



# Northland Pines School District: Your Solar PV Systems

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*Presented by:*

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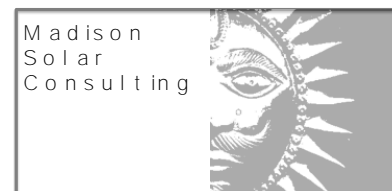
## Who are we?

### Mark Hanson

- Director of Sustainable Services at Hoffman Planning, Design & Construction
- Green Guy

### Niels Wolter

- Madison Solar Consulting
- Solar Guy



## Why are we here?

- Describe your new solar system and how it works
- Answer your questions about solar energy
- Explain how solar energy has become more economic than fossil energy
- Why you may want to think about a career in renewable energy

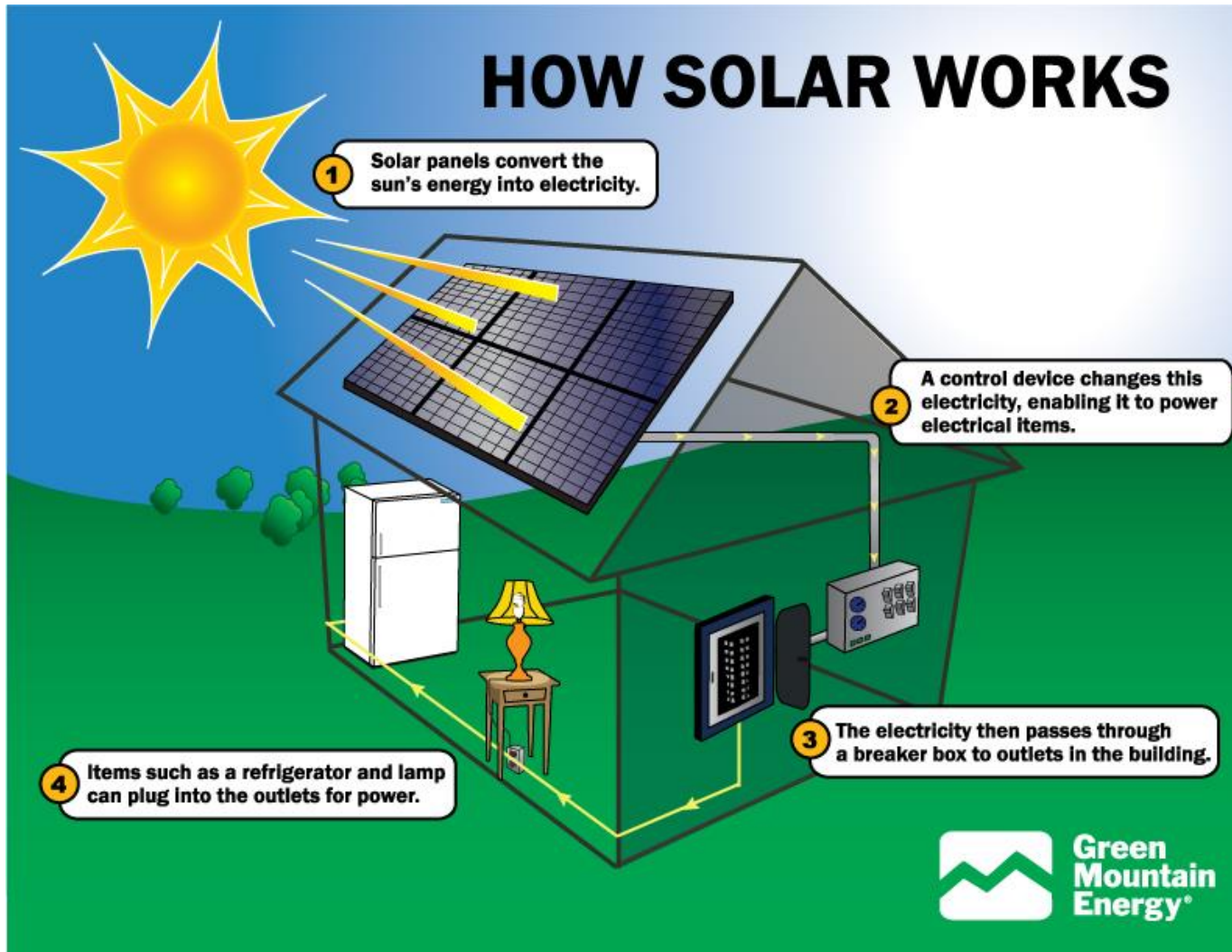


# The Solar Resource

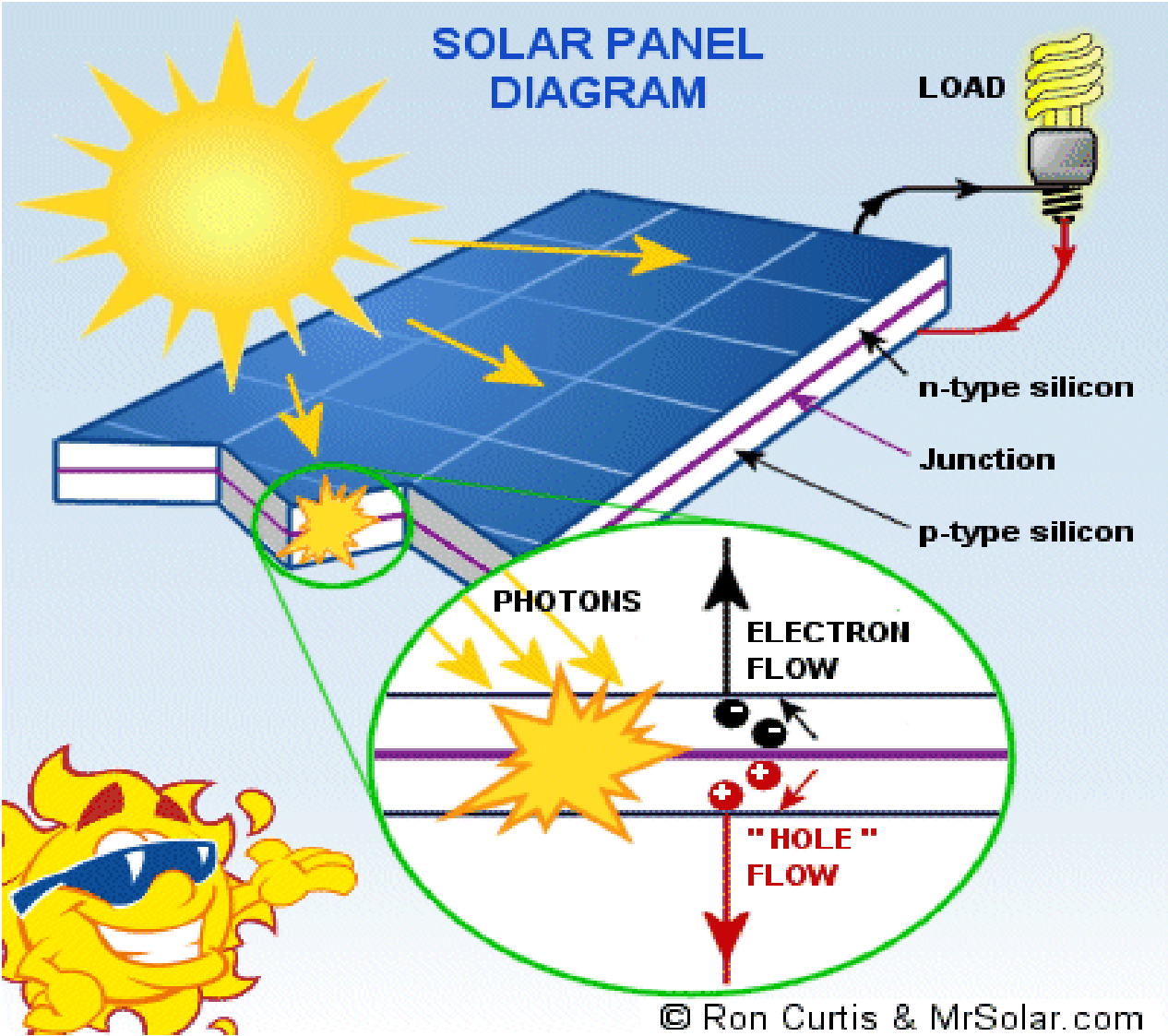
45 minutes of solar power striking the earth –  
enough to power human society for a year



# How are Solar PV Panels Used in a Building?



# How do Solar PV (photovoltaic) Panels Work?



## Recent Examples in Midwest



- Madison Country Day School
- Waunakee, WI
- December 2012
- 89 kilowatt (kW) capacity

- Holy Wisdom Monastery
- Middleton, WI
- September 2014
- 126 kilowatt (kW) capacity

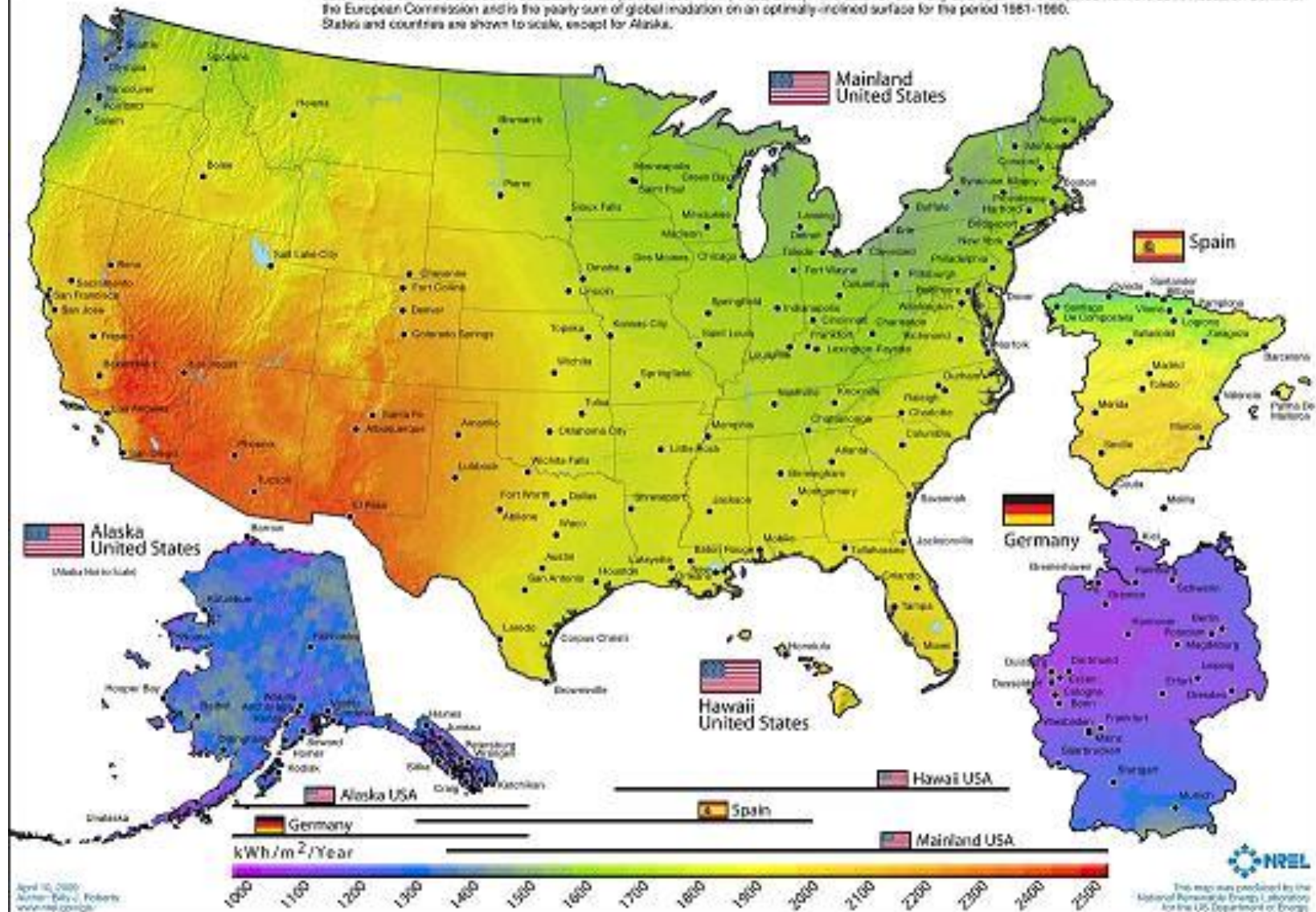




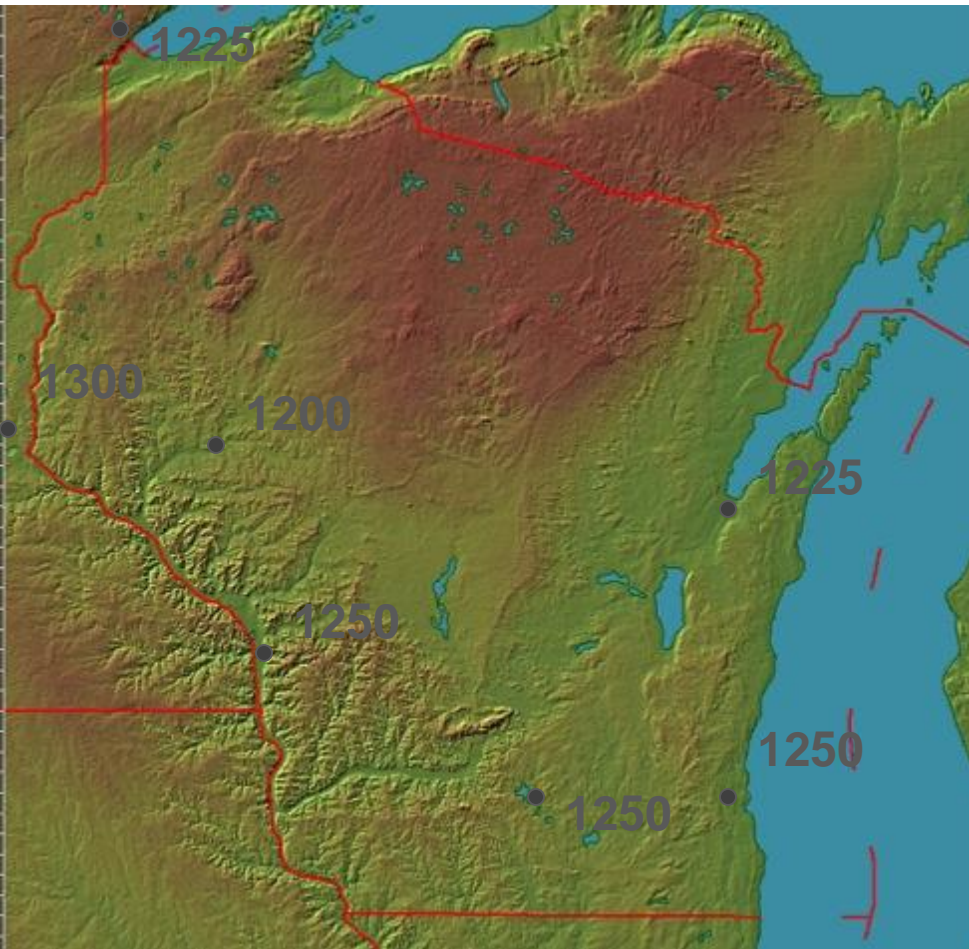


# Photovoltaic Solar Resource: United States - Spain - Germany

Annual average solar resource data are for a solar collector oriented toward the south at a tilt = local latitude. The data for Hawaii and the 48 contiguous states are derived from a model developed at NREL using geostationary weather satellite data for the period 1998-2005. The data for Alaska are derived from a 40-km satellite and surface cloud cover database for the period 1985-1991 (NREL, 2003). The data for Germany and Spain were derived from the Joint Research Centre of the European Commission and is the yearly sum of global irradiation on an optimally-inclined surface for the period 1981-1980. States and countries are shown to scale, except for Alaska.



# Solar Electric System Production (kWh/year)

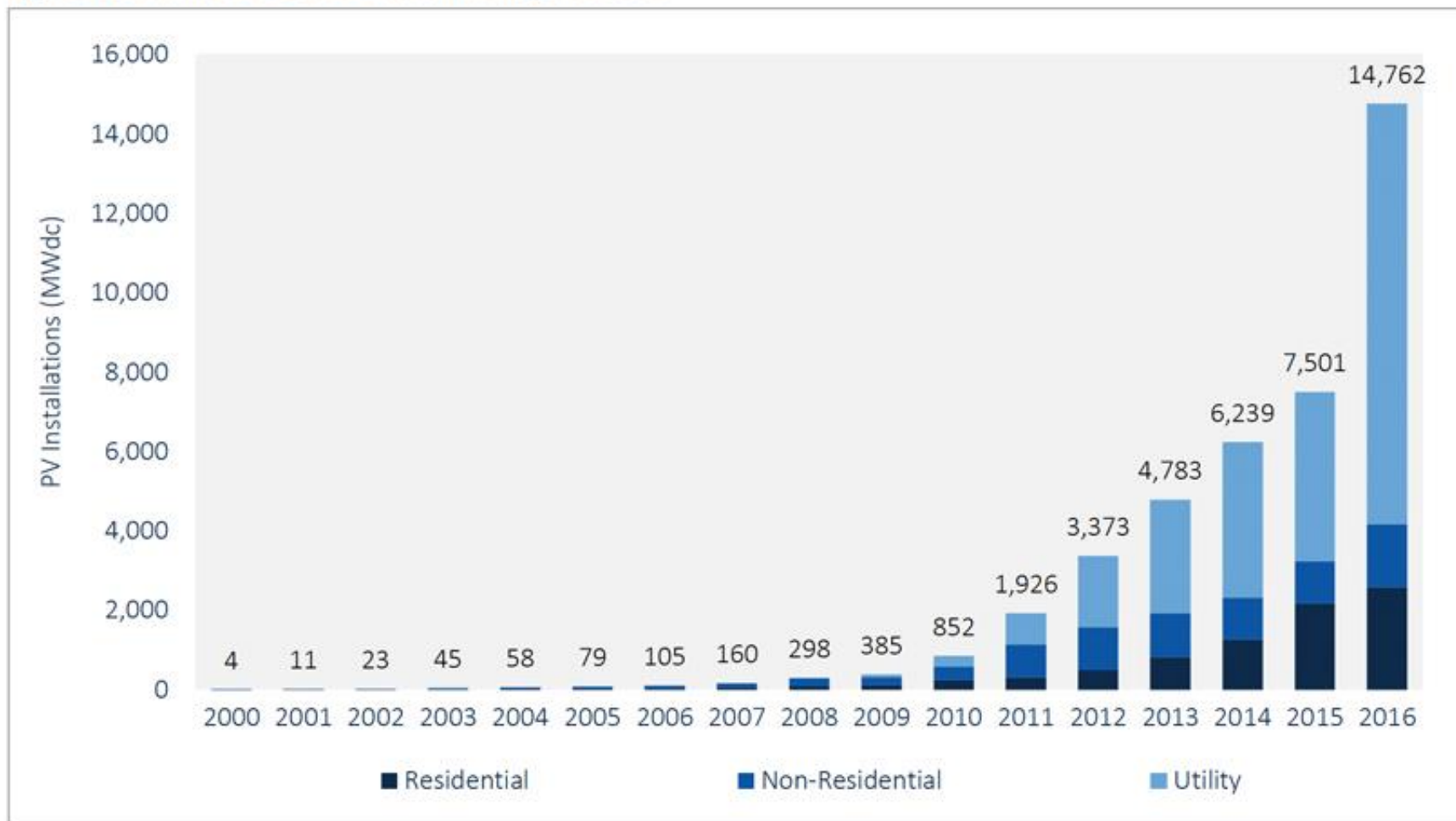


- For fix-mounted one kW crystalline system
- Requires ~70 ft<sup>2</sup> of modules
- 1 kW system in full sun for one hour = 1 kWh
- 1 kW system for one year ~1250 kWh/year

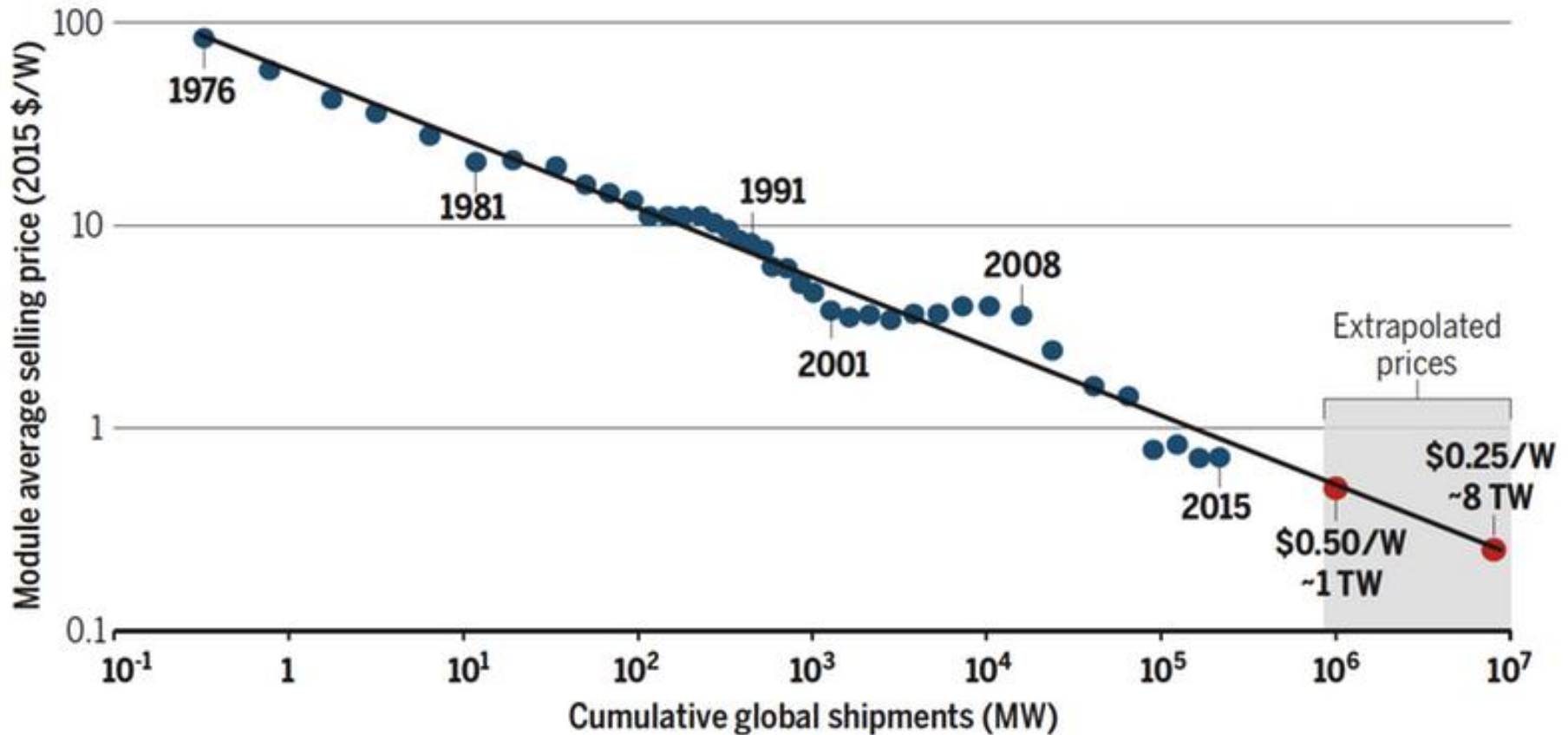
Source: Niels Wolter, Focus on Energy



Figure 1.1 Annual U.S. Solar PV Installations, 2000-2016



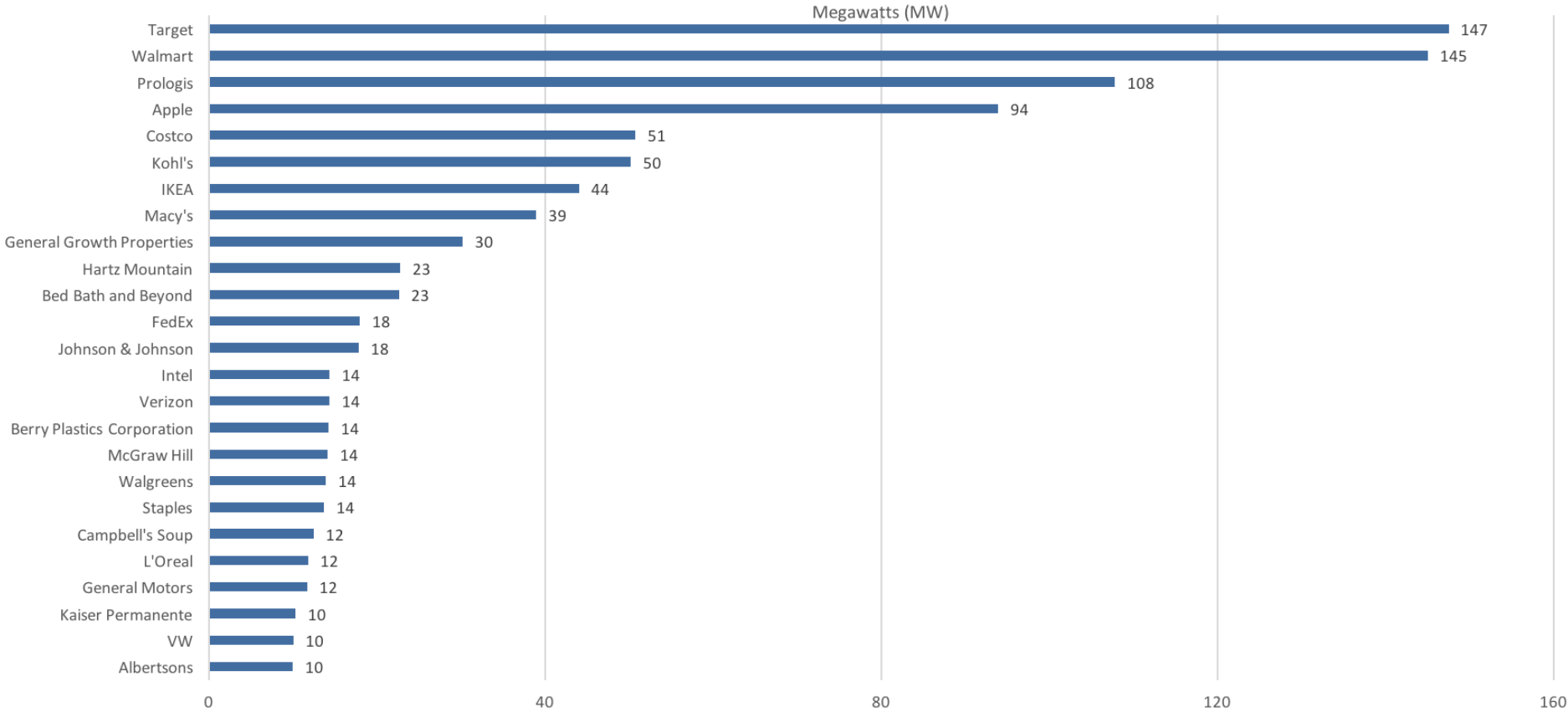
# Declining Module (panel) Price



Source Haegel et al, Science April 2017



# Largest Corporate Owners, 2016



# Solar, Demand Management, and Education Support Procurement Progress

- Planning Phase 1- Site and Financial Analysis: completed April 2017
- Planning Phase 2 – Incentives and Financing: completed July 2017
- Planning Phase 3 – Contracting, Installation, and Start-up: completed November 2017
  - Interconnection (November 2017)
  - Ongoing negotiations with We Energies at Land O' Lakes



# Solar PV Systems at the HS/MS and Elementary Schools

- HS/MS system size
  - 160 kW roof
  - 70 kW ground mount
- Eagle River Elementary system size
  - 100 kW ground mount
- Land O' Lakes Elementary system size
  - 90 kW ground mount



## Visual Impression

- Essentially hidden from street view at all three schools
- Ground Mount panels visible behind the schools
- Ground Mount panels provide safe access to hands on educational exposure and for public relations
- See following roof and ground mount PV system pictures at NPSD





## Bid Results

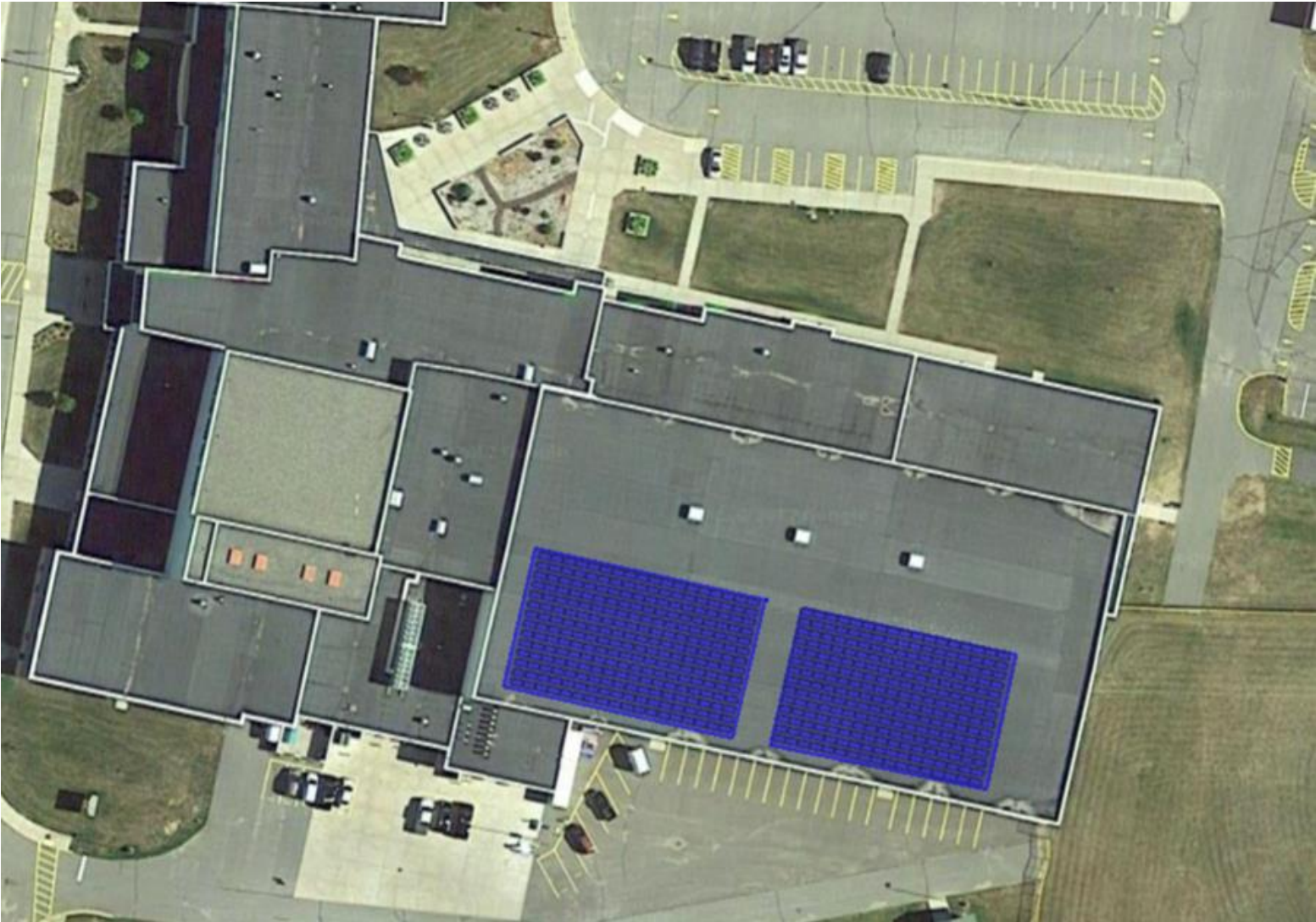
Four high quality bids

Selected Eagle Point Solar of Dubuque, Iowa

- \$1.50 per Watt
  - Less than initial estimate
- Mark Yeager of Sun and Daughters Inc. - local O&M support
- Installation history of over 850 systems and over 8,000 kW

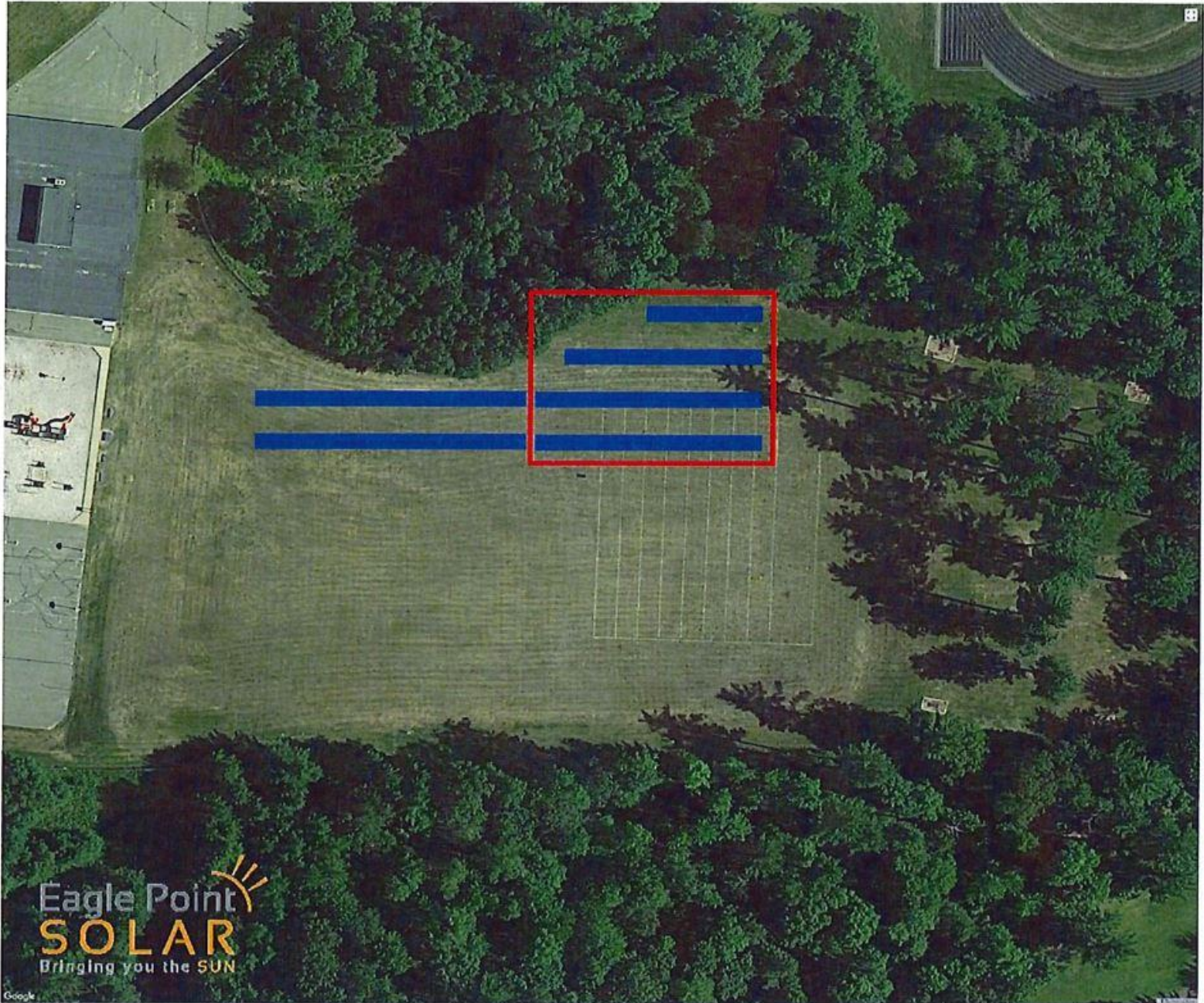


# HS/MS PV System Arrays on Field House





# Eagle River Elementary School – Ground Mounted 100.2 kW DC:





# Land O' Lakes PV System Array











My passion inside, since 1981  
My name outside, today

*Franco Traverso*  
Franco Traverso  
SLG345M

**ELECTRICAL SPECIFICATIONS**

measured under standard test conditions:

1000W/m<sup>2</sup> irradiance, AM 1.5 spectrum, 25°C cell temperature

**CARACTÉRISTIQUES ÉLECTRIQUES**

mesurée dans conditions d'essai normalisées:

1000W/m<sup>2</sup> rayonnement, spectre de 1.5 AM, température des cellules de 25°C

Maximum Power (P <sub>max</sub> ) Puissance Nominale Maximale	345 <sup>+5</sup> / <sub>0</sub> W
Maximum Power Voltage (V <sub>pmax</sub> ) Tension en Fonctionnement Optimal	<u>38.7 V</u>
Maximum Power Current (I <sub>pmax</sub> ) Courant en Fonctionnement Optimal	8.93 A
Maximum Voltage (V <sub>oc</sub> )	<u>47.3 V</u>



# Who's Involved?

- Customers: Established, credit-worthy non-profits with large facilities and large electrical loads
- Sustainable Services Provider: Mark Hanson: Hoffman Planning, Design & Construction
- Developers: Solar energy tax credit development companies able to structure ownership arrangements to monetize the federal Investment Tax Credit (ITC) for renewable energy equipment.
- Tax Equity Investors: Accredited U.S. investors with a need for passive income tax credits
- Debt Providers: Interested lenders, may include Wisconsin community banks
- Other Involved Parties: System Installers / O&M Providers, Building Energy Management Consultants, Legal & Accounting Professionals, Local Utilities for Interconnection, Insurers, etc.



**Building Energy Management Consultants**  
(Demand Management Controls)

**PROJECT ENTITY, LLC**  
Systems Owner

**Lender**

Debt \$

**Investor, LLC**  
(Passive Investors)

Equity \$

**Developer, LLC**  
(Developer-Member-Manager)

Equity \$

**Eagle Point Solar, LLC**  
(Solar Energy Contractor:  
Installation and O&M)

Energy Services Agreement: Installation, Energy  
& Energy Management, O&M, Insurance, Other

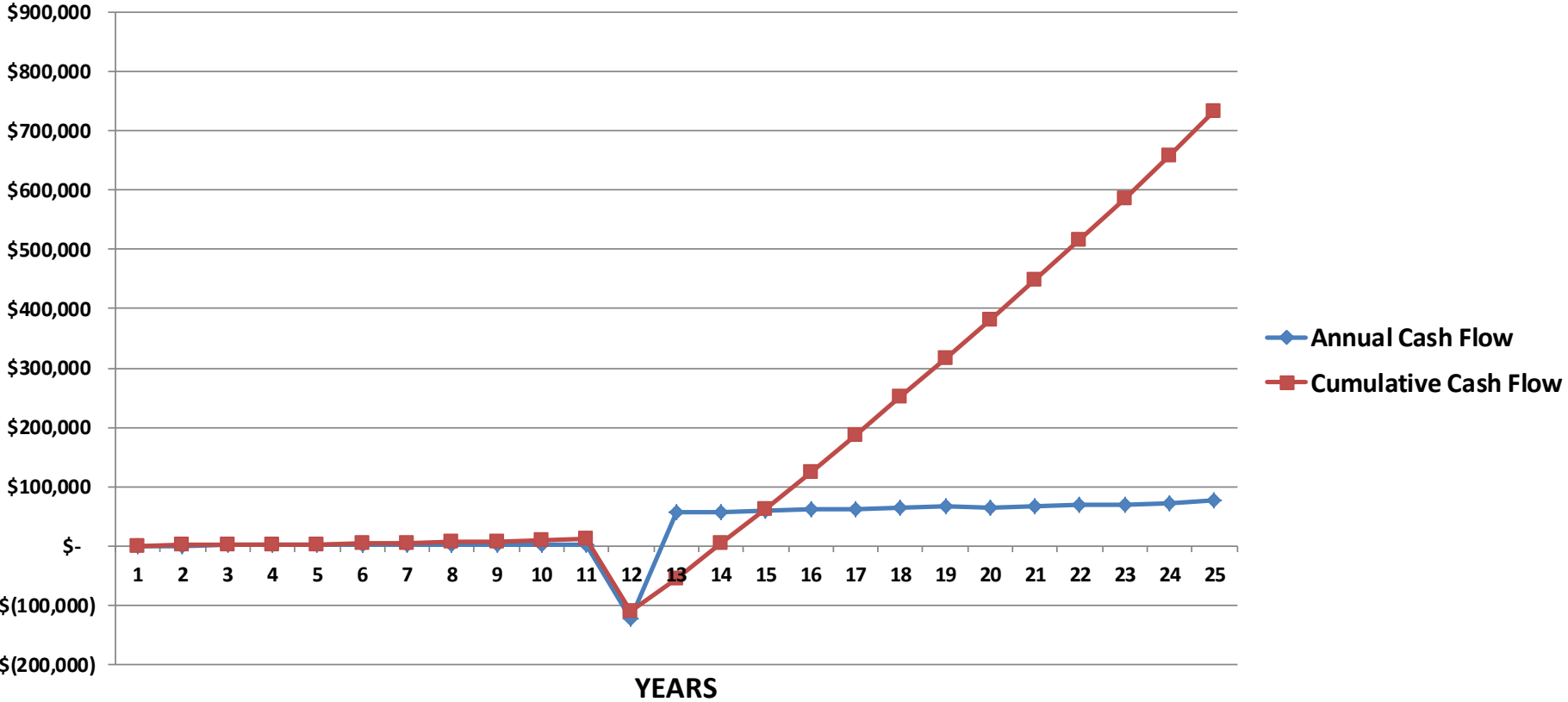
Some equipment owned  
directly by customer

**Northland Pines School District**  
(Customer / Existing Entity)

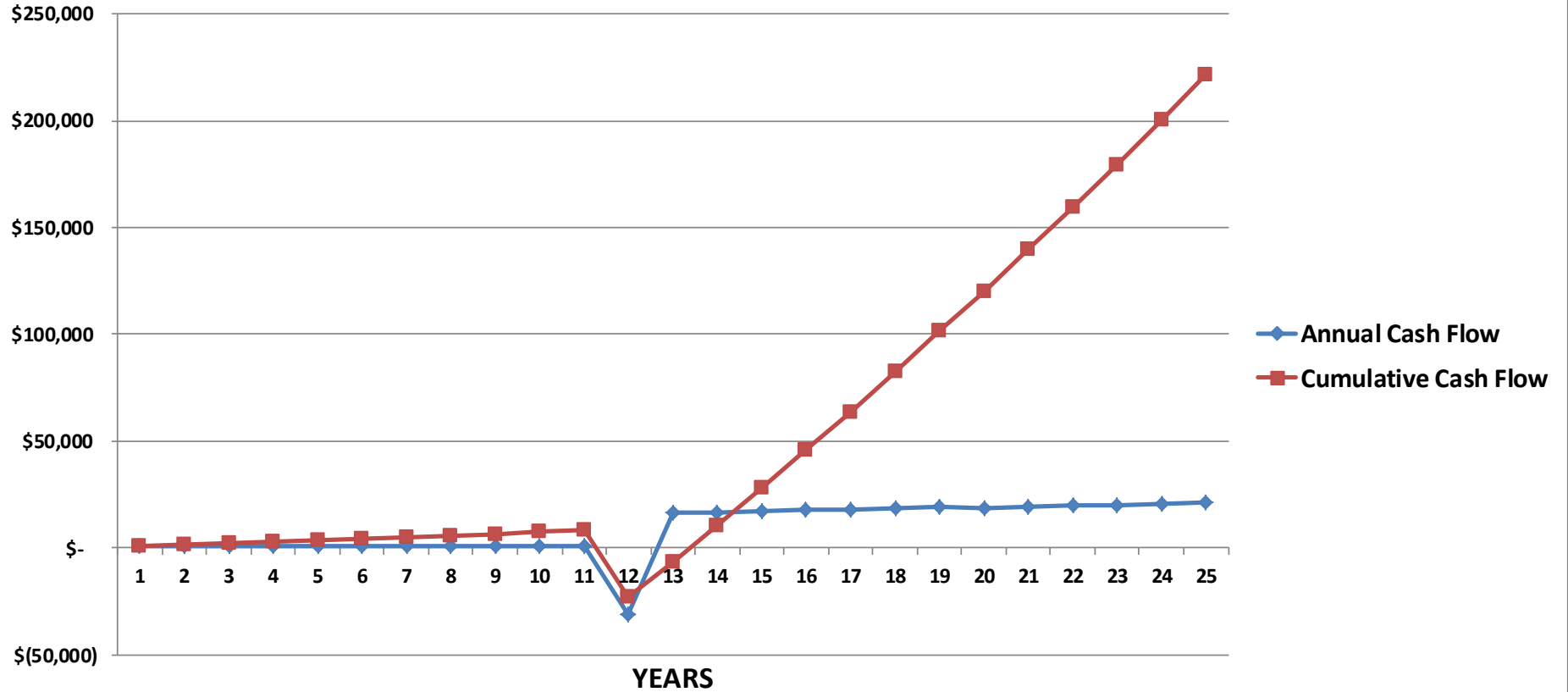
**Focus on Energy Incentives**



# Northland Pines HS/MS & Eagle River Elementary Cash Flow



# Land O' Lakes Cash Flow



# What questions do you have?

