



Seattle City Light



City of Seattle  
Department of Planning and Development



# Solar Works! In Seattle: Introduction to Solar Electric (PV)



Carkeek Park  
June 13, 2009

# Workshop Agenda

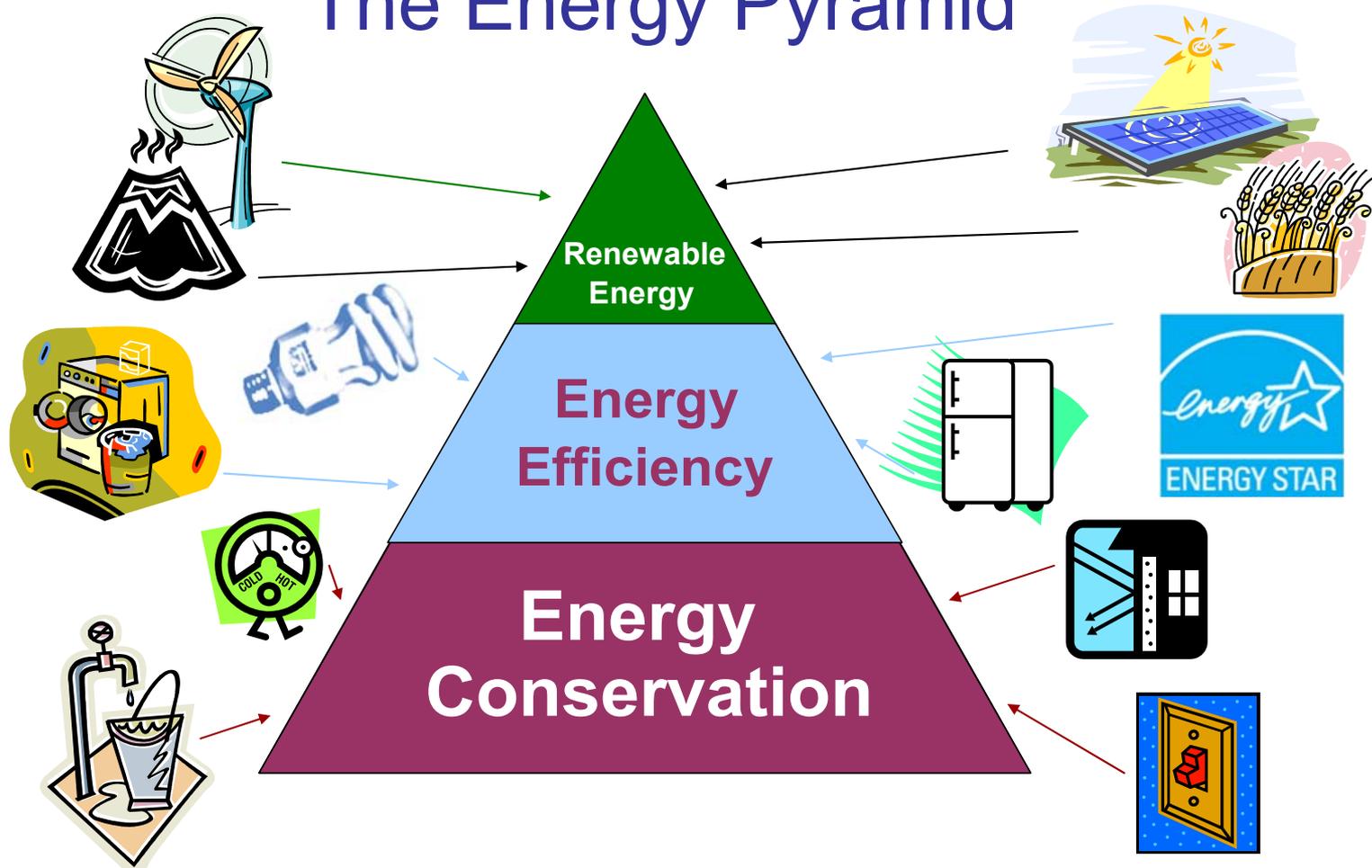
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- Introduction
- Seattle's solar energy resource
- How PV works
- System types and components
- Evaluating your site
- Maintenance
- Getting started- contracting and permitting
- Costs and Incentives



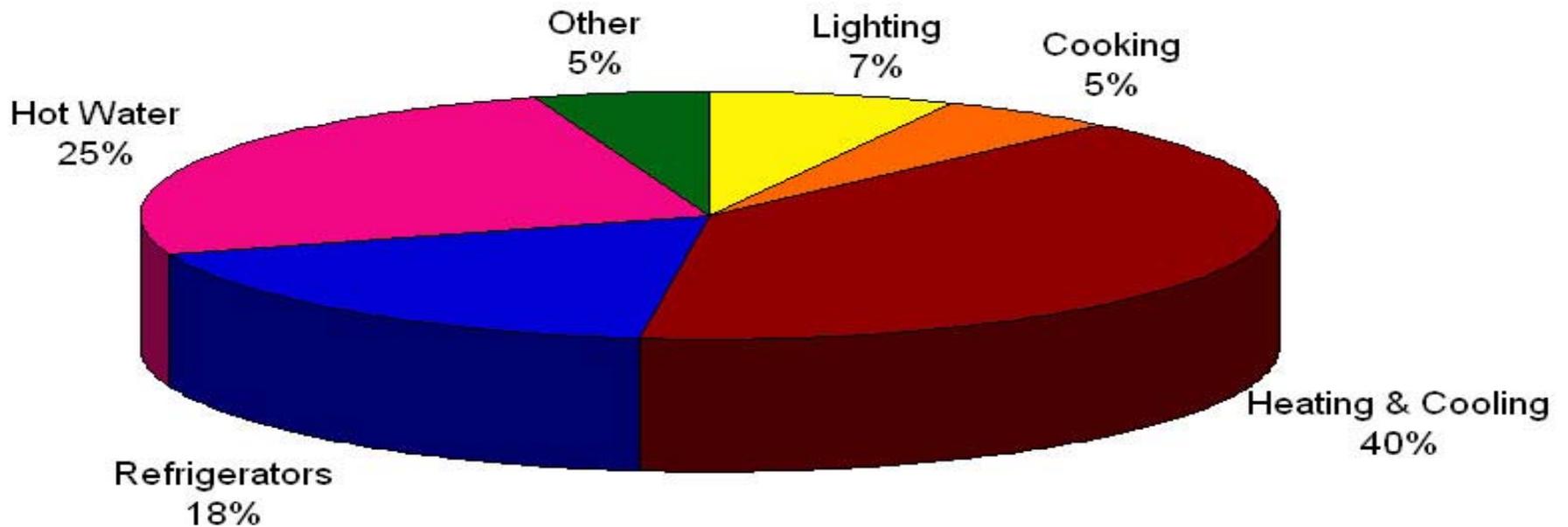
# Conservation and Efficiency FIRST!

## The Energy Pyramid



# Make the biggest impact in your home

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Source: WA CTED

# Benefits of Renewable Energy

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- Creates no climate changing emissions
- Cleaner air = better quality of life
- Increases independence from foreign sources of energy
- Contributes to local economies
- Can be “distributed”- power source closer to load bring benefits and efficiency to grid

# Solar's Unique Values

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*Photo credit: Sun Wind  
Concepts  
PCC Market in Fremont*

# Technologies

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Solar Energy can be harnessed via:

- **Solar Electricity  
(Photovoltaics, or PV)**
- Solar Water Heating
- Solar Space Heating



# Does solar energy work here?

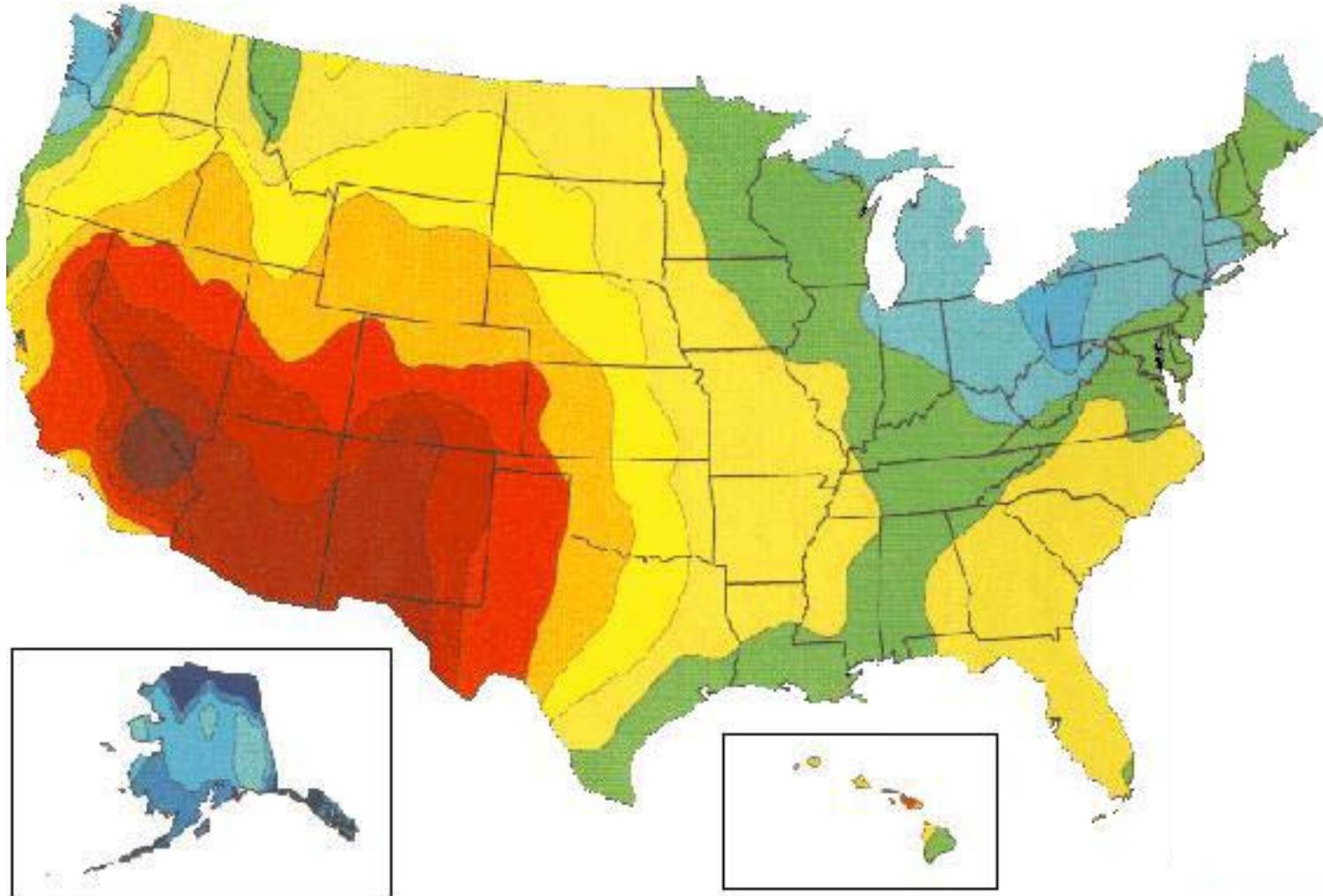


# How about here?



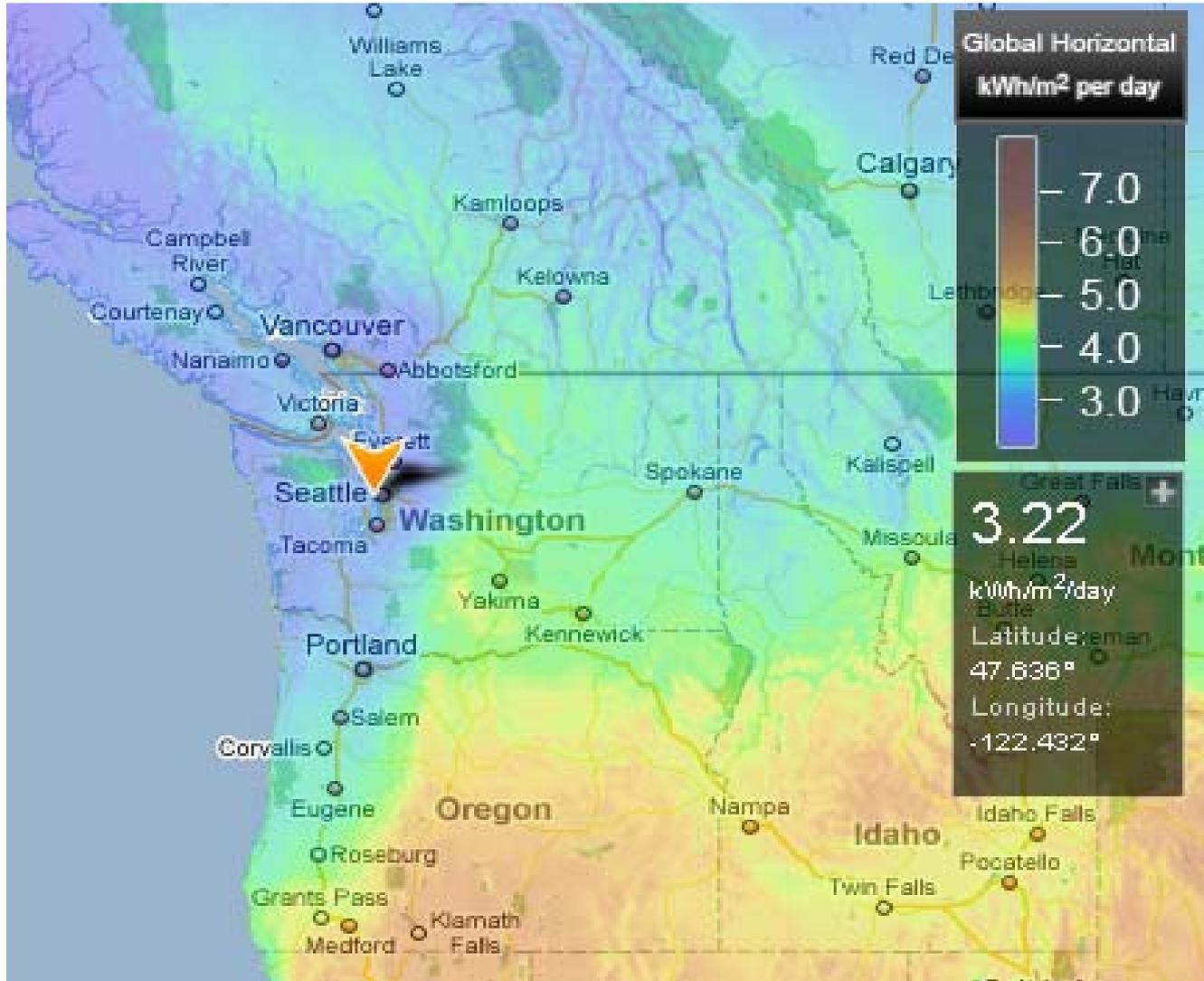
# Does solar energy work in Seattle?

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Source: NREL

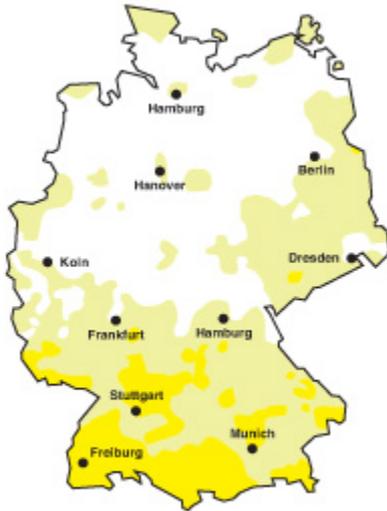
# A Closer Look



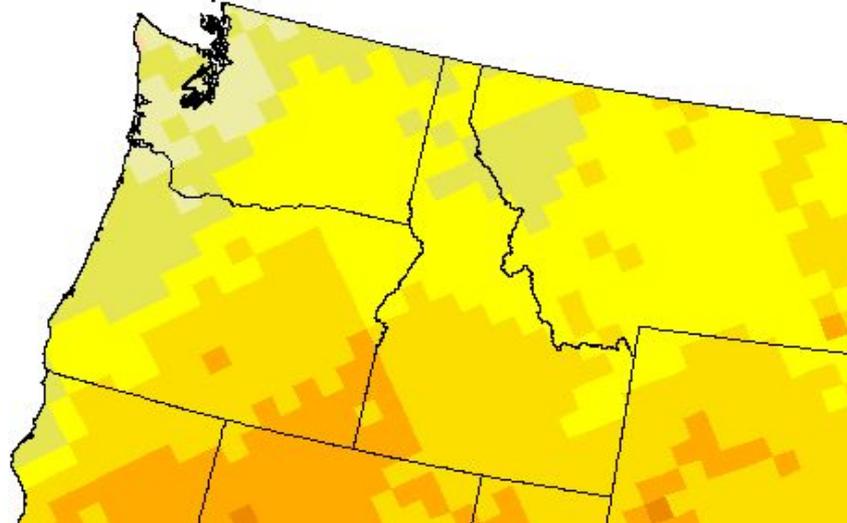
Source: FirstLook  
from 3TIER

# It's All Relative

- Average solar radiation in Seattle is 15% greater than in Germany



Germany



Northwest, USA

# How PV Works

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**Photo = Light...Voltaic = Electricity**

- Cells are made of semiconductor material (silicon).
- When light hits the semiconductor, energy is absorbed, knocking electrons free.
- Resulting current is captured through metal contacts and wires.

**Most electricity is produced on clear days and when the sun's rays are hitting a panel at a perpendicular angle**

# Electricity Terms

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- A Watt is a RATE of energy use or production
- Over time, producing energy at a certain rate, will give you an AMOUNT of energy.
- A Watt-hour is an AMOUNT of energy.
- 1000 Watts = 1 kilowatt
- 1000 Watt-hours = 1 kWh

A 100 Watt bulb x 10 hrs of use = 1 kWh used

A 23 Watt CFL equivalent could run for  
43 hours using the same amount of energy!!



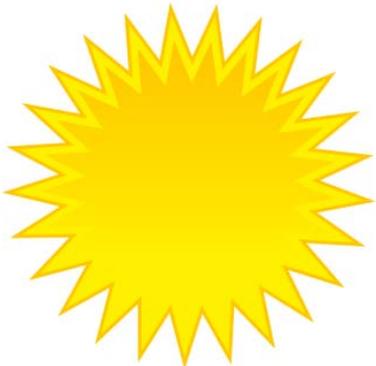
# Putting Terms to Use

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- Resource
- Capacity
- Production of energy

**In Seattle:**

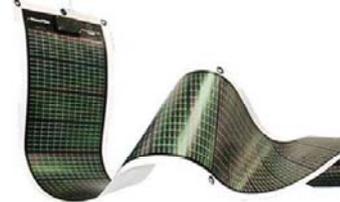
**1 kW of PV will (on average) produce 1000 kWh per year!**



# Types of PV

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- Mono-crystalline silicon
- Poly-crystalline silicon
- Amorphous Silicon (used for thin-film)

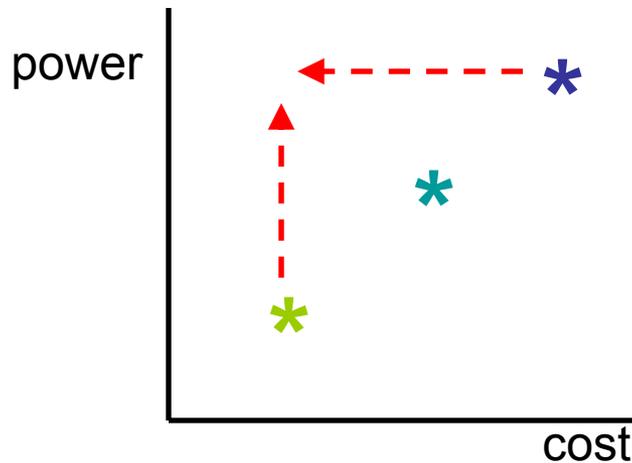


# Types of PV

- Mono-crystalline
- Poly-crystalline
- Amorphous Silicon

Cost to Produce

Efficiency



# Applications

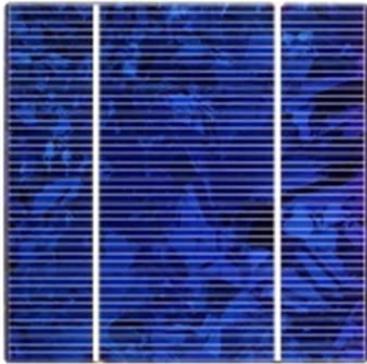
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- Stand-alone (off grid)
- Grid-connected
- Grid-connected with battery backup



# PV System Components

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Cell



Module

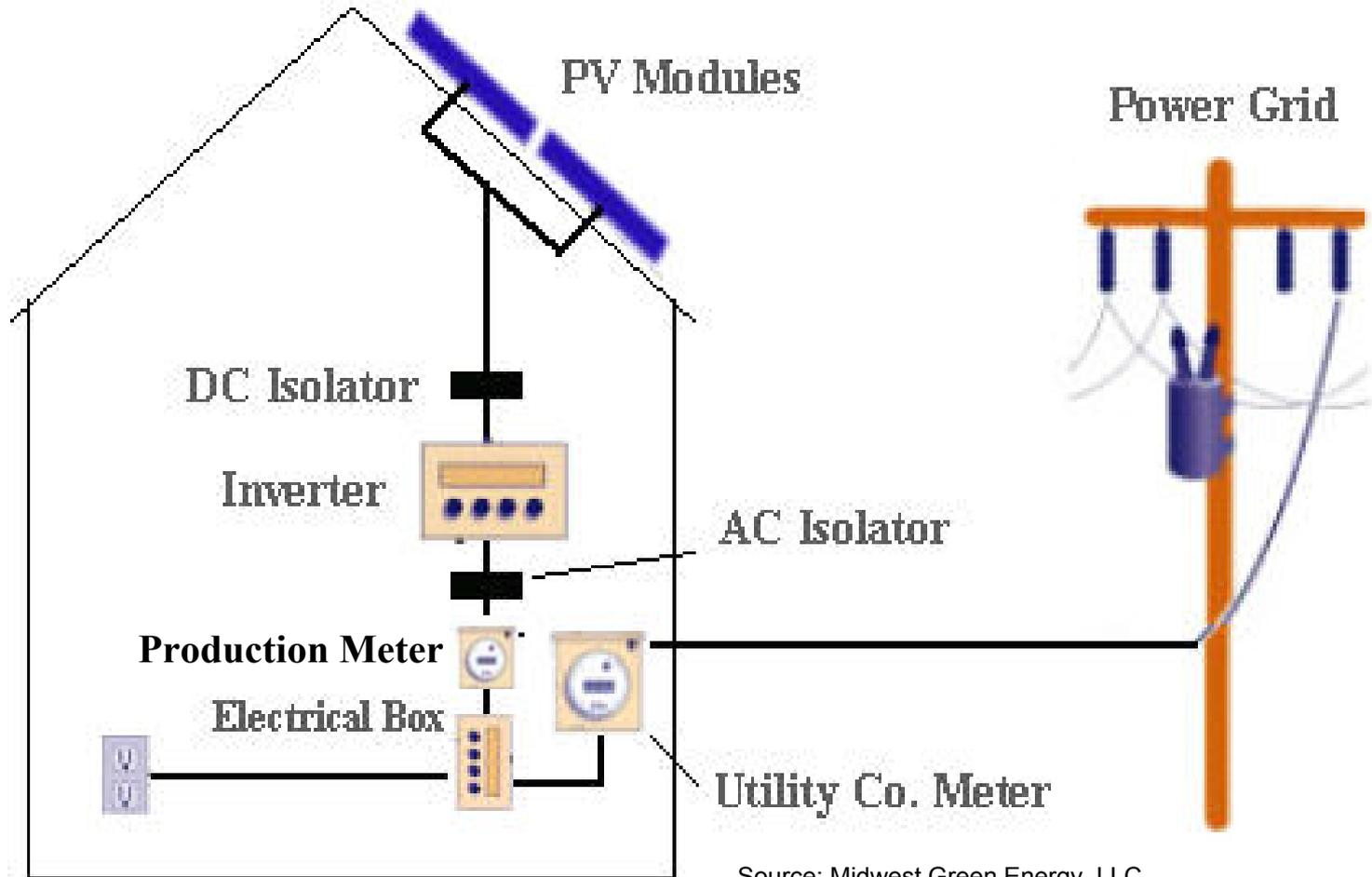


Array

- Inverter
- Mounting hardware
- Meter(s)
- Batteries (optional, for back-up power)

# How they come together

- A grid-tied system



Source: Midwest Green Energy, LLC

# How they come together



Source: Seattle City Light  
Red Cup Espresso, West Seattle

Break...

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# Will Solar Work for You?

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1. What are my goals for going solar?
2. Does my roof face South (or North, East, West)?
3. Are there trees or objects that shade my roof?
4. How much roof space is available?
5. How old is my roof?
6. What size investment can I afford?

# Site: Orientation (or Azimuth)

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Roofline & street map

OR

Compass: don't forget about declination

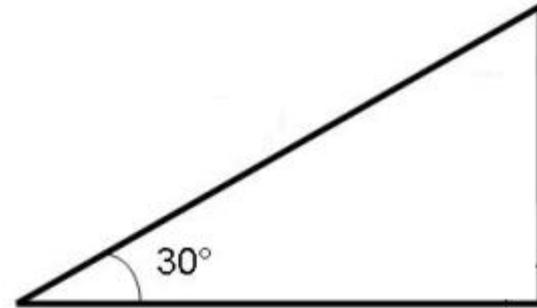


National Geophysical Data Center:  
<http://www.ngdc.noaa.gov/geomag/>

# Site: Tilt

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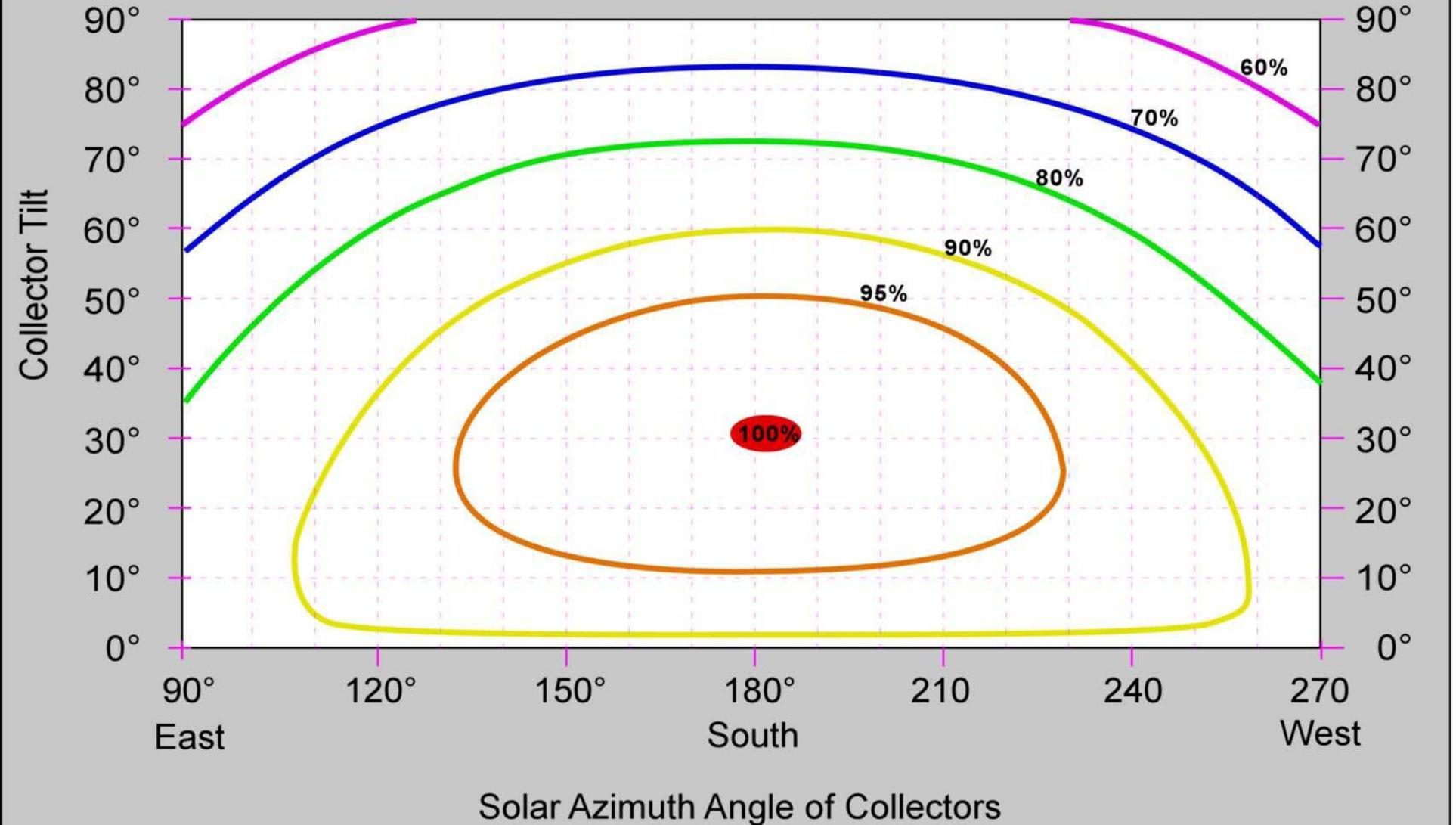
<u>Roof pitch tilt</u>	<u>Degrees tilt</u>
3:12	14.0
4:12	18.4
5:12	22.6
6:12	26.6
9:12	36.9
12:12	45.0



Rule of thumb:  
Optimal for solar =  
Latitude - 15°.

# TOF Values for Washington West of Cascades

for solar domestic hot water and solar electric systems



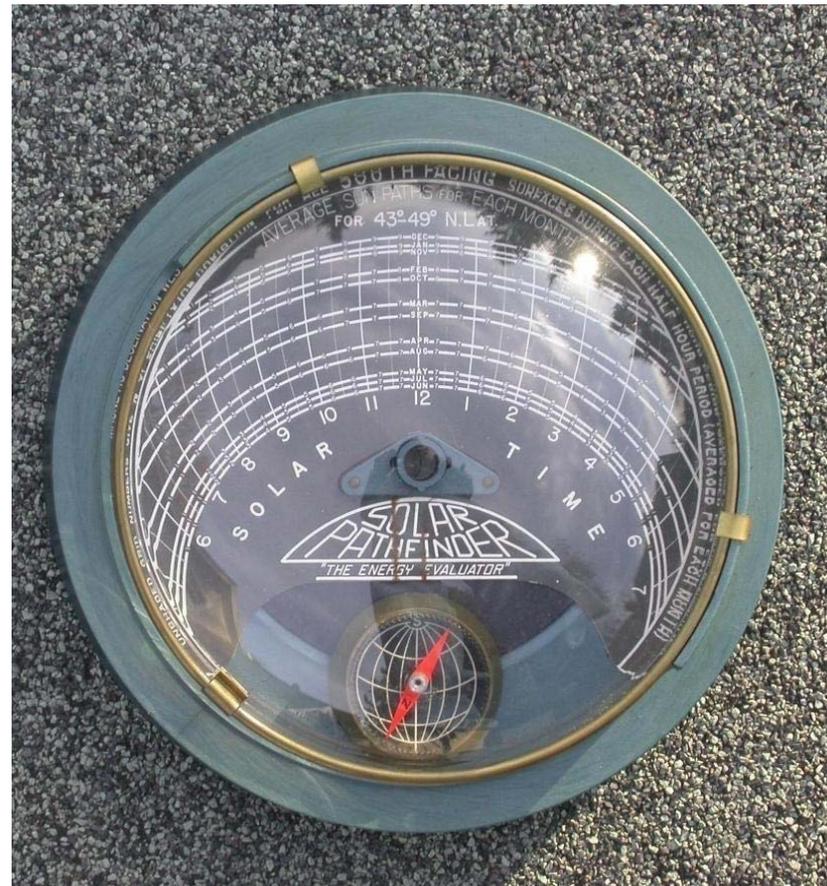
# Roof Evaluation

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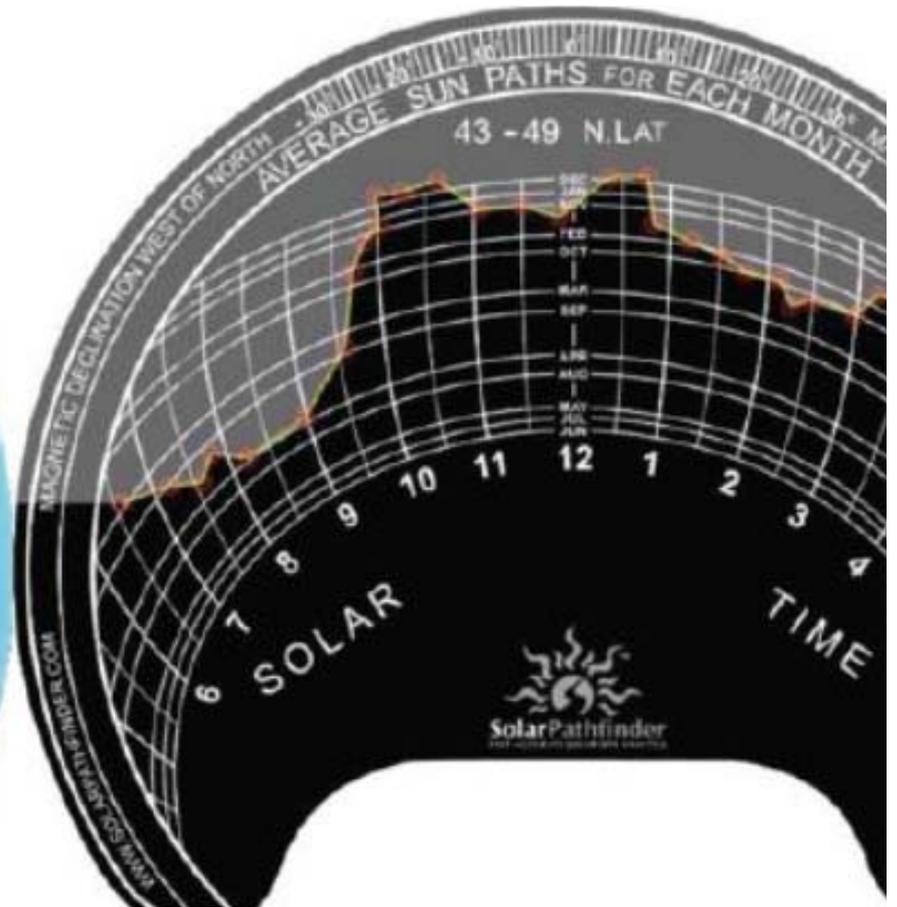
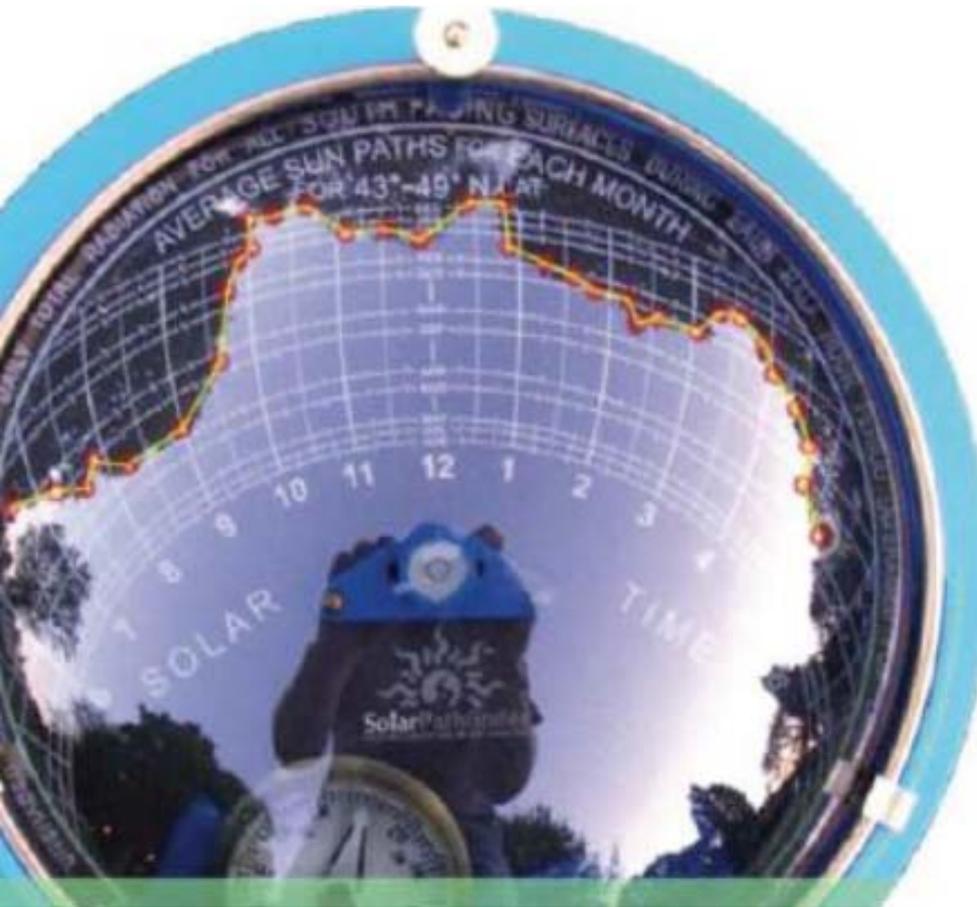
- Roof age and condition
- Mounting options for different roof types
- Shading...



# Site Evaluation: Shade



# Using a Solar Pathfinder



# What NOT to Do

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# An Interesting Example

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# Maintenance

- Keep panels reasonably clean.
- Understand your production estimates and watch the meter.
- Panels have some degradation, inverters can fail



# Sizing a System

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- Based on energy use:

1 kW capacity → 1000 kWh/year

My use: 300 kWh/month = 3600 kWh/year  
3.6 kW system would meet 100% of my use

- Based on roof space:

1 kW requires 100 square feet

- Based on budget:

1 kW currently costs \$8,000-\$10,000

# Identifying a Contractor

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- Solar Washington/ASES members
- Get three bids
- Look for:
  - Cost and long-term financial assessment
  - Production estimates
  - System design
  - Warranties
  - Services included

**Resources: [www.solarwashington.org](http://www.solarwashington.org) or  
[www.seattle.gov/light/solar](http://www.seattle.gov/light/solar)**

# Permitting

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- Electrical permit (always)
  - Use of Licensed Electrician required
- Building permit (occasionally)
  - DPD's Customer Assistance Memo (CAM) 420
- Home-owners association approval

Discuss permitting needs upfront with your contractor

# Interconnection & Net Metering

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- Interconnection is the technical tie-in of your generator to the power grid.
- Net metering is a billing arrangement.
  - “Bank” excess energy with the local utility
  - Meter spins backward; customer receives full retail value for each kWh produced
  - Excess generation is credited toward the next month’s bill.

# Contact Utility Early

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Dan Langdon (South of Denny)

206-386-4200

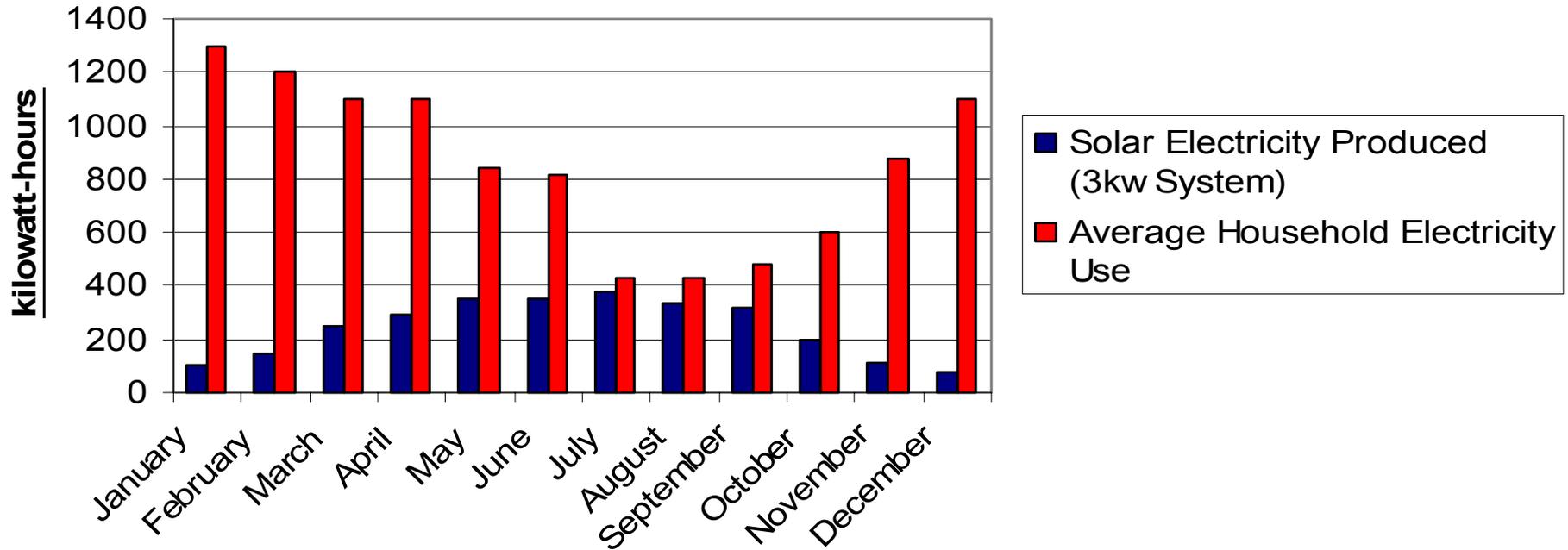
Candace Gruber (North of Denny)

206-615-0600

<http://www.seattle.gov/light/electricservice/default.asp>

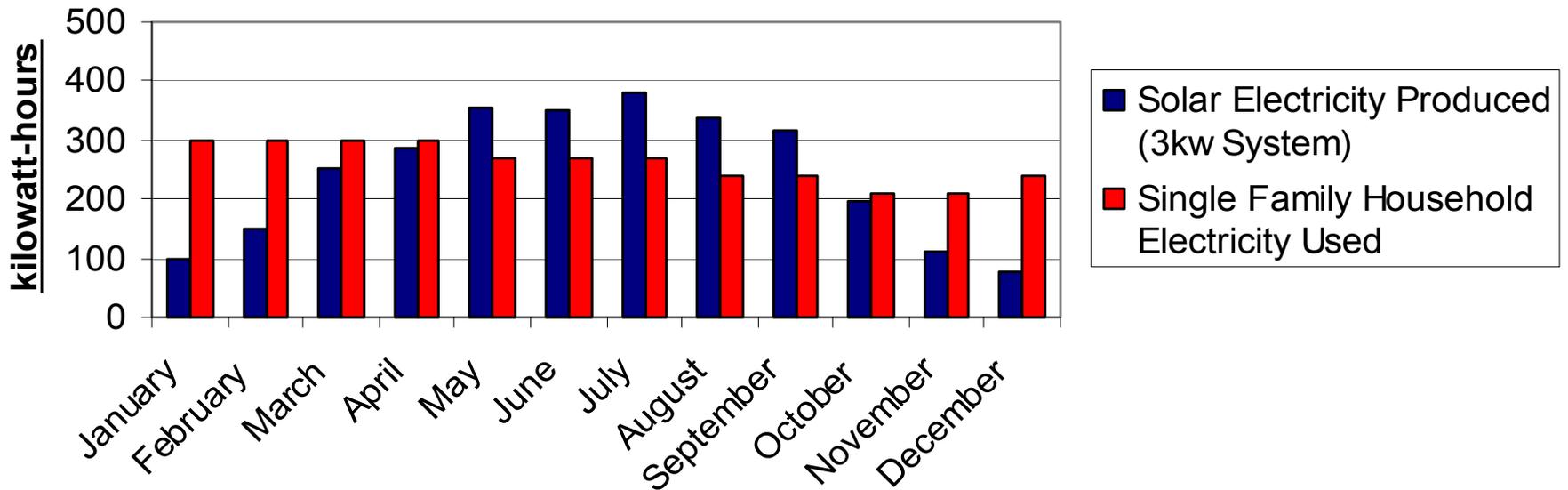
# Impacts on Electric Bill

Average Electricity Use vs. 3kW PV Production



# Efficiency First

## Efficient Home's Use vs. 3kW PV Production



# Understanding PV as a Financial Investment

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- Understand that this is a long-term investment
- “Payback” is not one-size fits all.
- The project’s unique return/payback is determined by:
  - Total cost
  - Energy produced
  - Energy replaced/offset
  - Incentives applied
  - Financing
- No one factor outweighs the others.

# Costs and Incentives

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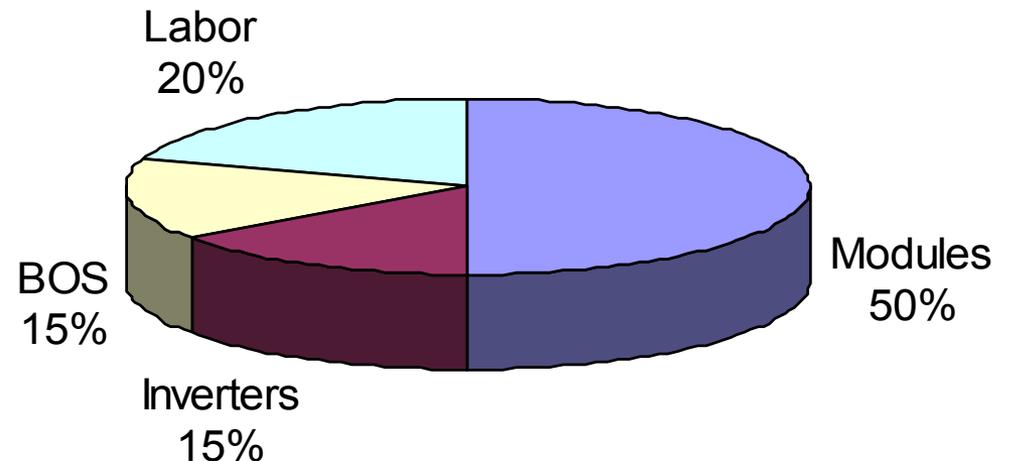
- Breakdown of upfront cost
- Net metering (already covered)
- Federal tax incentives
- State production incentives
- Green Tags/ RECs
- Financial analysis- pulling it all together

# PV System Cost Breakdown

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PV: \$8,000-\$10,000 per kW installed

- Modules: 40%-60%
- Inverters: 10%-15%
- Balance of Systems (BOS): 15%
- Design and Installation: 10%-20%



# Federal Tax Incentives: Business & Personal

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## Federal Corporate Tax Credit

- Solar credit = 30% of investment value

## Corporate Accelerated Depreciation

- Depreciate solar on 5 yr schedule

## Personal Tax Credit

- Solar credit = 30% (\$2000 cap removed for 2009 and beyond)

**Database of State Incentives for Renewables and Efficiency**  
**[www.dsireusa.org](http://www.dsireusa.org)**

## WA State Production Incentives: SB 5101

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- Production incentives offered by Seattle City Light for every kWh of solar energy produced
  - \$.15 for all PV
  - \$.36 for PV with modules manufactured in WA
  - With max of ~~\$2000~~ \$5,000 per customer per year
- Applies to power generated July 1, 2005 - June 30, 2014.

## Production Incentives cont.

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- Payments do not impact/reduce net-metering benefits!
- A 3 kW system w/ WA-made modules:

$$3 \text{ kW} \times 1000 \text{ kWh} \times \$.36 = \\ \$1080/\text{year}$$

A separate production meter is required to participate

# Green Tags (RECs)

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- Additional opportunity for revenue
- Transfers ownership rights of green attributes
- NW Solar Cooperative  
([www.cascadesolar.com](http://www.cascadesolar.com))
- Current terms: \$.02/kwh through 2009

# Financial Analysis

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## Assumptions

3 kW system

\$9/Watt

System Cost = \$27,000

Produces 1000 kwh/kW/year

Includes WA-made modules

Current electric rate = \$.07/kwh

## Incentives

Federal tax credit = \$8100

WA Production Incentives = \$1080/yr (6 yrs)

# Financial Analysis cont.

The first seven years:

Year		2009	2010	2011	2012	2013	2014	2015
System Cost	\$27,000							
Federal Tax Credit		\$8,100						
Production Incentive		\$1,080	\$1,080	\$1,080	\$1,080	\$1,080	\$1,080	
Electricity savings		\$210	\$216	\$223	\$229	\$236	\$243	\$251
Green Tag value		\$90	\$90	\$90	\$90	\$90		
Yearly income	(\$27,000)	\$9,480	\$1,386	\$1,393	\$1,400	\$1,406	\$1,324	\$251

Simple payback = 35 years

# Learn More...

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## Next event:

- **Shoreline SolarFest: July 18, 2009**

## Online Resources:

- [www.seattle.gov/light/solar](http://www.seattle.gov/light/solar)
- [www.nwseed.org](http://www.nwseed.org)
- [www.solarwashington.org](http://www.solarwashington.org)
- [www.dsireusa.org](http://www.dsireusa.org)