SOLAR ENERGY GENERATION POTENTIAL OF TOMPKINS COUNTY

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Presentation Outline

Brief Overview of Solar Energy → Solar Potential of Tompkins County → Economics

2 useful tools for home/business owners

Focus on Solar *potential*

Commercial/Industrial

Schools

Residential

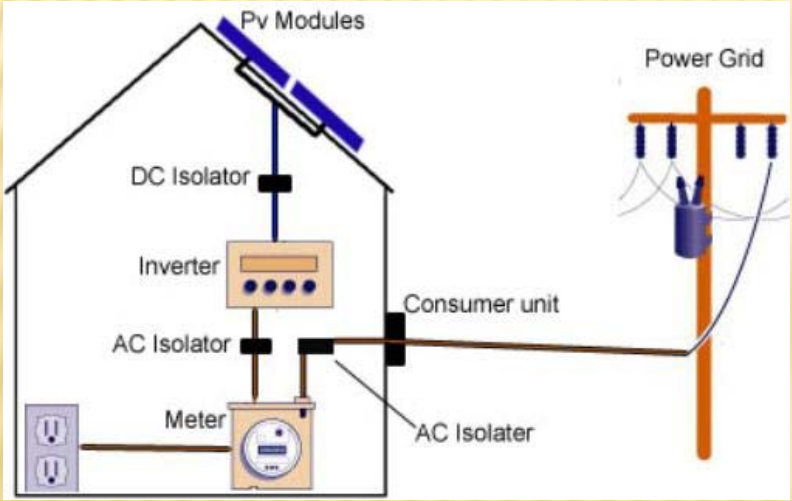
TWO TYPES OF SOLAR ENERGY SYSTEMS

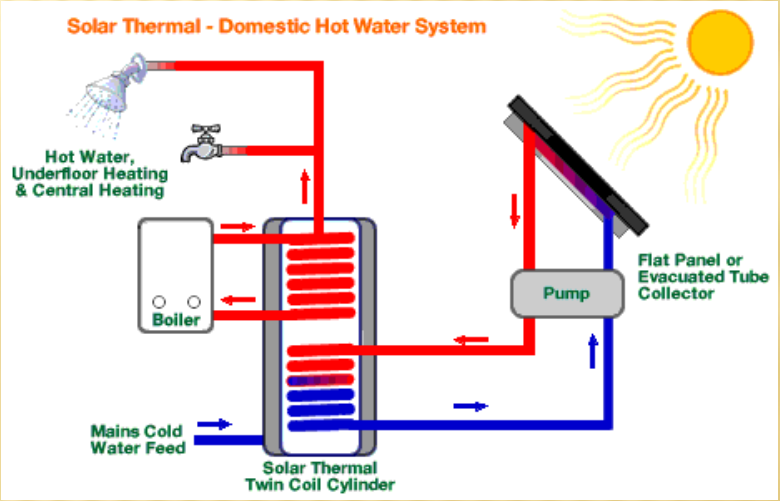
Photovoltaic (PV)

- Converts sunlight directly into electricity
- Simple, no moving parts

Solar Thermal

- Thermal energy from the sun is used to heat a fluid
- Most common use is hot water heating





PV system mounting

Roof mounted

- Less expensive
- Less obtrusive

Ground mounted

- More expensive due to large foundations and wiring to house
- Easier to scrape off snow
- Can adjust tilt angle seasonally

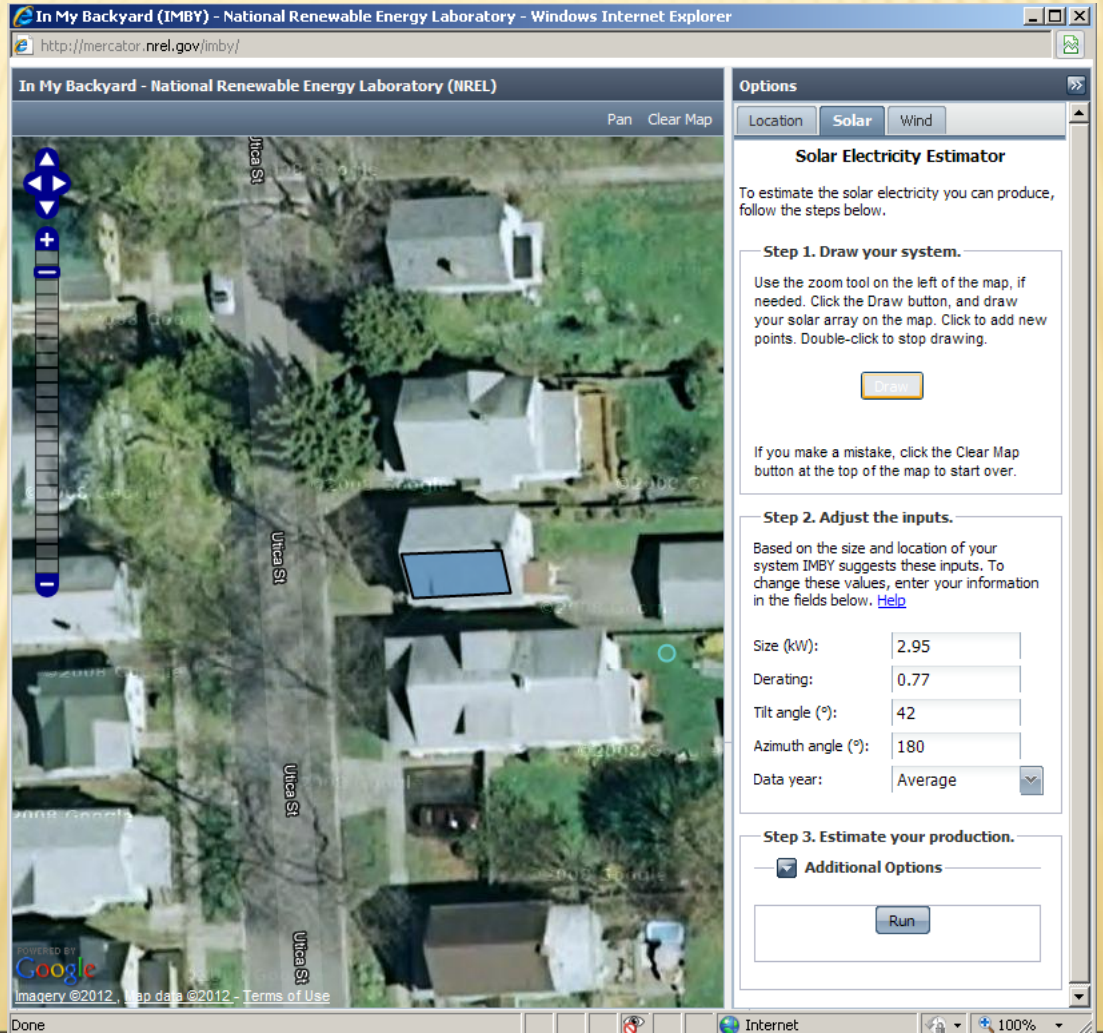
Tompkins County PV Leader

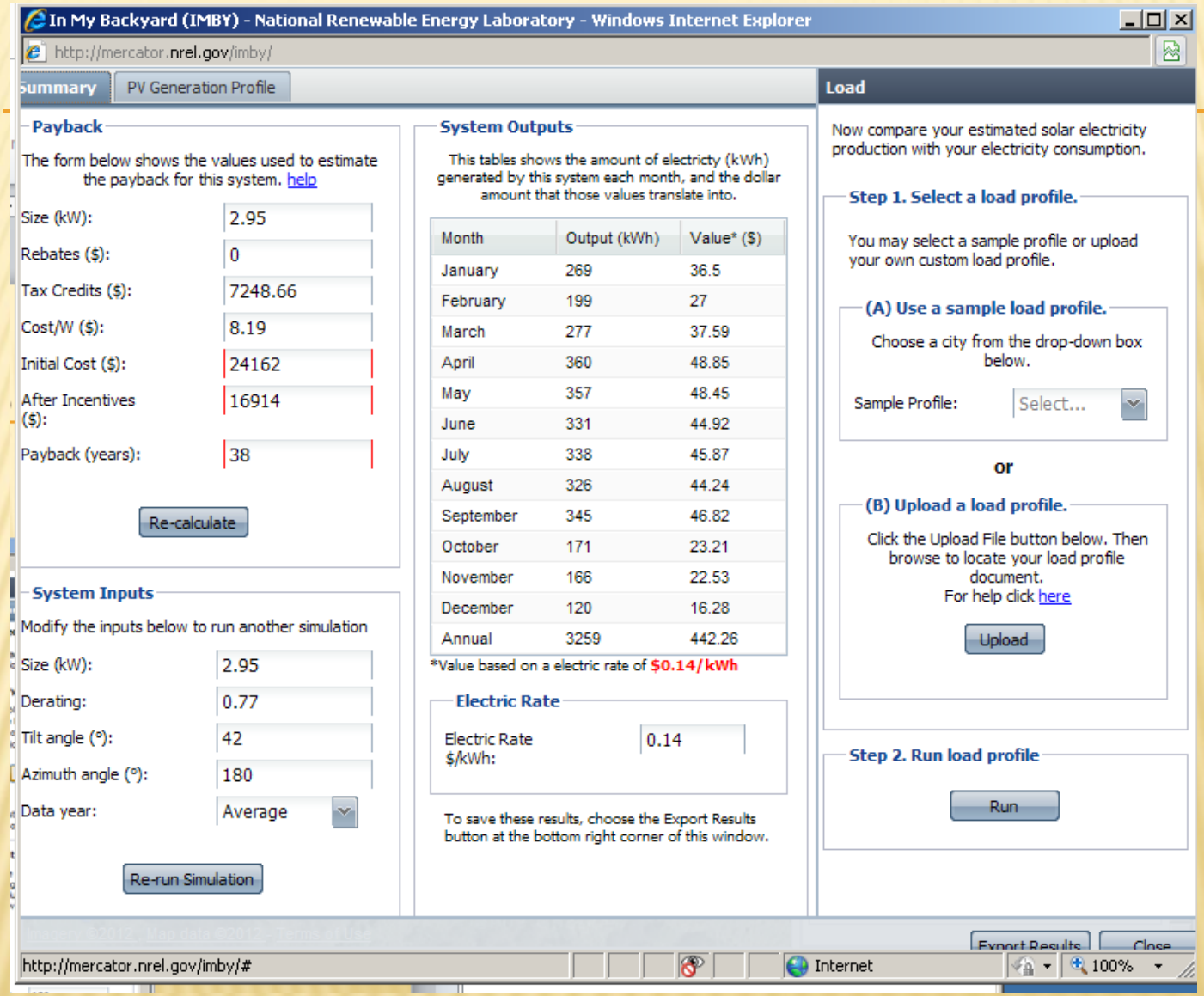
Leading PV Counties of New York		
	County	No. of Systems
1	Dutchess	379
2	Ulster	376
3	Westchester	352
4	Erie	315
5	Columbia	232
6	Albany	232
7	Tompkins	211

	Leading PV Counties of New York		
	County	Population	Systems per 10,000 Residents
1	Columbia	63,096	36.8
2	Tompkins	101,564	20.8
3	Ulster	182,493	20.6
4	Dutchess	297,488	12.7
5	Albany	304,204	7.6
6	Westchester	949,113	3.7
7	Erie	919,040	3.4

Tompkins County Solar Performance

- NREL's In My Backyard (IMBY) tool: http://www.nrel.gov/eis/imby/





- About 1,100 kWh of electricity per installed kW per year

Solar Potential: Commercial

- Building footprint data
- 120 ft^2 of roof area per kW
- Total electricity potential: 95 million kWh, 27% of sector demand in 2008

	Building	Area (ft^2)	Capacity Potential (kW)	Annual Energy Potential (kWh)
1	Ithaca Mall	575,559	4,796	5,275,954
2	Cayuga Mall	211,315	1,761	1,937,051
3	Home Depot	198,220	1,652	1,817,013
4	Lowe's	188,861	1,574	1,731,224
5	Triphammer Mall	173,081	1,442	1,586,576
6	Walmart	156,883	1,307	1,438,095
7	Tops Plaza	124,966	1,041	1,145,519
8	Wegman's	122,195	1,018	1,120,122
9	East Hill Plaza	117,451	979	1,076,633
10	*Big K-Mart	112,934	941	1,035,228
	Total:	1,981,463	16,512	**18,163,414**

Solar Potential: Industrial

- Same process as commercial
- Total electricity potential: 24 million kWh, 17% of sector demand in 2008

	Building	Area (ft^2)	Capacity Potential (kW)	Annual Energy Potential (kWh)
1	Borg Warner	552,395	4,603	5,275,954
2	*Morse Chain/Emerson Power Transmission Site	278,409	2,320	1,937,051
3	Borg Warner	227,005	1,892	1,817,013
4	Vanguard Printing	176,082	1,467	1,731,224
5	South Hill Business Campus	136,574	1,138	1,586,576
6	*Morse Chain/Emerson Power Transmission Site	106,979	891	1,438,095
7	Cargill Deicing Technology	87,079	726	1,145,519
8	TransAct Technologies	75,239	627	1,120,122
9	Therm Incorporated	73,091	609	1,076,633
10	Cargill De-icing Technology	63,659	530	1,035,228
	Total:	1,776,511	14,804	16,284,682

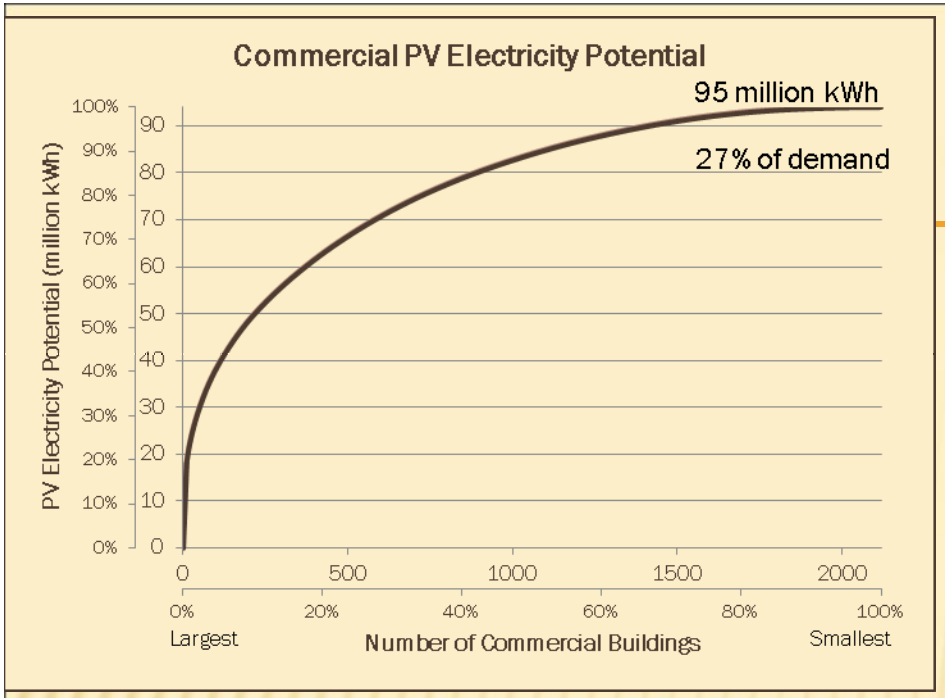
Solar Potential: Schools

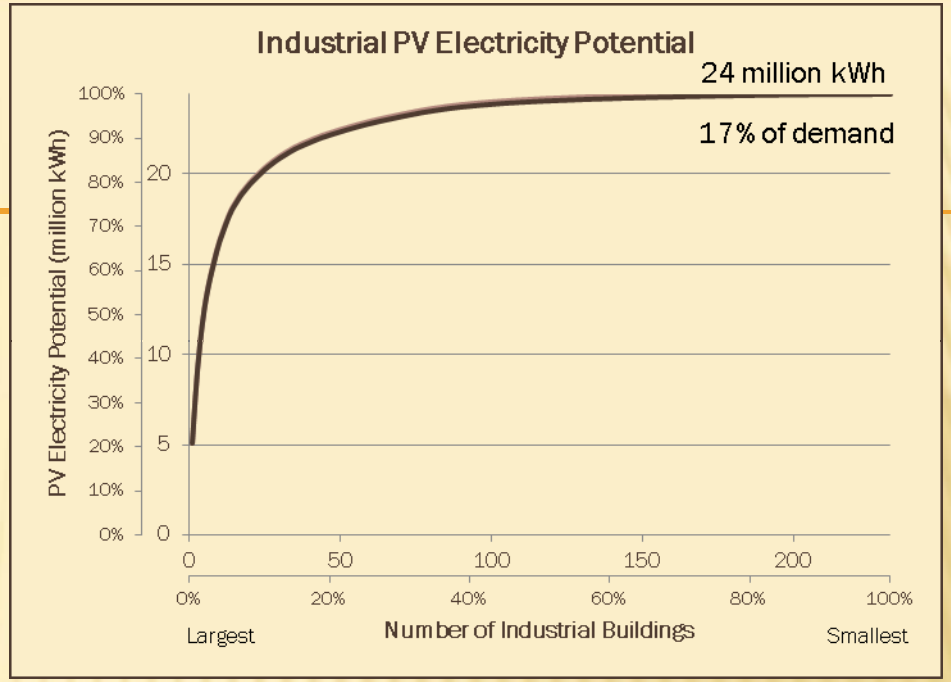
- More difficult to estimate: odd roofs and contours

Solar Potential: Schools

- Similar to commercial/industrial
- Used aerial images to estimate roof percentage available for PV arrays
- Total electricity potential: 44 million kWh, 13% of sector demand in 2008

	Building	Area (ft^2)	Percent of Roof Available	Net Capacity Potential (kW)	Net Electricity Potential (kWh)
1	Ithaca High School	222,484	70%	1,298	1,427,608
2	Dryden High School	179,743	50%	749	823,824
3	TC3	157,088	70%	916	1,007,982
4	Cornell Vet School	138,050	50%	575	632,728
5	Charles O. Dickerson High School	116,211	80%	775	852,212
6	Groton Elementary School	96,574	90%	724	796,736
7	Duffield Hall (Cornell)	94,771	20%	158	173,746
8	Barton Hall (Cornell)	91,762	50%	382	420,577
9	Bartels Field House (Cornell)	90,568	90%	679	747,184
10	Boynton Middle School	89,901	60%	450	494,455
	Total	1,212,337		6,706	7,377,053


Commercial PV Electricity Potential
95 million kWh
27% of demand
PV Electricity Potential (million kWh)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
90
80
70
60
50
40
30
20
10
0
0
500
1000
1500
2000
0%
20%
40%
60%
80%
100%
Largest
Number of Commercial Buildings
Smallest


Industrial PV Electricity Potential
24 million kWh
17% of demand
PV Electricity Potential (million kWh)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
20
15
10
5
0
0
50
100
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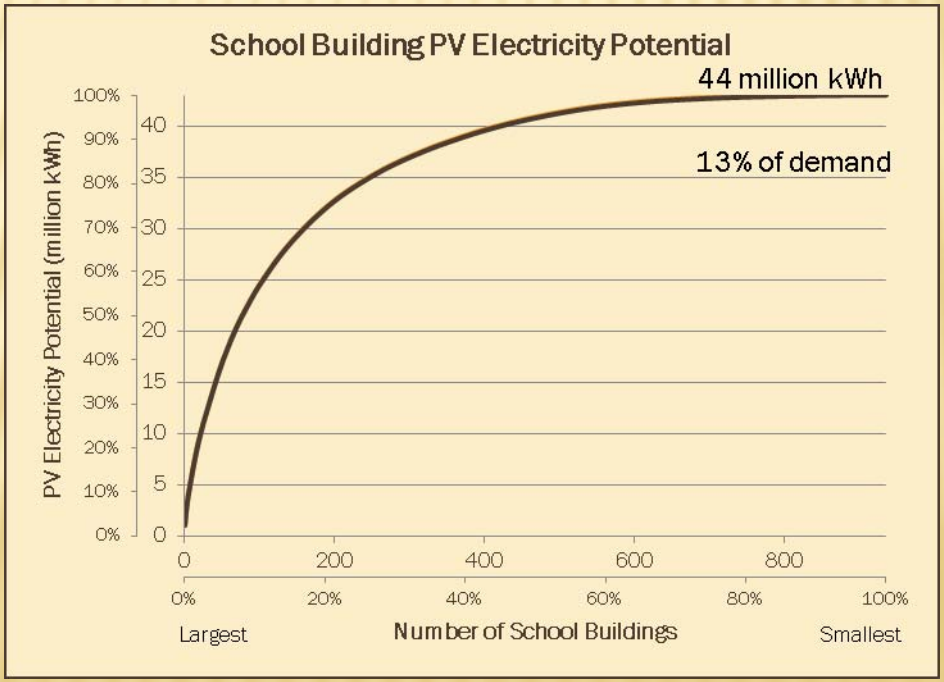
200
0%
20%
40%
60%
80%
100%
Largest
Number of Industrial Buildings
Smallest


School Building PV Electricity Potential
44 million kWh
13% of demand
PV Electricity Potential (million kWh)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
40
35
30
25
20
15
10
5
0
0
200
400
600
800
0%
20%
40%
60%
80%
100%
Largest
Number of School Buildings
Smallest

Solar Potential: Residential

- Very difficult to estimate
- Assume:
  - 80% of households in Tompkins County have potential for PV systems
  - All rural homes have potential for PV systems

TC Households		80% Scenario
Urban	16,441	8,648
Rural	22,526	22,526
Total	38,967	**31,174**

Solar Potential: Residential

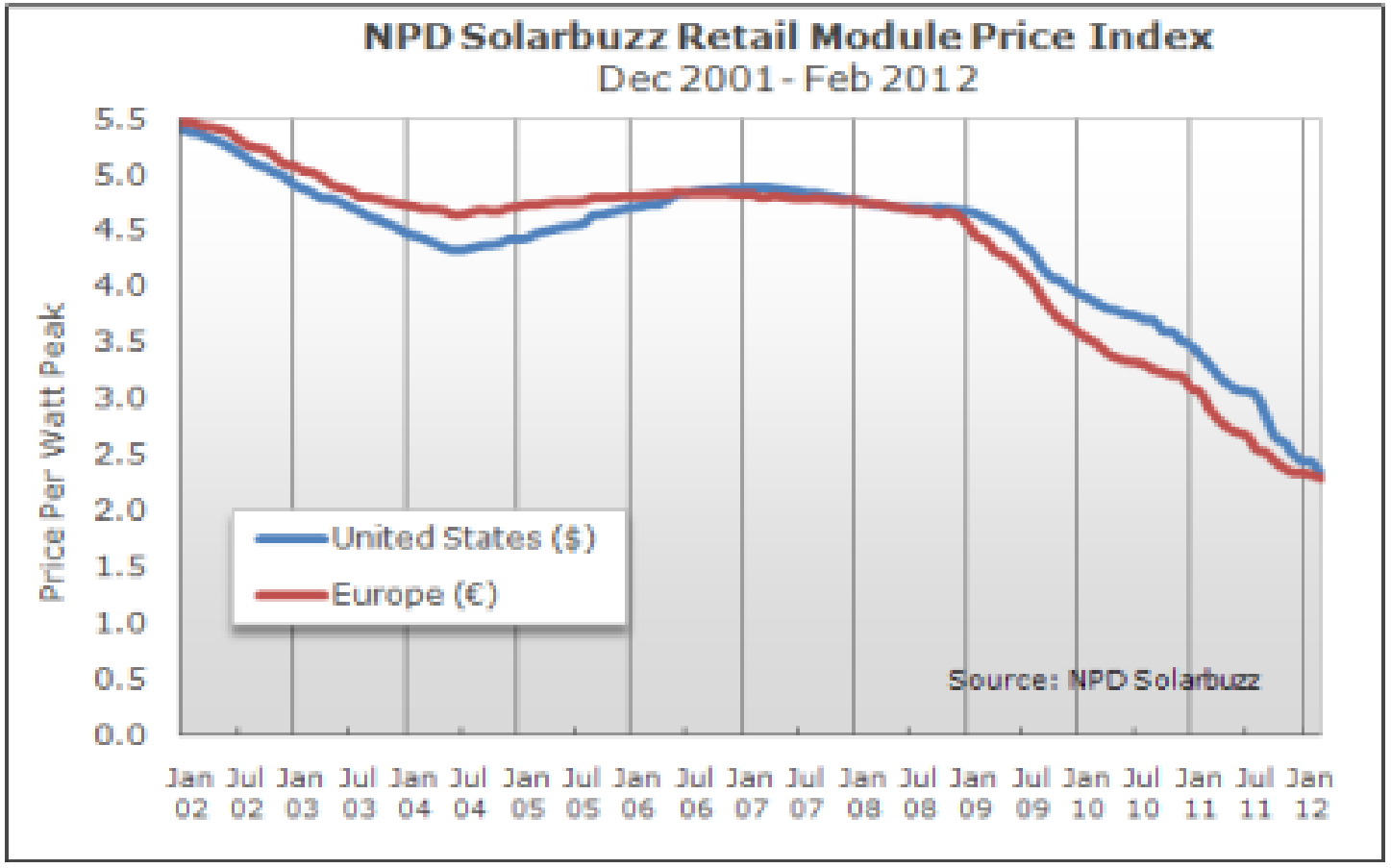
- Assume:
  - Urban homes have potential for a 3 kW system
  - Rural homes have potential for a 7 kW system

	Urban	Rural
Homes	8,648	22,526
Avg system size (kW)	3	7
Total Installed Capacity (MW)	26	158
Energy potential (kWh)	28 million	171 million
Total Potential Energy (kWh)	202 million	
% of Total Demand	69%	

Total Solar Potential

Ultimate Photovoltaic Potential by Sector			
	Capacity Potential (MW)	Energy Potential (million kWh)	Percent of Electricity Demand
Commercial	86	95	27%
Industrial	22	24	17%
Schools	40	44	13%
Residential	184	202	69%
Total	332	365	47%

PV Economics



- Average Module price: $2.29/W

Average System Prices

- Residential: $6.18/W
- Commercial/Industrial: $4.92

PV Economics

4 kW Residential System					
Gross Cost	NYSERDA Incentive	NYS Tax Credit	Fed Tax Credit	Total Incentives	Net Cost
$24,000	-$6,000	-$4,500	-$5,400	-$15,900	$8,100

NYSERDA Clean Power Estimator

Clean Power Estimator

GENERAL ASSUMPTIONS

City, State	Ithaca NY
Utility	New York State Electric and Gas (NYSEG)
Rate	Net Metered Residential Service-West Region (Service Class 1-West Region)
Technologies	PV only

PV SYSTEM

Size		4.0 kW-dc
Cost	$24,000	(Use default cost)
Tilt		30º
Orientation		South
PV Output Adjustment		-10%
O and M Cost		$0 per year

FINANCIAL ASSUMPTIONS

Electric Bill	$100 per month
Electric Bill Escalation	1.5% per year
Payment Method	Tax-Deductible Loan
Loan Rate	8.00%
Loan Life	30 years
Down Payment	0%

TAX CONSIDERATIONS

Tax Status	Married Filing Jointly
Taxable Income	$80,000 per year

Place cursor over the ? symbols for help

FINANCIAL ASSUMPTIONS

Electric Bill	$100 per month
Electric Bill Escalation	1.5% per year
Payment Method	Tax-Deductible Loan
Loan Rate	
Loan Life	
Down Payment	

- Pay Cash
- New Home Loan
- Refinance
- Tax-Deductible Loan
- Non Tax-Deductible Loan
- Lease
- Power Purchase Agreement (PPA)

TAX CONSIDERATIONS

Tax Status	Married Filing Jointly
Taxable Income	

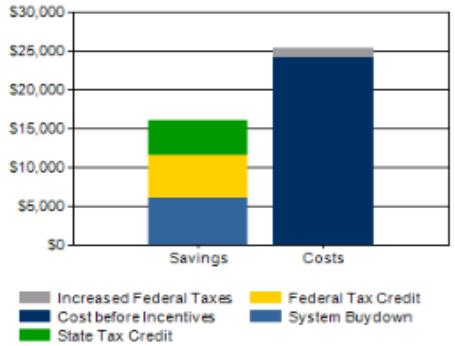
- Single
- Married Filing Jointly
- Married Filing Separately
- Head of Household

System Summary

Net system cost after all incentives:	$9,360
PV system electricity production:	4,304 kWh/year
Electricity production supplied by system:	49%
Carbon dioxide emission reduction:	3,906 lbs per year
Internal rate of return:	8%
Net present value:	-$668
Years to payback:	19.3

SELECT...	NET COST YEAR 1	MONTHLY ELECTRIC BILL	DAILY PV PRODUCTION	DAILY ELECTRICITY USE	MONTHLY PV OUTPUT
	NET CASH FLOW	CUM NET CASH FLOW	CUM DISC CASH FLOW	NET CASH FLOW DETAIL	POLLUTION PREVENTION

Net Cost Detail - Year 1



System Cost			$24,000
Incentives			
	NYSERDA PV EPBB (Res.) (Feb. 2012), 100% DF	$8,000	
	Federal PV Tax Credit (Res.)	$5,400	
	NY PV Tax Credit	$4,500	
	less Total Incentives		$15,900
Increased Federal Taxes			
	NY PV Tax Credit plus Total Federal Tax Increase	$1,260	$1,260
NET COST FOR YEAR 1			$9,360

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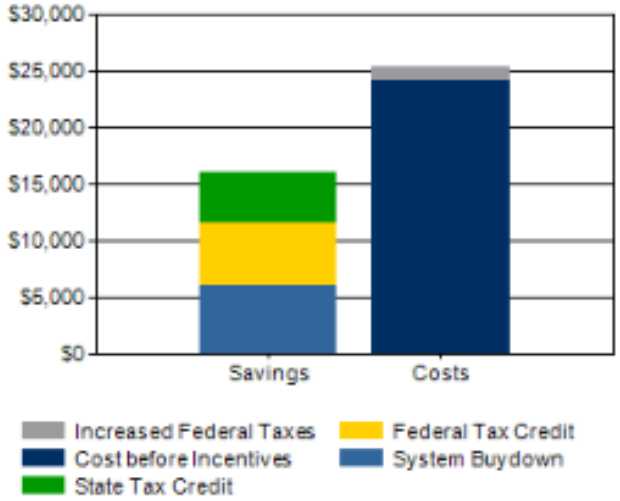

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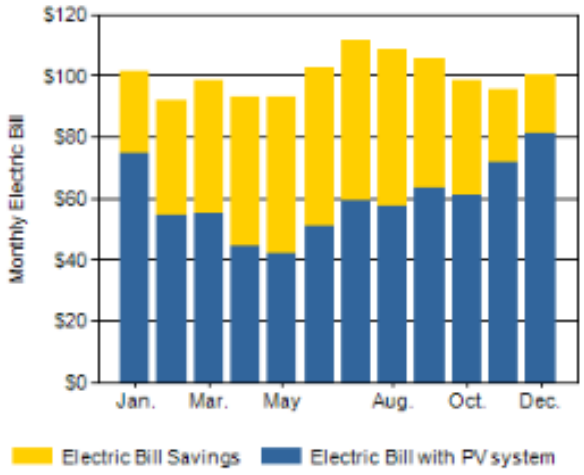
Monthly Electric Bill



	Without PV system	With PV system	Bill Savings
January	$101	$74	$27
February	$92	$55	$37
March	$98	$55	$43
April	$93	$44	$49
May	$93	$42	$51
June	$103	$51	$52
July	$112	$59	$52
August	$108	$57	$51
September	$105	$63	$42
October	$98	$61	$37
November	$95	$71	$24
December	$100	$81	$19
TOTAL	$1,200	$714	$486

This PV system will reduce your annual electric bill by 40%

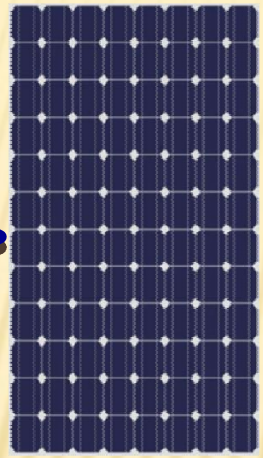
Conclusion

- PV Electricity potential over 300 million kWh
  - Almost half of county's electricity demand
- Economics of solar improving
- 2 very useful tools for home/business owners:
  - NREL's IMBY
  - NYSERDA's Clean Power Estimator

Appendix

PV system characteristics

cell



panel/module

array

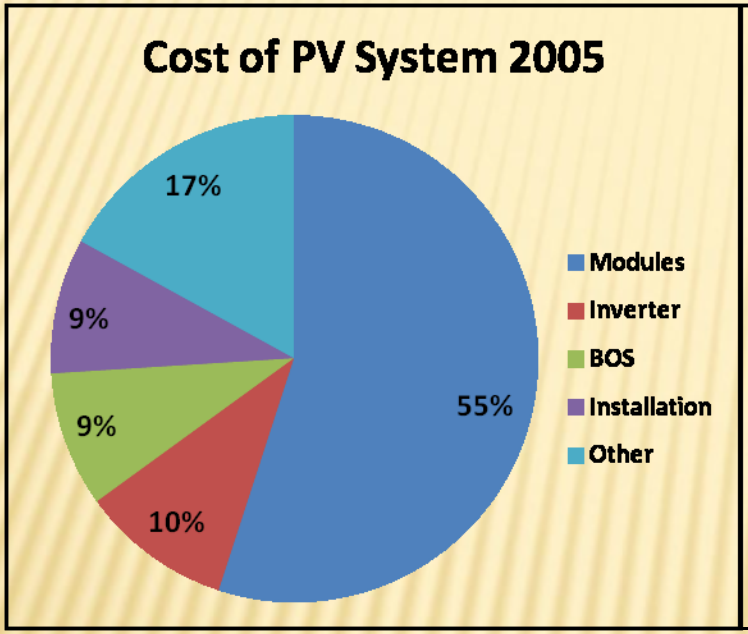
Standardized Testing Conditions

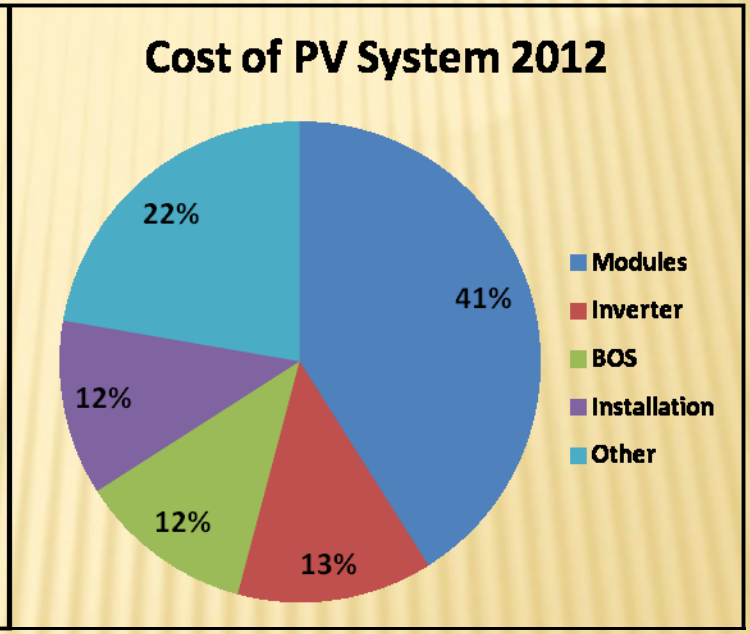
1000 W/m^2
25 ºC

For each kW of installed capacity:	
Module Efficiency	Module Surface Area (ft^2)
10%	109
12%	91
14%	78
16%	68
18%	61
20%	54

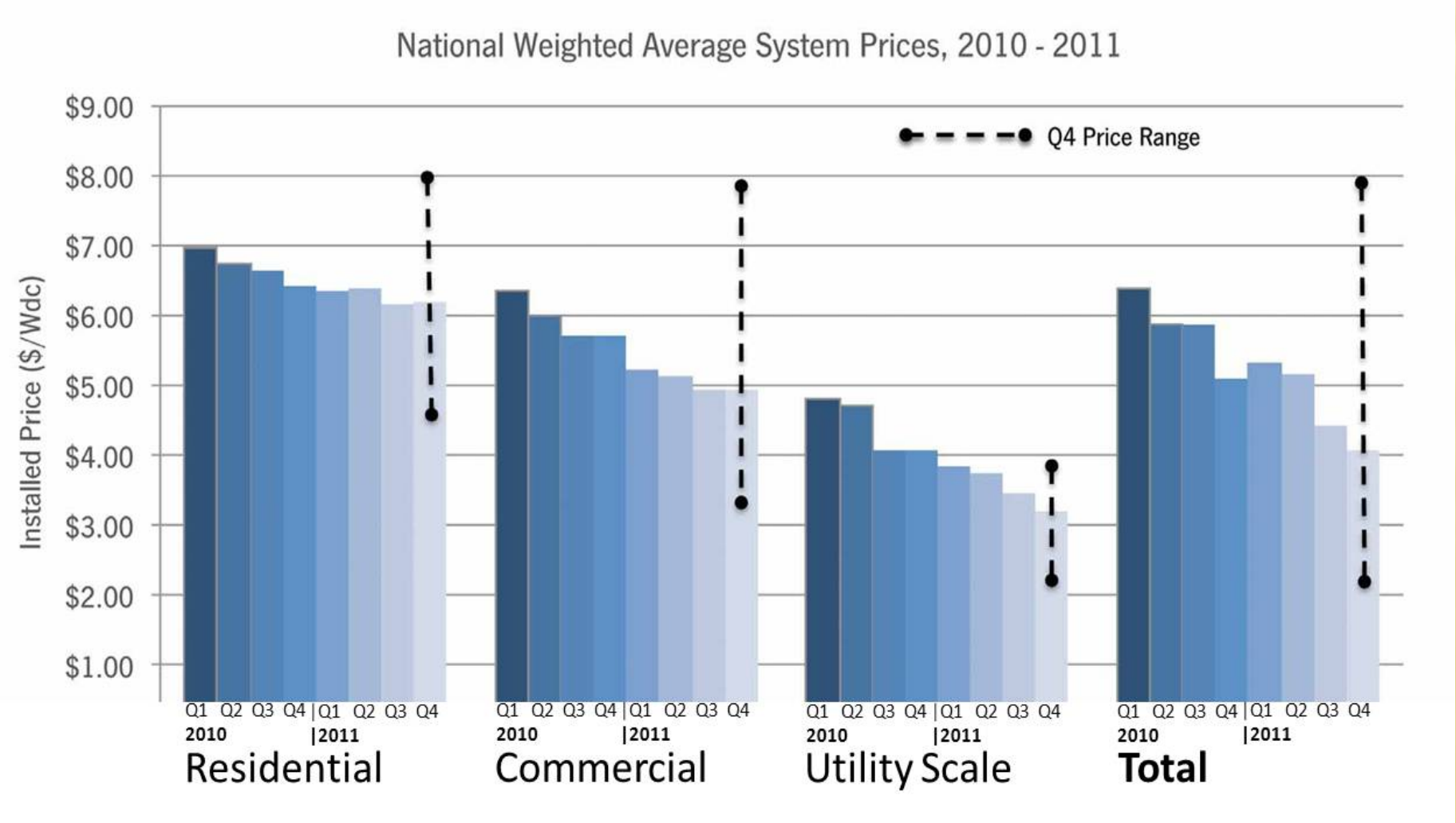
Falling module prices

- Current system costs are 24% less than they were in 2005





PV Economics



Individual system performance

- In 2008, TC had 37,443 households using a total of 293 million kWh of electricity
- This corresponds to an average household usage of 7,837 kWh per year

Avg. Household Demand: 7,837 kWh

System Size:	2 kW_p	4 kW_p	6 kW_p
kWh Generated:	2,171	4,341	6,512
% of Avg. Household Demand	28%	55%	83%

Average system costs

System Size	*Mount Style*	*Total Cost*	*NYSERDA Incentive*	*NYS Tax Credit*	*Fed Tax Credit*	*Total Incentives*	*Final Cost*
2 kW	Roof	$18,000	-$3,500	-$4,500	-$5,400	-$13,400	**$4,600**
	Pole	$20,000	-$3,500	-$5,000	-$6,000	-$14,500	**$5,500**
4 kW	Roof	$32,000	-$7,000	-$5,000	-$9,600	-$21,600	**$10,400**
	Pole	$36,000	-$7,000	-$5,000	-$10,800	-$22,800	**$13,200**
6 kW	Roof	$42,000	-$8,750	-$5,000	-$12,600	-$26,350	**$15,650**
	Pole	$48,000	-$8,750	-$5,000	-$14,400	-$28,150	**$19,850**

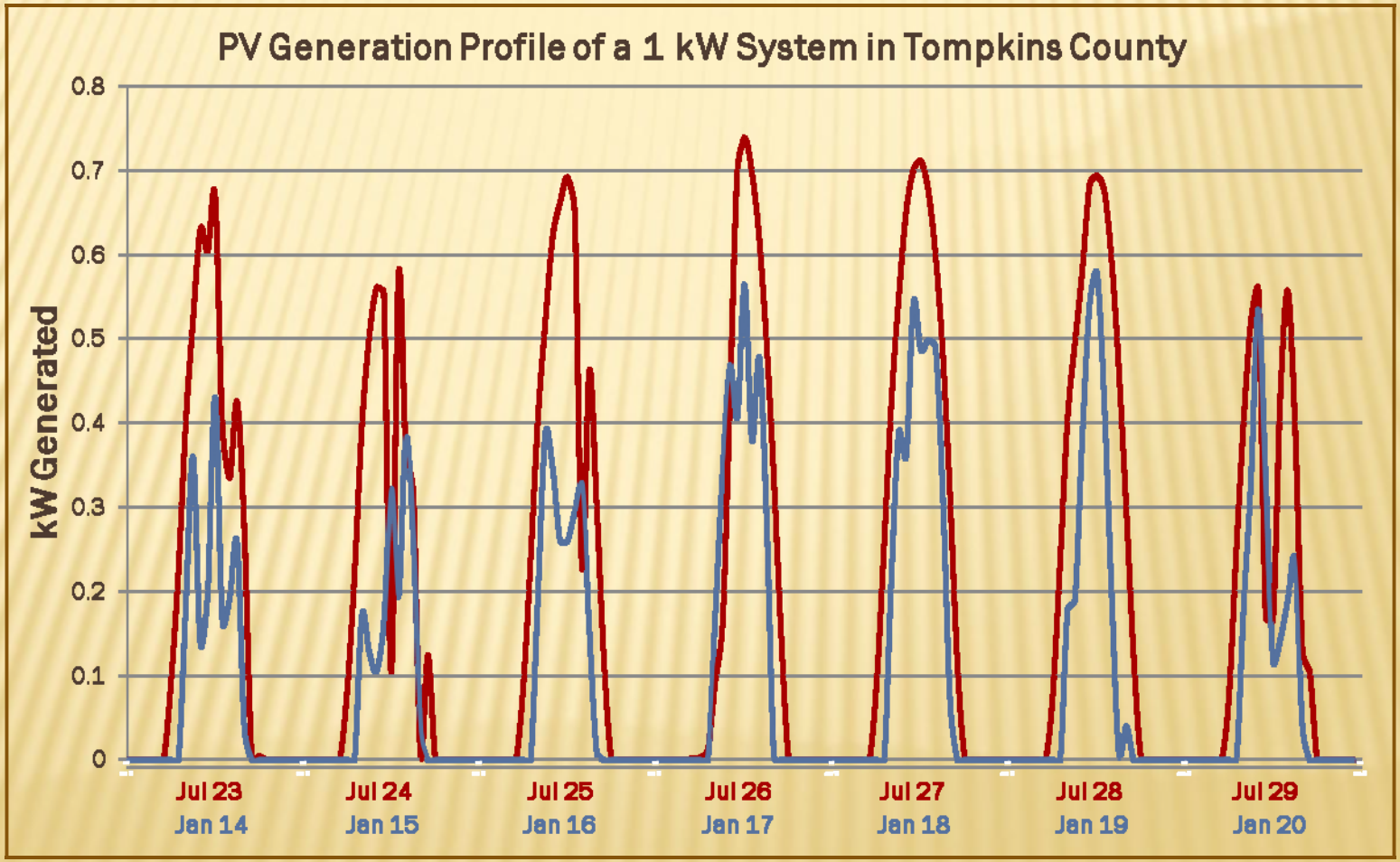
Financial Incentives

NYSERDA Renewable Portfolio Standard (RPS)

- Cash incentives of $1.50 per watt peak
- System Size Cap
  - Residential: 7 kW
  - Commercial: 50 kW
  - Gov't/non-profit: 25 kW
- Customers must purchase their system from an "Eligible Installer"
- Incentives are capped based on PV systems that do not exceed 110% of the previous year's energy consumption

Tompkins County Solar Performance

- ~1,100 kWh for every kW of installed capacity



Tax Opportunities

State Level

- NYS offers a tax credit of 25% of the system expenditures (i.e. after incentives have been applied) capped at $5,000
- Property tax exemptions (need to inquire with TC Assessor's office)

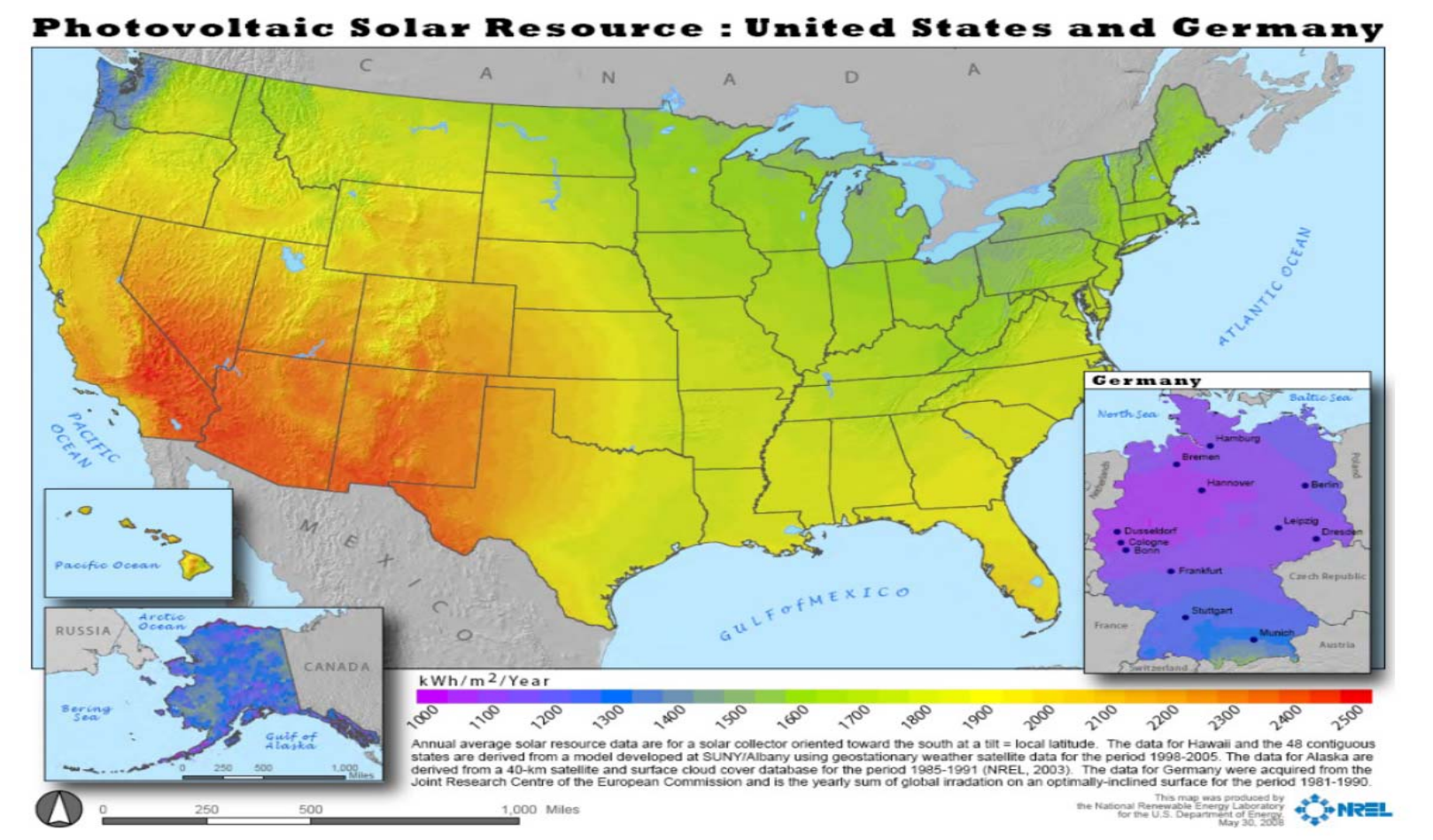
Federal Level

- Tax credit of 30% with no cap on the amount that may be claimed
- In contrast with NYS tax break, this is applied to total cost of system before incentives

Tompkins County Public Library

- January 2008, 147 kW PV system began operating on the roof of the TCPL
- System consists of 1430 modules and covers an area of 17,222 ft^2
- To date, the system has generated 989,000 kWh of energy, enough energy to power 83 (126) homes for a year
- Reduced CO_2 emissions by over 750 tons

Tompkins County Solar Resource



Germany: 17,320 MW installed PV capacity

US: 3,954 MW installed PV capacity

Encouraging Trends