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SUSTAINABLE ENERGY
ASSOCIATION

Solar Power 101

For Homeowners

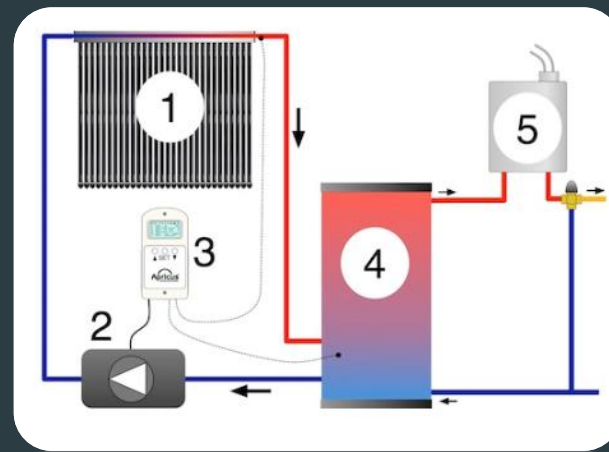
Presentation Overview

- ▶ Basics of Solar Thermal
- ▶ Basics of Solar Photovoltaics
- ▶ How to plan a project
 - ▶ How to size system
 - ▶ How to site system
 - ▶ How to pay for system
- ▶ Success Stories
- ▶ Purchase Options, Incentives and Resources
- ▶ Questions?

Solar Thermal Basics

- ▶ The average residential solar hot water system includes the following components:

1. Solar Hot Water Collector (Evacuated Tube or Flat Plate)
2. Pump Station
3. Controller
4. Hot Water Storage Tank
5. Backup Energy Source



Solar Thermal Operation

- ▶ Energy in sunlight is absorbed by the solar collector, heating up the liquid inside.
- ▶ The heated liquid is transferred back to the hot water tank by the circulation pump.
- ▶ Throughout the day solar energy gradually raises the temperature in the hot water tank.
- ▶ If the solar energy is not sufficient to provide hot enough water, a backup energy source (electricity, gas, oil etc) is used to further heat the water.



Solar Thermal Systems

- ▶ Technology Options

- ▶ Flat Plate Collector
- ▶ Evacuated Tubes

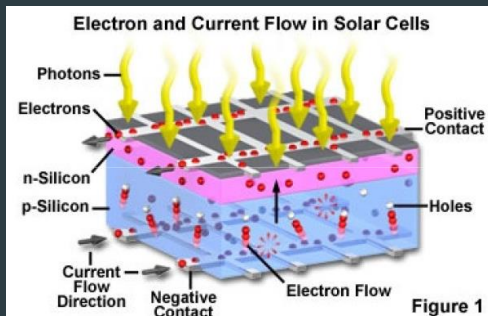


- ▶ Size and Costs

- ▶ Size it to the nominal summer load (~100 %)
- ▶ Average cost ~ \$8,000-10,000
 - ▶ Many variables in cost

Solar PV Basics

- ▶ <http://www.energizect.com/smart-energy-resources/energy-101/renewable-energy/solar>



http://www.gosolarcalifornia.org/solar_basics/how.ph
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How much electricity do you need? (Kilo-What?)

- ▶ Kilowatts (kW), Kilowatt Hours (kWh), Megawatts (MW)?
- ▶ Determine your electrical usage first (reduce it!) - then size the system
 - ▶ How to read your electric bill - customer charge, T&D, Supply, SBC
 - ▶ Rule of thumb for open roof: 150ft² = 1 kW

Average House = 600 kWh per month (7,200 kWh/year)

1 kW solar PV = 1300 kWh per year

To Grid, or not to Grid?

Grid Tied System

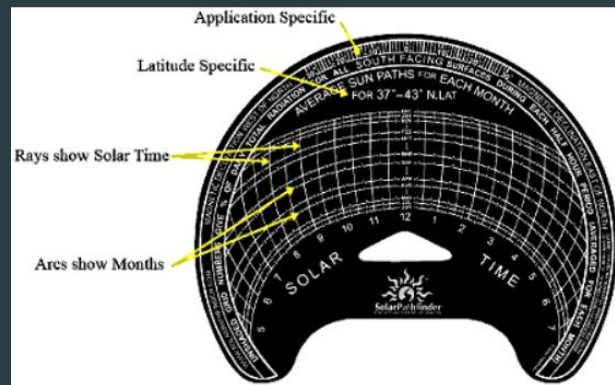
- ▶ Easier to install and maintain
- ▶ Less expensive (is this true?)
- ▶ Grid can supply back up power
- ▶ Feed excess electricity back into the grid (net metering)
- ▶ Eligible for incentives that off grid systems are not

Off Grid

- ▶ Works well for remote locations such as rural camps, islands, and boats
- ▶ Requires batteries to store power
- ▶ May be cheaper than running a new power line

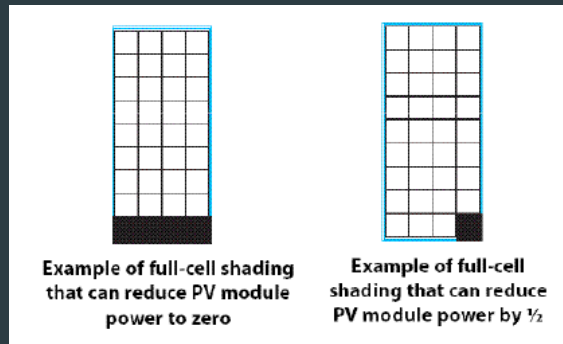
Where should I put my solar array? (siting)

- ▶ Optimum solar window 9am - 3pm
- ▶ Face it south
- ▶ Solar Pathfinder

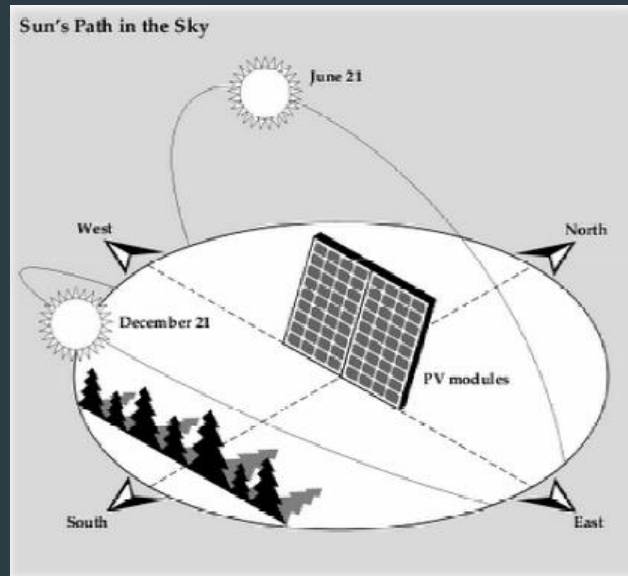


Shading on Modules

- ▶ Shading can halve or even completely eliminate the output of a solar array
- ▶ Micro-inverters and optimizers can help maximize output despite partial shading

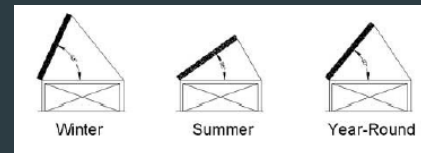
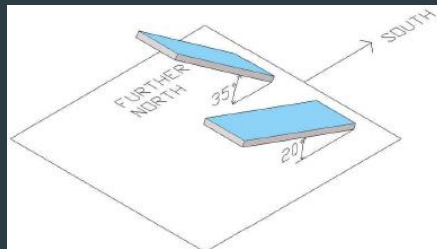


Site Selection - Orientation



Site Selection - Tilt Angle

- ▶ Max performance is achieved when panels are perpendicular to the sun's rays
- ▶ Year round tilt = latitude
- ▶ Winter + 15 latitude
- ▶ Summer - 15 latitude



Roof Mount Considerations

- ▶ Newer roof
- ▶ Structurally sound
- ▶ Penetrate the roof as little as possible
- ▶ Setbacks
- ▶ Leave 4-6" airspace between roof and modules
- ▶ On sloped roofs, fasten mounts to rafters not decking



Ground Mount Considerations

- ▶ Flat is ideal
- ▶ Wind speed at the site
- ▶ Soil type and strength
- ▶ Perimeter fencing
- ▶ Theft
- ▶ Access
- ▶ Storm water runoff



Solar Home in Durham, NH

Solar Hot Water System - \$8,000 (\$3050 after incentives)

Solar PV System - \$17,000 (\$7000 after incentives)

Incentives Utilized:

NH PUC Solar Hot Water Rebate (\$2600 - \$600 of this counts as a taxable energy grant)

NH PUC Solar PV Rebate (\$4400 - this counts as a taxable energy grant)

Federal Solar Tax Credit (30% of System Cost - No Limit) - for both PV and Thermal

15 Trina 235 Watt panels with Enphase Micro Inverters.

This makes the rated output 3525 watts with a projected annual output of 4,238 kWh meeting at least 80% of annual load (incentive to keep pushing on the energy efficiency and energy conservation front).

Anticipated system payoff, AFTER NH Solar Rebates and Federal Solar Tax Credits, 8 years.



***view more homes on Myenergyplan.net/ght

Purchase Options

- ▶ **Outright purchase**
 - ▶ Maximizes your return
 - ▶ Fuel is free for 20-40 years
 - ▶ Debt
- ▶ **Lease / Power Purchase Agreement (PPA)**
 - ▶ No up-front cost
 - ▶ No operating and maintenance responsibilities
 - ▶ Lien issue

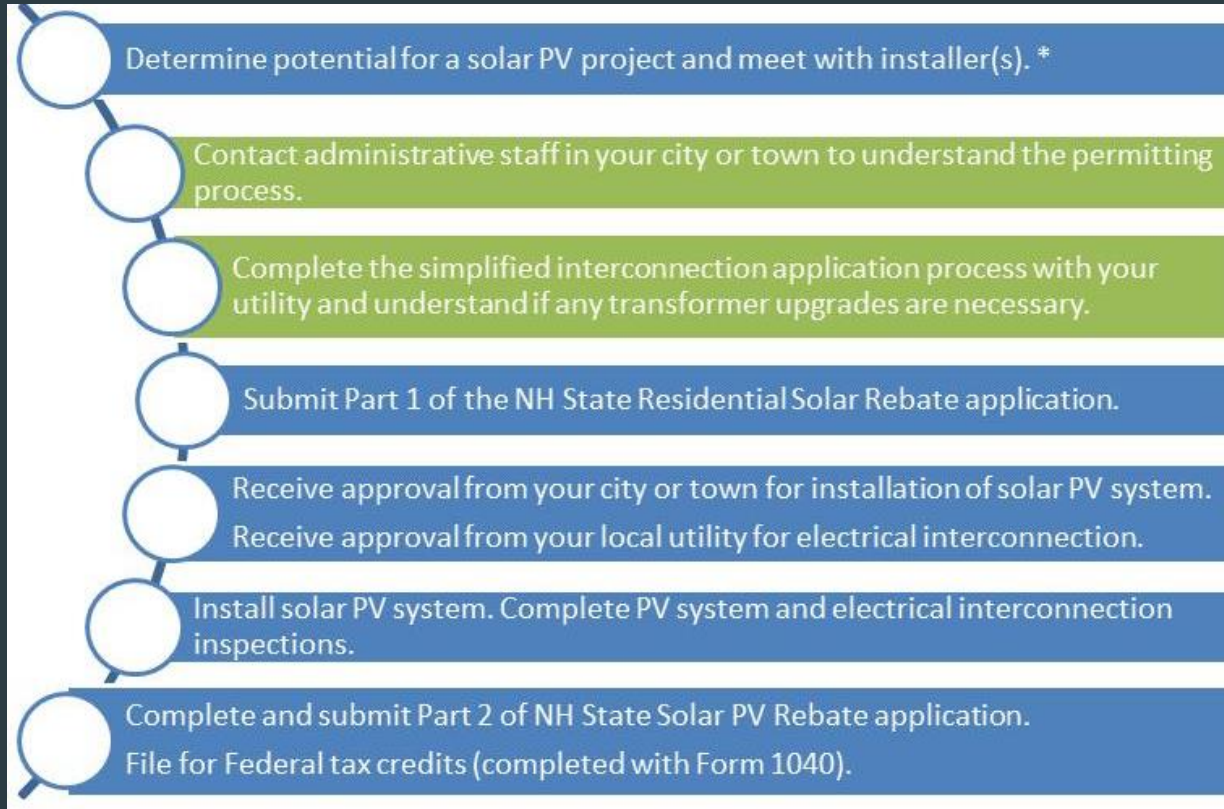
NREL Resource: <http://www.nrel.gov/docs/fy11osti/48969.pdf>

CESA Resource: <http://www.cesa.org/assets/2015-Files/Homeowners-Guide-to-Solar-Financing.pdf>

Solar Incentives

- ▶ PUC rebates
 - ▶ Solar Thermal = \$1500 - \$1900 depending on size
 - ▶ Solar PV = \$0.75/Watt up to \$3,750
 - ▶ www.puc.nh.gov
- ▶ Federal Investment Tax Credit = 30% of installed costs
 - ▶ May include site prep?
- ▶ Net Metering = full retail rate credit for each kWh that is exported to the grid (~17 cents/kWh)
- ▶ Solar RECs = up to 5.5 cents/kWh (\$55/MWh)

Steps to Consider When Pursuing Solar



* As with any significant purchase, shop around when considering purchasing a solar PV system. Gather as much information as possible, check contractor references and obtain multiple quotes.

Current Average PV Costs

- ▶ FY15 avg. sys size 6.55 kW
- ▶ FY15 Avg. sys cost \$24,500
- ▶ FY15 avg. per kW cost \$3,760/kW

Value added to Homes with Solar

- PV consistently adds value ~ \$4/watt.
- New and old homes benefit equally from investment made.
- Home buyers are consistently willing to pay more for a property with PV across a variety of states, housing and PV markets and home types.
- Value is ultimately dependent on the size of the system.

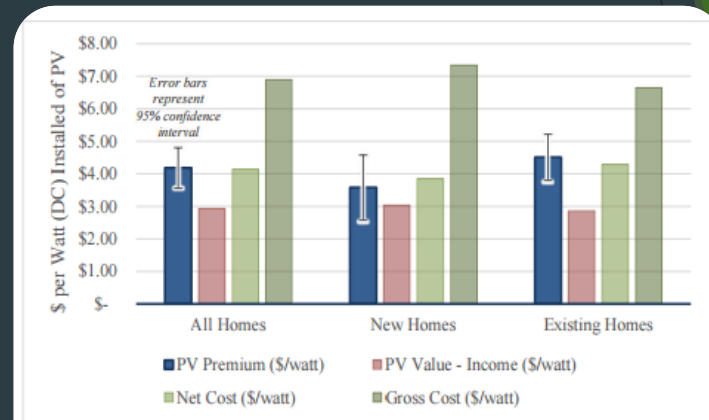


Figure 1: PV premium results for all homes, new homes, and existing homes compared with contributory-value estimates

New Hampshire Solar Development Strategies

- ▶ NH State Energy Strategy
- ▶ Renewable Portfolio Standard
 - ▶ Renewable Energy Fund
- ▶ Net Metering (PV)
- ▶ Property Tax Exemptions

Additional Resources

- ▶ Homepower Magazine - www.homepower.com
- ▶ IMBY- tool to calculate the size of a solar array
<http://www.nrel.gov/eis/imby/>
- ▶ www.nhsea.org
- ▶ www.puc.nh.gov → Sustainable Energy Division
- ▶ [Myenergyplan.net](http://myenergyplan.net) → Project Connector

Thank You

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