

NH RESIDENTIAL SOLAR 101

A PRESENTATION FOR RESIDENTIAL PROPERTY OWNERS

by Lakes Region Community College

with support from the U.S. Department of Energy
SunShot Initiative Rooftop Solar Challenge II
in partnership with New Hampshire Office of Energy
and Planning and Clean Energy States Alliance



Why a NH Residential Solar 101?

- Provide a common foundation of knowledge
- Publicize solar photovoltaic's (PV's) practicality and cost-effectiveness
- Part of U.S. Dept. of Energy's SunShot Initiative
 - A national effort to make solar energy fully cost-competitive with traditional energy sources by the end of the decade
 - Targeting the reduction of non-hardware "soft" costs for solar photovoltaic (PV) systems

Workshop Outline

A. Solar PV Fundamentals

B. Is Your Home a Good Fit for Solar?

C. Solar PV Financing and Incentives

D. Choosing a PV Installer

E. From Site Assessment to Energy Production

Disclaimer: Lakes Region Community College makes no guarantee as to the accuracy, completeness, usefulness or currency of the information in this presentation. Neither LRCC nor its sponsors shall be responsible for any errors or omissions herein.

Audience Assumptions

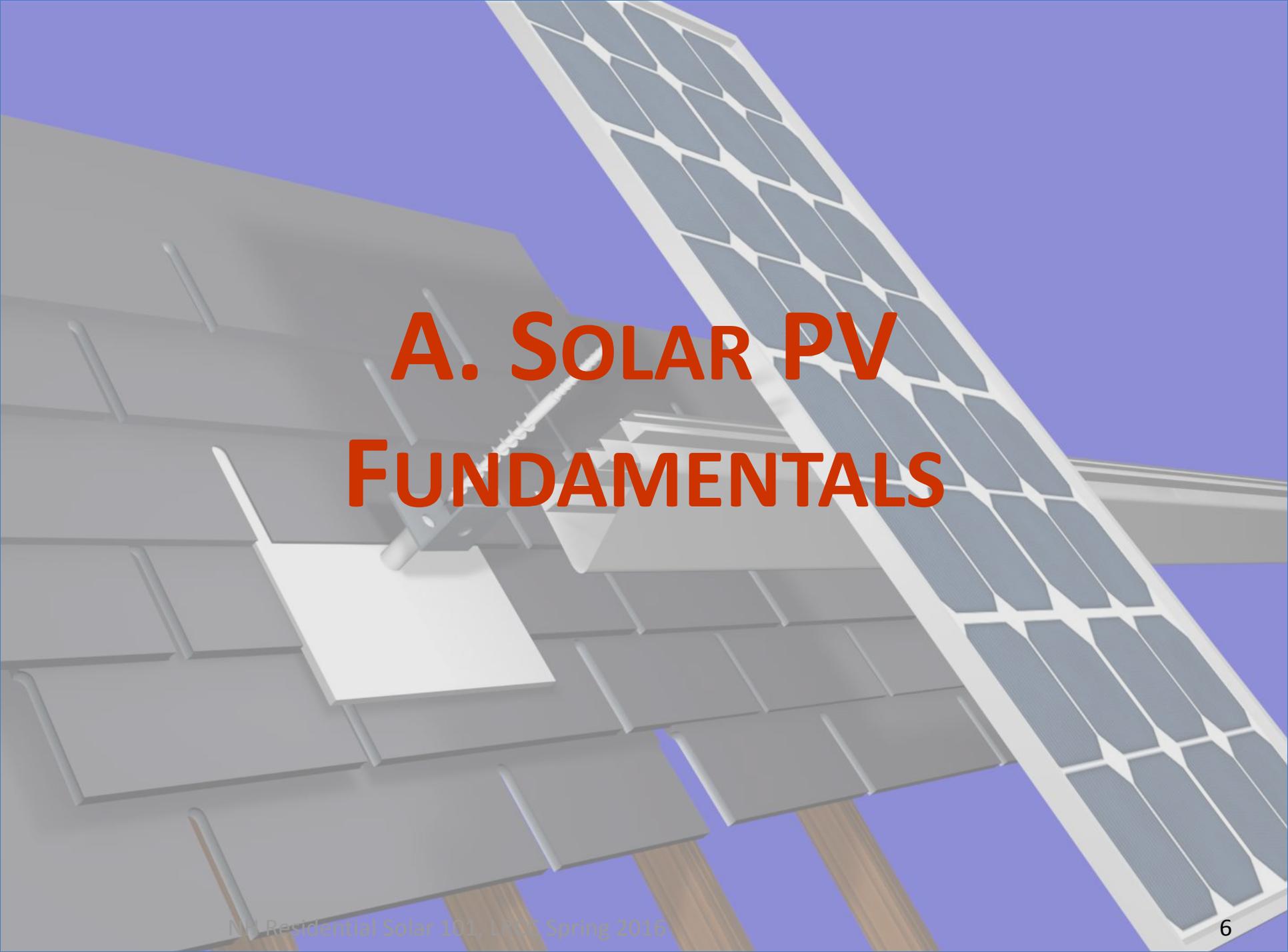
- New Hampshire-based homeowners and landlords
 - Not commercial, industrial or government
 - (*Solar 101 for NH Municipal Officials* companion presentation)
- Want to know more details about generating electricity from the sun
- Interested in all incentives and ownership options
- Want a grid-tied photovoltaic (PV) system
 - Get service from one of the four regulated electricity distribution utilities
 - Municipal utilities: special cases

Introducing Sally and Gary



We are considering solar PV for our house

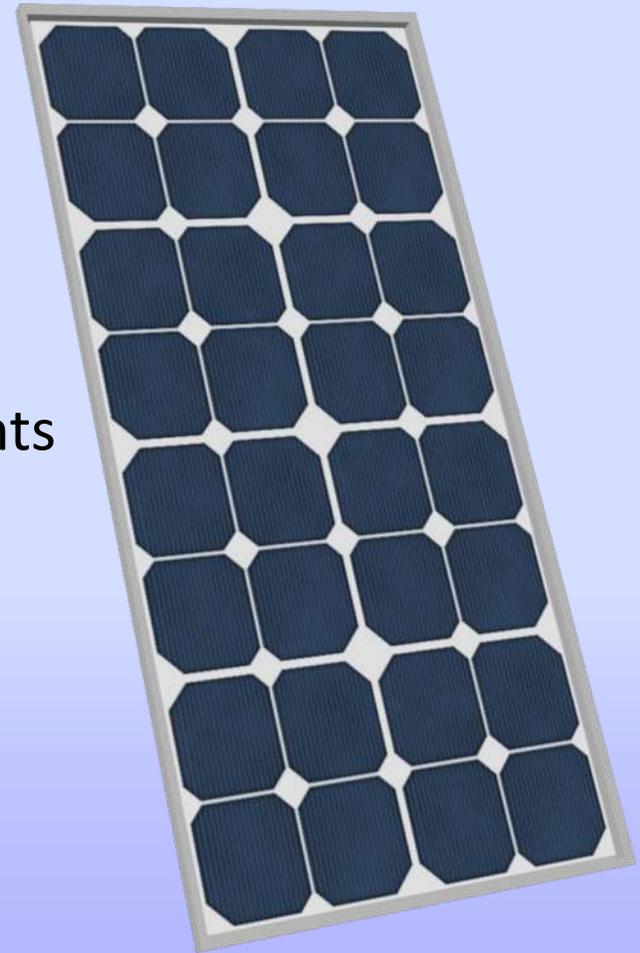
With these call-out boxes, we will be discussing options and our decisions

A 3D architectural rendering showing a solar panel mounted on a roof. The roof is covered with grey shingles and supported by wooden rafters. A white flashing is installed around the base of the solar panel to prevent water leaks. The solar panel itself is tilted and features a grid of blue photovoltaic cells. The background is a solid light blue color.

A. SOLAR PV FUNDAMENTALS

Why Go Solar?

- Economic benefits
 - A reliable, long-term income stream
 - Comparable return to other investments
- Environmental benefits
 - Reduced use of fossil fuels
 - Smaller ecological footprint
- Local self-reliance
 - Be your own power source!
 - New Hampshire jobs and local economy



Anatomy of a PV System

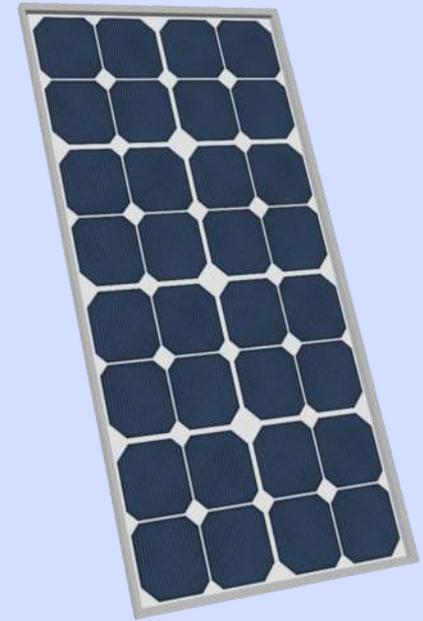
- Overall solar PV system:



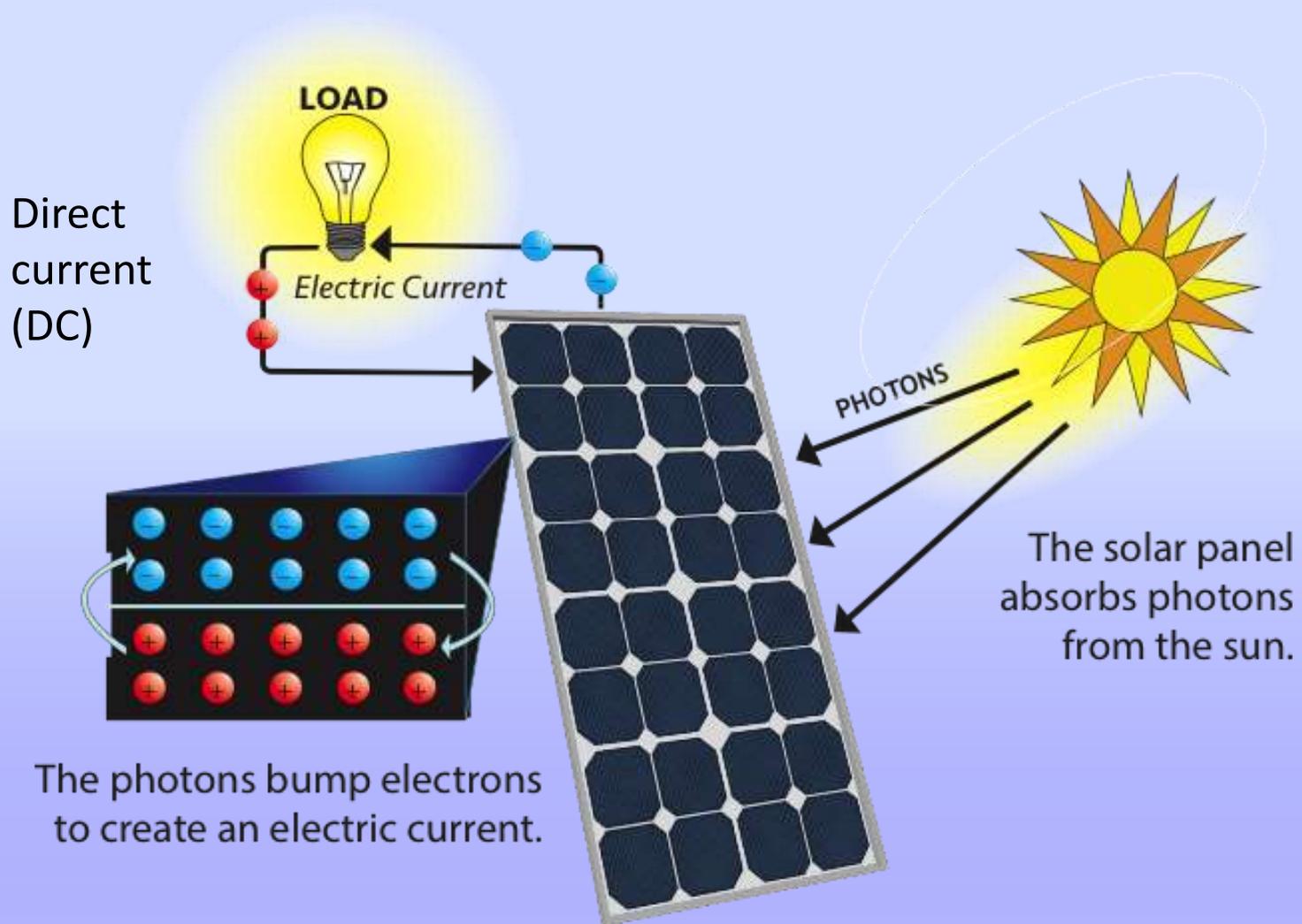
Anatomy of a PV System:

Panels

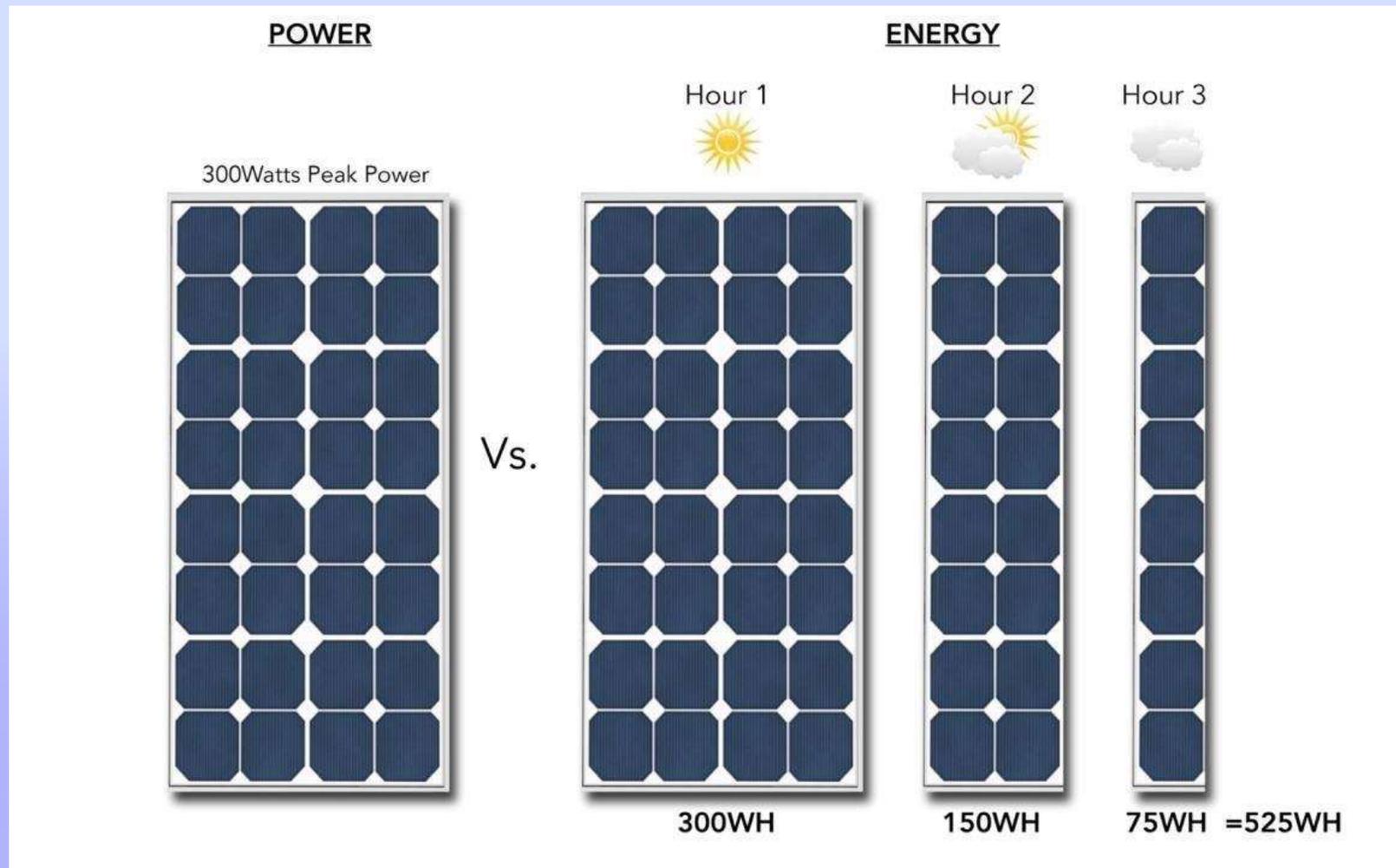
- Solar photovoltaic (PV) systems are sized in kilowatts
 - 2 to 10 kilowatts (kW) typical residential installation
 - Kilowatt rating is theoretical peak power production
- Most PV panels are rated ~250-300 watts DC
 - Approx. 15 watts / sq. ft. peak direct current (DC) output
 - Long-lasting: at ~80% initial output after 25 years
 - Tough: tempered glass



How PV Panels Produce Electricity

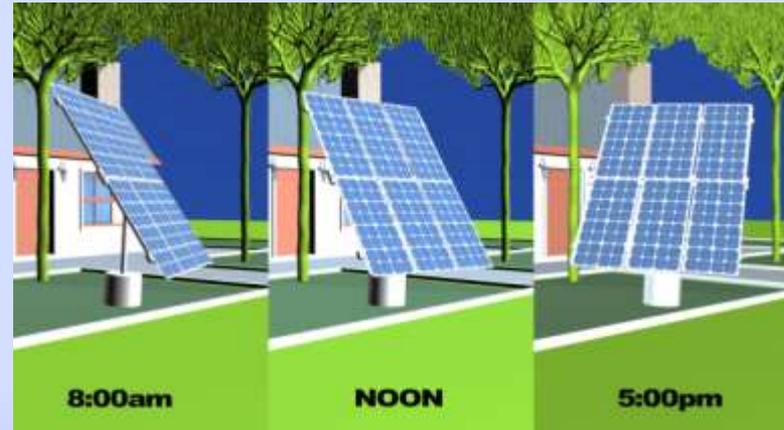


Power (watts) vs. Energy (watt-hours)



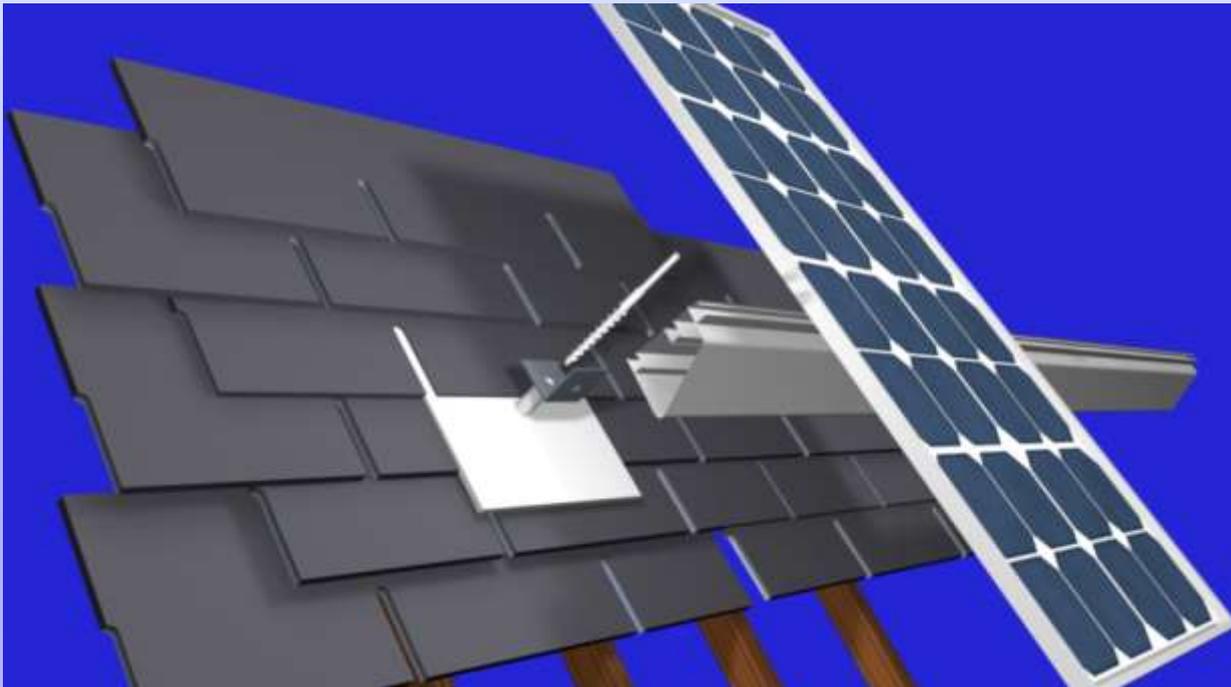
Anatomy of a PV System: Ground Mounts

- Pole-mount tracking systems
 - Dual axis tracking
 - ~30% more solar production
 - More expensive
- Fixed ground-mount
 - Usually with ground anchors
 - Sometimes ballasted (weighted) or concrete footings



Anatomy of a PV System: Roof Mounting

- Roof mounts
 - Usually less expensive than ground-mount
 - Anchoring systems for shingled roofs
 - Secure and weather-tight
 - Ask the installer about mounting on metal and other roofs

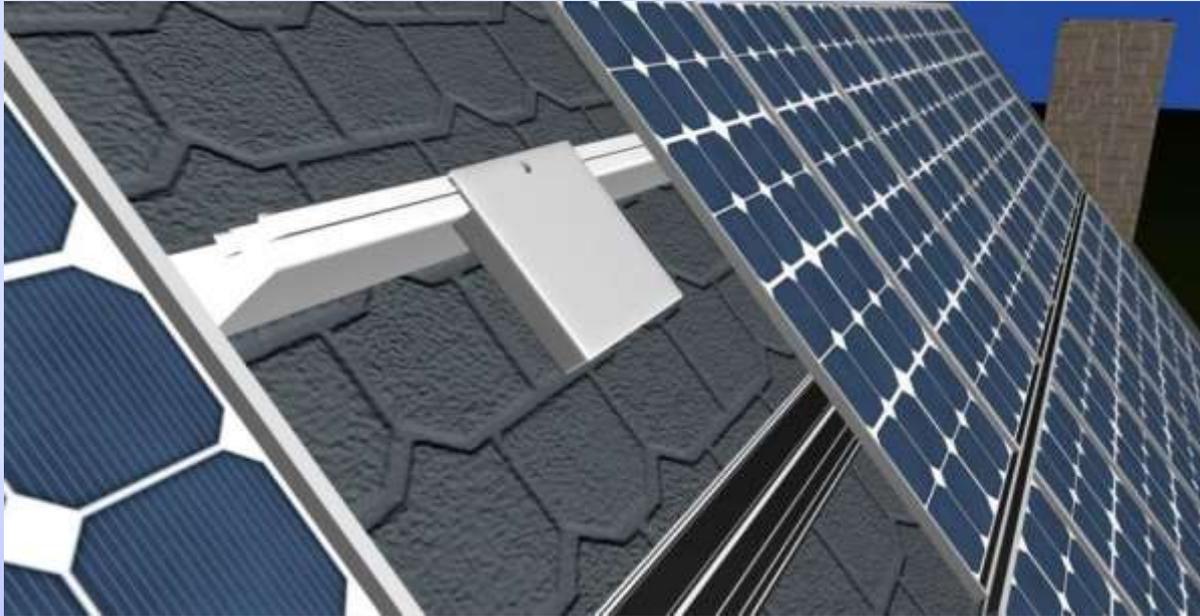


Anatomy of a PV System: Inverters

- Inverters convert DC current from the panels into AC current for:
 - Behind the meter household use
 - Feeding into the AC power grid
- Some losses from converting DC to AC
 - Example: 4.8 kilowatt DC → 4.4 kilowatt AC
 - Other losses from electrical wiring, high temperatures, shading, etc. (see later slides)
- *String (central) inverters*
 - Larger and centrally located near meter or circuit panel
 - Most cost-effective if few shading issues
 - Approx. 15 year life



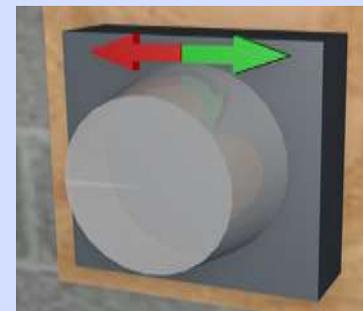
Micro-Inverters and Power Optimizers Options



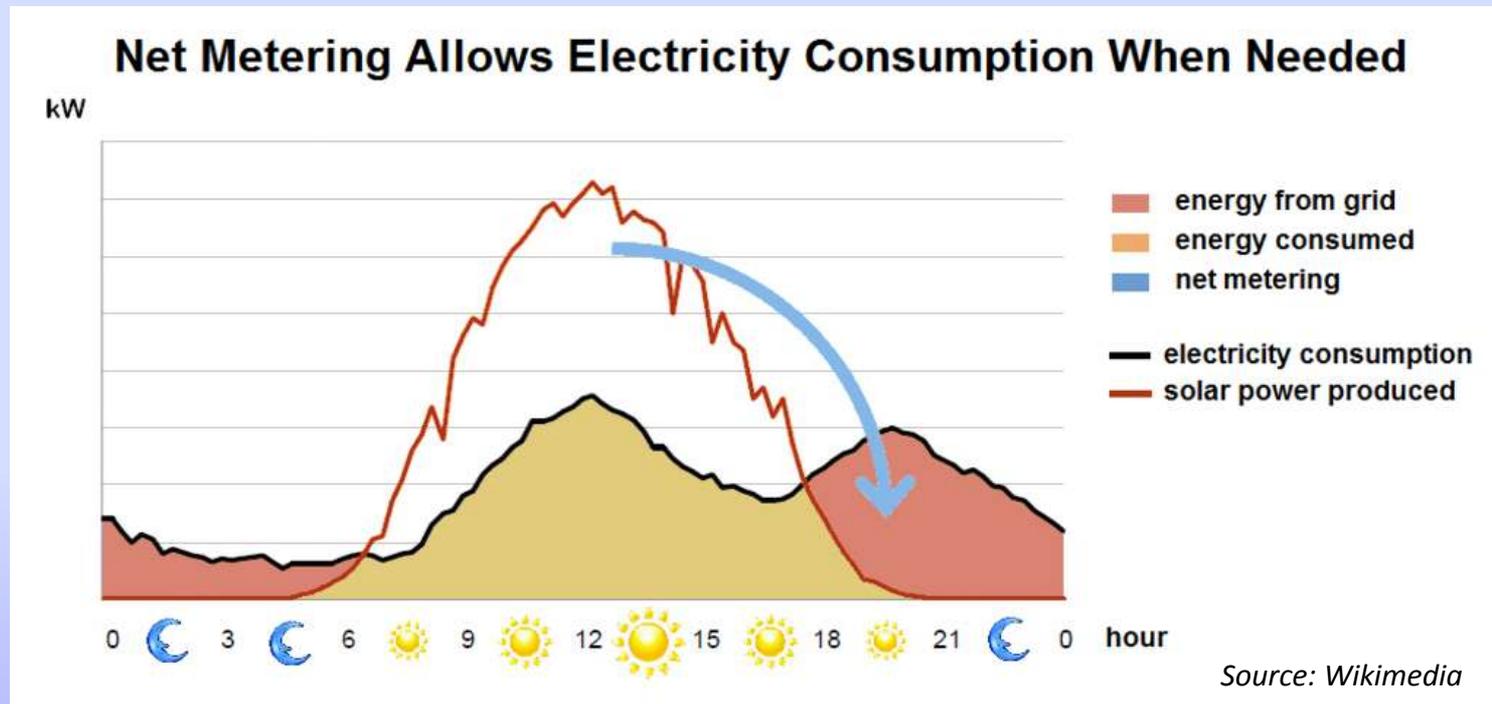
- *Micro-inverters*
 - Smaller and numerous, located on the solar panels
 - Converts DC solar panel output to AC *at the panel*
 - Reduces the impact of shading
 - More expensive, but may have 20+ year warranties
- Another option: *power optimizers* with central inverters

Connecting to the Grid and Net Metering

- Net meter- special electricity meter
 - Runs forwards: consuming electricity from grid
 - Runs backwards: producing electricity into grid
- Utility disconnect
 - Immediately shuts off solar power when grid goes down
 - Most grid-tied PV systems don't work during a power outage
- Separate RECs watt-meter
 - If selling renewable energy credits
- Off-grid PV systems
 - No connection to the electrical grid
 - Uses batteries to store solar energy
 - *Hybrid systems*: can do both -- added expense



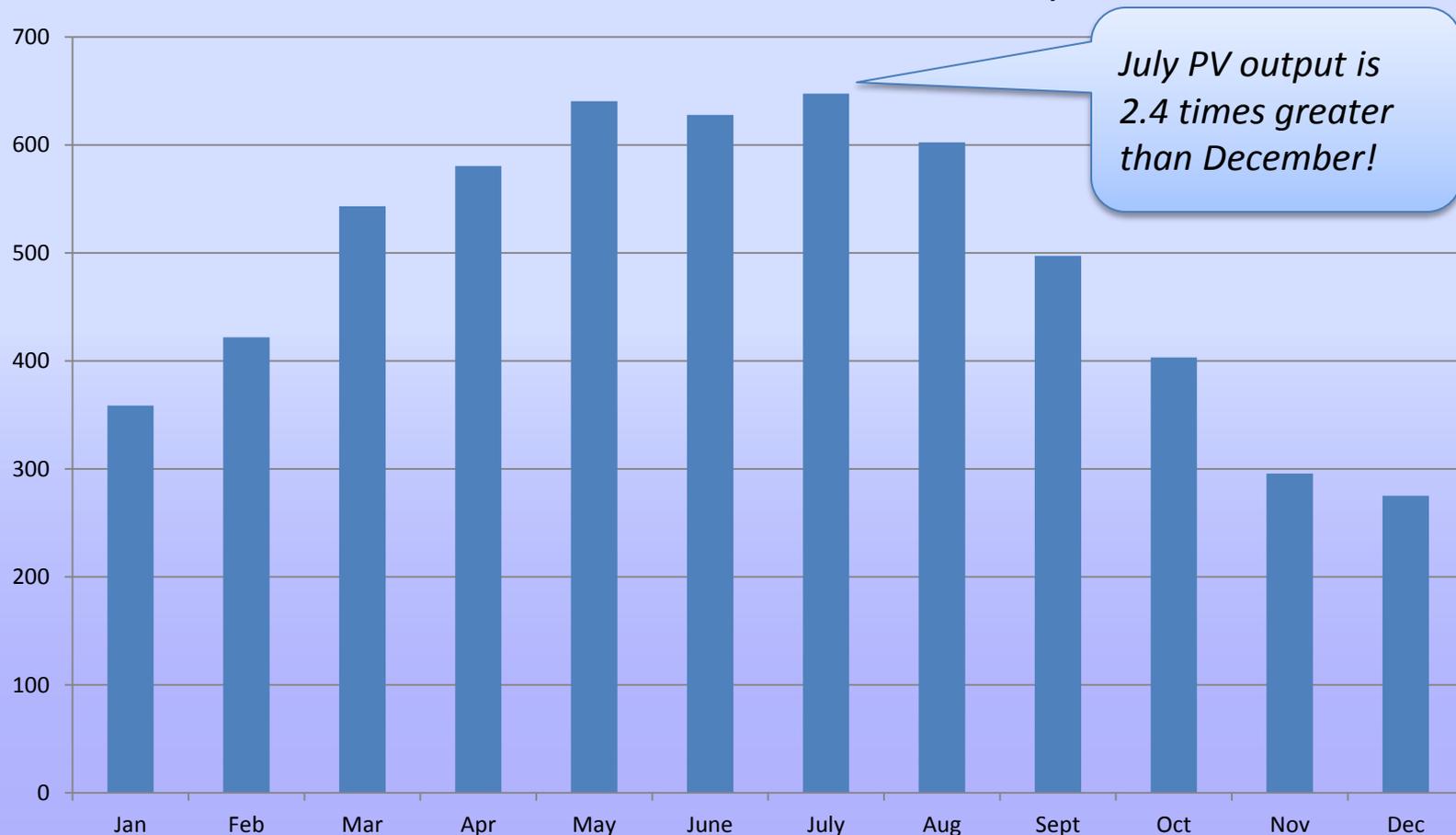
Net Metering Over a Day



- Red area: electricity consumed from the electrical grid
- Tan area: solar-generated electricity consumed “behind the meter”
- White area: “Net excess generation”
 - Net metering credit towards later consumption
 - Day vs. night, and summer vs. winter

Sample Monthly PV Electricity Output

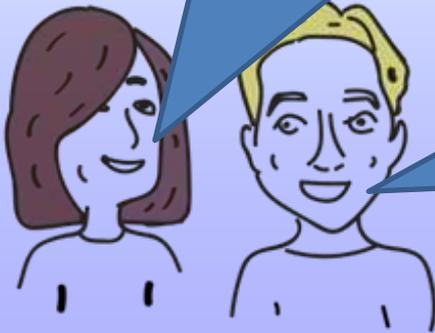
Kilowatt-hours Production in Concord, NH



Source: PVWatts 4.8kW System

Sally and Gary on Solar Equipment

Great to hear solar PV equipment lasts so long.



And it sounds like net metering makes sense.

B. IS YOUR HOME A GOOD FIT FOR SOLAR?

Factors for a Solar PV Good Fit

Reduce then produce!

1. Sunlight and shading
2. Appropriate orientation and tilt
3. Sufficient space for PV panels
4. Roof-mount and ground-mount practicalities
5. Siting, zoning and neighbors
6. Ability to net meter with the electric utility

Reduce then produce!

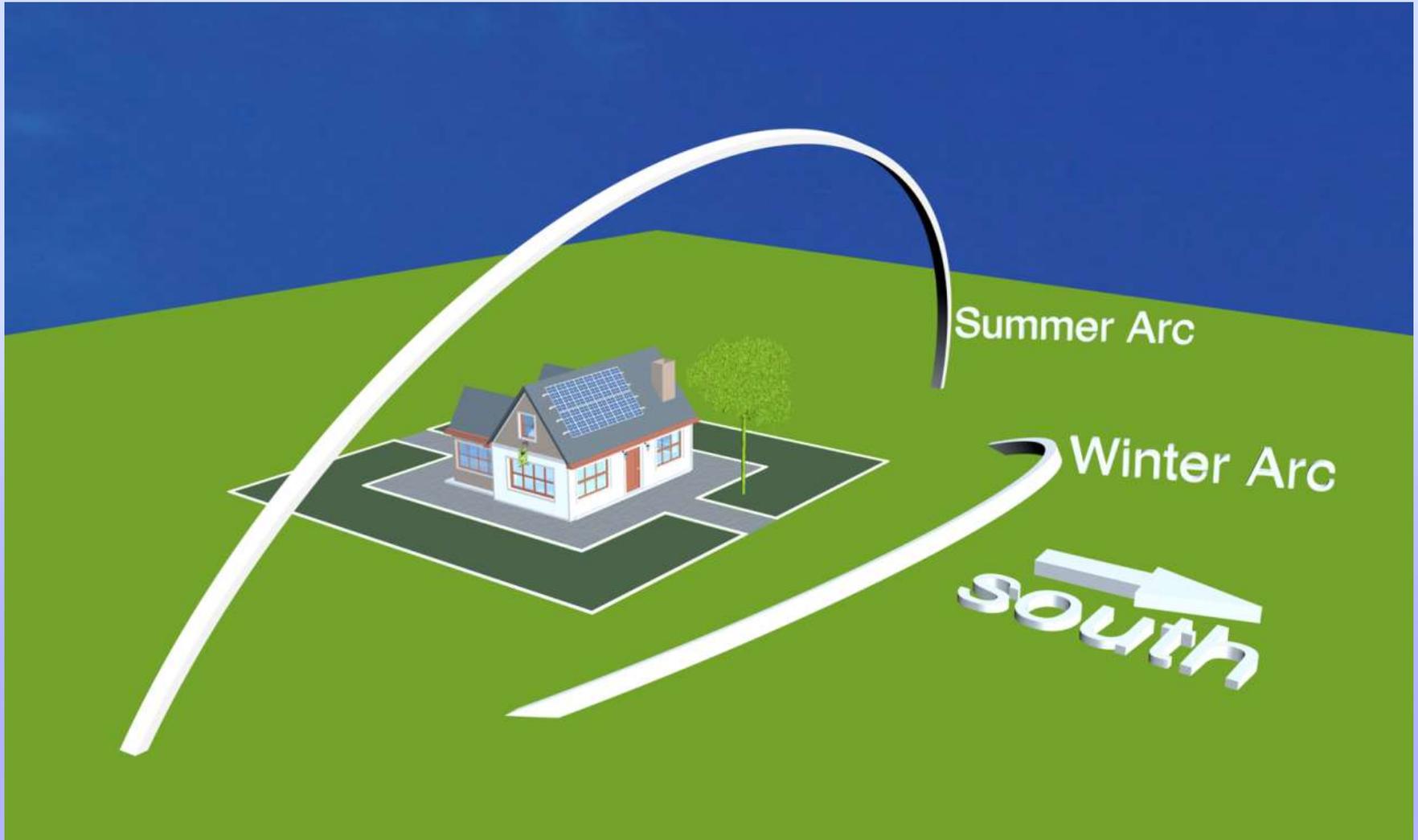


- ***Don't add solar to a house that is wasting energy!***
- Efficient house = smaller PV system needed
- Residential energy efficiency resources:
 - NHSaves- NH utility energy efficiency programs www.nhsaves.com
 - ENERGY STAR programs: existing homes, new homes, appliances...
 - Button Up home energy efficiency workshops

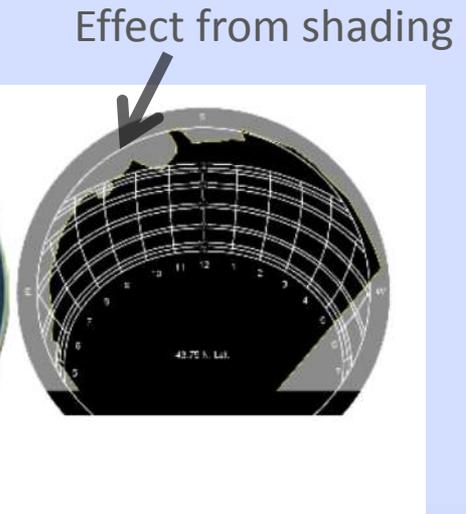
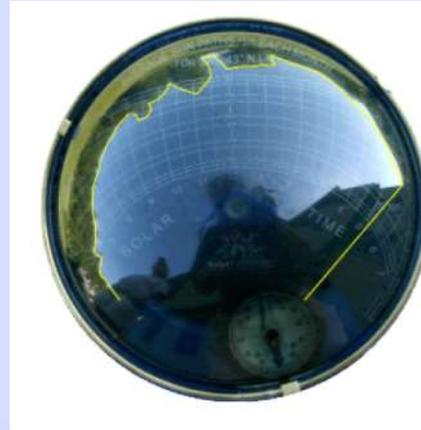
Sufficient Sunlight?

- Compare your annual electrical *consumption*...
 - ...with estimated solar electricity *production*
 - With net metering, typically want annual production to be equal or less than annual consumption
 - Sally and Gary consume about 6,000 kilowatt-hours / year
- Solar electricity production a factor of:
 - Shading- time of day and time of year
 - Panel orientation and tilt
 - Snow and dirt
 - Snow on panels is a minor factor for most NH installations
 - Other system factors (panel size and wattage rating, outside temperatures, inverter efficiency, wiring efficiency, age of panels, etc.)

Solar Factor #1: Sunlight and Shading

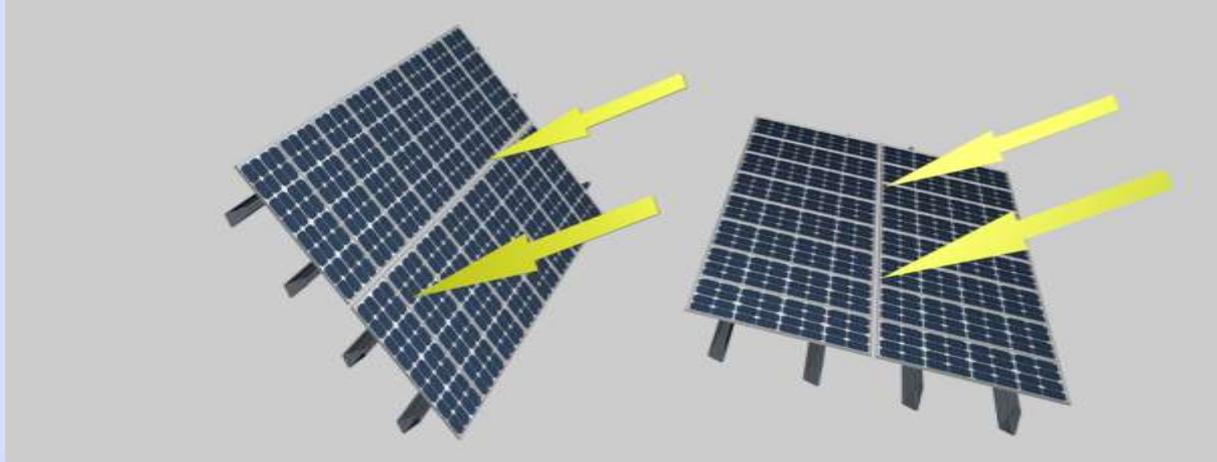


Factor #1: Shading Analysis



- “Solar Pathfinder” and similar professional tools
 - Can estimate shading by time of year and time of day
- Shading analysis
 - Quantifying the effect from shading
 - Outlined area- shading reduces annual PV output by 5%

Solar Factor #2: Orientation and Tilt



- Orientation (azimuth): true south (solar south: 180°) best
 - Orientations between 140° to 220° are usually acceptable
- Tilt: ideally sunlight shines at a right-angle to the panels
 - A 35° tilt works well in NH
 - Tilts between 15° to 55° still provide 95+% output
 - Want sufficient tilt for snow and ice to slide off
- Roof-mounts typically same angle and orientation as the roof
 - Ground-mount arrays have more flexibility

Factor #3: Sufficient Space for PV Panels

- PV power-to-energy output rule of thumb in NH:
 - Roughly 1.2 kilowatt-hours AC *energy* per year for every 1 watt of solar panel DC *power* rating
 - “*Your mileage may vary...*”
- Gary and Sally’s example: 4.8 kilowatt PV system
 - About 15 watts per square feet of panels
 - 16 @ 300 watt panels – about 320 sq. ft. of space
 - 4,800 watts peak DC power
 - $4,800 * 1.2 = 5,760$ kilowatt-hours AC energy / year



That’s a lot of math!

Free Cool Tool: PVWatts

pvwatts.nrel.gov

- Connects with Google Maps- Draw a PV array on your roof!
 - Examine factors that can affect solar electricity production
 - See how much electricity a potential array can produce
 - Need to manually enter shading and snow factors



The screenshot shows the PVWatts Calculator website. At the top left, it says "PVWatts® Calculator". On the right is the NREL logo. Below the header is a navigation bar with "Get Started:" followed by a text input field "Enter a Home or Business Address" and a "GO »" button. To the right are "HELP" and "FEEDBACK" buttons, and a dropdown menu for "ALL NREL SOLAR TOOLS". The main content area features a large orange cross icon made of smaller squares, the title "NREL's PVWatts® Calculator", and a paragraph: "Estimates the energy production and cost of energy of grid-connected photovoltaic (PV) energy systems throughout the world. It allows homeowners, small building owners, installers and manufacturers to easily develop estimates of the performance of potential PV installations." Below this is a "What's New" button. At the bottom right, there are social media icons for Facebook, Twitter, LinkedIn, and a plus sign, along with a "1K" follower count and a "Follow @PVWatts" button. The background of the page is a photograph of solar panels.

Source: National Renewable Energy Lab

Factor #4: Roof-Mount and Ground-Mount Practicalities

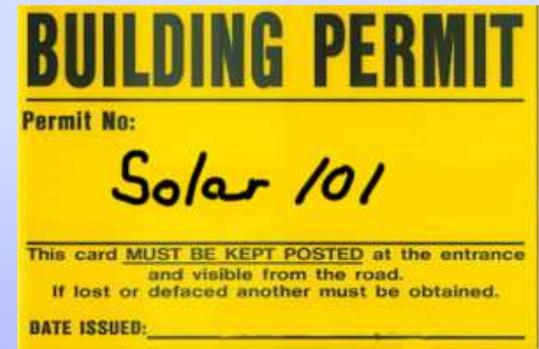
- Roof orientation and size
 - Needs plenty of unobstructed S, SW or SE facing areas
- Roof structural strength
 - *Good*: House well-built to modern building codes (1970s+)
 - *Concern*: Insufficient roof strength, high snow loads, ice dams, decay, etc.
- Safety and firefighter access
 - *Good*: Clearances to roof at peak, bottom and sides
 - *Concern*: Entire roof covered in solar panels
- Roof condition
 - *Good*: 10+ years in roof life
 - *Concern*: Roof needs replacing in less than 10 years
- *Ground-mount*:
 - *Sufficient space, visual appeal, fencing, safety, etc.*
 - *Ground anchoring, wind load, distance from electrical connection*

Factor #5: Siting, Zoning and Neighbors

- Neighbors and aesthetics
 - Usually minimal problems with roof-mount
 - Tall and visible ground-mount systems can be an issue
- Municipal zoning ordinances and other restrictions
 - varies from town to town
 - Historical districts
 - Condo and neighborhood associations
- “Solar sky space easements”
 - Preserves the right to unobstructed access to solar energy

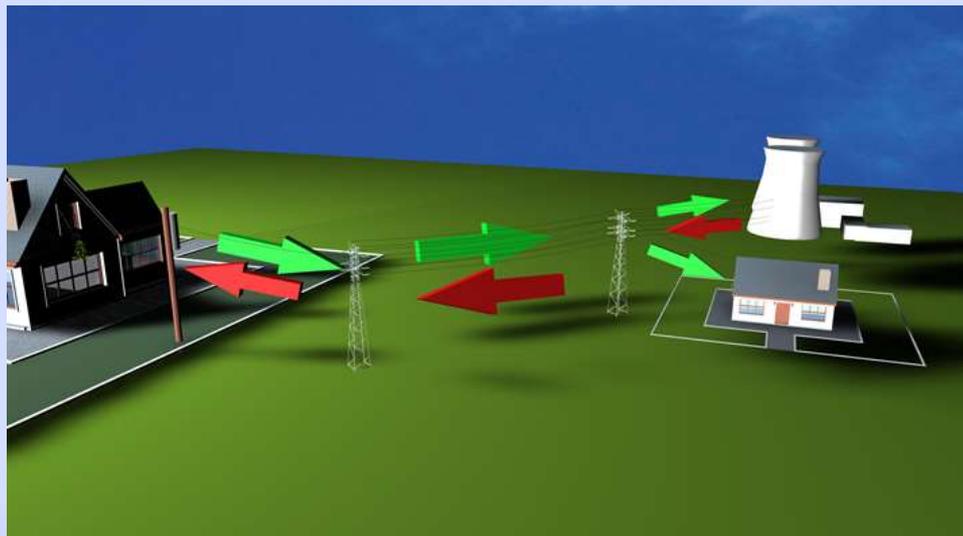
Factor #5: Municipal Permits

- Usually obtained by the solar installer
 - Electrical, building and/or solar permits
 - Typically included in the total cost of a solar installation
- *Potential problem areas:*
 - Structural engineering concerns
 - Panels in front yards
 - Ground-mount panels over 12 ft. high
 - Panels interfering with a neighbor's view
 - Insufficient setbacks
 - Substandard electrical system and/or PV interconnection
 - Historical districts



Factor #6: Ability to Net Meter with Electric Utility

- “Grid-tied” solar PV
 - Interconnected with the electrical grid
 - Utility credit for electricity production
 - Inverter and system must conform to utility standards and electrical code
- Permitted by NH net metering laws
 - *See later Net Metering slides*



Does Solar Work at Gary and Sally's House?



A 4,800 watt system should offset most of our annual electricity consumption. That would be about 16 panels.

Our house has a south facing roof that is big enough, but we will need to check on its condition. Shading and other factors will reduce our output by 11%.

C. SOLAR PV FINANCING AND INCENTIVES

Solar PV Financing

- Financial benefits and costs of solar PV
- Net metering in New Hampshire
- Paying for PV: financing options:
 - Direct ownership with a loan
 - Solar lease
 - Solar power purchase agreement (PPA)
- The electricity rates wild card

Financial Benefits of PV Solar

(Assuming direct-owned solar)

- *One-time* financial benefits-
reduces total cost
 - NH PUC solar rebate
 - Federal tax credit
 - Increased value of home
- *Ongoing* financial benefits
 - Renewable energy credit revenue (possibly)
 - Direct reduction in electricity consumption
 - Credit for *net metered* excess solar electricity production



Source: Wikimedia

Financial Costs of a Solar Investment

- *These financial costs are paid by someone...*
- Initial financial costs
 - Materials and installation
 - Permits, electrical connection, land, etc.
- Ongoing and other financial costs
 - Cost of capital vs. investing \$\$\$ elsewhere
 - Maintenance, removal for roof replacement, etc.
 - Depreciation, including inverter replacement
 - Eventual disassembly and disposal
 - Other- insurance, etc.

Paying for PV: The Bad News and the Good News

- The bad news:
 - Even with rebates and credits, PV systems are expensive
 - Similar to buying a new car
- The good news:
 - There are many ways to pay for PV systems
 - Some with no up-front costs
- More good news: PV systems generate revenue!

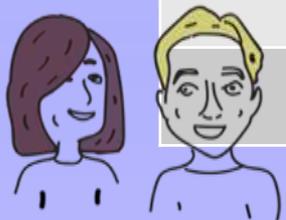


Source: Wikipedia

Sally and Gary's Initial Solar PV Costs

- Assuming Sally and Gary get:
 - 4.8 kilowatt roof-mounted, grid-tied PV system
 - *Your costs and incentives may be different...*

Component	Approx. Cost
16 solar panels- 300 watts each, with racking	\$7,000
Inverter, disconnect and electrical materials	\$4,500
Installation labor, permits, overhead and support	\$7,700
<i>(approx. \$4 / watt)</i> Subtotal:	\$19,200
Less: NH PUC rebate	(\$2,400)
Less: 30% IRS tax credit <i>(after rebate*)</i>	(\$5,040)
<i>(approx. \$2.45 / watt)</i> Net cost:	\$11,760



Financing Option #1: Direct Ownership

- *What it is:* Direct ownership of the solar array
 - Usually financed with loan arranged by installer, bank, etc.
 - Property owner responsible for up-front cost, maintenance, property taxes (if any), damage, etc.
- *Direct ownership advantages:*
 - PV electricity revenue
 - NH PUC solar rebate and IRS tax credit
 - RECs revenue (potentially)
 - Increase in property value www.pvvalue.com
- *Watch out for:*
 - Net metering rate with utility, potential increase in property taxes, financing liens if property is sold, inverter replacement costs, reroofing costs, warranty terms, and maintenance

Financing Option #2: Solar PV Lease

- *What it is:* Leasing a third party-owned PV system
 - Simple fixed monthly payments for a 10 – 25 year term
 - Possible buyout options
- *Lease advantages:*
 - No up-front costs
 - PV electricity revenue
 - Typically lower payments vs. direct ownership
 - Often installer responsible for maintenance
- *Watch out for:*
 - Lease terms and escalation clauses, unrealistic electricity revenue estimates, long lease term, property tax confusion, maintenance/replacement terms, reroofing costs, no govt. incentives, lease transfer terms if property is sold

Financing Option #3: Power Purchase Agreement (PPA)

- *What it is:* Property owner purchases PV electricity produced by an third-party owned system
 - Long-term PPA contract: 10 – 25 years
 - Pay only for the electricity produced by PV system
 - Possible buyout options
- *Power purchase agreement advantages:*
 - No up-front costs
 - Cost of PV-produced electricity typically less than utility/supplier electricity
 - Installer responsible for performance and maintenance
- *Watch out for:*
 - PPA terms and escalation clauses, varying monthly payments, unrealistic electricity rate projections, long PPA term, no govt. incentives, reroofing costs, property tax confusion, PPA transfer terms if property is sold

Financing Options: A Quick Comparison

Option	Initial Cost	Monthly Payment	Net Metering Revenue	NHPUC Rebate & IRS Credit	Sell RECS	Value at End of Term
Direct Owned with loan	\$\$\$\$\$	\$\$\$	YES	YES	~YES	YES
Lease	0	\$\$	YES	NO	NO	NO
Power Purchase Agreement	0	~\$\$	NO	NO	NO	NO

- The best option for you depends on many factors
- Sally and Gary chose direct-owned, with a home equity loan

Other Financing Options

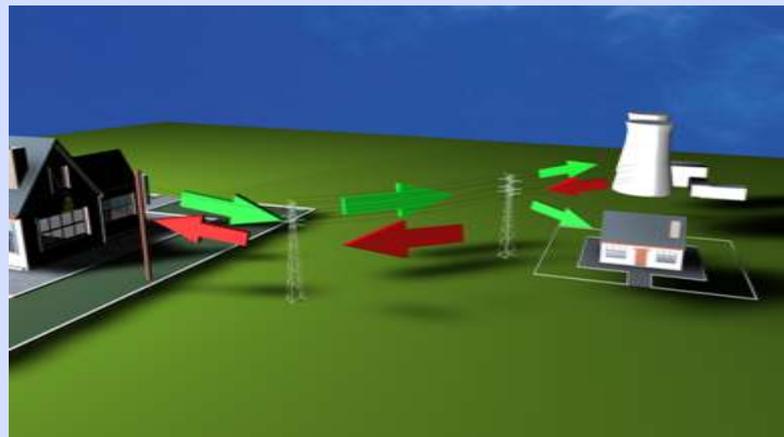
- Group net metering and community solar
 - Part of a group, with solar PV off-site
 - Similar to a power purchase agreement
 - Group needs to be serviced by the same electric utility
- Many loan and mortgage options
 - Home equity loan or line of credit
 - Mortgage financing at time of construction / purchase
 - HUD and FHA loan / mortgage programs
- Prepaid PPAs and leases



Source: YouTube

Net Metering in New Hampshire

- Net metering allows electricity ratepayers to get credit for electricity production
 - May be at the same retail rate as purchased electricity
 - Or a different, lower net metering rate
 - Usually a *credit* towards later electricity consumption (not \$)
- NH's 4 publicly regulated electric utilities share 100 Megawatts in net metering renewable energy allowances
 - Includes: Eversource, Liberty Utilities and Unitil, along with NH Electric Cooperative
 - *May 2016*: Net metering cap expanded from 50 to 100 mW
 - NH PUC to determine a new net metering tariff by early 2017
 - May be lower than current net metering rates



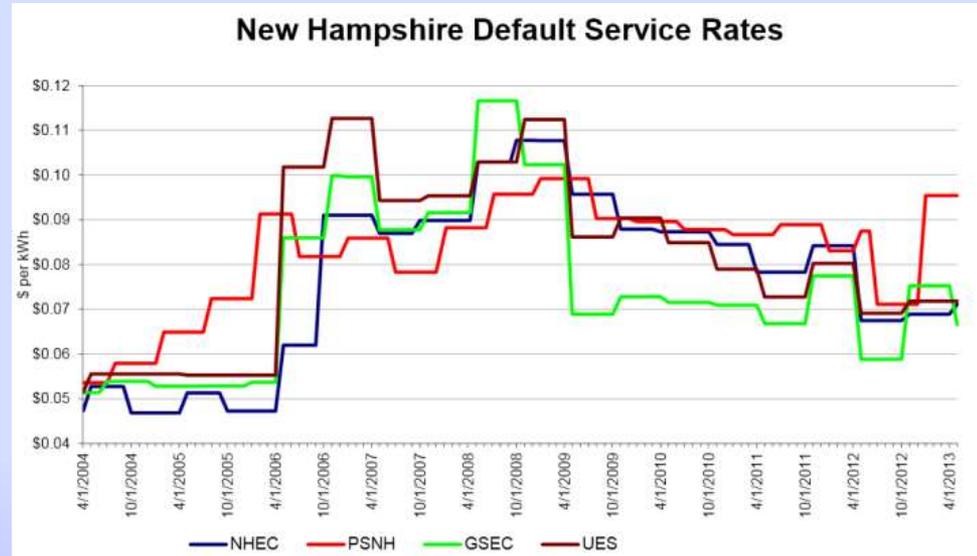
Net Metering Rates...

...It's Complicated!

- Residential net metering rates include credit for:
 - Supply charges (utility default supply or independent supplier)
 - Transmission and distribution charges
 - System benefits charges and taxes
- Net metering rates don't include credit for:
 - Fixed customer charges
 - Any electricity costs not tied to kilowatt-hour energy charges
- Who gets what net metering rate?
 - Existing net metering producers: rate structure remains as established
 - New NH Electric Co-op: residential net metering rates in May 2016: 8.6¢ produced vs. 12.1¢ consumed per kilowatt-hour
 - Other 3 utilities: depends on timing with old and new net metering caps, and outcome of NH PUC study

The Electricity Rates Wild Card

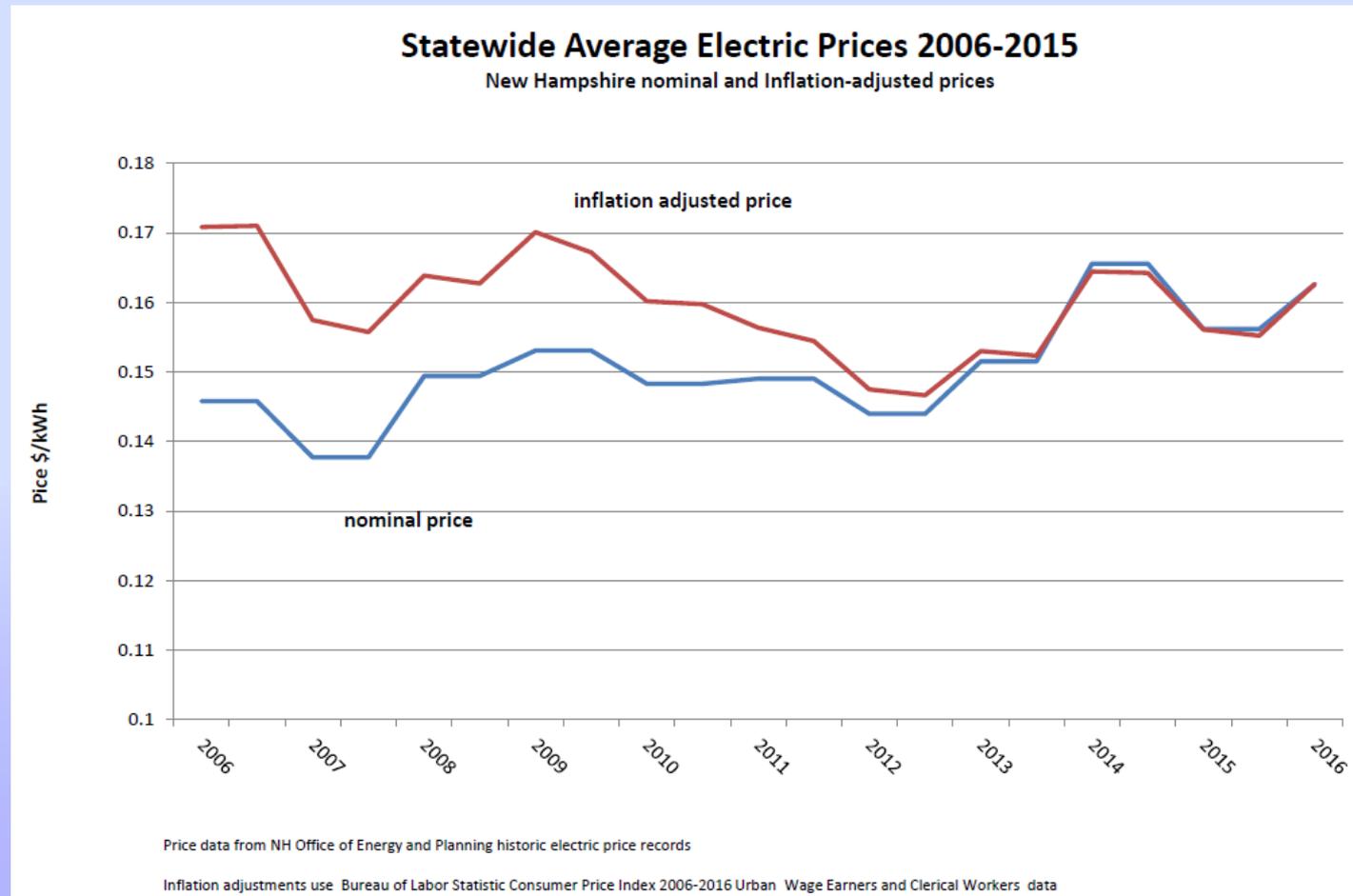
- New Hampshire electricity rates have varied dramatically in the past few years
 - Year-to-year
 - Summer-to-winter
 - Utility-to-utility
 - Competitive supplier vs. utility



Source: NH PUC, 2013. Supply portion only

- *Will future electricity rates increase or decrease?*

A Look Back: Average NH Electricity Prices



Past NH average residential electricity prices from NH OEP

- Weighted average total rates for the 4 NH electrical utilities
- Mid-2016 prices are trending *downward* (~11¢ - 14¢ / kilowatt-hour)

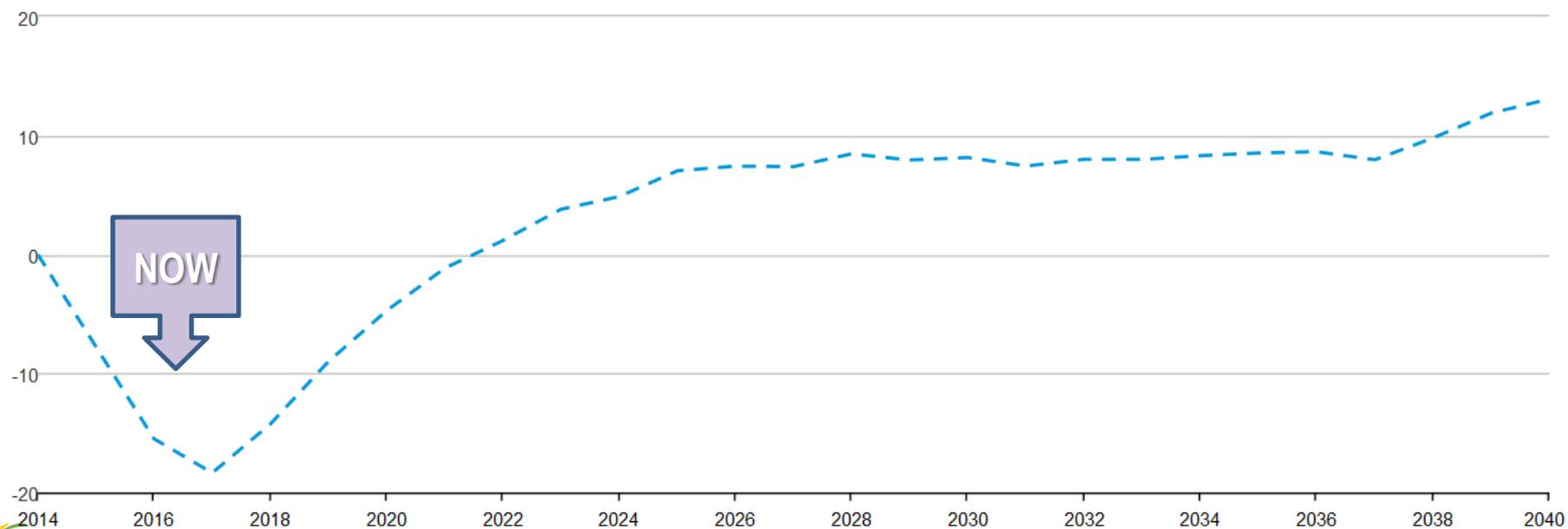
A Look Ahead: Projected New England Electricity Prices

Energy Prices: Residential: Electricity

 DOWNLOAD

Case: Reference case | Region: New England

Indexed to 2014 as percent



 Source: U.S. Energy Information Administration

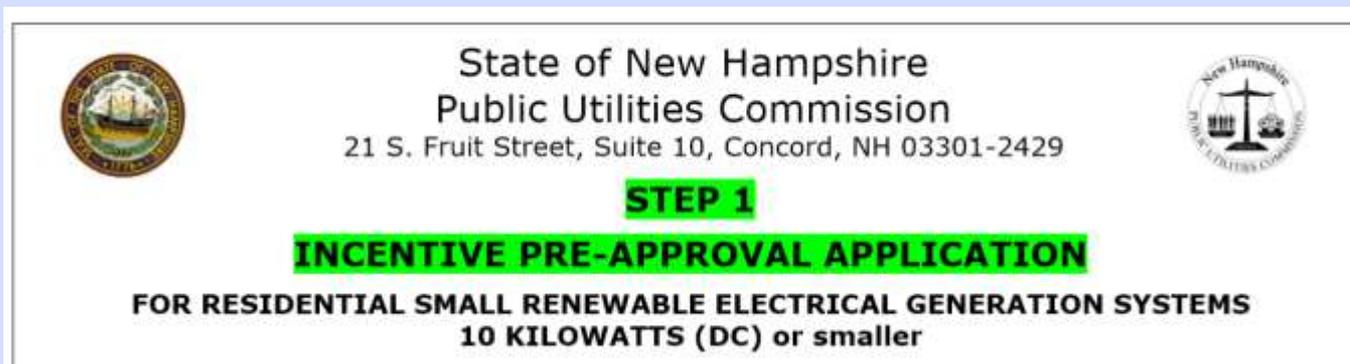
Projected *New England* residential electricity prices from U.S. DOE

- Predicting average 0.6% annual increase from 2014 – 2040
- In 2013 dollars -- does *not* include inflation

Reducing the Cost of PV with Incentives

- NH PUC Renewable Energy Rebate
- Federal Solar Tax Credit
- Renewable energy credits (RECs)
- Property tax exemption
- Utility and other incentives
- (Net metering)

NH PUC Residential Renewable Energy Rebate



- *What it is:*
 - A rebate program for residential owners of new PV systems
 - 50¢ per watt (DC) system size, rebate up to \$2,500
 - Considered taxable income (IRS 1099 issued)
- *Eligibility:* NH residential renewable systems up to 10 kilowatts
- *Application process:*
 - “Step 1” preliminary application to reserve a spot
 - “Step 2” final application after system has been connected to the grid
- *Timing:* available year-round
- *Current status:* Open. (Incentive reduced Oct. 2015 from 75¢ to 50¢ / watt)
Go to: www.puc.nh.gov -- Sustainable Energy Division

Residential Federal Renewable Energy Tax Credits

Form **5695** Residential Energy Credits
Department of the Treasury Internal Revenue Service
Name(s) shown on return
▶ Information about Form 5695 and its separate instructions is at [www.irs.gov/form5695](#).
▶ Attach to Form 1040 or Form 1040NR.

Part I Residential Energy Efficient Property Credit (See instructions before filing.)
Note: Skip lines 1 through 11 if you only have a credit carryforward from 2014.

1 Qualified solar electric property costs

- *What it is:* (residential)
 - 30% tax credit from total cost of solar installation
 - (NH PUC & other rebates: either income or reduces total cost)
 - Tax credit reduces taxes dollar-for-dollar
- *Eligibility:*
 - Individual and joint tax payers who own solar PV systems
 - And have federal tax liabilities; can carry forward to future years
- *Application process:* via federal 1040, Form 5695
- *Timing:* following year after the solar PV installation
- *Current status:*
 - Recently extended at 30% through 2019; drops to 10% by 2022

Consult a tax professional. www.irs.gov has Form 5695 instructions

RECs: Renewable Energy Credits



- *What it is:*
 - Yearly revenue for generating renewable energy
 - 1 REC = 1,000 kilowatt-hours = annual production from ~800 PV watts
 - Approx. \$50 revenue for 1 NH REC [Can also sell Mass. RECs]
- *Eligibility:* Direct owned PV systems
 - Needs a revenue-grade watt-meter
- *Application process:*
 - Production must be verified by an independent monitor
 - RECs are typically sold through an aggregator
 - Initial set up costs ~\$150, and yearly monitoring costs ~\$50 - \$100
- *Timing:* Application and approval by NH PUC
- *Current status:* Open. REC prices may vary year-to-year
 - Go to: www.puc.nh.gov Sustainable Energy /
Electric Renewable Portfolio Standard

Local Property Tax Exemption

LOCAL OPTIONAL EXEMPTIONS <i>(If adopted by city/town)</i>	
7)	<input type="checkbox"/> Solar Energy Systems Exemption (RSA 72:62)
3-b)	<input type="checkbox"/> Wind-Powered Energy Systems Exemption (RSA 72:37-b)
72:37-b)	<input type="checkbox"/> Woodheating Energy Systems Exemption (RSA 72:37-b)

- *What it is:*
 - NH municipalities can choose to exempt renewable energy properties from the assessed values
 - Or consider PV untaxed “personal property”
 - Otherwise solar installations increase assessed values
 - And increase property taxes
- *Eligibility:* varies by NH municipality
- *Application process:* inquire with municipal assessor
 - Use NH Dept. of Revenue Administration Form PA-29
- *Timing:* apply by April 15 in year preceding tax year
- *Current status*
 - 103 NH municipalities have a full or partial solar property tax exemption

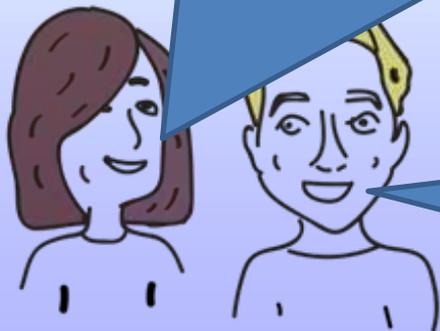
Go to: www.nh.gov/oep/energy/saving-energy/documents/dra-solar-exemption-report.pdf

Other Incentives and Resources

- NH Electric Co-op
 - Offers wide array of renewable energy incentives for Co-op members
 - Go to: www.nhec.com/renewable_energy_programs.php
- USDA Rural Energy for America program
 - Primarily for farms and small businesses in rural parts of NH
 - Low-interest renewable energy and energy efficiency loans
 - Go to: www.rd.usda.gov/programs-services/rural-energy-america-program-renewable-energy-systems-energy-efficiency
- Excellent resource: *A Homeowner's Guide to Solar Financing: Leases, Loans and PPAs*
www.cesa.org

What Incentives Will Sally and Gary Get?

Our electricity company is UniLib-EverCo-op. We hope to get about 14 cents per kilowatt-hour for our net metered PV electricity this year.

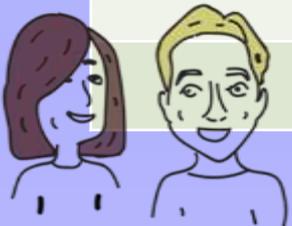


We look forward to getting both the NH PUC rebate and the federal tax credit. We are even going to sell our RECs.

Sally and Gary's Solar PV Revenue

- Gary and Sally's PV system
 - 4.8 kilowatt PV array generates ~5,760 kilowatt-hours/year
 - Net metered at 1:1 rates – reduces their electric bill
 - Doesn't include ongoing costs- maintenance, insurance, depreciation, etc.
 - *Your costs and revenue may be different...*

Item	Approx. Revenue
Net system cost: (after NH PUC rebate and federal tax credit)	\$11,760
Solar electricity production: 5,760 kilowatt-hours/year @ 14¢/kW-hour	\$806/year
Renewable Energy Credits revenue 5 RECs @ \$45 each, less \$75 monitoring costs	\$150/year
Total revenue	\$956/year
Return on investment (revenue/cost)	8.1%

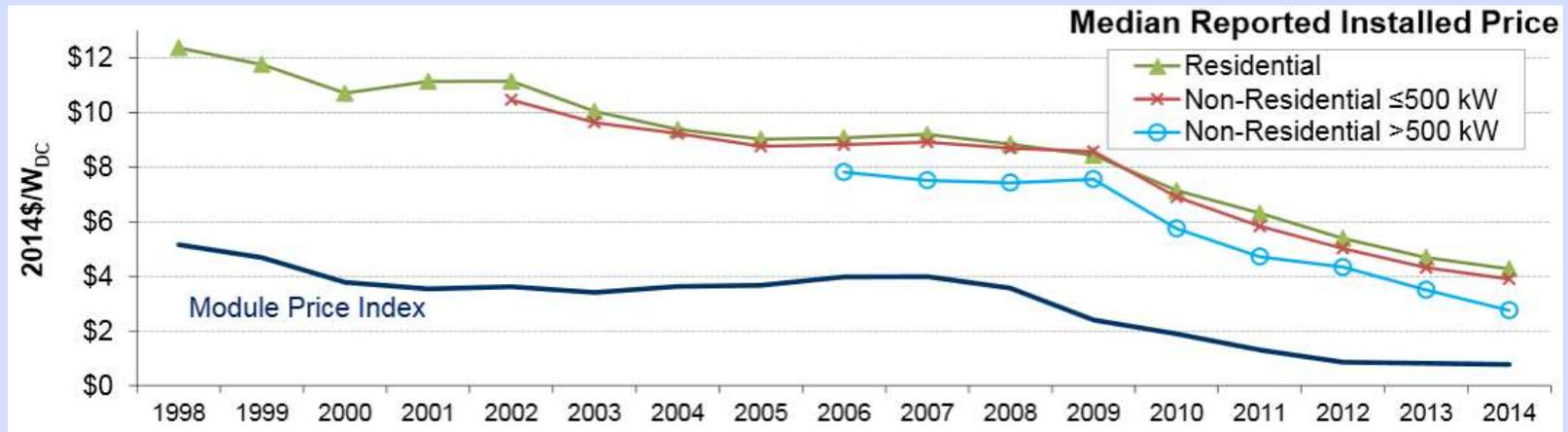


D. CHOOSING AN INSTALLER

Choosing an Installer: PV System Package

- Typical residential PV package includes:
 - PV panels with mounting and anchoring
 - Inverter(s), utility disconnect and net meter
 - Licensed installation, with wiring to existing electrical system
 - Municipal and utility permits and commissioning
 - 5-year labor warranty and manufacturers' eqpt. warranties
- Sometimes includes:
 - Internet solar production monitoring
 - Assistance with state, federal and RECs incentives paperwork
 - Extended warranties and/or service contracts
- Rarely includes:
 - Electrical upgrades
 - Roof structural upgrades
 - Removal and remounting, or end-of-life disposal

Choosing an Installer: System Price



Source: NREL, Aug. 2015

- Installed prices are volatile and variable
 - Still trending downward
- Understand what is included and not included in the contract price
- Financial considerations:
 - The total and net cost and cost per installed watt (if owned)
 - Contract length and long-term obligations
 - Yearly costs and income streams

Choosing an Installer: Capabilities

- Look for these solar PV installer capabilities
 - Solar design that matches the site
 - Licensed electrician installers on staff or contracted
 - NABCEP or other industry certifications
 - Experience with a variety of solar installations
 - Financing options

Choosing an Installer: Service

- High quality PV installer service includes:
 - Thorough site assessment
 - Willingness to answer questions
 - Clear and comprehensive contract documents
 - High quality components – 15+ year warranties
 - Long labor warranties- 5+ years
 - Excellent customer service and support
 - Good company reputation and longevity
 - Strong capabilities (see next slide)

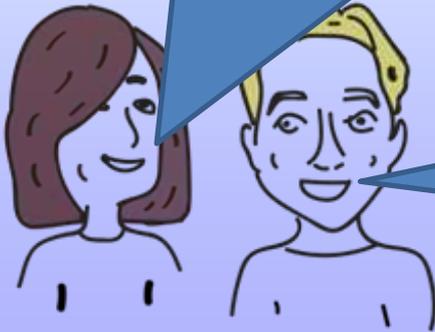
Choosing an Installer: *Warning Signs*

- Possible warning signs with a potential PV contractor:
 - Pushy- wants you to sign a contract today
 - Unresponsive- doesn't answer all your questions
 - Proposing a PV installation in an unsuitable location or poor design
 - Contract poorly written or lots of fine print
 - Unwilling to justify solar production estimates
 - Does not use experienced, licensed electricians for installations
 - Unwilling to pull permits or provide paperwork for incentive applications
- Information sources
 - Solar Energy Industries Association (SEIA), consumer protection resources: www.seia.org/policy/consumer-protection
 - NH Attorney General, consumer protection: doj.nh.gov/consumer
 - NH Better Business Bureau: www.bbb.org/concord

Sally and Gary Choose XYZ Solar Co.

I like XYZ's willingness to answer all our questions. They have done lots of installations, and are helping us with financing and incentive applications.

XYZ is such a cool company. They even have a golden retriever called "Sunny."



E. SALLY AND GARY'S JOURNEY: FROM SITE ASSESSMENT TO POWER PRODUCTION

Gary and Sally Started Exploring Solar PV

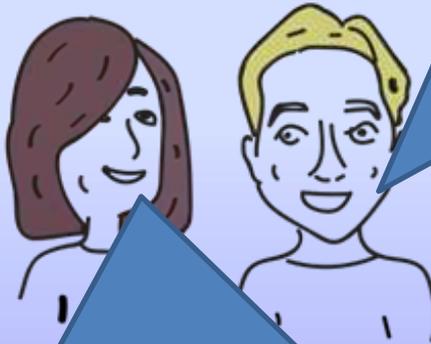


We talked about all the sun our house gets, and had fun drawing a roof-top solar array using PVWatts.

We called several solar companies, and got quotes for both leased and owned systems.

Sally and Gary Get Serious

We had to wait a while for net metering to become available again before we signed the contract



Once the contract was signed, XYZ Solar got to work setting up town permits, the utility interconnection, and the NH PUC rebate.

Installation and Beyond!

Installation was a snap – completed in one day! We are set to receive \$2,400 as a NH PUC rebate, and RECs revenue as well.



I have already seen our net meter run backwards! And the \$5,040 federal tax credit can be used over multiple tax years.

THANK YOU!

Thanks to Peter Adams of EVP Marketing and Media for graphics and support

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Residential and Municipal Solar 101 presentations
will be available in June at:

www.lrcc.edu/solar101