is a link "See All Summaries". A "Resources" sidebar on the left lists: RPS Data, Summary Maps, Summary Tables, Library, What's New?, and Search. The main content area is titled "Financial Incentives" and lists several programs:

- Local Loan Program
 - [City of Duluth - Residential Energy Efficiency Loan Program](#)
- Local Rebate Program
 - [City of Duluth - Residential Energy Efficiency Rebate Program](#)
- PACE Financing
 - [Local Option - Energy Improvement Financing Programs](#)
- Performance-Based Incentive
 - [Made in Minnesota Solar Energy Production Incentive](#)
 - [Renewable Energy Production Incentive](#)
 - [Value of Solar Tariff](#)
 - [Xcel Energy - Solar Production Incentive](#)

www.dsireusa.org

NABCEP Certification

- North American Board of Certified Energy Practitioners (NABCEP)
- www.nabcep.org
- Certification offers the public a high degree of protection because practitioners have to voluntarily meet standards and qualifications and pass an exam.
- Requirements for becoming NABCEP certified
 - Installation experience and classroom requirements
 - Detailed information for different track available online

Minnesota Educators

- Hibbing Community College Program:
 - Solar PV Technician Program
 - 25 credit course gets you test ready for NABCEP certificate of knowledge
- Century College
 - Advanced Solar PV Energy Systems
 - 30 credit requirement
 - Tests for NABCEP certificate of knowledge

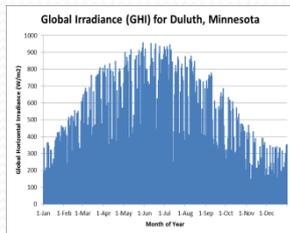
Trends in Technologies and Policy related to solar

- Energy Storage
 - Technology advancements
 - Economies of scale driving down costs (Tesla)
 - Complements solar energy systems
- Electric Vehicles
 - Driving scale for storage technologies

NRRI, Minnesota Power, and St. Louis County Solar Photovoltaic Study

Introduction

Minnesota Power (MP) requested assistance from the University of Minnesota Duluth Natural Resources Research Institute (NRRI) to investigate the performance of three solar photovoltaic (PV) arrays in a Northern Minnesota environment. This project would be a multi-year program to monitor solar system output, reliability, and other factors. Three 10 kilowatt arrays were to be installed on top of the six story Government Services Center (GSC) in downtown Duluth. The data from this study will be used internally at MP and the arrays would be a showpiece for St. Louis County, as well as a component of the pursuit of LEED certification for the GSC. This study would be the final portion of the Pyramid of Conservation, as renewable energy generation generally requires the highest investment. The Pyramid of Conservation is part of MP's Power of One® Conservation Improvement Program.

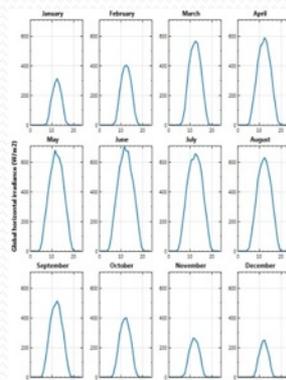


Objectives

NRRI's objective would be to validate and analyze the data from the three solar PV arrays in Duluth, Minnesota. Specifically, MP's research goals for this research project included topics such as:

- Relative performance of arrays in the short and long term.
- Correlation of actual data to modeled data in a Minnesota climate.
- Generation reaction to weather, e.g., cloud cover and low light situations.
- Validate vendor claims in regards to production.
- Understand installation methods and procedures.
- Performance measured against standard pyranometer measurements

This study was to be an empirical study to investigate actual solar PV performance in a Northeastern Minnesota environment.



Materials and Methods

The physical location of the solar PV installation was on top of the GSC, 325 W 1st Street, Duluth, Minnesota 55802. Annual irradiance and weather data for this location according to the NREL SAM database include:

- Global horizontal irradiance: 3.70 kWh/m²/day
- Diffuse horizontal irradiance: 1.78 kWh/m²/day
- Average temperature: 3.2°C
- Average wind speed: 4.7 m/s

Production data was acquired from an E-Gauge system and MV90 inverter data from MP. Weather data was provided by a weather station at the GSC.



	Silem Energy	Trina Solar	Teak Solar
Model Number	SE 205Wp	TSM-PA05 08 250Wp	RAIS XT-A 410Wp
Total Modules	52	40	24
Rated DC (kW)	18.66	10.01	9.82
Installed AC (kW)	10.10	10.00	9.00
Tilt (Degrees)	30	30	20
Module Space Used (ft ²)	832	704	667
Total Space Used (ft ²)	1,551	1,470	1,097
Total Ballast Weight (Pounds)	18,656	21,856	7,840
Inverter Used	Frontias IGPlus 10.1.3 Delta	Frontias IGPlus 10.1.3 Delta	APS TY300A Microinverter
Mounting System	AET Rayport B	AET Rayport B	Integrated into System

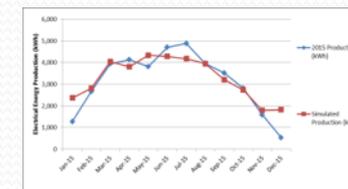
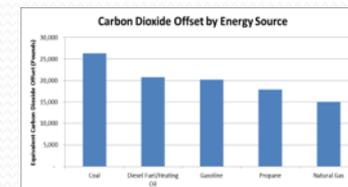
Preliminary Results

In 2015 the three solar PV arrays produced approximately 37,763 kWh of electrical energy at a capacity factor of 14.1%. The carbon dioxide offset due to this study was approximately 26,300 pounds as compared to energy production from coal. The actual production data matched the simulated data relatively well except for the months of January and December, 2015.

	Total System (\$)
Total Installed Cost	\$ 170,193
Incentives	
MP Conservation Contribution	\$ 42,375
MP SolarSense Rebate	\$ 70,000
Total Incentives	\$ 112,375
Net Cost	\$ 57,818

Month	Total Production (kWh)	Capacity Factor (%)
Jan-15	1,277	5.6
Feb-15	2,663	13.0
Mar-15	3,940	17.4
Apr-15	4,127	18.8
May-15	3,805	16.8
Jun-15	4,695	21.4
Jul-15	4,874	21.5
Aug-15	3,952	17.4
Sep-15	3,511	16.0
Oct-15	2,808	12.4
Nov-15	1,568	7.2
Dec-15	511	2.3
Total	37,763	14.1

Cost of Electricity (\$/kWh)	Est. Yearly Energy Savings (\$)	Estimated Payback Period, No Incentives (Years)	Estimated Payback Period, With Incentives (Years)
\$ 0.05	\$ 1,886.16	90.1	30.6
\$ 0.10	\$ 3,772.32	45.1	15.3
\$ 0.15	\$ 5,658.48	30.0	10.2
\$ 0.20	\$ 7,544.64	22.5	7.7
\$ 0.25	\$ 9,430.80	18.0	6.1
\$ 0.30	\$ 11,326.96	15.0	5.1



Thank you! Questions?

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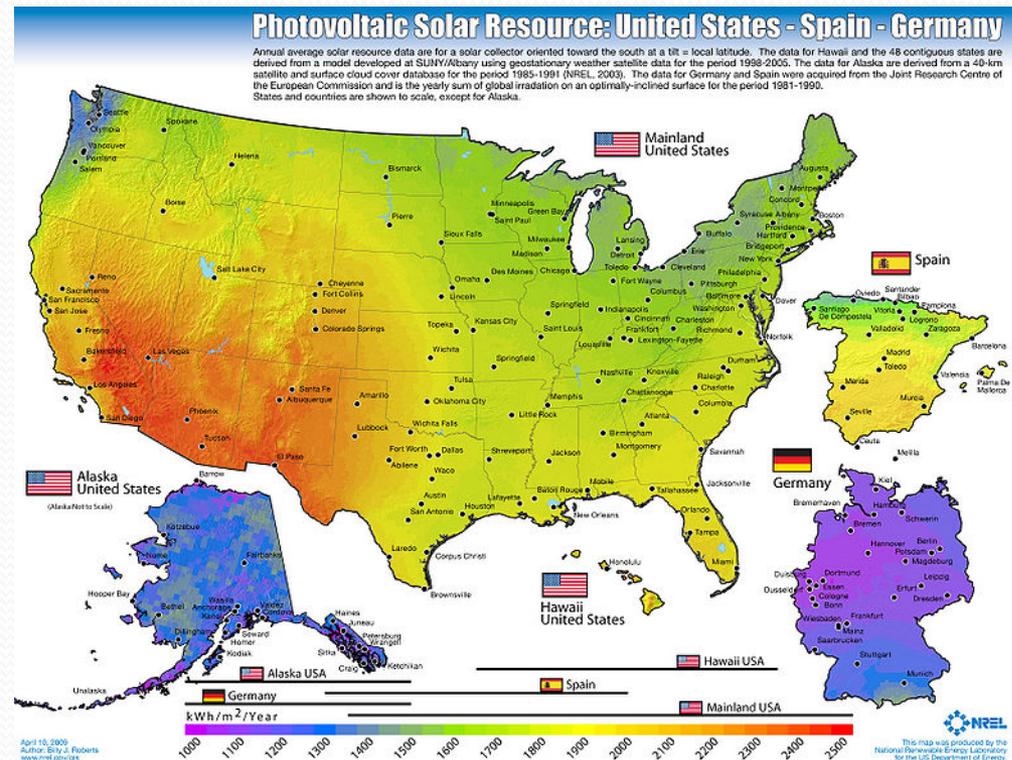
phelstrom@mnpower.com



Appendix: How solar works

Minnesota Solar Resource

- Good solar potential in MN
- Solar PV likes it cool and clear
- Good installation sites can produce 1250-1350 kWh per year per kWp installed



Grid-tied (PV) system

- Most common.
- Least expensive.
- Requires least maintenance.
- Connects directly to the electric distribution grid.
- Produces electricity used to power the loads in your home or business. Any excess energy is sent back into the utility grid to be used elsewhere.
- Automatically disconnects when there is an outage in order to prevent damage to equipment or personnel.

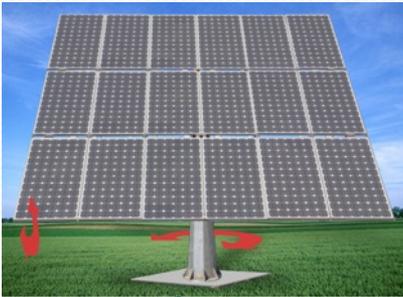
Grid-tied with battery backup system

- Less common than standard grid-tied systems.
- More expensive than standard grid-tied systems.
- Requires more maintenance.
- Has a battery component that allows it to continue functioning when there is a utility grid outage.
- Batteries aren't typically meant to power an entire home for a long period of time.
- Commonly installed when there is a need to back up critical loads.
- Has additional interconnection requirements.

Stand-alone system

- Least common type of PV system.
- Most expensive of the three types of PV systems.
- Operates independently of the grid.
- Commonly used in remote areas where the cost of bringing utility power to a site is very high.
- Must be carefully planned to match the home's energy needs to the system's size and storage capabilities.

Grid Tied System Components



DC Disconnect

DC

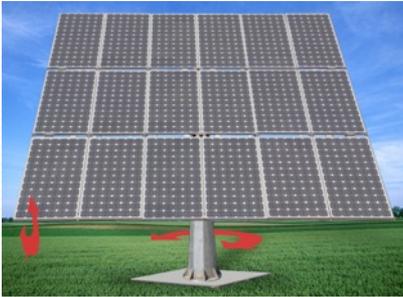


Inverter



AC

Grid Tied Battery Backup



Main Panel



Inverter/Transfer Switch

Solar Backup panel

Charge Controller



Entering the Market

- Parties interested in joining the market of solar installation companies should consider:
- Skills needed
- Tools needs
- Services values and expected

Questions?

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