Solar Ready Building

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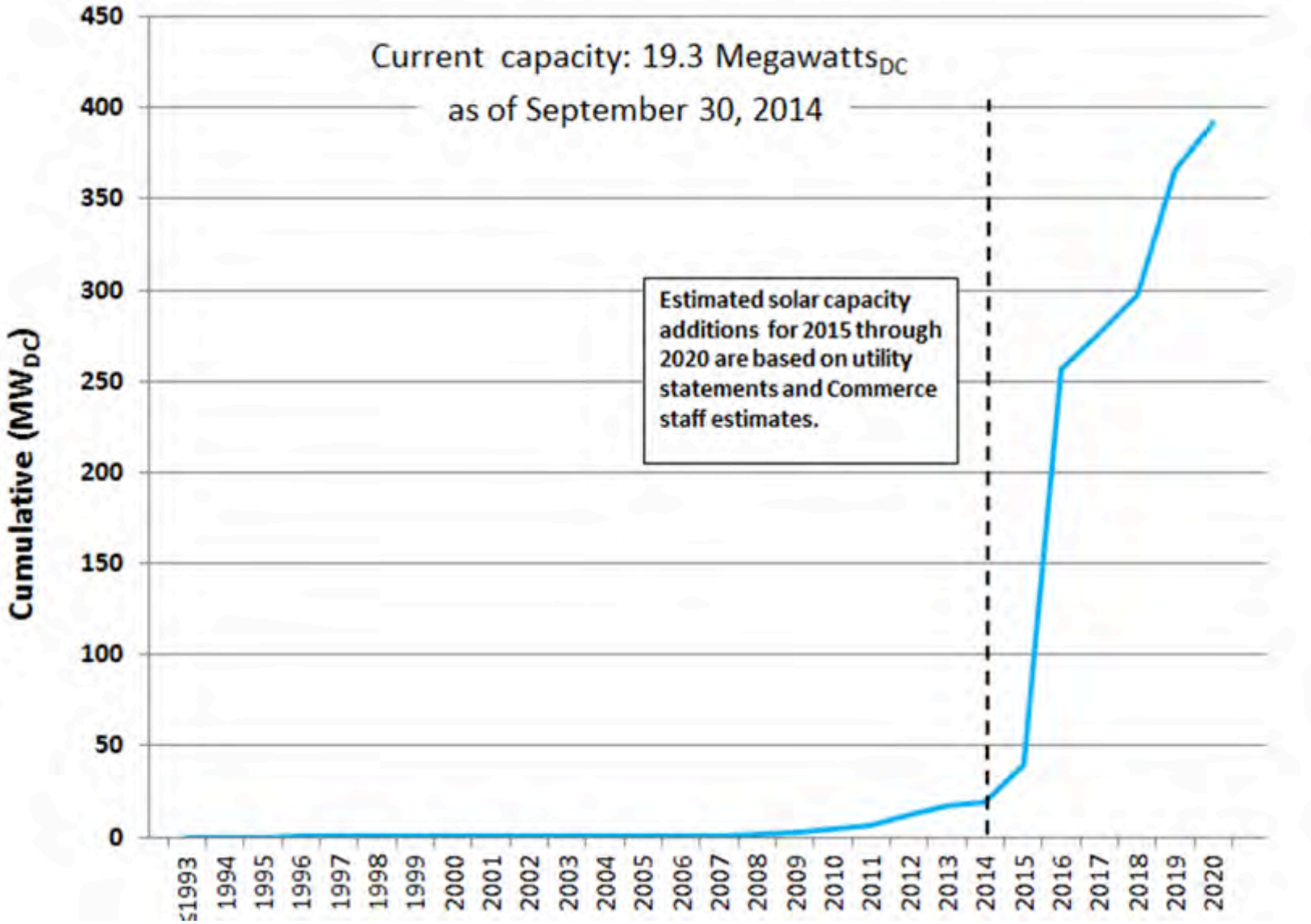
Overview

- The Solar Market
- What is Solar Ready?
- Why Solar Ready?
- Types of Solar
- Solar Ready Guidelines
- Resources
- Feel free to ask questions as we go

Table 2

COMPARISON OF CLEAN ENERGY MARKET DEVELOPMENT
Minnesota, 2000-2012

	2000	2012	2000-2012 percent change
Energy Efficiency cumulative savings	9 trillion BTU	56.5 trillion BTU	524%
Bioenergy electricity production	1,320 Thou MWh	1,838 Thou MWh	40%
Installed wind energy capacity	290 MW	3,004 MW	935%
Installed solar energy capacity	118 kW	11,550 kW	9670%
Biofuel (Ethanol) production capacity	220 millions of gallons	1,117 millions of gallons	408%


Current capacity: 19.3 Megawatts$_{DC}$
as of September 30, 2014
Estimated solar capacity additions for 2015 through 2020 are based on utility statements and Commerce staff estimates.
Cumulative (MW$_{DC}$)
450
400
350
300
250
200
150
100
50
0
≤1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
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2011
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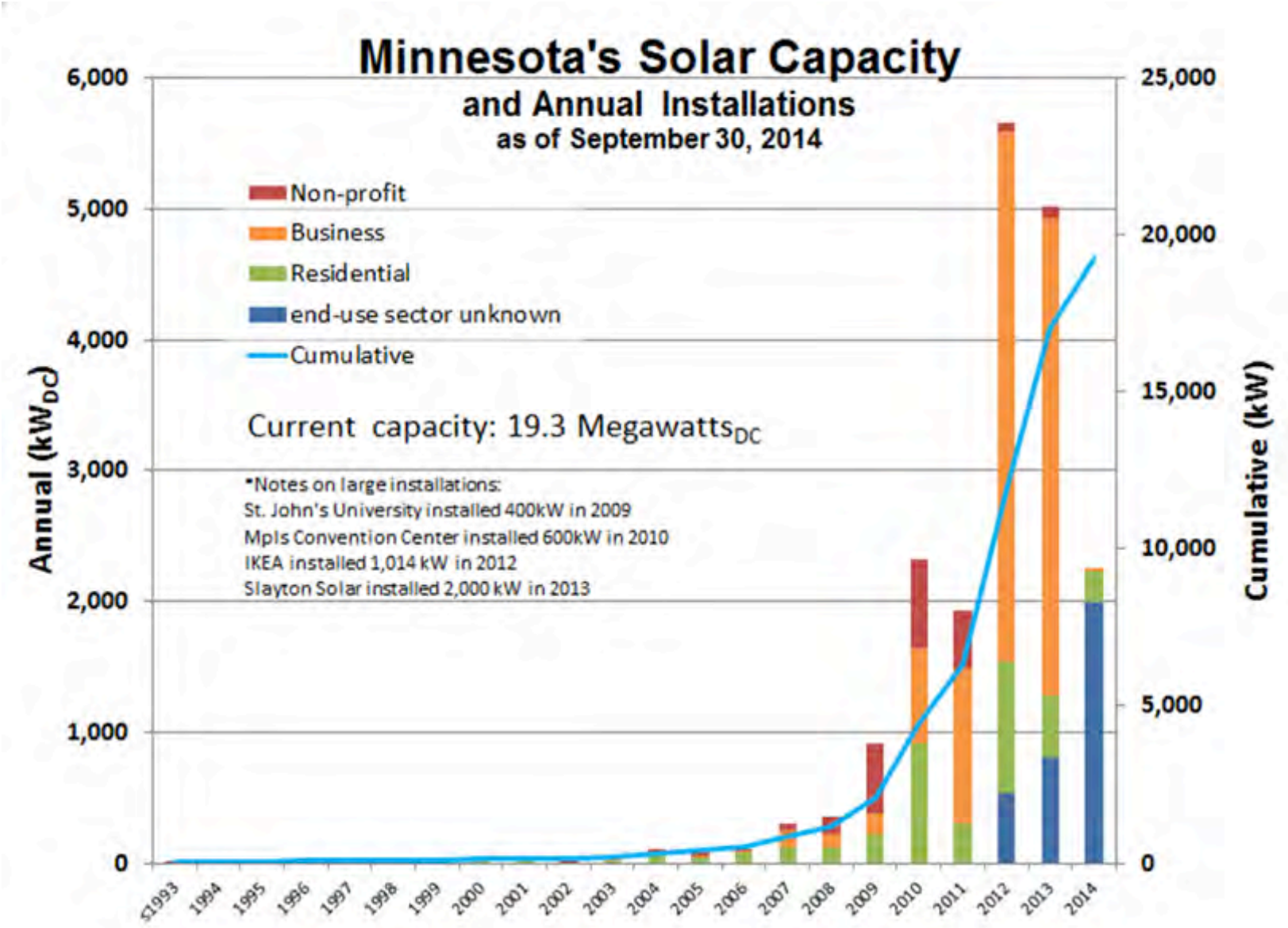
2014
2015
2016
2017
2018
2019
2020


Minnesota's Solar Capacity
and Annual Installations
as of September 30, 2014
Non-profit
Business
Residential
end-use sector unknown
Cumulative
Current capacity: 19.3 Megawatts$_{DC}$
*Notes on large installations:
St. John's University installed 400kW in 2009
Mpls Convention Center installed 600kW in 2010
IKEA installed 1,014 kW in 2012
Slayton Solar installed 2,000 kW in 2013
Annual (kW$_{DC}$)
Cumulative (kW)
6,000
5,000
4,000
3,000
2,000
1,000
0
25,000
20,000
15,000
10,000
5,000
0
≤1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014

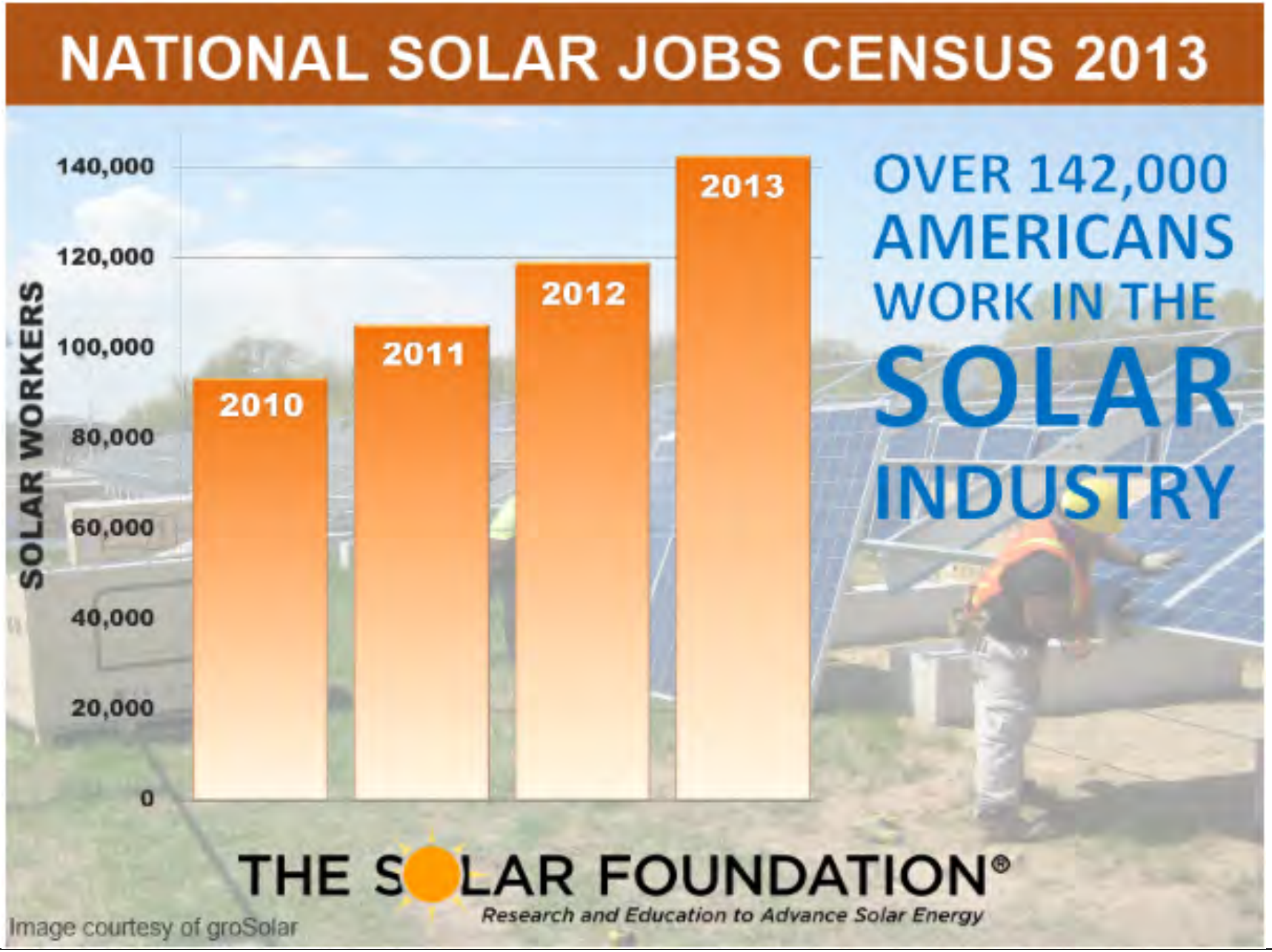
MN Power's PV Future

- Required to install about 4 Megawatts of small solar by 2020
- Presently installed is about 400 kW
- 1MW = 1000kW

2020: How many residential systems?

Today: 1,000 residential systems

2020: 4,000 residential systems


NATIONAL SOLAR JOBS CENSUS 2013
SOLAR WORKERS
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
2010
2011
2012
2013
OVER 142,000 AMERICANS WORK IN THE SOLAR INDUSTRY
THE SOLAR FOUNDATION®
Research and Education to Advance Solar Energy
Image courtesy of groSolar

Data by Sector—Number of Solar Workers in Minnesota

Sector	*2013 Jobs*	*2014 Projected Employment*	*2013 - 2014 Expected Growth Rate*
Installation	394	508	29%
Manufacturing	124	172	39%
Sales and Distribution	96	109	14%
Project Development	121	179	48%
Other*	129	141	9.3%
Total	**864**	**1,108**	**28%**

THE SOLAR FOUNDATION®
Research and Education to Advance Solar Energy

What is Solar Ready?

The National Renewable Energy Lab (NREL) defines a solar ready building as being designed and built:

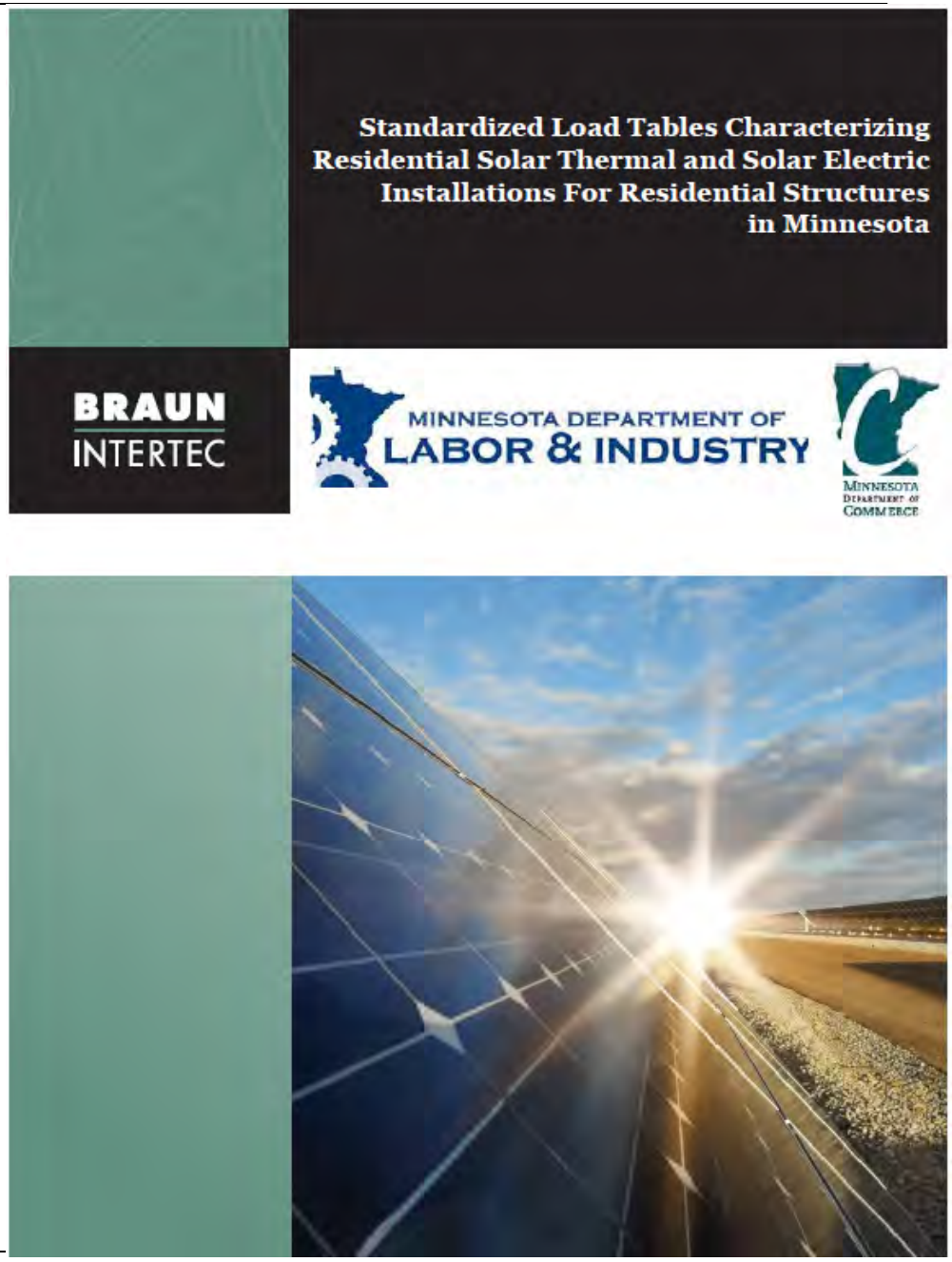
"to enable installation of solar photovoltaic and heating systems at some time after the building is constructed."

Basic components of a solar ready building:

1) A place on the roof of the building that has unrestricted solar access, is free of obstructions such as rooftop equipment or plumbing vents, and is structurally designed to accommodate the weight, wind, and drift loads that the system might impose.

This guide is available online at: http:// mn.gov/commerce/energy/images/FINAL-Standardized-Load-Table-Report.pdf

Or just Google Standardized Load Tables.



2) A internal chase or other means for connecting the solar system to the building's mechanical or electrical system.

3) Space within the building that is readily available for the installation of controls and components, such as electric invertors and hot water storage tanks.

Why Solar Ready?

The traditional design of our homes is one of the major barriers to the rapid development of solar in Minnesota. Homes were simply just not built for easy solar energy retrofits.

The concept of solar ready building sees buildings as infrastructure, multi-generational investments that consider not only today's market needs, but provide flexibility to meet the next generations' needs.

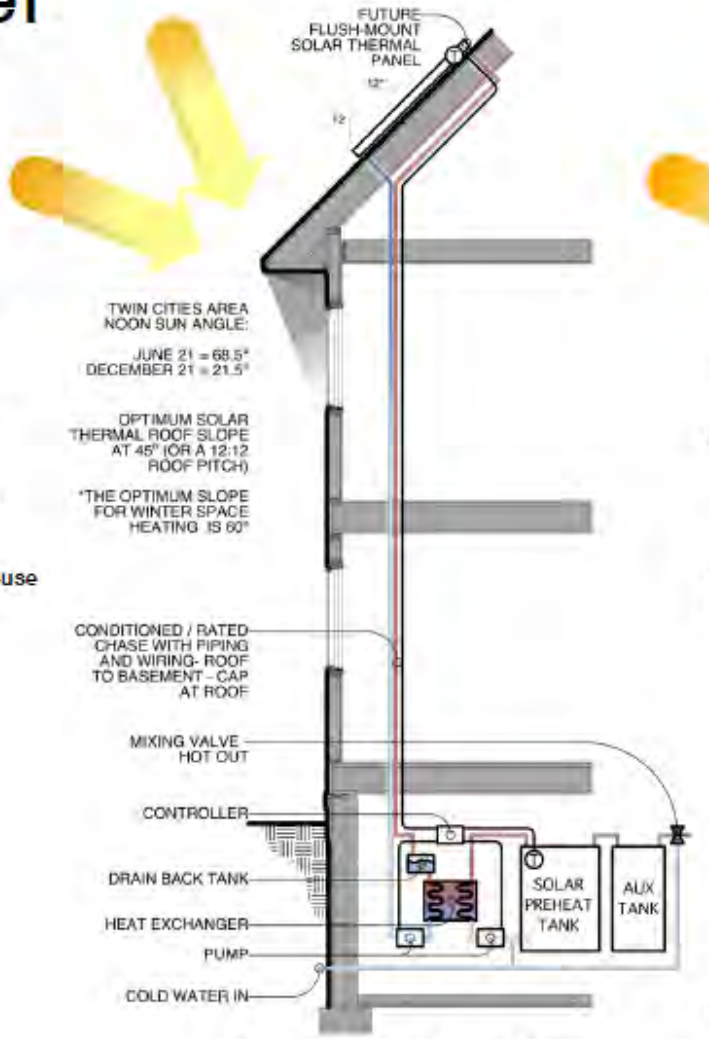
- The added expense to making a building solar ready is minimal if done during construction.

- Whereas, it can be cost prohibitive to do it on the back end.

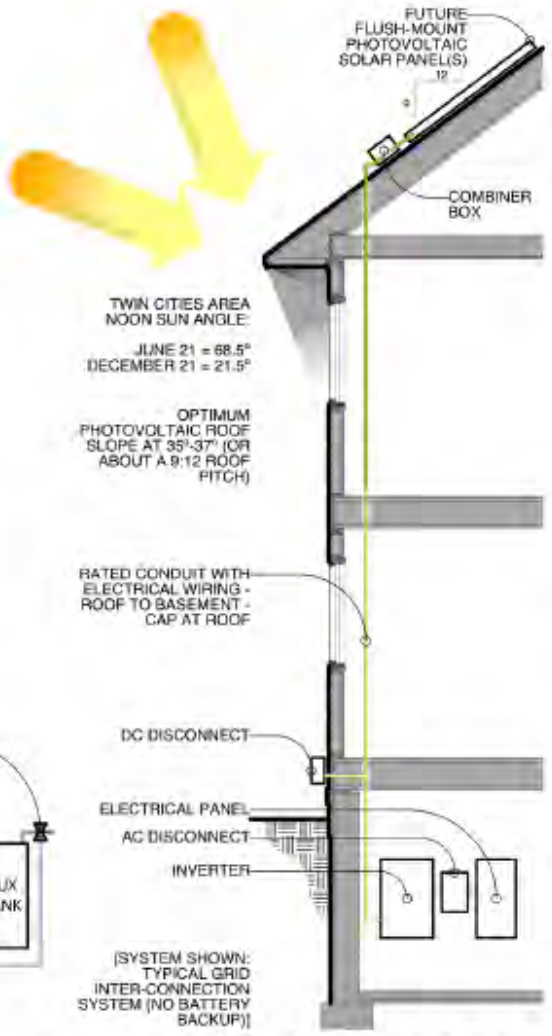
Solar Model

Budget Allowance for Solar Ready Construction

- ✓ $1,000 for a two-story residential building
- ✓ $5,000 to $7,500 for a three-story mixed-use building
- ✓ Estimated Cost for Retro-fitting Existing Structures to Incorporate Solar Ready Requirements
- ✓ $5,000± for a two-story residential building
- ✓ $20-30,000 for a three story mixed-use building



Example Solar Thermal Setup



Example Photovoltaic Setup

Solar Ready Building Design Guidelines for the Twin Cities, Minnesota

Types of Solar

- Designers and builders need to understand how to tailor to a building project to accommodate solar.
- Solar energy systems include active and passive systems, solar electric (PV), solar hot water (SHW), and solar space heating (SHA) systems.
- These solar ready guidelines are directed at the solar technology options readily available to Minnesotans today, but keep in mind up and coming technologies.

Photovoltaic (PV)

- PV systems generate direct current (DC) electricity when exposed to sunlight.
- An inverter converts the DC to AC matching the electricity supplied by the grid.
- They generally have no moving parts, require almost no maintenance, and last for decades.

Typical PV system

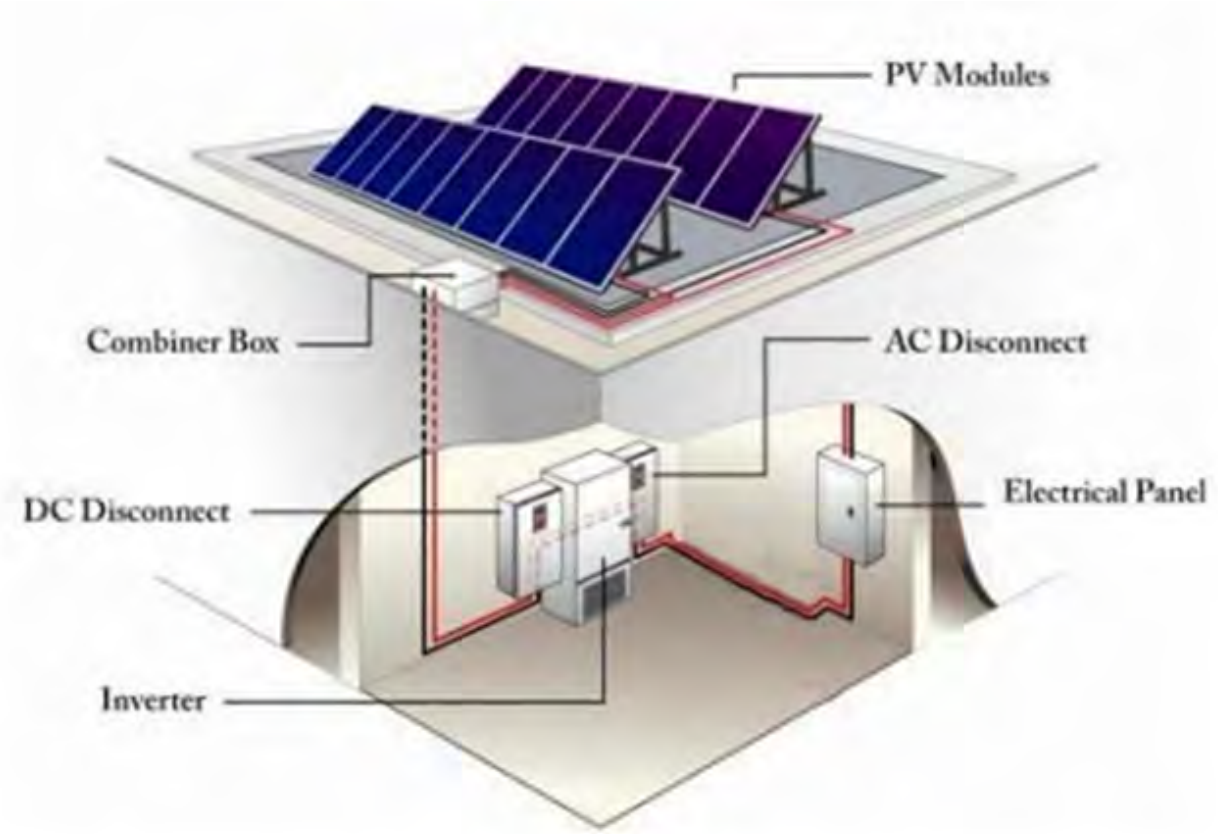


Figure 16. PV system components

Solar water heating (SWH)

- These systems are designed to heat hot water for domestic or heating use.
- They can be designed to supply 75% of a household's hot water.
- Typically consist of collectors, a controller, storage tank, and freeze protection.

SHW

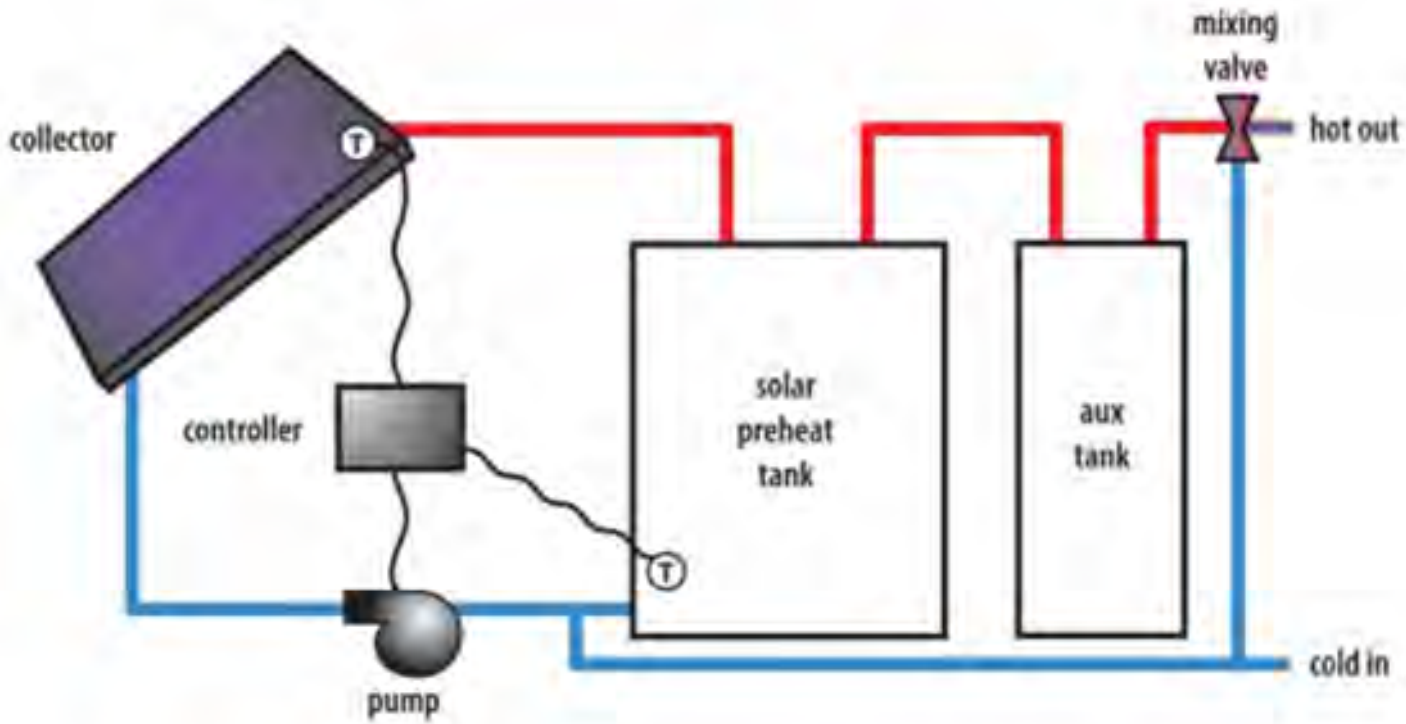
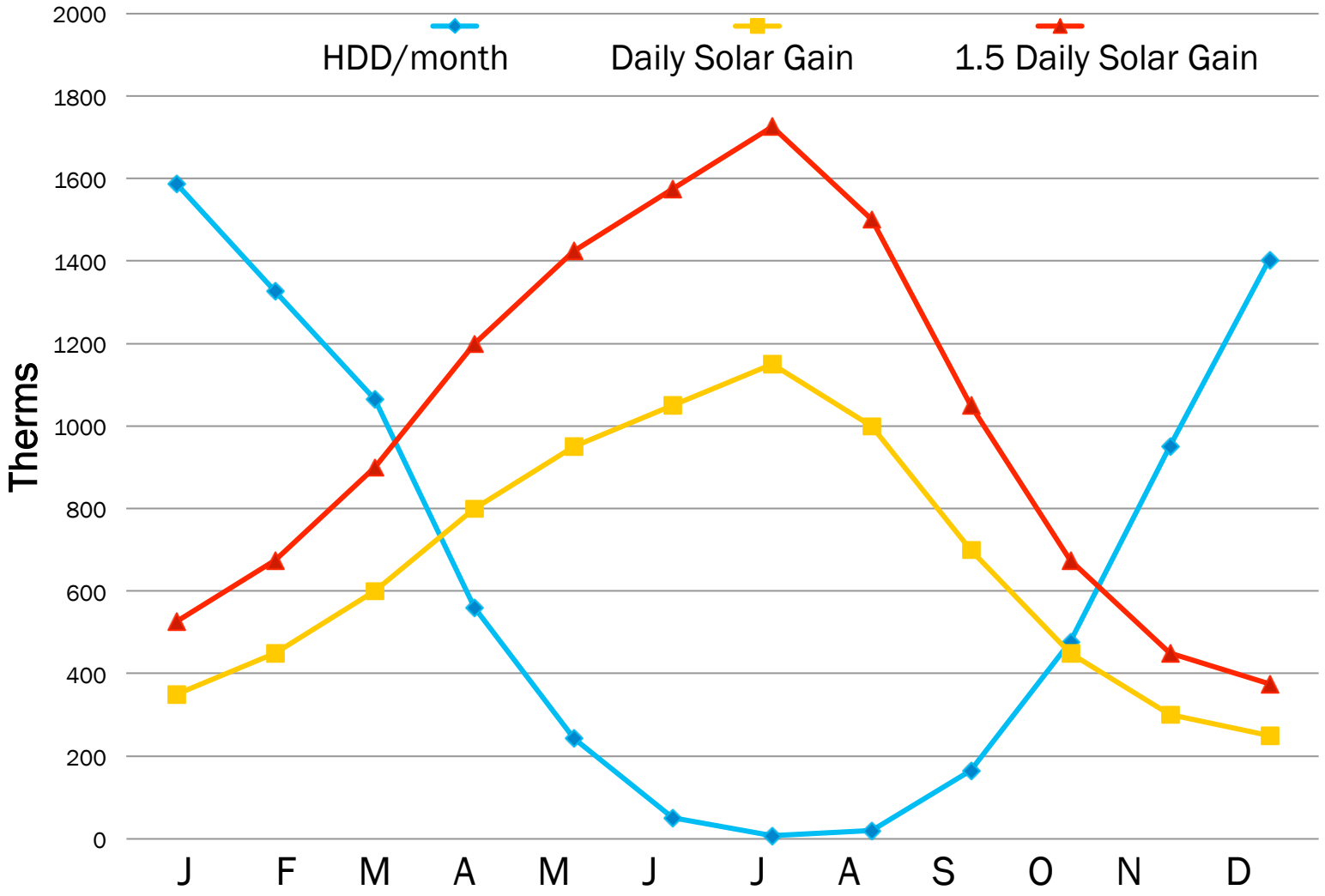


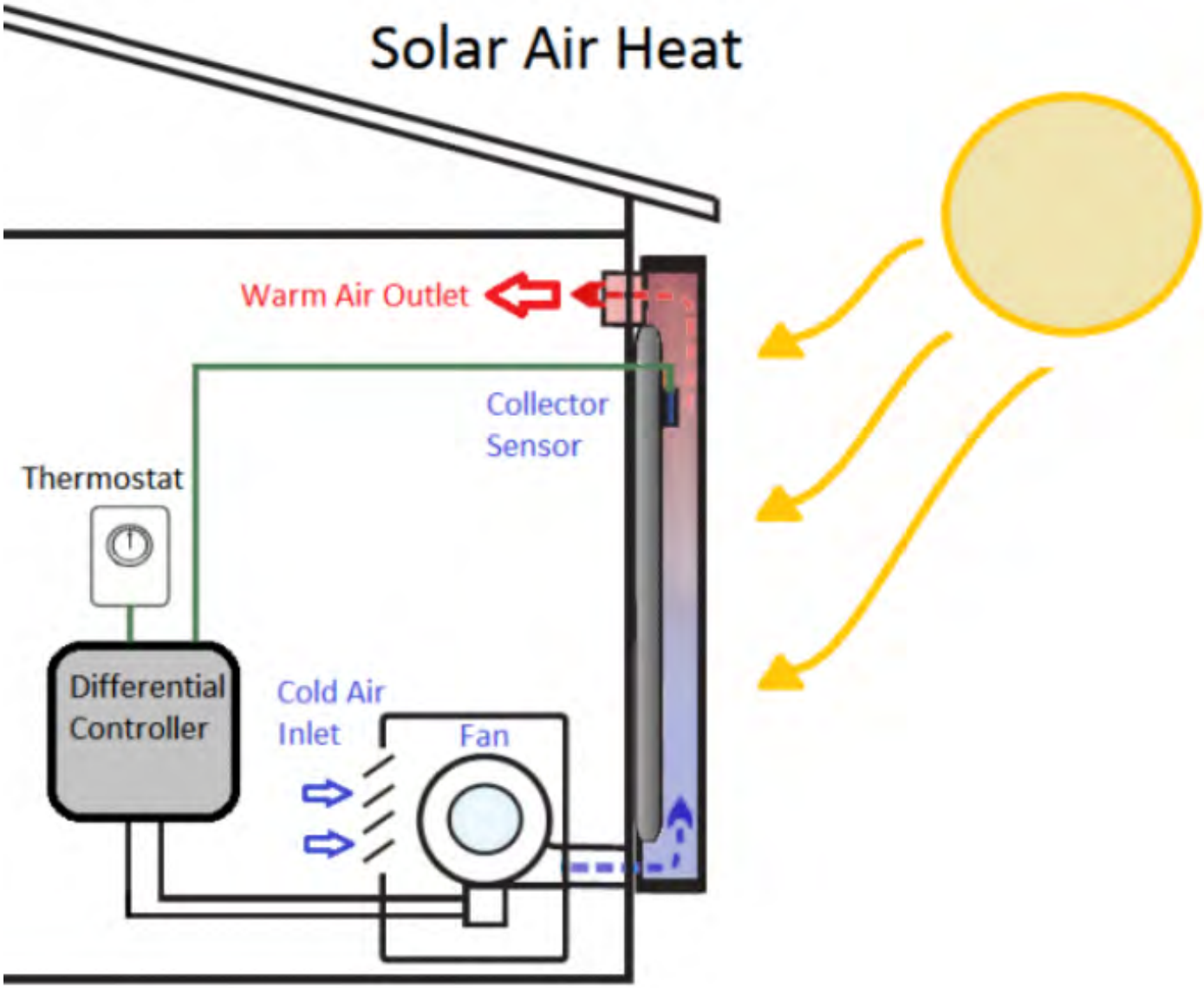
Figure 10. Direct system

Space-heat Mismatch



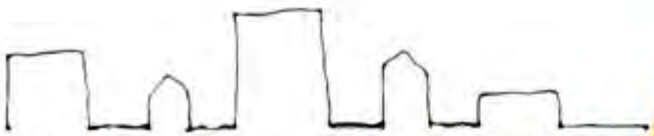
Solar Air Heating (SAH)

- These systems are designed to heat air for heating use.
- They can be designed to supply 15 to 30% of a household's heating load.
- Typically consist of collectors, a controller, and a fan.


Solar Air Heat
Warm Air Outlet
Collector Sensor
Thermostat
Differential Controller
Cold Air Inlet
Fan

Before we discuss the Building Solar Ready Guidelines are there any questions about solar?

This presentation is taken from the Solar Ready Building Design Guidelines prepared for the Minneapolis Saint Paul Solar Cities Program
by Lunning Wende Associates, Inc., coordinated by CR Planning, Inc. and funded by National Renewable Energy Laboratory (NREL).



Solar Ready Building Design Guidelines

Solar Ready Building Design Guidelines for the Twin Cities, Minnesota

Available at www.nrel.gov

According to an NREL Study PV System

Table 3: Cost to Make a Building Solar Ready[5]

	During Construction			After Construction		
Measures	**Equipment**	**Labor**	**Total**	**Equipment**	**Labor**	**Total**
Increase size of electrical panel	$459	$480	$ 939	$459	$1,200	$1,659
Run conduit	$374	$416	$ 790	$374	$1,040	$1,414
Relocate vents	n/a	n/a	n/a	-	$ 300	$ 300
Install panels on multiple pitches	n/a	n/a	n/a	-	$1,000	$1,000
Total	**$833**	**$896**	**$1,729**	**$833**	**$3,540**	**$4,373**

60% Savings

[5] Waier, P.R., ed. Green Building Cost Data. RSMeans. 1st Annual Edition, Norwell, MA: RSMeans. 2010

SHW System

Table 4: Cost to Make a Building SHW Ready[7]

	During Construction			After Construction		
Measures	**Equipment**	**Labor**	**Total**	**Equipment**	**Labor**	**Total**
Add mounting hardware SHW	$8.00	$20.00	$28.00	$8.00	$50.00	$58.00
Pipes to roof	$407.00	$1,109.00	$1,516.00	$407.00	$2,773.00	$3,180.00
Stub-out pipes	$2.00	$43.00	$45.00	$2.00	$ 106.00	$ 108.00
Relocate Vents	n/a	n/a	n/a	–	$ 300.00	$ 300.00
Install panels on multiple pitches	n/a	n/a	n/a	–	$1,000.00	$1,000.00
Total	**$417.00**	**$1,172.00**	**$1,589.00**	**$417.00**	**$4,229.00**	**$4,646.00**

66% Savings

[7] Waier, P.R., ed. Green Building Cost Data. RSMeans. 1st Annual Edition, Norwell, MA: RSMeans. 2010

Solar Ready Guidelines

These guidelines address specific:

- Site planning
- Building form
- Space planning
- Roofing
- Mechanical & Electrical issues

Site Planning

- Select a site with good potential for solar access. (Southern exposure)
- Minimal shading (remember that trees grow)
- Future development
- Zoning & Ordinances
- Neighbors

Poor site selection

Good site selection

Thermal System

Building Form

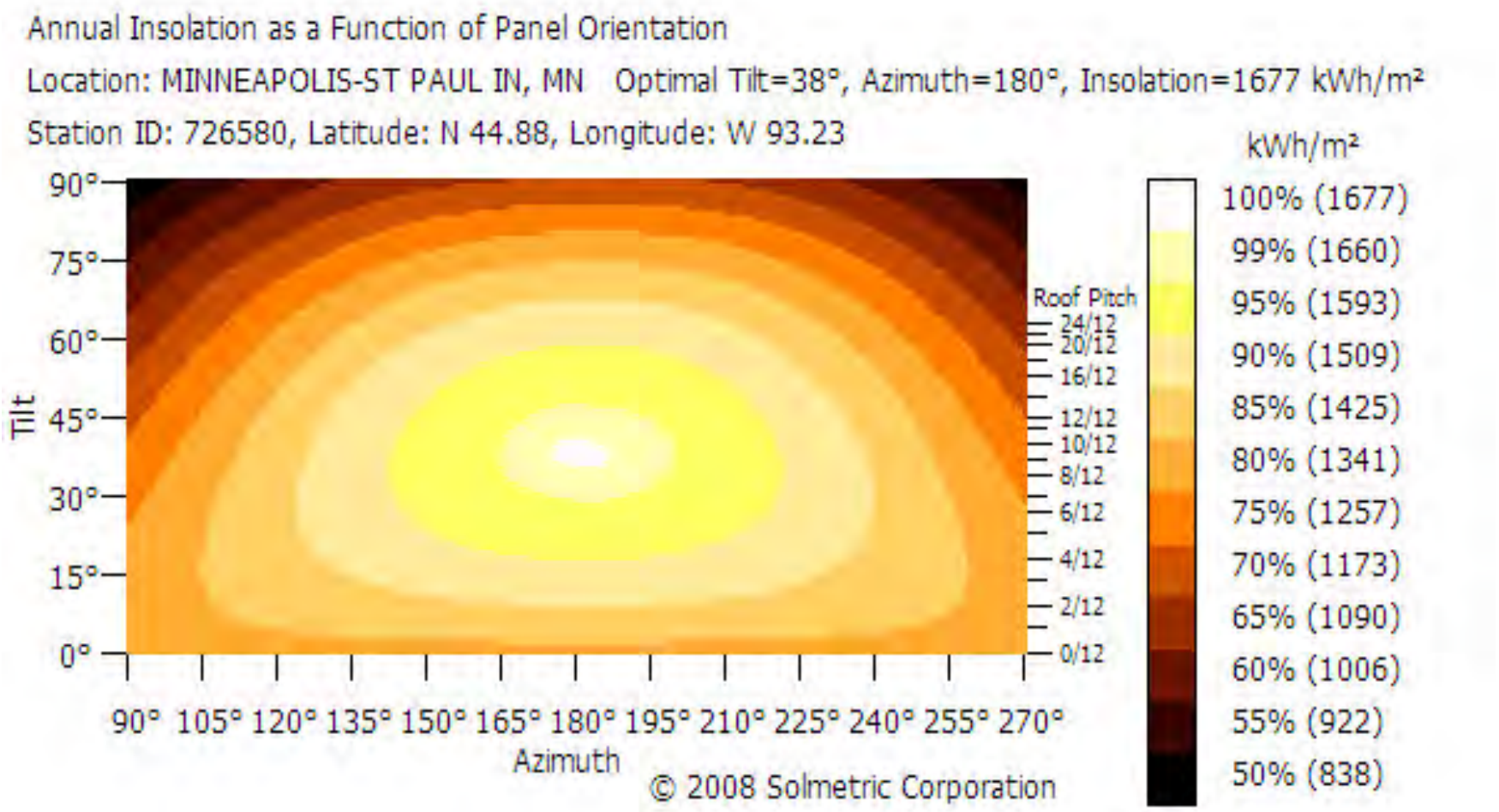
- Think of the area for solar as an essential space in the building program.
- Rule of thumb is 80 sq. ft. for 1 kW of PV and 130 sq. ft. for typical thermal application.
- Determine the size for the future solar array.

- Plan the building form - building height, roof projections, etc. – so that the roof area reserved for the solar array can receive the maximum amount of sun exposure.

Orientation

- Keep in mind that solar is just one aspect of a building's design. Southern orientation is necessary in almost all cases, but tilt is more forgiving.
- In Minnesota a 38° tilt is optimal for PV, but anything between 20° & 45° is good. 10:12 pitch = 39.81° 6:12 pitch = 26.57°
- Thermal is between 90° & 90°

The Tilt Effect:



At Tilt: 37 º and Azimuth: 179 º, Annual Insolation: 1677 kWh/m^2 (TOF: 100.0%)

www.solmetric.com

Space Planning

- PV systems need an inverter, AC & DC disconnects, and monitoring equipment.
- Designate a 3’ x 3’ space with a 3’ wide clearance next to the service panel.
- Best to locate the service area directly below the array area.

PV Equipment

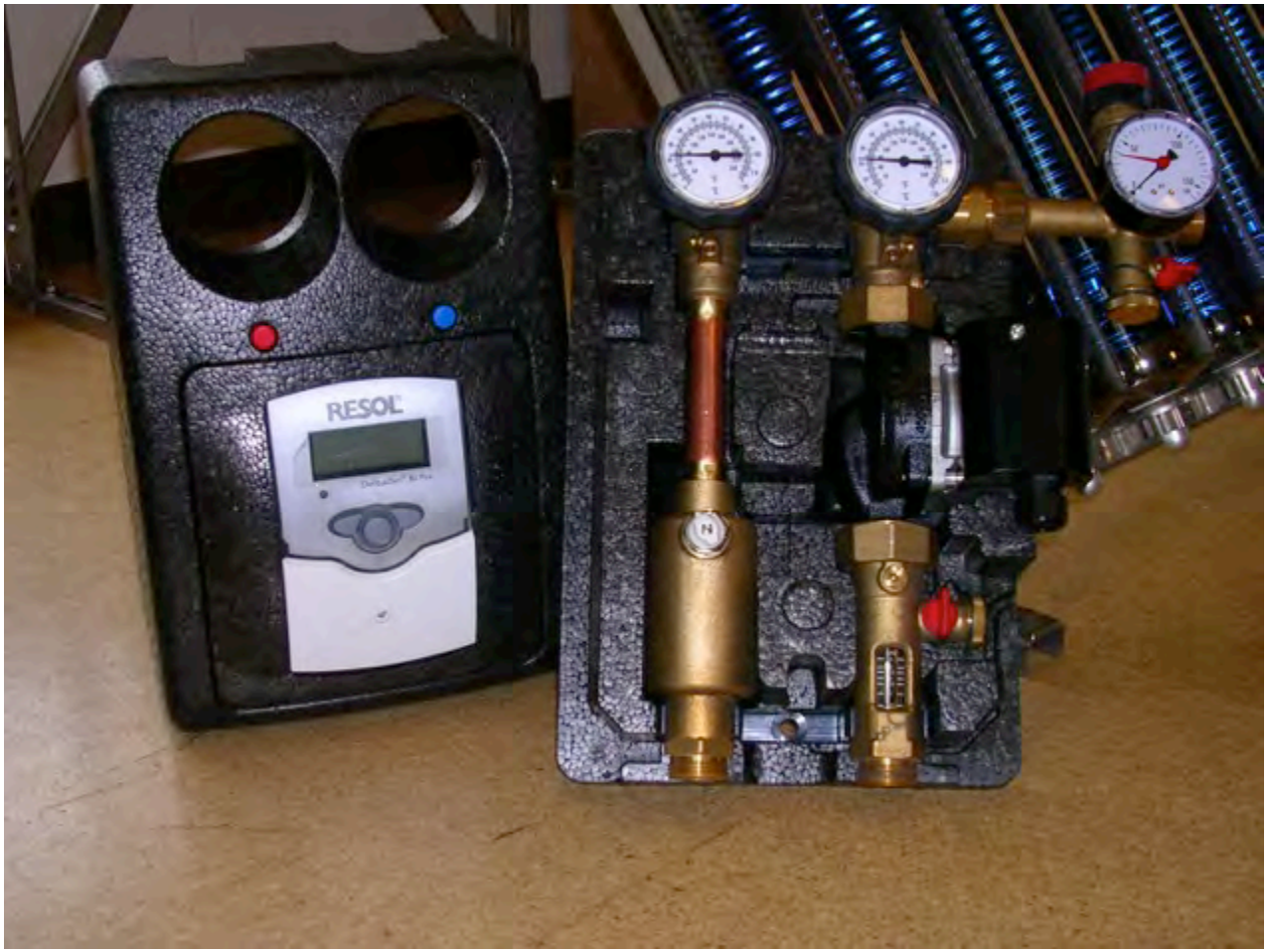
PV on Exterior

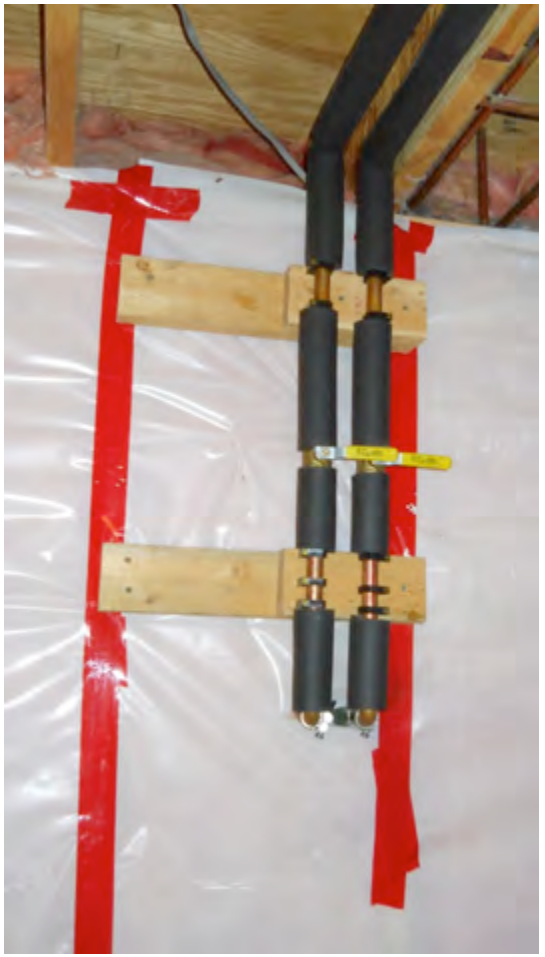
Basic PV Planning

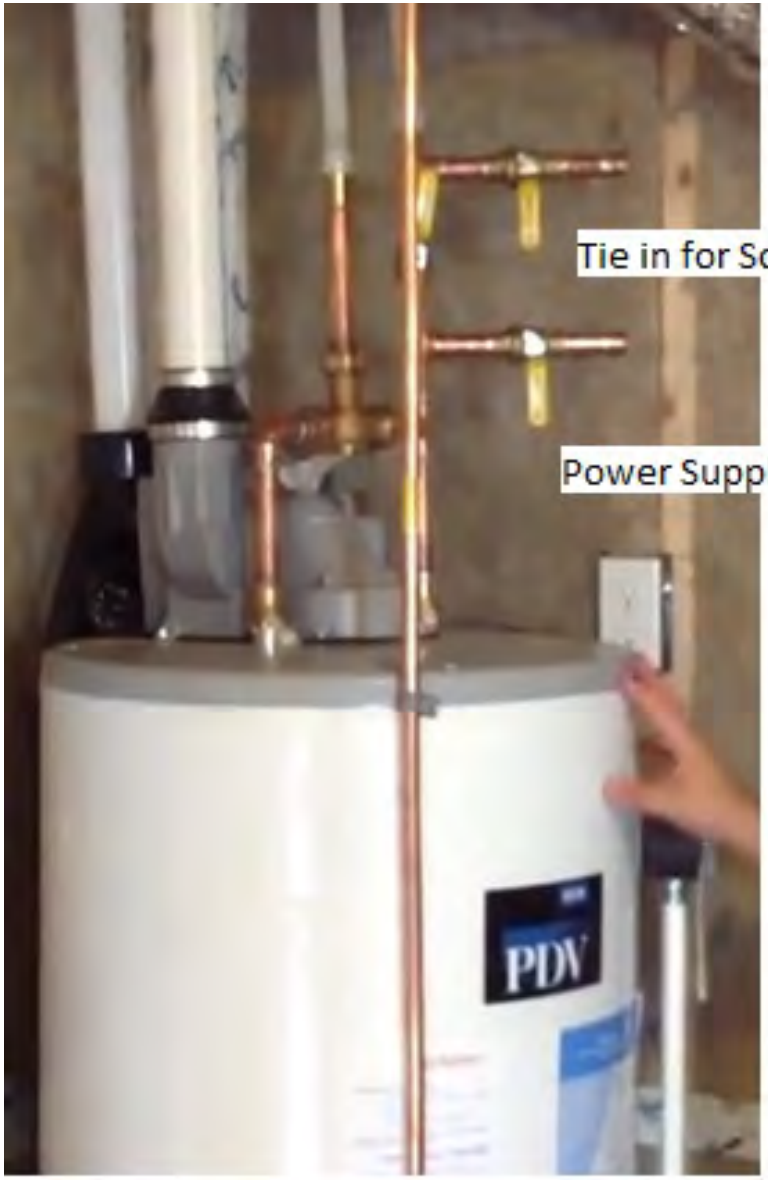
- Meter on the house
- Roof
  - Clear south face.
  - Pitch 10/12 or 12/12
- Standing Seam Metal Roof
- ¾” EMT from Mechanical to Attic
  - No more than 360 degrees (4 elbows)

Thermal Systems

- Thermal systems need space for storage tanks, pressure tank, pumps, and controls.
- Locate a continuous shaft in the floor plans for supply and return from the collectors to the storage tanks.
- Determine the amount of storage needed, Typically 80 to 120 gallons.


RESOL




Tie in for Solar
Power Supply
PDV

Basic SHW Planning

- Roof
  - Clear south face.
  - Pitch Not as important
- Standing Seam Metal Roof
- Two ¾” insulated pipes from Mechanical to Attic (color coded for hot and cold)
- Sensor wire

Roof Planning

- Location and size of the area with solar access depicted on the roof plan.
- Structural design that addresses the loads imposed by the future solar array.
- Description of roofing material and system.
- Inform the trades of the location of the array and the intention.

Flat roof standoff

Roof Vent Placement

Mechanical & Electrical

- A 2” metal conduit is needed to house the wiring.
- Provide sufficient space in the electrical panel. (Bottom left corner)
- Location for production meter next to main meter.
- For Thermal a ¾” insulated copper supply and return along with a sensor wire.

Resale Value

- A study by Lawrence Berkeley National Laboratory found solar not only saves money on electric bills, but also provide a boost to homes at resale.
- The study found that solar added about $5.50 per watt to the resale value of a home.

Resources for Building Companies & Their Customers

- **Department of Commerce Solar Helpline**
  - (651) 539-1848
  - Solar.Help@state.mn.us

- **Solar America Communities**

National Renewable Energy Laboratory
  - (303) 275-3000
  - www.nrel.gov

- **CR Planning, Inc.**
  - (612) 558-4904
  - www.crplanning.com

Thank You

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Division of Energy Resources

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