Community Solar Energy

The Middlebury 149 kW CSE, ACORN Energy Solar One, LLC

Efficiency and Renewables

16” thick Larsen truss walls, 26 years off grid. both energy reduction and energy production

- Deep Energy Retrofits are not practical for most people
- 30% gain from Home Performance with Energy Star ($7500 avg), means 70% of energy is still needed
- Need a serious push on Renewables

Vermont Act 170

- Sets goal of 77.5 MW of New Renewable capacity over the next 10 years in the SPEED program, with a goal that 20% of the state's electricity in 2017 be a new SPEED resource

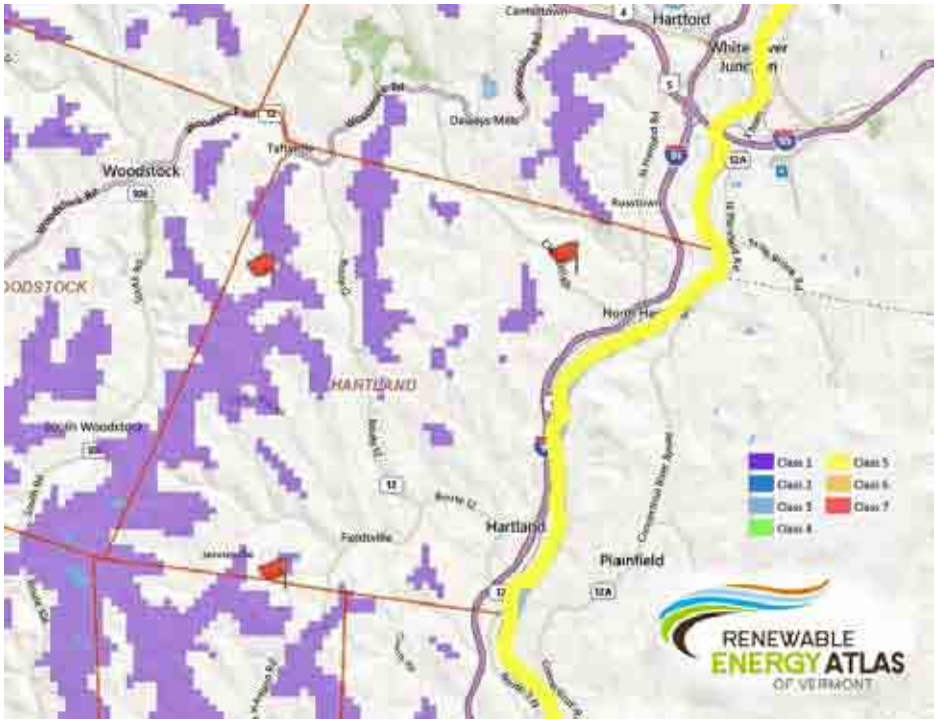
- Sets thresholds for triggering a state Renewable Portfolio Standard (Section 8004) based on SPEED resources 2005-2012

- Sets RE targets of 55% of Retail Provider's portfolio in 2017, increasing by 4% per year to 75% by 2032

- Increased Eligibility for VEDA programs

Renewable Energy Choices

- Low Wind Resource in UV
- Best Hydro is already taken, it has a large Biosystems loss, and there are many environmental and FERC regulations
- Biomass is most efficient for heat, and best use is CHP
- Solar has many uses, and is widely available using small to large, distributed facilities

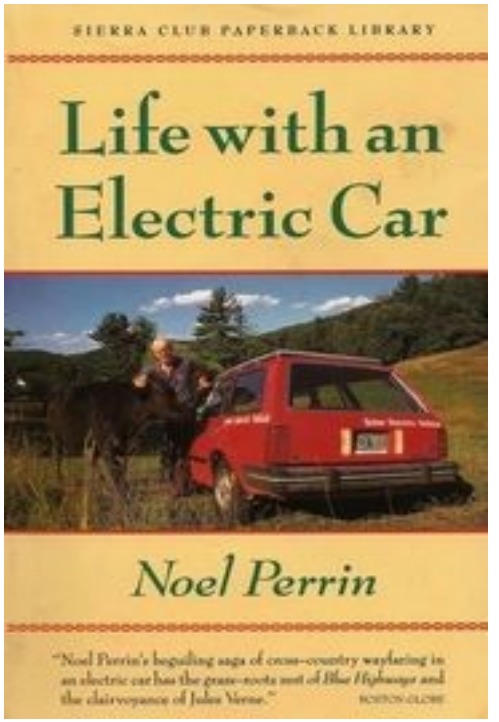


Map of Wind Resources in Hartland
Small area qualifies as category 1

The Many Faces of Solar

- Daylighting- started at 1800's health spas, gained wider popularity after W.W.2, and is now used to reduce lighting loads
- Passive heat- from simple sunspaces to highly insulated buildings with special glazing
- Solar Hot Water- can reduce water heating to a minimum
- Solar Electric- universal use
- Permaculture-the big picture

- Transportation-



An Upper Valley resident who had solar panels on his barn for charging his car

The Many Faces of Community Energy

Cobb Hill 2.7 kW community array

Acorn Energy Co-op

CO-OP POWER

- Bulk Purchase groups
  - -solar hot water systems
  - -solar electric systems
  - -fuel (wood, pellet, biodiesel)
  - -energy efficiency products
  - -green electricity
- Joint ownership of larger projects
- Information and Training
- Energy Audits
- Community Weatherization
  - -residential, schools, small municipal buildings
- Neighborhood “barn raisings”
  - -solar hot water installations (PAREI, Mt Holly)

The Benefits of Community and Solar

- "**It will be nice when solar gets here" (but I need oil to do work.**)
  -Trans. Town- How are you going to work when oil becomes expensive? Energy is not part of our mindset yet, and groups will support members
- **Cost Reduction**
  -less design, purchasing, permits, interconnections, maintenance
  -increased access to tax incentives, tax credits, funding sources, loans, ownership models, partnerships to reduce upfront and overall costs
  -participation can be unlinked from the whole cost of a system or property ownership ($500 Solar Shingles in CA, Brewster Solar Garden's 28 panels for 5 years for $5000 will return you $6400 of electricity)
- **Better Solar Access**
  -Solar Hartland found 1/3 of sites were good, and an NREL 2008 study found 22% of residential and 65% of commercial cool climate buildings were acceptable. 2/3's of roof sites need a better location.
  -Increased solar access increases output and reduces cost
- **Distributed Generation** in existing infrastructure can be built in stages
- Calif found **increased reliability** over individual residential systems

A Generic CSE

- **149 kW size**, VT net metering can be up to 500 kW, but the regulations become more extensive at 150 kW and up
- **Under 36 members**, SEC regulations become much more expensive above that
- **A shared site**, about an acre with very good solar access (above 94%) to increase generation
- **A business member**, to use the business tax incentives and expedite financing
- **Group Net Metering**, to distribute the electricity credits
- **$600,000**, 149kW array at $4/watt, not including other expenses

Organizing a CSE

- Finding Members (CSE)
- Locating a Site (CSE)
- Preliminary Design (CSE)
- Funding (CSE/sub)
- Legal- permits,LLC (sub)
- Procurement (sub)
- Installation (sub)
- Operation (CSE/sub)

On a cloudless day, the solar energy falling on Hartland is equal to the output of 186 Vermont Yankees, (after the uprate to 620 MW).

Finding Members

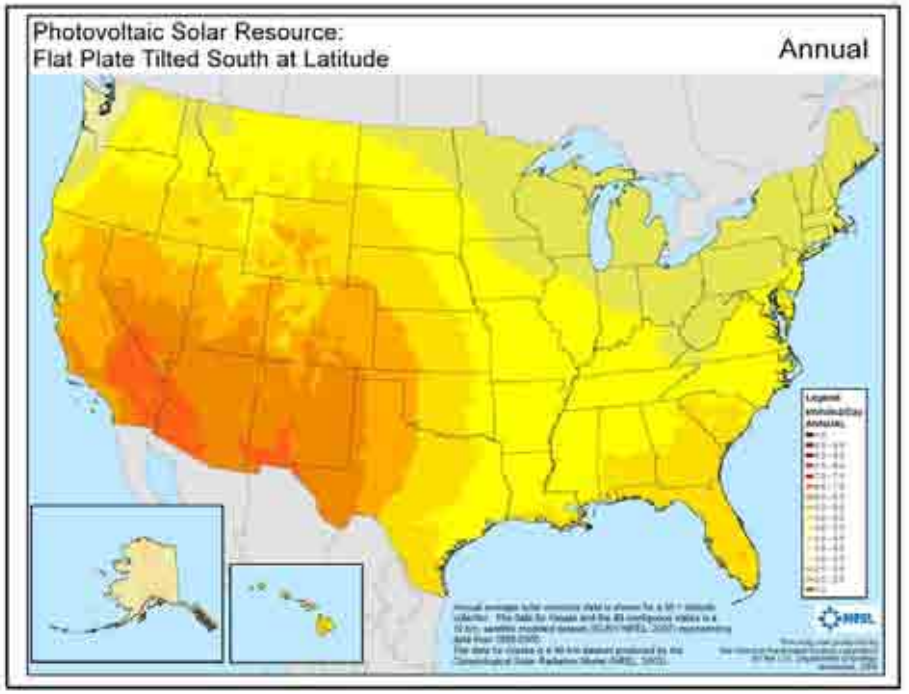
- Solar Hartland talked with close to 1000 people last summer at 12 booths, 8 events, and 15 site visits, and found a dozen people who were interested in forming a CSE group at a commitment equal to a residential PV system ($10,000-15,000). Many more would be interested if the amount were smaller
- Mad River Valley Energy did a survey and found most people (37%) were interested around the $1000-2500 level
- Poultney held meetings and also found many people wanted a lower threshold (around $1200, some at $600)
- Norwich did a followup survey to a bulk purchase drive, and found cost, tax credits, payback, structure, to be concerns. A CSE would help these issues.
- Businesses, however can have a strong financial motivation to get electricity from a CSE solar array, especially if they don't have a good on site location. Many are not aware of the incentives.

Definitions- all on the same page

- kW is a flow rate
  (7W versus 15W CFL)
- kWh is an amount
  (Electric bill)

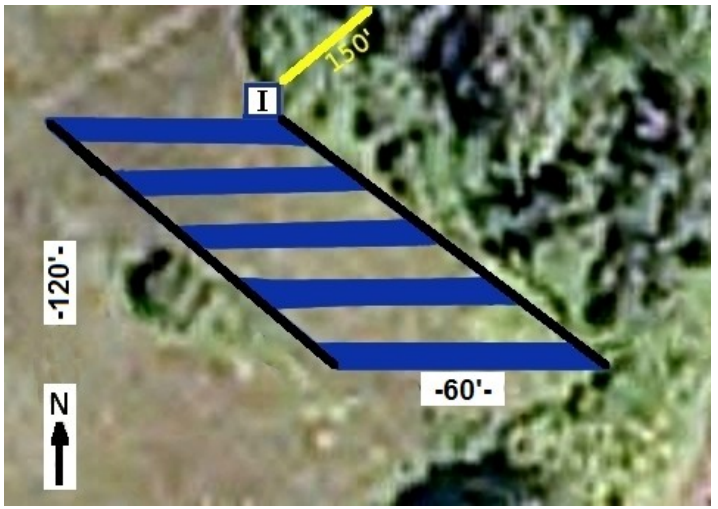
Maps like this one, and Redbook data, are in ***kWh per square meter per day***. For our purposes, since the Standard Test Condition for solar panels is 1000 watts/m2, we can divide out the terms, and the data becomes hours per day.

This allows us to multiply the nominal kW rating of the solar panels by these hours to get the kWh output per day.



NREL Solar Resource Map, annual

Locating a Site and Preliminary Design



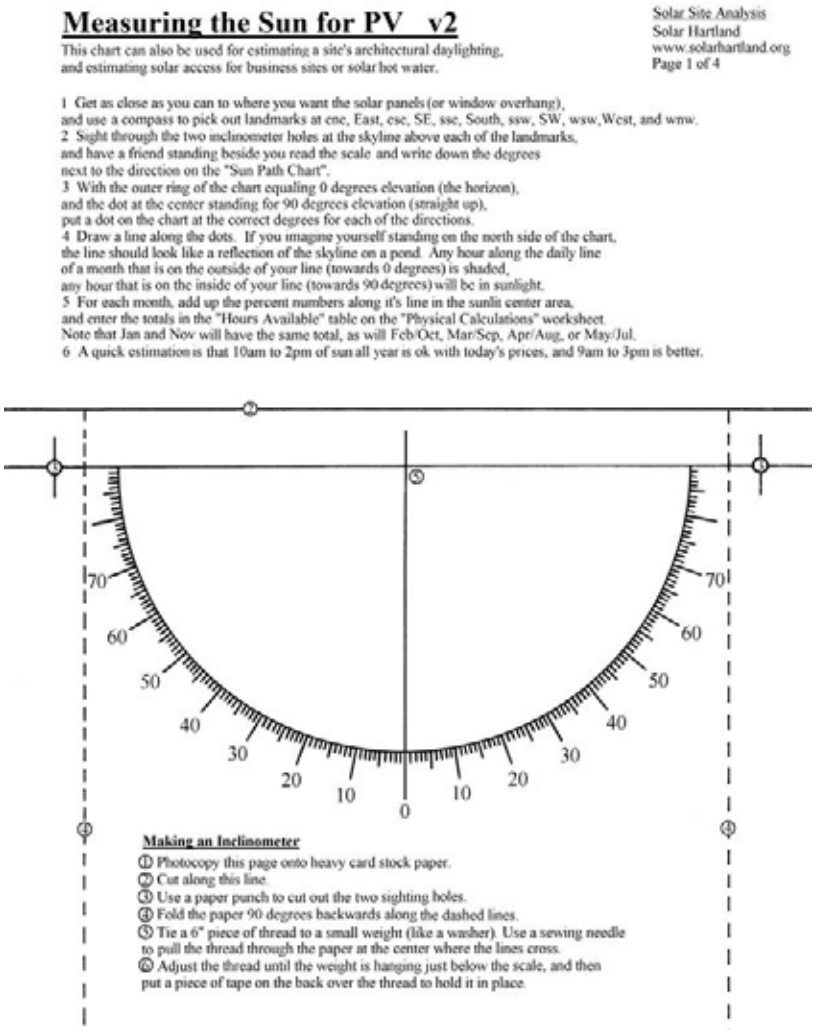
Measure the N-S length and E-W width of your site, and do a shading analysis using the SSA.

Then you can calculate how many hours of sunlight, how many panels will fit, how much electricity they will make, and a general cost.

- A 149 kW array needs a little less than one unshaded acre. This will serve about two dozen homes (which can vary from 1,000 to 12,000 kWh per year)
- Members all on the same Utility
- A site should be open to south, and have year round repair access
- 3 phase power service (3 wires at the pole top on a cross bar)
- Long term (40 year) arrangement for use of the land
- Use the SSA form to compare the solar access of various sites

A short detour for the 4 page Solar Site Assessment Form

- 1'st page- general instructions and inclinometer
- Does the same thing as a Solar Pathfinder, but less expensive



Measuring the Sun for PV v2

Solar Site Analysis
Solar Hartland
www.solarhartland.org
Page 1 of 4

This chart can also be used for estimating a site's architectural daylighting, and estimating solar access for business sites or solar hot water.

1 Get as close as you can to where you want the solar panels (or window overhang), and use a compass to pick out landmarks at ene, East, ese, SE, sse, South, ssw, SW, wsw, West, and wnw.
2 Sight through the two inclinometer holes at the skyline above each of the landmarks, and have a friend standing beside you read the scale and write down the degrees next to the direction on the "Sun Path Chart".
3 With the outer ring of the chart equaling 0 degrees elevation (the horizon), and the dot at the center standing for 90 degrees elevation (straight up), put a dot on the chart at the correct degrees for each of the directions.
4 Draw a line along the dots. If you imagine yourself standing on the north side of the chart, the line should look like a reflection of the skyline on a pond. Any hour along the daily line of a month that is on the outside of your line (towards 0 degrees) is shaded, any hour that is on the inside of your line (towards 90 degrees) will be in sunlight.
5 For each month, add up the percent numbers along it's line in the sunlit center area, and enter the totals in the "Hours Available" table on the "Physical Calculations" worksheet. Note that Jan and Nov will have the same total, as will Feb/Oct, Mar/Sep, Apr/Aug, or May/Jul.
6 A quick estimation is that 10am to 2pm of sun all year is ok with today's prices, and 9am to 3pm is better.

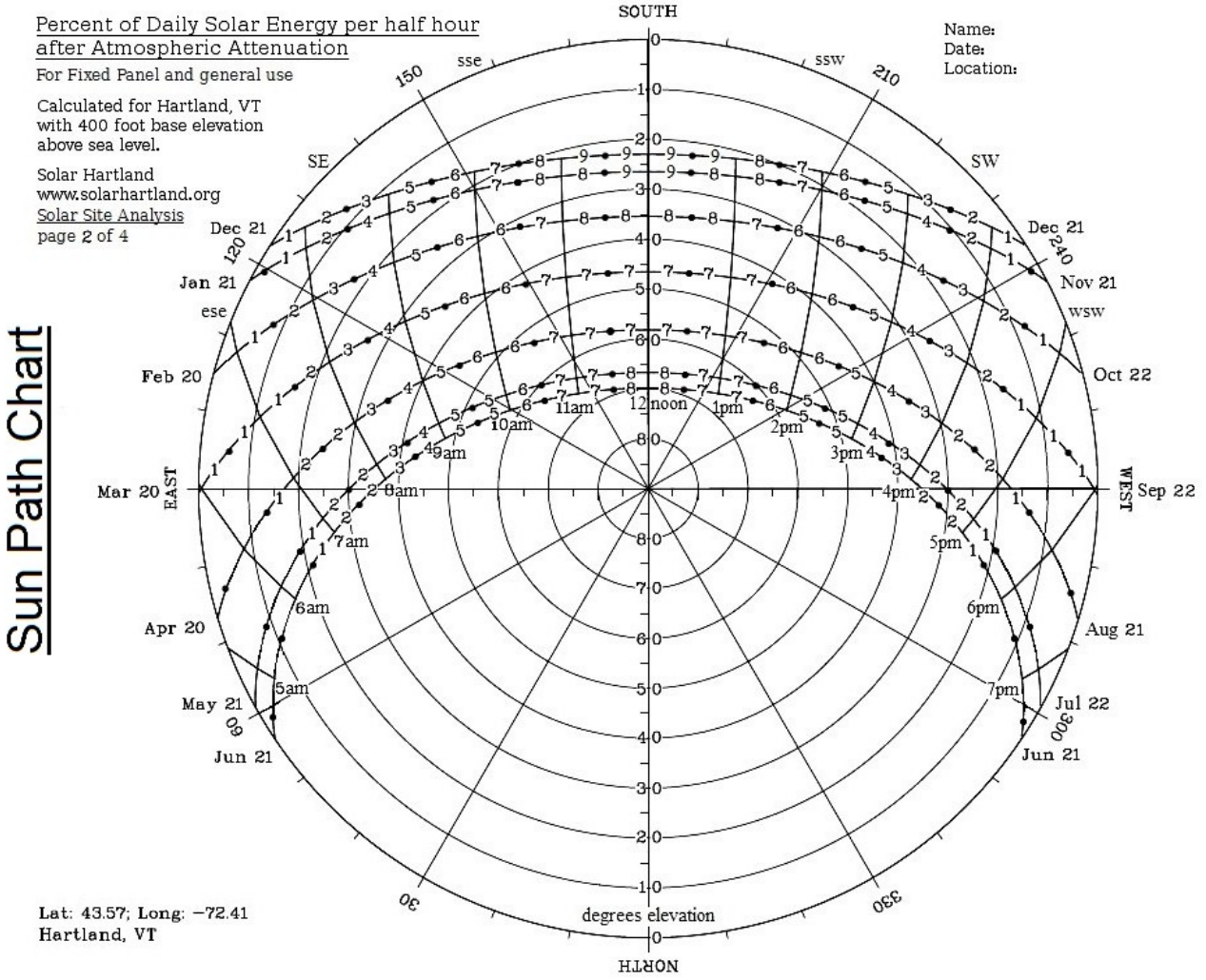
70 60 50 40 30 20 10 0 10 20 30 40 50 60 70

Making an Inclinometer

① Photocopy this page onto heavy card stock paper.
② Cut along this line.
③ Use a paper punch to cut out the two sighting holes.
④ Fold the paper 90 degrees backwards along the dashed lines.
⑤ Tie a 6" piece of thread to a small weight (like a washer). Use a sewing needle to pull the thread through the paper at the center where the lines cross.
⑥ Adjust the thread until the weight is hanging just below the scale, and then put a piece of tape on the back over the thread to hold it in place.

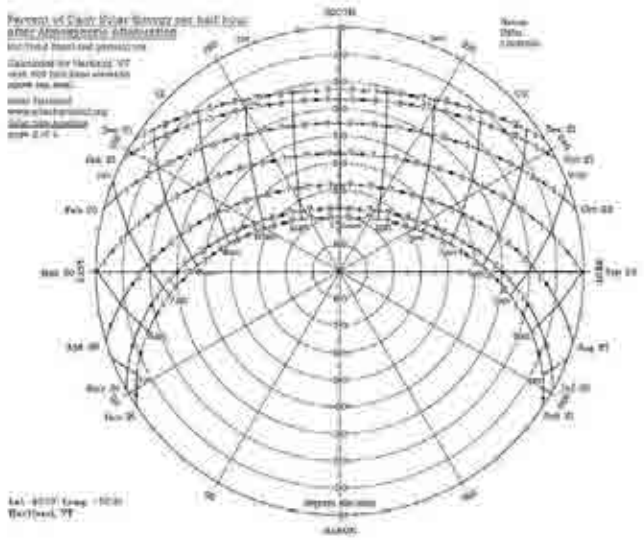
Compass Pendulum instead of Inclinometer

Percent of daily energy per half hour



Would anyone like to help develop a spreadsheet that skips the chart sketching step?

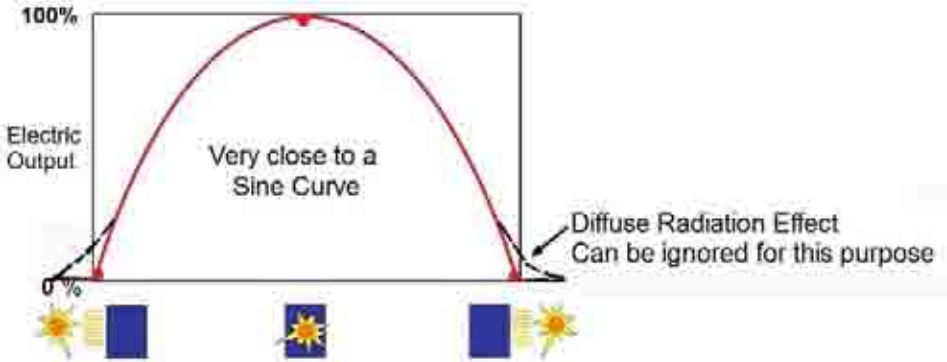
Factors for Sun Path Chart



"Solar Constant" at top of atmosphere is 1353 watts/m2

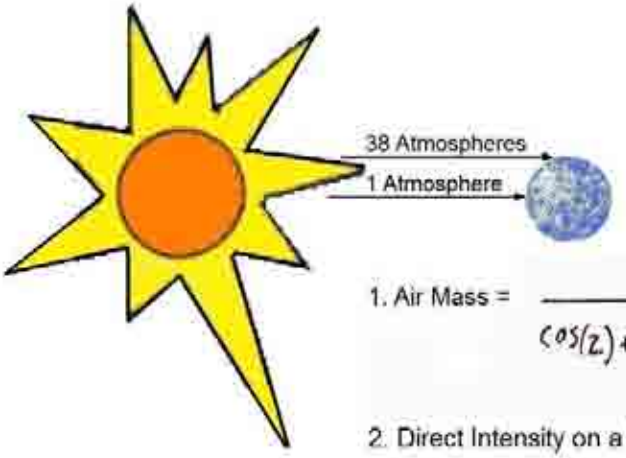
Standard Test Conditions for Solar Panels (at 77° F)
at bottom of atmosphere is defined as 1.5 atmospheres,
or 37 degrees latitude (average condition for US),
and corresponding spectral distribution.
This equals 1000 watts/m2

1. Angle of the Sun to the Panel



5 to 10 degrees off center won't affect output much

2. Thickness of the Atmosphere



A= Altitude in feet

Z= Zenith Angle

1. Air Mass = $\frac{1}{\cos(Z) + .50572(96.07995 - Z)^{-1.6364}}$

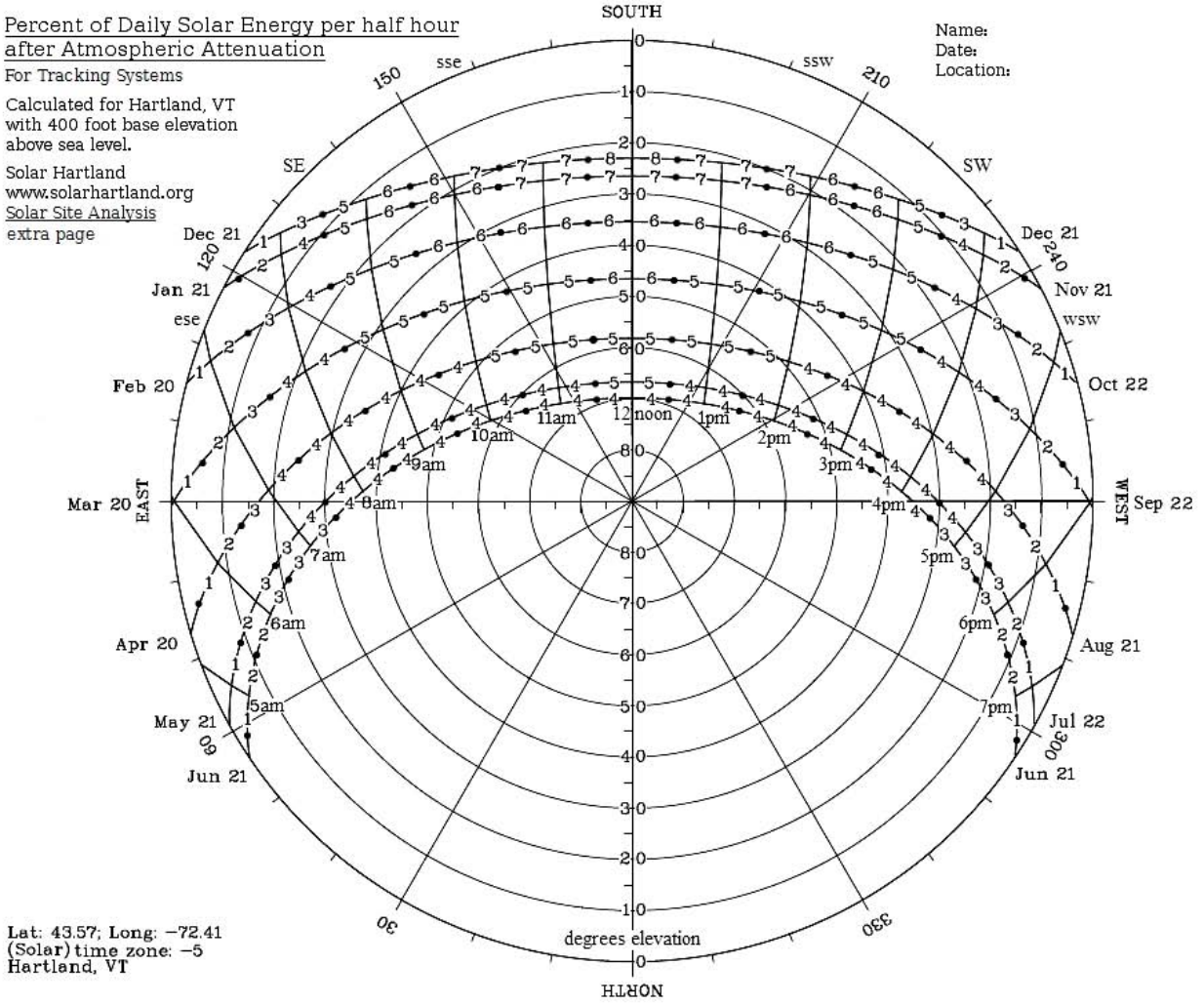
2. Direct Intensity on a Perpendicular Surface (kW/m2)

$$I_D = 1.353 \cdot \left((1 - A) \cdot 0.7^{(A_m^{0.678})} + A \right)$$

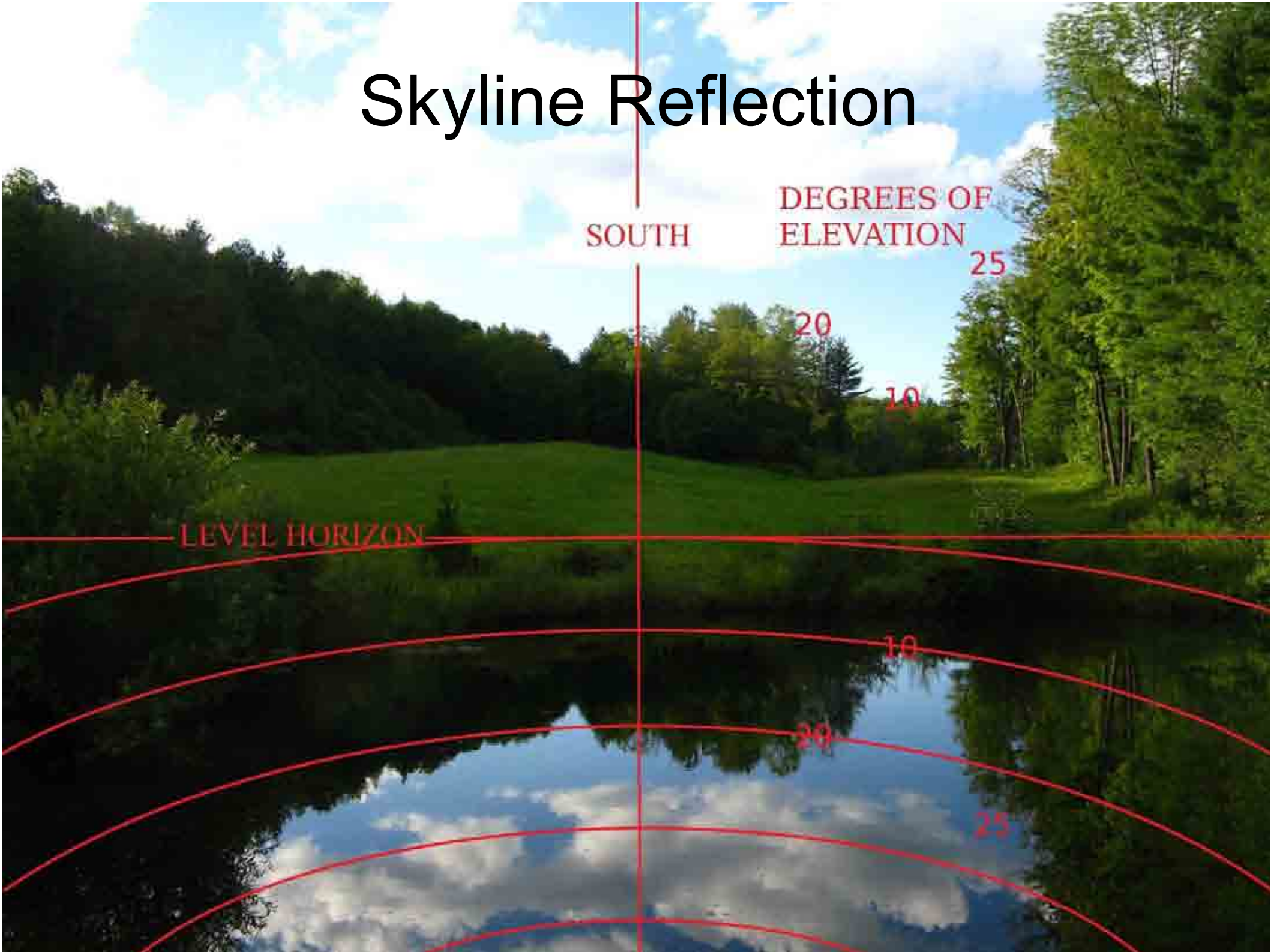
3. Add 10% for Diffuse Radiation Effect

$$I_G = I_D \cdot 1.1$$

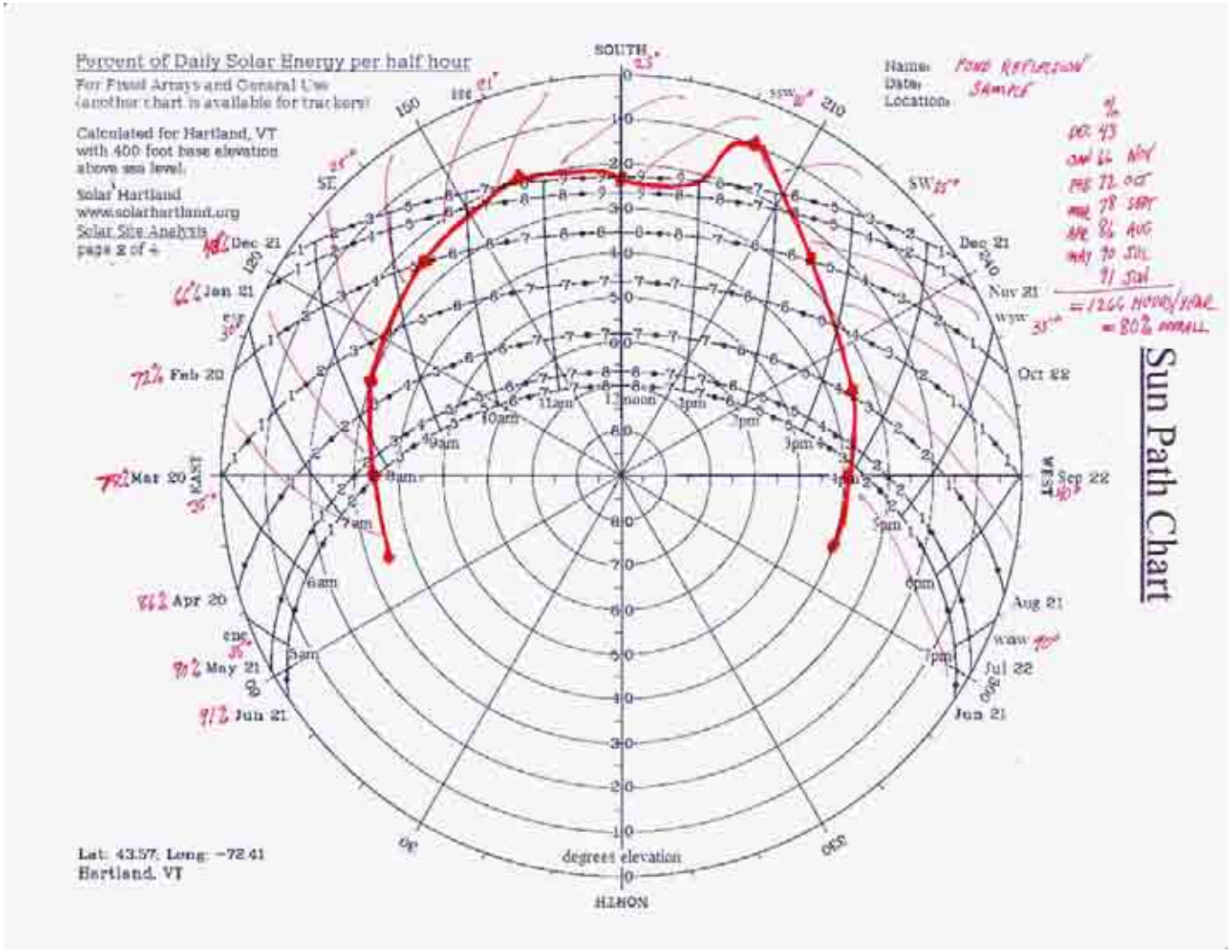
Tracking percent (panel angle left out)



Skyline Reflection



Skyline on Chart, Percents added up



Converting the Solar Percents to Output

- The percent is modified by NOAA/Redbook weather data according to different rack types
- For residential, calculate the array size using the homeowner's electric bill
- For a CSE, take the year hours and multiply by the output of the panels that will fit on your site, to get yearly kWh output

Physical Calculations for solar arrays
for Hartland, VT latitude and weather
Solar Site Analysis, page 3 of 4
Solar Hartland www.solarhartland.org

Name:
Date:
Location:

Hours available:
monthly% x days x hours/day by rack type
(% is from Daily Solar Energy shading graph)
(Fixed, Seasonal Adjust, 1 axis, 2 axis tracker)

Mo	%	x days	x	F	SA	1	2	=hours/mo
Jan		x 31	x	3.1	3.8	3.6	3.8	
Feb		x 28	x	4.1	4.1	4.9	5.0	
Mar		x 31	x	4.7	4.7	5.9	5.9	
Apr		x 30	x	5.0	5.0	6.4	6.5	
May		x 31	x	5.2	5.6	7.0	7.1	
Jun		x 30	x	5.4	5.9	7.4	8.0	
Jul		x 31	x	5.6	6.0	7.6	8.1	
Aug		x 31	x	5.3	5.3	7.1	7.3	
Sep		x 30	x	4.9	4.9	6.1	6.1	
Oct		x 31	x	3.9	3.9	4.7	4.7	
Nov		x 30	x	2.7	2.7	3.0	3.1	
Dec		x 31	x	2.4	2.6	2.7	3.0	
Add up Total Hours for the year								

Electrical Load:
from utility bills $/kWh = total of all kWh fees
Service Charge= per day fee

Month	kWh	$/kWh	+ Serv Ch	= total
Jan				
Feb				
Mar				
Apr				
May				
Jun				
Jul				
Aug				
Sep				
Oct				
Nov				
Dec				
Totals				

The 100% total hours per year are 1591 for Fixed, 1640 for SA, 2021 for 1 Axis, and 2094 for 2 Axis.
Divide your hours, by the 100% hours times 100, to find the percent solar access at your site: _____

System Losses:
The Default value is 0.77 efficiency for average equipment and Vermont's temperature, if you wish to adjust for specific equipment the factors used here are:

PV module rating 0.98	Panel mismatch 0.98	Diodes and Connections 0.995
Soiling 0.95	DC wiring 0.98	Inverter 0.95
Summer heating 0.94	AC wiring 0.99	Downtime 0.98

Tracking and Shading are accounted for in the calculations above
Multiply all the losses together to get an overall system efficiency, with these figures it equals 0.77

Amount of Electricity needed.
Take the yearly kWh total from the table above, and divide it by 0.77 to make a larger total needed for generation to account for the losses: kWh with compensation for Losses: _____

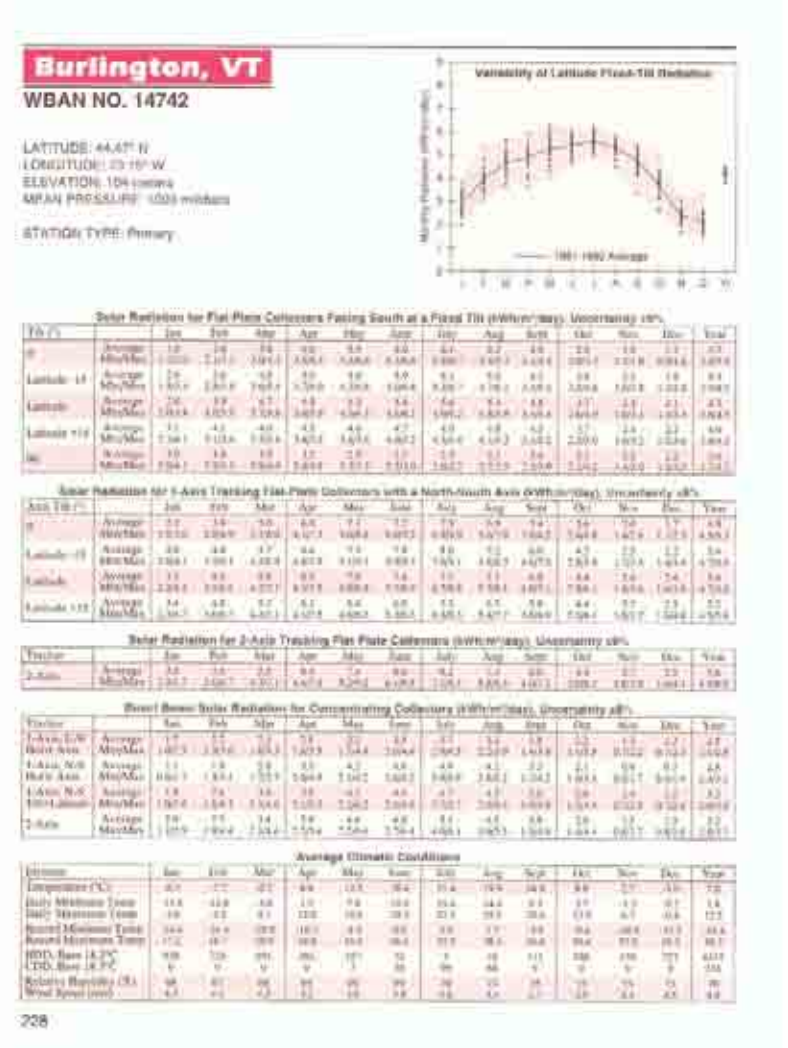
System Array Electrical size:
Divide the kWh with Losses by the Total Hours for the year to find the size of array in kW: _____

Azimuth and Tilt correction: (advanced)
If your panels face away from south more than 15 degrees, or are tilted less than 25 or more than 50 degrees from horizontal, please use PVWatts, http://www.nrel.gov/rredc/pvwatts/, to increase the kW size to compensate for the loss of output.

System Array Physical size
Divide array kW by 0.205 to find number of average panels (5' wide by 63" high): _____
Divide array kW by (0.01369 for monocrystalline, 0.01278 for polycrystalline, or 0.00581 for amorphous panels (thin film)) to find the average size in square feet for the array: _____
(The factors are kiloWatts per square foot. Monocrystalline (solid blue) panels are a bit more efficient, Polycrystalline panels (visible crystal pattern) are most common. Amorphous panels are generally glued onto new metal roofing and need to be about twice the area because of lower efficiency)

Redbook kWh output by weather

- The SSA form uses Albany, Burlington, and Concord data averaged together to get an Upper Valley approximation



Burlington, VT

WBAN NO. 14742

LATITUDE: 44.47° N
LONGITUDE: 73.15° W
ELEVATION: 104 meters
MEAN PRESSURE: 1020 millibars

STATION TYPE: Primary

Variability of Latitude Plate-Tilt Radiation

Solar Radiation for Flat-Plate Collectors Facing South at a Fixed Tilt (kWh/m²/day). Uncertainty ±8%

Solar Radiation for 1-Axis Tracking Flat-Plate Collectors with a North-South Axis (kWh/m²/day). Uncertainty ±8%

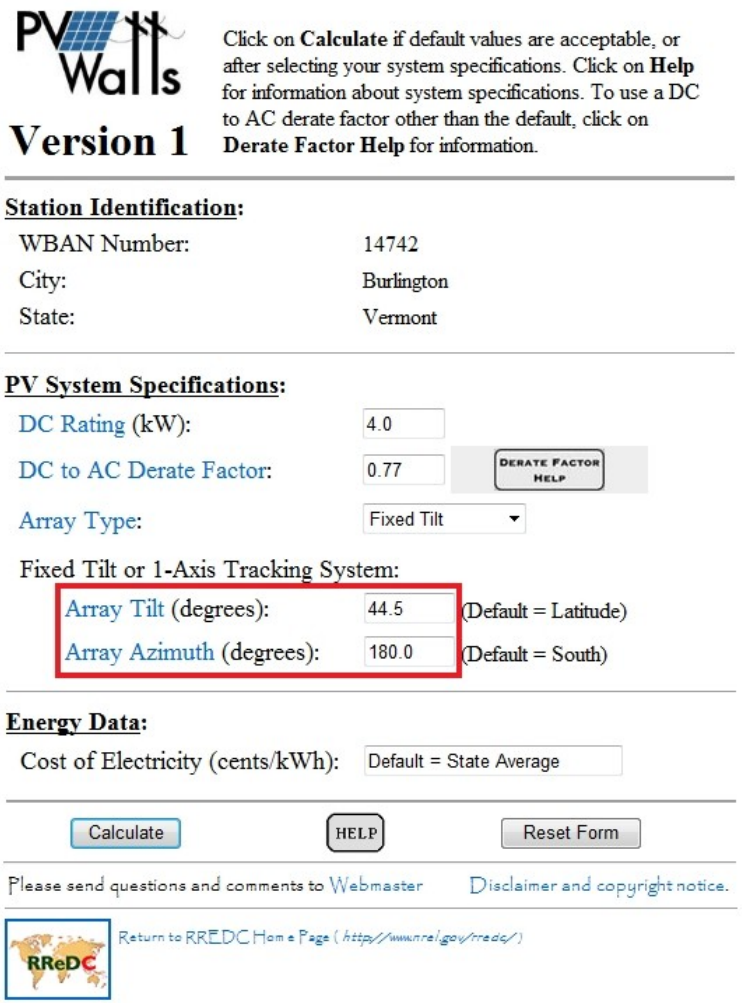
Solar Radiation for 2-Axis Tracking Flat Plate Collectors (kWh/m²/day). Uncertainty ±8%

Direct Beam Solar Radiation for Concentrating Collectors (kWh/m²/day). Uncertainty ±8%

Average Climatic Conditions

228

Azimuth and Tilt correction



- If the array faces:

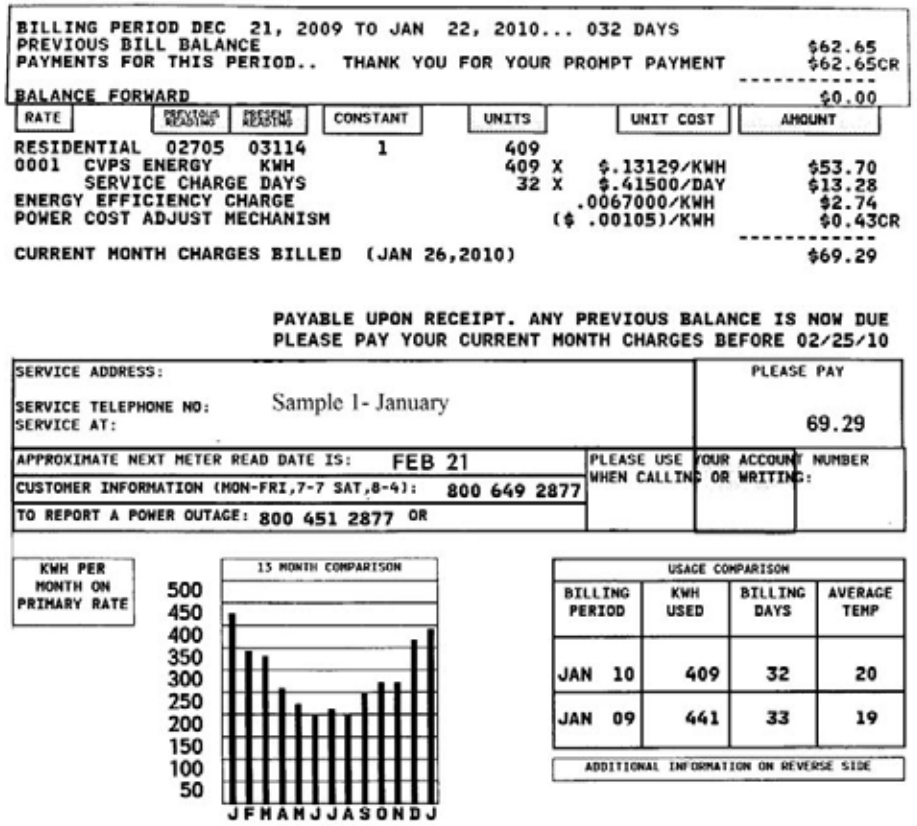
  -away from south more than 15 degrees

  -or up less than 25 degrees

  -or up more than 50 degrees from horizontal

- enter the kW output from the array along with the azimuth and tilt into PV Watts, to correct the output. (There is less than 2% loss up to these limits.)

Energy Efficiency Opportunity



BILLING PERIOD DEC 21, 2009 TO JAN 22, 2010... 032 DAYS

PREVIOUS BILL BALANCE	$62.65
PAYMENTS FOR THIS PERIOD.. THANK YOU FOR YOUR PROMPT PAYMENT	$62.65CR
BALANCE FORWARD	$0.00

RATE	PREVIOUS READING	PRESENT READING	CONSTANT	UNITS		UNIT COST	AMOUNT
RESIDENTIAL 02705	03114		1	409			
0001 CVPS ENERGY KWH				409	X	$.13129/KWH	$53.70
SERVICE CHARGE DAYS				32	X	$.41500/DAY	$13.28
ENERGY EFFICIENCY CHARGE						.0067000/KWH	$2.74
POWER COST ADJUST MECHANISM						($ .00105)/KWH	$0.43CR
CURRENT MONTH CHARGES BILLED (JAN 26,2010)							$69.29

PAYABLE UPON RECEIPT. ANY PREVIOUS BALANCE IS NOW DUE
PLEASE PAY YOUR CURRENT MONTH CHARGES BEFORE 02/25/10

SERVICE ADDRESS:
SERVICE TELEPHONE NO:
SERVICE AT:
Sample 1- January

PLEASE PAY 69.29

APPROXIMATE NEXT METER READ DATE IS: FEB 21

CUSTOMER INFORMATION (MON-FRI,7-7 SAT,8-4): 800 649 2877

TO REPORT A POWER OUTAGE: 800 451 2877 OR

PLEASE USE YOUR ACCOUNT NUMBER WHEN CALLING OR WRITING:

KWH PER MONTH ON PRIMARY RATE

13 MONTH COMPARISON

500
450
400
350
300
250
200
150
100
50

J F M A M J J A S O N D J

USAGE COMPARISON

BILLING PERIOD	KWH USED	BILLING DAYS	AVERAGE TEMP
JAN 10	409	32	20
JAN 09	441	33	19

ADDITIONAL INFORMATION ON REVERSE SIDE

- For Energy Committee members! half the site visits had a discussion of electric bills, and how to reduce electricity use.

Financial page of SSA

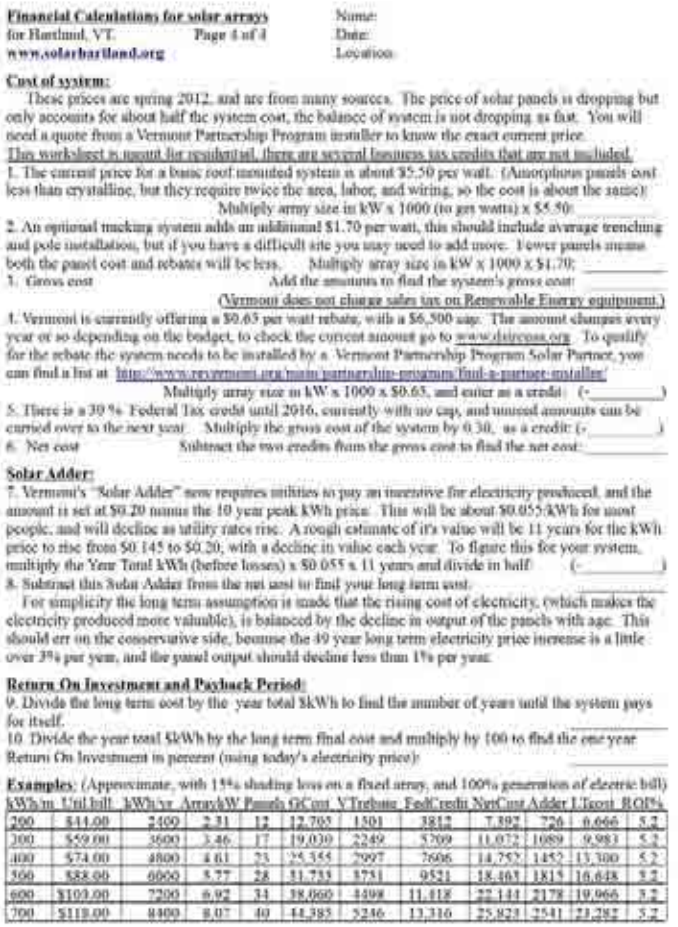
- The calculations on this page are for residential.
- For Business, add:

  -30% Fed Investment Tax Credit

  -Fed MACRS depreciation

  -VT Business Incentive

  These incentives, in combination with a reduction in peak demand on Time Of Use rates, (solar is a peaking source), **<u>can make Solar really attractive for a business</u>**



Financial Calculations for solar arrays Name:
for Hartland, VT. Page 4 of 4 Date:
www.solarhartland.org Location:

Cost of system:

These prices are spring 2012, and are from many sources. The price of solar panels is dropping but only accounts for about half the system cost, the balance of system is not dropping as fast. You will need a quote from a Vermont Partnership Program installer to know the exact current price.
This worksheet is meant for residential, there are several business tax credits that are not included.

1. The current price for a basic roof mounted system is about $5.50 per watt. (Amorphous panels cost less than crystalline, but they require twice the area, labor, and wiring, so the cost is about the same):
Multiply array size in kW x 1000 (to get watts) x $5.50: _____

2. An optional tracking system adds an additional $1.70 per watt, this should include average trenching and pole installation, but if you have a difficult site you may need to add more. Fewer panels means both the panel cost and rebates will be less. Multiply array size in kW x 1000 x $1.70: _____

3. Gross cost Add the amounts to find the system's gross cost: _____
(Vermont does not charge sales tax on Renewable Energy equipment.)

4. Vermont is currently offering a $0.65 per watt rebate, with a $6,500 cap. The amount changes every year or so depending on the budget, to check the current amount go to www.dsireusa.org To qualify for the rebate the system needs to be installed by a Vermont Partnership Program Solar Partner, you can find a list at http://www.revvermont.org/main/partnership-programs/find-a-partner-installer/
Multiply array size in kW x 1000 x $0.65, and enter as a credit: (- _____)

5. There is a 30 % Federal Tax credit until 2016, currently with no cap, and unused amounts can be carried over to the next year. Multiply the gross cost of the system by 0.30, as a credit: (- _____)

6. Net cost Subtract the two credits from the gross cost to find the net cost: _____

Solar Adder:

7. Vermont's "Solar Adder" now requires utilities to pay an incentive for electricity produced, and the amount is set at $0.20 minus the 10 year peak kWh price. This will be about $0.055/kWh for most people, and will decline as utility rates rise. A rough estimate of it's value will be 11 years for the kWh price to rise from $0.145 to $0.20, with a decline in value each year. To figure this for your system, multiply the Year Total kWh (before losses) x $0.055 x 11 years and divide in half: (- _____)

8. Subtract this Solar Adder from the net cost to find your long term cost: _____
For simplicity the long term assumption is made that the rising cost of electricity, (which makes the electricity produced more valuable), is balanced by the decline in output of the panels with age. This should err on the conservative side, because the 40 year long term electricity price increase is a little over 3% per year, and the panel output should decline less than 1% per year.

Return On Investment and Payback Period:

9. Divide the long term cost by the year total $kWh to find the number of years until the system pays for itself. _____

10. Divide the year total $kWh by the long term final cost and multiply by 100 to find the one year Return On Investment in percent (using today's electricity price): _____

Examples: (Approximate, with 15% shading loss on a fixed array, and 100% generation of electric bill)

kWh/m	Util bill	kWh/yr	Array/kW	Panels	GCost	VTrebate	FedICredit	NetCost	Adder	LTcost	ROI%
200	$44.00	2400	2.31	12	12,705	1301	3812	7,592	726	6,666	5.2
300	$59.00	3600	3.46	17	19,030	2249	5709	11,072	1089	9,983	5.2
400	$74.00	4800	4.61	23	25,355	2997	7606	14,752	1452	13,300	5.2
500	$88.00	6000	5.77	28	31,735	3751	9521	18,463	1815	16,648	5.2
600	$103.00	7200	6.92	34	38,060	4498	11,418	22,144	2178	19,966	5.2
700	$118.00	8400	8.07	40	44,385	5246	13,316	25,823	2541	23,282	5.2

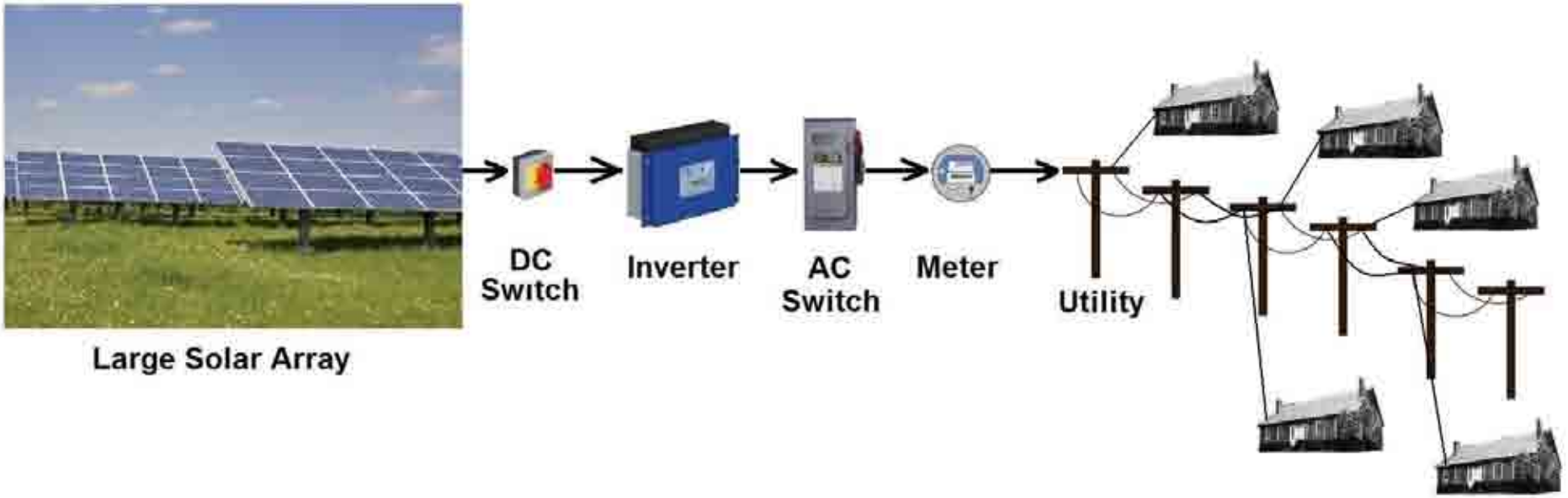
You have members and a site, now start assembling the budget

- Assume there are no grants available
- Finish calculating the large array to get a general price
- Group Net Metering vs SPEED-
  (How are you getting paid for the electricity generated?)
- Ownership Models- Where are funds coming from?
  Which members get the tax incentives?
- Long Term Plan for Distribution of the Electricity
- Operations and Maintenance Plan
- Estimated Income and Expenses
- Bring the future cash flows back (Net Present Value) for a loan

Finish the Array Layout to get kWh

- PV Watts predicts the best annual output for Hartland is from panels that are at a 36 degree angle from horizontal. Fixed racks at that angle with two average panels (63”x2) high will cover 8.5' of ground, and allowing 6” of vertical misalignment between rows and a 20 degree winter sun, on level ground the aisles need to be 18.5'
- A rack and an aisle add up to 27', divide the north/south length of your area by 27' to find the number of rows
- An average panel puts out 13 watts/ square foot, and two panels would be 10.5' tall, so each linear foot of row will produce 135 watts. Multiply the east/west length of your rows in feet by 135 watts, and divide by 1000, to find the output in kW.
- Multiply kW output by 0.77 efficiency, and then by the hours from the shading measurement calculation, to find the annual kWh output
- Multiply kW output by $4 per watt to find tentative system cost (“GMP Coffee Roasters 2008 100kW was $7/w, now would be $3.25” -Jeffrey Wolfe, Norwich Renewable Energy Forum, 12 Mar 2012)

Community Solar Energy



Vermont has a very good Group Net Metering law
that allows many individuals using the same Utility company
to balance their electricity use as a group.

This means that electricity production and consumption can
be at different locations, and that electricity production from
a large solar array can be credited according to the groups rules.

Group Net Metering vs. SPEED Standard Offer

- Default procedure for CSE's
- Members are paid in kWh, and need to monetize them to pay expenses, assume value to be $0.20/kWh. Loan may depend on member credit ratings.
- nontaxable income
- Overproduction beyond net for income is discouraged. GMP is the only utility that has a cash payment (at their option) in their rates.
- Group can include businesses, who can use tax incentives

- Unobtainium. Last allotment was oversubscribed in 2 minutes
- Guaranteed Feed In Tariff of $0.271/kWh for 10-25 years, makes financing much easier (note- kWh may be higher than $0.271 in 20 years)
- may be taxable income
- Act 170 schedules 77.5 MW allotment over the next 10 years
- Next round April 1, 2013

Many Ownership Models

- Think of an income producing apartment building
- Owners can be single parties, businesses, site owner, the net metering group members, tax investors, 3'rd party investors, lease companies
- Ownership mechanism can be Partnership, Limited Partnership, LLC, L3C in Vermont, Leasing Agreement w/ tax equity+SSA
- The ownership mechanism can be designed to “flip” ownership and kWh allocation from a major owner to the group after a designated depreciation period (generally after 5 years for the MACRS incentive) and a specified return is achieved
- All the US DOE publications and other states use an LLC designed to allocate tax benefits and kWh credits to members. Vermont Law School and Powersmith Farm suggest a Multilateral Licensing Agreement.

SEC

- The SEC has rules that apply to any public offering:

  -You shouldn't call this an “investment” or use the terms “shares” or “stock” (example- Calif SMUD “Solar Shingles”), it has to be a subscription or service (example- magazine subscription, or Brewster Solar Garden's “kWh output of 28 panels for 5 years for $5000”).

  -For over 35 members (beyond the “Private Placement Exemption”) there is a substantial registration process that will cost a few hundred thousand dollars.

  -There may be an exemption to the 35 limit for certain classes of instate subscribers (see Luke Snelling/ Energize Vermont)

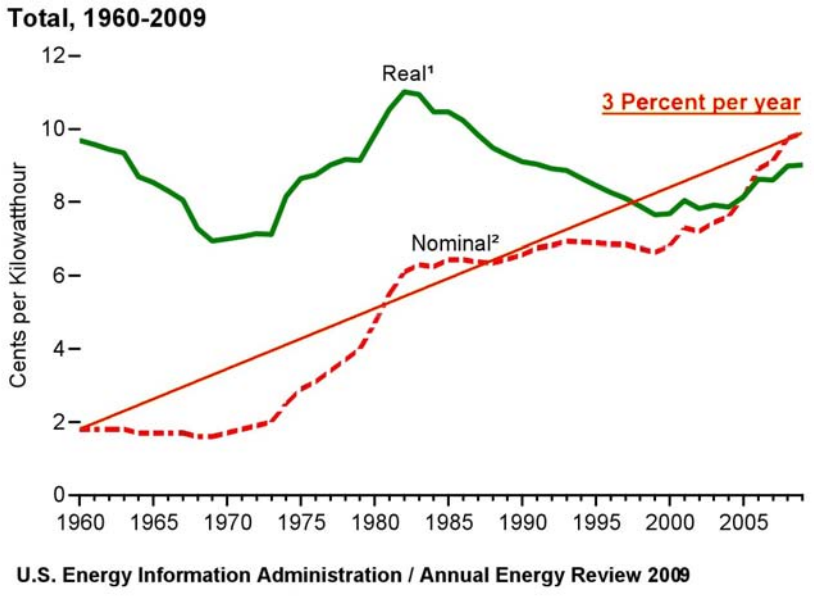
  -Advertising has to be limited to “sophisticated” investors

Taxes

- Federal 30% Investment Tax Credit may be carried over each year until 2016
- Federal Business MACRS is a 5 year class depreciation, about 26%
- Vermont Business Tax Incentive is 24% of the IRS ITC, or 7.2%
- No Vermont sales tax on solar energy equipment
- Federal Treasury Clean Renewable Energy Bonds, and the Section 1603 cash grant in lieu of tax credit were not renewed, which is bad for municipalities and other nonprofit (tax exempt) organizations
- At least one member of the group must have a large enough tax appetite to use these incentives, but there is one more restriction- most of the members will not be “materially participating” in the operation of the CSE, making it “passive income”. They may apply the tax credits only to income generated by other “passive activities”
- Vermont Act 127 sets $4/kW taxes per year on arrays 10kW and up, and there may be local taxes up to half again that amount

Utilities

Figure 8.10 Average Retail Prices of Electricity
(Average of Residential, Commercial, Industrial, Transportation)



U.S. Energy Information Administration / Annual Energy Review 2009

A 3% annual increase means that the "Solar Adder" will rise from the current average of $0.146/kWh to the $0.20 threshold in 11 years.

- Vermont is not a "Deregulated Market", technically the only entity you can have a "Power Purchase Agreement" with is your utility, Solar Service Agreements may be ok
- If it is necessary for one net meter group member to achieve a certain return to make involvement viable, the allocation of kWh credits can be adjusted
- Line stability is a concern on small lines, contact the utility early if your preliminary study looks like you have a good site. A smaller (under 100 kW) array may be possible on single phase lines

Trackers

- A tracker was more economical in only 2 of Solar Hartland's 24 site visits. In general they were $200 to $1200 more expensive for the same kWh output
- The problem is they need wide open locations, to receive early and late sun, not common in the Upper Valley
- Also, using the recommended 50' spacing, only 36% to 73% (25' or 0' margin) as many panels would fit on two recently measured 149 kW array sites, compared to fixed racks

The author's 1 kW tracker he built 14 years ago

Funding Agencies

- The Clean Energy Development Fund funds the Vermont Small Scale, Business and SPEED programs
- Vermont Economic Development Authority can provide loans
- The USDA Rural Energy Access Program provides competitive grants and loans. They also have a loan guarantee program (short form NA->$200k, long form 80 hours), however this may help a CSE loan application only a little because lenders have solar specific criteria
- Local Banks (and Insurance agencies) are just starting to have solar arrays in their view. Using a well known installation company will reduce due diligence fees and make your loan approval more likely
- Leasing agencies operate in the more attractive markets of AZ, CA, CO, HI, **NJ, MA, MD, NY** and PA. (It's possible to walk into Home Depot and get a system from SolarCity, or Lowes from Sungevity, in some of these states.) In Vermont the only lease available is tied to a tracker package (All Earth Renewables), and the only other dealer financing is like a credit card- 16.79% (Alteris/Real Goods)

Generic 149 kW Array Budget Items

Expenses

Basic Price- $600,000
Cost of Financing- 6%for5yrs, thenfloat
Due Diligence- $1200
Legal (LLC, permits)-$5,000 to $25,000
Permitting- $250
Power Line Extension-$15-20/ft,new3ph
Maintenance- $800/yr @ 3% inflation
Administrator- $3000/yr @ 3% inf.
Income tax/workmans comp ?
Inverter Replacement- $30,000 @yr20
Insurance- $1200/yr @ 3% inflation
Property Tax $4/kW+local, about$900/yr
Emergency Repairs- assume $300/yr
Land Lease- (ag use taxes on 1 acre) $100/yr or kWh credits?
Decommissioning- wide range - to +
Panel Degradation 0.5% per year

Income

Membership Subscriptions $300,000
Federal Investment Tax Credit $168,000
Federal MACRS depreciation 14%+12%
Vermont Business Tax Credit $43,200
Vermont Small Scale $36,000
Value of kWh $35,400/yr to year 11, 3%
Solar Adder $53,543
REC's go to Utility for their state quota
Fair Market Value? (decommissioning)

Equipment lifespan 30 years
(my 20yr old panels still produce 125%)
Land arrangement 30 to 40 yrs or longer,
(if price of kWh has risen more than panel loss, then keep running array)
Disclaimer! This budget is a work in progress, with many vague amounts!

The value of Solar Installations are deeply discounted by lenders in other states. The allowable loan amount will be based on about 65% of the net present value of the income stream (future dollars brought back to today's value).

With all this information in hand...

- The CSE is pretty well defined
- Request For Quotes can be sent out. The installation company will specify the components, run their own prediction of output, and return a price
- With this information, project specific numbers can be put in the budget
- Financing can be finalized, the net meter group can be set up
- The installation company can be given the go ahead, they will file the CPG and assist with incentive forms
- After commissioning, the CSE group steps back in with the Administrator monitoring output, filing yearly reports and taxes, making GNM and legal updates, and the group also maintains the facility

Groups currently working on a CSE

- Brattleboro- Tom Simon, Daniel Hoviss, www.cooppower.coop
- Hartland- Karl Kemnitzer, Chuck Fenton, www.solarhartland.org
- Mad River Valley Energy- Peter Boynton, Steve Butcher, Gaelan Brown, www.mrve.net
- Middlebury- Peter Carothers, Greg Pahl, Tom Dunne, www.acornenergycoop.com
- Norwich- Linda Gray, Norwich Energy Committee, linda.c.gray@gmail.com
- Poultney- Lukas Snelling, www.energizevermont.org
- Craftsbury, Middletown Springs, and Waterbury have people that are interested

References (these can be downloaded)

(In order of preference, first 5 are recommended)

A Guide to Community Solar:Utility, Private, and Non-Profit Project Development, U.S. Dept of Energy, Solar America Communities, 2010, Very good overall view

Community Solar Power, Obstacles and Opportunities, John Farrel, 2011, New Rules Project, Good case studies

Solar Photovoltaic Financing: Residential Sector Deployment, Jason Coughlin, Karlynn Cory, NREL, 2009, General financing models

Financing Non-Residential Photovoltaic Projects: Options and Implications, Mark Bolinger, LBNL, 2009, Good detailed analysis, see also 2011 followup wind report

Vermont Group Net Metering Information and Guidelines, Michael Dworkin, Dan Ingold, 2010, State specific info, “Multilateral Licensing Agreement” not LLC

Solar PV Project Financing: Regulatory and Legislative Challenges for Third Party PPA System Owners, Kathryn Kollins, Speer, Cory, NREL, 2010, Leasing+SSA's

Vermont Utilities Electric Service Requirements Manual, reduce Utility Rep's time

Photovoltaics Business Models, L. Frantzis, S. Graham, R. Katofsky, H. Sawyer, NREL, Navigant, 2008, Distributed ownership, 3'rd parties, and utilities

Solar Powering Your Community: A Guide for Local Governments, US DOE Solar America Communities, 2011, Very comprehensive guide

Lex Helius, The Law of Solar Energy, A Guide to Business and Legal Issues, Stoel Rives Law Firm, 2011, Detailed guide covering many states legal rules

Tracking the Sun III, The Installed Cost of Photovoltaics in the US 1998-2009, Barbose, Darghouth, Wiser, LBNL, 2010, Good analysis, dated figures

The Solarize Guidebook: A Community Guide to Collective Purchasing of Residential PV Systems, US DOE, 2011, Focused more on buying groups, NW

Pomerleau 1MW array, Vergennes

Where can I plug my car in?

Karl Kemnitzer, www.solarhartland.org

This presentation was made using 100% solar power