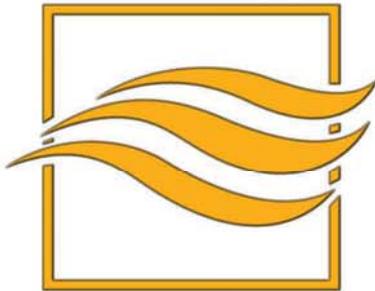
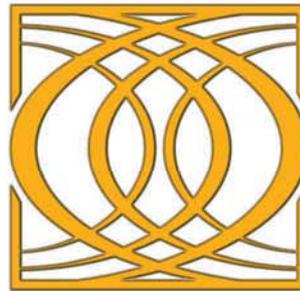




Solar Solutions for
Commercial Roofing Systems



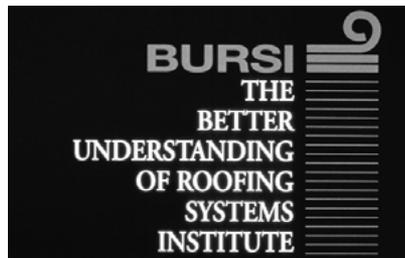
ECONOMICS



ENVIRONMENT



ENERGY



PV Economics

JM E³co.

The JM Eco-leadership™ Company

Overview/Objectives

- Review the concept of Price/Watt (\$/W)
- Examine the factors that make solar PV systems financially feasible
- Examine typical solar PV material/labor costs and structures
- Review the various types of incentives and their structures
- Understand how electricity costs and geographical location impact solar PV viability
- Review typical paybacks and the financial analysis required for PV systems

Price/Watt

- Adopted pricing scheme for Solar PV Systems, modules, inverters, mounting, etc. All priced in \$/W DC.

Sharp ND-224, 224 Watt module

- Sells for \$537.00/module
- Price per Watt = $(\$537.00)/(224W) = \$2.40/W$

Turnkey/Installed System, 100 kW DC

- Sells for \$550,000.00
- Price per Watt = $(\$550,000.00)/(100,000W) = \$5.50/W$

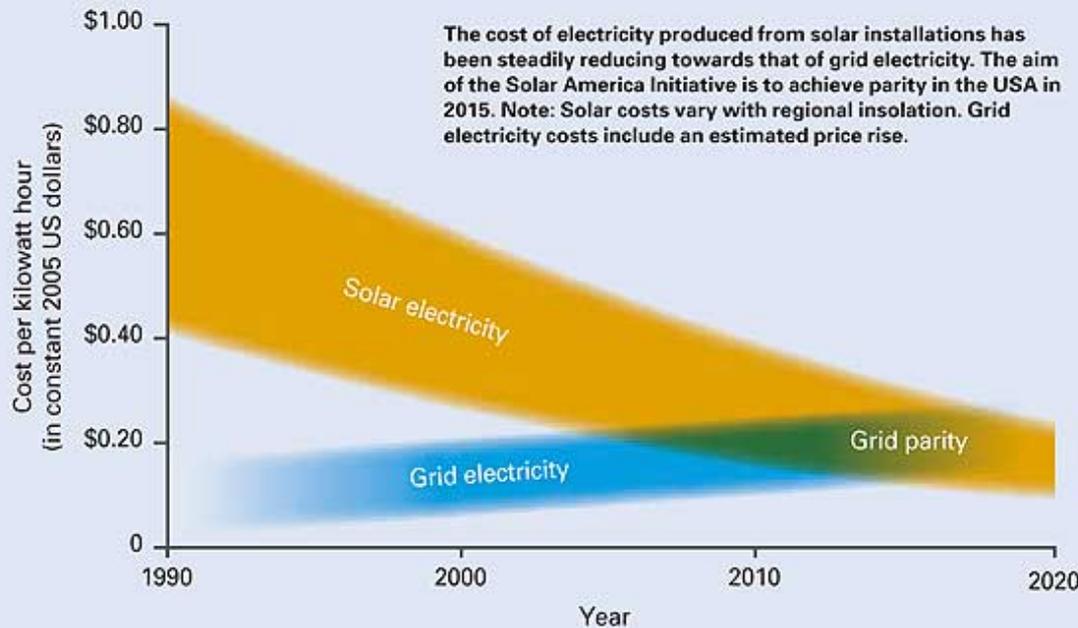
Market Competitive Systems: \$4.50/W – \$6.50/W

What Makes PV Economically Feasible?

- Cost of materials and labor
- Subsidies
 - Rebates
 - Grants
 - Etc.
- Cost of electricity
 - CA, HI, South, North-East
- Geographical location (Weather, amount of sunlight)
 - Pacific, South-West

Cost of Materials/Labor

THE PATH TO GRID PARITY



- Depends highly on:
 - Speed of cost reduction
 - Electricity rate increase
- Grid Parity already reached (with subsidies and rebates):
 - Hawaii ~ cost of electricity is \$0.22/kWh
 - California ~ cost of electricity is \$0.145/kWh
- Grid Parity expected to be reached (without subsidies and rebates) in approximately 2013

Solar PV Incentives/Subsidies

Business Energy Tax Credit (ITC)

- Corporate Tax Credit
- Credit is equal to 30% of expenditures
- No maximum cap on credit or system size
- Credits are available for eligible systems placed in service on or before December 31, 2016
- Allows taxpayers eligible for the credit to receive a grant from the US instead of the credit
- Eligible solar energy property includes equipment that uses solar energy to generate electricity
- Tax code: 26 USC § 48

Federal MACRS Depreciation

- Corporate Depreciation
- Under the federal modified accelerated cost-recovery system (MACRS)
- Eligible equipment is same as solar energy property under ITC
- 50% first year bonus depreciation for systems installed in 2009
- 5 year property deprecation schedule:
 - Year 1: 20%
 - Year 2: 32%
 - Year 3: 19.2%
 - Year 4: 11.52%
 - Year 5: 11.52%
 - Year 6: 5.76%
- Tax code: 26 USC § 168

Expected Performance Rebates

- Most common form of solar PV rebate
- Buy-downs or capital grants based on system size and/or expected PV system performance
- Usually requires PV modules and inverters to be CEC listed
- Requires the PV system to pass all required inspections
- Requires customer to enter an interconnection agreement
- Programs incorporate caps on system sizes
- Nomenclature: \$/W
- Current rebates: \$1.00/W DC - \$4.00/W DC

Expected Performance Rebate Example

Xcel Energy Solar Rewards Program



- Rebate amount \$2.00/W DC
- Rebate amount is capped at \$200,000
- Contract term is 20 years
- System size must be 10 kW – 2,000 kW DC
- PV modules and inverters must be CEC listed

Performance Based Rebates

- Based on actual PV system performance
- Usually requires revenue grade metering of PV system by a third party verification company
- Usually requires PV modules and inverters to be CEC listed
- Requires the PV system to pass all required inspections
- Requires customer to enter an interconnection agreement
- Programs incorporate caps on system sizes
- Nomenclature: \$/kWh
- Rebates range: \$.05/kWh - \$.32/kWh

Performance Based Rebates Example

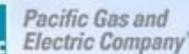
California Solar Initiative (CSI), Go Solar California

- 5-year PBI (Performance Based Incentive) Rebate
- Current rebate \$.15/kWh - \$.32/kWh
- Rebate is capped at a maximum system size of 1,000 kW
- Requires modules and inverters to be CEC listed
- Requires third party verification of PV system performance
- Offered to customers of:
 - Pacific Gas and Electric
 - Southern California Edison
 - San Diego Gas and Electric



Performance Based Rebates Example

California Solar Initiative Statewide Trigger Point Tracker



Last updated 1/11/2010

Administrator	Customer Class *	Current Step	Initial MW in Step	Unused MW from Previous Steps	Revised Total MW in Step	Issued Conditional Reservation Letters (MW)	MW Remaining	MW Under Review
PGE	Residential	6	27.40	0.54	27.94	13.39	14.55	0.43
	Non-Residential	6	55.60	22.30	77.90	25.81	52.09	6.98
SCE	Residential	4	19.70	1.10	20.80	10.16	10.64	2.49
	Non-Residential	5	49.30	32.03	81.33	39.06	42.27	8.28
CCSE	Residential	6	6.50	0.04	6.54	1.73	4.81	0.69
	Non-Residential	6	13.10	0.08	13.18	4.40	8.78	2.39

Step	Statewide MW in Step	EPBB Payments (per Watt)			PBI Payments (per kWh)		
		Residential	Non-Residential		Residential	Non-Residential	
			Commercial	Government/Non-Profit		Commercial	Government/Non-Profit
1	50	n/a	n/a	n/a	n/a	n/a	n/a
2	70	\$2.50	\$2.50	\$3.25	\$0.39	\$0.39	\$0.50
3	100	\$2.20	\$2.20	\$2.95	\$0.34	\$0.34	\$0.46
4	130	\$1.90	\$1.90	\$2.65	\$0.26	\$0.26	\$0.37
5	160	\$1.55	\$1.55	\$2.30	\$0.22	\$0.22	\$0.32
6	190	\$1.10	\$1.10	\$1.85	\$0.15	\$0.15	\$0.26
7	215	\$0.65	\$0.65	\$1.40	\$0.09	\$0.09	\$0.19
8	250	\$0.35	\$0.35	\$1.10	\$0.05	\$0.05	\$0.15
9	285	\$0.25	\$0.25	\$0.90	\$0.03	\$0.03	\$0.12
10	350	\$0.20	\$0.20	\$0.70	\$0.03	\$0.03	\$0.10

Renewable Energy Certificates (REC's)

- Also referred to as Renewable Energy Credits or Green Tags
- Traded environmental commodities (similar to stocks) traded on clean power markets
- 1 REC is proof that 1,000 kWh (1 MWh) of renewable energy was produced
- REC's market values range from \$5 - \$650 depending on state and market
- Credits are issued to customer by a certification agency assigning an identification number to each individual credit
- Usually does not require third party verification of PV system performance
- Utilities will often pay a customer to retain the REC's for the life of a newly installed system

REC Example, Customer Retained

Solar Renewable Energy Certificate (SREC) Program,
New Jersey Clean Energy Program (NJCEP)

- No caps on system size
- Requires program registration
- Additional NJCEP inspection required



Month	Year	Active kW DC	SREC Quantity		Monthly		Cumulative	
			Issued in Month	Traded in Month	High (\$/MWh)	Low (\$/MWh)	# of SRECs Traded	Weighted Avg Price (\$/MWh)
May	2010							
Apr	2010							
Mar	2010							
Feb	2010							
Jan	2010							
Dec	2009							
Nov	2009	97,482	8,192	7,292	\$ 688	\$ 170	21,850	\$559.45
Oct	2009	93,402	8,085	7,004	\$ 680	\$ 170	14,558	\$549.84
Sept	2009	92,015	8,796	5,119	\$ 700	\$ 170	7,554	\$524.90
Aug	2009	89,660	10,320	2,435	\$ 685	\$ 170	2,435	\$492.18
Jul	2009	83,807	6,626	Due to low trade volume, the July trades are reported with the cumulative pricing data starting in August.				
Total			40,019	21,850				

REC Example, Utility Retained

PNM REC Program



- PNM retains the REC's produced by customers with newly installed PV systems
- PNM pays customers \$150/MWh (\$0.15/kWh)
- Payments are made monthly
- Contract term of 20 years
- System size must be 10 kW – 2,000 kW DC
- PV modules and inverters must be CEC listed

Feed-In Tariff

- PV systems become very lucrative
- Utilities are obligated to purchase the solar energy produced from customers with PV systems at above market rates
- Utilities make up the difference by raising the electric rates for all customers

Utility has 1,000,000 customers \longrightarrow Buy \$100,000 of solar PV electricity each year \longrightarrow Add \$.10 to every customers annual bill

- Feed-in tariffs have been associated with the large growth in Germany/Spain (\$.50/kWh - \$.60/kWh)
- Fairly new in the US, only a couple feed-in tariff programs
- No cap on system sizes or payment amounts

Feed-In Tariff Example

Gainesville Regional Utilities, Florida

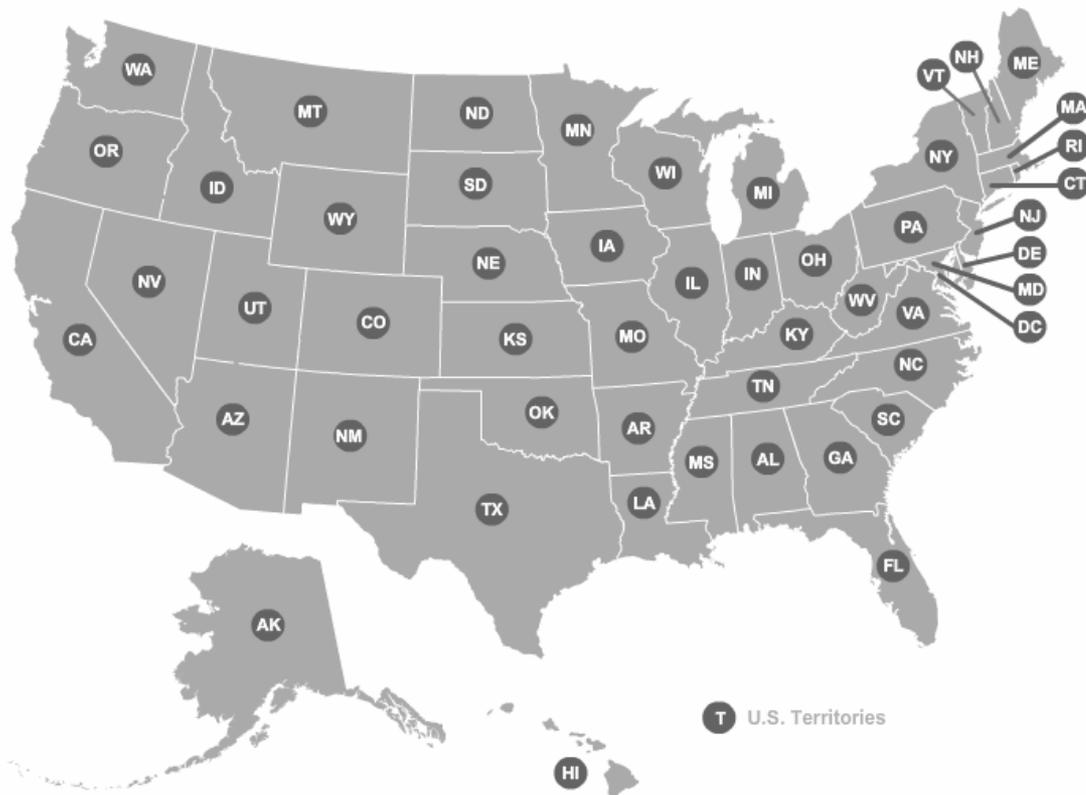


- Contract term of 20 years
- No limit on system size
- PV modules and inverters Do Not have to be CEC listed

Contract Entered into Under This Policy During Calendar Year	Fixed Rate per kWh Applied Uniformly From the Date of Installation Through December 31,	Fixed Rate \$/kWh Over Life of Contract	
		Building or Pavement Mounted (any size) or Ground Mounted < 25 kW	Free Standing (Non-Building or Non-Pavement Mounted)
2009	2030	\$0.32	\$0.26
2010	2031	\$0.32	\$0.26
2011	2032	\$0.30	\$0.25
2012	2033	\$0.28	\$0.23
2013	2034	\$0.27	\$0.22
2014	2035	\$0.26	\$0.21
2015	2036	\$0.25	\$0.20
2016	2037	\$0.23	\$0.19

DSIRESOLAR

Database of State Incentives for Renewables & Efficiency



*Information on all
incentives, rebates,
grants, etc.*

DSIRE:

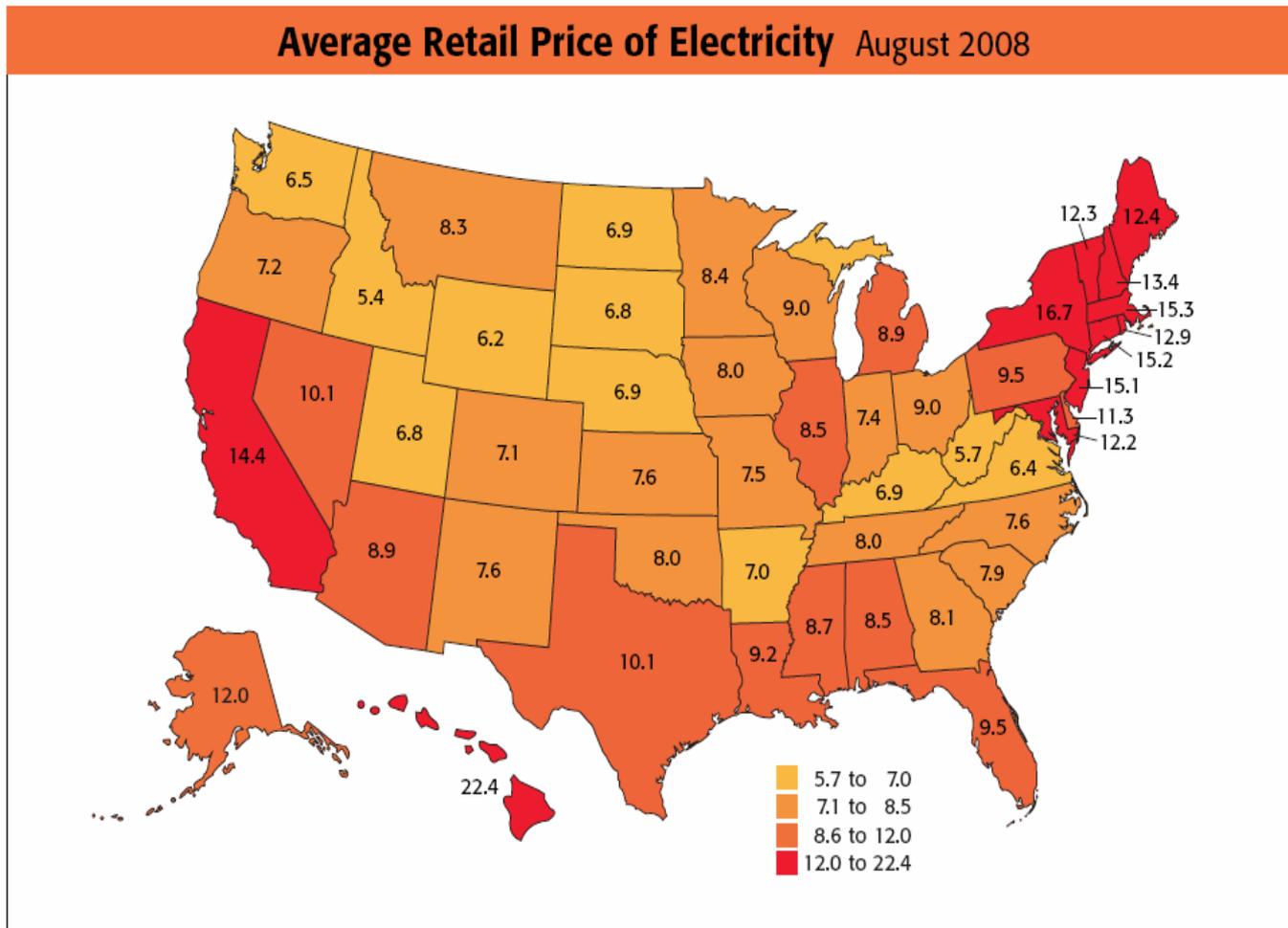
<http://www.dsireusa.org>

DSIRESOLAR:

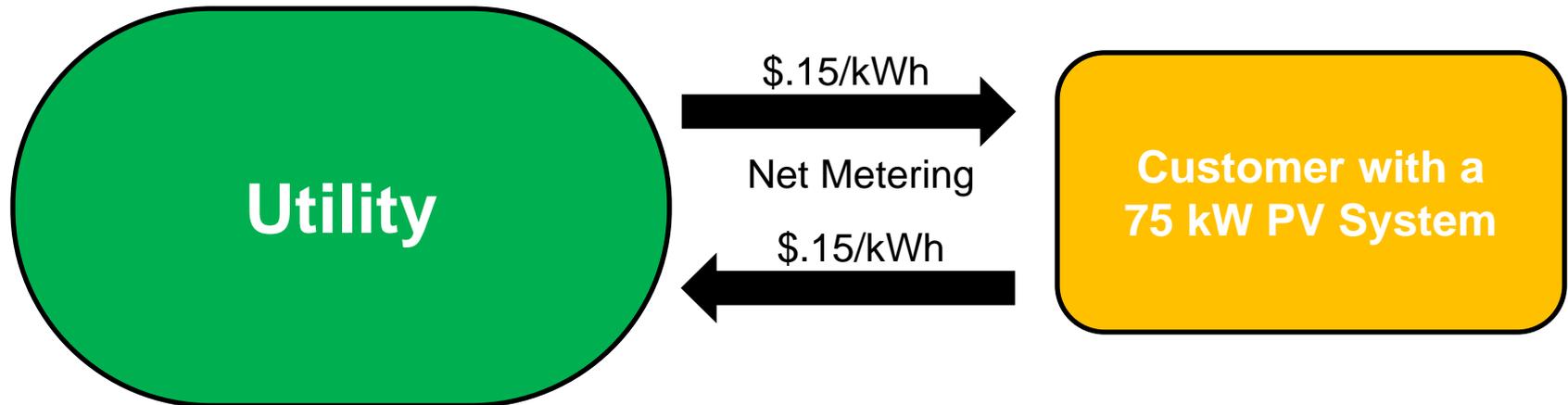
<http://www.dsireusa.org/solar/index.cfm?ee=1&RE=1&spf=1&st=1>

Cost of Electricity

Electricity Rates



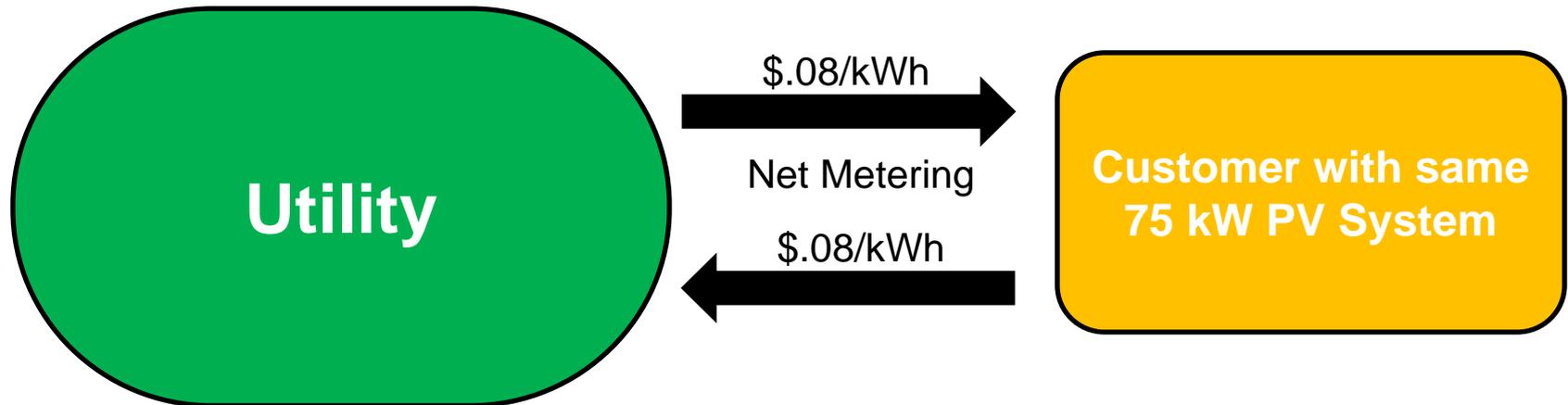
Energy/Monetary Savings



- System produces 100,000 kWh/year

→ Results in savings of $(100,000 \text{ kWh/year})(\$0.15/\text{kWh}) = \$15,000/\text{year}$

Energy/Monetary Savings



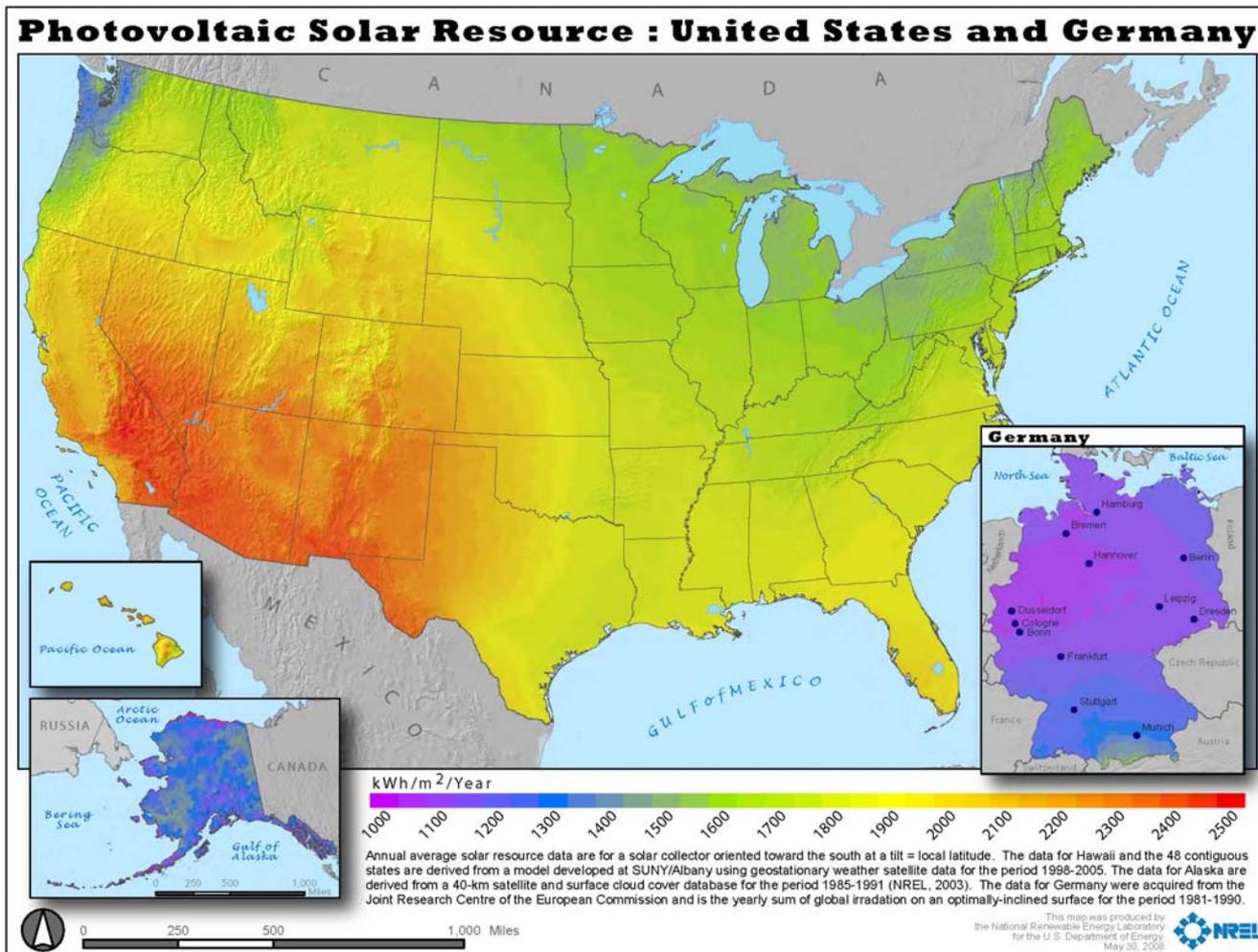
- System produces 100,000 kWh/year

→ Results in savings of $(100,000\text{kWh/year})(\$0.08/\text{kWh}) = \$8,000/\text{year}$

The higher the electricity cost, the higher the savings!

Geographical Location

Geographical Location, Irradiation



Energy/Monetary Savings

Los Angeles, CA

- 100kW System
- Pays \$.10/W for electricity
- Produces 148,300 kWh/year

\$ Savings of

$$(148,300 \text{ kWh/year})(\$.10/\text{kWh}) =$$

$$\longrightarrow \$14,830/\text{year}$$

Portland Oregon

- 100kW System
- Pays \$.10/W for electricity
- Produces 104,300 kWh/year

\$ Savings of

$$(104,300 \text{ kWh/year})(\$.10/\text{kWh}) =$$

$$\longrightarrow \$10,430/\text{year}$$

The more sunlight/irradiation, the higher the savings!

Payback Example

Preliminary Assumptions

Electricity/Utility Assumptions:

Annual Electricity Usage (kWh):	1,259,520
Annual Electricity Cost (\$):	\$107,000
Average Electricity Rate (\$/kWh):	\$0.085
Electricity Inflation Rate (%/yr):	6%
Electric Service Provider:	N/A

Facility/Roof Assumptions:

Facility Classification:	Commercial
Available Installation Area (SF):	100,000
Roof Membrane/Material:	TPO

PV System Assumptions:

Annual Energy Degradation (%/yr):	0.50%
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Tax/Financial Assumptions:

Federal Tax Classification:	Corporate
Federal Tax Bracket:	35%
Federal Investment Tax Credit:	30% of expenditures
Federal Accelerated Depreciation:	5-year MACRS

Rebate/Incentive Assumptions:

Utility/State Rebate:	(Select One)
Rebate Rate (\$/W, \$/kWh):	\$0.00
Renewable Energy Credits (\$/kWh):	\$0.15
Renewable Energy Credit Term (yr):	20

Inverter Replacement Cost (\$):	\$0
Annual Maintenance Cost (\$/W):	\$0.02

Results

System Size STC (kW):	225
Estimated First Year Energy Production (kWh):	337,500
Estimated First Year Energy Offset (%):	27%
PV Technology:	JM TPO Thin Film Solar Blanket
Attachment Method:	Heat Welded to Roof Membrane
Module/Panel Tilt (degrees):	0
Module/Panel Orientation:	South

System Price (\$):	\$1,237,500.00
Federal Tax Credit (\$):	\$371,250.00
Federal 5-year MACRS Depreciation (\$):	\$368,156.25
Utility/State Rebate (\$):	\$0.00
Renewable Energy Credits (\$):	\$965,818.89
Internal Rate of Return (%):	13.46%
Payback Period (yr):	7

Resources

- US cost of electricity
<http://www.eia.doe.gov/fuelelectric.html>
- Rebates and Incentive information
<http://www.dsireusa.org/>
- How to calculate tax credits with eligible rebates
"Accounting for PV System Rebates" Solar Pro. June/July 2009.

QUESTIONS?