Solar for New and Existing Buildings– Guidance for Contractors

In accordance with the Department of Labor and Industry's statute 326.0981, Subd. 11,

"This educational offering is recognized by the Minnesota Department of Labor and Industry as satisfying **1.5 hours** of credit toward **Building Officials and Residential Contractors code/energy** continuing education requirements."

For additional continuing education approvals, please see your credit tracking card.

Powerfully Green
Installing solar since 2007

Rebecca Lundberg

* NABCEP Certified Solar PV Installer ®
* Owner/CEO Powerfully Green
* Licensed MN General Contractor
* Experienced MN teacher

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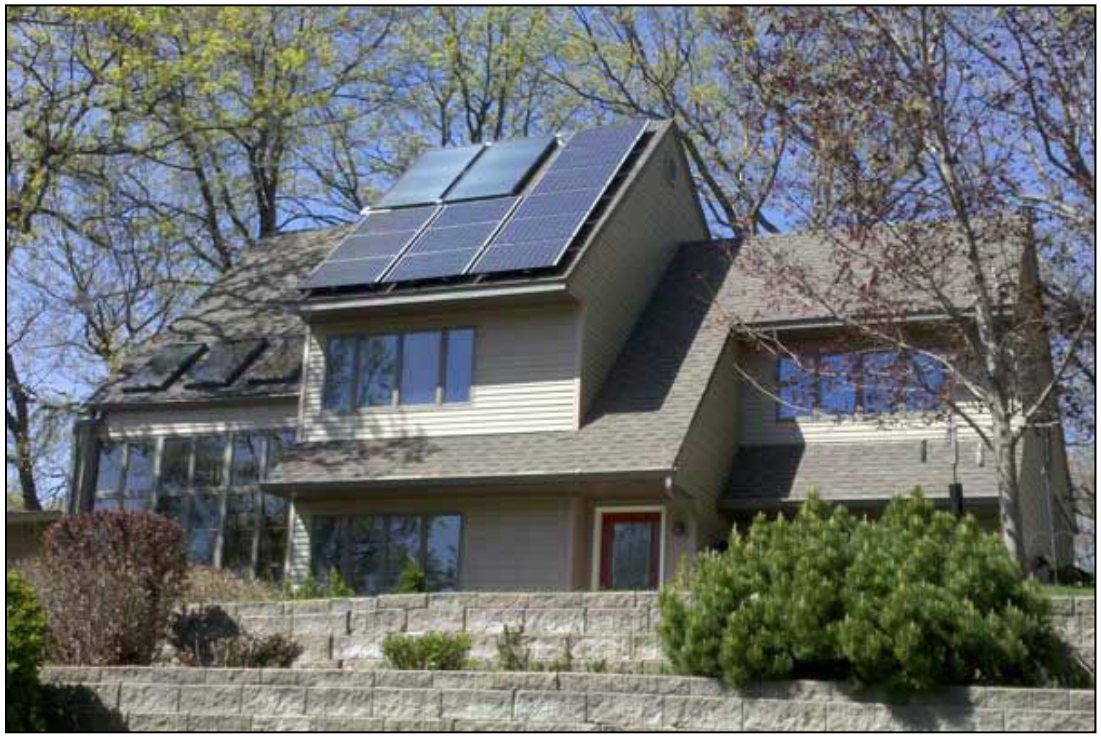
* NABCEP Certified Solar PV Installer ®
* Owner/Vice President Powerfully Green
* Vice President, MnSEIA
* 26 years in the construction business

What is Solar Power?

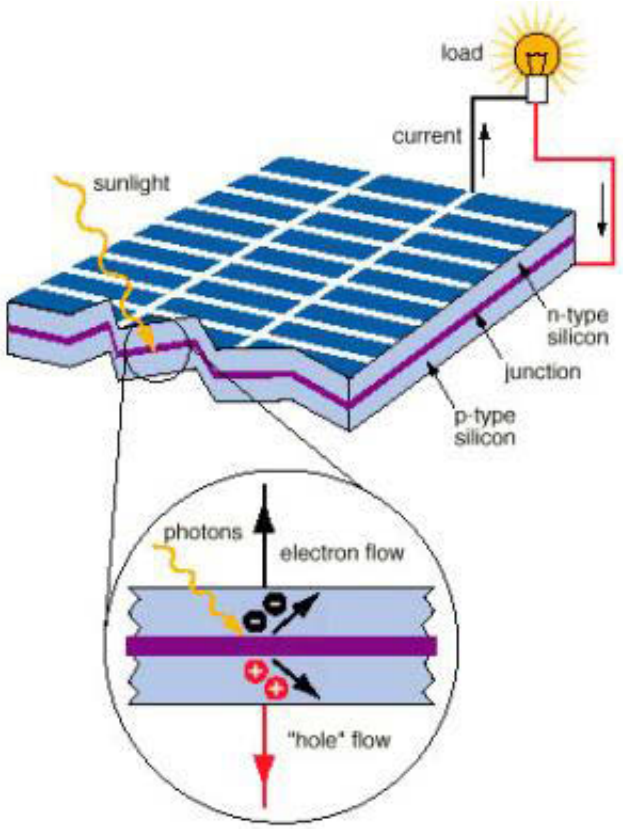
Energy that comes from the sun

- Two main technologies
  - Solar Thermal
  - Solar Electric photovoltaic (PV)



Solar electric
Photovoltaics (PV)

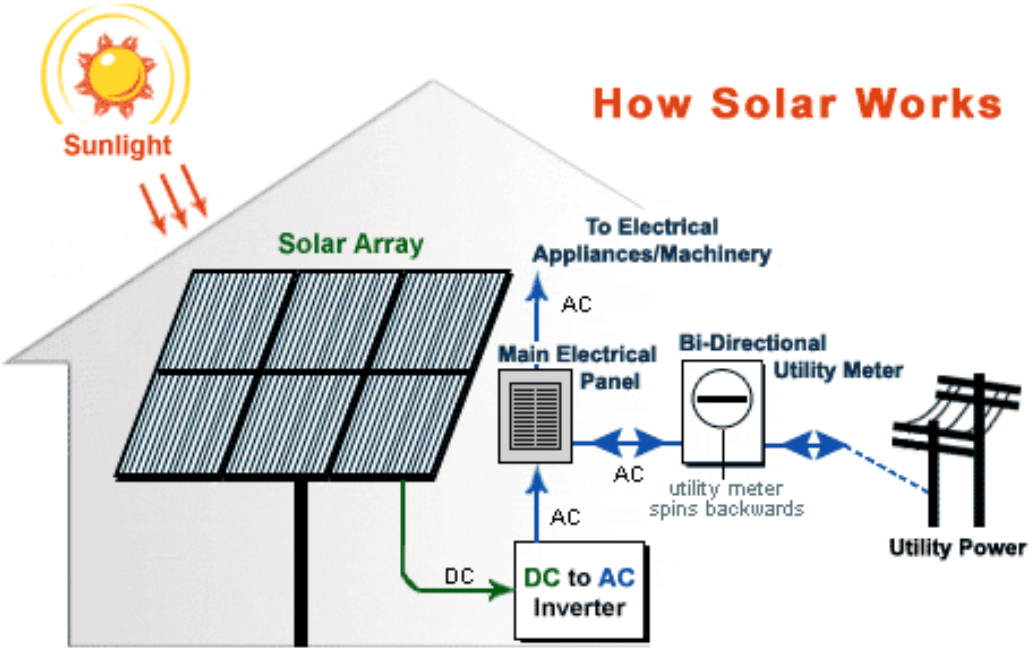
A PV cell



*Our society is becoming all-electric

*We can sell and/or store extra electricity

Parts of the grid-connected PV system



Coming soon – affordable battery backup?

Mounting Options in Urban Settings

The roof is there anyway, why not use it to power the home?

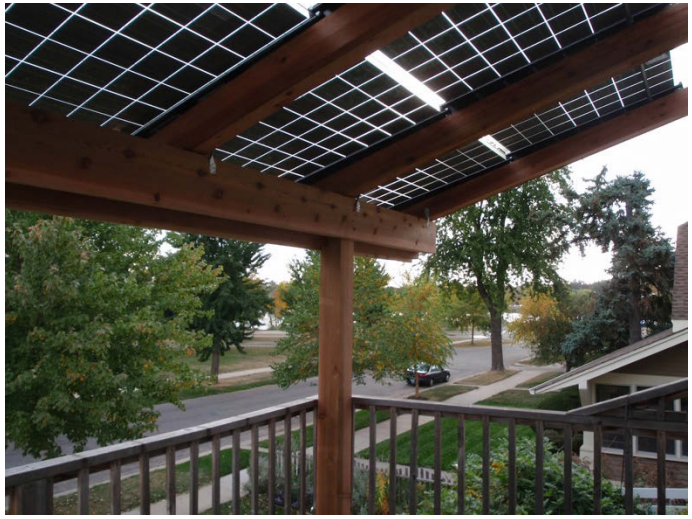
Asphalt shingles <u>really</u> aren't especially attractive (tar with sand on it, sometimes colored sand) we're just used to them. We can get used to looking at solar panels!

Mounting Options in Urban Settings

Building-integrated structures like pergolas and decks

Mounting Options in Urban Settings

BEFORE



AFTER: Solar on small hip roof and patio covering over balcony

Roofs in Rural Settings

Morris, MN

Buffalo, MN

An otherwise unused roof…

Powers the home, farm, and geothermal system

Pine City, MN

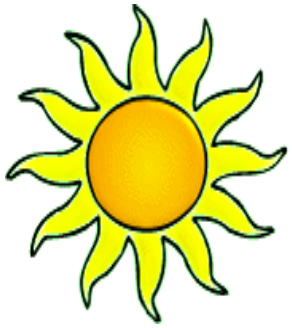
Ground-Mounted Solar

Bauer Berry Farm,
Champlin, MN

Residential ground mount
Woodbury, MN

Residential pole mount
Star Prairie, WI

Is it Adjustable? (on a roof?)



- The short answer is NO. Not unless it's a pole mount.
- Tipping the modules off the roof adds wind load, now we need a professional structural engineer, and your building inspector is wary.
- Today's incentives are performance-based and solar cells work great in diffuse light, flush-mounted is almost always the best choice, structurally, and aesthetically.

Is it Adjustable?

Only pole mounts are really adjustable

Structural Considerations

Live load for roofs:
5/16” x 3” lag screw, pull out strength
designed for 90 mph wind gusts

Standard flashing for composition roofs

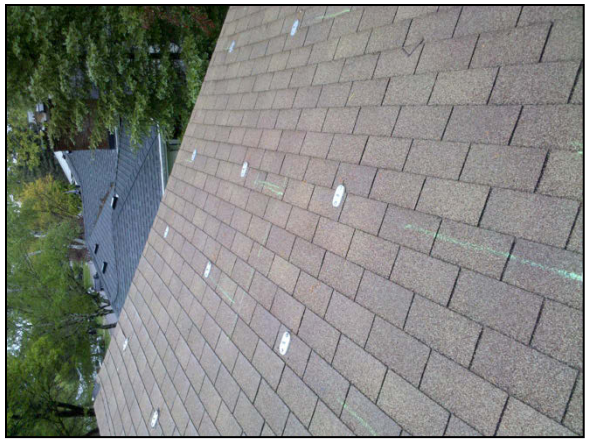
Dead load for roofs:
2.6 lbs/sq ft for pitched roof
~5-7 lbs/sq ft ballasted 10 degree pitch
~8-15 lbs/sq ft ballasted 20-30 degree pitch

Roofing Materials and Solar: Standing seam metal roof

Working together:
roofer flashes junction box like any other vent

S-5! clamps
Firmly attach the roof, every 1.5-2' (not 3.5-4')

Roofing Materials and Solar: Metal shingle roof or fake shake



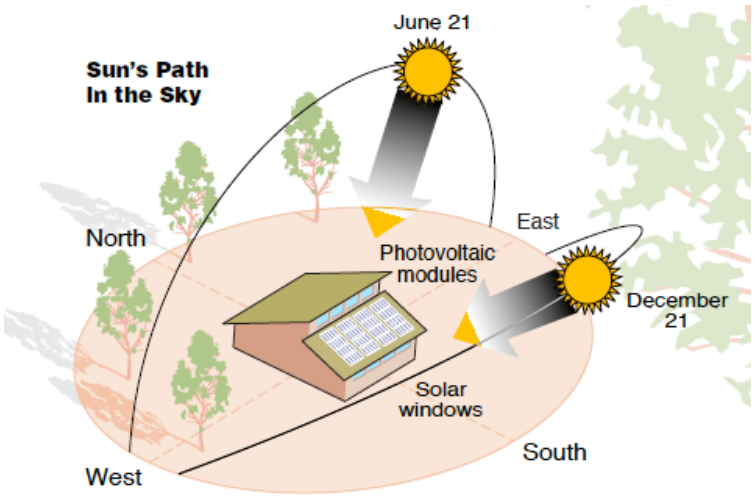
1. Solar stanchions & Soladeck

2. Oatey flashing (roofer)

3. Solar racking

4. Solar modules

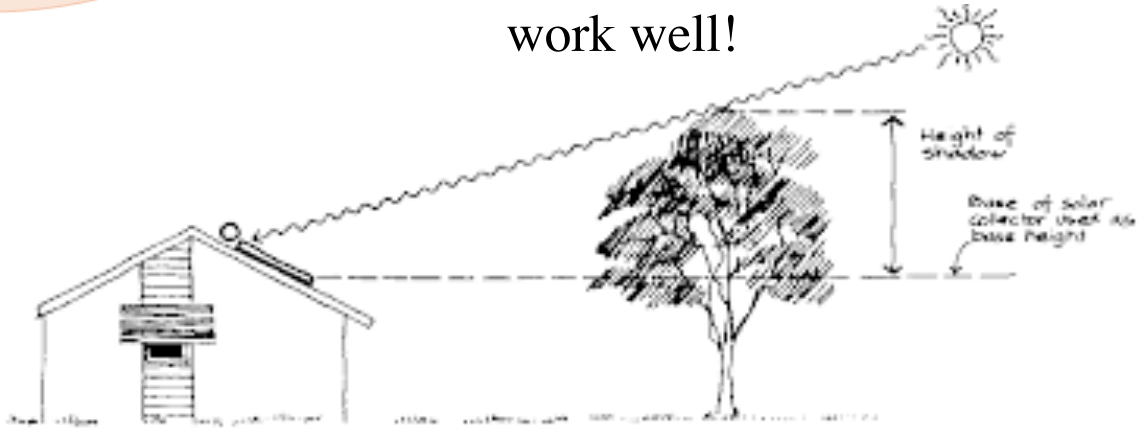
Landscaping with Solar in Mind



South-facing solar panels is 'ideal.'
Southeast/Southwest still really good.
East/West about 85% of ideal, still good.
Shade-free is the most important thing.

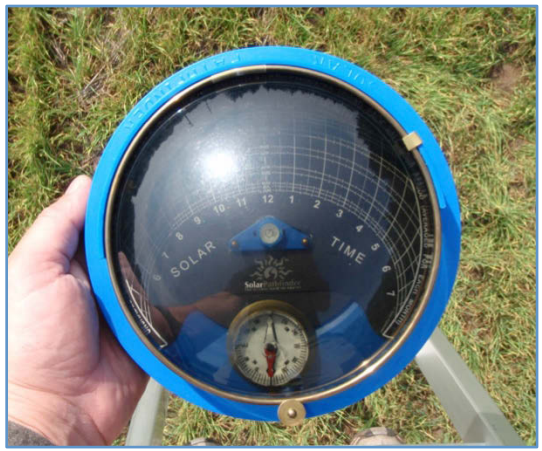
A little trigonometry made simpler: An object will shade 2.5 - 3 times it's height

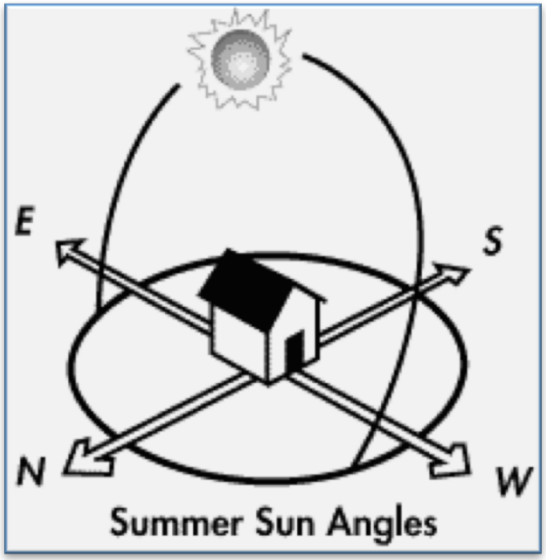
Solar panels need to be in the sun to work well!

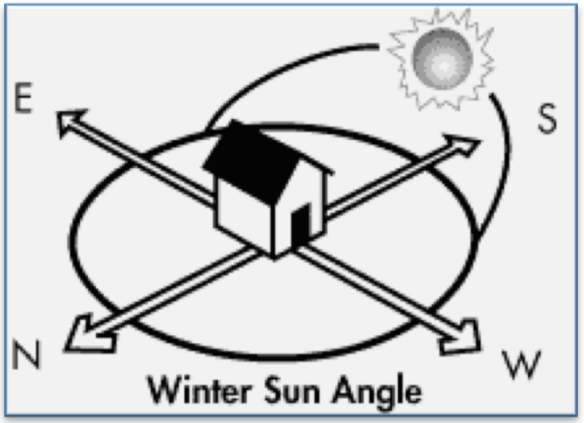


Adding Solar as an Option for customers

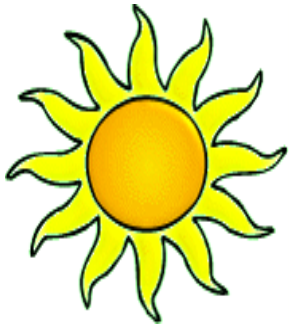
Solar panels turn sunlight into electricity – find a sunny spot







Planning for Net Zero Energy



NET ZERO *definition*:

Building Consumption + Energy Generation = Zero

Any energy generation counts – solar, wind, micro-hydro
There is no shortcut! "Net zero ready" is not net zero. Building well without thought to energy generation is not net zero.
Set the bar high, and make it happen. Our future sustainability needs us! **It's not that hard.**

Different than *off grid*.

Both parts of the equation are movable, some consumption variables are climate-based and site specific. There's a balance. RE options are site specific. Sun falls everywhere on the planet.

Planning for Net Zero Energy

Start with the DESIGN. Then put the design into action.

2009 Solar Decathlon (will you build it?)

Build ‘right!’

↓

Energy needs

↕

Solar

Planning for Net Zero Energy

The roof is going to be there anyway,
why not power the community with it?

Planning for Net Zero Energy

Michael & Linda Gallagher
Peacefield Farm
Stanchfield, MN

Planning for Net Zero Energy

Black Hawk, CO

HERS Modeling Assumptions

Modeled by: Max Nuttelman

Address of Residence: 0 Feldspar Road, Black Hawk, CO

Conditioned Floor Area (based on HERS definition, may differ from building jurisdiction): 283

	Component	BASE: U-0.19/SHGC-0.24 windows w/PV	
Envelope	Foundation walls	Basement walls: R24 closed cell; crawl walls: R19 vinyl batt	
	Foundation floor	R30 underslab AND R10 perimeter at exposed sections (from 48" below grade to top of slab)	R30
	Frame floor over ambient	R61 (7" closed cell foam and R13 batt)	
	Rim/band joist	R61 (7" closed cell foam and R13 batt)	
	Above-grade walls	R61 (7" closed cell foam and R13 batt)	R60
	Windows	U-0.19, SHGC-0.24 at all windows, full lite doors, and sliding/patio doors	U-0.12
	Roof/ceiling	R61 (7" closed cell foam and R13 batt)	R70
	Air leakage	1 ACH50	
Mechanicals	Heating system	ASHP, HSPF 10.3	
	Cooling system	ASHP, SEER 20.2	
	Domestic hot water	120 gallon electric, EF 0.94, backup for solar thermal	
	Location of ducts	N/A	
	Program. thermostat?	Yes	
	Mechanical ventilation	Balanced, 80% sensible recovery efficiency	
Appliances and Renewables	Refrigerator	400 kwh/yr	
	Dishwasher	280 kwh/yr	
	Clothes washer	Energy Star	
	High efficacy lighting	100%	
	Photovoltaics	18.9 kW south-facing, 30 degree tilt (84-225W panels)	
	Solar thermal	4-panel (128 sq. ft., 30 degree tilt, single glazing, flat black w 120 gal tank; DHW	
Projected HERS score		-39	

Initial HERS rating to compare windows came in at -39!

Windows on the 'wrong' side? Not with this view!
Building is site-specific, net-zero energy design is a constant.

Planning for Net Zero Energy

Line-side connection at the meter.

Wow look at all those solar panels!

No -- Look at how many solar panels you can fit if you think ahead (72!)

20.52 kW PV, 3 SHW, 1 SAH
10 kW for the all-electric net zero energy house
10 kW for the all-electric vehicle
No more fossil fuels, EVER.

Growing with ‘net zero’

1.82 kW on the back of the house

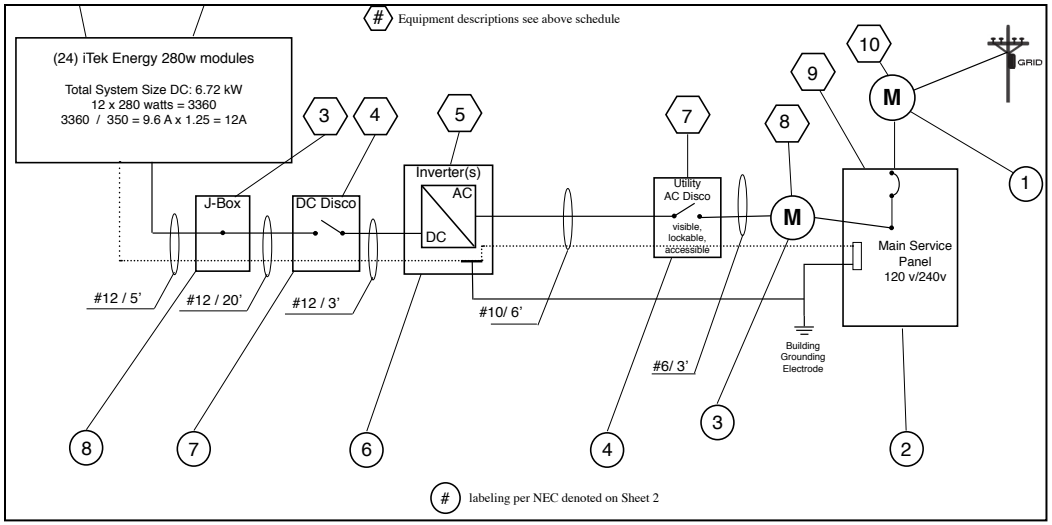
2.16 kW as a patio pergola with double-glass modules

* Original system = 1.26 kW on south-facing garage roof in 2007, domestic hot water added in 2008.

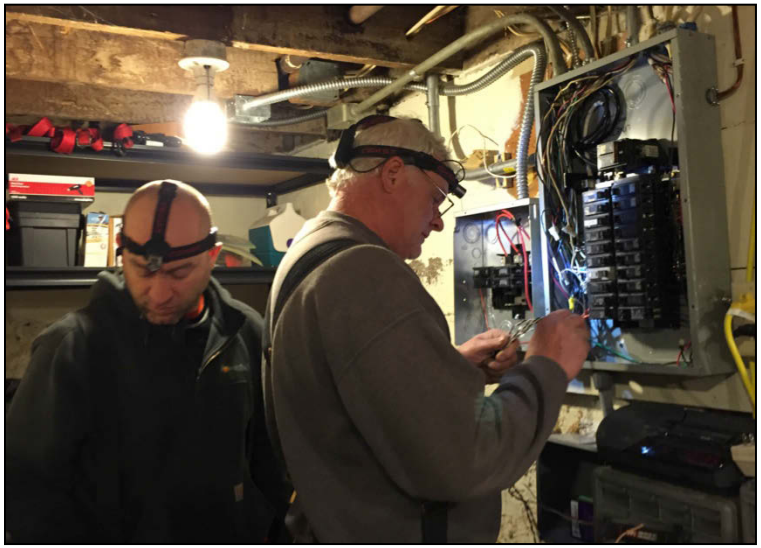
Added 3.825 kW to parallel the east-facing front of the house roof when we got a plug-in vehicle.

Total: 9.065 kW

Integrating Solar with the Electrical Plan

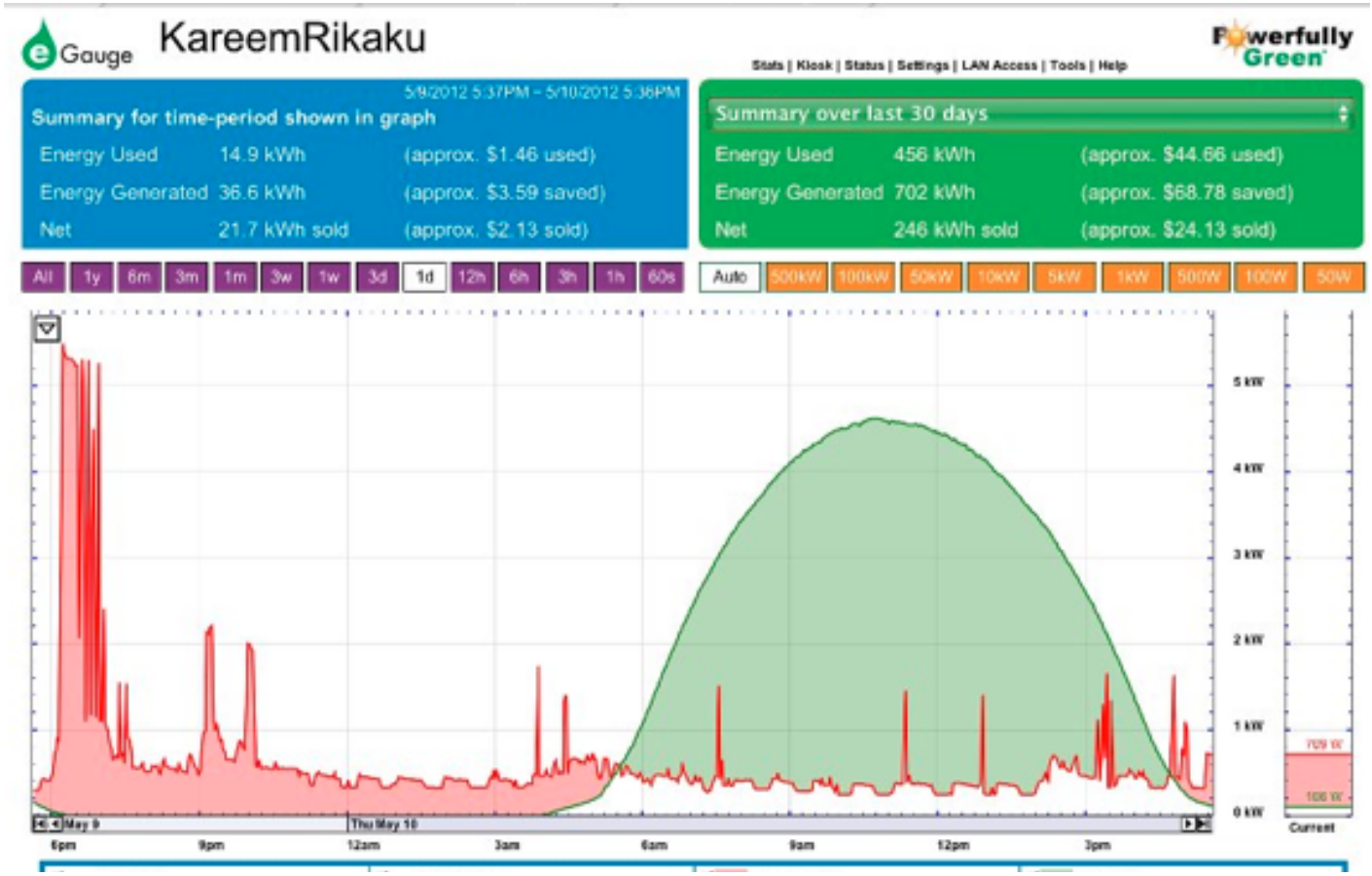


Solar connection details depend on the site and the exact system components. Backfed breaker often needs a 225A busbar, line side connection is easier with a 200A Milbank meter socket. Let's plan ahead together!

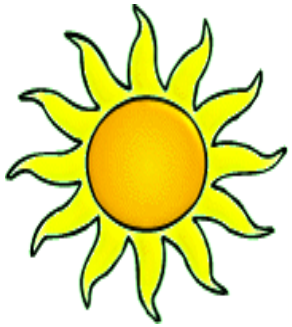


Monitoring the Home

- Solar System monitoring – LIVE data
- Whole building use, where do my kilowatt-hours go?



Planning for Solar



Some details are important!

- Roof real estate, roof type
- Landscaping
- Getting the electricity from the roof to the mechanical room
- Electrical interconnection

= ‘SOLAR READY’

“Solar Ready”

Edina, MN (2003)

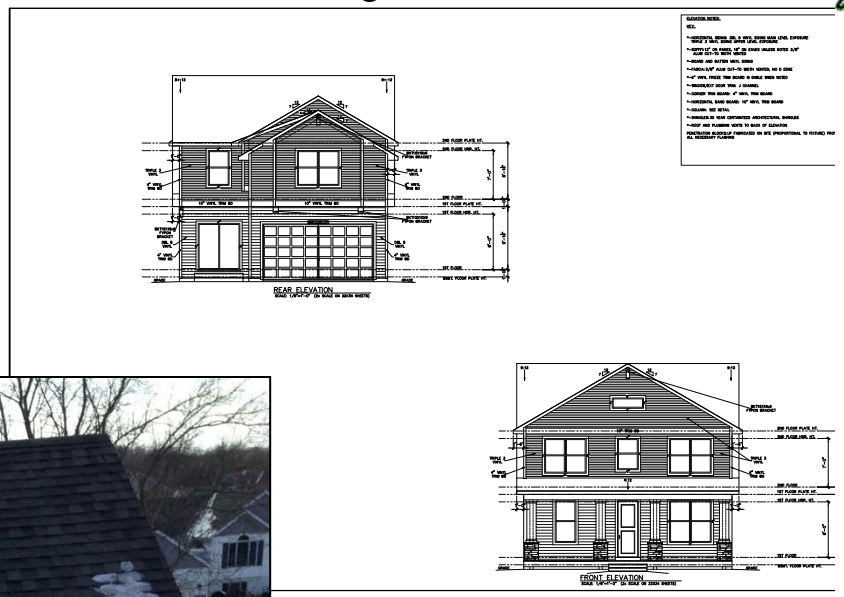
Inside chase and an extra conduit to outside for the solar production meter made an inside run possible.

Even a high-end home with a complicated roof line can set aside a large south-facing (rectangle) roof for solar panels.

“Solar Ready”

Eden Prairie, MN (2015)

A ‘Net Zero Community’ ?

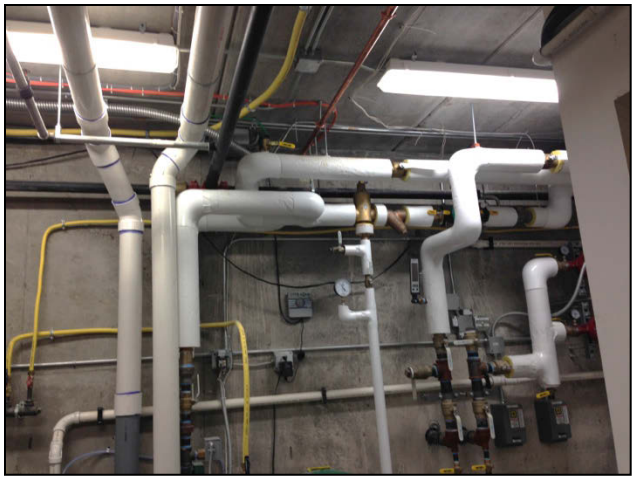


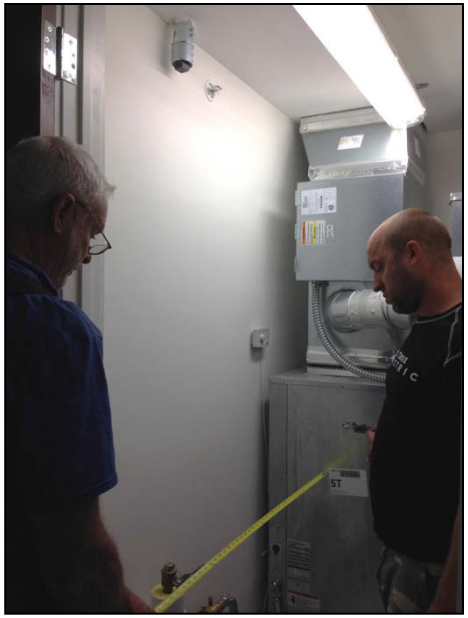
We were involved before any homes were built, and discussed net zero design with the builder.

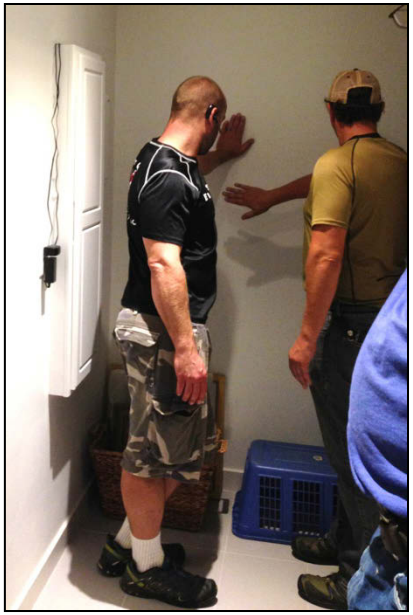
The ONE (little) roof surface on the model home that was ‘designed for solar’ ends up with ALL of the vent stacks and faces just north of west. Really?

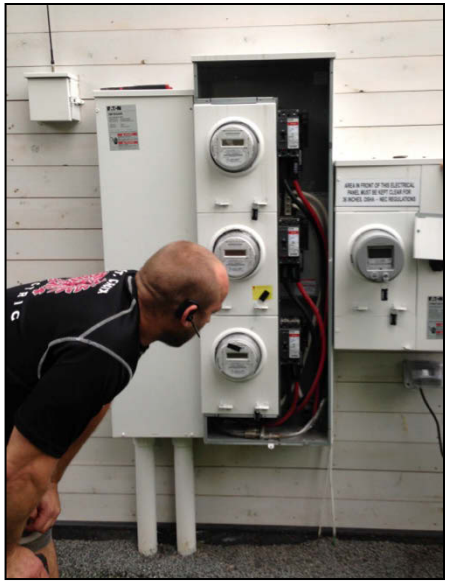
“Solar Ready”

Minneapolis, MN (2015)



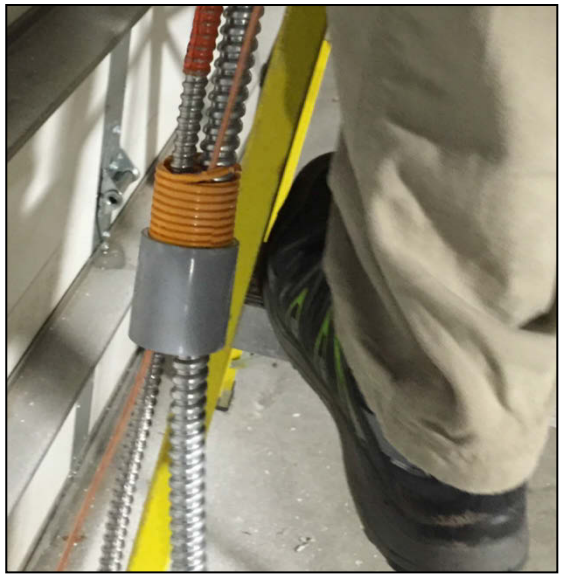






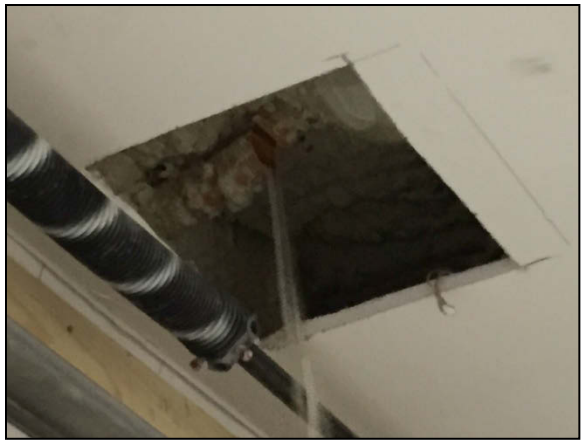
“Solar Ready”

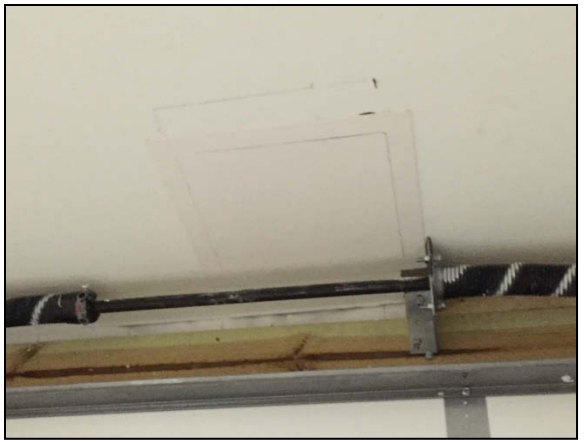
Minneapolis, MN (2015)



“Solar Ready”

Minneapolis, MN (2015)





“Solar Ready”

Minneapolis, MN (2015)

Successfully completed!

Working with Solar Professionals

Solar is a specialty trade. Every site is different.
Lots of details! Incentives change. Costs vary.

Ways to work together:

- Cross-refer customers
- Referral fee, flat or $/watt
- Collaborate

Powered by the Sun!

We have the technology.
Solar is going mainstream!
Working together for a
sustainable future.

Powered by the Sun!

The people of the world demand a change. Think BIG!